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Oke-Ode Dome: A Product of Fold Interference Followed By Shearing

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Abstract

The basement of Oke-Ode area consists of two groups of rocks: the pelitic to semi-pelitic and psamitic rocks that bear the imprints of, at least, three deformation episodes and are grouped together as the Schist-Quartzite Complex. The Pan African granitoids emplaced synchronously with the last phase of deformation constitute the second group. Imprints of at least four thermo-tectonic episodes were identified in the area. The first is the planar penetrative fabric while the second is the fold-forming imprint marked by the F_1 fold. The third imprint resulted from the refolding of the F_1 fold, that is, the F_2 fold. Shear deformation, which culminated in minor and major dextral and sinistral faults as well as a major shear zone and faults are the products of the last phase of deformation. Field data reveal a major domal structure, the development of which is attributed to interference of an asymmetric fold, F_2, on an earlier upright asymmetric fold, F_1. During latter deformation episodes, a major rotation and drag, occasioned by shear deformation, affected the dome. Presence of deformed minor dome and basin structures; rotated blocks; minor refolded folds in the metasediments; sheared major synform; and the structural cross-section across the antiform are in support of the existence of the dome.

Key Words: Dome, fold, shear, synform, episodes, granitoids

Introduction

Oke-Ode area falls within the Basement Complex of south western Nigeria between Longitudes 5^{o} 00'-5^{0} 10'E and 8^{0} 00'-38^{0} N. It is a part of the internal region (Ajibade and Fitches, 1988) of Trans-Saharan mobile belt (Pan- African Mobile Belt) sandwiched between the West African Craton to the west and Congo Craton to the southeast). The age of the belt has been put at Neo-Proterozoic (Annor, 1998). Field mapping exercises in the area revealed that the terrain is dominated by quartzite and schists which are possibly underlain by an older gneissose rock and altogether intruded by members of the Pan African granitoids. The polycyclic nature of deformation that is common to the basement rocks of Nigeria (Annor, 1998; Rahaman, 1988 ;) is fully registered in Oke-Ode area.

The dominant structural fabric of the Basement Complex of Nigeria is N-S trending, but a set of quartzite ridges in the study area appears to be perpendicular to this regional trend as seen on topographic map and satellite imagery maps (Fig.1). Attention was drawn to the unusual phenomenon and this prompted the mapping exercises aimed at finding out the cause(s).

Materials and Methods

Geological field mapping has been on-going in the area since 2006.During the period, structural data such as strike and dip, lineation trends as well as axes and plunges of minor folds were taken. Mesoscopic scale structures within the psamitic-pelitic rocks were used to unravel the mesoscopic and megascopic natures of deformation in the quartzite, schist, and amphibolite. This method has been adopted elsewhere (e.g. Annor, 1986). Structural data obtained around the dome were used to plot poles to foliation and lineation, as well as the attitudes of fractures. Mapping was done both around and away from the ridges at a scale of 1:25,000.

Results and Discussion

The area comprises two principal groups of rocks. They are the Quartzite-Schist Complex and the Late Intrusives. Quartz-schist, quartz-mica schist and mica schist constitute the members of the first group while granodiorite, granite and pegmatites are the members of the second group. The dominant lithologies are quartzite and schist of varying compositions. At the foot of the hill, the quartzite is micaceous with preponderance of muscovite, especially towards the northern side. Slices of quartz-mica- schist are interleaved with the folia of the quartzite. Sometimes, at the core, more massive quartzite layers, with little or no mica, were identified. Marginally tectonised (albeit weakly) granodiorite and fracture controlled, leucocratic, mesoporphyritic granite are dominant in the northwestern part of the area as shown in the geological (Fig.2)

Several small-scale folds were identified. Some of them revealed the imprints of two folding episodes, in form of refolded folds, in the semi-pelitic rocks (Fig.3). These outcrop-scale folds are numerous and essentially parasitic on major folds. Macro-scale F_2 folds were also observed in the schists and psamites as mentioned earlier. Even in thin-section, at microscopic scales, folds were observed especially in the meta-pelites. These are defined by optically continuous biotite and muscovite.

Isoclinal to recumbent and upright folds were observed. The isoclinal folds are fewer in number perhaps because they constitute the set of the first folds (F_1) which were formed during the D_2 / F_1 deformation phase. Their imprints have been obliterated during the D_3 / F_2 event when they were essentially refolded. The average axial direction is 290 ± 15^{0}. The second set of folds is upright asymmetric, seldom open, folds and trend generally 330 ± 20^{0} and plunge

approximately 22^0 northerly. In the quartzite, large-scale lineations were identified in the nose of the ridges east of Oke-Ode, where two sets of lineation were identified on an exposure. Their axes are almost perpendicular to each other, defining two episodes of lineation-generating process. The first set trends roughly N-S while the second trends roughly E-W. The two of them plunge at gentle angles northerly and westerly, respectively. Lineation directions on these later folds are generally sub-parallel to the axial direction of the fold, also trending about 280^0.

There is parallelism between S_0 and S_1 but there was transposition of foliation during the F_1 folding phase. Widespread intrafolial folds and shearing coupled with rotation along major shear zones are signatures of transposition.

Strike and dip readings around and across the quartzite body indicate that, in cross section, a sub-rounded to elliptical antiform occurs east of Oke-Ode town. The antiform is expressed by the quartzite ridges to the east of the town. Strata with sub-vertical planes are exposed in all parts of the antiform except in the north-western part. Essentially, the antiform possesses a *quaquaversal* dip as shown in the geological sections. In the north-western part, the strata are gently-dipping at angles less than $20^{0,}$ as opposed to the high-angle dips (70^0-85^0) in other parts, thus making it a north-westerly plunging antiform.

The evolution of this domal structure can be explained through two possible models. The first is Eskola's (1949) Mantled Gneiss Dome model. The second is Ramsay's (1967) interference pattern model. In the study area there is minor intrusion of the sheeted quartzite body. This does not occupy the centre as required, but occurs in the western girdle, to which the dome plunges. However, if it is assumed that there is a major granitic intrusion underlying the quartzite body, for which there is no field evidence, how then does one justify the existence of the complimentary synform? Hence, the tenable explanation for origin of the domal structure is by Ramsay's model.

Identification of small dome and basin structures (Fig.4) was difficult and the few ones that were identified also have their northwestern outlines marred due to the shearing that later affected the area. There are occurrences of dome-and-basin structures where the foliations are sub-horizontal. The asymmetric outline of the dome is suggestive of heterogeneous ductile strain distribution, possibly by pure shear. The origin of the mineral lineation may also be through heterogeneous simple shear. This is based on the occurrence of minor ptygmatic folds of quartz veins in the surrounding schist.

The antiform seems to have been affected by a major shear deformation that affected the area, south of the dome, causing the elongation of the antiform and the attenuation of the synform. Apparently, the widespread shearing and rotation that occurred in the study area led to the regional drag which also affected the dome. Further structural and geochemical examinations of this area, for which there is yet no published work, may yield some encouraging results in this regard. The fabrics of the rotated blocs around the dome are now almost perpendicular to that of the main basement fabric (Fig.5). The effects of the drag and shear deformation are also registered in the axial trace of a major antiform to the east of the dome. This is explicit in the sigmoidal shape of the latter. Shear zones and faults are good focuses for mineralization of certain metals and precious minerals (Volesky *et al*, 2003, Srivastava, 2011). A few kilometres north of the study area, gold occurs in shear zones and faults (Adekeye et al, 2012).

Conclusion

The Oke-Ode area consists of psamitic to semi-pelitic rocks that have witnessed poly-phase deformation and intruded by members of Pan African granitoids. The episodes of

deformation culminated in two series of folds which are non-co-axial leading to a major dome whose complimentary but sheared pinched synform is amenable to interpretation as a basin.

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Fig.1: Satellitte imagery map showing the relative positions of the study area (northwest) and the SW-NE trending regional Ila-Orangun/ Omu-Aran quartzite body.

Fig.1: Satellite imagery map showing the relative positions of the study area (northwest) and theSW-NE trending regional Illa-Orangun/Omu-Aran quartzite ridge (www.googlemap.com).

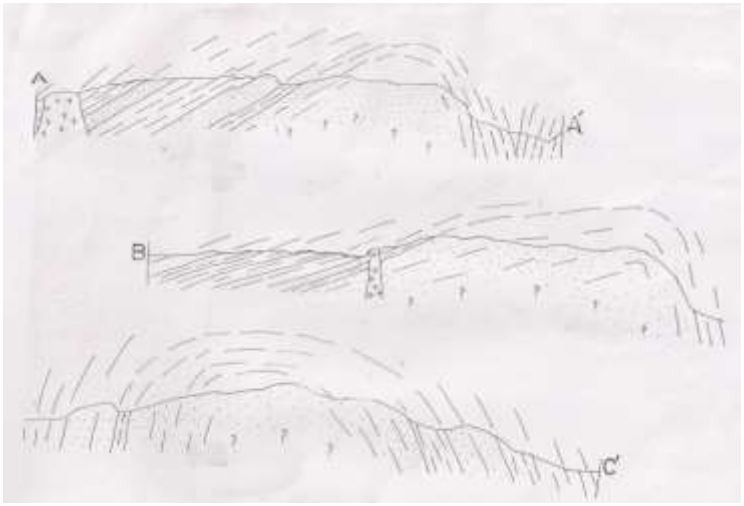

Fig.2: Geological map of the study area

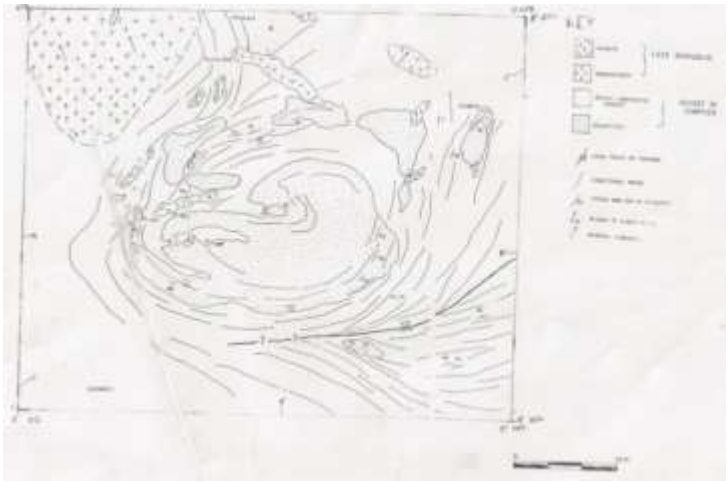

Fig.2b: Cross-sections of the study area.

Fig.3: Refolded folds in migmatized psamitic rock.

Fig.4: Minor domal structure in psamitic schist, ECWA Church, Oke-Ode (facing NW)

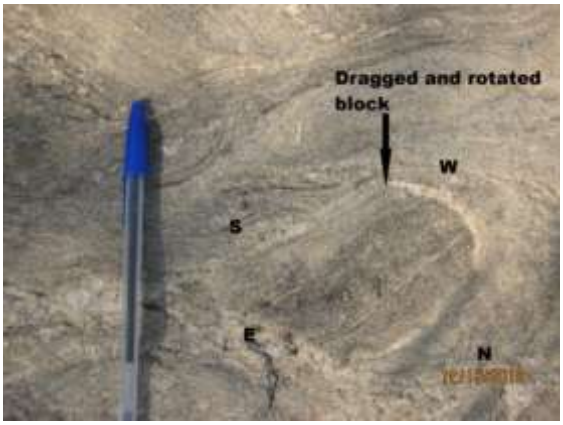

Fig.5: Fig.: Rotated block broken from Psamitic Schist (facing southwest), NE of Oke-Ode. The block has been rotated by almost 90^0. Note the granitization along the rim of the rotated block and the E-W trending fabric of the block.

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Transmission Dynamics of HIV-Malaria Co-infection with Treatment

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Abstract
This paper examines the Transmission Dynamics of HIV-Malaria Co-infection with Treatment in order to assess their synergic relationship in the presence of treatment. A nonlinear mathematical model for the problem is proposed and analysed qualitatively using the stability theory of the differential equations. Positivity and boundedness of solutions are analysed quantitatively. Sensitivity indices of the basic reproductive number ' R_0 'to the parameters in the model are calculated. Comprehensive mathematical techniques are used to analyse the model steady states. Results show that the disease free equilibrium point is locally asymptotically stable when the reproduction number is less than unity and unstable when reproduction number is greater than unity. Reduction in sexual activities of individuals with malaria symptoms decreases the number of new cases of mixed HIV-malaria infection and also protecting HIV infectives from mosquito bites. To illustrate the analytical results, numerical simulations using a set of reasonable parameter values are performed. The results suggest malaria treatment will have a positive impact on the control of HIV/AIDS.

Key words: HIV-Malaria, Co-infection, Treatment

1 Introduction

Human Immunodeficiency Virus (HIV) and malaria are two of the most deadly diseases at our time. The geographic overlap of these diseases in sub-Saharan Africa facilitates their co-infection. Together they accounted for over 3 million deaths in 2007 worldwide, (WHO 2005). Although the consequences of the co-infection of HIV with malaria parasites are not fully understood, available evidence now suggests that the infections act synergistically and their combination results in worse outcomes which poses a major public health concern. Recent studies have shown that there is an estimated 5% increase in malaria deaths due to HIV infection in Sub-Saharan Africa. Ever since the co-infections were recorded, malaria has seen a 28% increase in its prevalence and malaria related death rates have also nearly doubled for those with co-infections. Some of the areas in the world with high rates of malaria also carry heavy burden of HIV. The most severely affected areas in Africa include Zambia, Zimbabwe, Mozambique, Malawi and Central African Republic. In these countries HIV prevalence is over 10% and 90% of the population is exposed to malaria (UNAIDS, 2007). Malaria and HIV are common among poorest populations, pregnant women, and children under the age of 5 years.

Evidence for a Biological interaction in people who are co-infected with HIV and malaria has grown. Until 1998 there was no convincing evidence for an interaction between malaria and HIV (Chandramohan and Greenwood, 1998), but now cohort studies have shown that malaria infection causes an increase in plasma HIV viral load (Kublin *et al,* 2005). It has also been demonstrated that $CD^{+}4T$ lymphocytes decline temporarily during clinical malaria episodes in HIV infected (Geertruyden *et al* 2006). Repeated malaria infections are associated with a more rapid decline in CD^{+} 4T lymphocytes overtime (Mermin, 2006) suggesting that malaria may lead to faster disease progression from HIV to AIDS. Plasmodium falciparum has been shown to stimulate HIV-1 replication through the production of cytokines (Xiao *et al* 1998). In HIV-uninfected women, the risk for symptomatic or placental malaria decreases with each pregnancy. To ininfected women this gravidity-specific pattern is altered. A study from Malawi showed that HIV-1 plasma viral loads were significantly higher in patients with malaria infections than in those without and these levels remained higher for up to 10 weeks after treatment (Kublin *et al,* 2005). A study in rural Tanzania showed a significantly high prevalence of symptomless parasitemia in HIV infected adults and higher mortality due to malaria in these individuals (Atzori, 1993). In a study carried out in Uganda, it was established that HIV-infection has been found to increase the frequency of clinical malaria and parasite density with tendency to greater parasitemia with advancing immune suppression (Whitworth and Hewitt, 2005).

For the treatment for HIV and malaria co-infection, it is recommended to use a combination of anti-malarial and antiretroviral. The anti-malarial drug chloroquine has effects on HIV, inhibiting the production of infectious viral particles by impairing virus glycosylation. Chloroquine also has synergistic effects on HIV suppression with the protease inhibitors indinavir, ritonanir and saquinavir at concentrations achieved with prophylaxis dosing (Savarino *et al*, 2004). Vitro studies have shown a synergistic effect on malaria growth between the protease inhibitors ritonavir and saquinavir and both chloroquine and mefloquine (Skinner *et al*, 2007). Uneke and Ogbonna (2009) reviewed the impact of treatment using anti-malarial and antiretroviral agents in pregnant women with malaria and HIV co-infection. They evaluated safety and operational feasibility of use of anti-malarial and antiretroviral agents to treat co-infected pregnant women. An additional drug related interaction between malaria and HIV involves the use of trimethoprim-sulfamethoxazole prophylaxis in HIV infected patients. In rural Uganda, HIV infections patients given trimethoprim-sulfamethoxazole had a 76% decrease in rates of malaria compared with when they were not receiving trimethoprim-

sulfamethoxazole and patients who received antiretroviral therapy plus trimethopim-sulfamethoxazole had a 92% decrease in malaria rates (Mermin, 2006). Few studies that have been carried out to analyse the transmission dynamics of HIV and Malaria Co-infection where results have shown that there is a synergy between HIV and Malaria,. In this paper it is aimed at formulating and analysing a Mathematical model that incorporates the aspect of treatment.

2. Model formulation

A non-linear mathematical model is proposed to study the transmission dynamics of HIV-malaria co-infection with treatment. The proposed model subdivides the population of interest at any time *t*, denoted by $N_H(t)$ is subdivided into sub-population namely, Susceptible $S_H(t)$,those who are not yet infected either by HIV or malaria, individuals infected with malaria $I_M(t)$, HIV infected individuals not yet showing symptoms of AIDS $I_H(t)$, individuals dually infected with HIV and malaria $I_{HM}(t)$, individuals treated for HIV showing symptoms of AIDS and malaria symptoms, $T_H(t)$ and individuals with full blown AIDS still on treatment $A(t)$.

Thus the total population is given by

$$N_H(t) = S_H(t) + I_M(t) + I_H(t) + I_{HM}(t) + T_H(t) + A(t) \quad (1)$$

In formulating the model, the following assumptions are taken into consideration:

i. The susceptible human population is at a risk of been infected by HIV at a rate proportional to the density of HIV infected people and the susceptible vector population is at risk of getting malaria at a rate proportional to density of infected mosquitoes.
ii. There is no vertical transmission i.e. all recruitments are from natural birth without disease and no infective immigrants, and all parameters are positive.
iii. Treatment is for both malaria and AIDS patients.
iv. Antiretroviral therapy is given to AIDS individuals whose $CD4^+$T cell count is below 200/μL which is the recommended AIDS defining stage (WHO, 2005).
v. Susceptibles cannot simultaneously get infected with malaria and HIV since the transmission dynamics are different.

The other important population under consideration is the total vector population at any time *t* denoted by $N_v(t)$ which is sub-divided into sub-population of susceptible mosquitoes $S_v(t)$ and infected mosquitoes $I_v(t)$. From these classes we have

$$N_v(t) = S_v(t) + I_v(t) \quad (2)$$

Taking into account the above considerations, we then have the following schematic flow diagram:

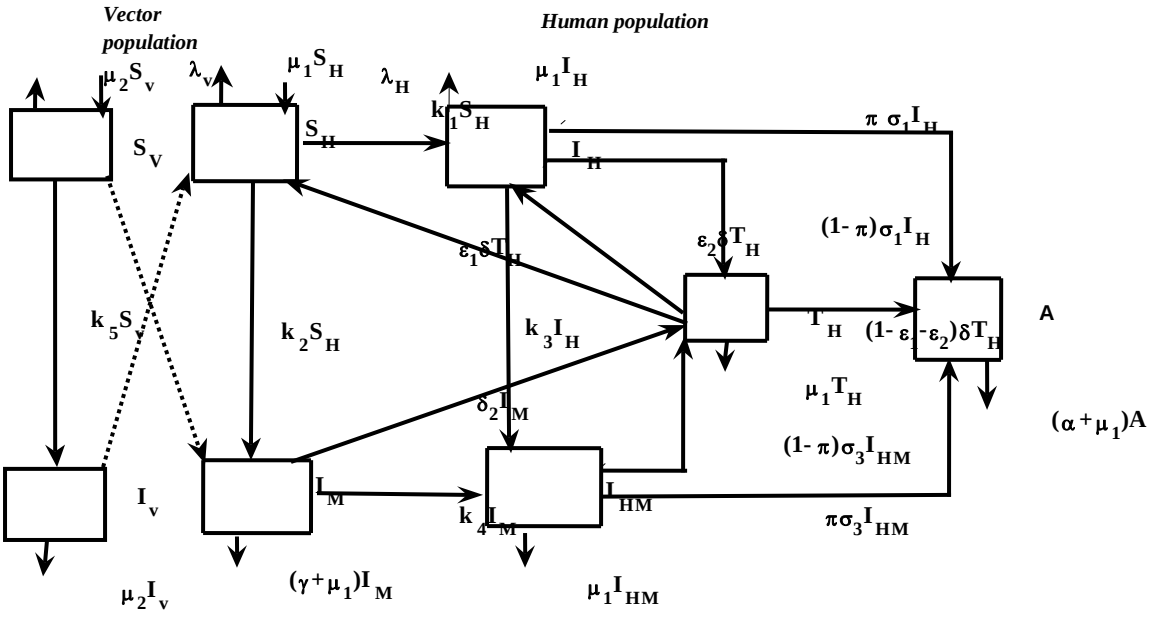

Figure 1: Diagram showing the flow chart of the HIV-Malaria co-infection treatment model

In the flow diagram:

$$k_1 = \frac{\beta_1(I_H + \theta I_{HM})}{N_H},\ k_2 = \frac{\beta_2 I_v}{N_H},\ k_3 = \frac{\beta_3 I_v}{N_H},\ k_4 = \frac{\beta_4 I_M}{N_H}, \text{ and } k_5 = \frac{\beta_5(I_M + aI_{HM})}{N_H}.$$

The model is thus governed by the following system of non linear ordinary differential equations:

$$\frac{dS_H}{dt} = \lambda_H N_H - \frac{\beta_1(I_H + \theta I_{HM})S_H}{N_H} - \frac{\beta_2 I_v S_H}{N_H} + \varepsilon_1\delta T_H - \mu_1 S_H,$$

$$\frac{dI_H}{dt} = \frac{\beta_1(I_H + \theta I_{HM})S_H}{N_H} - \frac{\beta_3 I_v I_H}{N_H} + \varepsilon_2\delta T_H - (\sigma_1 + \mu_1)I_H,$$

$$\frac{dI_M}{dt} = \frac{\beta_2 I_v S_H}{N_H} - \frac{\beta_4 I_M I_H}{N_H} - (\sigma_2 + \mu_1)I_M - \gamma I_M,$$

$$\frac{dI_{HM}}{dt} = \frac{\beta_3 I_v I_H}{N_H} + \frac{\beta_4 I_M I_H}{N_H} - (\sigma_3 + \mu_1)I_{HM}, \quad (3)$$

$$\frac{dT_H}{dt} = (1-\pi)(\sigma_1 I_H + \sigma_3 I_{HM}) - (\delta + \mu_1)T_H + \sigma_2 I_M,$$

$$\frac{dA}{dt} = \pi(\sigma_1 I_H + \sigma_3 I_{HM}) + (1-\varepsilon_1-\varepsilon_2)\delta T_H - (\alpha + \mu_1)A,$$

$$\frac{dS_v}{dt} = \lambda_v N_v - \frac{\beta_5(I_M + aI_{HM})S_v}{N_H} - \mu_2 S_v,$$

$$\frac{dI_v}{dt} = \frac{\beta_5(I_M + aI_{HM})S_v}{N_H} - \mu_2 I_v.$$

where

$$S_H(0) \geq 0,\ I_H(0) \geq 0,\ I_M(0) \geq 0,\ I_{HM}(0) \geq 0,\ T_H(0) \geq 0,\ A(0) \geq 0,\ S_v(0) \geq 0$$

In the system (3), β_1 is the per capita contact rate of susceptibles with HIV infected and HIV-malaria infected individuals, β_2 is the per capita contact rate of susceptibles with infected mosquitoes, β_3 is the per capita contact rate of HIV infected individuals with infected mosquitoes, β_4 is the per capita contact rate of malaria infected individuals with HIV infected individuals, β_5 is the per capita contact rate of susceptible mosquitoes with malaria infected and HIV-malaria infected individuals, μ_1 is natural mortality rate of humans, μ_2 is natural mortality rate of Mosquitoes, λ_H is birth rate of humans, λ_v is birth rate of mosquitoes, σ_1 is the rate at which HIV-Malaria Co-infection individuals progress for treatment, σ_2 is the rate at which malaria infected individuals progress for treatment, σ_3 is the rate at which HIV infected individuals progress for treatment, ε_1 is the progression rate at which malaria full recovered humans after treatment move to susceptible class, ε_2 is the progression rate at which HIV only and co-infected HIV- malaria move back to HIV infected class, α is the AIDS related death rate, θ is the average effective contact rate between susceptible humans and co-infected HIV-malaria, δ is the treatment rate, a is the mosquito biting rate, γ is the malaria related death rate, $(1-\varepsilon_1-\varepsilon_2)$ is the proportion that progresses to AIDS from treatment class, π is the progression rate from treatment, $k_1, k_2, k_3, k_4, and, k_5$ are the forces of infection.

For convenience, we analyse our model in terms of proportions of quantities instead of actual populations. This can be done by scaling the population of each class by the total populations. We make the transformation

$$s_h = \frac{S_H}{N_H},\ i_h = \frac{I_H}{N_H},\ i_m = \frac{I_M}{N_H},\ i_{hm} = \frac{I_{HM}}{N_H},\ t_h = \frac{T_H}{N_H},\ w = \frac{A}{N_H},\ s_v = \frac{S_v}{N_v},\ i_v = \frac{I_v}{N_v}, n = \frac{N_v}{N_H}.$$

Differentiating the fractions with respect to time it is easier to verify that $s_h,\ i_h,\ i_m,\ i_{hm},\ t_h,\ w,\ s_v,\ i_v,\ n$ satisfy the following system of non linear differential equations:

$$\begin{aligned}
\frac{ds_h}{dt} &= \lambda_H(1-s_h) - \beta_1(i_h + \theta i_{hm})s_h - \beta_2 i_v n s_h + (\gamma i_m + w\alpha)s_h + \delta t_h \varepsilon_1,\\
\frac{di_h}{dt} &= \beta_1(i_h + \theta i_{hm})s_h - \beta_3 n i_v i_h + \delta t_h \varepsilon_2 + (w\alpha + \gamma i_m)i_h - (\lambda_H + \sigma_1)i_h,\\
\frac{di_m}{dt} &= \beta_2 n i_v s_h - \beta_4 i_m i_h - (\sigma_2 + \gamma + \lambda_H)i_m + (\gamma i_m + w\alpha)i_m,\\
\frac{di_{hm}}{dt} &= \beta_3 n i_v i_h + \beta_4 i_m i_h - (\sigma_3 + \lambda_H)i_{hm} + (\gamma i_m + w\alpha)i_{hm},\\
\frac{dt_h}{dt} &= (1-\pi)(\sigma_1 i_h + \sigma_3 i_{hm}) - (\delta + \lambda_H)t_h + (\gamma i_m + w\alpha)t_h + \sigma_2 i_m,\\
\frac{dw}{dt} &= \pi(\sigma_1 i_h + \sigma_3 i_{hm}) + (1-\varepsilon_1-\varepsilon_2)\delta t_h - \alpha(w - \lambda_H) + w(\gamma i_m + w\alpha),\\
\frac{ds_v}{dt} &= \lambda_v(1-s_v) - \beta_5(i_m + a i_{hm})s_v,
\end{aligned} \tag{4}$$

$$\frac{di_v}{dt} = \beta_5(i_m + ai_{hm})s_v - i_v\lambda_v.$$

3. Model analysis

The normalized system (4) will be qualitatively analyzed so as to find the conditions for existence and stability a disease free equilibrium points. Analysis of the model allows us to determine the transmission dynamics of HIV-Malaria co-infection with treatment. Also on finding the reproductive number R_0, one can determine if the disease become endemic in a population or not.

3.1 Disease free equilibrium (DFE)

The disease free equilibrium of the normalized system (4) is obtained by setting

$$\frac{ds_h}{dt} = \frac{di_h}{dt} = \frac{di_m}{dt} = \frac{di_{hm}}{dt} = \frac{dt_h}{dt} = \frac{dw}{dt} = \frac{ds_v}{dt} = \frac{di_v}{dt} = 0. \quad (5)$$

At disease free equilibrium, it is assumed that there is no infection. Then we set $i_h = t_h = w = i_m = i_v = i_{hm} = 0$ in the system (4) above to get

$$\lambda_H - \lambda_H s_h = 0 \text{ and } \lambda_v - \lambda_v s_v = 0$$

implying that

$$s_h = 1 \text{ and } s_v = 1. \quad (6)$$

Therefore the Disease Free Equilibrium (DFE) denoted by E_0 of the system (4) is given by

$$E_0 = (s_h, 0, 0, 0, 0, 0, s_v, 0) = (1,0,0,0,0,0,1,0). \quad (7)$$

3.2 The Basic Reproduction number,' R_0 '

The basic reproduction number of the model (4) R_{HM} is calculated by using the next generation matrix (van den Driessche and Watmough, 2002).

The rate of appearance of new infection in compartment i gives the following:

$$F_i = \begin{pmatrix} F_1 \\ F_2 \\ F_3 \\ F_4 \\ F_5 \\ F_6 \end{pmatrix} = \begin{pmatrix} \beta_1 i_h + \beta_1 \theta i_{hm} \\ \beta_2 n i_v \\ \beta_3 n i_v i_h + \beta_4 i_m i_h \\ 0 \\ 0 \\ \beta_5 i_m + \beta_5 a i_{hm} \end{pmatrix}, \quad (8)$$

Using the linearization method, the associated matrix at DFE after taking partial derivatives gives

$$\mathbf{F} = \begin{pmatrix} \beta_1 & 0 & \theta\beta_1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & n\beta_2 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \beta_5 & a\beta_5 & 0 & 0 & 0 \end{pmatrix}, \quad (9)$$

The transfer of individuals out of the compartment i is given by

$$V_i = \begin{pmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \\ V_5 \\ V_6 \end{pmatrix} = \begin{pmatrix} \beta_3 n i_v i_h - \delta t_h \varepsilon_2 - (w\alpha + \gamma i_m) i_h + (\lambda_H + \sigma_1) i_h \\ \beta_4 i_m i_h + (\sigma_2 + \gamma + \lambda_H) i_m - (\gamma i_m + w\alpha) i_m \\ -\beta_3 n i_v i_h - \beta_4 i_m i_h + (\sigma_3 + \lambda_H) i_{hm} - (\gamma i_m + w\alpha) i_{hm} \\ -(1-\pi)(\sigma_1 i_h + \sigma_3 i_{hm}) + (\delta + \lambda_H) t_h - (\gamma i_m + w\alpha) t_h - \sigma_2 i_m \\ -\pi(\sigma_1 i_h + \sigma_3 i_{hm}) - (1 - \varepsilon_1 - \varepsilon_2)\delta t_h + w(\alpha + \mu_1) - w(\gamma i_m + w\alpha) \\ i_v \lambda_v \end{pmatrix}, \quad (10)$$

After taking partial derivatives this gives

$$\mathbf{V} = \begin{pmatrix} \lambda_H + \sigma_1 & 0 & 0 & -\delta\varepsilon_2 & 0 & 0 \\ 0 & \gamma + \lambda_H + \sigma_2 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_H + \sigma_3 & 0 & 0 & 0 \\ -(1-\pi) & -\sigma_2 & -\sigma_3(1-\pi) & \lambda_H + \delta & 0 & 0 \\ -\pi\sigma_1 & 0 & -\pi\sigma_3 & -\delta(1-\varepsilon_1-\varepsilon_2) & \alpha + \lambda_H & 0 \\ 0 & 0 & 0 & 0 & 0 & \lambda_v \end{pmatrix}, \quad (11)$$

with the inverse

$$\mathbf{V}^{-1} = \begin{pmatrix} \frac{q1}{q5} & \frac{-q2}{q6} & \frac{q3}{q7} & \frac{-q4}{q5} & 0 & 0 \\ 0 & \frac{1}{q8} & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{1}{q9} & 0 & 0 & 0 \\ \frac{-q11}{q5} & \frac{q12}{q6} & \frac{q13}{q7} & \frac{q10}{q5} & 0 & 0 \\ \frac{q14}{q18} & \frac{-q15}{q19} & \frac{q16}{q20} & \frac{-q17}{q21} & \frac{1}{q22} & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{1}{q23} \end{pmatrix}, \quad (12)$$

where

$$q1=\delta+\lambda_H, q2=\delta\varepsilon_2\sigma_2, q3=(-1+\pi)\delta\varepsilon_2\sigma_3, q4=\delta\varepsilon_2,$$

$$q5=\lambda_H(\delta+\lambda_H)+(\delta+(\delta-\pi\delta)\varepsilon_2+\lambda_H)\sigma_1,$$

$$q6=(\lambda_H(\delta+\lambda_H)+(\delta+(\delta-\pi\delta)\varepsilon_2+\lambda_H)\sigma_1)(\gamma+\lambda_H+\sigma_2),$$

$$q7=(\lambda_H(\delta+\lambda_H)+(\delta+(\delta-\pi\delta)\varepsilon_2+\lambda_H)\sigma_1)(\gamma+\sigma_3),$$

$$q8=\gamma+\lambda_H+\sigma_2, q9=\lambda_H+\sigma_3, q10=\lambda_H+\sigma_1, q11=(-1+\pi)\sigma_1,$$

$$q12=(\lambda_H+\sigma_1)\sigma_2, q13=(-1+\pi)(\lambda_H+\sigma_1)\sigma_3,$$

$$q14=(\delta+(-1+\pi)\delta(\varepsilon_1+\varepsilon_2)+\pi\lambda_H)\sigma_1,$$

$$q15=\delta((-1+\varepsilon_1+\varepsilon_2)\lambda_H+(-1+\varepsilon_1+(1+\pi)\varepsilon_2)\sigma_1)\sigma_2,$$

$$q16=(\delta+(-1+\pi)\delta(\varepsilon_1+\varepsilon_2)+\pi\lambda_H)(\lambda_H+\sigma_1)\sigma_3,$$

$$q17=\delta((-1+\varepsilon_1+\varepsilon_2)\lambda_H+(-1+\varepsilon_1+(1+\pi)\varepsilon_2)\sigma_1),$$

$$q18=q21=(\alpha+\lambda_H)(\lambda_H(\delta+\lambda_H)+(\delta+(\delta-\pi\delta)\varepsilon_2+\lambda_H)\sigma_1),$$

$$q19=(\alpha+\lambda_H)(\lambda_H(\delta+\lambda_H)+(\delta+(\delta-\pi\delta)\varepsilon_2+\lambda_H)\sigma_1)(\gamma+\lambda_H+\sigma_2),$$

$$q20=(\alpha+\lambda_H)(\lambda_H(\delta+\lambda_H)+(\delta+(\delta-\pi\delta)\varepsilon_2+\lambda_H)\sigma_1)(\lambda_H+\sigma_3),$$

$$q22=(\alpha+\lambda_H), q23=\lambda_v.$$

Therefore

$$\mathbf{FV}^{-1}=\begin{pmatrix} U1 & -U2 & U3 & -U4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & U5 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & U6 & U7 & 0 & 0 & 0 \end{pmatrix}, \quad (13)$$

where

$$U1=\frac{\beta_1(\delta+\lambda_H)}{\lambda_H(\delta+\lambda_H)+(\delta+(-1+\pi)\delta\varepsilon_2+\lambda_H)\sigma_1},$$

$$U2=-\frac{\delta\beta_1\varepsilon_2\sigma_2}{\lambda_H(\delta+\lambda_H)+(\delta+(\delta-\pi\delta)\varepsilon_2+\lambda_H)\sigma_1(\gamma+\lambda_H+\sigma_2)},$$

$$U3=\frac{\varepsilon_2\beta_1}{\lambda_H+\sigma_3}+\frac{(-1+\pi)\delta\beta_1\varepsilon_2\sigma_3}{\lambda_H(\delta+\lambda_H)+(\delta+(\delta-\pi\delta)\varepsilon_2+\lambda_H)(\lambda_H+\sigma_3)},$$

$$U4=-\frac{\delta\beta_1\varepsilon_2}{\lambda_H(\delta+\lambda_H)+(\delta+(\delta-\pi\delta)\varepsilon_2+\lambda_H)\sigma_1},$$

$$U5=\frac{n\beta_1\varepsilon_2}{\lambda_v},$$

$$U6 = \frac{\beta_5}{(\gamma + \lambda_H + \sigma_2)},$$

$$U7 = \frac{a\beta_5}{(\lambda_H + \sigma_3)}.$$

The eigenvalues of $\mathbf{FV}^{-1}$ are given by

$$\begin{pmatrix} 0 \\ 0 \\ 0 \\ U1 \\ U8 \\ U9 \end{pmatrix}, \quad (14)$$

where $U1$ is already defined above and $U8 = -\sqrt{\frac{n\beta_2\beta_5}{\lambda_v(\gamma + \lambda_H + \sigma_2)}}$, $U9 = \sqrt{\frac{n\beta_2\beta_5}{\lambda_v(\gamma + \lambda_H + \sigma_2)}}$.

It follows that the basic reproduction number which is given by the largest Eigen value for the normalised model system of the HIV/AIDS-malaria co-infection with treatment denoted by R_0 is given by

$$R_{0(HM)} = \max\left\{\frac{\beta_1(\delta + \lambda_H)}{\lambda_H(\delta + \lambda_H) + (\delta + (-1+\pi)\delta\varepsilon_2 + \lambda_H)\sigma_1}, \sqrt{\frac{n\beta_2\beta_5}{\lambda_v(\gamma + \lambda_H + \sigma_2)}}\right\}. \quad (15)$$

Denoting

$$R_{HIV} = \frac{\beta_1(\delta + \lambda_H)}{\lambda_H(\delta + \lambda_H) + (\delta + (-1+\pi)\delta\varepsilon_2 + \lambda_H)\sigma_1} \text{ and } R_{MAL} = \sqrt{\frac{n\beta_2\beta_5}{\lambda_v(\gamma + \lambda_H + \sigma_2)}}, \text{ we have}$$

$R_{0(HM)} = \max\{R_{HIV}, R_{MAL}\}$. R_{MAL} is representing a measure of the average number of secondary malaria infections in human caused by a single infective human or mosquito introduced into an entirely susceptible population. Similarly R_{HIV} is representing a measure of the average number of secondary HIV infections in humans caused by a single infective human introduced into an entirely susceptible population. We observe that R_0 of the full model is a combination of the HIV only and malaria only models.

3.3 Local Asymptotic Stability of Endemic Equilibrium

To determine the local stability of disease free equilibrium, the variational matrix $\mathbf{Z}_0$ of the normalised model system (4) corresponding to disease free equilibrium E_0 is obtained by the Centre Manifold theory as (Gumel *et al.,* 2006)

$$s_h = x_1,\ i_h = x_2,\ i_m = x_3\ , i_{hm} = x_4,\ t_h = x_5, w = x_6, s_v = x_7\ ,\ i_v = x_8. \quad (15)$$

with

$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 = 1$.

Model (4) can be re-written in the form $\frac{dX}{dt} = F(x)$ as

$$\begin{aligned}
\frac{dx_1}{dt} &= f_1 = \lambda_H(1-x_1) - \beta_1(x_2 + \theta x_4)x_1 - \beta_2 x_8 n x_1 + (\gamma x_3 + x_6\alpha)x_1 + \delta x_5\varepsilon_1,\\
\frac{dx_2}{dt} &= f_2 = \beta_1(x_2 + \theta x_4)x_1 - \beta_3 n x_8 x_2 + \delta x_5\varepsilon_2 + (x_6\alpha + \gamma x_3)x_2 - (\lambda_H + \sigma_1)x_2,\\
\frac{dx_3}{dt} &= f_3 = \beta_2 n x_8 x_1 - \beta_4 x_3 x_2 - (\sigma_2 + \gamma + \lambda_H)x_3 + (\gamma x_3 + x_6\alpha)x_3,\\
\frac{dx_4}{dt} &= f_4 = \beta_3 n x_8 x_2 + \beta_4 x_3 x_2 - (\sigma_3 + \lambda_H)x_4 + (\gamma x_3 + x_6\alpha)x_4,\\
\frac{dx_5}{dt} &= f_5 = (1-\pi)(\sigma_1 x_2 + \sigma_3 x_4) - (\delta + \lambda_H)x_5 + (\gamma x_3 + x_6\alpha)x_5 + \sigma_2 x_3,\\
\frac{dx_6}{dt} &= f_6 = \pi(\sigma_1 x_2 + \sigma_3 x_4) + (1-\varepsilon_1-\varepsilon_2)\delta x_5 - \alpha(x_6 - \lambda_H) + x_6(\gamma x_3 + x_6\alpha),\\
\frac{dx_7}{dt} &= f_7 = \lambda_v(1-x_7) - \beta_5(x_3 + a x_4)x_7,\\
\frac{dx_8}{dt} &= f_8 = \beta_5(x_3 + a x_4)x_7 - x_8\lambda_v.
\end{aligned} \tag{16}$$

The Jacobian of (16) at disease free is given by

$$Z_0 = \begin{pmatrix}
-\lambda_H & -\beta_1 & \gamma & -\theta\beta_1 & \delta\varepsilon_1 & \alpha & 0 & -n\beta_2\\
0 & \beta_1 - \lambda_H - \sigma_1 & 0 & \theta\beta_1 & \delta\varepsilon_1 & 0 & 0 & 0\\
0 & 0 & \gamma - \lambda_H - \sigma_2 & 0 & 0 & 0 & 0 & n\beta_2\\
0 & 0 & 0 & -\lambda_H - \sigma_3 & 0 & 0 & 0 & 0\\
0 & (1-\pi)\sigma_1 & \sigma_2 & (1-\pi)\sigma_3 & -\lambda_H - \delta & 0 & 0 & 0\\
0 & \pi\sigma_1 & 0 & \pi\sigma_3 & \delta(1-\varepsilon_1-\varepsilon_2) & -\alpha - \lambda_H & 0 & 0\\
0 & 0 & -\beta_5 & -a\beta_5 & 0 & 0 & -\lambda_v & 0\\
0 & 0 & \beta_5 & a\beta_5 & 0 & 0 & 0 & -\lambda_v
\end{pmatrix}, \tag{17}$$

We consider the case when $R_{HM} = 1$ (that is, $R_M < R_H = 1$) Let $\beta_1 = \beta^*$ be chosen as a bifurcation parameter. With $R_H = 1$ we solve for $\beta_1 = \beta^*$ from the equation

$$R_H = \frac{\beta_1(\delta + \lambda_H)}{\delta\lambda_H + \lambda_H^2 + \delta\sigma_1 - \delta\varepsilon_2\sigma_1 + \delta\pi\varepsilon_2\sigma_1 + \lambda_H\sigma_1} = 1,$$

to get

$$\beta_1 = \beta^* = \frac{\delta\lambda_H + \lambda_H^2 + \delta\sigma_1 - \delta\varepsilon_2\sigma_1 + \delta\pi\varepsilon_2\sigma_1 + \lambda_H\sigma_1}{\delta + \lambda_H}. \quad (18)$$

The linearization system (16) is transformed with $\beta_1 = \beta^*$ which has a simple zero eigenvalue. Hence the centre manifold theory can be used to analyze the dynamics of (16) near $\beta_1 = \beta^*$. It can be shown that the Jacobian of (16) at $\beta_1 = \beta^*$ has a right eigenvector associated with the zero eigenvalues given by

$w = \left(w_1, w_2, w_3, w_4, w_5, w_6, w_7, w_8\right)^T$.

Then

$$\begin{pmatrix} -\lambda_H & -\beta_1 & \gamma & -\theta\beta_1 & \delta\varepsilon_1 & \alpha & 0 & -n\beta_2 \\ 0 & K1 & 0 & \theta\beta_1 & \delta\varepsilon_1 & 0 & 0 & 0 \\ 0 & 0 & K2 & 0 & 0 & 0 & 0 & n\beta_2 \\ 0 & 0 & 0 & K3 & 0 & 0 & 0 & 0 \\ 0 & K6 & \sigma_2 & K7 & K4 & 0 & 0 & 0 \\ 0 & \pi\sigma_1 & 0 & \pi\sigma_3 & K8 & K5 & 0 & 0 \\ 0 & 0 & -\beta_5 & -a\beta_5 & 0 & 0 & -\lambda_v & 0 \\ 0 & 0 & \beta_5 & a\beta_5 & 0 & 0 & 0 & -\lambda_v \end{pmatrix} \begin{pmatrix} w_1 \\ w_2 \\ w_3 \\ w_4 \\ w_5 \\ w_6 \\ w_7 \\ w_8 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \quad (19)$$

where

$$w_1 = \frac{-\beta_1 w_2 + \gamma w_3 + \delta\varepsilon_1 w_5 + \alpha w_6 - \beta_2 n w_8}{\lambda_H}, \; w_2 = \frac{-\delta\varepsilon_1 w_5}{K1}, \; w_4 = 0,$$

$$w_5 = \frac{-K6 w_2 - \sigma_2 w_3}{K4}, \; w_6 = \frac{\pi\sigma_1\delta\varepsilon_1 w_5 - K1K8 w_5}{K1K5},$$

$$w_7 = \frac{-\beta_5 w_3}{\lambda_v}, \; w_8 = \frac{\beta_5 w_3}{\lambda_v}.$$

for which $w_3 > 0$ is a free right eigenvector. Furthermore, the Jacobian at E_0 has the left eigenvector associated with the zero eigenvalues at $\beta_1 = \beta^*$ given by $v = (v_1, v_2, v_3, v_4, v_5, v_6, v_7, v_8)^T$,

implying that

$$\begin{pmatrix} -\lambda_H & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -\beta_1 & K1 & 0 & 0 & K6 & \pi\sigma_1 & 0 & 0 \\ \gamma & 0 & K2 & 0 & \sigma_2 & 0 & -\beta_5 & \beta_5 \\ -\theta\beta_1 & \theta\beta_1 & 0 & K3 & K7 & \pi\sigma_3 & -a\beta_5 & a\beta_5 \\ \delta\varepsilon_1 & \delta\varepsilon_1 & 0 & 0 & K4 & K8 & 0 & 0 \\ \alpha & 0 & 0 & 0 & 0 & K5 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -\lambda_v & 0 \\ -n\beta_2 & 0 & n\beta_2 & 0 & 0 & 0 & 0 & -\lambda_v \end{pmatrix} \begin{pmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \\ v_6 \\ v_7 \\ v_8 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \quad (20)$$

where

$$v_1 = 0,\ v_2 = -\frac{K6v_5}{K1},\ v_3 = -\frac{\lambda_v v_8}{n\beta_2},\ v_4 = \frac{-\theta\beta_1 v_2 - K7v_5 - a\beta_5 v_8}{K3},\ v_6 = 0,$$

$$v_7 = 0,\ v_8 = \frac{-K2v_3 - \sigma_2 v_5}{\beta_5}.$$

for which $v_5 > 0$ is a free left eigenvector.

It can be shown that with $v_1 = 0,\ v_6 = 0, v_7 = 0,\ a$ is given by

$$a = -\{v_2 \frac{\beta_1\delta\varepsilon_1 w_5(\beta_1 w_2 - \gamma w_3 - \delta\varepsilon_1 w_5 - \alpha w_6 + \beta_2 n w_8)}{K1\lambda_H} - v_2 n\beta_3 \frac{\delta\varepsilon_1 w_5\beta_5 w_3}{K1\lambda_v}$$

$$+v_2\alpha \frac{\delta\varepsilon_1 w_5(\pi\sigma_1\delta\varepsilon_1 w_5 - K1K8w_5)}{K1K1k5} - v_3\beta_4 \frac{\delta\varepsilon_1 w_5 w_3}{K1} - v_3\alpha w_3 \frac{(\pi\sigma_1\delta\varepsilon_1 w_5 - K1K8w_5)}{K1K5}$$

$$+v_5\gamma w_3 \frac{K6w_2 + \sigma_2 w_3}{K4} - v_5\alpha \frac{(K6w_2 + \sigma_2 w_3)(\pi\sigma_1\delta\varepsilon_1 w_5 - K1K8w_5)}{K1K4K5} - v_3\gamma w_3^2\} < 0.$$

and b is given by

$$b = \left(\frac{K6v_5\delta\varepsilon_1 w_5}{K1K1}\right) > 0,$$

Theorem 1

If all inequalities $a < 0$ and $b > 0$ are satisfied then the normalised model system (4) has a unique endemic equilibrium which is locally asymptotically stable when $R_{HM} < 1$ and unstable when $R_{HM} > 1$.

3.4 Global stability of the disease-free equilibrium

Theorem 2

The disease free equilibrium of the system (4) is globally asymptotically stable whenever $R_{HM} < 1$ and unstable if $R_{HM} > 1$.

Proof

The proof is based on the comparison theorem (Lakshmkantham *et al*, 1989). The rate of change of the variables representing the infected components of the system can be written as follows:

$$\begin{pmatrix} \frac{di_h}{dt} \\ \frac{di_m}{dt} \\ \frac{di_{hm}}{dt} \\ \frac{dt_h}{dt} \\ \frac{dw}{dt} \\ \frac{di_v}{dt} \end{pmatrix} = (\mathbf{F}-\mathbf{V}) \begin{pmatrix} i_h \\ i_m \\ i_{hm} \\ t_h \\ w \\ i_v \end{pmatrix} - F_1 \begin{pmatrix} i_h \\ i_m \\ i_{hm} \\ t_h \\ w \\ i_v \end{pmatrix}, \quad (21)$$

which implies that

$$\begin{pmatrix} \frac{di_h}{dt} \\ \frac{di_m}{dt} \\ \frac{di_{hm}}{dt} \\ \frac{dt_h}{dt} \\ \frac{dw}{dt} \\ \frac{di_v}{dt} \end{pmatrix} \leq (\mathbf{F}-\mathbf{V}) \begin{pmatrix} i_h \\ i_m \\ i_{hm} \\ t_h \\ w \\ i_v \end{pmatrix}. \quad (22)$$

Given that all the eigenvalues of the matrix $(\mathbf{F}-\mathbf{V})$ have negative real parts, it follows that the inequality (22) is globally stable for $R_{HM} < 1$ and $(s_h(t), s_v(t)) \to 0$ as $t \to \infty$.

3.5 Sensitivity Analysis

We perform sensitivity analysis in order to determine the relation of model parameters to disease transmission (Issa *et al* 2010). In determining how best to reduce human mortality and morbidity due to AIDS and malaria, it is necessary to know the relative importance of the different factors responsible for its transmission and prevalence. Therefore a numerical sensitivity index is used to determine the parameter with high impact on initial disease threshold R_0,

$$\left(R_{0(HM)} = \max\left\{ \frac{\beta_1(\delta+\lambda_H)}{\lambda_H(\delta+\lambda_H)+(\delta+(-1+\pi)\delta\varepsilon_2+\lambda_H)\sigma_1}, \sqrt{\frac{n\beta_2\beta_5}{\lambda_v(\gamma+\lambda_H+\sigma_2)}} \right\} \right).$$ In order to measure the impact of HIV only, malaria only and HIV-malaria co-infection transmission and prevalence, analytical sensitivity analysis on all parameters with respect to basic reproduction number R_0 is done.

Numerical sensitivity analysis was done by computing sensitivity indices of basic reproduction number R_0 which measures initial disease transmission using the approach by (Issa *et al.*, 2010). Sensitive indices measures the relative change in state variable when the parameter changes. The normalized forward sensitivity index of a variable to a parameter is a ratio of the relative change in the variable to the relative change in the parameter. When a variable is a differentiable function of the parameter, the sensitivity index may be alternatively defined using partial derivatives.

$$r_q^{R_0} = \frac{\partial R_0}{\partial q} \times \frac{q}{R_0}$$

For example the sensitivity index of parameter value with respect to β_2 is given by $\mathrm{X}_q^{R_0} = \frac{\partial R_0}{\partial \beta_2} \times \frac{\beta_2}{R_0} = +\frac{1}{2}$ and Other indices $\mathrm{X}_{\beta_1}^{R_0}$, $\mathrm{X}_{\beta_5}^{R_0}$, $\mathrm{X}_{\gamma}^{R_0}$, $\mathrm{X}_{\delta}^{R_0}$, $\mathrm{X}_{\sigma_1}^{R_0}$, $\mathrm{X}_{n}^{R_0}$, $\mathrm{X}_{\lambda_H}^{R_0}$, $\mathrm{X}_{\lambda_v}^{R_0}$, $\mathrm{X}_{\pi}^{R_0}$, $X_{\sigma_2}^{R_0}$ and $\mathrm{X}_{\varepsilon_2}^{R_0}$, are obtained in the same manner.

Table 1. Numerical values of sensitivity indices of R_0

Parameters	Value	Referrence
β_1	0.15	Ratera *et al* (2012)
β_2	0.833	Okosun & Makinde (2011)
β_5	0.09	Kbenesh *et al*(2009)
σ_1	0.67	Ratera *et al* (2012)
σ_2	0.4	Okosun & Makinde (2011)
δ	0.5	Assumed
α	0.5	Ratera *et al* (2012)
γ	0.0003454	
λ_H	0.0384	Aziza *et al* (2012)
λ_v	0.12	Aziza *et al* (2012)
ε_1	0.0056	Mukandavire *et al* (2009)
ε_2	0.047	Assumed
π	0.033	Ratera *et al* (2012)
n	0.05	Aziza *et al* (2012)

Table 2. Numerical values of sensitivity indices of R_0 to parameters for the HIV/AIDS-malaria with treatment model, evaluated at the baseline parameter values given in Table 1

Parameters	R_H -Sensitivity index	Parameters	R_M _Sensitivity index	Parameters	R_{HM} -Sensitivity index
β_1	1	-	-	β_1	1
-	-	β_2	0.5	β_2	0.5
-	-	β_5	0.5	β_5	0.5
σ_1	-0.947112	-	-	σ_1	-0.947112
-	-	σ_2	-0.177085	σ_2	-0.177085
δ	-0.0102175	-	-	δ	-0.0102175
-	-	γ	-0.152913	γ	-0.152913
λ_H	-0.0426709	λ_H	-0.17002	λ_H	-0.17002
-	-	λ_v	-0.5	λ_v	-0.5
ε_2	-0.0243197	-	-	ε_2	-0.0243197
π	0.000829937	-	-	π	0.000829937
-	-	n	0.5	n	0.5

3.5.1 Interpretation of Sensitivity Indices

From Table 1 above, generally it shows that when the parameters β_1, β_2, β_5, π and increase while the other parameters remain constant the value of R_0 increases implying that they increase the endemicity of the disease as they have positive indices. When the parameters ε_2, γ, δ, $\sigma_1, \sigma_2, \lambda_H$ and λ_v decrease, while keeping other parameters constant the value of R_0 decrease, implying that they decrease the endemicity of the disease as they have negative indices.

We notice that the most sensitive parameter is the contact rate of HIV only infection and HIV-malaria infection β_1 with the susceptible. This is followed by the progression rate to treatment σ_1. The other which follows is the contact rate of infected mosquitoes with susceptible humans β_2, followed by contact rate of infected humans (malaria and HIV-malaria) β_5, mosquito recruitment rate λ_v, the average number of mosquitoes biting a human n. The rest follow in this decreasing order of sensitivity, malaria progression rate to treatment σ_2, human recruitment λ_H, malaria related death γ, HIV treatment rate δ, progression rate to HIV class for AIDS infectives' accessing ARVS ε_2 and the least sensitive parameter is the progression rate to AIDS class π.

4. Numerical Simulations

In order to illustrate the analytical results of the study, numerical simulations of the normalised model system (4) are carried out using the set of estimated parameter values below:

Table 3. Parameter values for normalised HIV/AIDS –malaria co-infection with treatment model.

Parameter Symbol	Parameter Values $(yr)^{-1}$	Source
β_1	0.86	Ratera *et al* (2012)
β_2	0.833	Okosun & Makinde (2011)
β_3	0.1	Estimated
β_4	0.001	Estimated
β_5	0.09	Blayneh *et al* (2009)
α	0.5	Tripathi *et al*., (2007)
λ_H	0.0384	Estimated
λ_v	0.012	Aziza *et al* (2012)
ε_1	0.01	Ratera *et al* (2012)
ε_2	0.047	Estimated
δ	0.5	Okosun & Makinde (2011)
σ_1	0.67	Estimated
σ_2	0.4	Estimated
σ_3	0.74	Estimated
θ	0.6	Issa *et al* (2010)
n	0.05	Estimated
a	0.2	Estimated
π	0.033	Estimated
γ	0.0232556	Estimated

Figure 2 below shows the distribution of population with time in all classes.

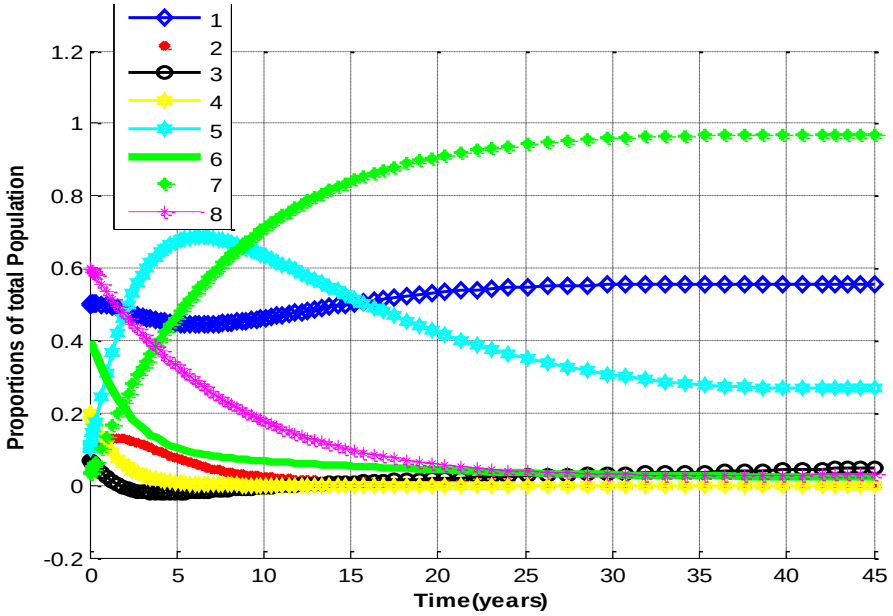

Figure 2. Variation of proportion of total population in different classes

The legend in figure 2 is as follows: 1-susceptible humans, 2-HIV infectives, 3-Malaria infectives, 4-HIV/Malaria infectives, 5-Treated infectives, 6-AIDS patients, 7-susceptible mosquitoes and 8-infected mosquitoes.

From figure 2 it is seen that initially the proportion of susceptible population decreases slightly with time and increases gently and finally reaching its equilibrium. This is due to treatment with ARV and anti-malaria drugs. As a result the infection is minimized in the population. In the initial stage of treated population, we observed that the treated population increases sharply. This is attributed to the proportions of individual progression for treatment from HIV, malaria and HIV-malaria co-infection populations. In a moment of time we again see that the treated population decreases steadily and eventually reaches its equilibrium. This is because individuals who are accessing treatment are now leaving the treated class. Those treated for malaria move to susceptible class whilst some of those accessing ARVs develop AIDS, others join the HIV infected group since they are still infective. We also notice a decrease in HIV infected, malaria infected and HIV-malaria infected populations. This is due to their progression for treatment. In the vector population we see a decrease in infected vector population. This is because malaria infected humans who are supposed to infect the mosquitoes have recovered. Thus mosquitoes have no source of infection, since mosquitoes gets infecting after biting a malaria infected individual. Consequently we observe an increase in susceptible vector population because as time goes we expect to have few infected mosquitoes. Thus we see an increase in mosquito susceptible population. Like other populations we observe also from Fig 2 that the mosquito susceptible population reaches equilibrium.

Figures 3-6, show the variation of proportions of Susceptibles, HIV infectives, treated malaria-HIV infectives, malaria and HIV and proportion of AIDS patients with treatment rate.

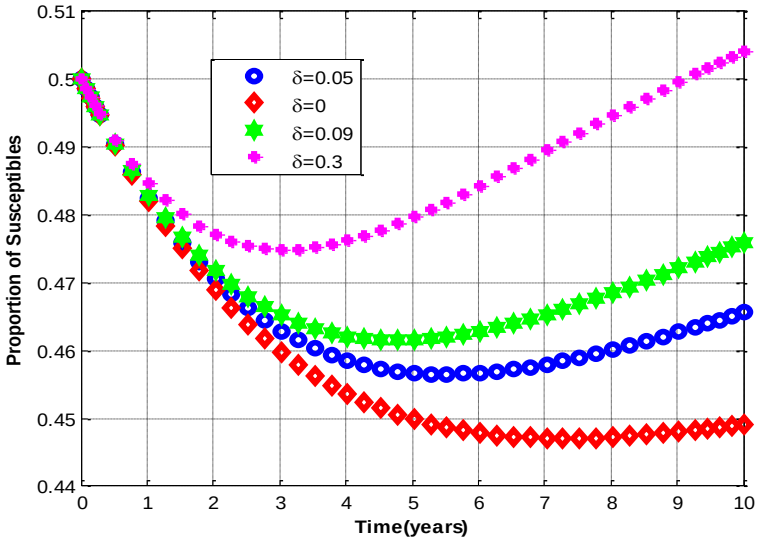

Figure 3. Variation of proportion of Human susceptible population for different values of treatment rate δ

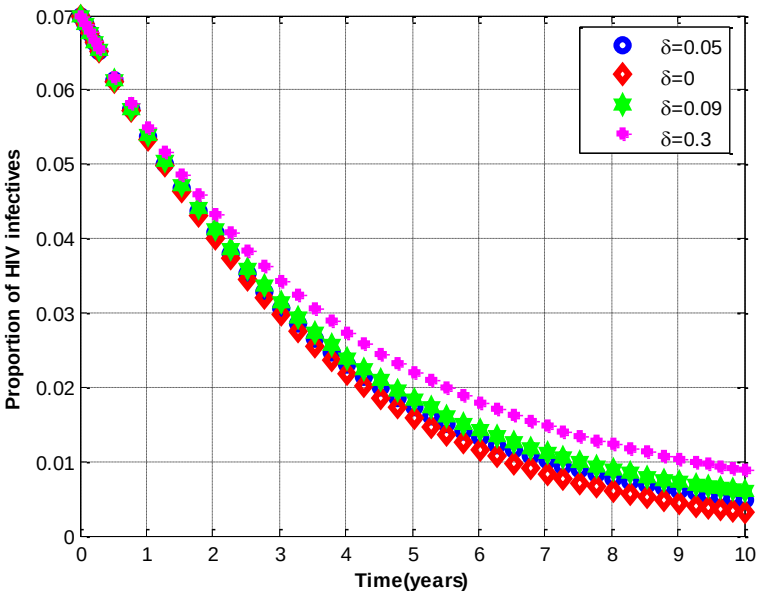

Figure 4. Variation of proportion of HIV infected population for different values of treatment rate δ

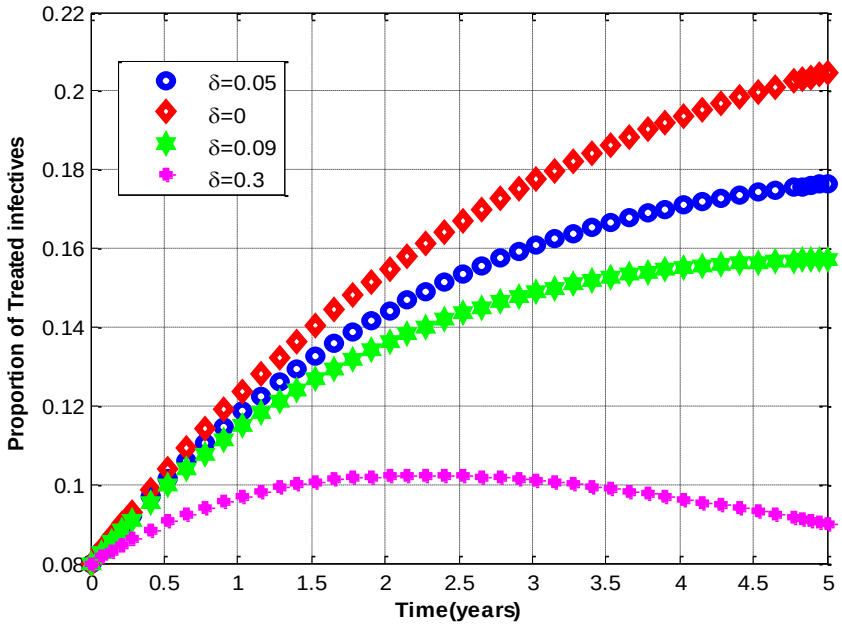

Figure 5. Variation of proportion of Human treated population for different values of treatment rate δ

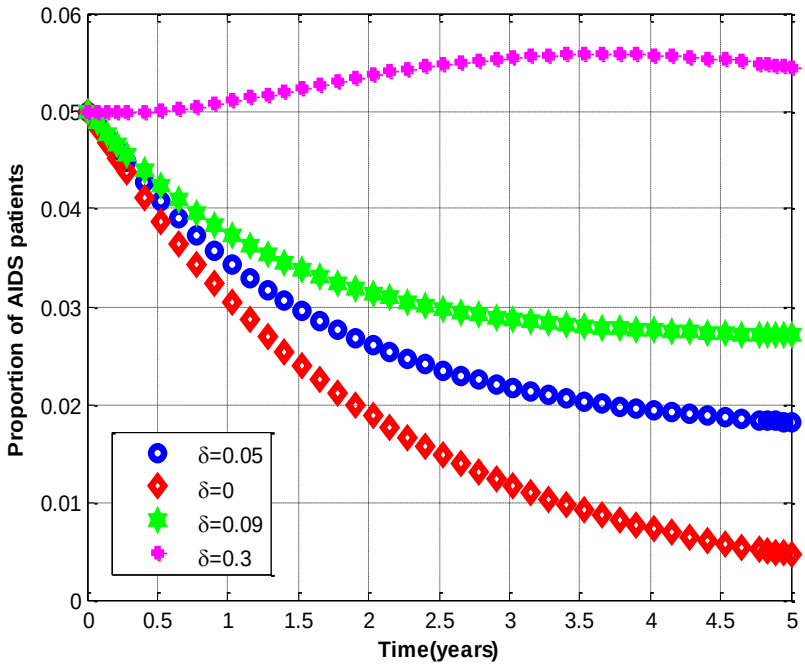

Figure 6. Variation of proportion of AIDS patients population for different values of treatment rate δ

It is observed that as the treatment rate increases, the proportion of susceptible population increases (Figure.3) because of people who have fully recovered from malaria join

the susceptible class. There are people living with HIV but have not yet developed AIDS and have been initiated to ARV treatment. When this group of people join the HIV infectives, they increase the population of HIV infectives in the community (Figure 4). It can also be seen from Figure 5 that as treatment is increased, the treatment proportion decreases because treated individuals leave the class. We notice in Figure 6 that when there is no treatment, the AIDS population decreases, meaning that death rate has increased as there is no treatment, but when treatment is in place, we see a significant increase in the AIDS patients population implying that they accessing ARV treatment which is prolonging their lives.

Figure 7 below shows the variation of proportion of malaria infected population for different values of the per capita contact rate of susceptibles with infected mosquitoes β_2.

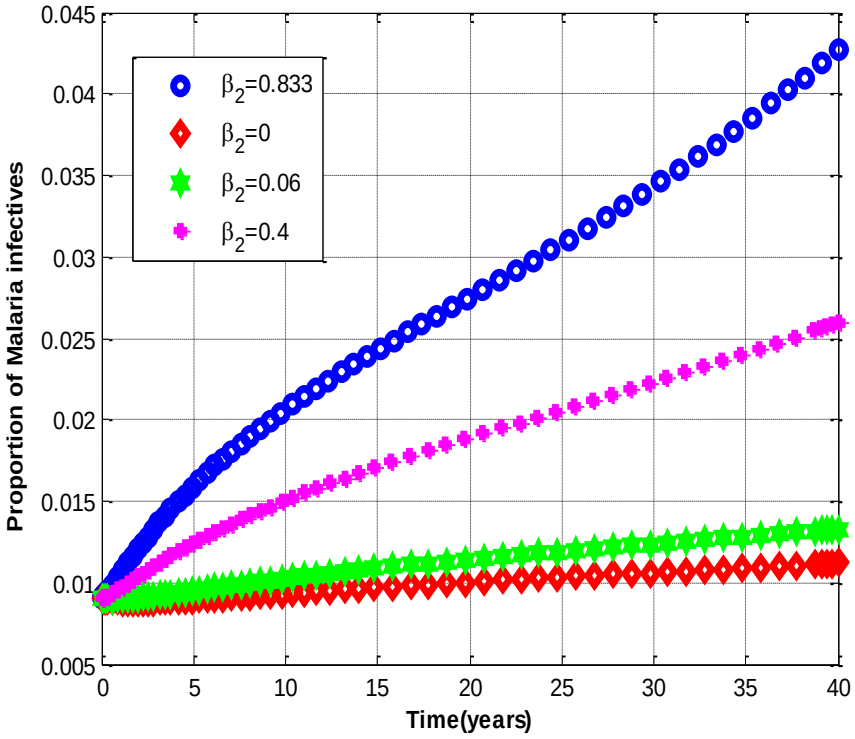

Figure 7. Variation of proportion of malaria infected population for different values of β_2

From Figure 7 it is seen that if the per capita contact rate $\beta_2 = 0$ between infected mosquitoes and humans, the malaria episodes are negligible, but as the value of β_2 increases there is also a progression of the proportions of malaria infectives. Therefore the governments and NGOs should seek optimal strategies to minimize the contact rate between infected mosquitoes and humans in order to control the endemic such as providing insecticide treated mosquito nets.

Figure 8 below shows the variation of proportion of treated patient's population for different values of the progression rate from treatment π.

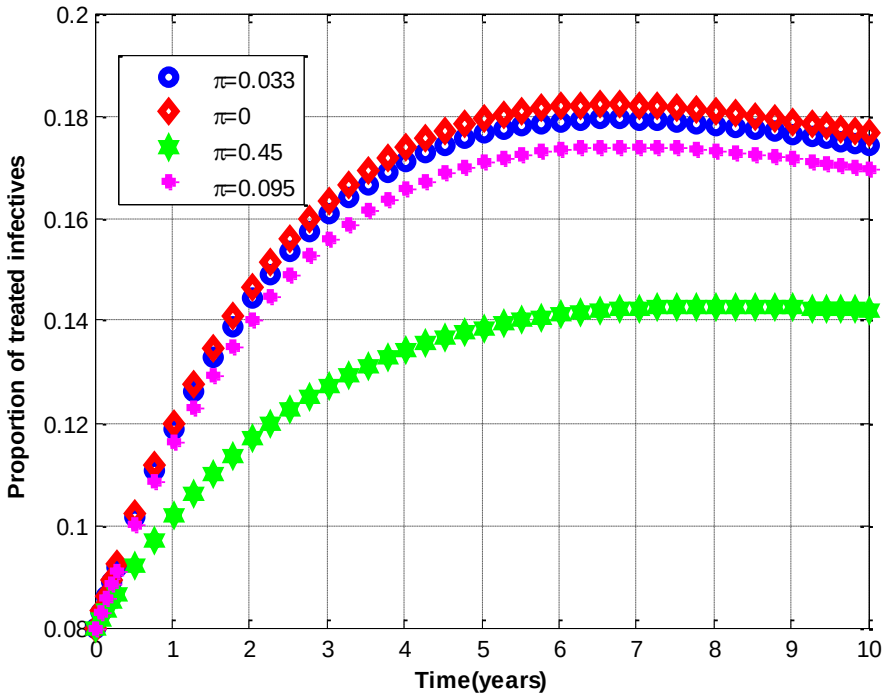

Figure 8. Variation of Proportion of Treated patient's population for different values of π.

It is noticed that noticed that the proportion of treated individuals decrease the progression rate from treatment π increase. This implies that people in the community are accessing treatment and some of those who are treated recover fully in the case of malaria. For the HIV case, those who respond well to treatment progress to the HIV infected class as they are still infective. It is also worth mentioning that not all treated HIV individuals respond well to treatment. Those who fail to respond, progress to AIDS class.

Figure 9 below shows the Variation of Proportion of the Susceptible Human population for different values of the progression rate at which malaria full recovered humans after treatment move to susceptible class ε_1.

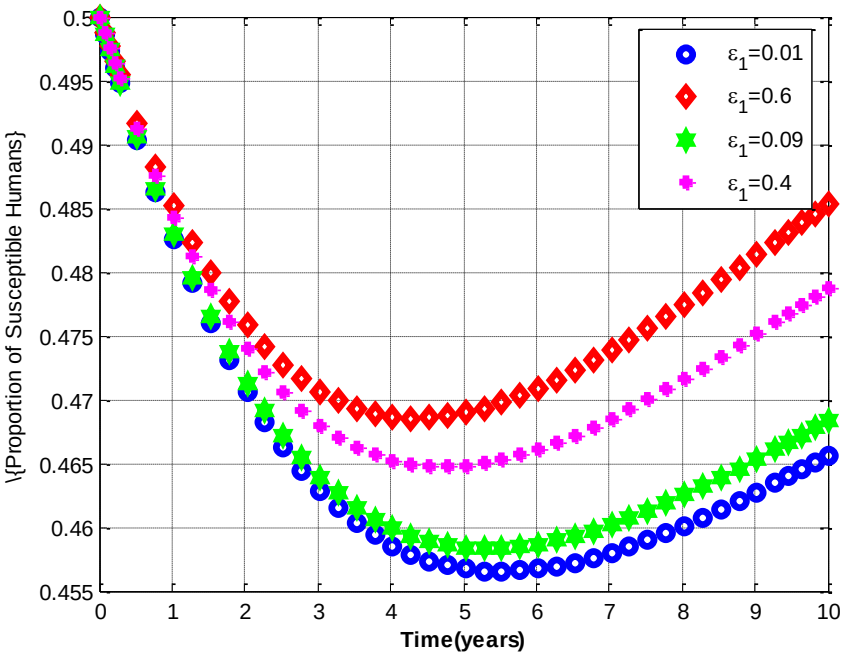

Figure 9. Variation of Proportion of the Susceptible Human population for different values of ε_1.

Figure 9 shows clearly that as the malaria recovery rate increases the susceptible human population increase. Malaria is curable but individuals who recover from malaria join the susceptible human class. That is the reason we are seeing an increase in the susceptible population. This indicates the significant effects of malaria treatment.

Figure 10 below shows the variation of proportion of the HIV infectives population for different values of the progression rate at which HIV only and co-infected HIV- malaria move back to HIV infected class ε_2.

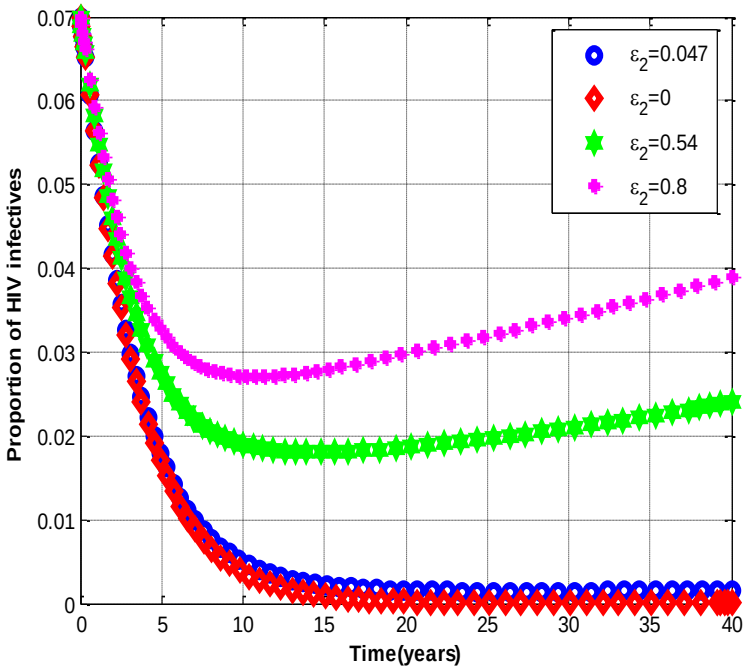

Figure 10. Variation of Proportion of the HIV infectives population for different values of ε_2

We observe that there is another increase in the HIV infected compartment as the progression rate to HIV infectives increases by the rate ε_2. These are a proportion of individuals on ARV treatment who have not shown symptoms of AIDS and are responding very well to treatment. It is a well know fact that HIV/AIDS is not curable. Thus those on treatment will join the HIV infective class since they are still infectious even though they are on treatment .This is a positive move in that the lives of people are prolonged with adherence to treatment.

5. Conclusions

A non linear mathematical model has been analyzed to study the effect of treatment on the co-infection HIV-malaria. Qualitative analysis of the model shows that the disease free equilibrium is locally asymptotically stable by the Routh Hurwitz criteria for threshold parameter less than unity and unstable for threshold parameter greater than unity. Centre manifold theory shows the HIV-malaria models endemic equilibrium is locally asymptotically stable whenever the associated reproduction number is less than unity. The impact of treatment in the model is also investigated. Numerical results are provided to illustrate the analytical results. Sensitivity analysis shows that the contact rate beta1 is the most sensitive parameter and least sensitive is the progression rate to AIDS class. Based on the findings it is observed that HIV accelerates the progression of malaria infection and malaria parasites promote proliferation of the HIV virus. It is concluded that malaria treatment and HIV treatment have a significant impact on the co-infection. Therefore malaria treatment can reduce the burden of HIV/AIDS-malaria co-infection and ARV treatment has shown to prolong the lives of people leaving with HIV/AIDS.

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Prediction Modeling of Urban Health Status in Cities - A Focus on Akure South West Nigeria

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Abstract

This study discusses environmental health issues in residential areas with the aid of empirical models for three residential zones in Akure, South west of Nigeria. The study begins with a general introduction to urban environment/health relationships. Thereafter, it goes on to discuss the attributes of the study area. For its methodology, the study made use of hierarchical sampling procedure to select household heads across residential districts of Akure town for a socio economic survey. The responses were collated while dummy variables germane to urban health relationships in the residential zones were fed into three models prescribed for the analysis. The models returned 'robust goodness of fit values' of 0.844, 0.902 and 0.711, respectively. The implications of the performance of the variables were discussed. The study noted among other findings that wastewater management, age of buildings, domestic water supply, management of gaseous wastes in buildings and mode of feacal waste management are critical issues in the study area. Appropriate policy recommendations were proffered in the study.

Key words: Urban, health, relationships, environment, empirical, models, variables, Akure

Introduction

There has been an increasing concern for the environment in many developing countries in the last half century. This is attributable to the increasing realization of the environment induced dangers posed to human health and life. This no doubt, emanates from the failures of basic environmental resources that ordinarily should guarantee healthful urban existence as well as the basic infrastructural facilities that would not work in Third World cities. Here in Nigeria, communicable diseases still rank as important contributors to ill health. About one-third of the disease burden in Nigeria, as in many other developing countries has been associated with environmental factors (McGranahan et.al; 1999). This manifests in high prevalence of environmentally related deaths, disabilities and morbidities The prevalence of communicable diseases in poor countries persists owing to the geo climatic environment, which is more conducive to many vector- borne diseases and macro parasites related diseases (WHO, 2009). There are also palpable contributions arising from the fact that both individuals and governments in the developing world have taken far fewer of actions that control disease transmission in the developed economies. Much as this is the case, there is need for empirical investigations from various disciplines on the dynamics of environments and health relationships on urban dwellers in Third World cities.

Urbanization - like agricultural change on the landscape, can be either beneficial or harmful to people's health (McGranahan et.al; 1999). Much depends on how the fallouts of urbanization are managed. There is a wide range of urban- related environmental problems that can adversely affect people's health. These emanate from the sheer demographic characteristics as well as the urban / physical growth components. When these problems are efficiently addressed, urbanization should lead to health gains. This is the thrust of environmental health - the scope of which includes housing, the residential environment and aspects of metropolitan planning and development (Abbot, 1996). Environmental health is concerned with the suitability of environmental conditions for the protection and promotion of human health. It is in essence, central to the practice of town and country planning. The rigour, intensity and devotion to the above especially in Third World countries vary across space and time for various reasons.

Among the harmful effects of urbanization in the Third World are health problems, emanating from the fallouts of inadequate urban infrastructures, poor city management and poor city planning. There are other palpable consequences such as traffic accidents, inadequacies of the urban transportation system and consequent loss of productive time to commuting. Others include health problems emanating from long exposure to vehicular pollutants. The pace of Third World urbanization does not promote sufficient societal learning necessary to adapt traditional rural institutions and governance to urban culture being on a 'crash program' (of) urbanization (Henderson, 2002). The costs of rapid urbanization stem from the sheer size of emerging cities and underdeveloped city institutions and human resources. These therefore do not allow sufficient time or room for experimentation and needful adjustments in city management.

Communicable diseases are still very important contributors to out-patient profiles in Nigerian hospitals for which environmental factors are major actors in the transmission cycle. Statistics across the globe express this same trend as literatures attest the fact that communicable diseases are the most common cause of death world over (Murray and Lopez, 1996). Literature also has it that out of the global 51 million deaths in 1993, 16.4 million arose from infectious and parasitic diseases. For many residents in Third World cities, urban existence or living is an arduous task of poverty, hunger, diseases and fatigue right from infancy. Murray and Lopez (1996) were later to affirm that 5.3% of global deaths are

attributable to poor water supply, sanitation and hygiene, all of which stress the urban poor in particular. These three all together account for 6.8% global diseases burden or 10% of third world disease burden. The contribution reflects very strongly the inequalities in access to safe, adequate water supply and sanitation and this border on the issues of environmental management' (Murray, et al; 1999).

From literature, Pollack et.al (2009) and Nunau and Satherthwaite (1999) emphasize the importance of environmental factors in urban health. This they established when they asserted that infectious and parasitic diseases are 'environmental' because they are transmitted through the environmental media - air, water, soil, food, feacal management or through insects or animal vectors in the environment. Arising from this, social processes are often of greater importance in determining the health of either individuals or the community (Montiel and Barten, 1999 and Pacione, 2002). On the strength of the above, the health of the individual becomes a reflection of his access to the fundamentals of urban existence wherever he lives. Inequalities in health are rooted in the asymmetries that exist in access to basic prerequisites for health in cities. It is therefore little wonder that the 1978 Alma Atta Conference endorsed the notion that links health to the living conditions of given population. The Conference also endorsed the roles of community participation in health (WHO, 1978; Montiel and Barten, 1999; and Pacione, 2002).

An effort at correcting the inadequacies in the urban environmental management systems in Nigeria is deducible from the Third National Development plan. This affirmed inter alia that:

> *'an efficient system of sewerage, drainages and refuse disposal is one of the most important factors affecting human health and the environmental quality of settlements ... in many urban areas, outmoded methods are still being employed in the disposing of human wastes, with streets still littered with garbage. The situation described has been with us for many years and indeed tended to worsen with increasing population and urban growth…' (FRN,1975).*

In view of the above as well as the complexity and magnitude of health and environmental issues in many cities in Nigeria and the developing world, improvements in urban health and that of the individual will require changes in physical and the socio economic environment of cities. It will also command an integrated approach that takes into account the wider socio-economic and environmental factors affecting health.

This paper derives from the collation and interpretation of socio-economic data across the residences in various neighbourhoods of Akure. The following sections report the salient features of the study.

Akure Residential Neighbourhoods

Akure the study area is a product of the typical Third World urbanization processes. Owing to a recent political cum administrative restructuring in Nigeria in the late 1970s, it began a metamorphosis from its hitherto quiet and low-lying provincial relevance to a bustling city of modern day regional significance in Nigeria, having become the state capital of the old Ondo State (Nigeria) on February 3, 1976.

Akure is located in Southwestern Nigeria (lat. 7°15'N and long. 5°14'E). It stands at a height of about 137 meters above sea level. Deriving from these location attributes, the city enjoys high humidity - a critical attribute in the management of the largely organic waste

component generated in the city. It has a projected population of over 500,000 (Balogun, 2012) as at 2006. It has many residential districts that keep evolving over time.

The political upgrading influenced the dynamics of the urbanization process, the evolving patterns and its associated problems in Akure. It also influenced the character of urban growth and population redistribution within urban centers of western Nigeria. There are structural peculiarities manifesting in the large presence of peripheral public and private residential estates as well as pronounced environmental problems. This contrasted strongly to the pre-1976 situations of mainly few private quarters and small public housing in the Government Reserved Area (GRAs). Today, trendy architectural renderings distinct from the pre-1965 compound architecture of the core heartland districts are common sights. There are marked changes in the building density and socio-economic housing characteristics across the urban setting. There are changes in residential composition and urban heterogeneity arising from the government staff (workers), their staff quarters, housing estates and the large informal/private housing producers attracted to the city.

The urban land use characteristics are also dynamic. Access to urban basic facilities and city management across these residential districts is not uniform hence, the attendant inequalities in urban health cross the town.

Materials And Methods

Akure the study area has residential quarters, aggregated for the purpose of this study, into 'natural areas'. These are amalgamations of city wards based on neighbourhood structural and morphological attributes, as well as the evolutionary trend across the cityscape. The general criteria used include the age of the buildings, natural rendering of the houses, location attributes and their facilities (socio-technological characteristics). On the strength of the above, the study area was classified into three broad categories. Thereafter, the study conducted a questionnaire exercise on each of these three areas.

The inner heartland: Made up of dominantly old structures predating European colonization. The zone consists of about 27 traditional quarters and wards (Okoko, 2004). By random choice, 14 of these quarters (51.85%) were selected for the questionnaire administration. The quarters selected include Odo lkoyi, Obanla, Igan, Odo Ijoka, Imuagun, Ijomu, Orita Igun, Idi Aagba, Owode, Eru Oba, Isolo, Araromi, Odopetu and Erekefa quarters.

The transition areas: This is an extensive postcolonial development, radiating in all directions and outwards from the city heartland. It is a zone characterized by strong mix of land uses-economic, administrative and residential. From the 10 broad areas in this zone, six quarters were also randomly chosen for the questionnaire exercise. They include Oke Aro Titun, Fanibi Quarters, Oke Ijebu, Okuta Elerinla, Awule Road axis and Upper Araromi/Oluwatosimile area.

The public housing districts: These are housing districts developed by public initiative and noted for their strict compliance with development control ethics. Of the four notable estates in the metropolis, the study sampled three estates namely ljapo Estate Alagbaka /Ala Housing Estate and the Federal Housing Estate.

From the above sample areas, the study employed the systematic sampling techniques to select respondents in the study areas for its socio economic survey. For this, the study did an inventory of streets in the sample areas. Using the inventory, the Table of Random Numbers was used to guide the unambiguous choice of streets. The study aimed at ten percent coverage in each sampled district using a 1:10 sampling frame with replacement. The starting point alone was arbitrarily chosen. In each chosen house, the study interviewed only adults, who ordinarily

should have been resident in the zone for not less than six months and usually the household head.

For the analysis, the study made use of ten significant predictor variables to build three socio economic models predicting the urban health disparity across the city residential districts. The dependent variable in the model is housing assessment. The research analysed the correlation matrix for the town at the disaggregated level. From this, strength of association and the direction of association between the criterion variable (y) in the model and the independent variables were determined in a pair wise fashion across the residential districts. The predictor variables are:

- Roofing materials (RFMAT)
- Type of kitchen (KITTY)
- Management of gaseous waste (GAWAS)
- Mode of refuse disposal (REFUSE)
- Type of building used (BLDG)
- Type of toilet (TLET)
- Age of the house (HSEAGE)
- Type of domestic water supply (DOMWAT)
- Wall materials (WALMAT)
- Management of household waste water (WASWAT)

This study presents the double - log models as against the linear models with these models owing to the following:

- Given a perfect fit, the explanatory powers of the $\mathbf{r^2}$ are enhanced
- There is the possibility of presenting regression coefficients directly as elasticity estimates and
- The models enhance homescedasticity - errors having been distributed over the estimate parameters.

The general form of the equation used is:

$y = a + b_1x_1 + b_2x_2 \ldots b_nx_n + e$ ……..……(1)

This in the double log format transposes to:

$\text{In } y = a + b_1 1nx_1 + b_2 lnx_2 \ldots b_n l_n x_n + e$ …… (2)

Where $b_i - b_n = 1 \ldots 10$ are the parameters to be estimated

X_i-X_n = the independent variables (predictors) as highlight above

y = the dependent variable - housing assessment.

Results and Discussion

Urban health modeling for the Core area: Out of ten (10) predictor variables fed into the city heartland model, only five had significant relationship with the dependent variable in this residential district. These variables are: BLDG, WASWAT, HSAGE, REFUSE and KITTY – at the 0.05 level of significance (= 0.05) and in that order of importance. These were strongly correlated with the dependent variable – Housing Assessment.

The urban health assessment model developed for the district is given as:

In y = - 0.044 + 0.127 In WASWAT + 0.029 In RFMAT + 0.009 In WALMAT - 0.079 In GAWAS + 0.036 In DOMWAS + 0.166 In KITTY - 0.099 ln TLET + 0.154 In REFUSE

+ 0.441 In BLDG + 0.095 In HSEAGE

$\mathbf{r^2}$ = 0.844 …… (3)

Given this model in equation 3, 84.4% of the anticipated relationship is explained by the independent variable. Empirical highlights of the model reveal that one unit increase across the type of building used in the model will contribute a 0.441 quantum to the assessment of housing situation in the core of Akure town. With a strong correction factor of 0.815, housing across the inner city will improve as the building type improved. It need be recalled that this is a zone with 65% old rooming houses and over 20% of old storey buildings.

The model also predicts that wastewater management is also critical in predicting the assessment of housing in the inner city. It has a Beta coefficient of 0.193 and a correlation value of 0.786. This implies a direct relationship between wastewater management and housing assessment in the core districts. This variable induces a 0.127 unit change in the prediction of housing situation in the core. The model also predicts a strong direction relationship with the dependent variable, with a regression coefficient value of 0.095 in the model, while holding the slope intercept value of 0.044 and regression coefficients of other variables constant.

Other statistically significant variables are mode of refuse disposal (REFUSE) and type of kitchen facility (KITTY) in the model. They have strong correlation values 0.811 and 0.823, respectively with the dependent variable. Mode of refuse disposal is a critical factor as it accounts for city aesthetics or visual offence and health in cities. The type of kitchen is important as most buildings in the core rely on incidental spaces in the yard or in-house corridors for culinary activities. Other variables in model sum up in their contributions to give all round significant F-statistics hence their importance, albeit to lesser degrees.

Urban health modeling for the transition areas: The model here constitutes the LEAD equation as the model accounts for 90.2% of anticipated relationship with the independent variables prescribed. Of the 10 predictor variables fed into the model, (equation 4 below), four variables are in significant relationships with the dependent variable.

In y = - 0.086 + 0.1841nWASWAT - 0.101InGAWAS + 0.006InWALMAT 0.014InRFMAT + 0.254InDOMWAT - 0.0005InREFUSE + 0.116InTLET + 0.706InHSEAGE - 0.I92InBLDG + 0.025InKITTY

$\mathbf{r^2}$ = 0.902 …….... (4)

These are HSEAGE, WASWAT, DOMWAT and GAWAS.

Empirical highlights reveal that HSEAGE given the highest degree of contribution to this relationship with a beta coefficient of 0.751 and an absolute significant t- value. The model predicts that unit increase in this variable given a 0.706 increase in the assessment, while holding the slope intercept value of -0.086 and the regression coefficients of all other variables constant. This conforms to *apriori* expectations as newer housing units are more aesthetic and conform to high order planning and development control standards.

The regression coefficients of other variables WASWAT, DOMWAT and GAWAS can be explained as above. The specific potential effects of improvement schemes on domestic water supply and wastewater management on urban health need be highlighted. The domestic water situation will be enhanced by wider coverage that will bring about water delivery as close as possible to the points of use. This will greatly reduce rate of water borne diseases transmission. This is more so the case as the health enhancement attributes of these variables on urban dwellers as evidenced from literature is confirmed on ground. On the other hand, long queues at few reliable water sources and the long distances covered to procure this essential need will reduce. In this vein too, reliance on heavily polluted wells and other non-conventional sources will reduce.

The model however implicates the gaseous waste management in the transition districts to a magnitude of 10.1% depletion in the dependent variable while holding other variables constant. There is a need to monitor the implementation of development plans as approved in this district. Proposed spaces for culinary activities on building plan are either not so implemented or converted to living spaces thus forcing residents to use spaces within buildings for cooking.

The peripheral public housing districts: The quantitative equation for the double log model for this area is

Ln y = -1.120 + 0.233InWASWAT + 0.005InGAWAS + 1.552lnTLET - 0.016lnWALMAT – 0.077lnRFMAT + 0.287lnDOMWAT + 0.369lnBLDG – 0.093lnHSEAGE – 0.083lnREFUSE - 0.669KITTY

$\mathbf{r^2} = 0.711$ …… (5)

The model has a goodness of fit value (r^2) of 0.711. This implies that 71.1% of the variations in assessment of housing (y) are accounted for by the ten independent variables in the model. The other variables not included in the model account for the remaining explanation. Further details of the model reveal that only three independent variables are in significant relationship with the dependent variable. These are : TLET, WASWAT and DOMWAT. Their other attributes are as presented on Table I below:

Table I: Showing significant parameters in the Periphery model

Beta Regression Correlation
Variables Coefficient coefficient coefficient coefficient Significance
Ln (TLET) 0.679 1.552 0.635 0.0040
Ln (WASWAT) 0.456 0.233 0.532 0.0472
Ln (DOMWAT) 0.141 0.287 0.486 0.0012
Source: computed by author.

The regression equation infers that a unit increase in the variable TLET will generate an increase of 1.552 units in the dependent In y (ASSESSMENT) given that all other effects on the hyperplane and the slope intercept are held constant. The equation 5 and the Table above reveal further that the variable WASWAT is the second highest contributor to the model. This derives from its coefficient of 0.456. Its correlation value with the dependent variable (0.532) is positive, while it has a significant value of 0.0472. Given the regression equation. a unit increase in wastewater management (WASWAT) will generate a 0.233 increment in housing assessment given that all other effects are held constant. The positive correlation with (In y) in equation 5 and the positive correlation of the regression coefficient conform to common reasoning. These yardsticks expectedly improve the assessment of the environment hence the importance to urban health.

The third significant variable - domestic water supply strategy (DOMWAT) has a beta coefficient value of 0.141 and a positive but low correlation coefficient of 0.486 with the dependent variable. Given the model, it has a regression coefficient of 0.287 that as earlier explained implies that, given a 100% change in domestic water supply, the variable will generate 28.7% explanation in the dependent variable. Being a positive attribute, whatever will enhance the domestic water supply situation should be encouraged. Urban management strategies such as non-network portable water schemes and the preservation of surface water sources especially within built up areas need be embraced. This may be in the short run while complex, expensive approaches can be accommodated over time.

Conclusion

The study as presented highlights major factors in the urban health portfolio across residential neighbourhoods in Akure; South West Nigeria. It need be stated that the dynamics of environmental health relationships across the study area typifies what obtains generally in Nigeria albeit, empirical studies of this sort removes the grey areas and help fine tune the directions of policy needs and policy interventions.

A critical start off point for policy intervention is the domestication and effective implementation of all international environmental treaties that are working elsewhere but far from being known or implemented in Nigeria. A case in point is the Belgrade treaty, which emphasizes environmental education at all levels. These will pave way for new environmental behavioral patterns. There is the need therefore for a policy framework that will mandate the Municipal Authorities to organize periodic environmental enlightenment campaigns is in this regard. Apart from this, local legislations should be enforced. To this end, this paper advocates the empowerment of the development control machinery in the Local Planning Authorities in monitoring activities.

Along with the issues discussed above, all the variables fed into the models deserve the attention of policy makers. This arises from the fact that all the $\mathbf{r^2}$ values returned were quite robust. The values are 0.844, 0.902 and 0.711 for the three main districts, respectively. This is important as all the predictor variables accounted for the $\mathbf{r^2}$ values obtained. These also emphasise the fact that in Akure, qualitative housing attributes are still lacking in our towns. Among the significant variables however, it was observed that wastewater management scheme cuts across all the districts. Age of the building was implicated for the core and transition districts while domestic water supply scheme is implicated for both transition and the public housing districts.

The multiplicity of these significant variables across the residential districts and their interactions make environmental health needs especially for the poor a critical need. The multiple variables make room for sectoral management interventions such as will help ‘rejuvenate’ or ‘renew’ the core areas or upgrade newer districts where age of buildings were implicated. This will enhance needed health gains and stem urban epidemiology in Nigerian towns and Third World cities.

Wastewater management as implicated across the town imposes a need for the pursuance of neighbourhood or integrated drainage schemes to channel off these effluents to safe treatment areas or urban agricultural fields for wastewater reuse. Where this is not feasible right away, enforcement of on site treatment facilities as usually provided on Site Plans’ should be done on development proposals. Domestic water supply was implicated in the newer districts. This calls for urgent and deliberate government intervention at expanding conventional urban water coverage. This will ensure delivery as close as possible to points of use, thus maximizing health benefits. Provision of deep wells sited at approved distances away from salga or other liquid waste facilities will be relied upon where conventional water provisions fail or are not sustained. This study posits that this should, as a policy requirement be a mandatory provision in development plans, given the fact that urban water supplies are epileptic in Nigerian cities. On a final note, the study opines that urban health demands the attention of all - both private and public initiatives if the health gains of healthful urban existence is to be derived by all.

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The effect of psychological consultation with a Logotherapy oriented group on social avoidance, anxiety of being criticized and personal worthlessness

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Abstract

The main purpose of this study is to test the effect of psychological consultation with a Logotherapy oriented group on reducing Social Anxiety. The research was performed using an Experimental Method. The research was designed by using Pretest-Posttest Control Group Design of the real experimental designs. Since the study is aimed at determining the cause and effect relationship between the independent variable (Psychological consultation with a Logotherapy oriented group) and dependent variable (Social Anxiety). In this study, Logotherapy is suggested as a new model to be used in the treatment of social phobia rather than being an alternative approach to the ones used in the treatment of social phobia until today. It has been found that psychological consultation practice with a Logotherapy oriented group is effective in reducing Social Anxiety level. Besides, it has also been found that psychological consultation practice with a Logotherapy oriented group is effective in reducing the levels of Social Avoidance, Anxiety of Being Criticized and Feeling of Worthlessness.

Keywords: Logotherapy, Psychological consultation with group, Social Avoidance, Anxiety of Being Criticized, Personal Worthlessness.

1. Introduction

Social Phobia responds well to the treatment. Therefore one must get help before adding new issues to the problem using other handling methods. Medication and psychotherapy methods are applied in the treatment. The medications do not improve the social skills of the individual. That's why, the most effective method during the treatment process is to use medication and psychotherapy together (İnan, 2009). Treatment periods vary from person to person since they are shaped according to the needs of the individual (Sheehan, 1999).

In the treatment of Social Phobia, the first psychological treatment approach whose efficiency was proved was "adaptation treatment". During the adaptation treatments based on the principle of exposure, therapist makes a list of the environments in which the patient shows a behavior of avoidance and tries to make the patient enter the environments hierarchically, from easier to the harder. The aim is to improve the skills of the patient in the social environments and build a feeling of self-confidence showing that the feared results will not come true (Sungur, 2000).

An important study on Social Phobia which was published was carried out by a French Psychiatrist, Paul Hartenberg in 1901. Hartenberg approached to Social Phobia from a cognitive behavioral perspective (Fairbrother, 2002). The results of the study carried out on adolescents by Mercan (2007) proved that "social skill training integrated with Cognitive-Behavioral approach" was effective on reducing the social anxiety of the adolescents and this effect continued at the end of a six-week follow up study. Feeney (2004) set forth that there was an important recession in the rate of showing phobic indications of the individual in his Social Phobia treatment performed with Cognitive Behavioral therapy consisting of 31 sessions. After the sessions, the level of participation in social life of the individual increased considerably. According to the findings of a research by Aydın (2006) in which the efficiency of a cognitive behavioral intervention program for reducing the indications of social anxiety in the adolescents was evaluated, the levels of social anxiety and cognitive error were significantly reduced in the experimental group compared to the control group.

In a study aimed for testing the efficiency of cognitive behavioral group therapy in socially concerned Chinese people living in Hong Kong, experimental and control groups were designated in such a way that they had similar characteristics of experimental group. Findings showed that there was a significant decrease in the social anxiety and negative emotions of the individuals receiving cognitive behavioral group therapy (Wong & Sun, 2005).

In a research in which cognitive behavioral therapy and phenelzine were applied, it was seen that the effect of phenelzine started earlier than cognitive behavioral therapy. However, when the cognitive behavioral therapy receiving group and on-medication group were compared six months later, it was seen that Social Phobia relapsed by 50% in the group treated with phenelzine and yet there was no indication of relapsing in the patients receiving cognitive behavioral therapy (Baldwin, 2000).

In the study by Yıldırım (2006) testing the efficiency of brief-intense-emergency psychotherapy in Social Phobic university students, when the pretest and posttest point averages of six subject who were given psychotherapy were taken into consideration, the program was found effective in reducing the high anxiety levels, fear and anxiety levels related to social situations and high point values in terms of areas of avoidance from anxiety situations, and this effect was also verified with follow-up test results.

Individuals with Social Phobia start feeling intense fear and anxiety before they enter the environment; because, unplanned thoughts occur suddenly and without recognition to the person. The individual accept unplanned thoughts as true without questioning whether they are

true or not. He/She improves some methods not to experience these thoughts. As a result, it turns out to be a vicious circle. As the avoidance behaviors increase, fears also do. They alienate from environments further as they fear more. As a result, their performance decreases more and more consequently their fears come true (İnan, 2009). The basic way to get out of this vicious circle is that the individual faces the thing that he/she fears. Since the Logotherapy is based on this understanding, in other words the individual needs to experience what he/she is afraid of, but not to escape from or avoid it; it is thought to have a permanent effect on the treatment of social phobia in a short time. The supporting research findings have been provided below:

In a therapy performed by Frankl, a patience having depressive characteristics with Anxiety, phobic conditions, obsession and compulsion made the following comment about the process after the experienced recuperation as a result of the sessions performed once in every two weeks for six months: "If I need to summarize what I have gained, (1) Confidence; (2) Skill to apply the paradoxical intention in various situations; (3) To accept my Neuroses instead of fighting them; (4) The changes in my attitude towards my symptoms: I can laugh at them now; (5) Changes in my wife: changes after applying the technique to herself while helping me during the process; (6) To be able to talk about my symptoms: my previous therapists would get angry with me when I talked about my symptoms, they only would want me to talk about my past all the time; (7) To see that the situations I am afraid or ashamed of most are normal; (8) I cured myself and learned to use Paradoxical intention whenever I needed. I did not become addicted to my doctor like the previous ones; it is not a fatal reason for me if an appointment is cancelled by my doctor." (Gerz, 1961). An intermittent, continuous and integrated psychotherapy program was suggested by Bartos (1995) in the treatment of Borderline Personality Disorder. This model consists of psychoanalytic perspective as a means to understand the disorder, cognitive behavioral techniques as a means of treatment and Logotherapy which is an existential psychotherapy method used as a connective power in the connection of three components. The clients make mistakes now and continue to make just like all humans. But they can face their mistakes, accept their responsibilities, learn from their mistakes and fix them, look for ways to avoid mistakes in the future and go on with their lives.

Logotherapy and Cognitive-Behavioral Therapy were integrated and a residential treatment program was conducted for the War Veterans with Post-traumatic Stress Disorder. Program was completed in 60 days, Veterans, in their answers, stated that they spent more time with their families and less time alone and they actively looked for the feeling of meaning and aim in their life. The Veterans also accepted that they had the responsibility to make positive changes in their lives (Wasan, 2000).

In 2007, Somov designed a therapy program for the prisoners using drugs in Pennsylvania prison. This program aimed to trigger the internal dialog between the introvert patient and himself rather than personal dialog oriented process between the patients. Sentences cited from the group bulletin set forth the efficiency of the experience: prisoner M.H. "What is the meaning of my life? To be close to a drug dealer. Today I reviewed my notes and realized there are lots of meanings of my life. I do not have to be a slave to anything any more; actually I realized I never had to. Where I am is my choice."

In 1999, Ungar argued that Logotherapy could be applied in neurosis types which derive from existential frustration, inner emptiness, psychological complexes and traumas of the past, but that are resulting from present dilemmas of the values and conscience.

In the study by Cho (2008), examining the effect of a group life in which a logo-autobiography program was applied on the meaning of life and mental health in the spouses of the alcoholics, designated an experimental group and a control group; and Logotherapy

oriented approach was applied in the experimental group, but not in the control group. As a result of the study, it was found that meaning scores of the individuals in the experimental group were higher and depression, somatization, interpersonal sensibility and anger scores were lower than the ones in the control group.

Schultze and Miller (2004) considered that using Logotherapy, professional life guidance in a society where people from different nationalities live, could help the individuals with different world views in their search of meaning. The search for meaning in the life of individual is key to the career development works. The consultants will help individuals to see that they have the spirit and source of the power provided by the spirit through discussion the existence of the human spirit.

Various aid models were developed and applied in the treatment of social phobia. In this study, Logotherapy is suggested as a new model to be used in the treatment of social phobia rather than being an alternative approach to the ones used in the treatment of social phobia until today. No approach may be adequate alone in the treatment of social phobia. The deficiency of an approach may be the superiority of another. In this context, using more than one approach with an eclectic understanding rather than using only one will enable to obtain more functional results in the treatment of social phobia. Logotherapy is considered as a functional method to be used within this eclectic approach in the treatment of social phobia. This study was carried out with the aim to determine whether Logotherapy is an efficient method to be used in the treatment of social phobia or not.

2. Method

2.1. Research Design

The research was performed using an Experimental Method. Experiment is the method to define the cause and effect relationship using the rules and instructions by minimizing the possibilities of error, prejudice and coincidence (Plotnik, 2009). The main purpose in experimental designs is to test the cause and effect relationship generated between variables. To achieve this purpose, the researcher needs to make a random assigning to treatment groups which are the levels of the variable, manipulate the independent variable and control the exogenous variables (Büyüköztürk et al., 2008). By taking these characteristics of experimental method into consideration, it can be said that experimental method has two basic superiorities over the other methods. One of these superiorities is that it enables to reveal the relationship between cause and effect. The second one is that it can be controlled. In other words, it is possible to control the variables other than the independent variable which may have an effect on the dependent variable addressed in the research.

The research was designed by using Pretest-Posttest Control Group Design of the real experimental designs. This design is one of the most commonly used experimental designs in education and psychology. In this design, firstly two groups are composed with random assigning from the predetermined subject pool. The groups are determined in a random way so that one is experimental and the other is control group. Then the subjects in both groups are measured concerning the dependent variable before the practice. During the practice, while the experimental treatment is given to the experimental group, it is not given to the control group. Lastly, measurements of the subjects in the groups concerning the dependent variable are obtained using the same instrument or spouse form (Büyüköztürk et al., 2008). Design is;

R G1 T1 G2
R G3 T2 G4

what the initials stand for are as follows; G1: Experimental Group Pretest, T1: Treatment (Psychological consultation practice with a Logotherapy oriented group), G2: Experimental Group Posttest, G3: Control Group Pretest (Placebo Practice), T2: Treatment (Guidance study aimed at Social Phobia); G4: Control Group Posttest. R shows that the subjects are randomly assigned to the groups. The elements in the experimental and control groups are formed in an unbiased way so that they are equal to each other (Yolcu, 2009). In the research, Logotherapy oriented Group Experience is taken as independent variable and Social Anxiety as dependent variable.

2.2. Data Collecting Instruments

2.2.1. Personal Information Form: Name-Surname, department, class level, gender, perceived socio-economic level, perceived academic success level and questions related to collecting information on how successful the individual sees himself/herself in life are included in the form.

2.2.2. Social Anxiety Scale (SAS): The scale was developed by Özbay and Palancı (2001) to determine the issues with "social anxiety" experienced by university students. The scale, which was designed to have a practicability for the university student population, is organized in a structure to measure the skills appropriate for social situations and anxiety which may occur in these situations. Test was subjected to criterion and structure validity. For criterion validity, five related scales of SCL-90 scale, Rathus assertiveness schedule and Social introversion subtest of MMPI test were used. A three-factor test structure of 30 items was formed as a result of factor analysis for structure validity. Factor analysis was performed with SPSS FACTOR (SPSS 10.0/WINDOWS). In the factor analysis performed, factorability was reviewed using various methods. Firstly, all correlation matrices among all items were reviewed and compliance was sought. Paradigm compliance and Sphericity tests were carried out. It was found significant with KMO paradigm compliance coefficient as .90 and Barlett Sphericity as 3644.58 at the level of $p<.001$. In the first factor analysis, maximum significant factor number was reviewed by using a circular method with the method of graphicing eigenvalues of factor analysis that are bigger than one. It was determined that the compliant and explainable factor number was three. These three factors obtained with varimax rotation factor analysis were (1) Social avoidance, (2) Anxiety of being criticized and (3) Feeling of individual worthlessness. Total variant explained by three factors is 32.9%.

i. *Social Avoidance:* This factor includes various situations and symptoms that can be addressed in the context of social anxiety such as avoiding social relations, unwillingness to communicate, social interaction anxiety, difficulty to speak, blending into the crowd, experiencing authority anxiety, issues of being seen and observed. The factor which explains the 22.3 of the total variant consists of 12 items.
ii. *Anxiety of Being Criticized:* This factor, which consists of anxiety such as excessiveness of efforts to control himself/herself, being afraid of making mistakes, anxiety of being humiliated and rejected, explains the 6.2 of the total variant.
iii. *Feeling of Individual Worthlessness:* This factor, which reflects the emotions and states such as feeling insignificant, not being satisfied with himself/herself, not getting help from others, identity of failure, not accepting any criticism and personal characteristics, explains 4.4 of the variant.

It was seen that there are positive linear relations that are suitable for theoretic explanations at the level of $r=.43$, $p<001$ with MMPI Si subtest, $r=.51$, $p<.001$ with sensibility in interpersonal relations subtest of SCL subtests, $r=.25$, $p<.01$ with concern test, $r=.36$, $p<.001$

with phobic anxiety subtest, r=.40, p<.001 with depression subtest all of which are used for criterion validity of the test.

Practicableness of compliance for distribution was analyzed with reliability calculations. As a result of the variant analysis, result at the level of F=68.58, p<.001 was found significant. Cronbah Alpha value which is calculated with in-test consistency method for reliability calculations was .89. Test likert type has a 5-point rating system between 0-4. Increasing of the scores obtained indicates that the Social Anxiety level also increases (Palancı& Özbay, 2001).

2.3. Data Analysis Techniques

The data obtained in the study were analyzed using a ready statistical package program. Data analysis techniques and reasons for using these techniques are given below:

2.3.1 Data Analysis Methods Reason

t test in independent groups: It is a parametric technique used to compare the meaningfulness of the difference between the averages obtained from two different independent paradigm groups (Köklü et al., 2007; Büyüköztürk, 2010). In the pretest-posttest comparisons of the averages of Experimental and Control groups, t test was used in Independent groups.

t test in dependent groups: It is a parametric technique used to compare the meaningfulness of the difference between the averages of two paradigms obtained from two-relationship paradigm. When each point in a paradigm is matched to a point in the other paradigm, two paradigms are related (Köklü et al., 2007). It is used in two related measurements or experimental or scanning studies where the points are obtained (Büyüköztürk, 2010). In dependent groups, t test is used in the pretest-posttest comparisons of the averages of experimental group points and pretest-posttest comparisons of the averages of control group points.

3. Findings

Table1. Point average and standard deviation value of fear of negative evaluation, social avoidance, being criticized and individual worthlessness

	Groups	Mean	Std. Deviation	N
PRETEST	Exp_fearofNE	43,7500	4,71320	8
	Exp_SocAvoid	2,7396	,27973	8
	Exp_beingcritic	2,6375	,46272	8
	Exp_indworth	2,4063	,35826	8
	Cont_fearofNE	42,0000	6,14120	8
	Cont _SocAvoid	2,8542	,60216	8
	Cont _beingcritic	2,7375	,42741	8
	Cont _indworth	2,2031	,79882	8
	Total	12,6660	17,77898	64
POSTTEST	Exp_fearofNE	29,0000	2,82843	8
	Exp_SocAvoid	,5625	,28781	8
	Exp_beingcritic	,9625	,48972	8
	Exp_indworth	,5156	,44540	8
	Cont_fearofNE	29,5000	3,58569	8
	Cont _SocAvoid	1,1146	,61711	8
	Cont _beingcritic	1,1000	,48697	8
	Cont _indworth	,7344	,34355	8
	Total	7,9362	12,50389	64

Experimental and control groups' pretest- posttest point average and standard deviation value regarding fear of negative evaluation, social avoidance, being criticized and individual worthlessness is examined on table 1.

Table2. ANOVA results of pretest-posttest point average regarding fear of negative evaluation, social avoidance, being criticized and individual worthlessness

Source	Sum of Squares	df	Mean Square	F	P
Intercept	28665,44	63			
Groups (individual/Group)	28322,84	7	4046,63	661,34	,000
Error	342,60	56	6,11		
Tests of Within-Subjects Effect	1814,09	64			
Measurement (Pretest/posttest)	715,87	1	1	715,87	165,03 ,000
Group* Measurement	**855,31**	**7**	**122,18**	**28,16**	**,000**
Error	242,91	56	4,33		
Total	30479,53	127			

According to results significant differences had been found before and after experiment in fear of negative evaluation, social avoidance, being criticized and individual worthlessness scores of individuals who participated experimental and control groups. In other words, common effects of being in different treatment group and repeated measures factors on fear of negative evaluation, social avoidance, being criticized and individual worthlessness is significant (F(7-56) = 28,16, P<,001).

The finding indicates that participation in experimental group which applied Logotherapy oriented group counseling and control group which applied placebo application has different effects on situations of fear of negative evaluation, social avoidance, being criticized and individual worthlessness. Logotherapy oriented group counseling makes positive progress about fear of negative evaluation, social avoidance, being criticized and individual worthlessness in comparison with before experiment and control group. This result shows that Logotherapy oriented group counseling is effective about coping with fear of negative evaluation, social avoidance, being criticized and individual worthlessness situations.

4. Conclusion and Discussion

It could be stated that Psychological consultation with a logotherapy oriented group is efficient in reducing Social Avoidance level. The social escape-avoidance behaviors of the individuals expressed in sentences such as “I avoid from catching someone’s eye while talking”, “There is nothing worse than being humiliated”, “I postpone lots of behaviors with the anxiety of making mistakes”, “I have difficulty in talking in front of my class”, “I escape from asking things I do not understand to others”, “I do not talk in front of a crowd even in a subject I am familiar with” changed in a way to increase the social functionality of the individual after the psychological consultation practice with a Logotherapy oriented group. The reason behind this can be explained with the paradoxical intention, one of the basic techniques in Logotherapy method. Logotherapy empowers clients by connecting them with strong inner resources in the face of adversity; this involves a considerable cognitive shift for clients, who may perceive themselves as powerless, ineffectual, or victims (Hutchinson& Chapman, 2006). The procedure in paradoxical intention consists of reversing the attitude of the patient to the extent that a contradictory desire is placed instead of fear. When this technique of the Logotherapy is used, the ability of the individual to withdraw from himself/herself is fulfilled. At the same time the patient is enabled to distance himself/herself from his/her neurosis (Frankl, 2009). The basic philosophy of this technique is that the individual risks facing the most negative situation he/she fears. In 2002, Ascher stated that the role of the Paradoxical intention on the excessive form of the Social Phobia is to help to increase the desired performance of the individual by preventing the goal of staying calm of the individuals who are experiencing the excessive form of the Social Phobia. By doing so, the patients are manipulated to enter the situations where they experience recurrent anxiety, focus on the outstanding aspect of the sympathetic disorder and attempt to extend this process. After that, the individuals are instructed to stay in the situation until they gain calmness. Therefore, the individual, who is afraid to blush in front of others, is asked to participate in lots of discomforting situations such as “try to blush as the red of the traffic light. Go red so much that the other people turn their heads not to be blind.” In the psychological consultation practice with a logotherapy oriented group, the individuals are given an opportunity to face the situations they react with an escape-avoidance behavior before the practice. When considered with the thought “Truth heals”, a great reduce was observed in the avoidance behavior of the individuals in social environments as a result of testing and seeing the reality by experiencing it.

Psychologic consultation with a logotherapy oriented group is efficient in reducing Anxiety of Being Criticized level. If messages with wrong contents coming from the environment (such as “It is better to hold your tongue than talking in a subject you are not familiar with and being disgraced.”, “If you want others to respect you, you should have a good appearance.”, “In this hostile world, you always have to be careful not to give people something to make fun of.”) are perceived as important facts and behaviors are manipulated in accordance with these beliefs, social anxiety may be triggered (Gümüş, 2006). Before a psychological consultation practice with a Logotherapy oriented group, uncertainties of the individuals in situations such as “I always check myself not to make any mistake”, “I blush when I talk to someone”, “I can not do anything while I am being stared at”, “I should not make any mistakes to be accepted by people”, “I care not to make mistakes while I am talking”, “While doing something in a crowded environment, I think people are staring at me”, “I always fear to be misunderstood”, “I fear to be criticized by other people” were reduced after psychological consultation practice with a Logotherapy group. The reason is that the individuals clearly realize how intention turns into a focus of thought and how it effects emotions and intentions during a psychological consultation practice with a Logotherapy oriented group. This realization enables the individuals to focus on their strong aspects instead of focusing on the purpose. In other words, the individual evaluates himself/herself taking all factors into consideration in the process instead of evaluating by associating himself/herself only with the purpose. The purpose of dereflection technique of Logotherapy is to help the patient see creative and experimental values which go beyond their weak aspects and allow them to move in line with these values (Lukas, 1986; Wong, 2002). Before the psychological consultation practice with a logotherapy oriented group, the individual himself/herself makes the evaluation that he/she thinks others may do and behaves in accordance with the this evaluation. In other words, individual realizes this: Others' evaluations concerning himself/herself are the evaluations of him/her concerning himself/herself. This realization changes the focus of thought and, this change of focus contributes to the process of testing the truth.

Psychological consultation with a logotherapy oriented group increases the appreciation of individual’s self functionally. After the psychological consultation practice with a logotherapy oriented group, the thoughts and emotions of the individual such as “I do not think I have an admirable aspect”, “I am not generally content with my physical appearance”, "I care to behave in a way the others may like me”, “Being rejected means being humiliated for me”, "I think I am no good” change in a way that facilitates adopting into the academic social life efficiently. For instance, participants with a thought “I think I am no good" and related feelings perceptibly realized that this is an over-generalized thought and they have succeeded things in life which they did not consider as success before (such as getting into university) and this changed the thought that they are no good. It is a result of dereflection and paradoxical intention techniques which are commonly applied in psychological consultation practice with a Logotherapy oriented group and also method of modification of attitudes. With the method of modification of attitudes, the individual is manipulated to realize his/her strong aspects (Marshall, 2009). It was observed that the participants took the aspects they thought as negative about themselves and attributed value to both themselves and their lives. That is to say, they always focused on the aim they wanted to achieve, but the sources they took as reference were always negative thoughts and emotions. In 1980, Lamb worked with a 19-years-old student, who was afraid of fainting, in a study in which he tested paradoxical intention. Lamb encouraged the student to be excited and face what she was afraid of. When the student tried to do what she feared, she realized she could not, could complete her exams without getting

excited. Also an improvement was observed in her attitude concerning the situation she experienced. As a result of the psychological consultation practice with a logotherapy oriented group, participants realized their positive characteristics which they had and helped them achieve the desired goal, rather than the goal itself. They tested how functional the characteristics which they realized were in the process of achieving the goal with paradoxical intention practices.

The following suggestions can be made in line with the findings obtained as a result of the research:

1- Psychological consultation practice with a logotherapy oriented group is effective on social phobia in a short time. In this context, the individuals suffering from social phobias should be helped with short therapy sessions using this technique.
2- Psychological consultation practice with a logotherapy oriented group is effective on social avoidance in a short time. In this context, individuals experiencing difficulty in participating social environments during such times when social life gains importance should be helped.
3- Psychological consultation practice with a logotherapy oriented group is effective on anxiety of being criticized in a short time. In this context the individuals experiencing anxiety of being criticized should be helped with short therapy sessions by making them realize their strong aspects with the method of shaping attitudes.
4- Psychological consultation practice with a logotherapy oriented group is effective on feeling of worthlessness in a short time. Since the value attributed by the person to himself/herself determines the life style, this item is of great importance. In this context, the individuals with a feeling of worthlessness should be helped to find a meaning in their lives and realize their own values by aiding them in their search for meaning.
5- Undergraduate students of Psychological Counseling and Guidance program must be gained cognitive competence and behavioral skills to apply consultation practice with Logotherapy oriented individuals and groups.
6- Researches concerning the efficiency of consultation practice with a logotherapy oriented individual and consultation practice with a logotherapy oriented group on the treatment other anxiety disorders can be carried out.

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Study of Absorption-Ability of *Aspergillus flavus* (Biomass) of Heavy Metals

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Abstract

The ability of the fungi *Aspergillus flavus* as a biosorbent to remove Lead and Copper ions in single and binary solutions was investigated. *Aspergillus flavus* was cultured in potato dextrose broth in an incubator at 150 rpm, 30 ^{o}C for 5 days. The cell biomass was washed several times with distilled water and then dried in a conventional hot air oven at 70 ^{o}C for 24 hours. A known weight of dried biomass was combined with 100 ml metal solution of lead, copper and mixture of both at different concentrations in 250 ml conical flasks. Sampling was drawn after 24 hours for each experiment. After centrifugation of the supernatant at 300 rpm for 15 mins, the concentration of the metal ions in the supernatant was determined using Atomic Absorption Spectrophotometer (Perkin Elmer analyst 300). The biosorption capacity was calculated at the various concentration of the metal solution in single and binary systems for 24 hours while other physicochemical parameters such as pH, biomass concentration and temperature remained constant. The results obtained showed a general increase in biosorption capacity with increase in the concentration of metal ions. The biosorption capacity on the Lead ions was found to be 3899 mg/g (mg of metal/g of biosorbent), at the concentration of 4 g/l of lead ions, while that of copper was 3736 mg/g of Cu^{2+} ions absorbed at 4 g/l of copper ions. In the binary system, the absorption capacity for Cu^{2+} ions was 3250 mg/g and that of Pb^{2+} ions was 2080 mg/g at a concentration of 4 g/l of both ions. The results for the binary system suggested that the copper ions got more absorbed than the lead ions but was still less than in the single system which may indicate that the metal ions competed for the same binding sites thus leading to the reduction in the uptake capacity.

Keywords: Aspergillus flavus, biosorption, heavy metals, Lead, Copper

Introduction

Water bodies such as Lakes, Rivers and Oceans are constantly overwhelmed with many toxic contaminants. Heavy metals are the major inorganic contaminants present in effluents from industries such as mining, electroplating, battery, refineries, and so on. The presence of metal ions in final industrial effluents is extremely undesirable, as they are toxic to both lower and higher organisms.

Heavy metals released into the environment by industrial activities are non-biodegradable, and so tend to persist indefinitely, circulating and eventually accumulating throughout the food chain, becoming a serious threat to the environment (Volesky and Holan, 1995). Waste water from industries such as electroplating, plastic and paint industries and the battery making industries, contain heavy metals such as lead and copper, which when discharged into water bodies pose a serious threat to aquatic life. Existing technologies such as chemical precipitation, chemical oxidation or reduction, electrochemical treatment, evaporative recovery, filtration, ion exchange, and membrane technologies, for heavy metals removal from waters and wastewaters are often ineffective (especially at environmental levels), and they are expensive and unavailable in developing countries (Opeolu *et al*., 2010). A higher percentage of these pollutants are therefore being released into aquatic ecosystems by manufacturing facilities in Nigeria, and the need to find alternative, inexpensive and effective methods for heavy metals abatement from waters becomes inevitable. Biosorption is an emerging field in this regard and has great potentials for application in developing economies (Opeolu *et al*., 2010).

Biosorption is simply the passive uptake of toxicants by dead or inactive cells of microorganisms/plants, as a metabolically passive process, it requires no energy. Most studies of biosorption for metal removal have involved the use of either laboratory-grown microorganism or indigenous microorganisms isolated from the waste water to be treated (Tsezos and Volesky, 1981). Many aquatic microorganisms, such as bacteria, yeast and algae can take up dissolved metals from their surroundings onto their bodies and can be used for removing heavy metal ions successfully (Asku et al., 1991).

The phenomenon of heavy metal biosorption is not based on a single mechanism, it is a complex process which involves several mechanisms that differ quantitatively and qualitatively according to the biosorbent types, its origin and it's processing. Possible biosorption mechanisms are physical-sorption, chemisorptions, ion-exchange, complexation, coordination, chelation, micro-precipitation and entrapment of metal ions in inter or intra-fibrillar capillaries and spaces of the structural polysaccharide networks of the biosorbents. In general, all types of biomaterials have shown good biosorption capacities towards all types of metal ions. Important fungal biosorbents include Aspergillus species (Kapoor and Viraraghavan, 1997; Binupriya et al., 2006), Rhizopus species (Bai and Abraham, 2002), and Penicillium species (Niu et al., 1993). Because of the absence of rational method for prediction of the biosorption potential of a microorganism, the only method for identifying and developing newer and efficient biosorbents is the sustained screening of microbes (Muraleedharan et al. 1995).

Accordingly, this study aims at isolating an indigenous fungus, from heavy metal contaminated soil and testing the potency of this organism in adsorbing heavy metals from a stock solution.

Material and Method

This section outline the materials and Equipment used in carrying out the experiment.

The experiment could be divided into two parts. The first part is the fungus isolation and biosorbent preparation and the second part is the biosorption experiments. The Potato Dextrose Agar medium composed of (gl^{-1}) potato (5.0), dextrose (20.0), agar (13.0), and chloramphenicol (0.1). While the Potato Dextrose broth, PDB was prepared from this composition Irish Potatoes (200 g) and glucose D (20 g). The organism was isolated from soil sample by standard method of isolation, and colonies formed the isolated were identified as *Aspergillus flavus* based on its colour (green) and microscopic observation.

The isolated Aspergillus flavus was further transferred to fresh PDA and grown for another three days, to ensure that the organism was in its exponential growth phase. The organism was further transferred to 1000 ml of Potato dextrose broth (PDB). The inoculated flask was agitated on a shaker at 150 rpm and 30 ^{0}C for 5 days, to increase the quantity of the biomass. After 5 days, the cell biomass was harvested from the culture broth by filtration using a 110µm filter paper. The residue was washed with generous amount of distilled water and dried/inactivated in a conventional hot air oven at 70 ^{0}C for 24 hrs ready for the Biosorbent experiment.

Analytical grades, Lead nitrate ($PbNO_3$) and Copper sulphate ($CuSO_4$) were dissolved in distilled water to get metal concentrations of 1, 2, 3, and 4 g/L for each metal. The binary metal solution was prepared by mixing equimolar amounts of the various concentrations of both metal salts in a conical flask, to obtain the same concentrations as the single metal solutions. The pH of the solutions was adjusted accordingly using dilute HCl.

Biosorption experiments were conducted to investigate biosorption capacity of the dead Aspergillus flavus biomass in various metal concentrations. The same weight of biomass was combined with 100 ml metal solution of lead, copper and mixture in different conical flasks and incubated on a shaker at 125 rpm with the temperature being maintained at 30 ^{0}C for 24 hrs. Sampling was done after 24 hr for each concentration of the single metals and the mixture. The supernatant with free residual metal was obtained by centrifugation at 3000 rpm for 15 minutes. The concentration of metal in the supernatant was determined using an Atomic absorption spectrophotometer, Perkin Elmer analyst 300.

Data Evaluation

The biosorption capacity was calculated as follows:

$$Q = \frac{v(Ci - Cf)}{m}$$

Q is the metal uptake (mg metal per g biosorbent), *v* the liquid sample volume (ml), *Ci* is the initial concentration of the metal in the solution (mg/L), *Cf* is the final (equilibrium) concentration of the metal in the solution (mg/L) and *m* the amount of the added biosorbent on the dry basis (mg).

Results and Discussion

The percentage removal of the metal ions in single metal systems by the *Aspergillus flavus* biosorbent is shown in Figure 1. It was observed that there was a gradual increase in the percentage removal of metal ions present in the synthetic wastewater with increase in metal ion concentration. From the result of the biosorption experiment, Pb^{2+} ions had the highest percent removal of 96.63% at a metal concentration of 3g/L. Above this concentration, the percent removal decreased. This could be as a result of the saturation of the binding sites on the

biosorbent .The biosorption capacity was 2899mg/g at an initial Lead concentration of 3000mg/L , biomass of 0.1g, temperature of 30^0C and at pH of 4.0 as shown in Figure 2.

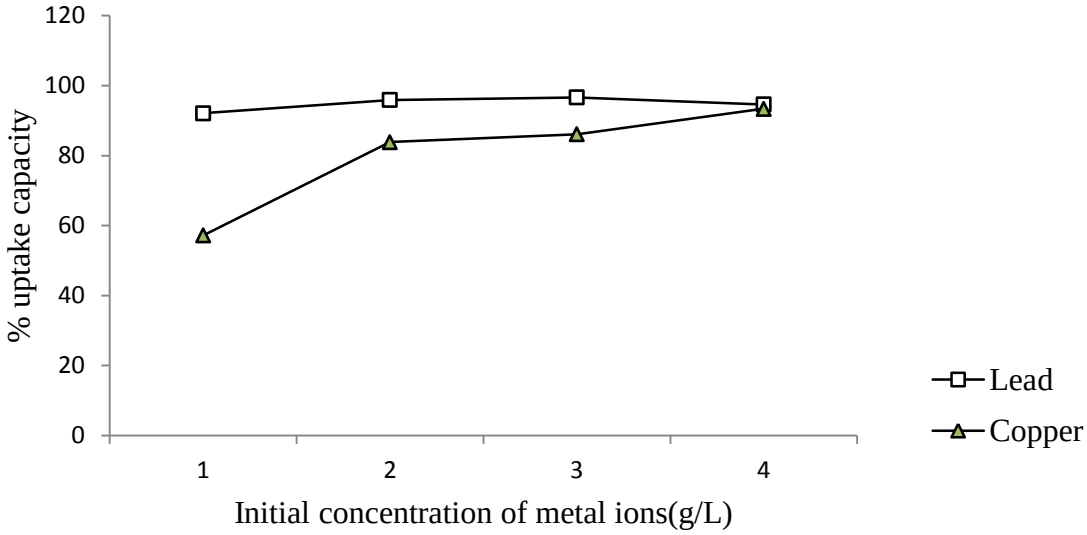

Figure 1: Variation of % uptake capacity of biomass with initial concentration of metal ions for the single metal systems

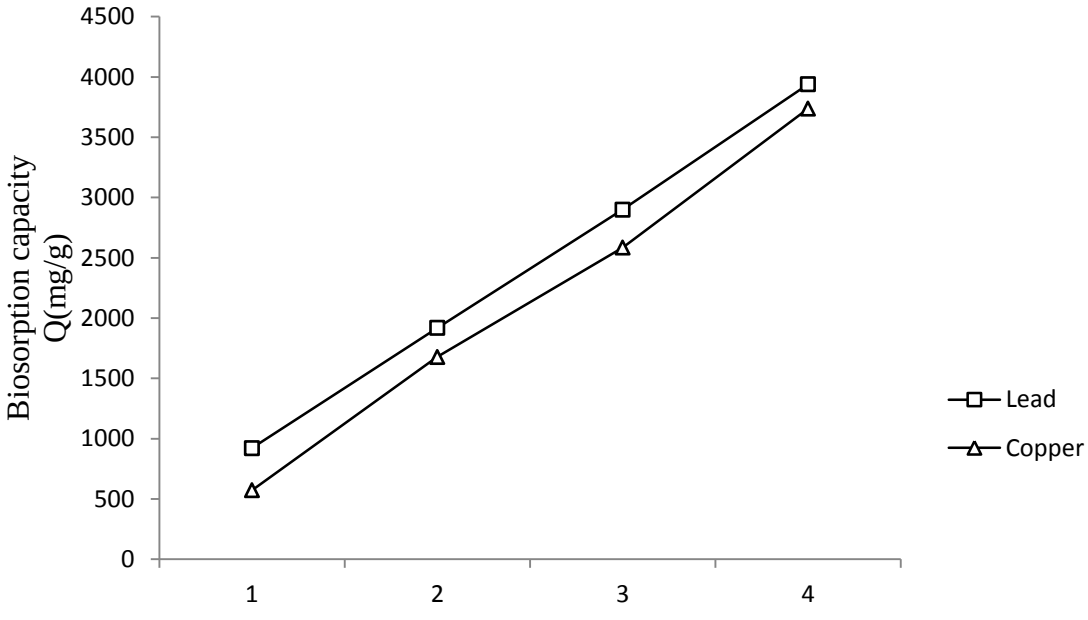

Figure 2: Variation of biosorption capacity with initial metal concentration in the single metal systems

For the Copper solution, percent uptake increased progressively from 57.2%-93.4% for the range of concentration considered as shown in Figure 1. This suggests that there were still available binding sites for the copper ions, and the biomass is yet to be saturated. The biosorption capacity was 3736mg/g at an initial Copper concentration of 4000mg/L, constant mass of biomass and pH as shown in Figure 2.

The biosorption in the binary metal system presented a slightly different scenario. In the binary mixture as shown in Figure 3, it was observed that at a low concentration, the biosorbent favoured the uptake of Lead. As the concentration was increased, the equilibrium shifted to favour the uptake of Copper. This is as a result of the ions competing for the available binding sites on the biosorbent surface as suggested in dual metal systems (Kok et al, 2001). The results shows that the uptake of lead was reduced by the presence of competing Copper ions, as can be seen from the case of the single Lead solution.

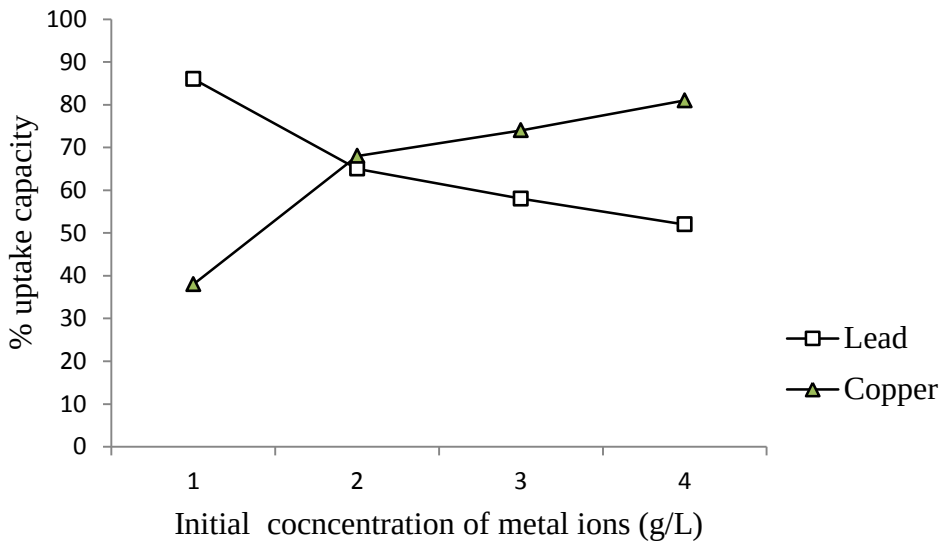

Figure 3: Variation of % uptake capacity with with initial concentration of metal in the binary metal system

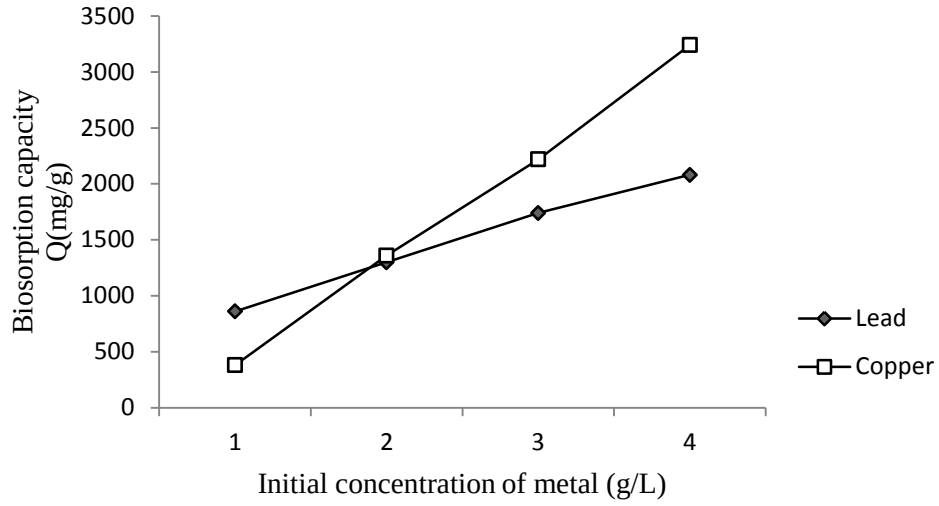

Figure 4: Variation of Biosorption capacity with initial concentrations of metal in the binary metal system

The biosorption favoured the copper metal than the lead in the binary metal system as depicted in Figure 4. The maximum capacity with lead was 1850mg/g while that of the copper was 3250mg/g.

Conclusion

The removal of metal ions in synthetic wastewater by using biosorption technology was studied. Based on the results, the following conclusions can be drawn. The dead biomass of *Aspergillus flavus* was very effective in removal of Copper and Lead ions from the synthetic waste water. A very small quantity of this biomass, about 0.1g was sufficient to remove a large amount of metal ions in solution. The Fungus *Aspergillus flavus* was found to be an efficient biomaterial for removal of some heavy metals from industrial wastewater. The percent removal of Copper ions was 93.4% with an effective dose of 0.1 g of biosorbent (*Aspergillus flavus*) and 96.63% for Lead ions with the same mass of biosorbent.

In the binary system, the presence of copper ions appeared to reduce the biosorption capacity of lead ions.

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Women Participation in Formal and Traditional Governance in Ghana: Overcoming the Obstacles

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Abstract

Mainstreaming women through gender specific policies is an acknowledged precondition for achieving meaningful development in any developing country such as Ghana. Regrettably, it is only recently that issues of women participation have been recognized as such in the context of policy reforms in both administrative and local government arenas in Ghana In the context of governance, women's concerns had surfaced intermittently and have merely been highlighted in political party manifestoes and agenda. Most areas of Ghana are rural and lack essential services. And considering their role in rural community development, the state of women's participation in the governance process is crucial and deserves special attention if development is to be delivered in a more sustainable and efficient manner. To do this effectively, the obstacles to women participation must be unveiled and eliminated to overcome some of the challenges in rural development delivery. The paper examines the level of female participation and the challenges they face in the governance processes in Ghana. To do this, questionnaires were administered to some elected and appointed women in government, women in traditional positions were interviewed and some interviews and focus group discussions were also conducted. The study established that there are serious challenges in gender balancing both in terms of formal and traditional governance policy and reform agenda in Ghana. Consequently, female representation in both formal and traditional governance systems has been very minimal. The study concludes that, in order to support and accelerate the rural development process through formal and traditional governance, additional strategies have to be employed, which promote the self-reliance of women (economically as well as socially), build women's capacities and remove structural obstacles.

Key words: Traditional Governance, Formal Governance, Participation, Women, Obstacles

1. Introduction

Since independence, Ghana has carried out various transformational efforts to decentralise political and administrative authority from the centre to the local level. The latest and most comprehensive effort began in 1988 through the introduction of the New Local Government System. By this, extensive powers and competencies were transferred to districts and one hundred and ten (110) district assemblies were created as legislative, executive, planning and rating authorities.

The local government effort was undertaken having in mind certain key aspirations including the following:

- to provide more responsive, equitable and participatory development;
- to bring government and decision-making nearer to the people and quicken the processes;
- and to serve as a training ground in political activity.

The structure of the new local government system as practised in the Fourth Republic is made up of a Regional Coordinating Council and a four-tier Metropolitan and three-tier Municipal/District Assembly system. Under Article 241 (1) of the Constitution, it is stated that, "for the purposes of local government, Ghana shall be deemed to have been divided into the Districts in existence immediately before the coming into force of the Constitution". In order words, the one hundred and ten districts in existence immediately before the Constitution came into force were deemed to have continued in existence. This was the situation for the first ten years of the existence of the Constitution.

In exercise of the powers given him by Article 241 (2) of the Constitution, the president, under the "Creation of Districts Instrument, 2003, and the 'Creation of Districts (No.2) Instrument, 2003, created twenty-eight more districts in 2003 in addition to the existing one hundred and ten, making a total of one hundred and thirty-eight districts. Thirty-two more districts were created in 2007 to bring the total number of districts to one hundred and seventy (170). The Ministry of Local Government subsequently issued the necessary Legislative Instruments establishing District Assemblies for the newly created districts (Ahwoi, 2010).

In terms of composition, the 1992 constitution changed the membership of the District Assemblies slightly from what obtained under the PNDCL 207. Instead of two-thirds elected and one-third appointed, the Assembly is now composed of seventy per cent elected and thirty per cent appointed. The Member or Members of Parliament from constituencies in the district have also been made non-voting members of the Assembly. The District Chief Executive (DCE) continues to be a member. However, the Local Government Service (LGS) Act, 2003, Act 656, appears to have taken a step backwards as far as this constitutional provision is concerned. Section 25 of Act 656 vests all powers of appointment of the staff of the LGS, and this is defined to include the staff of the DAs in the President, except that under sub-section (4), the President may delegate this power. Thus theoretically, every member of the LGS from the conservancy labourer to the District Coordinating Director (DCD) is appointed by the President. This according to Ahwoi (2010), is a retrograde step because under effective decentralisation, the movement is in the direction of vesting the power of appointment directly in the local authorities, as indeed Article 240 (2) (d) of the Constitution seeks to do, not centralising it and permitting a delegation of the exercise of that power. In Uganda, for example, District Service Commissioners are established in every district by the District Councils themselves. Then within the framework of broad policy on appointments provided by

the Ugandan Public Services Commission, each District Service Commission advertises and recruits its own staff and other employees.

In terms of participation at the DAs, Article 240 (2) (e) provides that "to ensure the accountability of local government authorities, people in particular local government areas shall, as far as practicable be afforded the opportunity to participate effectively in their governance". Various strategies have been introduced to achieve this constitutional decentralisation objective. The "ordinary residence requirement" in the qualification criteria for candidacy for local government elections; the anti-poverty features such as making local government elections free and state sponsored, the non-partisan character of local government elections, are all designed to ensure not just participation, but participation by the people that decisions affect most directly. Similarly, the local hearing requirements of the National Development Planning (System) Act are also designed to ensure effective participation. District planning Authorities are required to conduct public hearings on proposed district development plans and shall consider the views expressed at the hearings before the adoption of the proposed district development plans.

Other spheres of government in Ghana are the regions and the central government. Each geographic region is made up of a number of districts and there are ten regions in Ghana. Their function is to coordinate and monitor the activities and plans of districts and to ensure that they are in consonance with national aspirations, policy and direction. The region will also undertake larger projects that benefit more than one district. There is a regional coordinating council (RCC) headed by a politically appointed regional minister. The regional coordinating council is made up of the district chief executives, presiding members of the district assemblies under the region as well as representatives of the traditional authorities. The RCC is serviced by the regional coordinating director and a team of bureaucrats and regional heads of departments. The function of central government in all of this is to provide overall policy direction, and to coordinate, monitor and evaluate development efforts at the national level.

In Ghana, the 1992 Constitution enjoined on development programming to ensure that culture informs all development activities. The original notion of separating the cultural dimension from development and seeing culture only for tourism purposes is becoming a thing of the past (Kendie & Guri, 2007). Indeed new partnerships are being sought between the "traditional" and the "formal" systems for local level development. From historical development most activities, be they social, economic, political or spiritual, revolve around traditional authorities (chiefs and elders) in the rural areas (Wayo, 2006). The responsibility of the traditional governance is to maintain the link between people and the government, to maintain law and order, to promote development and ensure sustainability of development (Busia, 1968; Nukunya, 2003). The traditional leaders, thus, become the focal point around which all development activities are expected to be performed at the local level. In other words, getting local people to participate in development activities requires the active involvement of traditional authorities since they are the pivot of all activity in rural areas.

It is evident in the Ghanaian set up that the presence of a strong traditional institution, such as the chieftaincy institution, in rural areas has served as one of the best ways of getting the people involved in non-routine activities aimed at improving their welfare. This is attributable to the respect citizens have for the traditional leaders and how they also have the welfare of their citizens at heart. It is obligatory for such authority to ensure the welfare of their areas of rule as is enshrined in most of the oaths traditional leaders (chiefs) swear when they assume the throne.

However, one aspect of the governance process remains critical to rural development efforts: the representation and participation of women in the governance process both traditional and formal governance. The involvement of this category of people would give the government and traditional authorities more control over local development. However, on the global scale, Ghana ranks 122nd out of 190 countries with 8.7% female representation in parliament according to the Inter-Parliamentary Union (IPU) in 2010. Rwanda ranked first on the world scale with 56.3 per cent female representation in parliament.

2. Research Methodology

This paper was based on the review of information collected from secondary sources i.e. published books, reports, research works, journals and newspapers. Trend and content analysis was adopted to discuss electoral data gathered basically from the offices of the Electoral Commission of Ghana. Some information was also collected through interviews and questionnaire administration from a cross section of women parliamentarians, female assembly members and women in administrative positions as well as some male counterparts and traditional authorities.

3. Women in formal and traditional governance in Ghana

Various provisions in the design of the decentralisation and local governance process should have made the participation of women in public decision-making easier. These provisions include those for a non-partisan local government system, the freedom to use the local language for the business of the assembly and the discretion in creating additional sub-committees. The latter could have provided a sharper focus on responding to the concerns of various sections of the population, including women. But it did not. The initial participation of women in local government was low and has remained so. In 2004, women made up about 12.5% of Members of Parliament (25 out of 200). In 2008, the figure reduced both nominally and proportionately to 20 and 8.7% respectively. This was very interesting given that women constitute more than half of the total population. However, in the 2012 elections the figure rose to 29 representing 10.5% an improvement on the 2008 figure but still below the proportionate figure in 2004.

With respect to the District Assembly elections, in 1998, the Government of Ghana gave a directive that reserved 30% of the appointed membership of assemblies for women. Examination of the proportions of appointed members suggests that assemblies selected just around 30%, even though that was supposed to be the minimum. Only 3 of the 110 Presiding Members were women. In the same year, the total number of male contestants in the district assembly elections was 12,625 compared to 547 female contestants with 196 women elected into the assemblies. Although in 2002 there was an almost 50 per cent increase in the participation of women (from 547 to 965) the number of male contestants was still disproportionately high: 13,170. It was a similar story for 2006 when there was another remarkable increase in the number of female contestants (1772) and less than half (478) were elected into the assemblies.

Many of the current assemblies in the country have two or three elected females, as against 16 or 17 males. Despite efforts by governments to increase the percentage of women in the district assemblies, the unfortunate reality is, most regions had failed to meet the governments' quota. The government reserved the rights to appoint 30 per cent of all district assembly members and had further reserved 50 per cent of its appointed seats to women. However, in most regions the numbers of female assembly appointees are about 35 per cent.

Perhaps part of the difficulty of making women's presence felt at the district assembly level is the general paucity of women in government administration itself, both as politically appointed heads of districts and as administrators and civil servants. Out of nine district chief executives in the Upper West Region in 2012 for instance, only one was a woman (11.1%). The situation is similar for women as civil servants and administrators. Women constitute 32 per cent of the entire civil service and 24 per cent of those in local government with most being in the secretarial and clerical classes. Only 12 per cent of the decision-influencing category – the administrative class – is female. In 1999, there were only 3 women amongst the 110 district coordinating directors (3.6%). As at 2012, there was only one female District Coordinating Director in the Upper West Region. The story is not different in the other regions of the country. This low representation is disturbing given that the district coordinating directors provide technical guidance to the assemblies. They are therefore responsible for providing inputs for planning, ensuring equity in implementation, monitoring for efficiency and effectiveness, and evaluating for impacts.

In Ghana, traditional authority is based at the grassroots on community chiefs and elders. Traditional authority revolves around such leaders as chiefs, elders, clan heads, family heads, landlords, queen mothers, and chief priests or priestesses. According to Boateng (1994), communities are organised under sub-divisions, divisions and paramountcies. However, in the case of northern Ghana, except in a few areas, there is no provision for the queen mother and the priestesses, making traditional governance a male affair in this part of the country. According to Ibrahim (2004), in Dagbon, three chieftaincy positions Gundogu, Kpatuya and Kululogu are reserved for daughters of the Ya Na, the paramount chief of Dagbon. Also, among the Nanumba, there are female chiefs with the title Pona meaning 'female chief'. Except in these few instances, women in northern Ghana do not become chiefs. Women in northern Ghana, therefore, are not privileged like their southern women in the decision making processes of traditional governance where the institution of chieftaincy involves the queen mother**.**

In summary, while the visibility of women in formal government has increased, the numbers are still very low – both as administrators and as assembly members/ parliamentary representatives. The issue is not the numbers of women alone, but their self-knowledge, confidence, clarity of purpose, priorities, commitment and ability to skilfully present their perspectives. Their participation in traditional governance has not improved especially in the three northern regions where there is no vacancy in majority of cases for women in the traditional chieftaincy systems.

4. Obstacles to Women's Participation in formal and traditional governance in Ghana

Although the constitution guaranteed the equal rights for women, the reality is that they are not seen as equal, their roles are closely tied to their reproductive and household activities only. At the same time women are considered as unfit to perform political and community affairs. This is due to lack of clarity in the constitution and some traditional systems in northern Ghana on the role of women in development. This is especially serious with traditional governance in northern Ghana, where women do not have the opportunity of becoming queen mothers in the chieftaincy institution like their southern counterparts.

Patriarchy as a system, an ideology and practice tends to impact in different ways on the lives of women in northern Ghana. Patriarchal attitudes become so embedded that they are taken as natural. Even where there is supposed equality, these attitudes tend to prevail. Socio-cultural norms and religious misinterpretations are used frequently for challenging and reinterpreting women's rights and create insecurity for women. And although women have

equal political rights to participate as voters and representatives, in reality they can be actively discouraged to do so. The patriarchal system in this part of the country enforces rules and laws in such way that affect the self-confidence of women, limit their access to resources and information and thus keep them in a lower status than men. This in no little way affects their involvement in both formal and traditional governance systems in the country.

The male-biased environment within political institutions in the country also deters women from participation. The fact that there are few women on decision-making bodies means that these women have to work within styles and modes acceptable to men. As a result women cannot give attention to their issues. Sometimes they are treated by their colleagues and society harshly. Many-if not all-male elected members harbour negative attitude towards elected women members. They believe women should not run for general seats. Lack of cooperation by men in the traditional sector is a significant barrier to women's participation and effectiveness in decision-making in the sector especially in northern Ghana.

The widely-held perception, that political activity is "dirty" and not for decent women is also a barrier. Women have also not been voted for because politics is often viewed as belonging to an arena which is best managed by men. Husbands and families are reluctant to have their women in the public eye. Women are said to lack public arena skills and some complain of intimidation by male opponents.

Education is the strongest factor influencing women's control of their own fate. Women are further handicapped because of lower educational achievements and the prevalence of social norms that severely restrict their freedom of movement in the public place. And so, they do not show interest in participating in both traditional and formal government activities that open them up for public assessment and criticism.

Women's lower economic and social status, multiple roles and lack of time all limit their access to formal social services and general advancement. With comparatively little education, poorer state of health and greater food insecurity, women in the Ghana are particularly vulnerable. Women, especially widows, childless, disabled and aged are also at risk of public ridicule and abuse when they attempt to compete with men for political positions. Chieftaincy, which is the major traditional institution in the country responsible for traditional governance, is a no go area for women in the northern part of the country. While their southern counterparts are privileged to have the feminine equivalence of the chief "queen mother", all royalties to the stool are managed by the chief (that is, the male). Their multiple roles as wives, mothers, daughters, community workers and income-generators severely limit their time for community interaction and mobilisation.

Inside the assembly, women have yet to make their presence felt. In spite of the increases in their numbers provided for by government directive, their performance has been muted. This has been attributed to lack of self-confidence, a limited capacity to communicate in English and a lack of understanding of assembly procedures. Other problems include being shouted at in assembly proceedings or being ignored by presiding members when they (women members) want to make interventions. The short notices for meetings and transportation costs incurred during assembly work have also been indicated as constraints for them. Women members employed in the formal sector also identify difficulties in combining assembly responsibilities with their jobs such as getting time off to attend to assembly and community business. Elected women also worry about being able to undertake development activities to justify their selection. Women have been constrained from entering local level politics by the lack of finances for campaigning and time constraints needed to manage domestic responsibilities, income-generation activities and political work.

The elected women member's participation in local government bodies remains generally insignificant, as they are not given any specific duties. The absence of operational guidelines and terms of reference for female elected representatives, the limited capacity of the female elected representatives to operate in public institutions of this nature, the lack of awareness over their roles and responsibilities, the systematic discrimination and biases by male elected colleagues all these are seen as factors impeding women's meaningful participation in local government.

5. Policy Recommendations and Conclusion

5.1. Recommendations

Women in Ghana have low political status as compared to men. Their participation results from their low socioeconomic status stemming from social norms of a male dominated society confining women to the household. Their unequal status in society gives them unequal access to the educational, economic and other opportunities offered by the state and society. All these factors reinforce each other to keep women's political participation low. But women's adequate political participation is a precondition for bringing women in the mainstream of development process as a way of making development more sustainable and meaningful.

Due to socio-political and religious bindings, women especially elected women cannot play their role and thus people's aspiration and expectation of them were not met up. To ensure a meaningful participation of elected women members and women in general as an essential step towards ensuring development at the rural areas, the following policy prescriptions may be taken into consideration:

1. To create greater awareness among women about their low status in society and the need to improve it, motivational programs along with programs for expanding opportunities for education, health care and employment should be launched. Specific programs should be undertaken by the government and non-government organizations in order to create an awareness among the women in the grass roots levels that political participation would give them an access to the political decision making process relating to the allocation of resources.

2. Mass media should be used to educate and mobilize public opinion in such a way that the realization about the benefits of women's full participation in the national development efforts is created among people.

3. Women should be given various opportunities for leadership training, training regarding the activities of governance and education in order to encourage them to take up political and leadership position. Supportive services should be provided to allow women participate in these training courses.

4. There is urgent need to undertake research on women's participation in politics, their voting behaviour, consciousness and participation in the political parties.

5. Women should be introduced into the chieftaincy institution in the northern part of the country and concerted efforts made to create an outfit for them as it pertains in the southern part of the country.

6. Finally, increasing the number of women in decision making positions does not in itself translate into greater empowerment for women. Measures to increase the number of women representatives need to be accompanied by measures to improve the quality of participation.

5.2. Conclusion

Women have acquired some legitimate space in rural political institutions that can raise their marginalized position, though they are still a minority. Merely having women Assembly and Parliamentary Members does not automatically mean that the interests of women in the rural community are represented. Without women's needs and interests being taken into account, without opportunity for them to participate in and influence decision-making, development interventions and planning, sustainable results will not come, Khan (2006).

Yet, having women in these leadership positions is an important step in changing the male-dominated political agenda. At least they have the opportunity to attend the meetings, interact with officials and take part in important discussions. It also ensures their mobility across the social hierarchy. In order to support and accelerate the rural development process through formal and traditional governance, additional strategies have to be employed, which promote the self-reliance of women (economically as well as socially), build women's capacities and remove structural obstacles.

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Is The 'Public' A Discursive Construct? Reflection from Gender Perspective on Water Management Experiences of Selective Countries

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Abstract

The purpose of this article is to investigate whether the term 'public' discursively construct. Doing so, it goes through the historical travelling of planning theory with special emphasis on feminist engagement. It also analyses gender planning in common resources management drawing insight from three cases of Zimbabwe, Thailand and India. The aim is to discern from insights on resources use, institution and incentives to show how the notion of public is fluid and the consequences of this fluidity for women's gendered interests. The paper analyses the results in relation to importance of participation in governance concern and two types of human development with gender dimension and women empowerment approaches. It concludes that 'public' is a discursively construct and which has gendered consequences.

Keyword: Gender, Planning, Private, Discursive, Feminist, Water, Resources

Introduction:

The 'public' is a central concept in planning. It is discursively produced which deals a process of involving confrontation of different rationalities and knowledge articulated from a variety of power positions. To critically analyze whether the term 'public' is discursive construct, the essay takes gender and water management experiences. It focuses on planning of gender and management especially on the resource uses, institutions, preferences and incentives.

Conventional planning is reflexive of science and technology. It is bias to rational analysis like logical framework analysis, profit–loss, input-output, market value, ratio analysis etc. On the other hand, feminist planning argues that conventional planning works having the notion of public, and this can be understood in the context of public–private dichotomy that feminizes and depoliticise the private. In this article, it will be investigated how the notion of public fluid and the consequences of this fluidity for women have gendered interests.

The article works to trace out how public–private dichotomy engaged in water management field in different countries. It takes three countries water resource experiences to illustrate how the notion of 'public' varies over time and place. The first part of the article deals with the issue, rationality of selection and methodology. In the second half, it moves to planning history and feminist engagement with analysis of contradictory distinction of public versus private, formal versus informal. In the third of it, it goes to deal with case of water resource management in Zimbabwe, Thailand and India. Finally, synthesis is drawn from cases, and it has been linked up with empowerment approaches of Wieringa (1994) and Kabeer (2001).

Methodology and Objective of the Study

With an aim to unveil the extent of 'public' as discursive construct, the study applies case studies from secondary sources as data and information. It mostly applies literature review, case study and discourse analysis methods for analysing data and information. In addition, the results were shared in an academic forum where relevant experts were present and gave their feedback. After incorporating the comments and feedback, the paper has been developed.

History of Planning Theory and Feminist Engagement

Social Engineering: Since the inception, planning techniques and practices have been central to development. Due to the application of scientific and technical knowledge to public domain, planning rented legitimacy and stimulated hopes about development enterprise. The concept of planning actually embodies the belief that social change can be engineered, directed and produced at will (Escobar, 1992:132).

Modern planning theory is influenced by the economics, guided by Keynesian economic principles. They were expert on a type of planning that was rooted in the collection data, evaluation of alternative courses of action, and creation system for implementation. They expanded the planning definition as a designed activity and incorporated scientific activity (Stiftel, 2000: 4).

There are factors in European planning history. Firstly, the development of town planning is as a way of dealing with the problems of fast growing industrial cities. Secondly, the rise of social planning and increased intervention by the professionals and the state in society, in the name of promoting people's welfare. Finally, the intervention of modern economy is crystallized with the institutionalization of the market, and the formation of classical political economy (Escobar, 1992).

The changes in the 19th century of European countries did not come naturally, but required huge ideological and materials operation, and often times plain coercion. People did not become accustomed to the factory work or living in the crowded and inhospitable cities happily, but they had to be disciplined on it. They have shaped not only social structure and institutions but also the way people experience and construct their subjective identity. Planning actually redefines social and economic life in accordance with the criteria of rationality, efficiency and morality which are consonant with the history and needs of capitalist, industrial society, but not those of third world. As a system of representation, planning thus depends on making people forget the origins of its historical mediation. It relies upon, and proceeds through, various practices regarded as rational or objective which are in fact highly ideological and political *(ibid).*

The notion of 'Public' in the history of planning model: Having the idea of Jeremy Bentham, the technocratic rationalism (Utilitarianism) planning model draws on the John Stuart Mill. This model brings logic and reason to decision making process, where having utilitarian position, the ends of the planning process is being defined as the utility of the majority. The public interest is the aggregation of the individual interests. It gives emphasis on the evaluation of consequences of public action and measurement of individual preferences in terms of monetary cost and benefits. The important thing in this model is, planning is regarded as impartial and value free and planning is a matter of expertise rather than judgment and appropriateness of action and values. In addition, it has a notion that neutral planning aims at 'greater good', but the reality is the values are perpetuated under the clock of scientific rationality (Roy, 2001, Campbell and Marshall, 1999).

The Professional (/procedural) planning draws from the idea of Emmanuel Kant. It acknowledges the complexity and interconnectedness of the planning issues, and it also accepts judgmental and political nature of planning activity while affirming that argument or choice can be narrowed down based on the professional expertise and rigorous adherence to procedure. It ensures accountability to the general populace, and formal administrative structure makes sure that formulated policies will inevitably be in the public interest. In this, professional planning model planners provide counselling for wise and technically informed decisions, and they act on behalf of the state necessarily serve the public interest through the consistent, fair and impartial way in which they uphold the rules and procedures of the bureaucracy. Alike the technocratic rationalist model of planning, the professionalism is also having the assumption about the impartial role of planners in following rules of depoliticises planning activity *(ibid).*

In the incrementalism or pragmatism planning, it starts from a position where there is no absolute givens. Knowledge is acquired by doing and experimentation, and it is imperfect and temporary. Reality is embedded in experience and planning becomes a process of practical problem solving guided by gradualist policies which are associated with incremental reform. It closely linked with the importance of individual freedoms and acceptance of market as the most efficient mechanism to distribute resources. Planners should act as referees to administer the rules of the game among multiple and diverse interest. The purpose of the planners is to ensure that due procedure has been followed. Ethical values in this planning are situational, dependent on the capacity of each individual to learn from the experience they encounter. Good and right is a matter of continuous re- evaluation *(ibid).*

Communicative planning model replaces positivist notion of rationalism by a communicative conception. It believes that reasoning within policy making is not entirely rejected but reconceptualised as an inter- subjective process leading to mutual understanding and action. It explicitly locates public interest in a dialogic public domain. The rational and

scientific are not regarded as superior to other forms of knowing. It brings new territory for planning on the basis of participatory democracy in terms of constructing alternative democratic possibilities. In this case planners facilitate discourse, and attempts to ensure that marginalized interests are represented. Feminist critiques not only confront procedural ethics with the questions of dominance and hegemony, but also bring to light a crucial set of epistemological and normative elements; how the idea and ideal of the public rests upon the ideals of the private *(ibid).*

Advocacy planning that developed by Davidoff acknowledges that a position of value neutrality is impossible to achieve. Davidoff urges planners to become committed practitioners to ensure a degree of fairness in planning process and ensure that all groups have voice. In this point, she moves further since information is a complex source of power, as planners control and manipulates information, they are not acting in a neutral way. She also added that planners necessarily give equal consideration to all views *(ibid).*

Feminist engagement and distinction between public and private: Feminist engagement in planning theories allow to take step further, particularly by dismantling entrenched public private dichotomies, and pointing to the intertwines of meaning that undergird ostensibly innocent concepts. William (1983: 243) pointed the emergence of the idea of the public in Anglo- American ideas and practices, as an area of generalized privilege, seclusion, and protection of others free from public scrutiny. His work (1973) also suggests a set of layered dualisms, like public versus private, urban versus rural and culture versus rural. Feminist theorists have begun to revisit these social and spatial boundaries to focus the ways in which these dualisms are deeply gendered. By exploring the literacy and reformist narratives of fin-de-siecle European cities, it has been showed how public places of cities were seen to be masculine domain (Wilson: 1991 in Roy, 2001:115). "Feminist theorists have persistently questioned this public- private dichotomy (Sandercock and Forsyth: 1992 in Roy 2001:115). Feminist geographer is particularly concern how set of dualisms and feminizes and privatizes, thereby depoliticizing whole range of issues. To Massey (1994 in Roy : 2001) ,"the idea of the public as an arena of political action and social change rest on inert and static private separate from civic concerns".

The dichotomy of public versus private is discursively produced. It is not a term of having universal and timeless connotation, rather it is ascribed specific meaning in the crucible of given historical moments, what Habermas recognized in his attempts to recover a particular model of the public. Feminist theorists pointed how the significance of public comes to be fixed through knowledge/ power relations. In other way, Habermas is concerned with discourse within the realm of the public; feminists focus the discursive process through which the public comes to be defined. Feminists view, therefore, brings to light elasticity of the public, how its reach shrinks and extends with considerable flexibility and often in keeping with particular political imperatives, which is politics of the public (Roy, 2001:116).

Results: Gender Planning in Common Property Resource Management

In common property resource management, how gender planning is influenced by the public – private dichotomy can be explained by taking examples from different contexts. Doing so, the paper brings examples from Zimbabwe, Thailand and India which to a great extent allows building common understanding on the phenomenon. Afterwards, it moved through critical look to understand how gender is being perceived, what the assumptions about individual preferences are and also how household has been looked at.

Case Study 1-The Field of Water Management in Zimbabwe

Incentives and informal institutions: **"**In terms of communal water resource, incentives are defined as those mechanisms that motivate individuals' water use and their participation in collective arrangement for its management. Institutions are the structures of rules, roles and authority through which individual participation is translated into collective action" (Cleaver, 98: 348). Incentives might be formal or informal mechanism that may induce users of a common property resource to undertake collectively beneficial but individually costly actions (Seabright, 1993: 117 in Cleaver, 1998: 349). Two themes are predominant in understanding incentives; firstly, it is individual upon whom the incentives act, and strongest incentives likely to arise from concern about the maximization or defence of production (Wade, 1986 in Cleaver, 1998: 349); secondly, incentives may arise from the pressures of scarcity (Wade, 1988 in Cleaver 1998: 349), and the desire to maximize the use of a resource (Ostrom & Gardner , 1993 in Cleaver,1998: 349).

Generally, there is a view that women are predominantly motivated to improve their domestic water supplies in order to save time, which can be used as income generating activities as well. Women are thought to be willing to pay whether in cash or in labour in order to secure water closer to their home, and there has been substantial emphasis in the water sector to secure this.

Besides the general view of women's motivation on water use, there are number of implicit assumptions; these are- women primarily use single source, and they are strongly motivated to take it closer to their home, it also further assumed that those who collecting water are also the mangers of water supplies who participate in the water project (Cleaver, 1998: 349).

The water management project models the water use based on the notion public private dichotomy. Women are seen as domestic or private user and men as productive or public user. Moreover, it is contradictory for its assumptions and views; since, women are predominantly recognized as domestic water user, but incentives to improve such water supplies are determined in terms of increasing economic activity.

Formalizing institutions: The project believes that formalized institutional arrangement is being considered more likely to be robust and enduring than informal ones. In the water sector a concern with institutions has been manifested through much work on water committees, water user groups, and associations. This formalized arrangement of water management approach has raised number of difficulties on women's involvement, particularly in terms of time and money. In addition, the model of institutions proposed is a formal one based on organizations having explicit forms of decision making, rules and contracts. Evidence proves that this very culture of committees a barrier to women's involvement, and overlook the informal systems of managing resources where women play a vital role. Especially, formal management system exclusionary to poorer women with less labor to break or bend the rules in order to secure their minimum water supplies (Cleaver, 1998).

Household structure, gender priorities and complex water preferences: While policy related literature emphasises that women place on securing the adequate supply of water for domestic uses within little time, but Nkayi District of Zimbabwe says that women's water preferences are not so linear rather it is complex and in respect of lot of other factors. The model of incentives and water use does little to recognize the complexity of water use and decision making within household. Likewise, institutional approaches generally focus on non-household institutions such as local organization and markets, and analyze incentives in

relation to these. As individual participation in the activities of collective action may be mediated by household dynamics, therefore more analysis is necessary.

Case 2- The Experience of water resource sector in Thailand:

The Asian Development Bank's (ADB) technical assistance for capacity building in Thailand's water resource sector (referred as TA3260) shows that there was assumption of assisting Thai government in developing a unified water resource management. The idea was to strengthen integrated water resource management, and improve service delivery in irrigation. Public participation has been predicted as the heart of the ADB's country strategies in the water sector, whereby institutional arrangements at the community level will be strengthen (ADB, 2000:14 in Resurreccion, Real and Pantana, 2004:522) .

Participation: The meaning of the participation that employed in TA 3260 refers to a process in which information about a planned project is made available to the public and where dialogue ensues regarding project option. This discourse of participation does not consider gender perspective. Therefore, in practice, the discourse of participation may used to keep real power in hands of outsiders. For instance, the participation can legitimate a project by gaining the sanction or formal approval of key people in the community- predominantly men and upper class women. Women and men have different needs in resource use activities, and it might be that men needs are likely to be favoured over women's. Furthermore, the processes function such a way that reflect the gender relations in the society and gendering since they reproduce those relations and their unequal nature. The reproduction of gender relations is embedded in the hierarchies and bureaucratic layers of institutions involved, in terms and requirement for participation, incentives and accounting mechanisms

(Resurreccion, Real and Pantana, 2004:531).

Institutionalisation: River Basin Committees (RBC) are being established, and considered as key organization at the local and regional level to confirm to function as decentralized decision making structure for the unified water resource. In RBCs women were appointed by virtue of their stature in the sub district organizations, and the committee members were appointed in their capacity as representatives of the RID (Royal Irrigation Department) , *muang fai* leaders, village headmen and representatives of other state agencies concerned with water issues. Man members underline their lack of interest in including women members or their concerns, which leads to man- centred construction of water users, pre-dominantly man selection and composition of the committees and lack of gender sensitivity among the current members. Besides this, women may also reproduce the man domination in the organization due to their limited freedoms and inertia deriving from practices that ensure relatively stable relationships, or believe that undue their assertiveness on their part would weaken the family's interest as whole, or perhaps simply accept that such arrangement are natural (Resurreccion, Real and Pantana ,2004:526).

Resource use: Women have not traditionally recognized as the main caretaker of irrigation facilities. Water for agriculture use is always been considered as man resource. Evidence shows that women are also playing crucial role in irrigation, especially when problem occurs in irrigation system (Resurreccion, Real and Pantana , 2004).

Women's space, participation and empowerment: Water resource management project both in Zimbabwe and Thailand comprises the notion of participatory approach for its management. The way that incentives have been identified for women's water user in Zimbabwe was simply based on single categorizing women's preference without understanding its complexity. In addition, it focuses on formal institution where women are less likely to take

part. Furthermore, identifying women as domestic water user exclude their potentials and contributions in water management activity. It also strengthens the public- private dichotomy.

In Thailand TA 3260, the formation of RBC overlooked the fact that the communities are socially organized along with the axes of gender and class. Therefore, women were largely excluded at every level of participation and consultation. The RBC as a formal institution for water resource management does not provide enough space for women's involvement; even it is discriminatory for women's representation.

Experience of Indian water resources management: Indian experiences in regard to water management tell that participation is popular in both as a method of acquiring local knowledge and as away encourages project sustainability, but it contains the potentials for unjustified exercise of power; that is, it could be tyrannical (O'Reilly, 2006). She also noted that women fieldworkers simultaneously exercise, and are influenced by, participation as category of power. There have opportunity to disrupt dominant meanings of participation that management and consultant would like to see implemented. Participation is actually a form of power travel through agents.

Discussion: Other side of the coin- An Analysis of underlying Assumptions

In the above case studies, women's central place in the domestic water sector is based primarily on an analysis of their "natural" role in household reproduction. In addition, it is perceived that women primarily use a single water source. Furthermore, it has been found women have been identified as the main drawers of water, and the primary promoters of hygiene practices at household level, and as those most likely to benefit from improved water supplies, as these will alleviate their burden of domestic tasks. In line with this, women are strongly motivated to take action to bring water source closer to their home. Moreover, women who collect water are also the managers of water supplies but women's productive concerns are not focused upon.

Besides this, gender approaches have largely concentrated on increasing women's representation in such organisations. The justification is that women's involvement in decision making and management will ensure that resource is managed more accurately. In contrast to this, users of water are perceived as economic agents, taking decisions about water use and management based primarily on their expectation of quantifiable economic benefits.

Regarding individual preferences, the cases reflect that women use a single source of water and are predominantly motivated to improve their "domestic" water supplies in order to save time. Women are "thought" to be willing to pay either in cash or kind in order to secure a source of water near to their home. Women are a homogeneous group, who have multiple roles in reproductive, productive and community management activities. But in most cases, it has been found that women's interests are different from men. The cases focuses on priorities of men and women separately where women more of reproductive and men productive. Nevertheless, women do not only use water for domestic work but also other productive activities.

Besides the aspects of individual preference, household is been considered as an isolated unit and rarely regarded as in its social location. Moreover, it is assumed as a homogeneous unit and there are no complexities regarding the decision making process even in the case of water usage. Households and all of their members have unitary interests. Women are the prime fetchers and carriers of water when time savings is the only operating incentive for women. It considered the gender division of labour as static which in reality is not. With the new income generating opportunities there is a shift in gender roles which are constantly

negotiated by the women. The incentive framework does not consider these changes. The model of incentives and women's involvement fails to account for the impact of wider household concerns and offers no model of household negotiation or compromise over resource use and decision making. It oversimplifies the division between "domestic" and "productive" activities at household level. In reality, there are negotiations between men and women over water usage priorities.

Participation is an important aspect of governance. Women's participation in the water resources management is crucial since it shapes their everyday life experiences and also as Papart (2000) noted gender and power are greatly ignored in the concern of governance. Moreover, governance has been seen as gender neutral concept. Therefore, women's effective participation in the water management process is important from governance as well resources management perspective. It essentially would contribute to the human development, as Truong (1997) pointed out two important aspects of human development, where one is oriented toward human needs, which promotes more humane values and respects totality of human existence. The other one is a model of development that places the human actors at the centre-stage of the development process. In connection with this, above mentioned cases could be linked to the later model of development which can place men and human equally in resource management which could contribute towards a just society. But when the whole planning process is influenced by the notion of private versus private, it certainly puts limit and unrecognized certain priority of a particular group of the community.

Concluding Remarks:

The distinction between public–private is discursively produced, where women are less likely to participate in public domain due to existing power relation what keeps them as subordinate. Women's empowerment can be seen as probable solution of it. In empowerment approach women's subordination is seen as holistic process, encompassing all aspects o women's life. Empowering women or women's groups means give them to make their own choices, to speak out their voices and control their own lives. This approach is at present the most fruitful way to forward for issues of women and development (Wieringa, 1994: 832- 4). Since in the projects, literally there are spaces for women participation, but it is unachievable to women due to the power relation. Therefore women could not exercise their choices. To Kabeer (2001:80-1), "empowerment can be seen as an expansion in the range of potential choices available to them".

The purpose of this paper is to critically discern from insights on resource use, institution and incentives to show how the notion of public is fluid, and consequences of this fluidity for women's gendered interest. The distinction between public- private is discursively constructed and ascribed specific meaning in the crucible of given historical moment.

Having this in practice, both of the projects of water resource management in Zimbabwe and Thailand is discriminatory to women in addressing their preferences, resource use and institution for its management. It is interesting to see that while women are using water for the cattle then it has been considered as domestic use, but when hired person done it then it is productive work. In vein with this, in Thailand's case, irrigation has been considered as men's needs whereas domestic use for women. But it is clear that women are using water as productive purpose as well. Therefore it is understood that the construction of the term public is discursive and which in relation to men has uneven impact on women.

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The Use of Ethnoveterinary Practices in The Treatment Of Skin Diseases in Small Ruminants in IWO Agricultural Zone of Osun State, Nigeria

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Abstract

Sustainable livestock production of any nation is partly dependent on her effective management of the available stock of animals. Most of the livestock in Nigeria are infected with varieties of diseases ranging from skin diseases to others related to gastro intestinal tracts (GITs). This development had in recent past resulted into lost of most livestock and Nigeria has lost most of her productive stocks because of the rural dwellers could not afford conventional methods of treatments. This study therefore assessed the use of ethnoveterinary practices (EVPS) in the treatment of skin diseases in small ruminants in rural communities of Osun State. Multi-stage sampling was used to select fifty one respondents for this study. The data for this study was collected with well structured questionnaires. Data collected were analysed using frequency distribution, means, and standard deviation as descriptive tools while Chi- square was used to test the relationship between the variables of the study. Semi- intensive system of rearing system is the most (53.0%) common rearing method in the study area. Skin mange is the most common ruminant diseases in the area (80.4%) and was found to be common during the raining season (98.2%). Mode of transmission of the skin diseases is physical contact (98.2%) and the signs of the diseases include irritation/rubbing of body against the wall (76.5%), ruffled flur and falling of hair (70.6%), white scaly skin (68.6%), formation of scab (35.3%) and alopecia (17.6%). Ehnoveterinary practices (EPVs) is most common (78.4%) health management practices in the study area. The most widely utilized ethnoveterinary materials in the study area include used engine oil (54.90%), sulphur (54.9%), kerosine (49.0%), and battery carbon (43.1%). The preparation is applied topically (82.4%) while others are applied orally. Respondents claimed that they have adequate access to local materials (100.0%) and the cost of treatment using the local materials is cheaper (98.2%). The result of Chi- square analysis indicates a significant relationship between the determinants of use of ethnoveterinary practices and effectiveness of ethnoveterinary practices in the study area. Length of time before recovery (x= 41.765), mode of administration (x= 21.353), accessibility to local materials (x= 44.608), preparation of local materials (x= 69.640), number of survived animals (x= 51.157), sources of the local materials (x= 1.162), cost of treatment (x= 43.314), and effectiveness of the method (68.137) were found to be significant with the effectiveness of the ethnoveterinary practices while time of administration of the local preparation has nothing to do with the effectiveness of the method.

Keywords;Ethnovetrinary,Practices,Treatment,Skin Diseases,Small Ruminants.

Introduction

Small ruminants are a source of food and financial security for the rural poor. According to FAO (1983) quoted in Von Kaufmann *et al*. (1986), more than 50 per cent of milk produced for human consumption is from sheep and goats in Niger and Somalia. Thirty five per cent of the total Nigerian meat supply are thought to come from small ruminants (Bayer, 1982) and almost 30 per cent of the total meat consumed in the semi-arid zone are from small ruminants (Wilson, 1982). The importance of small ruminants for meat and milk production in the tropics is well established (Devendra and Burns, 1970; Williamson and Payne, 1974; Haas and Horst, 1979; Matthewman, 1977; Gatenby, 1986). Little (1982) found that in pastoral production systems in Kenya, goats are usually the only source of milk available for households in the dry season when both sheep and cattle have migrated. Because of their small size, sheep and goats provide more convenient sources of meat than cattle. Bayer (1982) even revealed that small ruminant meat contributes three times more than beef to the total meat consumed in rural areas of Northern Nigeria.

Sustainable livestock production of any nation is partly dependent on her effective management of the available stock of animals. Most of the livestock in Nigeria are infected with varieties of diseases ranging from skin diseases to others related to gastro intestinal tracts (GITs). Scabies, mange, scab, or itch are all terms referring to mite infections that cause inflammation and irritation of the skin and itching. These diseases cause significant losses and waste to the sheep and goat industry wherever they are a problem. Economic losses result from a reduction in the amount of meat and quality of wool/fiber produced. Control and prevention programs are a significant cost to the producer. On a larger scale, mite infections impact the local and international trade of animals. The economic importance of common scabies exceeds any other type and possibly all other types combined. Psoroptic scabies is prevalent in the most temperate climatic zones of the world, including Iceland, Europe, Africa, Middle East, Balkans, Pakistan, India, and South and Central America. Australia, New Zealand, Canada, and the United States have eradicated the disease.

Most of the developing countries including Nigeria rely wholly or partly on traditional herbal medicine for treatment and control of animal and human diseases. The absence of adequate conventional animal health care systems in the rural communities makes them to rely on traditional medicine for their primary health care (Schillhorn van veen, 1997). The rural settings also depend on traditional or indigenous knowledge mainly because ethnoveterinary knowledge is handed down orally from generation and from region to region so also among and within communities. It has been developed through trial and error and deliberate experimentation. Therefore, it is less systematic, less formalized, and not universally recognized as a valid method of disease control in animals. Ethnoveterinary medicine easy of accessibility compare to conventional drugs, easy to prepare and administer, cost very little or nothing at all, it is part of one's own culture and It is environmental friendly (Ngeh *et. al.*, 2007).The practice enhances livestock production for improved human nutrition and income generation. It was discovered that the practice builds on indigenous knowledge and practices, it therefore enjoys a high rate of acceptance. In larger extent, indigenous knowledge is being preserved in a continuing way. Farmers are empowered and encouraged to participate in development as there is increased awareness of the importance of environmental conservation.

Moreover, when orthodox veterinary medicine was introduced, many orthodox veterinarians did not promote indigenous practices in any ways because they did not understand it and therefore, they did not appreciate the role, which ethnoveterinary medicine played in the life history of mankind (Toyang e*t. al.,* 1995). In most countries all over the world, the state law were and have not been enacted to govern ,advocate and promote the utilization of the

traditional knowledge in either independent, alongside the modern ones or in complementary with the orthodox medicine (Toyang e*t. al.,* 1995). Orthodox veterinary medicine was also thought to be very primitive and witchery while modern drugs were to be more professional because they were easier to use and apply (Fielding, 1997). Some people even believed that ethnoveterinary medicine never used to cure diseases completely (The ANTHARA Team, 1997). It was also found out that there was little research done to support the argument for the practice of ethno veterinary medicine and therefore, there being no enough scientific evidence, there was increased lack of confidence in the effectiveness of ethnoveterinary medicine(Fielding, 1977).

Specific objectives

The following objectives were addressed:

1) To examine socio economic characteristics of the small ruminants' farmers in study area.
2) To elicit common small ruminants diseases with their corresponding indigenous cures in the study area.
3) To elicit the existing ethnoveterinary practices in the study area.
4) To determine the level of effectiveness of the ethnoveterinary practices among the ruminants' farmers in the area.
5) Identify the reasons for using ethnoveterinary practices.

Materials and Methods

The study was carried out in four towns namely Iwo, Papa, Bodeosi and Fagbaibi, all in Iwo Agricultural Zone of Osun State .Iwo is an ancient city, which is about 52km Northwest from Osogbo, the Osun State capital and 53km southeast of Ibadan, the Oyo state capital. The population of the study is all the ruminants farmers in the study area .An initial survey was carried out to identify farmers in each towns having small ruminant animals (sheep and goat), and based on the results, , four (4) towns namely Iwo , Papa ,Bode-osi and Fagbaibi were purposely selected at different distances. The purpose was to achieve maximum sample variation in the use of ethnoveterinary practices in treatment of skin mange in the study area. Multi-stage sampling was used to select fifty one respondents for this study. The data for this study was collected with well structured questionnaires. Data collected were analysed using frequency distribution, means, and standard deviation as descriptive tools while Chi- square was used to test the relationship between the variables of the study.

Results and Discussion

The table 1 below shows the distribution of respondents by socio-economic characteristics. The mean age of the respondents was 41.4. Most respondents were between the age brackets of 45-45 years. This indicates that most of the respondents were still active and this could assist in the administration of the local herbs. More than half (64.7%) of the respondents were males, which was an outcome of the sampling procedure which show that male respondents used ethnoveterinary practices as major means of treating skin diseases in the small ruminants. It was also revealed that 74.5% of the respondents were married while 39.2% of the respondents interviewed were engaging in farming as their primary occupation. About 33.3% of the respondents had primary school education and with other having post primary and tertiary education. More than half (54.9%) of the respondents were into

subsistence small ruminants rearing which indicates that most of them rear these animals for their immediate family animal protein need. About 29.5% of the respondents had spent more than ten years in small ruminants production. Most of the respondents (80.4%) got their capital for small ruminants enterprise from personal savings. Majority of the respondents (64.7%) were satisfied in the practice of small ruminants enterprise. Table 2 showed that most of the farmers (80.4%) claimed that skin mange is the common ruminants disease, while 37.3 % of the respondents claimed it was peste des petits ruminants (PPR) while 23.5% said it was foot rot.

It was also revealed that 76.5% of the respondents said one of the signs and symptoms of the skin mange is irritation, rubbing of the body against the wall, 70.6% said ruffled fur and falling of hair, 68.6% said white scaly skin, 35.3% said formation of scab, 17.6% said alopecia. Nearly all the respondents (98.2%) interviewed said that the mode of transmission of the disease is physical contact.

It was observed that about 60.8% of the respondents used both conventional and traditional methods of treatment in their health management practices. Nearly all the respondents (78.4%) used ethnoveterinary practices to treat skin mange while other 21.6% used this method to treat other diseases. All of the respondents claimed that they have adequate access to local materials for the preparation of the local drugs. It implies that these local materials can be found in their environment. This is also in agreement with Ngeh *et al*.(2007) which claimed that ethnoveterinary medicine materials are readily available in our locality. About 54.9% of the respondents applied used engine oil, 54.9% applied sulphur, 49.0% applied Kerosene and 43.1% applied battery carbon for control and treatment of the disease.

Many researchers and practitioners in the field of veterinary medicine and animal health had established that conventional method is the most effective method for treating most of the diseases in both large and small livestock. This finding supports that of THE ANTHARA TEAM, (1997) which reports that ethnoveterinary is not effective to cure all the diseases. However, it is highly effective in the treatment of skin diseases in small ruminants as indicated in table 4 below.

Table 5 indicated the reasons why respondents adopted ethnoveterinary practices in the treating of their livestock. All of them (100.0%) claimed that materials for the preparation of local medicine are highly accessible. Moreover, 98.2% of them also claimed that the cost of the treatment is cheaper, 94.1% are of the opinion that the treatment with ethnoveterinary preparation has no side effects while some (78.4%) are of the view that ethnoveterinary practices build on indigenous knowledge.

The result of Chi- square analysis indicates a significant relationship between the determinants of use of ethnoveterinary practices and effectiveness of ethnoveterinary practices in the study area. Length of time before recovery (x= 41.765), mode of administration (x= 21.353), accessibility to local materials (x= 44.608), preparation of local materials (x= 69.640), number of survived animals (x= 51.157), sources of the local materials (x= 1.162), cost of treatment (x= 43.314), and effectiveness of the method (68.137) were found to be significant with the effectiveness of the ethnoveterinary practices while time of administration of the local preparation has nothing to do with the effectiveness of the method.

Table 1: Frequency distribution of the respondents according to their socio- economic characteristics

n= 51

Socio –economic characteristics	Frequency	Percentage
Age		
30-35	13	25.4
36-40	13	25.4
41-45	11	21.6
46-50	04	7.8
>50	10	19.6
Sex		
Male	31	60.8
Female	20	39.2
Marital status		
Single	10	19.6
Married	38	74.5
Widow	03	5.9
Widower	01	1.9
Main occupation		
Farming	20	39.2
Civil service	19	37.3
Trading	07	13.7
Artisan	02	3.9
Others	01	1.9
Educational background		
Primary school certificate	17	33.3
Modern school certificate	04	7.8
Secondary school certificate	08	15.7
National certificate of education	08	15.7
Higher national diploma (HND)	04	7.8
Bachelor of Science (B.SC or B.TECH	05	9.8
Others	01	1.9
Year(s) spent in small ruminant production		
1-5	14	27.5
6-10	12	23.5
10years and above	25	49.0
Sources of capital		
Bank loan	02	3.9
Personal savings	41	80.4
Donation from friends and relatives	03	58.8
Cooperative societies	04	7.8
Others	01	1.9

Source: Field survey, 2012

Table 2: Frequency distribution of respondents by the common diseases in the study area

Diseases in the locality	Frequency	Percentage
Skin mange	41	80.4
Peste pes ruminants	19	37.3
Foot rot	12	23.5

n=51
Source: Field Survey, 2012

Table 3: Frequency distribution of respondents by materials being used in treatment of skin mange

Materials used	Frequency	Percentage
Used engine oil	28	54.9
Sulphur	28	54.9
Kerosene	25	49.0
Battery carbon	22	43.1

*** Multiple responses**
Source: Field survey, 2012

Table 4: Frequency distribution of the respondents by effectiveness of EPVs in the treatment of skin diseases

Effectiveness of EPVs	Effective	Not effective
Number of animals survived from the treatment	40 (78.4%)	11(21.6%)
Mean of recovery period	43 (85.5%)	8 (14.5%)
Access to materials for preparation	51 (100.0%)	0 (0.0%)

Source: Field survey, 2012

Table 5: Frequency distribution of respondents by reasons for using EPVCs in the treatment of skin diseases

Reasons for using EPVs	Frequency	Percentage (%)
Highly accessible	51	100.0
Cheaper	50	98.2
No side effects	48	94.1
Builds on indigenous knowledge	40	78.4

Source: Field survey, 2012

Table 6: Analysis of the relationship between the determinants of ethnoveterinary practices and the effectiveness of the practices using Chi-square model

Determinants of use of EPVCs	Chi-square value	Df	p-value	Remarks
Time of administration	0.961	1	0.327	NS
Length of time before recovery	41.765	18	0.001	S
Mode of administration	21.353	1	0.000	S
Access to materials	44.608c	3	0.000	S
Method of preparation of local materials	69.640c	2	0.000	S
Number of animals that survived	51.157c	9	0.000	S
Sources of the local materials	1.162	5	0.000	S
Cost of treatment	43.314	1	0.000	S
Effectiveness of the method	68.137c	3	0.000	S

C= Means on the same row with different superscripts are statistically significant ($p<0.05$)
Source: Field survey, 2012

Conclusion

Based on the findings of the study, this study concludes that ethnoveterinary practices is cheap and affordable for rural farmers and can enhance good health and productivity of small ruminants. Where there is no access to conventional medicine, ethnoveterinary medicine can be used to cure some certain diseases.

Recommendations

1. There is need for more research into other diseases of small ruminants that are treated by ethnoveterinary practices (EVPs) among the rural livestock owners.
2. Other researcher can investigate into value addition of local medicine, how it can be packaged in an attractive packs and containers.
3. The research should be done to know the quality and quantity of these local medicines that is needed to cure a disease. There should be actual measurement to calculate the dosage required to cure a disease.
4. The more research should be conducted to know the chemical and medicinal properties of some plants and other materials that can be useful for treatment.
5. There is need to research into more indigenous knowledge used by the farmers to solve the health problems affecting their animals.

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