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Finite Element Analyses of Mortarless Wall Panel

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Abstract: The complexity of mortarless masonry wall behaviour was primarily governed by its dry joints characteristic. Dry joint features can be found in mortarless wall construction where no adhesive or mortar layer present. The behaviour of mortarless wall was addressed previously by experimental and analytical work. However there are lacks of research of analytical work particularly on the mortarless masonry wall considering dry joint features due to its complexity characteristic. Therefore this paper present finite element analyses on series of mortarless wall model. The analyses results then verified by comparing the results and response with those measured through experimental to monitor the accuracy and reliability of program. A 2D finite element program was developed to analyse dry joint masonry wall. The developed program was able to analyse linear and nonlinear problem. Four series of finite element wall model were developed that consists of solid hollow wall model, wall with stiffeners model, and wall with window opening models that simulate under various eccentricity of loading. The models were simulated in nonlinear environment and under compressive vertical load. The results show that the model was able to predict the correct response of mortarless masonry panels with good agreement and its demonstrated adequacy to provide reasonable results. [Report and Opinion. 2009;1(2):1-16]. (ISSN: 1553-9873).

Keywords: dry joint, masonry wall, finite element analysis, plane stress, compressive load

1.0 Introduction

Finite element method has been extensively used in analysing masonry structures and numerous models have been developed to simulate the behaviour of different types of the conventional mortared masonry systems [1 - 5]. Finite element technique is used to simulate the full masonry response under loading and also to implement the nonlinear solution procedure of the masonry system. However, analytical studies on the mortarless block systems are limited and depend mainly on the type of block used to assemble the walls. Interlocking mortarless load bearing hollow block wall is different from conventional mortared masonry systems in which the mortar layers are eliminated and instead the block units are interconnected through interlocking protrusions and grooves [5]. Putra block is one of interlocking block that can use in mortarless construction thus introducing dry joint interface between each block [13]. The dry joint characteristic of Putra block was assessing by experimentally which then extended to the analytical work [14]. Paulo [6] reported on experimental research on the structural behavior of dry joint masonry subjected to in-plane combined loading and also addressed a simplified method of analysis based on a continuum of diagonal struts. He also contributes the knowledge of dry joints under cyclic loading where focuses on the characterization of Coulomb failure criterion and the load-displacement behavior including aspects as surface roughness, dilatancy, and inelastic behavior [7]. However, there a lack of analytical work on the corresponding problem which related to dry joint of masonry. Therefore, this paper present analyses on the series of mortarless wall model using finite element analyses which then verified by comparing the results with those measured through experimental.

In this study, structural behaviors of mortarless wall system are accessed using 2D finite element program that specially developed to analyze this type of construction. A finite element model is proposed to predict the behaviour and failure mechanism of the wall system subjected to vertical compressive load. Mortarless wall system described here used Putra blocks develop by University Puta Malaysia as a main material. Then the analyses results are compared with existing experimental data in order to satisfy the validation process.

2.0 Proposed finite element model

The application of the finite element model has been shown by analysing mortarless wall constructed by interlocking hollow concrete block. Interlocking hollow concrete block used in this study known as Putra block invented by University Putra Malaysia. The following elements have been used to model masonry assemblage:

i. Eight-noded isoparametric plane element
ii. Six-nodded isoparametric interface element

The details of formulation of shape function of these elements can be obtained in [5]. Eight-noded isoparametric plane element is used to model masonry constituent (block). The eight nodes are located at the corners and mid side of each element as shown in Figure 1. Six-nodded isoparametric interface element of zero thickness located between material elements is employed to model the interface characteristics of the dry joint and bond between block and grout (if any). Three nodes are located on one side of the material element and the other three located on the other side as shown in Figure 1.

2.1 Proposed material model

In this study, the best fit equation of the experimental data of masonry block under uniaxial compression test for both ascending and descending parts is adopted [15]. It can be expressed as

$$\sigma = \frac{p\left(\varepsilon/\varepsilon_0\right)\sigma_0}{p-1+\left(\varepsilon/\varepsilon_0\right)^p} \qquad (1)$$

Where
σ, ε instantaneous values of the stress and the strain, respectively
σ_0, ε_0 the ultimate stress (peak) and the corresponding strain, respectively
p a constant called material parameter depends on the shape of the stress-strain diagrams

Other material properties that obtained from experimental work on dry joint behavior were normal stiffness, kn and shear stiffness, ks. Kn was given as follows

$$K_n = K_{ni} + Ad^B{}_n \qquad (2)$$

Where K_{ni} is the initial normal stiffness at zero stress and d_n is close up deformation. The close up deformation become main feature that makes the dry joint differs from the mortar joint under compressive load where the gradual closing-up of the space between the block to block surfaces.

2.2 Failure Criteria

The proposed model uses the biaxial compression strength envelope proposed by Vecchio [8]. The principal stresses on two orthogonal directions are denoted by σ_1 and σ_2 with $|\sigma_1| \leq |\sigma_2|$. The failures envelop is shown in Figure 2 for all stress states. For tension-compression region, the envelope relation that is used in this region can be written as

$$\sigma_{1p} = f_{eq} = \sqrt{1-\left(\sigma_2/f_c'\right)^2}\, f_t' \qquad (2)$$

$$\sigma_{2p} = \sigma_{1p}/\alpha \leq 0.65 f_t'$$

In which σ_{1p} tensile stress and σ_{2p} compressive stress
Where
f'_t is tensile strength of block unit
f_{eq} is equivalent tensile strength

3.0 Development of the finite element code

A Finite element program has been written in Fortran language and used as a main tool to analyse the mortarless wall model in this study. This program was developed to simulate the behavior of mortarless wall with special attention to simulating the contact behavior of dry joint interface.

Nonlinear analysis may be carried out using three methods; incremental or stepwise procedure, iterative and incremental-iterative technique (mixed technique). Mixed method or the incremental-iterative technique procedure has been adopted in the numerical solution due to the technique is possible to produce accurate results [5]. Fig. 3 shows solution procedure of the nonlinear analysis used in this study.

4.0 Finite element analyses mortarless masonry model

Four series of 2D finite element discretization model namely as Group A, B, C and D are developed in this study according to their specific accommodation of stiffeners arrangement in each wall as shown in. Group A models are considered for solid hollow wall without any stiffeners, Group B designated for wall model that having stiffeners over its perimeter and Group C is modelled for wall having stiffeners over its perimeter and at along length of mid height of wall. The developed models are based on the actual dimension of experimental panel constructed using Putra interlocking blocks. The size of panels used in this study are 3000mm x 1200mm x 150mm (height x length x thickness) for group A, B and C. For the group D, the size of panel used is 1500mm x 1600mm x 150mm with 600mm x 800mm of window opening located at the center of panel. The details of models to their corresponding group are shown in Table1. All models are simulated under the vertical compressive load that applied at top of wall. The loading is applied based on eccentricities considered as stated in Table 1. The wall models are idealized to span vertically by discretized the wall according its actual height and width. For the boundary condition the wall model is defined as fix and rolled at bottom and top of wall respectively. To define a fix condition in FE model, the translation of corresponding node need to restrain in x and y direction. For the application of roller condition, the translation in x direction needs to be restrained. Two dimensional (2D) finite element discretization of the wall in $x - y$ plane is adopted as shown in Fig. 4. Material properties used for masonry block and dry joint were based on actual experimental value are shown in table 2 and 3.

For the block, the typical properties are used to characterize the material properties such as E_o for initial elastic modulus, f'_c for compressive strength, f'_t for tensile strength and ν for poisson ratio. In this study, the best fit equation of the experimental data of masonry block under uniaxial compression test for both ascending and descending parts is adopted [5]. Trough this, the new features called material properties was introduced to consider the shape of the stress strain diagrams known as p in equation 1.

5.0 Results and Discussion

The results are presented in term of their maximum load, vertical displacement and lateral displacement along height corresponding to respective eccentricities.

5.1 Wall compressive strength

Table 2 shows the predicted strength of the walls associated with the corresponding available experimental test results. The used eccentricity range (from e = 0.0 to e = 55mm) can be divided into three regions, axial and lower eccentricity region, middle eccentricity region and higher eccentricity region. The comparison between the predicted and test results of wall compressive strength of three groups shows that the predicted capacities are quite close to the test results. The discrepancies between the FE model and the test results are varied from -0.68% to 22% which also shown in Table 2. The predicted maximum load that obtained by FE models are over estimated for lower and medium eccentricities. However, the FE model showed a reduction in the wall capacity in the higher eccentricity especially in the Groups A and C. This is due to tensile stress produced in tension side of the wall which caused opening in the mortarless joints and reduced the wall capacity. This is also may due to the flexural effect that governed by FE model in the higher eccentricity. However, FE model of D1 predicted well the compressive strength of wall where it gives same results as those measured by experimental.

5.2 Axial deflection

Figure 5 to 8 shows the results of vertical deflection of walls Group A to Group D for both experimental and finite element analyses. The results are presented for zero eccentricity. All the walls are loaded axially

until failure and the results of vertical displacement over load are plotted. Results of un-stiffened wall of Group A as shown in Fig 5 shows that nonlinear relationship are govern by both measurement of experimental [9] and FE. From the figure, it shows a good prediction in term their response for both measurements. The FE deflection shows limited deflection compared to those measured by experimental. This is may be due to uneven surface of block where caused the deformation of un-stiffened wall leading to the nonlinear progressive contact deformation of the dry joint interface which reveals extensive deformation at the lower load level. Deflection of both measurements was in good agreement in the first loading but became scatter when loading increased. The differences of results were in the range 14 to 39%. Deflection measured by experimental shows the value increased with higher magnitude for each loading increment. However FE seems to have a limited deflection even though could achieve higher load. Maximum deflection that could achieve by FE was 5mm. This is may be due to the application of boundary condition at top of FE model where may not allow more deflection.

Fig. 6 shows the vertical displacement results of wall with stiffeners over its perimeter represent by Group B. The finite element results were compared with the experimental results that tested by Fares [10]. The response that predicted by FE was different compared with experimental results. The initial extensive deformation was shown by FE results, but it does disappear in the experimental results. This behaviour due to the simplicity taken by FE model which consider the existing of grout only and not include the steel reinforcement in modeling. However the existing of stiffeners also affected the overall behavior of the walls by produced better deformation compared than unstiffeners wall. The deformation was controlled by the weight of wall where in stiffeners wall it tend to response as assemblage of unit to large entity thus results more deformation and also eliminate the effect of dry joint. FE model was overestimated the deflection in initial of loading, but it seems to approach the experimental values when the load reach 300 kN. It can be seen that, using vertical stiffeners reduces the maximum vertical deformation to 3.78 mm as predicted by FE model. This value was 23% of maximum vertical deformation of the un-stiffened walls. The reduction of the vertical deformation in stiffened walls compared to the unstiffener wall was also confirmed by the test results.

Fig.7 shows the vertical deflection of stiffened wall C1 of Group C. The response of deflection of C1 was similar to B1 where FE model overestimate the prediction of deflection at early stage of loading. However the predicted deflection by FE was decreasing by load until it meets the experimental deflection value at 400kN. This is may be due to existing of stiffeners at middle height of wall and crushing of the grout of stiffeners where causing deflection rate reduced. The response that predicted by FE explained that the model having a ductility. It can be seen that, by using vertical stiffeners the deformation is reduces the maximum vertical deformation to 4.7mm in wall C1 as predicted by the FE model. This value is 22% of the maximum vertical deformation of the un-stiffened walls. As shown in Fig. 7, comparable results have been obtained by the FE model and the experimental test results of wall C1. The initial stiffness of the wall was relatively overestimate predicted by the numerical model curves however it closely predicted the stiffness at higher loads. The reduction of the vertical deformation in stiffened walls compared to the un-stiffened wall was also confirmed by the test results. It can be shown that the effect of the horizontal middle stiffeners is limited on the vertical deformation of wall C1 compared to B1.

Fig. 8 shows the results of vertical deformation of wall with opening for both finite element and experimental measurement [12]. The results are shows good agreement at initial stage of loading and results in good response. However, remarkable differences in deformation could be observed in higher loading before bridging back nearly at failure load. The deformations that predicted by finite element seems to has a limited capacity compared to the experimental values. This is may be due to developed model has higher stiffness. Other than that, the roughness of block in experimental specimens also may influence the deformation of wall. The behavior that obtained by experimental mainly due to the variation in the contact behavior of dry joints that was affected by the geometric imperfection caused by block bed irregularity and variation of block height [5]. This will affect the full seating by each block in wall. The stiffness that obtained by finite element also more higher compared to the experimental thus giving that the developed model able to predict the response of wall with opening but with the limited capacity of deformation.

5.3 Lateral deflection

The variation of predicted lateral deflection along the wall height near the failure load for un-stiffened walls A2 and A3 are respectively shown in Fig. 9 and 10. As it is clearly shown in the figures, the wall panel that loaded in more eccentricity (e = 55 mm) revealed higher lateral deformation than in the less

eccentricity (e = 40mm) loaded walls due to the flexural effect of eccentric loads. The similarity between the FE model analysis and test results is distinct which indicates accurate simulation for lateral deformation of wall by the developed FE model. This is reflecting the block beds geometric imperfection that incorporates into the FE model. The discrepancies between the FE predicted maximum deflection are varied from -38% to 19% of the experimental maximum deflection.

Fig. 11 to 12 shows the variation of lateral deflection along the walls height near the failure load for the stiffened walls B2 and B3 respectively. With exception of wall B1 the lateral deflection along the walls height are closely predicted by the model. The differences between the predicted and the corresponding test result are varied between -15% and -53%. This behavior is due to the initial imperfection along the wall height observed in the experimental setup which affected the deflected shape and also the wall capacity. Perceptible reduction occurred in the magnitude of lateral deformation of the eccentrically loaded walls in the stiffened walls compared to the unstiffened wall due to the vertical stiffeners. The predicted reduction by the numerical model in the walls loaded with eccentricity of 55mm reaches 57%. In the stiffened walls, deflected shape and location of the maximum deflection are affected highly by the unsymmetrical boundary condition at the top and bottom of the analyzed walls.

Fig. 13 shows the variation of lateral deflection over wall height of stiffened walls C3. The lateral deflections along the walls height are closely predicted by the model as shown in Fig. 12. The variation of results may be due to the initial imperfection along the wall height observed in the experimental setup which affected the deflected shape and also the wall capacity. The differences of lateral deflection are higher in mid height region due to flexibility of interlocking unit and may also influence by flexural effect of wall. The differences between the predicted and the corresponding test result are varied between -3% to 45%. Perceptible reduction occurred in the lateral deformation of the eccentrically loaded walls in the stiffened walls compared to the un-stiffened wall due to existing the vertical and horizontal stiffeners. The predicted reduction by the numerical model in the walls loaded with eccentricity of 55mm reaches 58% in Group C compared to Group A.

Table1 Designation of wall model according to their group

Group	Designation	Eccentricity (e) mm
A	A1	0
	A2	40
	A3	55
B	B1	0
	B2	40
	B3	55
C	C1	0
	C2	55
D	D1	0

Table 2 Dry joint material properties

Joint	K_{ni}, N/mm^3	K_s, N/mm^3	Coefficient A	Coefficient B
Dry joint	5.0	1000	282.2	2.01

Table 3 Masonry block material properties

Type of material	E_o,, N/mm^2	f'_c, N/mm^2	ε_o	Material parameter	f'_t, N/mm^2	Poisson ratio, ν
Concrete block	9050.7	-18	-0.0021	2.5	1.98	0.2

Table 4 Predicted strength of wall by FE

Group	Designation	Eccentricity (e) mm	Max comp. load (kN) FE	Max comp. load (kN) Experimental	Discrepancy %
A	A1	0	476	373	5
	A2	40	338	322	-4
	A3	55	271	283	
B	B1	0	600	532	11
	B2	40	570	460	19
	B3	55	400	395	1
C	C1	0	600	615	-3
	C2	55	440	443	-0.68
D	D1	0	450	450	

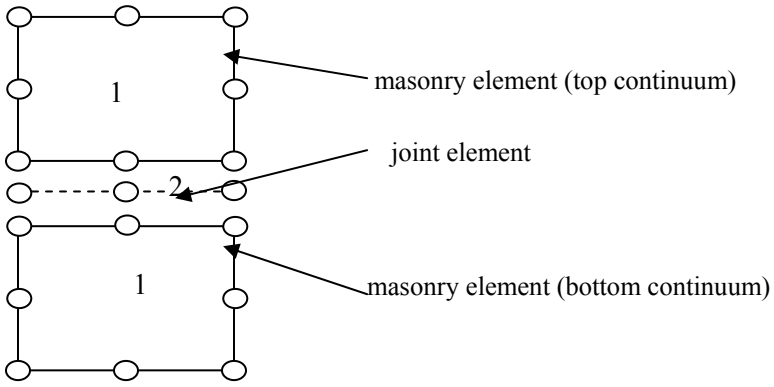


Figure 1. Masonry and interface joint element

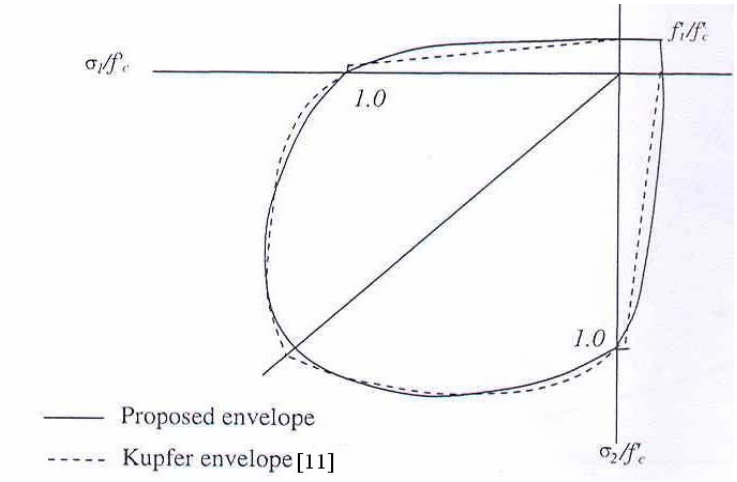
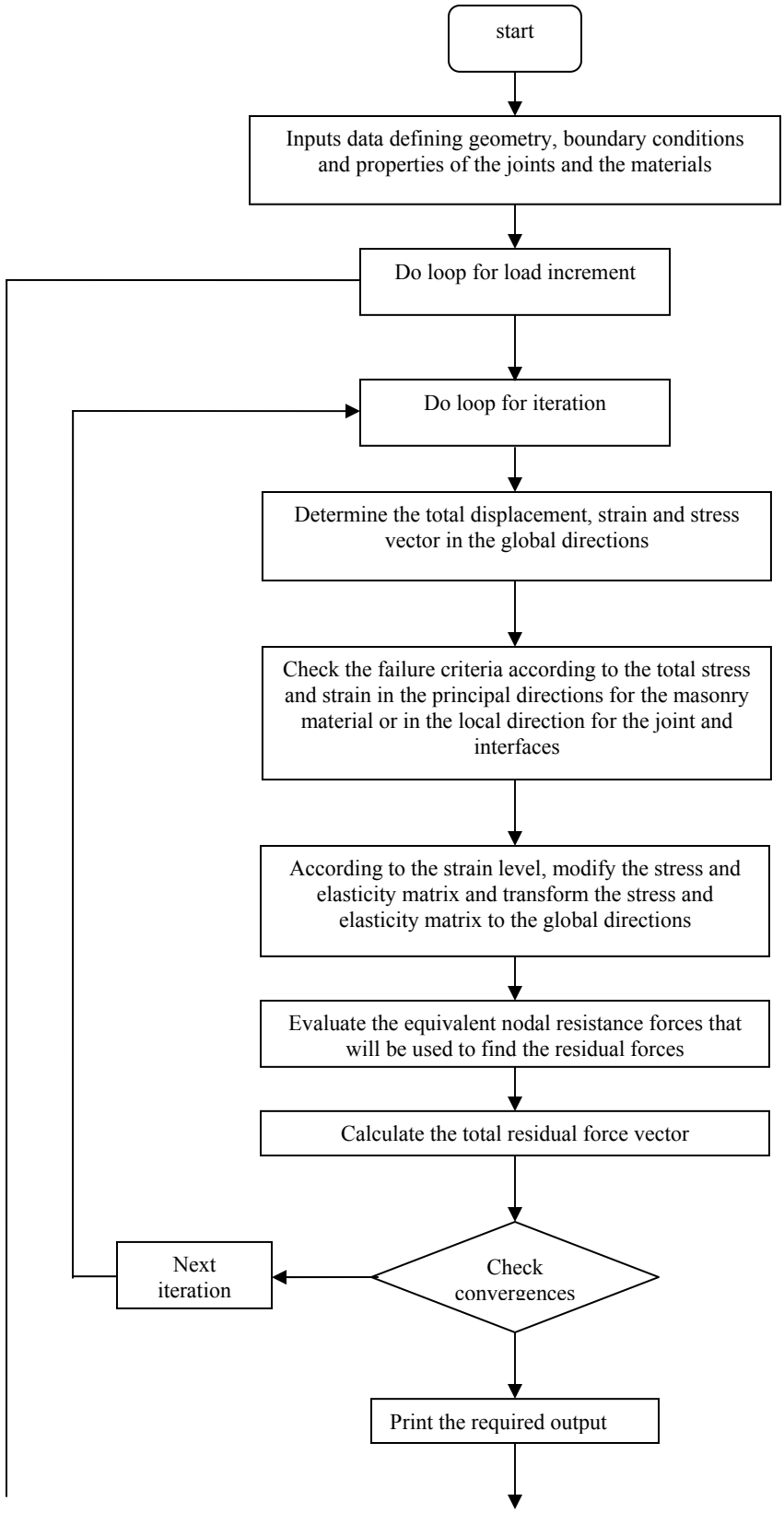


Figure 2 Masonry Failure envelope for different stress state


start
Inputs data defining geometry, boundary conditions and properties of the joints and the materials
Do loop for load increment
Do loop for iteration
Determine the total displacement, strain and stress vector in the global directions
Check the failure criteria according to the total stress and strain in the principal directions for the masonry material or in the local direction for the joint and interfaces
According to the strain level, modify the stress and elasticity matrix and transform the stress and elasticity matrix to the global directions
Evaluate the equivalent nodal resistance forces that will be used to find the residual forces
Calculate the total residual force vector
Check convergences
Next iteration
Print the required output

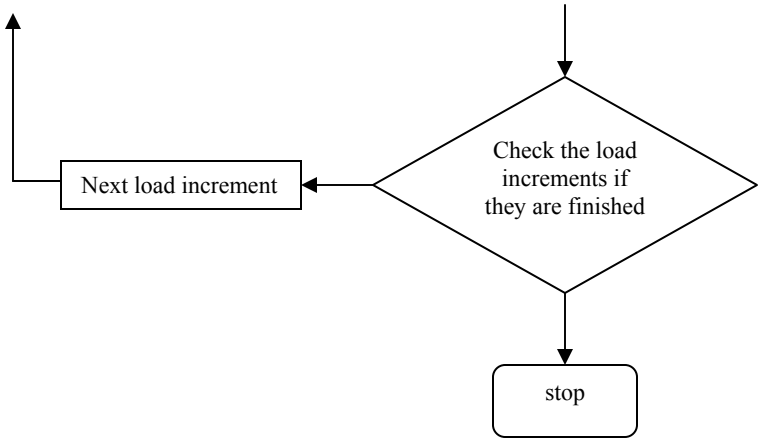


Figure 3 Solution procedure of the nonlinear analysis [5]

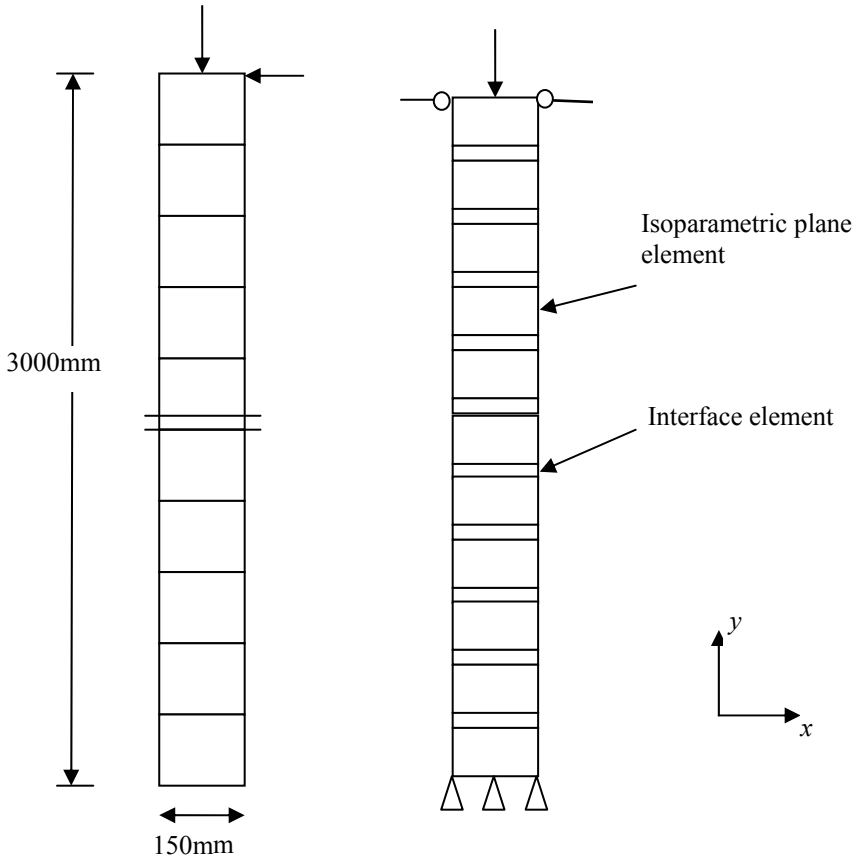


Figure 4 2D finite element discretization of wall model

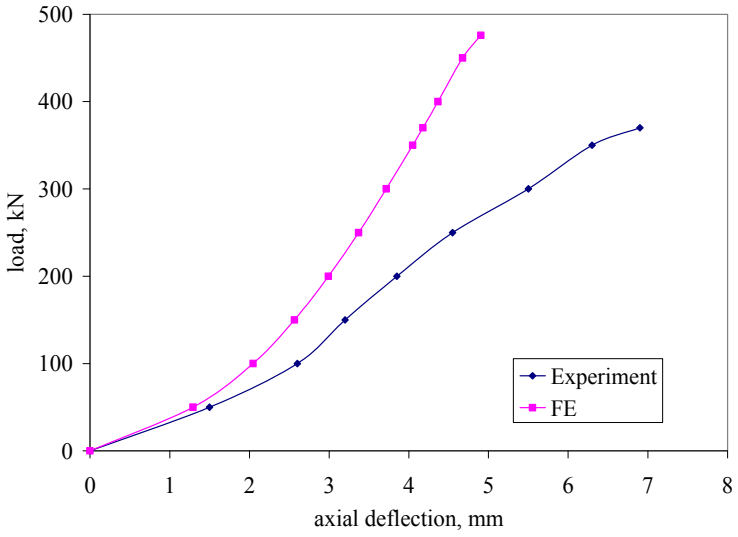


Figure 5 Load vs axial deflection of A1

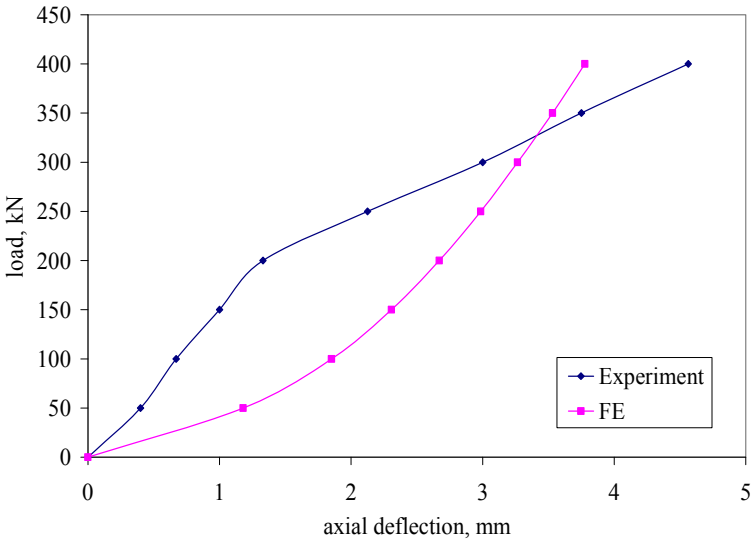


Figure 6 Load vs vertical deflection of B1 wall

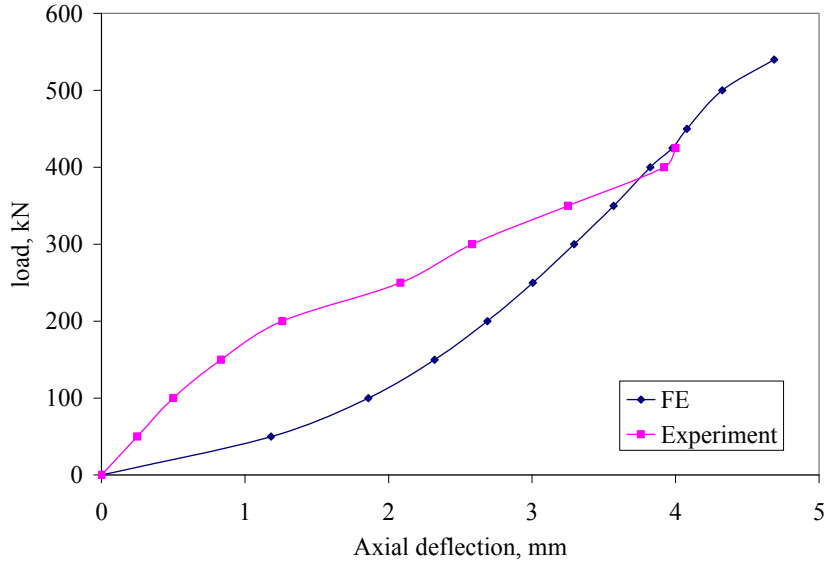


Figure 7 Load vs vertical deflection of C1

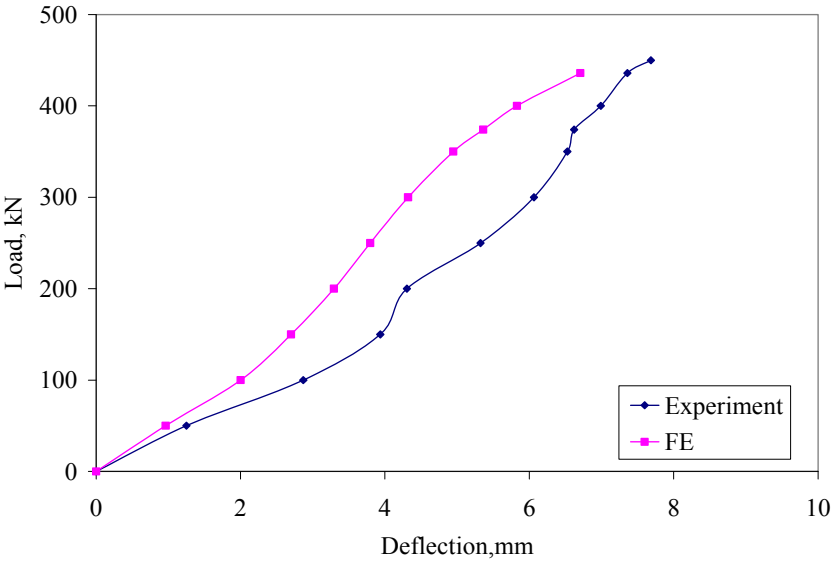


Figure 8 Vertical deformation of wall D1

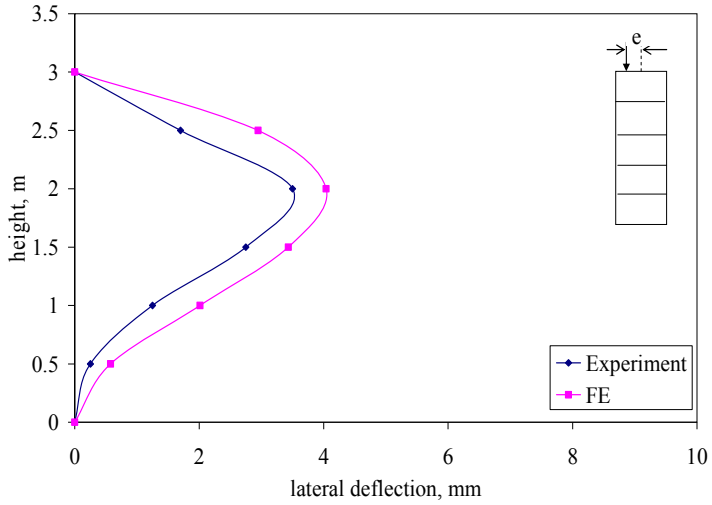


Figure 9 Lateral deflection over height of A2 (e = 40 mm)

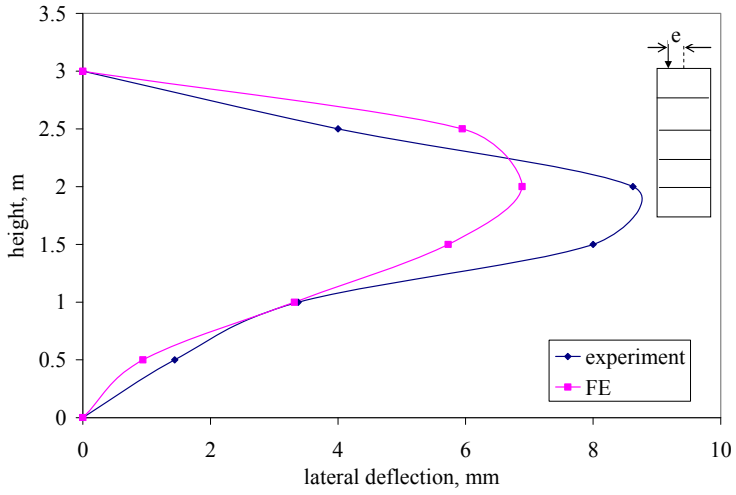


Figure 10 Lateral deflection over height of A3 (e = 55mm)

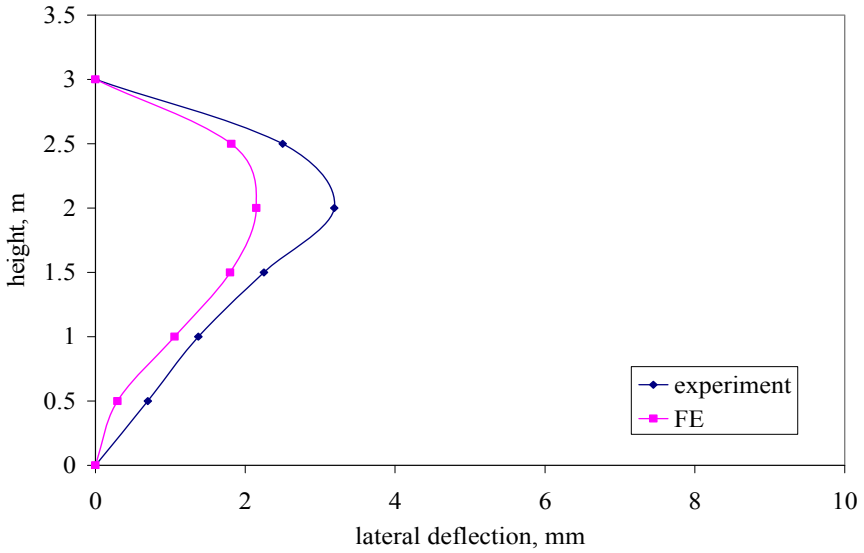


Figure 11 Lateral deflection over height of B2 (e = 40 mm)

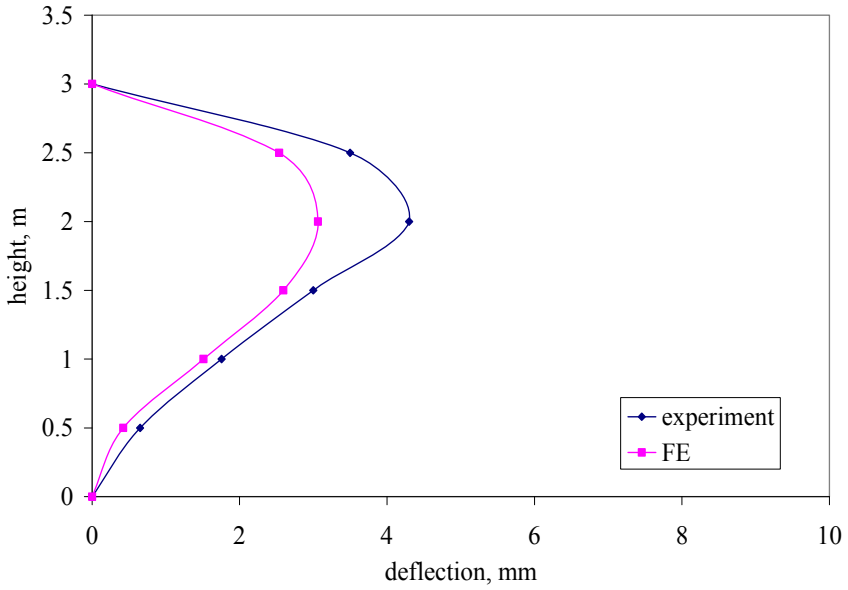


Figure 12 lateral deflection over height of B3 (e = 55mm)

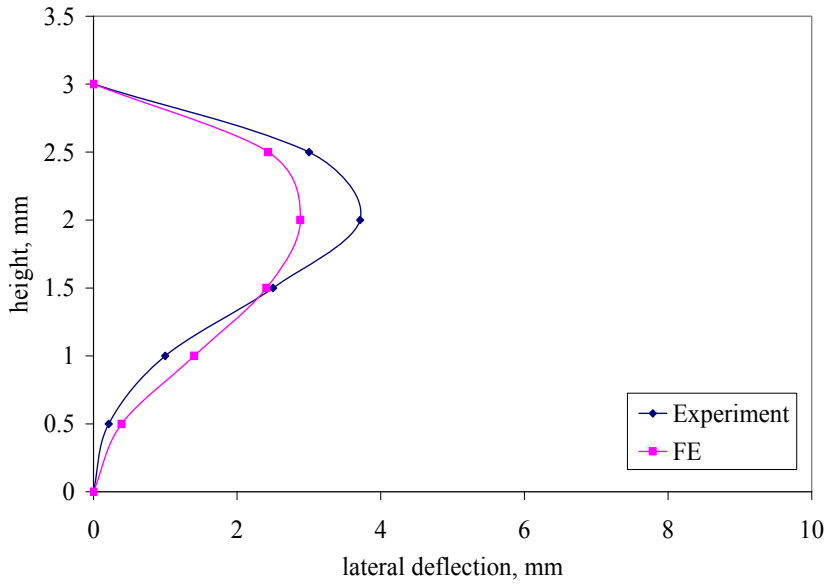


Figure 13 Lateral deflection of C3 (e = 55 mm)

6.0 Conclusion

The paper presents experimental results on the validation study between developed finite element model and available experimental data. Based on the results obtained, the models are able to predict the correct response of mortarless masonry panels subjected the vertical compressive load. A finite element analysis of model demonstrated its adequacy to provide reasonable results. For the group A, the variation of predicted lateral deflection along the height for the un-stiffened exhibit good agreement in term their response for both measurements with slightly differences in the range 14% to 39%. While for stiffened walls the lateral deflection of wall were closely predicted by the model. Perceptible reduction occurred in the lateral deformation of the eccentrically loaded walls in the stiffened walls compared to the unstiffened wall due to the vertical stiffeners. The wall panel that loaded eccentrically revealed higher lateral deformations than the axially loaded walls due to the flexural effect of eccentric loads. The similarity between the finite element model analysis and test results is distinct which indicates accurate simulation for lateral deformation of wall by the developed finite element model. Therefore, the finite element program can be used for further work as a tool to predict or to obtain the database for development of design method for mortarless wall masonry.

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An Incidence of Substratum Discolouration in a Tropical West African Lagoon.

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Abstract

A greenish discolouration of the lagoon floor at the Bayeku area of the Lagos lagoon was observed in January 2006. We report here an investigation of the area between December, 2005 and Feburary, 2006 as part of a larger study. A total of 19 species from 13 genera were reported. *Oscillatoria tenuis* (95,800 trichomes per ml) was implicated as the causative organism for the substratum discolouration. Increased insolation, especially reaching the lagoon floor, low salinity, absence of flood conditions, suitable sediment type (fine – medium sand) and high nutrient (PO_4 - P > 0.24 mg/L; NO_3 – N > 4.40mg/L) levels possibly encouraged the algal proliferation and subsequent substratum discoloration. It is suggested that improving water quality indices and salinity after January caused the disappearance of the discolouration on the substratum. [Report and Opinion. 2009;1(2):17-25]. (ISSN: 1553-9873).

Keywords: algae, water quality indices, substratum.

INTRODUCTION.

Coastal algal blooms respond to nutrient load from anthropogenic sources (Lee, 1999; Onyema, 2007). South-western Nigeria is endowed with an intricate network of rivers, creeks and lagoons, that serve as conduits transferring highly nutrified waters from hinterland to coastal areas. Bloom conditions have been reported in some of these waters (Nwankwo *et al.*, 2003a; Nwankwo *et al.*, 2008). Blooms of *Microcystis aureginosa*, *M. flos-aquae* and *M. wesenbergii* were reported in the Lagos lagoon (Nwankwo, 1993), Ogun river at Iju (Nwankwo, 1993) causing bluish colouration, anoxia, odour, impacting taste to the water (Nwankwo *et al*., 2003a) and kuramo lagoon (Nwankwo *et al.*, 2008). Blooms of *Trichodesmium thiebautii* have also been reported off the Lagos coast (Nwankwo, 1993) during thermocline conditions and more recently a bloom of *Bellerochea malleus* that caused brownish discolouration off the Light house beach, Lagos (Nwankwo *et al*., 2004) was documented. Blooms of *Anabaena flos-aquae, A. spiroides* (cyanobacteria), *Cerataulina bergoni*, *Chaetoceros convolutus, Coscinodiscus centralis* (diatoms) and *Ceratium furca, C. fusus, C. tripos* and *Noctiluca scntillans* (dinoflagellates) are known to induce harmful effects in waters of south-western Nigeria (Nwankwo, 1993; Nwankwo *et al.*, 2003a, b, Onyema, 2008). There is at present a report of substratum discolouration in the Lagos lagoon system (Onyema and Nwankwo, 2006) implicating *Beggiatoa alba* and *Oscillatoria* spp as causative species.

Between December, 2005 and Feburary, 2006, a greenish discolouration of the substratum at Bayeku was observed and thoroughly investigated. We report here the composition of the organisms before, during the

bloom period and after the collapse. Water quality indices before, during and after the substratum discolouration were also estimated and investigated. This report is part of a larger study that was already ongoing at the time of the occurrence.

MATERIALS AND METHODS.

Description of study area.

The Lagos lagoon opens into the sea via the Lagos habour all through the year. The tidal height is low (<1.5m) and the tidal exchange weak. It is shallow (<2m) and connected to the Epe lagoon to the east. The area investigated was (Fig 1) the Bayeku area of the Lagos lagoon (Latitudes 6^0 32^lN and 6^0 31^lN and Longitudes 3^0 31^lE and 3^0 32^lE). A greenish, slimy covering of suspected algae on the lagoon floor was observed for the very first time in this area. Nutrient rich water is known to flow from eutrophic creeks and creeklets systems in the area. Furthermore, poor sewerage systems are the common state of the rural dwellers of the immediate area. Hence direct dumping of domestic wastes is carried out in the closet water body.

Collection of samples

Water samples for determining water quality characteristics were collected at the site before substratum sample collection. The boat was anchored throughout sample collections. Water samples were collected in 1L plastic bottles with screw cap from 0.5m depth from the water surface. This was labeled and transported to the laboratory for chemical analysis.

Substratum samples (top 5cm) were collected within a 5cm² quadrat carefully placed on the greenish material / lagoon floor. A spatula was gently used underwater to scrape the topmost part. After carefully scooping up the greenish scum, it was gently spooned into a plastic bag while still underwater. Duplicate samples were collected on each occasion. Out of water and in the boat, samples were transferred to 75cl screw capped plastic containers. Samples were fixed with formalin (4% unbuffered) and labeled appropriately on the field before onward transportation to the laboratory. This process was carried out on each sampling occasion.

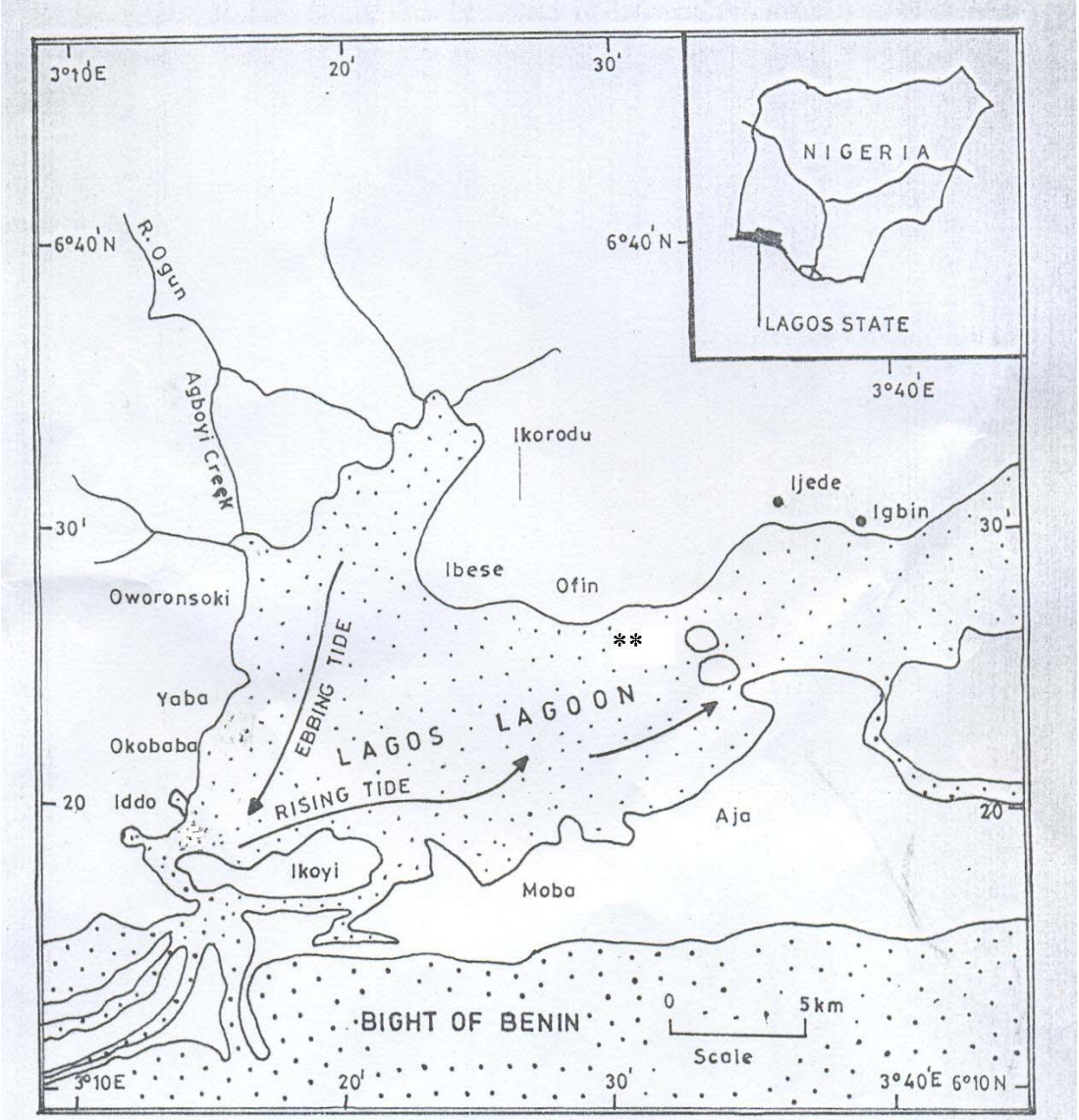

Fig. 1 : Lagos lagoon showing sampling site **

Physico-chemical analysis

Air and surface water temperatures were measured in-situ using a mercury thermometer while water depth was estimated with a calibrated pole. Total dissolved solids was determined by evaporating 100ml aliquot at 105^{o}C and total suspended solids estimated by filtering 100ml of sample through a pre-weighed filter paper, dried to constant weight and reweigh. Conductivity was measured using the HANNA instrument while salinity was determined using the silver-nitrate chromate method. The surface water pH was determined with a Griffin pH meter (Model 80) while dissolved oxygen was measured using a Griffin oxygen meter (Model 40). Biological and chemical oxygen demands were measured using methods

described in APHA (1998) for water analysis. Calorimetric methods using a Lovibond Nesslerier were adopted for the direct determination of phosphate-phosphorus and nitrate-nitrogen values while sulphate levels were measured using the gravimetric method. Calcium and magnesium ions were determined using a 400 single channel, low flame photometer. Concentrations of copper, iron and zinc were determined with an atomic absorption spectrophotometer (A.A.S.) Uni cam 99model.

Biological Analyses

In the laboratory, the drop count microscope analysis method described by Onyema (2007) was used to estimate the substratum algal flora. Microscope analysis was carried out on samples within 48hours of collection. Identification materials were used to assist and confirm identification of species (Smith 1950; Hendey, 1958, 1964; Desikachary, 1959; Wimpenny, 1966; Patrick and Reimer, 1966, 1975; Whitford and Schmacher, 1973; Vanlandingham, 1982; Nwankwo, 1990, 2004a; Bettrons and Castrejon, 1999; Siver, 2003; Rosowski, 2003).

RESULTS.

Physico-chemical.

Air (31 - 32 ^{o}C) and water (30 - 31 ^{o}C) temperatures were high through out the sampling period while the sampling depth was averagely 1.31m. The water remained slightly alkaline throughout the study (7.01 – 7.10). The total dissolved solids (20 - 33 mg/L), salinity (2.30 - 20.60 $^{o}/_{oo}$), chloride content (770.0 – 6930 mg/L), conductivity (2335 – 12,500 µS/cm), acidity (3.0 - 8.8 mg/L), alkalinity (28.5 - 100.3 mg/L), total hardness (562.5 - 4687.0 mg/L), sulphate (6.1 – 60 mg/L) and cation content (Calcium 111- 500, Magnesium 35.6- 859 mg/L) increased as the dry season progressed, while there was a corresponding decrease in total suspended solids (1590 – 8260 mg/L), nitrate (2.5 - 4.8 mg/L), biological (5 - 11mg/L) and chemical oxygen demands (10 – 49 mg/L) and heavy metals levels (Iron 0.14 - 0.35, Zinc 0.003 - 0.006mg/L) (Table 1).

With regard to the algae, just one species each was recorded for December 2005 (*Microcystis aureginosa* Kutzing) and January 2006 (*Oscillatoria tenuis* Agardh), However, 17 species were recorded in February (Table 2). Although, total biomass in terms of cell numbers was high in January (95,800 trichomes per ml) it was for a sole species. This organism (*Oscillatoria tenuis* Agardh) is the implicated microalgae responsible for the greenish discolouration of the lagoon floor at Bayeku. Furthermore, February recorded 3 cyanobacteria, 8 centric diatoms and 6 pennate diatoms species. *Actinophycus splendens* Ralfs and *Biddulphia laevis* Ehrenberg were important diatoms and *Oscillatoria limnosa* Agardh for the cyanobacteria in terms of numbers in February.

Table 1: Monthly variation in water quality characteristics at Bayeku area of the Lagos lagoon (Dec., 2005 – Feb., 2006).

Physico-chemical parameters	Dec., 2005	Jan., 2006	Feb., 2006
Air temperature (^oC)	32	31	31
Water temperature (^oC)	30	31	30
Depth (m)	1.42	1.24	1.41
Total Suspended Solids (mg/L)	33	27	20
Total dissolved Solids (mg/L)	1590	5120	8260
Salinity ($^o/_{oo}$)	2.30	9.20	20.60
Chloride (mg/L)	770.0	3086.0	6930
Conductivity (µS/cm)	2335	7877	12500
pH	7.05	7.01	7.10
Acidity (mg/L)	3.0	8.8	8.1
Alkalinity (mg/L)	28.5	30.4	100.3
Total Hardness (mg/L)	562.5	360.0	4687.0
Nitrate- Nitrogen (mg/L)	4.4	4.8	2.5
Sulphate (mg/L)	6.1	10.8	60
Phosphate- Phosporus (mg/L)	0.24	0.26	0.04
Silica (SiO_2 mg/L)	1.9	2.6	2.1
Dissolved Oxygen (mg/L)	5.5	4.2	4.3
Biological Oxygen Demand (mg/L)	11	9	5
Chemical Oxygen Demand (mg/L)	49	27	10
Calcium (mg/L)	165	111	500
Magnesium (mg/L)	35.6	50	859
Copper (mg/L)	0.002	0.002	0.002
Iron (mg/L)	0.35	0.22	0.14
Zinc (mg/L)	0.005	0.006	0.003

Table 2: Substratum algal composition (before, during and post bloom) at Bayeku (per ml).

Algal Taxa	Dec., 2005	(Bloom) Jan., 2006	Feb., 2006
Class – Cyanophyceae			
Order I – Chrooccocales			
Microcystis aureginosa Kutzing	170	-	-
Order II – Hormogonales			
Lyngbya limnetica Lemm	-	-	5
Oscillatoria curviceps C.A. Agardh	-	-	10
Oscillatoria limnosa Agardh	-	-	60
Oscillatoria tenuis Agardh	-	95,800	-
Class – Bacillariophyta			
Order I - Centrales			
Actinophycus splendens (Sch adbolt) Ralfs	-	-	205
Biddulphia laevis Ehrenberg	-	-	125
Coscinodiscus centralis Ehrenberg	-	-	10
Coscinodiscus eccentricus Ehrenberg	-	-	10
Coscinodiscus radiatus Ehrenberg	-	-	5
Cyclotella meneghiniana Kutzing	-	-	15
Melosira moniliformis (O.F. Muller) Agardh	-	-	10
Melosira nummuloides Agardh	-	-	35
Order II – Pennales			
Cymbella affinis Kutzing	-	-	15
Navicula mutica Kutzing	-	-	5
Nitzschia palea (Kutzing) Wm Smith	-	-	5
Pleurosigma angulatum (Quekett) Wm Smith	-	-	55
Pleurosigma elongatum Wm Smith	-	-	15
Synedra crystallina Kutzing	-	-	20
Number of species (S)	**1**	**1**	**17**
Species abundance (N)	**170**	**95,800**	**605**

DISCUSSION.

The water quality status at the site ranged between low and high brackish water conditions. Low brackish condition (S=2.30‰) was experienced in December while high brackish condition (>9.20‰) reflected the dry months. As the rain ceased, turbidity reduced while transparency increased. Furthermore, insolation increased probably reaching the lagoon floor. This coupled with high nutrient levels (PO_3^{2-} > 0.24mg/L, NO_3^- > 4.4mg/L, SO_4^{2-} >6.1mg/L), low brackish condition (<9.2$^0/_{00}$) and low depth (<1.42m), favorable sediment type (fine – medium sand) and absence of flood conditions probably encouraged the proliferation of the epipelic algal population in January. According to Valangdiham (1982), *Oscillatoria tenius,* the causative cyanobacterium, in the substratum discolouration, is a saprobiont which can exist either as plankton or as an attached form. Palmer (1969) reported that *Oscillatoria tenuis* is the second most tolerant *Oscillatoria* species to organically induced stress. It's important to note that both sole species in December and January are known pollution tolerant cyanobacteria forms for the region (Nwankwo, 2004b).

Importantly, the highest level of nitrate (4.8 mg/L) recorded for this study was in January at the time of the greenish occurrence.

Oscillatoria spp are reported in literature to have wide tolerance limits to pH, salts and organically enriched environments (Valangdiham, 1982; Lee, 1999; Nwankwo, 2004b; Onyema, 2008). In Nigeria, Onyema *et al*., (2003) has reported *Oscillatoria tenius* in organically polluted parts of Lagos lagoon. Similarly, Chindah and Pudo (1991) have reported *Oscillatoria tenius* from the Bonny river associated with oil related effluent. According to Valangdiham (1982) *Oscillatoria* species are heavily favoured in organically nutrified waters. The existence of high BOD levels in excess of 9mg/L at this site may be pointer to the probably stressed water quality status. According to Hynes (1960), BOD above 8.0mg/L may indicate severe organic pollution.

The disappearance of the bloom in February may be associated with increased salinity ($\geq 20.6^{0}/_{00}$) and reduced nutrient load (PO_4 – P 0.04mg/L; NO_3-N = 2.05mg/L). Onyema and Nwankwo (2006) reported a high abundance of epipelic algal forms in the dry months at some organically polluted sites of an estuarine creek in Lagos.

This investigation highlights the bane of increasing levels of pollutants from anthropogenic sources in the Lagos lagoon and the role of algal indicators in capturing changes in water quality.

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Effect of Duckweed meal on the rate of mold infestation in stored pelleted fish feed.

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Abstract
The effect of duckweed (*Lemna pauciscostata*) meal on the rate of mould infestation in stored pelleted fish feed was carried out. Freshly harvested duckweed was dried and thoroughly ground into powder using a milling machine. Five dry fish feeds were then prepared using duckweed as a replacement for fishmeal at 0%, 10%, 20% and 30% respectively at 40% crude protein, a diet for catfishes. The resultant pelleted feeds were sun dried for 24hrs and stored in airtight polyethylene bags at room temperature. Quantitative mold count using direct colony counts on pour plate technique with 24hr old culture was carried out bi-weekly until profuse growth were recorded within 24hrs in all experimental feeds. Results showed that mold count from experimental feeds decreased with increasing concentration of duckweed. Ethanolic extracts also showed higher inhibitory properties on radial mycelial growth of all the isolates. Isolates identified were *Fusarium oxysporium, Penicillium digitatum, Aspergillus niger, A.fumigatus, A..flavus, Rhizopus stolonifer* and *R..oryzae.* [Report and Opinion. 2009;1(2):26-31]. (ISSN: 1553-9873).

Introduction.

Feeds are a major cost input into the aquaculture industry and their insufficiency is prominent among the factors responsible for inadequate aquacultural production of fish.

Compounded feeds are prepared with biologically decomposable materials. These materials decompose while in storage due to environmental factors such as temperature and humidity. Change in temperature and humidity affects the moisture content of compounded feed as well as the rate at which chemical changes takes place thereby enhancing invasion and growth of fungi in the feed (Sena and Anderson, 1995; Effiong and Eyo, 1999). Recontamination of feedstuffs by adventitious microorganisms during storage is of primary concern to the feed processor.

Moulds are the principal spoilers of feedstuff in storage (Chow, 1980). Moulds infestation reduces the nutritional value of feeds through loss of dietary lipids and amino acids (Jones, 1987). They also produce mycotoxins, which cause staleness of feed (Chow, 1980). He also stated that there is no effective way of eliminating fungal growth in stored pelleted feed. Their growth can only be controlled.

Research work on the problems of storage of feedstuff \feed has been rather scanty despite the enormous harmful effect it poses on the development of aquaculture in Nigeria (Effiong and Eyo, 2001).

Duckweed meal has been reported to resist attacks by mould for more than 5 years (Skillicorn et al., 1993). Duckweed meal is the compounded form of the group of aquatic macrophytes from the family Lemnaceae.

The dried powdered and directly pelleted forms of this plant have been observed in storage for 13 years without any signs of fungal growth or physical damage, retaining its nutrient content (Mbagwu, 2001).

This study is therefore aimed at determining the effect of duckweed meal on the rate of mould infestation in stored pelleted fish feeds.

Materials and Methods

Freshly harvested duckweed was thoroughly rinsed with clean water and evenly spread on a mosquito net-size mesh outside to sundry and thereafter dried in a forced air oven at 165 ^{0}c for 48 hours and ground to powder with a milling machine according to Mbagwu and Adeniji (1987).

Five dry diets were prepared in which fish meal was replaced with duckweed at 0%, 10%, 20% and 30% levels using the method of Akegbejo Samson (1999) at 40% crude protein, a diet for catfishes.

The various feed ingredients were thoroughly ground into fine meal and mixed together with vitamin premix and salt using hot water. The resultant mixture was pelleted with Moulinese HV6 model pelleting

machine and sun dried for 24 hours. The diets were stored in airtight containers at room temperature for 2 weeks.

1.0g of each feed sample were ground using pestle and mortar, to prepare 10-fold serial dilution. Agar was prepared using sterilized glasswares according to manufacturer's instruction and autoclaved at 121 ^{0}c for 15 minutes. It was allowed to cool to about 37 ^{0}c before 1% streptomycin was added to prevent bacterial contamination (Nwachukwu, 1988).

A 48hour old culture of the isolates were subcultured and incubated at room temperature to produce pure cultures from which stock were prepared and stored. A bi-weekly mould count from each experimental diet was carried out quantitatively using direct colony count on pour plate technique (Miles and Misra, 1938) with 24-hour-old culture. Enumeration continued until profuse growth was recorded within 24 hours in all the experimental diets.

Mould isolates were characterized during sporulation on the basis of cultural and morphological characteristics as well as microscopic examination (Samson and Reenen-Hoekstra, 1988). Sample of duckweed meal was ground using an Automatic Weed Grinder after it was thoroughly washed and air-dried. 5g of this each was measured and blended with 25ml of sterile distilled water (Oyagade, 1994). After thoroughly blending for 7 minutes, the slurry was filtered through a four –layered muslin cloth. The filtrate was passed through a 0.48 millimicron Millipore filter and transferred into sterile bottle.
In order to compare the efficiency of the extraction process, 95 % alcohol was used as the comparative solvent using the same method.

Radial mycelial growth inhibition tests were carried out on the isolates (Van-Etten, 1973; Oloke et al., 1988). The extracts were separately incorporated into molten PDA at 18ml of media to 2ml of extract. Control plates had either sterile water or ethanol without extract.

Agar- extract mixtures were poured into sterile glass petri dishes and allowed to set (Adedayo, 1994). Mycelial plugs of the test organisms of 5.0mm diameter were cut using sterile cork-borer from the advancing margin of the fungal colonies. These were placed at the center of PDA containing concentrations of 5% sterile distilled water or ethanol. All plates were incubated at 25 0c and radial mycelial growth recorded for 72 hours at 24 h0urs interval

Results and Discussion.

The bi-weekly fungal count (cfu) from the experimental feed at varying concentrations of duckweed showed decrease in fungal growth with increasing concentration of duckweed (Table 1). This observation could be attributed to the antifungal properties of duckweed acting against the growth of fungal species in the feed. Skillicorn et al., (1993) attributed the long storage characteristic of duckweed meal to the presence of high levels of wax. It could be possible that wax presents physical barriers to the growth of molds, which might impair their utilization of nutrients in the feeds. The molds isolates from the experimental feed samples were ***Fusarium oxysporium, Penicillium digitatum. Aspergillus niger, A. fumigatus, A. flavus, Rhizopus stolonifer*** and ***R. oryzae.***

. Chow (1980) reported that the most common molds involved in the spoilage of feedstuffs belong to the *Aspergillus and Penicillium* species among others. The presence of Aspergillus flavus from the feed indicates the possibility of mycotoxins, compounds produced by this species that are toxic to both humans and fish.

Feedstuffs known to be contaminated by A. flavus include groundnut cake, maize, sorghum, cottonseed cake, copra and cassava (Chow, 1980). The same author however reported that for aflatoxins to be produced, A. flavus must be present alone in a practically pure culture and that the presence of other molds, yeast or even bacteria seems to interfere with aflatoxin production. These findings have also been reported by Abdulhamid (2008).

The effect of duckweed extracts on the radial mycelial growth of fungal isolates from the experimental feeds is shown in Table 2.Differential efficacy on the test organisms was observed between the aqueous and ethanolic extracts of duckweed meal. Ethanol appeared better as an extractant judging from the wider activity spectrum and the resultant effect on the isolates. This observation perhaps suggests the possibility of the occurrence of bioactive substances that are not only soluble in water but also in organic solvent in the plant material. Majekodunmi et al., (1996), and Martinez et al., (1996) reported that a higher activity of extractable natural products were obtained in ethanol compared with aqueous extracts. Odemena and Essien (1995) also reported that the bacterial activity of alcoholic extracts of the roots of fluted pumpkin, Telfaria occidentalis was better than that of aqueous extracts.

Natarajan et al., (2005) reported the antifungal properties of three medicinal plant extracts against Cercospora arachidicola. They reported that fungal growth was gradually suppressed with increasing extract concentration. Similar findings have been reported by Lucia et al., (2002), Silva et al., (2001) and Costa et al., (2000). These reports are similar to the findings of this study.

Olafimihan (2003) working on the antibacterial properties of aqueous and ethanolic extracts of Neem plant reported that the antibacterial activity of the concentrated extract increased with increase in its concentration. This report is similar to the findings from this study with he observation that increasing concentration of duckweed meal in experimental feed resulted in decreasing fungal growth.

The environmental conditions of temperature and relative humidity during the period of the study were high and fell within the ranges that support luxuriant growth of molds in the experimental feed sample. The temperature range varied between 27.2 and 30.6 0c while relative humidity remained constant between 79 and 80%.

According to Chow (1980), growth of fungi is only possible at temperature above 250c and relative humidity values at 65%. There any reduction in fungal growth in the experimental feeds could not be attributed to directly affect the rate of fungal infestation of compounded feed in storage.

Conclusion

The results obtained from this study indicate reduced growth performance in the fungal species isolated from the experimental feed which also signified low infestation rate.

Fungal growth decreased generally with increase in concentration of duckweed meal in feed samples.

The result of this experiment have shown that duckweed has the potential of being a beneficial agent for the control of fungal growth in compounded feed in storage.

Table 1:Percentage composition of experimental feed with different inclusion levels of duckweed meal.

Ingredients (g)	0%	10%	20%	30%
Duckweed	0	2.6	5.2	7.8
Fish meal	26	33.4	20.8	18.2
Yellow maize	48	48	48	48
Soya Bean meal	15	15	15	15
Groundnut cake	6	6	6	6
Vitamin premix	2	2	2	2
Bone meal	2.5	2.5	2.5	2.5
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100

Table 2: Bi- weekly fungal counts at varying concentrations of duckweed in experimental feed.

Concentration of Duckweed (%).	Fungal count (cfu\ml)(x 10^7)							
	Time (wk)							
	2	4	6	8	10	12	14	16
0	12	20	31	43	72	Profuse	Profuse	Profuse
10	5	9	21	35	52	108	Profuse	Profuse

20	3	11	18	27	48	90	Profuse	Profuse
30	-	-	9	16	21	54	76	Profuse

Table 3: Effect of duckweed extracts on the radial mycelial growth of fungal isolates

Test Organism	Mycelial growth (mm)					
	Aqueous Extract			Ethanolic Extract		
	0%	5%	10%	0%	5%	10%
Fusarium oxysporium	46	21	10	10	-	-
Penicillium digitatum	50	35	24	9	5	-
Aspergillus niger	47	27	18	16	7	2
Aspergillus fumigatus	38	18	12	4	-	-
Aspergillus flavus	50	38	20	16	-	-
Rhizopus oryzae	36	29	16	14	-	-
Rhizopus stolonifer	42	21	13	22	10	4

Table 4:Proximate composition of experimental feed with different inclusion level of duckweed

Feed Sample	% Crude protein	%Ether extract	%Ash content	%Moisture content	%Crude fibre
0%	43.35	14.02	12.30	1.00	6.50
10%	42.56	14.29	12.00	1.00	4.46
20%	41.87	12.83	11.90	2.00	5.13
30%	45.06	11.76	13.29	2.00	4.90

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The Influences of Extremely Low Frequency Magnetic Fields of 60Hz AC Electric Power on Mung Beans Growth

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ABSTRACT: There are many reports about the biological effects of extremely low frequency magnetic fields (ELF MFs),but few of them investigate how different intensity MFs act upon the growth of living organisms. This study aims to assess the influences of the different intensity of ELF MFs on the early growth of living organisms using mung beans as test materials. We used 60Hz 110Vrms AC electric power as the source and made a toroidal magnetic coil by self for this experiment. The ELF MF is induced using a magnetic circuit with a toroidal magnetic coil and a 60W lamp in series, which is driven by 60Hz 110V AC electric power, the maximum intensity of ELF MF is 950mG. To utilize the magnetic field intensity decay when distance increase, to choose the three kinds different magnetic field intensity (such as 875mG,155mG and 1.8mG rms value). We used three groups of mung beans (each group is 50 beans) were exposed to the three kinds different magnetic field intensity separately, and observed the lengths of stems and leaves of mung beans after five days growth. The results indicate that the magnetic field intensity is 875mG and 155mG have an enhancing effect on the early growth of mung beans. [Report and Opinion. 2009;1(2):32-41]. (ISSN: 1553-9873).

Key words: ELF MF; biological effect,AC electric power,mung bean

1. Introduction:

Because popularization of electricity and modernization of life, to place in the electric power line generally and use home electrical appliances frequently on the human inhabitancy space, there are ELF MFs produced also exists around the living space. We used a magnetic meter (TES-1390 ELF Magnetic Field Meter, Bandwidth:50~300Hz,TES Electrical Electronic Crop. made in Taiwan) to measure the root mean square value of ELF MF intensity of home electrical appliances such as hairdryer, desk lamp, razor,etc. We can get magnetic field intensity greater than 100mG (rms value), when to measure home electrical appliances closely

(5cm to 10cm away). Because most countries adopt the reference levels which were announced by ICNIRP in 1998 for general public exposure to time-varying electric and magnetic fields as the standard. The formula of reference level for general public is 50/f (f is the frequency ,unit:KHz), the reference level is 833mG when f is 60Hz.

For understanding the biological effect of different kinds magnetic field intensity, we made a toroidal magnetic coil by self, the coil produced the maximum ELF MF intensity is 950mG. To utilize the magnetic field intensity decay when distance increase, to choose the three kinds different magnetic field intensity (such as 875mG,155mG and 1.8mG rms value). We exposed test materials (mung beans) in the three kinds different magnetic field intensity, and observed different magnetic field intensities act upon the early growth of test materials.

2.Materials and Methods

2.1 Plant material

Mung beans were used as the test subject in this study. We selected 150 mung beans of almost the same weight (0.09 g) and similar appearance, so that the sample error can be greatly reduced, and divided into three groups of 50 mung beans. Two groups of them are grown in a magnetic field (exposed group 1 under higher magnetic intensity and exposed group 2 under lower magnetic field intensity), and the other group is placed in an ambient weak magnetic field (control group). We used a rectangular culture plate (dimension is 47╳27╳ 3.5cm) which was spread the fine sand of depth 3cm to grow three groups of mung beans together. The environmental parameters of three groups that were maintained in the test room were almost the same, and the light was supplied by white fluorescent lamps .The close environmental parameters of three groups can be achieved so that the growth difference between them only comes from the magnetic field variable. The environmental parameters such as temperature is 28±2℃, humidity is 60±6% ,illumination is 1120±50LUX(day) and 563LUX(night).

2.2 Exposure System

The purpose of this study is mainly to assess the influence on the early growth of mung beans exposed to the different magnetic field intensities. The equipment needed in this experiment included a 60-Watts incandescent lamp, a toroidal magnetic coil, an oscilloscope/ frequency analyzer, etc. In order to produce the environment of higher magnetic intensity, we made a toroidal magnetic coil with air gap by self is shown in Figure 1. We entwined Iron wire (cross-section diameter =2mm) to become a toroidal iron core with diameter of 21cm and a 9 cm air gap (cross-section diameter=4cm). The core was wound 158 turns with copper wire (cross-section diameter =2mm) to become a toroidal magnetic coil. The magnetic flux density (B) circulating in the coil and air gap can be theoretically expressed in the following equations:

$$B = \frac{Ni}{RA}, \qquad R = \frac{l_c}{\mu A} + \frac{l_g}{\mu_0 A}$$

where R is total magnetic reluctance of the core and air gap, μ and μ_0 are the magnetic permeability of the core

and air respectively (μ ~5000 μ_0), A is the cross-section area of the toroidal iron core, N is the number of turns of coil, i is the current flowing through the coil, lc and lg are the core circumference and air gap distance, respectively. The exposure system is shown in Figure 2. We used 60Hz 110Vrms AC electric power as the source and a 60-Watts incandescent lamp as the load, and covered on lamp with an iron bucket to hide the light of lamp, to avoid other interference for mung beans growth.

We measured the highest magnetic field intensity of the air gap of coil is 950mG. The air gap of coil was to be placed the mung beans of exposed group one. In order to get more experimental data for statistics, we used 50 mung beans of each group which were put on culture plate will take larger area. Because the magnetic field intensity decay when distance increase, we measured the magnetic field intensity of the relative position of each group on culture plate is shown in Figure 2. We got more accurate data were the magnetic field intensity of exposed group one is 875±75mG, exposed group two is 155±55mG, control group is 1.8±0.8mG.

The MF source came from the toroidal magnetic coil that was driven by the 60Hz 110V AC electric power. To measure the waveform and spectrum of the ELF MF, we used a little probe coil of diameter 3cm (Misakian, 1993) to induce an electromagnetic force close to the coil . The probe was connected to an oscilloscope/frequency analyzer (Tektronix TDS2012B, Bandwidth:100MHz) to obtain the components of 60Hz 110V AC electric power magnetic field in time and frequency domain are shown in Figure 3 a and b. We found the waveform of 60Hz 110V AC electric power is distortion and the frequency spectrum with harmonics.

2.3 Methods

We prepared three cylindrical containers with diameters of 5cm and poured into 50ml distilled water, then put three groups of mung beans in the cylindrical container, respectively. We moved three cylindrical containers in the positions of rectangular culture plate be shown in Figure 2. After the three groups of mung beans have been imbibing water for 8 hours, so dehydrated beans were simply rehydrated to allow enzyme reactivation, they were taken out. The three cylindrical containers were removed and three groups of beans were put back in their original positions of culture plate to continue growing, and then were sprayed into appropriate distilled water by a sprinkler every 12 hours. Because three groups of mung beans grew on culture plate together, so the environmental parameters of three groups were almost the same. After mung beans have been growing for 5 days are shown in Figure 4, three groups of mung bean sprouts were taken out, in general mung bean sprout have two leaves, and the stem length and leaves length of each mung bean sprout was measured.

3. Result

We observed the growth of two exposed groups was faster than the growth of control group during 5 days .The average stem lengths and average leaf lengths of each group mung bean sprouts were recorded are shown in Figure 5. We analyzed experimental data by statistical method are shown in Table 1. The average stem

lengths of mung bean sprouts exposed to 875±75mG and 155±55mG ELF MF were great than those of control mung bean sprouts (P<0.01,one-tailed paired sample t-test). The average leaf lengths of mung bean sprouts exposed to 875±75mG and 155±55mG ELF MF were great than those of control mung bean sprouts (P<0.01, one-tailed paired sample t-test), too. We can find an enhancing effect on the growth of mung bean is exposed under 875±75mG and 155±55mG ELF MF. Otherwise, there is no significant different between the exposed group one and exposed group two mung beans (P>>0.05, one-tailed paired sample t-test).

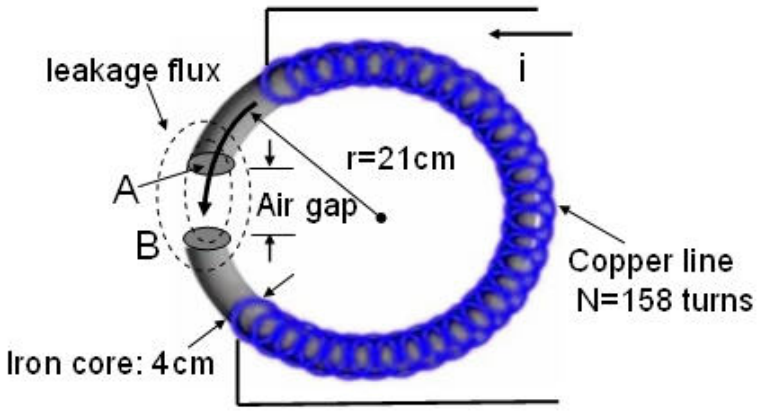


Figure 1. The toroidal magnetic coil with air gap

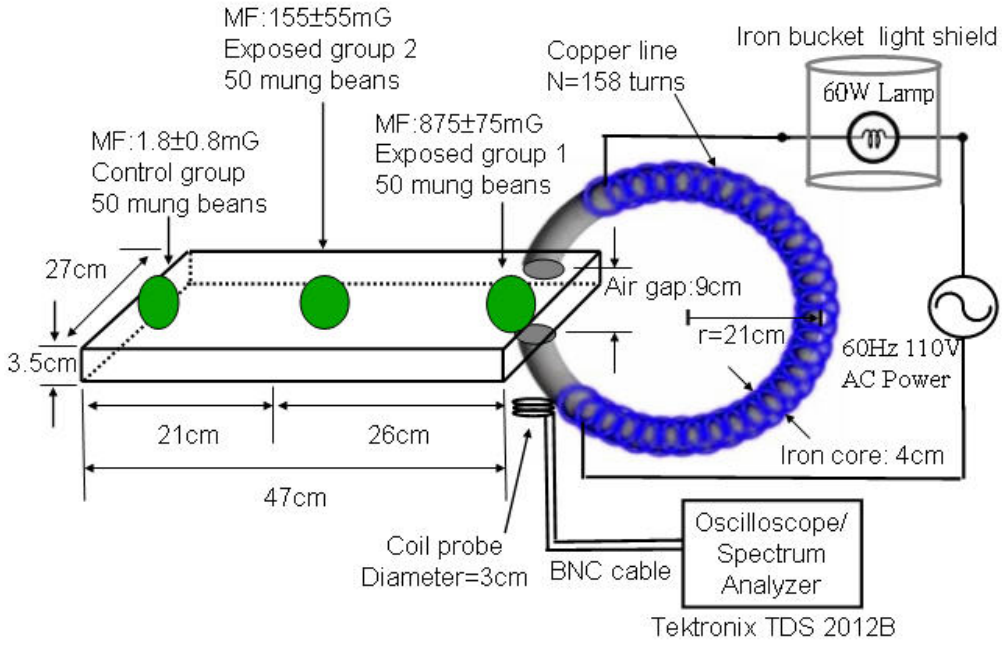


Figure 2. The exposure system of this experiment

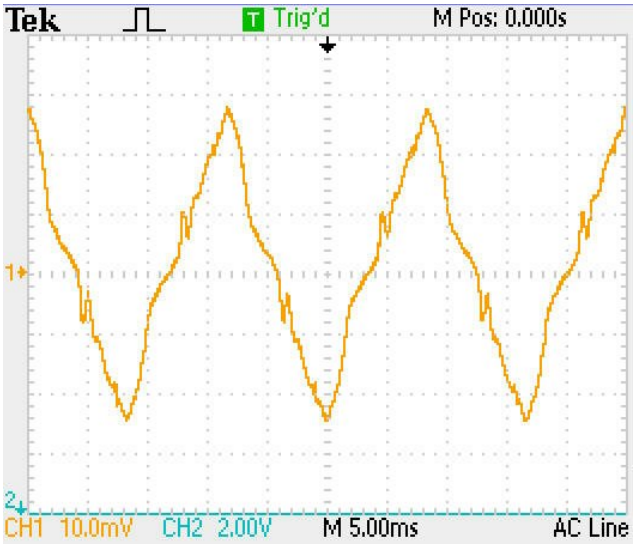


Figure 3. a: The waveform of 60Hz 100V AC electric power magnetic field is distorted sine wave

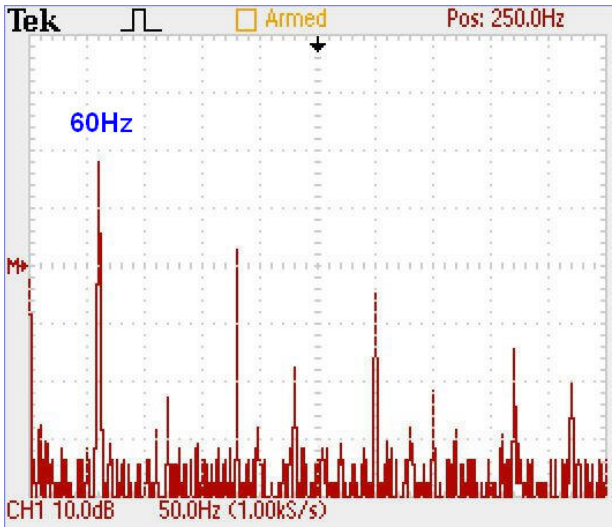


Figure 3. b: The frequency spectrum of 60Hz 100V AC electric power have harmonics, the measured bandwidth of analyzer is 500Hz.

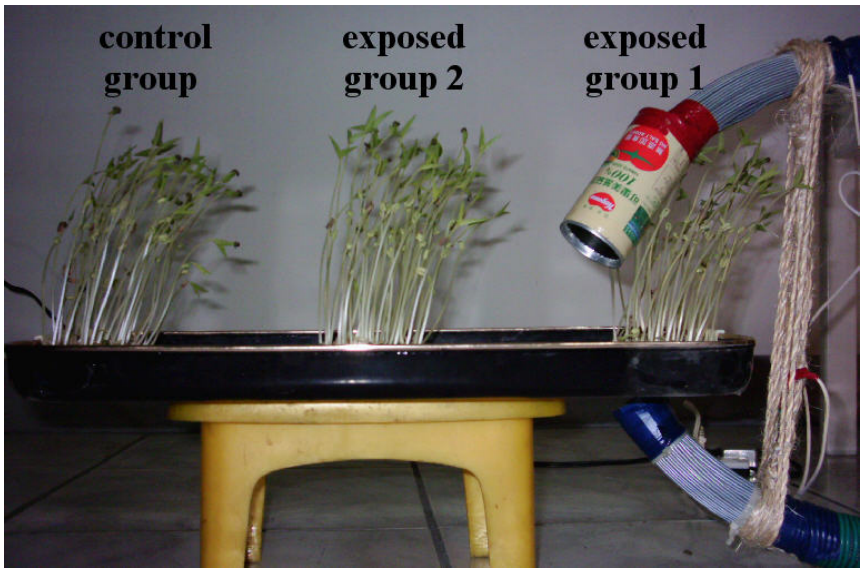
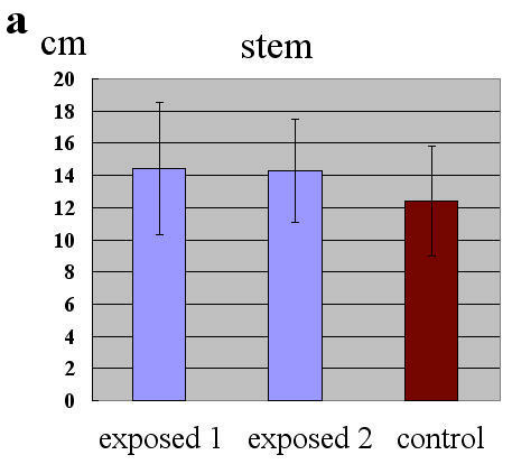
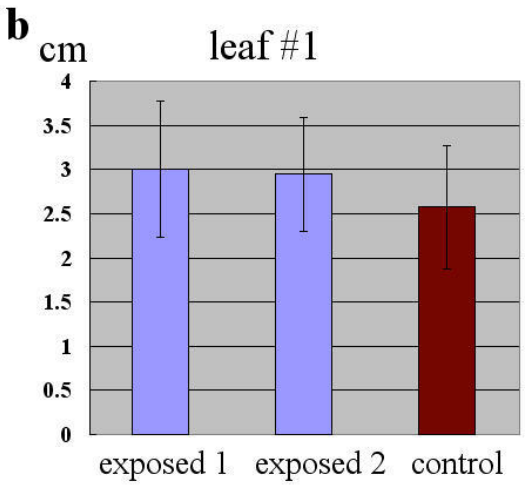


Figure 4. The early growth of exposed 1,exposed 2 and control group mung beans after five days





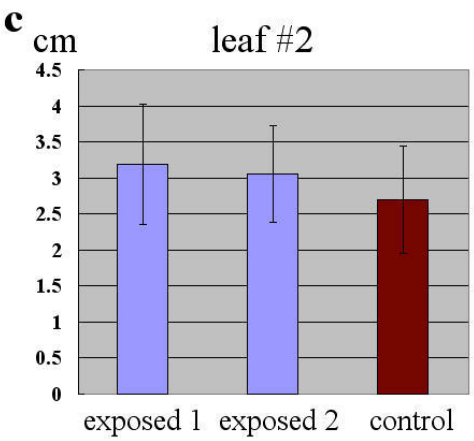


Figure 5 a: The average stem lengths of each group mung beans. b: The average lengths of first leaf of each group mung beans. c: The average lengths of second leaf of each group mung beans.

Table 1.The statistical analysis of three groups mung beans growth

statistics	analyze exposed 1 and control group	analyze exposed 2 and control group	analyze exposed 1 and exposed2 group
P value for stem	0.0054	0.0043	0.4213
P value for leaf#1	0.0025	0.0039	0.3709
P value for leaf#2	0.0017	0.0088	0.2156

4. Discussion

According to the reference levels which were announced by ICNIRP in 1998 is 833mG (f=60Hz) for general public exposure to time-varying electric and magnetic fields, to prevent the influence that may cause to the nervous function of human. However, the experiment results show that the magnetic field intensity is 875±75mG and 155±55mG have an enhancing effect on the growth of mung beans (Smith,1993;Davies,1993; Soja,2003 ;Huang,2007). So, the growth of plant would be modified when plant exposed ELF MF intensity above 100 mG for a long time. The enhancing influence is abnormal phenomenon for growth of plant, because the motion of Ca^{++} ion on the cells of plant is changed (Lednev,1991;Smith,1993). Therefore, we worry about body health would be influenced when human exposed ELF MF intensity above 100 mG for a long time. We can get magnetic field intensity greater than 100mG (rms value), when to measure home electrical appliances closely (5cm to 10cm away). To use home electrical appliances closely then we would expose higher magnetic field intensity, maybe influence the health of human body. So should avoid exposing ELF MF intensity above 100 mG for a long time in order to reduce the biological effect of extremely low frequency magnetic fields. For electrical appliances and high-voltage line can induce higher magnetic field, we should keep the appropriate distance to protect the health of human body.

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The Inflation Dynamics of the ASEAN-4: A Case Study of the Phillips Curve Relationship

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Abstract: The conventional Phillips curve argues that there is a trade-off or negative relationship between unemployment and inflation. The aim of this study is to investigate the validity of the Phillips curve for the ASEAN-4 countries: Philippines, Thailand, Indonesia, and Malaysia from 1980 to 2005. Besides unemployment, the relationship of interest rate, exchange rate, and supply shocks to inflation, were also investigated. Using various econometric techniques like Ordinary Least Squares and Instrumental Variables, it was found out that for the ASEAN-4, there seems to be no stable one-to-one trade-off between unemployment and inflation. Variables that could help control inflation were also different for the four countries. For Thailand, the inflation lag, unemployment and oil dummy were significant. As for Indonesia, the interest rate, 1997 East Asian Financial Crisis dummy, and oil dummy were significant in affecting inflation. The OLS regression gave the best linear unbiased estimate for both countries. For the Philippines, serial correlation was detected. Thus, Prais-Winsten method was employed. It was then shown that the unemployment lag, interest rate, and exchange rate lag were significant at the 10% level of significance. [Report and Opinion. 2009;1(2):42-44]. (ISSN: 1553-9873).

Key words: Phillips curve; inflation; unemployment; ASEAN

I. Introduction

The empirical studies on the Phillips curve analyzing the relationship of unemployment rate to the inflation rate are the results of the search for a tool for forecasting inflation and implementing monetary policy. The conventional Phillips curve argues that there is a trade-off or negative relationship between unemployment and inflation (Dornbusch, *et al.* 2005). Economists soon modified the Phillips curve theory to focus on inflation in relation to unemployment. The aim of this paper is to investigate the validity of the Phillips curve for the ASEAN-4 countries: Philippines, Thailand, Indonesia, and Malaysia from 1980 to 2005. Some variables that could affect inflation are also analyzed. Thus, this paper will explore some tools that could aid in the inflation targeting strategies of the ASEAN-4 economies.

II. Empirical Model

I used annual Consumer Price Index, exchange rate (domestic currency per dollar), and money market interest rate data sets supplied by the United Nations Statistical Database (UNSD). For each country, the inflation rate was computed as the percentage change in the Consumer Price Index. That is, inflation rate= $(CPI_t - CPI_{t-1})/ CPI_{t-1} * 100$. All CPI and inflation rates data would have 2000 as the base year (CPI= 100). In addition, since the UNSD only have survey data for unemployment, we acquired more reliable unemployment rates from the National Economic Development Authority of the Philippines website. All of the annual data sets covered the period from 1977 to 2005.

For the empirical model, I modified the equations by Gordon (1997), Dua (2006), Stiglitz (1997), Staiger, Stock, and Watson (1997), and Smith (2000). In the formulation of a simple augmented Phillips curve, I also utilized Wan's (2001) linear model involving lagged inflation and cyclical unemployment as explanatory variables.

For Equation 1, I use the augmented version of Stiglitz's model to capture inflationary expectations by including the lagged inflation rate as a measure of the expected inflation rate. In addition, I include an unemployment lag to determine if such would provide a better fit. I also have additional explanatory variables: interest rate, lagged exchange rate, 1997 East Asian financial crisis binary dummy, and oil shock dummy variable for oil price fluctuations.

$$\pi_\tau = \beta_{0\tau} + \beta_1 unemp_t + \beta_2 \pi_{\tau-1} + \beta_3 unemp_{t-1} + \beta_4 intrate_t + \beta_5 xr_{t-1} + \delta_0 97 + \delta_1 oil + \upsilon_\tau \quad (1)$$

The following are the hypotheses for the signs of the explanatory variables:

- Unemployment, unemp, and unemployment lag, $unemp_{t-1}$, as stated by the Phillips curve, is negatively related to inflation. That is, if the demand for labor increases due to an expansionary monetary expansion, the unemployment rate would fall causing wages/ prices to rise. Thus, creating a trade-off between inflation and unemployment.
- The inflation lag, $\pi_{\tau-1,}$ the assumed expected inflation, is positively related to inflation. I assume this using the adaptive expectations theory.
- The interest rate, intrate or mmintrate, is positively correlated to inflation. Increasing interest rates results to higher costs for businesses, which causes prices to rise.
- Due to policy lags, the current exchange rate may be endogenous. Thus, I assume that the exchange rate lag is exogenous and use it in the model. The exchange rate I use is in the form: domestic currency per dollar. I use xr_1 to account for trade prices. I hypothesize that an increase in xr_1, a depreciation of the local currency, would increase inflation because of a higher import prices.
- Binary dummies, 97 and oil, were added to account for price shocks brought by the 1997 financial crisis and oil crises. Such control variables are expected to have a positive sign because they serve as supply shocks. To account for East Asian financial crisis, the years 1997 and 1998 have their 97 dummy equal to one. Meanwhile, the oil dummy for 1980, 1990, and 2005 is equal to unity since oil price fluctuations occurred during those years.

For Equation 2, I use first differencing. This model will only be used if the equation experiences unit root problems. Such unit root behavior was tested using the Phillips-Perron test.

$$\Delta\pi_\tau = \alpha_0 + \Delta\beta_1 unemp_t + \Delta\beta_2 \pi_{\tau-1} + \Delta\beta_3 unemp_{t-1} + \Delta\beta_4 intrate_t + \Delta\beta_5 xr_{t-1} + \delta_0 97 + \delta_0 oil + \upsilon_\tau \quad (2)$$

To have more efficient estimates, I tested Equations 1 or 2 for heteroskedasticity and serial correlation. If either problem exists, corrections are employed to ensure consistent estimates. As will be discussed later, I also used Instrumental Variable method for Malaysia. More specifically, since unit root behavior occurs in the inflation variable, I used an instrument, the inflation lag of Singapore, for the inflation lag of Malaysia.

IV. Discussion of Regression Results

Using t-test, with an H_0: B_j=0, and a two-sided alternative of H_1: $B_j \neq 0$, the results for Equation 1 can be summarized as follows:

Table 1. Fully-corrected regression results for Equation 1
Dependent variable: Inflation
Significance level: 10%

Explanatory Variable	Indonesia	Malaysia	Thailand	Philippines
Infla_1	-.0488733 (.1096472)	.3483649 (.2066877)	.3773198 (.1637375)	-.0074889 (.1133733)
Unemp	0.2920096 (.7119024)	-.4904054 (.5649236)	-.9443959 (.4813811)	1.164838 (1.157631)
Unemp_1	.0188285 (.8245843)	.3516186 (.5329042)	-.389395 (.5979983)	-2.008291 (.7032352)
Mmintrate	1.200941 (.1402781)	-.060483 (.1525026)	-.3699473 (.3366451)	2.594078 (.2925591)
Xr_1	.0001955 (.0008092)	-1.265882 (1.38491)	-.1813196 (.1655893)	.8965375 (.3458095)
D97	-14.92133 (5.921631)	1.656048 (1.073852)	4.670027 (2.812547)	-3.558471 (3.915062)
Doil	4.907661 (2.690442)	1.596374 (1.078417)	5.304789 (1.658721)	4.543862 (4.269187)
Constant	.5815264 (.9750957)	.07467 (.830654)	-.9713239 (.566889)	-.2621564 (.9492679)
R^2	0.8855	0.4730	0.6918	0.8244
Adj R^2	0.8409	0.2680	0.5720	0.7561
n	26	26	26	26

For Thailand and Indonesia, the OLS regression gave the best linear unbiased estimate (BLUE). For both countries, the error terms have constant variance and have no autoregressive conditional heteroskedasticity (ARCH). There were also no random walk and serial correlation problems. For Thailand, using the adjusted R^2 value, 57.20% of the inflation variation was explained by the model. This is an improvement compared to Equation 1's adjusted R^2 value of 23.44%. Moreover, the inflation lag, current unemployment rate, and oil dummy were significant at the 10% level. The significance of the inflation lag is consistent to the findings of Dua (2006). This may signal that inflation is inertial (Smith, 2000). For Thailand, past inflation influences people's expectations on future inflation. Meanwhile, it was also estimated that a one percentage increase in unemployment, decreases inflation by .94439 percentage points. Such value is very near to one. Thus, I could say that the Phillips curve is present in Thailand using 1980-2005 data. Unemployment and inflation have a trade-off. This finding is similar to that found by Bhanthumnavin (2002). Oil price shocks also influenced Thai inflation values immensely. It was implied that, controlling for all other variables, when there is an oil price shock, predicted inflation is about 5.30 points higher than for a year without an oil price shock (i.e. inflation= doil + constant). That is, when there are oil price fluctuations, inflation increases by about 5.30 + (-.917)= 4.329 percentage points. From these, I could see that as the price of energy rises, the inflation rate will increase as production becomes more expensive. For Indonesia, the significant variables at the 10% significance level were the interest rate, oil and 1997 financial crisis dummies. The dummy for the 1997 East Asian financial crisis, surprisingly, depresses predicted inflation by about 14.92 percentage points. More specifically, ceteris paribus, during the 1997 East Asian financial crisis, inflation decreases by approximately .581- 14.92= |-14.339| percentage points. Such result, most probably, was due to lower productivity growth and aggregate demand in the economy. This finding was similar to that of Vong (2001) in his study of Macau's Phillips curve. Meanwhile, the oil dummy indicated that, in the presence of oil price shocks, ceteris paribus, predicted inflation for Indonesia, is 4.9076 percentage points higher than usual. That is, when there are oil price shocks, inflation increases by .581 + 4.9076= 5.4886 percentage points. In addition to these, it was seen that unemployment and its lag were not statistically significant. The unemployment variables also had positive signs which could indicate that there maybe no trade-off between inflation and unemployment. Being a developing country, it seems to be that Indonesia suffers from both persistent high inflation and high unemployment rates.

For the Philippines, using OLS, it was found out that the unemployment lag, interest rate, and exchange rate lag were significant at the 10% level. For a one percentage point increase in the unemployment lag, inflation decreases by 2.0367 percentage points. Such supports the trade-off between unemployment and inflation as indicated by the Phillips curve. That is, if the demand for labor increased due to an expansionary monetary policy, the unemployment rate would fall. Then, wages and consumer prices will tend to rise. Moreover, the significance of the unemployment lag could indicate that fiscal policies relating to inflation might not have an immediate effect. There could be policy lags. Meanwhile, a percentage point increase in interest rates increases inflation by 2.613 percentage points. In addition, when the exchange rate lag increases by one percentage point, inflation increases by 0.8893 percentage points. This supports our hypothesis that depreciation in the domestic currency makes local goods more competitive. Such increases aggregate supply and results to an increase in the price level. However, even though the Philippines' OLS model gave significant results, it is not BLUE. Using Durbin's alternative test for autocorrelation, with a p-value of 0.0167, at the 10% significance level, there was evidence that the Philippines' Equation 1 regression suffers from serial correlation. Generally, when corrected for serial correlation, I have seen that the standard errors decreased. Although they are characterized by lower coefficients, unemployment lag, interest rate, and exchange rate remain significant. For a one percentage point increase in the unemployment lag, inflation decreases by 2.0082 percentage points. On the other hand, a percentage point increase in interest rates increases inflation by 2.594 percentage points. In addition, a one point percentage increase in the exchange rate lag increases inflation by 0.8965 percentage points.

For Malaysia, the OLS model explains 43.15% of the variation in inflation. Only unemployment was significant at the 10% level. A one percentage point increase in unemployment decreases inflation by 1.543 percentage point. Such finding is still consistent with the OLS estimates of Tang and Lean (2007): that there exists a trade-off between unemployment and inflation in Malaysia. However, while this might support the Phillips curve hypothesis, we should be careful with the interpretation of results. This is because, when tested for unit root behavior using the Phillips-Perron test, with a p-value of 0.1298, it was found out that the past values of inflation were correlated. In addition, the inflation lag might be endogenous. It might be correlated with the error term. To solve for this problem, I use the inflation lag of Singapore as an instrumental variable for Malaysia's inflation lag. I use Singapore data since I thought that its price levels might be highly correlated with that of Malaysia. Such may be a result of

their geographical proximity and trading relations. The simple correlation of Malaysia's inflation lag with Singapore's inflation lag was 0.7162. In addition, when Malaysian inflation lag was regressed with all other exogenous variables and the Singaporean inflation lag, it was found out that Singapore's inflation lag, with a p-value of 0.079, was significant. This supports one of the assumptions for an instrument. The covariance of our instrument, Singapore's inflation lag, and our x_j, Malaysia's inflation lag, is not zero. Meanwhile, I assume that Cov(Singapore_inflation_1, u)= 0. When I used Singapore_inflation_1 as an instrument for infla_1 in our Malaysian OLS model, the inflation lag and unemployment were significant at the 10% level. The inflation lag fulfilled our expected sign. However, again, we could not be sure as to the reliability of these results. Using the Phillip-Perron test, there was an evidence of a highly persistent time series. The past values of inflation are still correlated. Thus, I use Equation 2, the first-differenced model, for our analysis. The regression with Equation 2 showed that there seems to be no significant variables which could affect inflation. Such results might be consistent but not efficient. This is because of the presence of large standard errors caused by either heteroskedasticity or serial correlation. When tested for both stationary and autoregressive conditional heteroskedasticity, the first-differenced model was characterized by homoskedasticity. However, when tested for serial correlation of order 1, AR(1), and higher order correlation using the Breusch-Godfrey LM test for autocorrelation, it was evident that the Equation 2 for Malaysia suffers from serial correlation. With these, we have seen that although differencing could eliminate most of the serial correlation, it has not done so for our model. Most probably, our model suffers from higher order serial correlation. To correct for serial correlation, I use Prais-Winsten estimation. When corrected for serial correlation, the first-differenced equation, Equation 2, had lower standard errors. This shows that the existence of serial correlation produced large standard errors. For the fully-corrected model, it was only the inflation lag, with a p-value of 0.109, which is nearly significant at the 10% level. From the regression results, it can be seen that as the instrumented inflation lag increases by one percentage point, inflation increases by .3483 percentage points. The nearly significant value might have been the result higher order autocorrelation. The model might not have been fully-corrected because I also used Prais- Winsten method—a method which only employs feasible GLS estimation of AR(1). In addition, we should also take note that the FGLS is not unbiased and therefore, is not BLUE. Moreover, although it may be asymptotically more efficient than the OLS estimator in the presence of serial correlation, we cannot fully assume weak dependence because of a small sample size of 26. Another possible reason for our findings is that Singapore_inflation_1 might not be a completely exogenous instrument for Malaysia's inflation lag. Our IV, Singapore's inflation lag might be correlated with the error term. This could happen because Malaysia and Singapore are closely-linked economies. For example, there is a possibility that the exchange rate between the currencies of the two countries is correlated to our IV. Thus, Singapore's inflation lag might not be the best IV for Malaysia's inflation lag. With this, it is recommended, that in future studies, the exchange rate lag, the interest rate lag, and others be tested as possible instrumental variables.

I will now focus our discussion on the theorized Phillips curve relationship: trade-off between unemployment and inflation. I will analyze the signs of the unemployment rate for the four countries without emphasizing their significance at the 10% level. Using the fully-corrected models, it was found out that for Thailand and Malaysia, there exist a trade-off between unemployment and inflation. The negative coefficients for unemployment are the evidences for this. The trade-off is approximately one-to-one for the two countries. Such relationship supports the Keynesian view on the Phillips curve. That is, at least for the short-run, unemployment and inflation have a negative relationship. In contrast, the unemployment coefficients for Indonesia and the Philippines were positive. The findings for the Philippines are consistent with Dua's findings (2007). The positive relationship between unemployment and inflation is supported by Rational Expectations Theory. There may be no trade-off between unemployment and inflation because markets respond quickly to changes in prices and wages.

IV. Conclusions and Recommendations

For the ASEAN-4, significant or not, there seems to be no stable one-to-one trade-off between unemployment and inflation. I also found out that the variables which could help control inflation were different for the four countries. Meanwhile, to have more conclusive results and achieve normality, I suggest obtaining a bigger sample size, e.g. usage of quarterly data. In conducting tests, such would give us higher degrees of freedom. In addition, for serial correlation problems, error terms such CPI minus unit labor cost can be used (Smith, 2000). I also suggest a lag for interest rates. There maybe a possibility that the previous year's monetary policy regarding interest rates might have a significant effect on the inflation rate. In addition, to better explain inflation dynamics, stock prices, energy/ petroleum prices, and other functional forms (e.g. quadratic or logarithmic form) can be utilized in future studies. Furthermore, panel data analysis could be utilized. Lastly, cointegration tests may be employed to explore the feedback dynamics of employment- inflation relationship.

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Changes in epipedal development in soils of a gravelly hilly terrain

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Abstract

This study investigated variations in properties of surface soils of 4 physiographic positions on a hilly landscape in 2007. A transect was used to align sampling sites on the identified topographic land units of summit, midslope footslope and valley bottom. Ten soil samples (replicates) were collected from each physiographic position (treatment) and the experiment was arranged in a randomized complete block design. Soil data were subjected to analysis of variance using the PROC mix-model of SAS computer software. Results showed significant differences ($P < 0.05$) in soil properties except bulk density. There were also variations in soil morphological properties. Based on these, topsoils from summit, midslope and valley bottom were classified as ochric epipedons while those of valley bottom were categorized as plaggen epipedons. There is need to study similar landscapes in the study area for the purpose of using data for delineating soil in terms of suitability for different land uses. [Report and Opinion. 2009;1(2):45-55]. (ISSN: 1553-9873).

Keywords: Edaphology, epipedon, pedogenesis, topography, tropical soils.

Introduction

Soil is a product of interactions between climate, parent material, relief and organisms over a period of time. Its formation involves complex pedogenic processes (Buol *et al*., 1997) such as additions, losses, translocations and transformations. While climate (Johnson. Maynard *et al*., 2004) and organisms (Quideau *et al*., 2001) actively influence

soil formation, topography indirectly affects rate of pedogenesis and distribution of soil nutrients (Wang *et al.*, 2001).

Differences in soil formation along a hillslope result in differences in soil properties (Brubaker *et al.*, 1993) which affect pattem of plant production, litter production and decomposition (Wang *et al.*, 2001). Whereas organic matter varied with landscape position (Bhatti *et al*.,1991), C and N processes were found to be influenced by the same factor (Hobbie,1996). In addition to the above edaphic properties, landscape influences soil texture, penetration resistance (Bruand *et al.*, 2004) root development (Busscher *et al*., 2001) exchangeable basic and acidic cations (Stutten *et al.*, 2004), soil exchange chemistry (Clien *et al*., 1997), and nutrient budget (Mallarino 1996) hence important in fertilizer management (Paz-gonzalez *et al*., 2000).

These changes in soil physicochemical properties affect greatly epipedal or surface horizons of soils being an interface between the earth's crest and atmosphere with direct influence of climo-and bio-sequence on it. It is in this regard that an index was developed to characterize and monitor changes in near surface soils in soil survey and land evaluation studies (Grossman *et al*., 2001; Seybold *et al.*, 2004). Field morphological evaluations of epipedons of near surface soils have not be actively applied in soil quality assessments (Grossman *et al.*, 2001). Absence of such near surface evaluations could be responsible for the spate of land degradation in the hilly landscape of the southeastern Nigeria. Most pedological studies in the study area dwell on profile pit studies including subsurface horizons (Akamigbo and Igwe, 1990; Igwe *et al.*, 2005; Onweremadu, 2008) and in lowland area of southeastern Nigeria. It becomes necessary to characterize epipedal horizons of soils of a hilly landscape for the purpose of sustained use of soil and for environmental friendliness. Based on the above, the major objective of this study was to investigate the selected physico chemical characteristics of gravelly topsoils overlying a hilly slope in southeastern Nigeria for the purpose of classification and use in soil management

Materials and Methods

Study Area

The study was carried out before the on-set of wet season in 2007 on a gravelly hilly uncultivated landscape at Okigwe, southeastern Nigeria. It is located on latitude $5^0$48'46. 970''N longitude $7^0$35'54.810"E and with an altitude of 300 m (Handheld Global Positioning System Receiver readings- Garmin Ltd Kansas, USA). Soils of the study are derived from falsebedded sandstones (Ajalli formation) of the maestrichtian geologic era and proximal to the upper coal measures (Nsukka formation) of the Danian geologic era. Okigwe has a humid tropical climate, having a mean annual rainfall of 2250 mm and a mean annual temperature range of 27-28 ^{0}C (FDALR, 1985). Orographic rainfall is common in the area occupying over 25 km^2 land area, and the windward side of hills receive more rainfall than the leeward landscape. it has a sparsely vegetated shrubby rainforest with windward portions of hills having taller and varied plant species occurring in distinct tiers. Hillside farming, stone mining, hunting, quarrying, gathering of fruits especially cashew (*Anarcadium occidentale*), nomadism and several agro-based cottage industrial ventures constitute major socio-economic activities.

Field Sampling

A windward side of the hilly landscape was used for the study. The method of Brubaker *et al*. (1993) guided field sampling of soils. In this method, categories of landscape positions were identified as upper interfluves, lower interfluves, shoulder, upper linear, lower linear and footslope. However, the study was divided into 4 landscape positions namely summit, midslope, footslope and valley bottom and these physiographic positions were connected by a transect. Soil sampling (topsoil) was done along the transect. Abney level was used in measuring slope percent while Munsell colour chart was used to determine colour of peds. Ten soil samples were collected from each sampling point giving a total of 40 soil samples from the 4 landscape positions .The 4 landscape positions constituted treatments while 10 samples were replicates and the experiment was laid out in a Randomized Complete Block Design (RCBD) in order to accommodate other sources of variation being a field study. Soil samples were air-dried, sieved using a 2-mm sieve and stored in polyethylene bags in readiness for laboratory analyses. Gravel content was estimated by weight of the total soil (50 g for each soil sample).

Laboratory Analyses

Particle size distribution dispersed in sodium hexametaphosphate, was determined by hydrometer method according to the procedure of Gee and Or (2002). Bulk density was measured by core procedure (Grossman and Reinsch, 2002). Water holding capacity was determined on undisturbed samples as the difference of water contents at – 0.03 MPa, determined by pressure plate and –1.5 MPa, determined by pressure membrane (Dane and Hopmans, 2002). Total soil carbon was estimated by combustion at 1140 ^{o}C using Leco (R-12 analyzer (Leco Corp, St. Joseph, M1). Soil pH was measured potentiometrically on a 1:2 soil/water solution (Henderson *et al.,* 1993). Cation exchange capacity was estimated by ammonium acetate at pH 7 (Soil Survey Staff, 2003). Calcium carbonate equivalent (CCE) was measured by treating soil sample (<2 mm) with HCl and evolved $C0_2$ estimated manometrically (Soil Survey Staff, 2003).

Data Analyses

Soil data were subjected to analysis of variance (ANOVA) using PROC Mix –model of SAS (Little *et al.,* 1996) and means were separated using a standard error of the difference (SED) at 5% level of probability.

Results and Discussion

Soil morphology: Morphological features of studied soils are shown in Table I, indicating thin epipedons (0 –8 cm) for soil of the summit, midslope and footslope while epipedons of the valley bottom were thick (0 – 58 cm) with few artifacts. Except in valley bottom, soils of other physiographic positions were well drained and redder. Soils of the summit and footslope were weak fine granular–structured with soils of the midslope exhibiting massive structure. Soil rupture-résistance was dominated by very friable status at all the epipedons except in those originating from valley bottom. Soils were predominantly A- (Summit and Midslope) and Ap-horizons (Footslope and Valley bottom). Variability in depth of soils could be as a result of colluviation, although in a similar landscape in Sweden, Allen (2002) attributed it to vertical schistosity. Colour changes in the study site could be due to drainage differences since soils might have

originated from similar parent material (Ajalli and Nsukka formations). Mechanization difficulties may constrain the use of soil of the summit and midslope due to slope (>16%) coupled with high gravel content. Indeed, intensive cultivation of soils of the higher physiographic positions may lead to land degradation. However, adoption of conservation measures such as terraces and vegetative strips may sustain arable agriculture (11RR and ACT, 2005) .

Soil physical properties: Soil physical properties are presented in Table 2, with soils exhibiting significant ($P< 0.0001$) variations in particle size distribution and moisture content while bulk density showed non-significant differences among physiographic land units. Sandiness decreased downslope while the other particle sizes increased in the same direction. This could be due to larger size of sand and its decreased transportability while silt and clay sizes are smaller and lighter hence easily moved in suspension towards the valley bottom. Silt – clay ratio, which is an index of age of soil, decreased downlope, indicating that soils of the summit are younger due to instability caused by erosion and colluviation unlike epipedons of lower physiographic positions. Despite non-significant variability in bulk density, the attrribule was found to be higher in valley bottom possibly due to seasonal flooding of soils. Continued wetting and drying of soils decreases aggregate stability (Caron *et al.,* 1992) , leading to collapse of soil pores and production of finer particles and macro-aggregates (Levy and Miller, 1997), implying increased bulk density and decreased macro-porosity .In a similar study on a fragipan, Scalenghe *et al.(*2004) reported higher density on wetted soil when compared with dry soil.

Water holding capacity increased towards the valley bottom physiographic position, and this could be attributed to higher values of clay downslope .Similar findings were reported by Ezeaku and Anikwe (2006)in soils of southeastern Nigeria. In addition to clay content, organic matter distribution contributed significantly ($P\leq 0.05$) to differences in soil moisture content (Table 3.) in line with the findings of Dekker *et al.* (1999) in topsoils in Netherlands, France, Sweden and Germany. However, soil organic matter interacts with other soil properties to influence water behaviour in soils (Ellerbrock *et al*., 2005; Eynard *et al.,* 2006).

Other soil chemical properties of epipedons in the study site are shown in Table 3 and they varied significantly ($P\leq 0.05$) along physiographic positions. Soil pH decreased

towards the summit, suggesting possible loss of basic cations which finally accumulate at the valley bottom. Differences in soil pH were very significant among physiographic positions, and this could be used in delineating the hilly landscape into different arable land use types since soil pH governs the distribution crop nutrients in soil. Although soils were generally acidic, topography may have contributed to local differences in its distribution in the studied soils. Results of soil pH were higher (pH water = 5.27-7.6) and contrasted with findings of Onweremadu (2007) in a similar study (pH water =4.0-4.7 in the same agroecology. This variation could be due to land use and topography. Calcium carbonate equivalent (CCE) values were low in all physiographic units particularly in epipedons from the summit. This could be as a result of combined effect of leaching and runoff losses. The study site is within the northernmost part of the rainforest agroecology of southeastern Nigeria while higher values of CCE are expected in drier ecological zones of Nigeria. Presley *et al*. (2004) reported higher values of CCE in semi-arid soils of Kansas in USA, and these values increased with depth of soils. However, this study did not investigate sub-horizons of studied soils.

Classification of epipedons

The soils of summit, midslope and footslope were thin (0-3,0-5, and 0-8 cm respectively) with Munsll colour values greater than 4 (moist) and chroma of 4. In addition to these, soils of summit, midslope and footshop had CCE of 10, 12 and 14 g kg, respectively (Table 3), suggesting the classification of these topsoils as ochric epipedones. Soils of the valley bottom contained artifacts with Ap horizon of 0- 58 cm thick possibly due to cultivation and prominent marks of farm tools unlike the other soils , hence classified as plaggen epipedons.

Table 1. Selected Soil Morphological Properties

Physiography	Horizon	% slope	Depth (cm)	Colour (moist)	Structure	Artifacts	Consistency (moist)	Gravel (32-2 mm)	Drainage
Summit	A	21	0-3	LRB 5YRS 6/4	1fgr	Nil	Vfr	46	WD
Midslope	A	16	0-5	LRB 5YR 6/4	0 ma	Nil	Vfr	43	WD
Footslope	Ap	8	0-8	RB 5YR5/4	2 fgr	Nil	Vfr	32	WD
Valley bottom	Ap	0-2	0-58	DG 5YR 4/1	2 m abk	Few	fi	26	PD

LRB = light reddish brown, RB = Reddish brown, DG = Dark gray

O = Structure less, 1 = weak, 2 = moderate, f = fine m = medium Ma = massive base = angular blocky, Vfr = very friable, WD= well drained, PD = poorly drained, fi = friable

Table 2. Soil Physical Properties

Physiographic horizon Depth	Sand g kg^{-1}	Silt g kg^{-1}	Clay g kg^{-1}	SCR	BD M gm^{-3}	WHC g kg^{-1}
Summit	850	90	60	1.5	1.41	24
Midslope	845	70	85	0.7	1.37	28
Footslope	800	90	110	0.8	1.32	36
Valley bottom	780	95	126	0.7	1.43	44
SEDp=0.05	1.38	1.95	5.06	0.05	0.02	1.22
P = values	<0.0001	<0.0001	<0.0001	0.0001	NS	<0.0001

SCR = silt – clay ratio, TC = textural class WHC = water holding capacity.

Table 3. Selected soil chemical properties

Physiography	Horizon	Depth cm	pH water	CEC cmo1kg^{-1}	CCE g kg^{-1}	OC g kg^{-1}
Summit	A	0-3	5.2	5.6	10	11.6
Midslope	A	0-5	5.4	7.8	12	14.2
Footslope	Ap	0-8	5.5	7.9	14	34.4
Valley Bottom	Ap	0-58	6.1	9.8	24	39.8
SEDp= 0.05			0.09	1.56	0.08	0.07
P-values			<0.001	<0.001	<0.001	<0.0001

CEC = cation exchange capacity, CCE = calcium carbonate equivalent, OC=organic carbon.

Table 4. Classification of studies epipedons

Physiography	Horizon	Depth (cm)	Epipedon
Summit	A	0-3	Ochric
Midslope	Ap	0-5	Ochric
Footslope	Ap	0-8	Ochric
Valley Bottom	Ap	0-58	Plaggen

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Aspect related changes in biomass stocks and carbon sequestration rates of *Shorea robusta* (Sal) forest of Central Himalaya

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Abstract
Biomass and carbon sequestration are one of the most controversial debates among scientists dealing with the importance of terrestrial ecosystems in mitigating global warming. Extrapolation of average biomass values, outmoded inventories and lack of scientific understanding are the crux of the dispute. For a better understanding this paper demonstrates the impact aspect related changes on biomass stocks and carbon sequestration rates of a similar aged young sal forest on adjoining aspects in Indian Himalayan region. The North Eastern aspect in spite of having lesser biomass showed greater sequestration rate than the South Eastern aspect which has higher biomass and less sequestration rate. Percent soil carbon also varied on the two aspects. [Report and Opinion. 2009;1(2):56-60]. (ISSN: 1553-9873).

Introduction

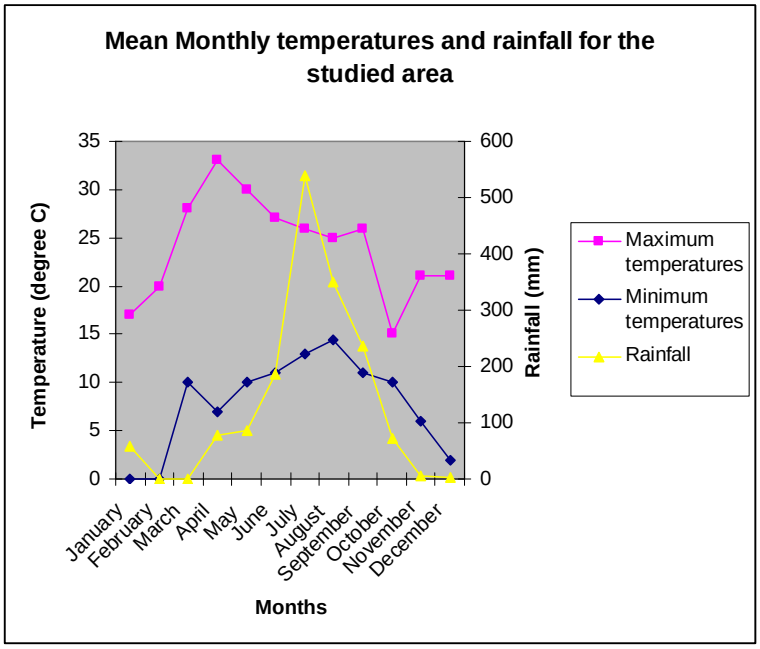
There is disturbing recent evidence about the unexplained carbon sinks and the uncertainty in the biomass stocks in the terrestrial ecosystem (Houghton 2002, Houghton 2005). These publications by Houghton have added extra urgency to work of terrestrial ecologists concerned with the carbon cycle. There is growing demand of accurate rates of biomass stocks and carbon sequestration rates in the warming world. Researcher know that is difficult to measure an annual carbon sequestration rate of even a small area, and impossible to quantify the change globally.

Biomass varies with environmental, anthropogenic and topographical factors. In spite of its importance in the present scenario, uncertainty in terrestrial biomass studies have persisted largely due to (i) the extrapolation of average biomass values used in most calculations for measuring biomass stocks till date, the possibility that anthropogenic disturbances, topographic features and environmental gradients occur in forests with biomass significantly different from average biomass, (ii) the inventories carried out for the measurement are out of date, incomplete or lacking. Extrapolation of results obtained from plots studied earlier can be problematic as most previous studies were concentrated to a fairly intact forest which will result to an overestimation of biomass.

Carbon sequestration rates and biomass stocks varies in time and space. A young forest would sequester more carbon than an old forest. Similarly, forests associated with better quality of soils would yield higher carbon sequestration rates. Evidently, different species will behave in a different manner; a faster growing species (Eucalyptus, Popular etc) would sequester more carbon than a slow glowing species (Oaks etc). However, the slow growing species might out perform the fast growing species with time. Nevertheless, generalizations are difficult to make. In a nutshell there are a number of factors that would influence the carbon sequestration rates of a forest i.e. temperature, rainfall, soil type and quality, biotic components like microbial growth, predation, pollination etc. Not to forget topographical features and human disturbance. Hence, without a greater understanding of all the above mentioned factors the biomass and carbon sequestration rates will be at best, reliant on some guesswork. The paper is focused on aspect related changes in biomass and carbon sequestration rates in the forest of *Shorea robusta* the dominant and most extensively distributed species on India

Site sites

The study sites lie between 29 ^{0} 21`-29 $^{0}$ 24`N latitude and 79^{0} 25`- 79$^{0}$29`E. A rise of 270 m in altitude corresponds to a fall of 1^{o}C in the mean temperature up to about 1500 m, above which the fall is more rapid (Singh and Singh 1987). Uttarakhand occupies an area of about 53,000km^{2}. This region is often called as Uttarakhand Himalaya, the eastern part of which is the Kumaun region where the forests of present study are present. *Shorea robusta,* has an absolute dominance below 800 m, begins to be replaced by *Pinus roxburghii* above 1200m in response perhaps to lower temperature and disturbances, both natural and man made. The altitudinal belt of 800-1000m is tension zone where a mixture of broad leaf species such as *Holoptelia integrifolia*, *Mallotus phillipinses* Mull. and *Terminalia tomentosa* Bedd., gain local preponderance due to weak tolerance of *Shorea robusta* but remain associated with it. The soil may vary from deep loamy sand to shallow residual mountain soil. The study was conducted between altitudes of 900m to 1100m. The maximum temperature was 33^{o} C in April and minimum 0^{o}C in January and February. The total rainfall throughout the year was 1611.6 mm.



Materials and Methods

The study was conducted during 2004 -2005. The data were collected from two aspects i.e. North eastern and South eastern aspects. The methods as given here pertain to data collection procedure and analysis for carbon accumulation in biomass and soil carbon of forests using acceptable allometric equations (Table. 1) for the encountered species in this study. The vegetation analysis was also made using 10 sample of 10x10m on each aspect. Density, frequency and basal area were also measured for the forest. For the estimation of tree biomass, tree and sapling occurring in permanent plots were categorized into different girth classes on the basis of their circumference taken in December 2003.These trees/saplings in each permanent plot were measured again in December 2004 i.e. after 12 months. Using the allometric equations the biomass of different components (bole, branch, twig, foliage, stump root. lateral root, and fine roots) in different girth classes was calculated separately from the circumference measured in 2003 (B1) and in 2004(B2). The net change in biomass (ΔB= B2- B1) yielded the annual biomass accumulation. For estimating soil carbon three pits were dug in both the aspects up to 90cm depth in different strata to best represent the forest in terms of slope, aspect, vegetation, density and cover. Form each pit soil samples were collected from 4 different soil layers (0-10; 10-30; 30-60; 60-90 cm). Soil carbon can be estimated by the following Walkey's and Black (1958). Phyto-sociological analysis was done following Mishra 1968.

Table1. Allometric relationship between the biomass of the tree components (y kg tree^{-1}) and girth to breast height (x,cm). The equation used was InY = a+b InX (Source Rawat & Singh 1988).

Biomass (Kg tree^{-1})	Intercept (a)	Slope (b)	r^2	s_yx
Bole	-2.83	1.98	0.98	0.12
Branch	-2.04	1.50	0.92	0.19
Twig	-2.69	1.46	0.98	0.09
Leaf	-1.74	1.18	0.96	0.15
Total	-1.79	1.89	0.98	0.11

Results

In the forest on the North eastern aspect the density of ***Shorea robusta*** was 590 trees/ha. The mean tree basal area was 3.47 m^2 ha^{-1} and the total basal area 20.473 m^2 ha^{-1}.In the South Eastern aspect the density of ***Shorea robusta*** was marginally lower (480 trees/ha) The mean basal area was 4.91 m^2 ha^{-1} and the total basal area was 28.983 m^2ha^{-1} .

The total biomass of the tree layer in the North Eastern aspect was 408.61t ha^{-1}which incremented to 411.28 t ha^{-1} in the next year of which approximately 53% is contributed by bole,13% by branch, 5% by twig and 4.2% by leaf .The total biomass production of this aspect is was 8.73 t ha^{-1}. The total biomass in the South Eastern aspect the total biomass was slightly higher as compared to the north eastern aspect. The total biomass was 413.88 tha^{-1} on the first year and then incremented to 415.76 t ha^{-1} in the next year, of which approximately 54% is contributed by bole, 12% by branch, 5.3%by twig and 3.77% is contributed by leaf. It is important to note that the total biomass was on the higher side but the total production is estimated to be lesser than the north eastern aspect. The NPP of north eastern aspect is 8.73 tha^{-1} and that of south eastern aspect was 3.21 t ha^{-1}, the carbon sequestration rates also varied in the two aspects. Thus, the total carbon also varied in both the aspects. The North Eastern aspect in spite of having lesser biomass showed greater sequestration rate than the South Eastern aspect which has higher biomass and less sequestration rate.

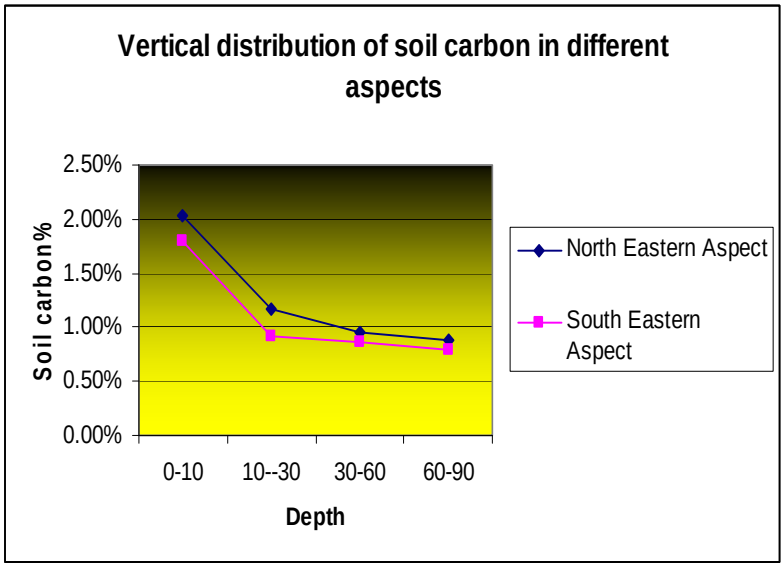
Table 2. Biomass and Carbon distribution in different tree components in North Eastern aspect

Component	B_1 (t ha^{-1})	B_2 (t ha^{-1})	ΔB (B_2-B_1)	Carbon (t ha^{-1})
BOLE	214.74 t ha^{-1}	219.81 t ha^{-1}	4.44 t ha^{-1}	2.22 t ha^{-1}
BRANCH	53.22 t ha^{-1}	54.20 t ha^{-1}	0.98 t ha^{-1}	0.49 t ha^{-1}
TWIG	23.25 t ha^{-1}	23.61 t ha^{-1}	0.36 t ha^{-1}	0.18 t ha^{-1}
LEAF	17.05 t ha^{-1}	17.32 t ha^{-1}	0.27 t ha^{-1}	0.135 t ha^{-1}
TOTAL	408.61 t ha^{-1}	411.28 t ha^{-1}	2.67 t ha^{-1}	1.33 t ha^{-1}

Table3. Biomass and Carbon distribution in different tree components in South Eastern aspect

Component	B_1 (t ha^{-1})	B_2 (t ha^{-1})	ΔB (B_2-B_1)	Carbon (t ha^{-1})
BOLE	224.40 t ha^{-1}	225.50 t ha^{-1}	1.1 t ha^{-1}	0.55 t ha^{-1}
BRANCH	51.25 t ha^{-1}	51.40 t ha^{-1}	0.15 t ha^{-1}	0.075 t ha^{-1}
TWIG	22.19 t ha^{-1}	22.24 t ha^{-1}	0.05 t ha^{-1}	0.025 t ha^{-1}
LEAF	15.65 t ha^{-1}	15.68 t ha^{-1}	0.03 t ha^{-1}	0.015 t ha^{-1}
TOTAL	413.88 t ha^{-1}	415.76 t ha^{-1}	1.88 t ha^{-1}	0.94 t ha^{-1}

The soil carbon concentrations in both the aspects were estimated up to 90cm depth. The soil carbon of the North Eastern aspect was found to be on the higher side than the soil carbon of South Eastern aspect. The top layers of the soil (0-10) in both aspect showed maximum carbon % 2.03% in South Eastern aspect and 1.79% North Eastern aspect and decreased up to 0.89 % in South Eastern aspect and 0.798% in North Eastern aspect in last (60-90) cm



Discussion

Site and vegetation mapping has shown that forest respond with great sensitivity to even minute differences in temperature and moisture regimes (Schoene, 1983). Modern technologies augment understanding of globe's carbon cycle and role of forests in it. However, forest inventories are indispensable to complement or substantiate estimates and models for quantifying vast carbon stocks and flows in forest ecosystem. Improved and more frequent inventories and forest assessments have become essential with the advent of obligatory carbon stock changes by countries (FAO, 2005). It is also not clear how much of the discrepancy is the result of omissions of management practices, natural and human induced disturbances, space and time and how much is the result of environmentally enhanced rates of tree growth on biomass and carbon sequestration rates.

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1/4/2008

Evaluation of Sea water Intrusion in Freshwater Aquifers in a Lagoon Coast: A Case Study of the University of Lagos Lagoon, Akoka, Nigeria.

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ABSTRACT: A geophysical technique has been employed to investigate seawater intrusion into freshwater aquifers in the coastal environment of the Lagos lagoon at the University of Lagos campus, Akoka, south-western Nigeria. Electrical resistivity method employing the Schlumberger array was used to acquire data for six vertical electrical soundings to investigate the vertical extent of seawater intrusion. The study revealed that the subsurface in contact with the lagoon was invaded by saline oceanic seawater. The Schlumberger electrode array which utilized current electrode half spacing from 1m to 500m was used to acquire both resistivity and induced polarization data in the proximity of the Lagos lagoon. Typical curve types reported for coastal areas such as the KQ, KQQ, and HKQ were observed in the investigated area and 4-6 geoelectric layers were delineated at an average depth of 71m. The subsurface lithology comprised of fine through medium grained sand to coarse sand intercalated in most cases with sandy clay and clayey sand. The resistivity of the intruded saline water was found to range between 1.8-37.2Ωm at a depth interval of 0.7-79m and the thickness of saline layers was found to be greater in the proximity of the coastline. The result of the investigation revealed that even under non-pumping conditions, the study area suffers from acute saline water intrusion and could be aggravated if there is groundwater abstraction. Ways to check the seawater intrusion problem through artificial recharge have been proposed in the study. [Report and Opinion. 2009;1(2):61-72]. (ISSN: 1553-9873).

Keywords: Geoelectric sections, resistivity, seawater intrusion.

1. Introduction

Over time, there has been heavy reliance on groundwater resources to supplement surface freshwater supplies for use in domestic, industrial and agricultural requirements. Most times, however, groundwater resources are preferable to surface water resources on the basis of easier protection from pollution and better dependability during drought periods. It has also been found that groundwater supplies are more economic in purification aspects than alternative water supplies, specifically surface water resources.

Coastal sedimentary basins the world over have been inundated by saline oceanic seawater intrusion which leads to the invasion of wells drilled to the subsurface to yield freshwater by saline water, and Nigeria has not been an exception. Saltwater intrusion in coastal aquifers in Nigeria have been a source of public grievance as several wells drilled to the groundwater table were abandoned only a few months after due to saline water intrusion. Even in some areas, freshwater supplies from groundwater sources have been impossible due to saline water dominating aquifers. Saltwater intrusion is a natural process that occurs in virtually all coastal aquifers, it is not only a national phenomenon, but a global crisis.

In characterizing the extent of this occurrence, attempted studies have been directed particularly to coastal areas in contact with seas, but rather few studies have been conducted to evaluate the

possibility of the occurrence via a lagoon. Even most studies in this regard attribute the seawater as being relict and neglect the obvious impact of the saline water bodies. With a maritime area of about 46,500km^2 and a coastline of 853km parallel to the Atlantic ocean, Lagos, is essentially a maritime state backed up by numerous rivers, lakes, creeks, swamps and lagoons; in an attempt to evaluate the possibility of seawater intrusion to the subsurface via the lagoon, this study was conducted.

The investigation of seawater intrusion in freshwater aquifers has been based on geophysical techniques especially the electrical resistivity and electromagnetic methods which relies on resistivity contrasts as the seawater intruded zone is approached, (Goldman *et al.,* 1989; Fitterman and Deszcz-Pan, 2001; Kontar and Ozorovich, 2006; Khalil, 2006; Al-sayed and El-Qady, 2007); their studies were carried out in the proximity of seas. The presence of seawater causes groundwater to be considerably saline, hence the aquifer resistivity is reduced considerably, and the resistivity method can delineate the boundaries of the body of saline water. The fact that a resistivity contrast exists at the interface between fresh and saline water is sharp, the resistivity method has proved useful.

A geochemical study can also be used to determine the possibility of seawater intrusion and this has been used by Lee and Song, 2007. However, for enhanced results, a combination of geophysical and geochemical analysis have proved useful, (Hwang *et al.,* 2004).

Oyedele (2001) combined a geophysical and geochemical analyses to show the presence of seawater intrusion in Victoria Island and Iwaya in Lagos state, south-western Nigeria. He suggested that the freshwater/saltwater interface (FWSWI) is relatively shallow and water withdrawals are from depths close to the FWSWI. And he contends that excessive groundwater withdrawals can increase the incidence of seawater intrusion.

Adepelumi *et al.* (2008) in an attempt to demarcate possible areas for groundwater development in the Lekki area of Lagos state, obtained resistivity results which revealed a dominant trend of decreasing resistivity with depth, indicating an increase in salinity with depth. They however traced the presence of the salinity to excessive groundwater pumping and the reduction of groundwater gradients. They established the inherent presence of saline water in the subsurface of their area of investigation as being trapped during the transgressive, and the regressive movement of the ancient sea during the quaternary times when some sediments were contemporaneously deposited under marine condition. They inferred that the saline water found at a shallow depth (10-30m) was probably trapped during marine transgression and/or it migrated from depth by differential pressure-gradient. One can infer the source of saline water in the subsurface as connate according to the referenced report. They, however, did not particularly cite the influence of the lagoon which surrounded their study area. Their analysis is based on Kingston *et al* (1983) who suggested that prior to the fluctuation of the sea level in Lagos area, series of miogeoclinal depressions were formed at the edge of the rifting Atlantic Ocean. These depression zones were later filled with seawater where the sediments were deposited. It can be inferred that the saltwater was trapped during the period of marine deposition. The possibility of seawater intrusion by the tidal movement of saline seawater presently was not examined. And this study attempts to bridge that gap.

The Lagos lagoon coast bordering the University of Lagos to the east on the lagoon front overlooking the university guest houses, senate building, University library, human resources development board offices and the faculty of engineering are the focus of the study. It lies on latitude 6^{o}30$^{'}$40$^{''}$N and 3^{o}24$^{'}$52$^{''}$E longitude. It lies on marshland of vast mangrove and freshwater swamps, surrounding a small and much dissected table land consisting of freshwater swamp

forest, mangrove swamp forest, sandy plain vegetation and rainforest vegetation (Ayolabi, 2004). The Lagos lagoon borders the university campus to the east and south. Bariga borders it to the north while Yaba lies towards the west. A canal runs along almost the whole of the western stretch of the university, while a marsh which has an open connection to the lagoon encompasses the whole of the northern stretch of the University, linking up with the canal in the west.

2. Hydrogeologic Setting of the Study Area

The study area is situated in Lagos State (figure 1) which is found within the Benin basin. The geology has no basement outcrop. It lies on the longitude 3^0E and latitude 7^0N with alternate wet and dry seasons. The Benin basin extends almost from Accra in Ghana, through the Republics of Togo and Benin to Nigeria where it separated from the Niger- Delta basin by Okitipupa ridge (Ondo state) at the hinge of the Benin flank. The bottom of the sedimentary basin in the Benin basin consists of unfossilferous sandstones and gravels weathered from the underlying Precambrian basement. On top of these are marine shales, sandstones and limestones of Albian to santonian ages.

The area of investigation is low-lying with some depressions observed which are prone to flooding, as they are apparently below the surface of the lagoon.

The surface geology is made up of the Benin formation (Miocene to Recent) and the recent littoral alluvial deposits. The Benin formation consists of thick bodies of yellowish (ferruginous) and white sands (Jones and Hockey, 1964). It is friable, poorly sorted with intercalation of shale, clay lenses and sandy clay with lignite. The formation is overlain in many places by considerable thickness of red earth composed of iron-stained regolith formed by weathering and ferruginization of the rode (Onyeagocha, 1980). Multi-layer aquifers have been classified by Longe *et al.* (1987) into three types-the first encountered at a depth of 38m of average thickness of 8m and is not a major source of water supply and stands the risk of pollution because of its nearness to the surface. The aquifer probably belongs to the recent littoral/alluvial depth of 30m to 120m below sea level near the coast, it consists of an alternating sequence of sands and clay. The aquifer probably belongs to the continental Ilaro formation which is described as a sequence of predominantly coarse sandy estuarine deltaic and continental beds. The third aquifer is made up of alternating sequences in shape. This aquifer is the most productive and exploited region. It occurs between depths of 30-100m below sea level in inland areas and 120-270m near the coast. The thickness varies between 10 and 35m. The aquifer most likely forms part of the Ilaro formation.

In the Benin basin, salt water intrusion into recent sediments aquifers occurs beneath a freshwater lens in a belt stretching from the coastline to a distance of 5km in some places. Saltwater intrusion has also been found to occur in the confined aquifers of the coastal plain sands in a zone stretching from Apapa to Lekki within Lagos metropolis (Oteri and Atolagbe, 2003).

Lagoons are common features on the Guinea coast of West Africa. The Lagos lagoon with a surface area of 6354.798km^2 is open, tidal and brackish, and is the largest of the eight lagoons in southwestern Nigeria. The Lagos lagoon, a water body in the heart of the metropolis, cuts across the southern part of the metropolis, linking the Atlantic Ocean (in the west and south) and the Lekki lagoon (in the east). The Lagos lagoon consists of three main segments, Lagos harbour, the metropolitan and Epe division segment.

The bottom water of the lagoon has high temperatures which were relatively constant throughout the year. The temperatures varied between 32.7^{o}C in December 2002 at the entrance of the Ogun river near Ikorodu and 27^{o}C in 2003. During the rains (April to November) the influx of river

water and heavy cloud cover in the sky resulted in a gradual fall of the temperatures to a minimum of 26^{o}C.

There is differential salinity in the lagoon due to the effect of the Atlantic Ocean. The bottom deposits ranged from coarse shelly sand around the mouth of Lagos harbour through various grades of muddy sand to mud. Sandy mud or muddy deposits occurred in the central areas with muddy sand or sand being attributed to the fast water currents in the area. The seabed in the metropolitan areas is relatively higher and increases towards the Epe segment of the lagoon. The seabed has been distorted by semi and large scale mining especially towards the Ikorodu area of the lagoon.

All the water bodies dominating Lagos State, the Lagos lagoon inclusive, others have a common connection to the Atlantic Ocean via the commodore channel (see figure 1). Thus some of the hydrologic conditions prevailing in the Gulf of Guinea are reflected to some extent in the Lagos lagoon, going by the definition put forward earlier.

The entire Gulf of Guinea is highly stratified with a thin surface layer of fresh tropical water overlying high salinity subtropical water (because of density difference). An additional contribution of saline water comes from subducted subtropical water from the Atlantic Ocean. This saline water communicates with the Lagos lagoon via the Commodore channel largely dependent on the direction of the tides.

3. Data Acquisition and Processing

In this work, a total of six VES points were occupied along selected traverses namely AA', BB' and CC'. The traverses AA' and CC' were taken parallel to the shoreline of the lagoon stretching westward, while the traverse BB' was taken perpendicular to the shoreline. The Schlumberger electrode array was utilized for the data acquisition which was done with the ABEM terrameter SAS 1000. The current electrode half spacing for the survey ranged from 1 to 500m in successive steps.

The field data were curve matched using the conventional curve matching technique and the layer parameters obtained were used as an input model for a fast computer iteration and modelling software known as RESIST©. The application of this software is a standard procedure for obtaining a fairly accurate estimate of the subsurface resistivity distribution.

The addition of Induced Polarization (IP) data to a resistivity investigation improves the analysis of resistivity data in three ways: (1).Some of the ambiguities encountered in resolving thin stratigraphic layers while modeling electrical resistivity data can be reduced by the analysis of IP data, (2).IP data can be used to distinguish geologic layers which do not respond well to an electrical resistivity survey; and (3).The measurement of another physical parameter (electrical chargeability) can be used to enhance a hydrogeologic interpretation such as discriminating equally electrically conductive targets such as saline, electrolytic or metallic-ion contaminant plumes from clay layers.

The interpreted data were contoured in order to observe the resistivity, thickness, and depth of saline layers and the freshwater/saltwater interface (FWSWI). The SURFER© 8 software was used in producing the maps.

Table 1: Summary of Interpretation

VES No	Geoelectric Layers	Resistivity (Ωm)	Thickness (m)	Depth (m)	Curve Type	Probable Lithology	Inferred Interpretation
1	1	37.50	1.2	1.2	KQ	Fine to medium sand	Topsoil
	2	58.30	9.9	11.1		Medium sand	Intermediate quality water
	3	33.33	101.0	112.2		Sandy clay	Saline water
	4	9.00	-	-		Sandy clay	Saline water
2	1	41.50	1.7	1.7	KQQ	Fine to medium sand	Topsoil
	2	74.90	6.5	8.2		Medium sand	Intermediate quality water
	3	37.20	12.5	20.8		Sandy clay	Saline water
	4	34.50	58.4	79.2		Sandy clay	Saline water
	5	7.60	-	-		Sandy clay	Saline water
3	1	43.7	1.6	1.6	KQ	Fine to medium sand	Topsoil
	2	56.9	9.1	10.7		Medium sand	Intermediate quality water
	3	42.1	59.2	69.9		Sandy clay	Saline water
	4	12.70	-	-		Sandy clay	Saline water
4	1	11.5	0.7	0.7	HKH	Fine to medium sand	Topsoil
	2	3.6	2.2	2.8		Sandy clay	Saline water
	3	61.6	16.6	18.8		Medium sand/Sandy clay	Intermediate quality water
	4	7.0	52.4	71.2		Sandy clay	Saline water
	5	514.1	-	-		Coarse sand/ Clayey sand	Very good quality water
5	1	101.00	0.7	0.7	KQH	Coarse sand	Topsoil
	2	131.60	0.9	1.6		Coarse sand	Very good quality water
	3	64.1	5.8	7.4		Sandy clay	Intermediate quality water
	4	1.8	12.8	20.2		Sandy clay	Seawater/ very saline water
	5	210.7	-	-		Coarse sand/ Clayey sand	Very good quality water
6	1	47.9	0.8	0.8	AKQH	Fine to medium sand	Topsoil
	2	260.7	1.2	2.0		Coarse sand/ Clayey sand	Very good quality water
	3	309.9	6.0	8.0		Coarse sand/ Clayey sand	Very good quality water
	4	89.7	29.9	37.9		Clayey sand	Good quality water
	5	8.0	34.0	71.9		Clay	Saline water
	6	532.5	-	-		Coarse sand/ Clayey sand	Very good quality water

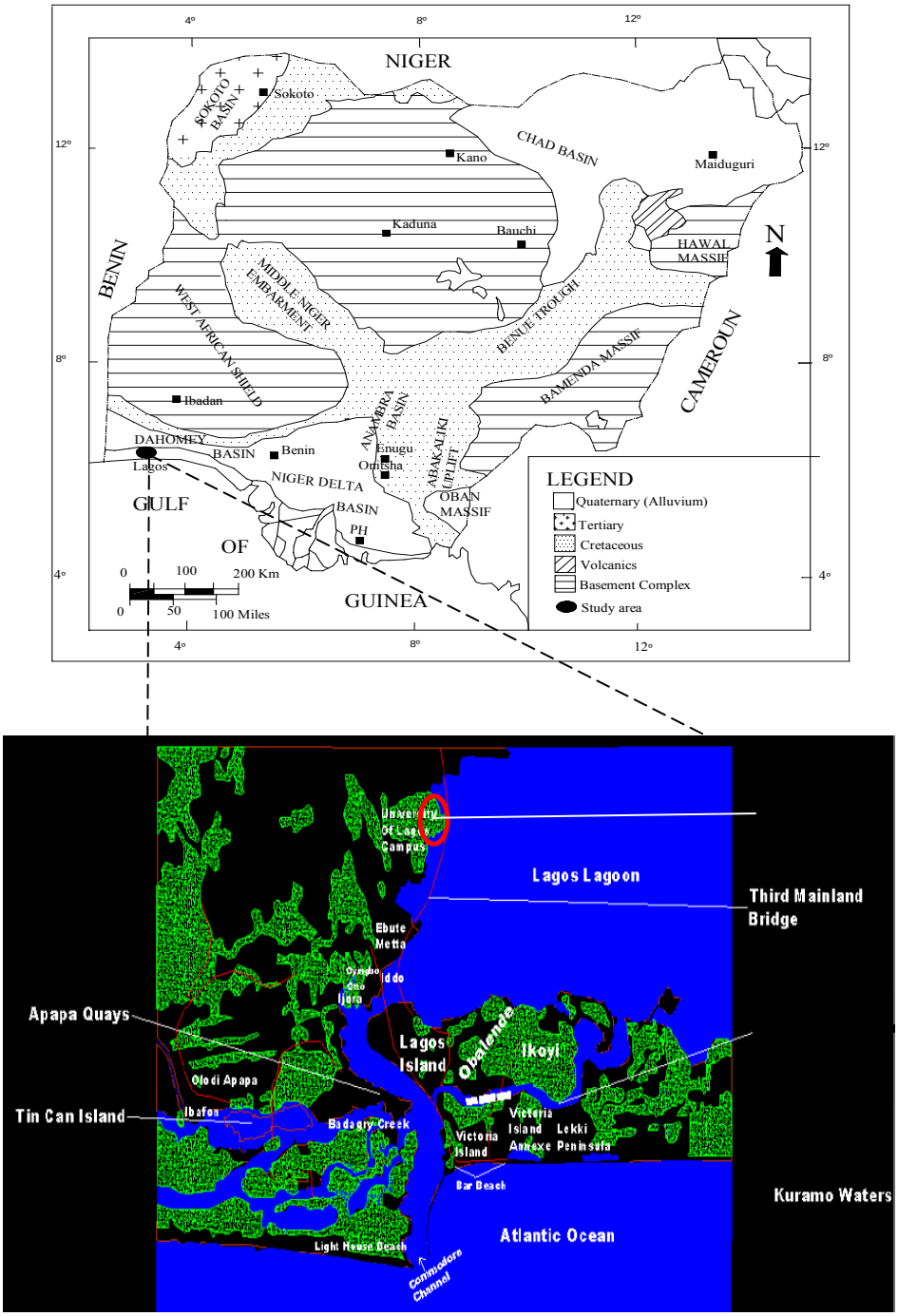
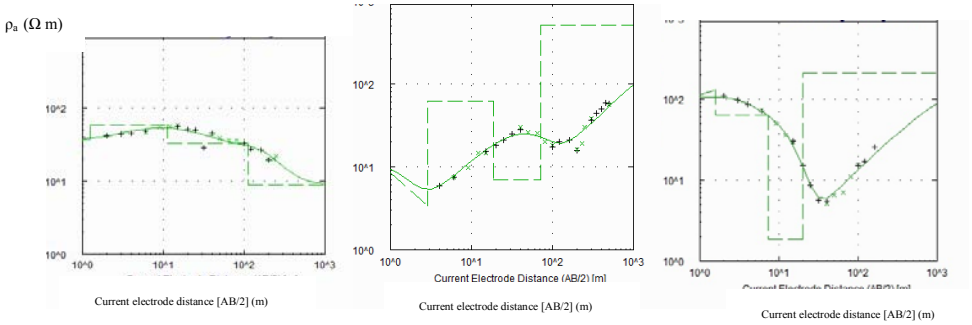
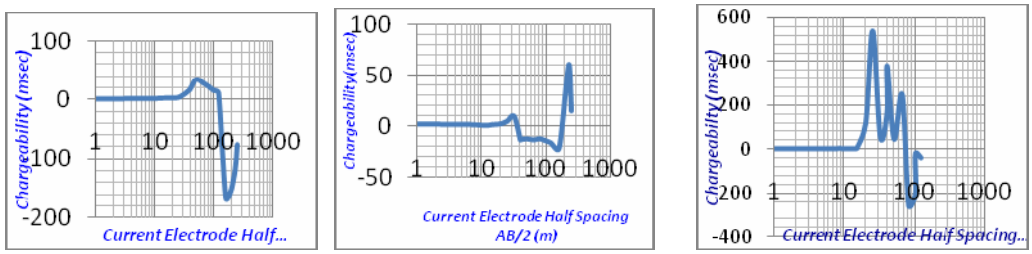


Figure 1: Geological map of Nigeria showing the location of the study area. Inset is the image of Lagos state showing the distribution of lagoon water up to the study area.



a.Iterated curve for VES 1 ***b.Iterated curve for VES 4*** ***c. Iterated curve for VES 5.***

Figure 2a-c: Representative samples of computer iterated resistivity curves



a.IP curve for VES 1 ***b.IP curve for VES 3*** ***c.IP curve for VES 5***

Figure 3a-c: Representative samples of induced polarization curves.

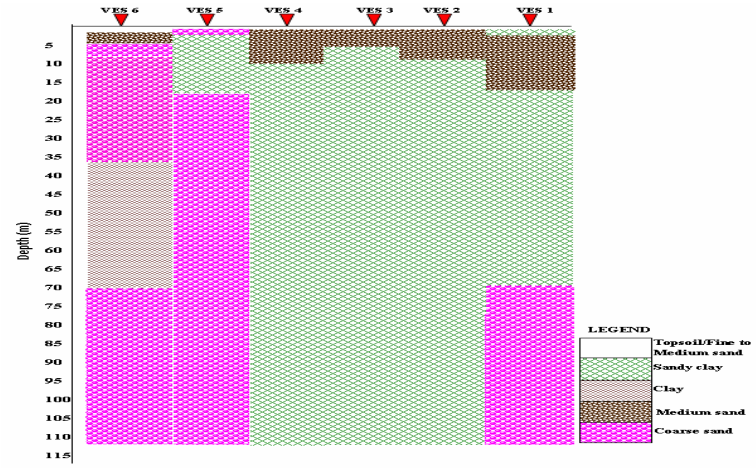
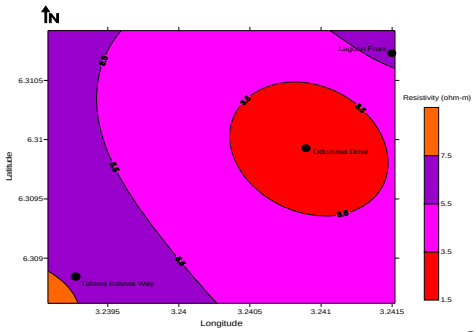
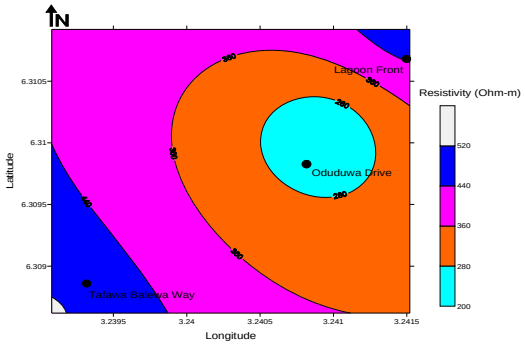


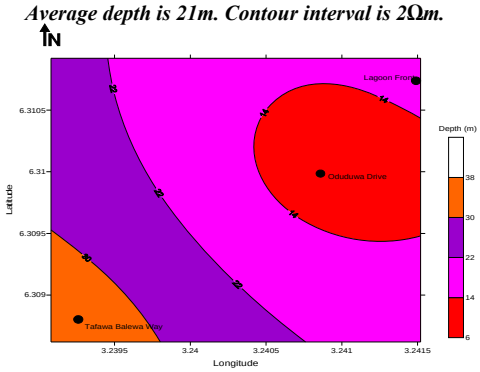
Figure 4: Subsurface conceptualisation of the study area inferred from the VES and IP interpretation correlated with the available borehole log.



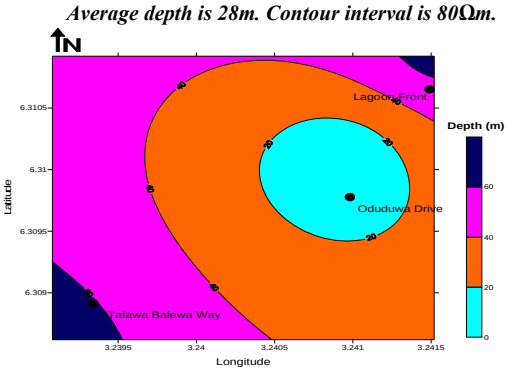
a.Isoresistivity map for saline water horizon (2-46Ωm). Average depth is 21m. Contour interval is 2Ωm.



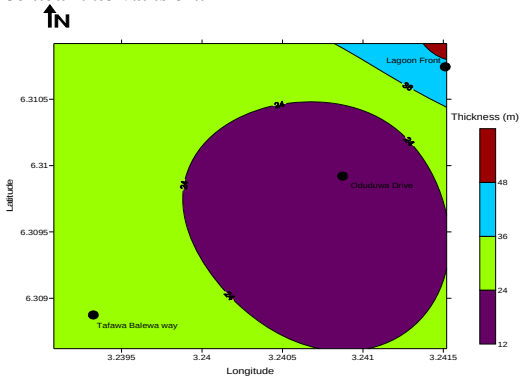
b.Isoresistivity map of freshwater aquifer. Average depth is 28m. Contour interval is 80Ωm.



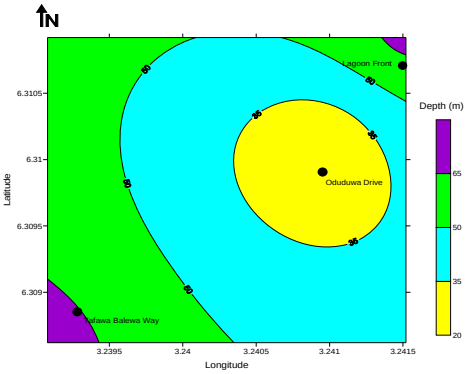
c.Depth to saline water isoresistivity surface. Contour interval is 8m.



d. Depth to freshwater aquifers. Contour interval is 20m.



e.Isopach map of saline beds. Contour interval is 10m.



f. Contour map of depth to freshwater/saltwater interface Average depth is 54m. Contour interval is 15m.

Figure 5a-f: Isoresistivity, isopach and depth maps of the study area.

4. Discussion of Results

The analysis of resistivity data revealed the presence of four to five geoelectric layers along profiles AA' and BB' while six geoelectric layers characterized profile CC'. Typical curve types characteristic of saline water intruded zones were observed such as AKQ, KQH, KQ and KQQ. The curves were found to descend gently indicating a conductivity decrease which can be

explained in terms of the seawater intrusion into subsurface formations. The descending segment of the VES curves are characterized by a steeply low resistivity zone (figure 2). The IP curves were interpreted thus: the electrode-depth ratio was used to estimate the depths at various electrode spacings. Chargeabilities of < 50msec were interpreted as sand, while those >50msec or negative were interpreted as clay; fluctuations in the IP profile was not unconnected with the clay and sand mixture. These were interpreted as sandy clay or clayey sand depending on the degree of fluctuation.

The correlation of the resistivity, IP (figure 3) and available borehole log in the study area revealed that the topsoil along traverse AA' is made up of fine to medium sand with characteristically low resistivity attributed to the overflow of saline oceanic seawater via the lagoon. The resistivity ranges between 11.5Ωm to 43.7Ωm with a thickness ranging from 0.7m to 1.7m. This layer is underlain by a medium sand bed which is the second geoelectric layer of resistivity 3.4Ωm to 74.9Ωm, and thickness of 2.2m to 9.9m. The third geoelectric layer beneath this traverse is a continuous sandy clay formation which grades into the fourth geoelectric layer beneath VES 1, 2, 3 and 4; and into the fifth geoelectric layer beneath VES 2. These layers are considered to suffer from acute seawater ingress, with formation resistivity of 7Ωm to 42.10Ωm. The thickness of this layer ranges from 12m to 70m. (See figure 4). The fifth layer beneath VES 4 is a high resistivity coarse sand or clayey sand formation.

The geoelectric section along traverse BB' consists of VES 5. The topsoil is the first geoelectric layer with formation resistivitiy>100Ωm and is made up of coarse sand. The second geoelectric layer, even though it is a relatively good freshwater aquifer; apart from its proximity to the surface and consequently, exposure to pollution, it's thickness of 0.9m does not favour exploitation. The third geoelectric layer can be considered as the zone of rapidly mixing fresh and saline water. With a formation resistivity of 64.1Ωm and thickness of 5.8m, it is comprised of medium sand/ sandy clay. The fourth geoelectric layer suffers from acute saline water intrusion due to the presence of seawater. With a resistivity of 1.8Ωm and thickness of 12.8m, it is composed of sandy clay. It is underlain by a coarse sand/clayey sand freshwater aquifer zone of unknown thickness and resistivity of 210.7Ωm.

The geoelectric section along traverse CC' consists of VES 6. The topsoil is sand formation with a resistivity of 47.9Ωm and 0.8m thick. The second and third geoelectric layers which are coarse sand beds are freshwater bearing aquifers saturated by very good quality freshwater. The formation resistivities are 260.7Ωm and 309.9Ωm, and 1.2m and 6m thick respectively. The fourth geoelectric layer is composed clayey sand, saturated with good quality water. The resistivity of this layer is 89.7Ωm and it is 29.9m thick. The fifth geoelectric layer has a resistivity of 8Ωm, and 34m thick. The lithology which is composed of saline-water saturated clayey formation is underlain by coarse sand bed which bears very good quality water. This layer has a resistivity of 532.5Ωm.

The interpreted data were subjected to processing using the SURFER 8 Golden software to produce the various contour maps. These show the lateral and horizontal extent of saline oceanic seawater intrusion. The study area shows evidence of subsurface formations by saline water intrusion. The depth of penetration of saline water intrusion increased from the lagoon coastline inwards.

Maps of isoresistivity surfaces for estimating depth to saline and freshwater zones at the locations occupied are shown in the figures below (figure 5a-f). The observed trend is that the thickness of the saline water formation is increasing towards the coast. In addition, the depth to the saline water

zone is found to be relatively shallow near the coast compared to inland areas. The depth to the FWSWI varies from about 72m near the coast to about 20m in inland areas. The resistivity of the freshwater aquifer is found to decrease as distance from the coast increases.

The isoresistivity contour map for saline water surfaces indicates that the resistivity of saline water tends to decrease towards the coast. Higher resistivity values are observed further away from the coast, i.e. at Tafawa Balewa way. It is expected however that this resistivity grades gradually through intermediate water to good quality water as distance from the coast keeps increasing. And the isoresistivity map for freshwater shows that reasonably good aquifers containing very good quality water can be found far away from the coastline. This is attributable to the high resistivity values which are observed as the distance from the coastline increases.

The depth to saline water surfaces is shallower in the proximity of the lagoon. With an increase in the distance from the coastline, the depth to saline water surfaces increases to about > 22m. the traverse taken at Tafawa Balewa way was at a higher elevation than those occupied at the Lagoon Front and Oduduwa Drive in which the water and ground level were approximately the same. The explanation then was that the salts are transported when there is overflow, moved further by wind action, settle gravitationally and are pushed down the subsurface by meteoric water. In the case of Tafawa Balewa way, the saline water hits the wall of the adjoining ground carrying some sediments, salts inclusive. Further lagoon water hitting the walls transports the salts further until they meet an impermeable layer which traps the salts.

The thicknesses of saline water zones are greater in the proximity of the lagoon. Less thick beds are found away from the lagoon. The thickness of saline water intrusion is lowest at Oduduwa Drive because it is dominated by freshwater aquifers and the most we can find is intermediate water of rapidly mixing fresh and saline water.

The salinity problem may exist due to upward movement of water and salts from groundwater. For coastal aquifers, the influence of seas, oceans, and lagoons are predominant. Since it is a saline problem, the validity of including lagoons in the picture have been emphasized. The salt enrichment process of the subsurface is spread over to thousands of millions years, during which the determining parameters of rainfall, hydrology and other climatic factors have not remained constant. Much as we do not want to envisage relict seawater, whether or not it occurs, or the salinity can be attributed to saline surface water intrusion shall become apparent at the end of this treatise.

One of the potential causes of subsurface salinity which does not require too geologically long a time, has been reported by Achari *et al.* (2005) was the inundation of an entire barrier by the surface influx of seawater where the tsunami impact on groundwater quality was assessed. They proferred an explanation for the process that led to groundwater salinization thus: when seawater ingressed over the surface, by waves with heights ranging from 4 to 7m, it carried along some dissolved salts, which were lodged in the soil. The salts brought by the mighty waves sink into the soil and with the first rains of the year, the absorbed salts leach down to the groundwater aquifer and contaminated it. When the dry summer months advance, evaporation causes the salt to accumulate in the subsurface, pending recharge (by the sea, which brings in more salts anyway). Rainfall recharge pushes the saltwater, further down in an attempt to establish hydrodynamic equilibrium capillary rise in rainless months push the salts up. In all, the soil salinity is significant for a considerably long time and is a continuous process.

5. Conclusion

In evaluating seawater intrusion into coastal aquifers of lagoonal environments, six vertical electrical sounding measurements were conducted at selected stations at the University of Lagos, Akoka; to acquire both resistivity and IP data. From the one dimensional interpretation of the acquired data, it was found that saline water intrusion which is characteristic of seawater penetrated the subsurface in contact with the lagoon. The depth of the intrusion increased as distance from the coastline increased. In addition, typical curve types which are characteristic of coastal Nigeria sedimentary basin such as the KQ, KQQ, KQH, HKQ and AKQH were observed in the study area.

The astonishing rapidity with which saline water inundates the subsurface has been elucidated and elaborated. The study shows that the area suffers from acute saline water intrusion. It also attempted to look at the origin of the salts as being due to the deposition of sediments during flow towards land areas and the influence of meteoric water which serves to push some of these sediments down the subsurface. The study however, is not a radical departure from the view that saline water found its way into the aquifers due to an upwelling of saline water, whose origin is connate. Infiltration ponds whose water are natural floodwaters can be used to recharge coastal aquifers so that the rate of withdrawal is balanced by the rate of freshwater recharge.

Seawater intrusion is a natural phenomenon in coastal aquifers. Whether we like it or not, it occurs. Ways in which this happens have been examined. However, it becomes problematic when man withdraws water close to coastal areas. So in attempting to minimize the problem, monitoring its expansion and retreat, a geophysical approach has been proposed.

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Interleukin-8 (IL-8) profile in Nigerians with *Plasmodium falciparum* infection

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ABSTRACT: The profile of serum interleukin-8 (IL-8) among 96 volunteers infected with *Plasmodium falciparum* was investigated. Volunteers with severe malaria infection had mean IL-8 level of 580.0±101.5 pg/ml, moderate (245.8±32.4 pg/ml) and mild (102.0±56.2 pg/ml). The difference in the IL-8 levels of severe, moderate and mild infections was statistically significant (χ^2 = 388.8, p<0.05). The IL-8 profile of volunteers of age groups <16 years and >16 years with mean IL-8 concentrations of 466.1.5±62.5 pg/ml and 154.7±120.4 pg/ml, respectively, was observed and the difference in the mean IL-8 levels between these children and adults was statistically significant (χ^2 = 156.2, p<0.05). The relationship between IL-8 levels and age was positively correlated (r = 0.9). We deduce that IL-8 can be used as biomarker of intensity of malaria especially in severe malaria infection in our locality. [Report and Opinion. 2009;1(2):73-77]. (ISSN: 1553-9873).

Keywords: Interleukin-8 (IL-8); Nigerians; *Plasmodium falciparum;* infection

INTRODUCTION

About 300-500 million people suffer from malaria and 1.5-2.7 millions die annually (Sturdler, 1989). In sub-Saharan Africa, malaria exerts great influence on human health where is poses the greatest impact of morbidity and mortality among infectious diseases (WHO, 2000). Malaria infection has been implicated to be associated with immune responses, including elevated inflammatory cytokine levels (Moormann *et al*., 1999).

Interleukin-8 (IL-8) belongs to a class of cytokines referred to as chemokines. Chemokines are small proinflammatory peptides (8 to 17 KDa) which regulate innate and adaptive immunity (Luster, 2002). Some chemokines, including IL-8 have been identified as biomarkers of cerebral malaria mortality in Ghanaian children (Armah, *et al.,* 2007). IL-8 serum concentration among patients suffering from severe malaria has been shown to be highest at a time when no parasite was detected in the blood smear (Burgmann *et al.,* 1995). Also, report from Thailand revealed elevated IL-8 levels in falciparum-infected patients (Friedland *et al.,* 1993). Furthermore, a study conducted in Gabon, observed that IL-8 among other cytokines was significantly higher in severe malaria than in uncomplicated malaria (Kremsner *et al.,* 1995).

Many studies have been carried out concerning changes in serum cytokine levels in malaria-infected people in different part of the globe as it relates to the age of individuals (Linton and Thomas, 2000; Pawelec *et al.,* 1999; Pettiford *et al.,* 2002; Marie *et al.,* 2000). For example, Pettiford *et al.* (2002) documented that the percentages of both $CD8^-$ and CD8* T-cells producing IL-8 decreased with age. Conversely, IL-8 concentrations may increase with age (Pettiford *et al.* 2002) due to proinflammatory shift to type 2 patterns which leads to production of anti-inflammatory cytokines (e.g., interleukin-10) that inhibits the production of IL-8 (Pettiford *et al.,* 2002; Marie *et al.,* 2000).

In spite of the impact of malaria infection on our health and the role inflammatory cytokines play in regulating immune responses during protozoan infections (Brenier-Pinchart *et al.,* 2001); there is dearth of information on the profile of IL-8 in malaria-infected individuals in our locality. In this communication

therefore, we evaluate the profile of IL-8 with the intensity of malaria infection and establish the relationship between IL-8 levels and age.

MATERIALS AND METHODS

This study was carried out in Ihieve-Ogben; a rural community in Owan East local government area of Edo State. It is located at latitude 6˚N and longitude 6˚E. Agriculture especially farming and hunting is their predominant activities, while a few of them, mostly women, are traders. There is rainy season period of April to October which is followed by a dry season of November to March. Malaria transmission is perennial but highest during the rainy season.

Ninety six individuals who had malaria attack based on *P. falciparum* parasitaemia in their thick blood smears stained by Geimsa stain participated in the study. The malaria parasitaemia was categorized as mild (< 1000 asexual form of parasite/µL), moderate (1000-10,000 parasite/µL) and severe (>10,000 parasite/µL). They also had fever (axillary temperature of >37.5˚C) and clinical symptoms such as headache, vomiting, diarrhea, prostration, respiratory distress and other symptoms and signs of severe malaria as documented by WHO (2000). They were recruited after informed consent was obtained following thorough explanation of all procedures and the objective of the investigation. Ethical permission was obtained from Edo State Ministry of Health, Benin City, Nigeria. Volunteers with other detectable diseases such sickle cell anaemia, viral hepatitis B were excluded in the investigation using standard procedures and kits.

Whole venous blood (3 ml) was collected from a peripheral vein by venipuncture in the sterile EDTA bottle. Blood was processed by the centrifugation and the serum was immediately subjected to cytokine assays. The serum IL-8 concentration was determined by a standard enzyme-linked immunosorbent assay (ELISA) from kits obtained from Abcam plc, Cambridge, United Kingdom according to the manufacturer's instructions. From the information supplied by the manufacturer, the upper limit of normal serum IL-8 concentration is 76pg/ml with the mean serum IL-8 level of 44pg/ml.

The data obtained in this study were subjected to statistical analysis, namely, correlation and chi-square tests using Microsoft Excel statistical package.

RESULTS

Table 1 shows the intensity of malaria infection and mean serum IL-8 concentrations. Ninety six malaria positives were categorized based on their parasite load. Severe infections were observed in 32 patients with mean serum IL-8 level of 580.0±101.5 pg/ml. Fourty four volunteers had moderate infection with mean IL-8 concentration of 245.8±32.4 pg/ml, while 20 patients had mild infection with mean IL-8 level of 102.0±56.2 pg/ml. The difference in the IL-8 levels of severe, moderate and mild infections was statistically significant ($\chi^2 = 388.8$, $p<0.05$).

The IL-8 profile of 96 malaria-infected volunteers of which 53 volunteers were of age group <16 years while 43 patients of the age group >16 years with mean IL-8 concentrations of 466.1.5±62.5 pg/ml and 154.7±120.4 pg/ml, respectively, were documented (Table 2). The difference in the mean serum IL-8 level for age group <16 years and >16 years was statistically significant ($\chi^2 = 156.2$, $p<0.05$). The relationship between IL-8 levels and age was positively correlated ($r = 0.9$).

Table 1: Intensity of malaria infection and mean IL-8 levels

Intensity of infection/µL	Mean IL-8 (pg/ml)	No. infected
Mild <1000	102.0±56.2	20
Moderate 1000-10,000	245.5±32.4	44
Severe > 10,000	580.0±101.5	32

Table 2: Mean IL-8 levels with age group

Age group (years)	Mean IL-8 (pg/ml)	No. infected
>16	102.0±56.2	43
<16	245.5±32.4	53

DISCUSSION

We reported a significantly higher level of IL-8 among malaria positive participants in severe infection than both mild and moderate parasitaemia levels. This accords the report of Kremsner *et al.* (1995) and it implicates IL-8 in the immunopathogenesis of *P. falciparum* infection in our locality. Our investigation is proved valid by the report of Suguitan *et al.* (2003) who asserted that cytokines are secreted in response to *P. falciparum* infection. Furthermore, cytokines are implicated in the pathogenicity of malaria by the unique ability of *P. falciparum* to adhere to capillary and postcapillary venules endothelium during the second half of 48-h life cycle, a process called cytoadherence (Luse and Miller, 1971; MacPherson *et al.*, 1985). Cytoadherence confers survival of the parasite by ensuring microaerophilic venous environment which is better suited for parasite maturation; and the parasite adhesion to the endothelium allows the parasites to escape clearance by the spleen (Cranston *et al.*, 1984; Looareesuwan *et al.*, 1987; Ho *et al.*, 1990). Chemokines are chemotactic agents that enhance cytoadherence *in vivo* (Neote *et al.*, 1993). Human erythrocytes as well as postcapillary venular endothelial cells express the promiscuous Duffy antigen receptor (DARC) that binds to chemokines of the C-X-C (e.g., IL-8) class with high affinity (Neote *et al.*, 1993). So the presence of DARC on erythrocyte suggests that falciparum-infected erythrocyte may respond to chemotactic gradient. This probably explains our observation of significantly elevated level of IL-8 in patients with severe malaria infection.

We observed that a higher level of IL-8 for age group <16 years than age group >16 years. This pattern of age-related IL-8 profile of malaria-infected individuals supports the findings of (Archibald *et al.*, 2001; Pettiford *et al.*, 2002). This demonstrates the role age play in conferring immunity on malaria-infected individuals. It has been reported that a higher percentage of lymphocytes in children with malaria, produced IL-8 than did those of adults (Archibald *et al.*, 2001). Consistent with this, the percentages of both $CD8^-$ and CD8* T-cells producing IL-8 decreased with age (Pettiford *et al.*, 2002). IL-8 is a proinflammatory, chemotactic chemokine for neutrophils and T cells and a neutrophil stimulant that is involved in the severity of infectious diseases (Marie *et al.*, 2000; Burgman *et al.*, 1995; Mukaida *et al.*, 1992). It activates neutrophil to release lysosomal enzymes and induces them to adhere to the vascular endothelim, all extremely useful effects in infants, whose leucocyte function is immature (Mukaida *et al.*, 1992).

In this study, *P. falciparum* infection has been shown to induce the production of IL-8 and so implicate it in the pathogenesis of malaria disease. Our finding suggests that high levels of IL-8 is associated with high risk of *P. falciparum* infection and hence can be used as biomarker of severe malaria infection in our locality. Since there is dearth of information, it is therefore recommended that data in this direction be investigated in order to establish their roles in malaria disease pathogenicity, considering the role of cytokines in immunopathology of diseases and the global public health significance of malaria.

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Dual-Band Planar Helical Antenna for WLAN Operation

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Abstract – A novel dual-band planar helical antenna is proposed. The antenna is in the form of a rectangular helix, and is obtained by printing a plurality of linear metal strips on both sides of a dielectric substrate and then connecting the strips at their ends by shorting pins through via-holes in the substrate. The total length of the rectangular helix controls the antenna's first or fundamental resonant frequency, and by adjusting the first turn spacing of the helix, the antenna's second resonant frequency can be adjusted. A constructed prototype with its first two resonant frequencies excited at about 2.4 and 5.2 GHz suitable for WLAN operation is presented and studied. [Report and Opinion. 2009;1(2):78-79]. (ISSN: 1553-9873).

Index Terms: planar antennas, printed antennas, helical antennas, mobile antennas

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I. Introduction

Helical antennas are generally formed by winding a wire conductor into a right-hand or left-hand coil and have a much shorter linear dimension than the straight monopole antennas. They have also been widely used in cellular phones for mobile communications [1], [2]. In this paper, we present a novel design of planar helical antenna suitable to be printed and integrated on the system circuit board of a communication device. The proposed planar helical antenna includes several sections of a rectangular helix printed on two sides of a circuit board. In addition, the proposed antenna has two different turn spacings along the helix such that the first two resonant frequencies of the antenna can be adjusted to meet the desired dual-band operation for cellular mobile communications (such as in the 900 and 1800 MHz bands) or WLAN (wireless local area network) operations (such as in the 2.4 and 5.2 GHz bands). In this study, the proposed antenna integrated on the top portion of a dielectric substrate about the size of the system circuit board of a practical PDA (personal digital assistant) device for dual-band WLAN operation in the 2.4 GHz (2.4–2.484 GHz) and 5.2 GHz (5.15–5.35 GHz) bands was presented and experimentally studied.

II. Antenna Design

The results showed that the proposed dual-band planar helical antenna printed and integrated on the top portion of a 0.8 mm grounded FR4 substrate (relative permittivity 4.4), which can be considered as the system circuit board of a practical PDA device. Notice that the ground plane (a size of width 70 mm and length 100 mm) printed on the back surface of the FR4 substrate does not cover the top portion of the substrate's back surface (a size of about 70×9.5 mm^2 in this study). On the front and back surfaces of the top no-ground portion of the substrate, the proposed planar helical antenna is printed.

The antenna comprises a rectangular helix occupying an area of 5×7.5 mm^2 and a connection metal strip of length 2 mm, which connects the helix to a 50 Ω microstrip feed line printed on the substrate's front surface. The rectangular helix is formed by printing linear metal strips on the front and back surfaces of the substrate and then connecting the strips at their ends by shorting pins through via-holes in the substrate. In this design the rectangular helix has about 4 turns with a cross-sectional area of 0.8×5 mm^2. Also note that the metal strips printed on the front surface are oriented horizontally, and the metal strips on the back surface are inclined such that each strip is connected at its two ends to two adjacent strips on the front surface.

All the strip widths of the proposed antenna are set to 1 mm. The spacing between each turn are all selected to be 0.5 mm, except that of the first turn is 1 mm, that is, nonuniform turn spacings are designed for the proposed antenna. The detailed dimensions of the proposed antenna are studied, which are obtained with the aid of the commercially available software Ansoft HFSS (High Frequency Structure Simulator). In this design, the total length of the rectangular helix is about 43.5 mm, which controls the antenna's first or

fundamental resonant frequency (about 2.4 GHz in this study), and by adjusting the first turn spacing of the helix (1 mm here), the antenna's second resonant frequency is tuned to be at about 5.2 GHz. [Note that, when the first turn spacing is set to 0.5 mm (that is, a uniform turn spacing of 0.5 mm along the helix), the antenna's first resonant frequency remains at about 2.4 GHz, but the second resonant frequency will be shifted to a frequency (about 5.5 GHz) higher than 5.2 GHz.] This property is similar to that of the nonuniform wire helical antenna studied in [1]. Accordingly, the first and second resonant modes of the proposed antenna can be easily controlled, which makes it capable of dual-band WLAN operation in the 2.4 and 5.2 GHz bands.

III. Experimental Results and Discussion

Two separate wide resonant modes at about 2.4 and 5.2 GHz are obtained. The simulated results are obtained from Ansoft HFSS, and good agreement between the measurement and the simulation is observed. From the measured results, the 10 dB return-loss bandwidths obtained are 208 MHz (2366–2574 MHz) and 252 MHz (5143–5395 MHz) for the lower and the upper modes, respectively, which cover the required bandwidths of the 2.4 and 5.2 GHz bands.

The radiation characteristics were also studied. The study plots the radiation patterns at the center operating frequencies (2442 and 5250 MHz) of the 2.4 and 5.2 GHz bands, respectively. In the *x*–*y* plane, the measured radiation patterns at the two frequencies are close to omnidirectional. Other frequencies across the 2.4 and 5.2 GHz bands were also measured, and similar radiation patterns as plotted here are observed. The study presents the measured peak antenna gain across the two operating bands. For the 2.4 GHz band, a stable peak antenna gain of about 2.9 dBi is measured. For the 5.2 GHz band, the peak antenna gain ranges from about 2.4–2.7 dBi.

IV. Conclusions

A novel planar helical antenna with nonuniform turn spacings for dual-band operation has been proposed, and a prototype printed and integrated on a grounded dielectric substrate about the size of the circuit board of a PDA device for 2.4/5.2 GHz WLAN operation has been constructed and studied. Results show that two separate wide resonant modes at about 2.4 and 5.2 GHz are excited for the constructed prototype, and good radiation characteristics have been obtained.

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Clinicopathological and Biochemical Studies on Tilipia Zilli Exposed to Climate change and Cadmium Chloride (0.25p.p.m.)

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Abstract Heavy metals are recognized as cumulative toxic substances causing serious health hazards to man depending on their concentration.Fourty fish (Tilipia Zilli) were collected from Abbassa Sharkia government and fed commercial fish diet. Thirty fish were exposed to cadmium chloride) 0.25p.p.m.) And 30◦ temp. For 21 days. Ten fish were kept without treatment (control). Haematological analysis of the exposed group demonstrated a marked elevation in serum glutamic oxaloacetic transaminase, serum glutamic pyruvic transaminase, serum glucose, urea, creatinine, sodium, potassium and phosphorus, while serum calcium, haemoglobin and PCV were reduced . Histopathological examination of the fish exposed to cadmium chloride revealed necrobiotic changes of hepatocytes and epithelial lining of renal tubules spleen showed depletion of melanomacrophage centre. Necrosis of the gill filaments was also noticed. It could be concluded that cadmium chloride at 0.25 p.p.m induced deleterious effects in fish such as damage of liver, Kidney, spleen and gills, which were reflected on the biochemical and hematological parameters. Heavy metals induced cumulative effect; therefore equivalent lesions of fish may occurr in humans. Moreover, immune suppression could play an important role in predisposing for further infections conditions. [Report and Opinion 2009;1(2):80-89]. (ISSN: 1553-9873).

Key words: Pollution – cadmium, fish, immunity.

INTRODUCTION

Heavy metals are persistent contaminants in the environment that come to the forefront of dangerous substances such as cadmium, lead, mercury, copper and zinc causing serious health hazard in humans and animals [1-10]. The agricultural and industrial wastes partially treated or without treatment are being discharged into surface water [11-16]. Such metals are absorbed from polluted water through gills, skin and digestive tract of fish by bio-concentration and bio-magnification. Chronic cadmium toxicity or "itai-itai" disease was recorded [17-20].

Cadmium toxicity was interfered with calcium/phosphorus ratio [21, 22] Suppression of cell mediated and humoral response of mammals exposed to sublethal dose of cadmium has been reported [23-26].

Histophathological examination of fish exposed to cadmium showed edema of secondary gill lamellae, degeneration of hepatocytes and epitheliallining of renal tubules. Degeneration and necrosis in the gill lamellae of fish xposed to cadmium were noticed [13-19].

Heavy metals are recognized as cumulative toxic substances causing serious health hazards to man depending on their concentration.

MATERIALS AND METHODS

Experimental design: Total of fourty fish 100-200 gm body weight of each was acclimatized a tized to laboratory conditions for two weeks before use. They were divided into control group (10 fish) and experimental group *(30* fish) that was exposed to cadmium chloride at a concentration of 0.25 p.p.m. and 30◦ temp. for 21 days.

Blood samples were collected from the

caudal vein after 7 and 21 days of exposure. Serum for biochemical analysis and heparinized blood for hematological investigations were obtained from each sample.

Biochemical analysis: Test kits of Bio Merieux (France) were used for evaluation of serum glutamic pyruvic transminase and glutamic oxaloacetic transaminase [20]. Serum glucose was assessed according to Trinder [23]. Serum urea and creatinine were determined using kits of Bio Merieux (France). The concentration of cadmium, sodium, potassium and calcium were detected by using atomic spectrophotometry according to Forstner[13]. **Hematological examination:** Blood hemoglobin (Rb) was assessed by Drabkin [12]. Hematocrit value was carried out by using microhaematocrit capillary tubes, centrifuged at 1200 r.p.m. for 5 min.

Bacteriological examination

Bacterial isolation was done from skin, liver and kidney of fish on blood tryptose agar, MacConcky agar and tryptic soy agar plates. The plates were incubated aerobically and anaerobically. The bacterial isolates were identified morphologically and biochemically, according to Nomiyama [18].

The serum IgM was measured according to Fuda et. al. [15]. Antisera for fish were prepared by immunizing rabbits as previously described by Fuda et.al [15]. The procedure for labeling antibody fragment with enzyme was performed.

Elisa assay procedure: Assay was carried out in 96-well polystyrene ELISA microtiter plates (Titertex, Horsham, P A). The microtiter plates were coated with rabbit antigrey mullet IgM and were fractionated by DE-52 at a concentration of 40 μg/ml in 0.01 MPBS. A volume of 150 μl was dispensed into each well and incubated for 4 hrs at 4°C.

Blocking was achieved after one washing with 200 μl of 0.01 MPBS + 0.1 % 20 μl per well and two washings with 200 μl of PBS +1% PBS. 0.01% thiomerosol was added to each well and incubated for 2 hrs at room temperature.

Incubation of samples and standards after washing was carried out as described above. 100 μl of sample and standard were placed into the appropriate wells in the microtiter plates and incubated at room temperature.

Incubation with peroxidase labeled antibody after washing was done as described above, each well received 150 μl of peroxidase labeled antibody 1:1600 in PBSBSA, followed by incubation for 12 hrs at room temperature.

Histopathological examination:

Specimens from gills, liver, Kidney and spleen were collected from both control and exposed groups at the end of experiment. The samples were fixed in 10% neutral buffered formalin. Five-micron thick paraffin sections were prepared and stained with H&E for microscopic examination [27]

Statistical analysis: The obtained data were subjected to the student T test.

RESULTS

Serum biochemical analysis: Fish exposed to cadmium chloride (0.25 p.p.m) showed a significant icrease of SGPT and SGOT activity with pronounced elevation of urea and creatinine by 1st, 2nd, 3rd week of exposure. High level of sodium and potassium in serum of exposure fish was noticed (Table 1). Hyperglycaemia and hypocalcemia were noticed along the experimental period with-marked elevation of serum cadmium (Table 2).

Haematological profile: Reduction of Hb concentration and P.C.V value were observed (Table 2). **Bacteriological examination:** Pure culture of *Streptococcus spp., Staphylococcus spp. Agrobacterium spp., Flavobacterium spp. and Lactobacillus spp.* were isolated from the internal and external organs of exposed fish (Table 3).

Determination of fish IgM: There was a significant decrease in total protein and IgM level from the first week of exposure until the end of last week (Table 4).

Pathological findings

Macroscopical lesions of exposed fish revealed congestion in all internal organs after 21 days. Liver appeared friable and dark red. Peticheal haemorrhages around the operculum, and abdominal cavity were observed. Congestion and edema of gill lamellae were seen (Fig.1).

Histopathological examination revealed necrobiotic changes in hepatocytes and disorganization of hepatic cord (Fig.2). Kidney

showed shrinkage of glomerular tufts and degeneration of proximal tubular epithelium (Fig. 3). The anterior Kidney showed depletion of melanomacrophage center (Fig. 4). Sloughing of epithelial lining of secondary gill lamellae with lymphocytes, oesinophils, polymoph infiltration were observed (Fig. 5). Necrosis of both primary and secondary gill lamellae was sometimes seen (Fig. 6). Hyperplasia of primary and secondary lamellar epithelium associated with shortening and fusion of gill lamellae with obliteration of interlamellar space were noticed (Fig. 7). Rupture of pillar cells and capillaries associated with lamellar telangiectasis were also observed (Fig. 8).

Table 1: Effect of cadmium chloride .25p.p.m. on kidney and liver function of Tilipia Zilli

Exposure time	SGOT U/L	SGPT U/L	Urea mg/dl	Creatinine mg/dl	Sodium Meg	Potassium Meg
1st week (control)	90.0 ± 0.17	20.7 ± 1.7-5	3.29 ± 0.27	0.76 ± 0.72	124 ± 0.57	4.19 ± 0.07
1st week of exposure	91.00 ± 2.40	25.5 ± 0.73	3.90 ± 0.34	0.81 ± 0.01	131 ± 0.76	4.60 ± 0.02
2nd st week control)	90.00 ± 0.10	22.1 ± 1.48	3.30 ± 0.28	0.75 ± 30	120.3 ± 4.8*	4.33 ± 0.58
2nd st week of exposure	125 ± 0.45*	29 ± 2.1*	3.91 ± 0.13**	0.90 ± 0.19**	138 ± 0.70**	5.9 ± 0.08
3rd week (control)	90 ± 2.2	20.00 ± 0.05	3.20 ± 0.27	0.72 ± 0.27	126 ± 4.2	4.1 ± 0.09
3rd week of exposure	136 ± 2.46*	35 ± 1.56*	4.6 ± 24*	0.99 ± 0.18**	148 ± 7.6	6.25 ± 0.13

* Segnificant P< 0.05 ** highly significant P < 0.01

Table2: Some hematological and biochemical changes in Tilipia Zilli exposed to cadmium chloride.

Exposure time	P.C.V %	Hemoglobin gm/dl	Glucose mg%	Cadmium p.p.m	Calcium mg/dl	Phosphonis mg/dl
1st week (control)	21.00 ± 0.06	8.7 ± 0.3	62 ± 1.20	0.05 ± 0.01	5.6 ± 0.32	4.2 ± 0.07
1st week of exposure	17.9 ± 0.05	8.1 ± 0.01	68 ± 0.46	0.08 ± 0.016	4.00 ± 0.87	6.1 ± 0.21
2nd st week control)	22 ± 0.29	8.1 ± 0.36	60 ± 0.05	0.054 ± 0.068	5.4 ± 0.91	4.1 ± 0.66
2nd week of exposure	17 ± 1.97	7.00 ± 0.98**	70 ± 1.93**	0.12 ± 1.03*	4.2 ± 0.73*	6.4 ± 0.12*
3rd week (control)	20.0 ± 1.32	8.1 ± 0.07	62.2 ± 0.70	0.04 ± 0.01*	4.4 ± 0.73	3.9 ± 0.1
3rd week of exposure	16.9 ± 0.8	6.91 ± 0.23*	84 ± 0.02*	0.16 ± 082*	3.5 ± 0.88*	6.1 ± 0.6*

* Segnificant P< 0.01 ** highly significant P < 0.05

Table 3: Bacteriological recovered in Tilipia Zilli exposed to cadmium chioride (0.25 p.p. m).

Bacterial strain	External surface	Internal organs	Internal organs liver	Gills
Agrobacterium spp.	$4.1x10^7$	$3.8x10^6$	$3x10^4$	$5x10^7$
FlavobacterIum spp.	$7x10^7$	$6.2x\ 10^6$	$6X10^3$	$7.3X10^8$
Staphylococcus spp.	$6x10^5$	$5x10^4$	$6.2x10^3$	$4.2x10^6$
Streeptococcus SPP.	$5x10^7$	$9x10^5$	$7x10^6$	$3x10^7$
Lactobacillus spp.	$3.3x10^3$	$4.4x10^6$	$2x10^3$	$2x10^6$

Table 4: Influence of cadmium chloride 0.25 p.p.m on 1gM and protein level.

Exposure period	1gM/old	Total protein/neg/dl
Control	0.98 ± 0.13	7.84 ± 0.23
1st week of exposure	0.80 ± 0.23**	7.00 ± 0.69*
2st week of exposure	0.74 ± 0.84*	6.42 ± 0.29*
3st week of exposure	0.68 ± 0.44 *	6.2 ± 0.48*

* Segnificant P< 0.01 ** highly significant P < 0.05 ± Standard errors

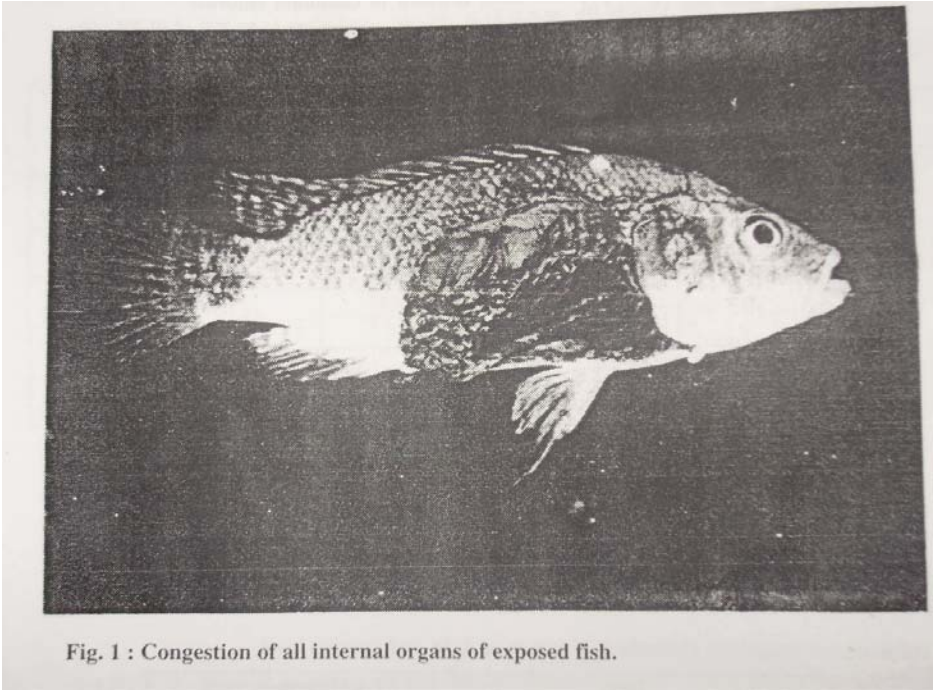

Fig. 1 : Congestion of all internal organs of exposed fish.

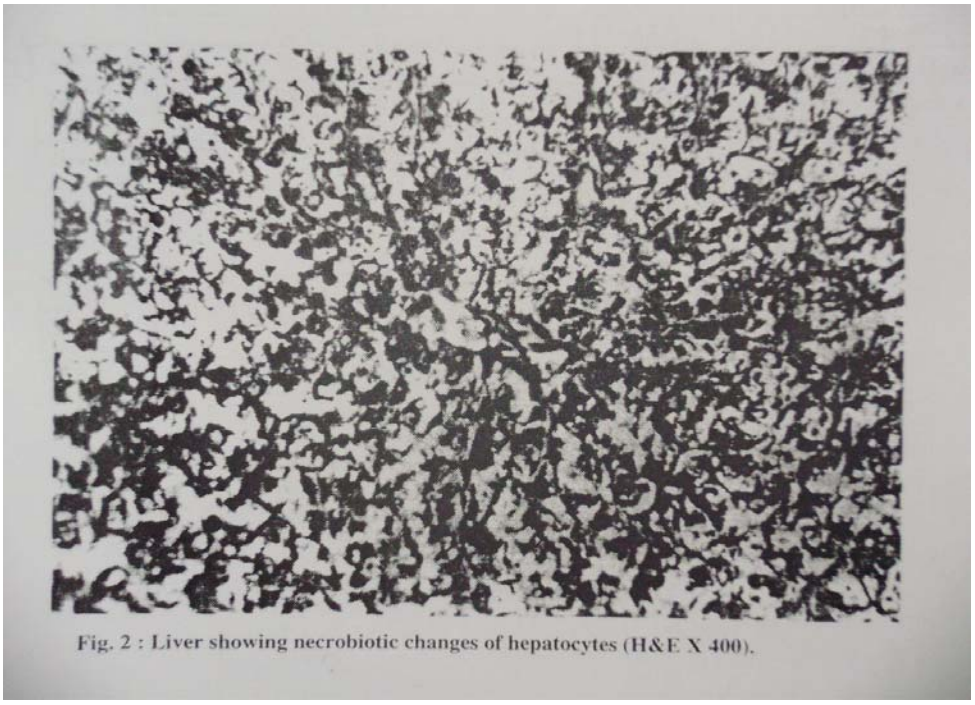

Fig. 2 : Liver showing necrobiotic changes of hepatocytes (H&E X 400).

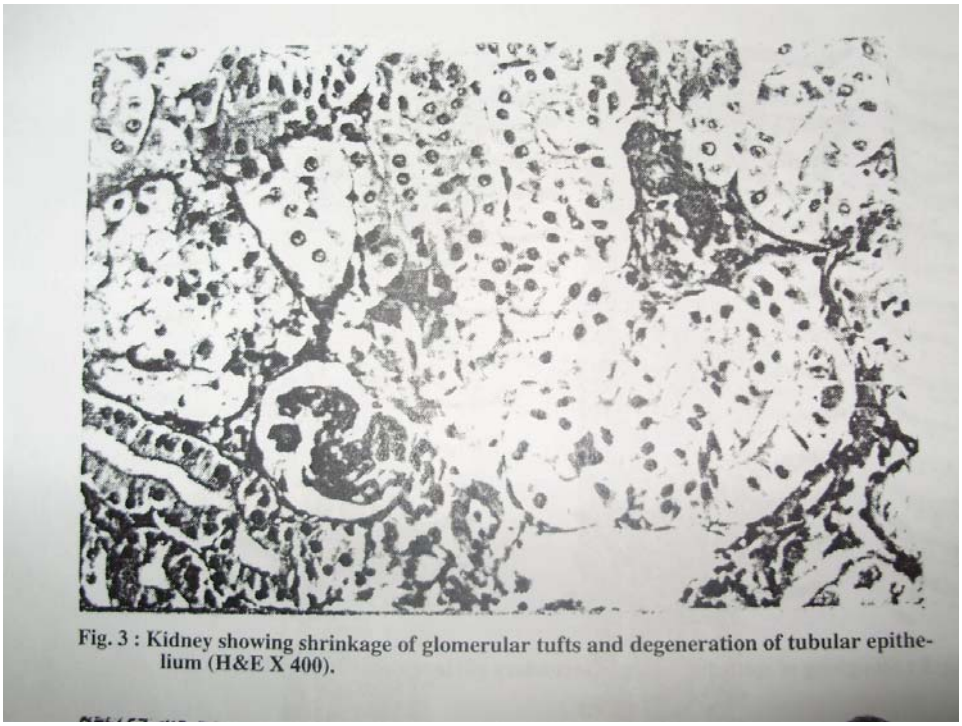

Fig. 3 : Kidney showing shrinkage of glomerular tufts and degeneration of tubular epithelium (H&E X 400).

Fig. 4 : Spleen showing depletion of melanomacrophage center and haemopoietic elements (H&E X 100).

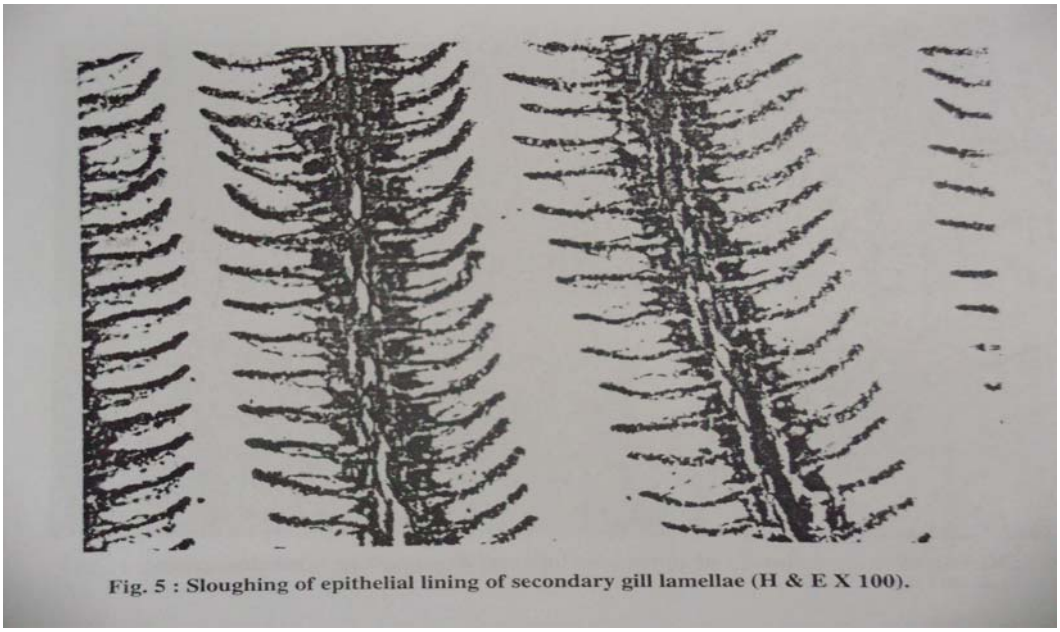

Fig. 5 : Sloughing of epithelial lining of secondary gill lamellae (H & E X 100).

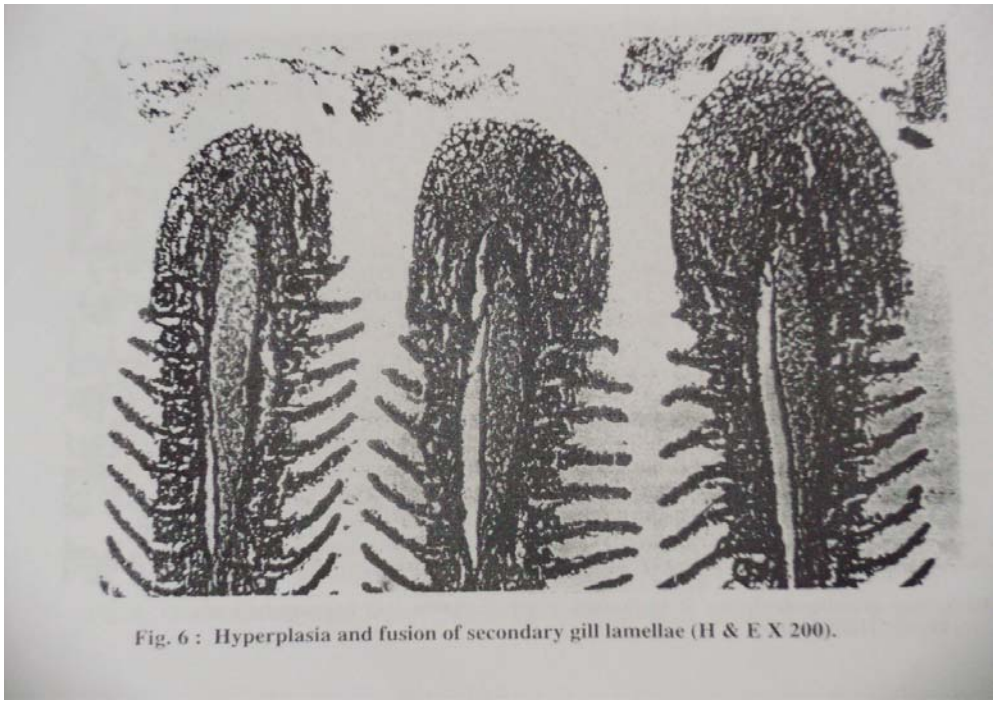

Fig. 6 : Hyperplasia and fusion of secondary gill lamellae (H & E X 200).

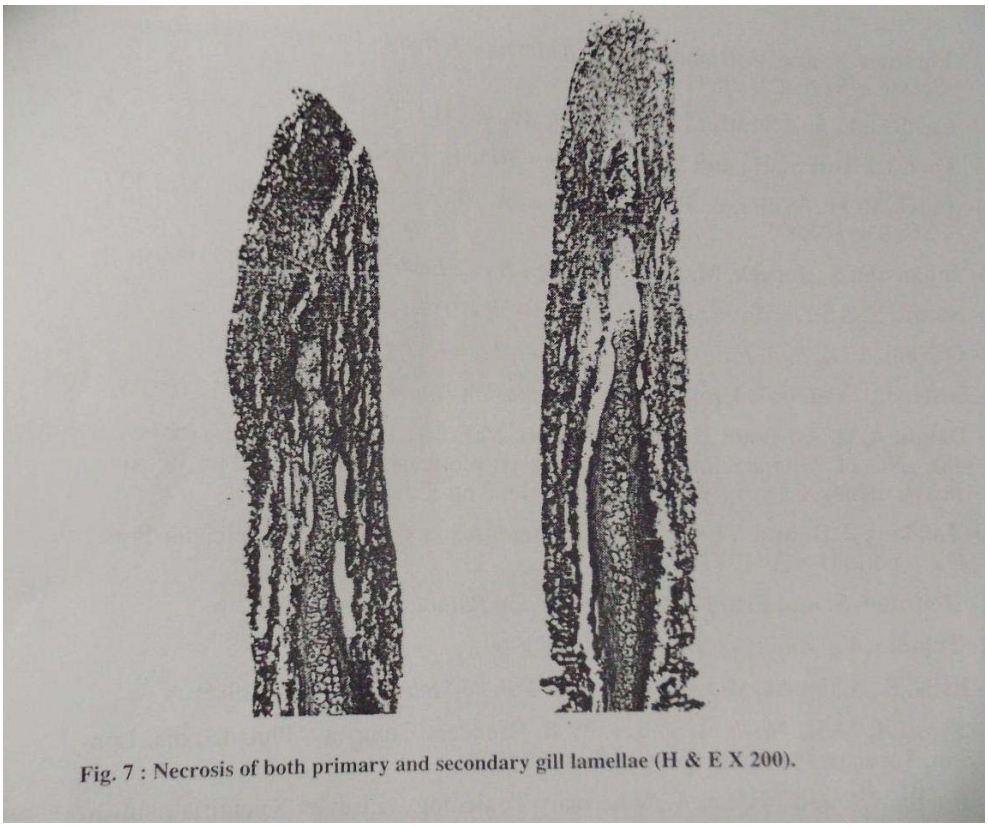

Fig. 7 : Necrosis of both primary and secondary gill lamellae (H & E X 200).

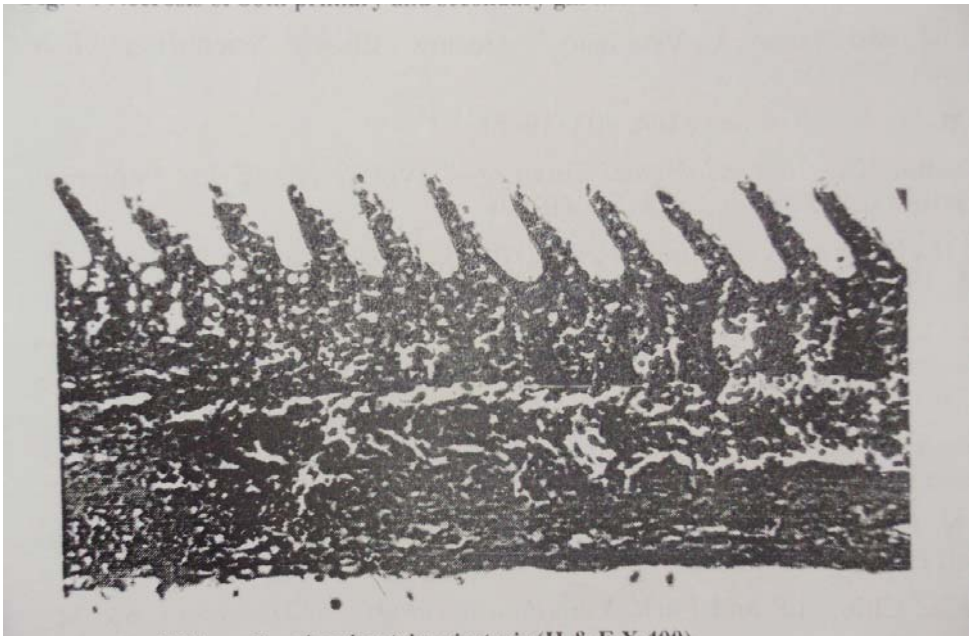

fig. 8 : Gill lamellae showing telangiectasis (H & E X 400).

DISCUSSION

Aforementioned data of exposed fish to cadmium chloride (0.25 p.p.m) for 3 weeks revealed an elevation of serum GPT, GOT, urea and creatinine.

These findings are in agreement with previous results. Elevation of urea and creatinine beside liver enzymes in cadmium-exposed fish may be attributed to liver and kidney injury. Reduction of calcium level in serum may have resulted from its increased excertion in urine through inhibition of calcium ATPase enzyme. On the other hand, increase of the phosphorus level in serum of exposed fish was noticed. Cadmium chloride toxicity leads to disturbance in blood electrolytes followed by skeletal changes [23, 25]. Hyperglycemia was observed in the present work which coincides with that obtained in Rainbow traut and salmogaidneri [25]. The blood glucose level was affected by the rate of carbohydrate metabolism under hypoxia and stress conditions. Hyperglycemia is attribute to stress stimuli followed by rapid secretion of both glucocorticoids and α-techolarnines from the adrenal tissue [2]. Regarding to hematological profile exposed fish, hemoglobin and P.C.V. values were decreased. These results are in agreement with previous findings [17, 18]. The erythropenia resulted from reduction of Hb concentration and P.C.V. value in Kwait Mullet due to disturbance of osmoregulatory mechanism accompanied with destruction of gill membrane and failure of gas exchange [19]. Cadmium interfered with sulpha-hydride groups of essentials enzymes [4, 25]. Heavy metals are recognized as cumulative substances leading to serious health hazards to man and animals [6-9].

In the present study, a significant decrease of IgM and total protein during the experimental period were observed. Reduction of IgM level indicated that the cadmium chloride toxicity leads to suppression of immune system of exposed fish which become susceptible to any infective agents [15, 20]. There is a significant decrease in IgM level in fish exposed to cadmium chloride if compared with control which may have resulted from high cortisol secretion that was indicated by hyperglycemia in exposed fish.

Macroscopical examination of fish exposed to cadmium chloride for 21 days revealed a congestion of all internal organs and friable bloody liver. These findings are in agreement with those mentioned by other authors [1-9].

Degeneration and necrosis of hepatocytes may be attributed to the cumulative effect of cadmium and to the increase of its concentration in the hepatic tissue during experimental period. These results agreed with Frolin et al. [14], who stated that liver has an important detoxical role of exogenous waste products as well as externally derived toxins such as heavy metals.

Necrobiotic changes of epithelial lining of renal tubules were observed especially the proximal convoluted tubules that were reflected on electrolytes reabsorption such as calcium, phosphorus, potassium and sodium. These findings come parallel to those previously reported.

It could be concluded that cadmium chloride at 0.25 p.p.m induced deleterious effect in fish such as damage of liver, kidney, spleen and gills, which were reflected on the biochemical and hematological parameters. Heavy metals induced cumulative effect; therefore equivalent lesions of fish may occur in humans. Moreover, immune suppression could play an important role in predisposing for further infections conditions.

Gills showed sloughing of epithelial lining and necrosis of some lamellae. Hyperplasia, shortening and fusion of the secondary gill lamellae that may lead to a great disturbance of gas exchange and ionic regulation were noticed [28]. Lamellar telangictasis resulted from rupture of pillar cells and capillaries under effect of chronic irritation of cadmium chloride and leads to an accu- mulation of erythrocytes in the distal portion of the secondary lamellae [29]. The subepithelial space of the secondary gill lamellae was infiltrated with inflammatory cells. This finding is in agreement with that previously ment- ioned [29, 30]. Mucinous metaplasia of lamellar epithelial lining is considered as adaptive mechanism against heavy metal toxicity. These alterations are in agreement with those previously mentioned [31].

It could be concluded that cadmium chloride at 0.25 p.p.m induced delet- erious effects in fish such as damage of liver, Kidney, spleen and gills, wh- ich were reflected on the biochemical and hematological parameters. Heavy metals induced cumulative effect; therefore equivalent lesions of fish may occurr in humans. Moreover, immune suppression could play an important role in predisposing for further infections conditions.

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