The Social Sciences 1(2): 133-138, 2006

Predicting Urban Health Status-An Empirical Modeling Approach from Cities in South West Nigeria

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Abstract This study discusses contemporary environmental health issues 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, environment, empirical modeling approach, 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[1]. This manifests in high prevalence of environmentally related deaths, disabilities and morbidities. The prevalence of communicable diseases in poor countries persists owing to the geoclimatic environment, which is more conducive to many vector-borne diseases and macro parasites related diseases. There are also palpable contributions arising from the fact that both individuals and governments have taken far fewer of actions that control diseases 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[1]. 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[2]. 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'[3]. The costs of rapid unabating urbanization stem from the sheer size of emerging cities

and underdeveloped city institutions and human resources. This therefore does not allow sufficient time or room for experimentation and adjustments.

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[4]. 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. [4]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 3 together accounts for 6.8% global diseases burden or 10% of third world disease burden[4]. 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[5].

Literature emphasizes the importance of environmental factors in urban health[6]. 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[7,8]. On the strength of the above, the health of the individual is 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[7,9,10].

An effort at correcting the inadequacies in the urban environmental management systems in Nigeria is deducible from the Third National Development plan[11]. 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, streets are 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 ...[12]'

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 use and collation of socio-economic data across the residences of Akure. The following sections report the salient features of a study of residential neighbourhoods of Akure Southwest Nigeria.

Typical scenario across Akure residential neighbourhoods: Akure the study area is a typical city of the 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. $7^0$15'N and long. $5^0$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 (2005) of 484,984[13]. It has many residential districts that keep evolving over time.

The political upgrading influenced the dynamics of the urbanization process, pattern and 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 dominate. 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.

MATERIAS 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 unifying attributes 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[14]. By random choice, 14 of these quarters (51.85%) were selected for the questionnaire administration. The quarters selected include Odo Ikoyi, 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 chosen for the questionnaire exercise. These 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 Ijapo Estate Alagbaka/Ala Housing Estate and the Federal Housing Estate.

From the above sampling 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 (TOLET)
- Age of the house (HSEAGE)
- Type of domestic water supply (DOMWAT)
- Wall materials (WALMAT)
- Management of household wastewaters (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 r^2 are enhanced
- There is the possibility of presenting regression coefficients directly as elasticity estimates and;
- The models enhance homescedasticity-errors are distributed over the estimate parameters.

The general form of the equation used is:

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

This in the double log format transposes to:

$$\text{In } y = a + b_1 \text{ In } x_1 + b_2 \text{ In } x_2 \ldots . b_n \text{ In } x_n + e \quad (2)$$

Where b_i-b_n = 1…..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 heath modeling for the core areas: Out of 10 predictors 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 In TLET + 0.154 In REFUSE
+ 0.441 In BLDG + 0.095 In HSEAGE

$$r^2 = 0.844 \quad (3)$$

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 variable 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 + 0.184ln WASWAT-0.101lnGAWAS
0.006lnWALMAT + 0.014lnRFMAT +
0.254lnDOMWAT-0.0005lnREFUSE +
0.116lnTLET + 0.706lnHSEAGE-0.192lnBLDG +
0.025lnKITTY

$$r^2 = 0.902. \quad (4)$$

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 :

$$\text{Ln } y = -1.120 + 0.233\text{lnWASWAT} + 0.005\text{lnGAWAS} + 1.552\text{lnTLET} - 0.016\text{lnWALMAT} - 0.077\text{lnRFMAT} + 0.287\text{lnDOMWAT} + 0.369\text{lnBLDG} - 0.093\text{lnHSEAGE} - 0.083\text{lnREFUSE} - 0.669\text{lnKITTY}$$

$$r^2 = 0.711 \quad (5)$$

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 1 below:

The regression equation infers that a unit increase in the variable TLET will generate an increase of 1.552 units in the dependent ln y (ASSESSMENT) given that all other effects on the hyperplane and the slope intercept are held constant. This same 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 (ln 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.

Table 1: Showing significant parameters in the Periphery model

Variables	Beta Coefficient	Regression coefficient	Correlation 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 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 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. Fasakin[14] Call for a policy framework that will mandate the Municipal Authority to organize periodic environmental enlightenment campaigns is in this light. 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 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 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 public housing districts.

The multiplicity of these significant variables across the residential 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 of these effluents to safe treatment areas or urban agricultural fields for wastewater reuse. Where this is not feasible right away, provision of on site treatment facilities as usually fitted on 'Site Plans' should be enforced on development sites.

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.

This study opines that urban health 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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