# STRATIFICATION AND LIVESTOCK POPULATION CENSUS FOR ENUGU URBAN, NIGERIA: A PILOT SURVEY

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**ABSTRACT**

***Stratification and livestock population census for Enugu Urban, Nigeria, between February and April 2005 is described. Based on ground reconnaissance, six stratification zones identified for Enugu Urban (180 km$^2$) were, unplanned Village set-up (9.69 km$^2$), High-density built-up areas (20.25 km$^2$), Medium-density built-up areas (7.90 km$^2$), Low-density built-up areas (9.50 km$^2$), Commercial areas (26.44 km$^2$) and Undeveloped lands/Farms (106.93 km$^2$). About 46.63 km$^2$ or 25.90 % of the stratified Enugu Urban was principal suburbs. Estimated livestock population was achieved with 91.70 % of 2927 households in 21 sample blocks of about 8.34 Km$^2$ or 17.88 % of the principal suburbs. Livestock population and average population density for stratified Enugu Urban were 32309 (179) for goats, 17027 (95) for sheep, 3765 (21) for pigs, 16152 (90) for dogs, 4338 (24) for cats, 108354 (602) for chickens, 28985 (161) for turkeys and 17160 (95) for ducks. The results of this study may be useful in the formulation of Veterinary, Livestock, Public and Environmental Health Policies, as well as for Livestock Diseases Surveillances, Research Communications and Bioinformatics. The model for this survey could also be adapted for other urban cities in Nigeria and the developing countries of the world where there are no reliable livestock population statistics.***

**Keywords:** Urban stratification, livestock population, diseases surveillances, Bioinformatics.

## INTRODUCTION

The civil service, railways and coal mining activities were among the attractions for early immigrant workers to Enugu. Many settlements, which now constitute the principal suburbs, had rapidly sprung up within and at the outskirts of the Coal City. Today, Enugu Urban is a heterogeneous community characterized by social stratifications.

Livestock (goat, sheep, pig, dog, cat, chicken, turkey, and duck) keeping in Enugu was a natural consequence of human settlement. There is now noticeable increase in the number of livestock on free range within the City. Many domestic animals, which strayed about the city, had constituted public menace. Moreover, the situation whereby domestic animals were allowed to scavenge on street garbage, refuse dumps, sewage effluents, slaughter premises, markets, shallow streams, open parks, farmlands, and school premises etc., constituted potential hazards to public and environmental health. *Toxocara canis*, one of the commonest parasites of dogs in many parts of the world (Woodruff, 1975; Stewart *et al.*, 1979), is the most important cause of Visceral Larval Migrans (VLM) in man (Beaver, 1956). Chiejina and Ekwe (1986) had reported on the environmental contamination associated with *Toxocara* eggs in dog feaces in Enugu and Nsukka. Dada and Belino (1979), Onadeko and Ladipo (1989) also described the public health significance of Ascariasis, Trichuriasis and helminthes' ova in dog feaces from Nigerian urban towns. Rabies is also transmitted to man through the bite of a rabid dog. 'Street rabies virus' (SRV) had been demonstrated in the saliva of dogs (Vaughn *et al.*, 1965). Other human infections like trichinosis and hydatid diseases may be contracted from infested pork and beef, respectively.

The aim of this pilot study was to establish stratification zones in Enugu Urban for an effective conduct of livestock population census, test the instruments of urban livestock population census, assess the reliability and usability of the demarcation maps and ascertain the time that may be required to conduct livestock population census for Enugu Urban. Since there is a dearth of information on livestock population figures in Enugu and other urban cities of Nigeria, data from this pilot survey and related studies may be useful in the formulation of Veterinary, Livestock, Public and Environmental Health Policies, as well as for Livestock Diseases Surveillances, Research Communications and Bioinformatics.

## MATERIALS AND METHODS

**Ground Survey:** Street map of Enugu Urban obtained from the Department of Lands, Surveys and Urban Planning, Enugu was used for this survey. Based on ground reconnaissance, six stratification zones were established. The extent of each stratum was demarcated on the stratification map of Enugu while the areas (Km$^2$) were determined by the use of a squared graph paper. Twenty-one sample blocks were randomly selected from the principal suburbs of Enugu (excluding commercial and farmlands which had no permanent livestock). The extent of the 21 sample blocks were established physically on the ground both by pacing (a pace ≈ 1 metre) and with the aid of a pedometer strapped to the hip belt. Guides to the extent of the strata and sample blocks were produced (Figure 1).

Table 1: Stratification zones and sample blocks in Enugu Urban*

| Stratification Zones | | | | Sample Blocks | | | |
|---|---|---|---|---|---|---|---|
| Strata | Text Abbreviation | Area ($Km^2$) | % of Urban Enugu | No. | Area ($Km^2$) | Bounding streets | Principal Suburbs (where sample blocks were located) |
| Unplanned Village Set-up | 'Village' | 9.69 | 5.38 | 1 | 0.76 | Entire Agu-Abor | Agu Abor |
| | | | | 2 | 0.56 | Half of Ugbo Odogwu | Ugbo Odogwu |
| | | | | 3 | 0.64 | Entire Ugwu Aaron | Ugwu Aaron |
| | | | | 4 | 0.70 | Entire Ugwu Alfred | Ugwu Alfred |
| High density areas | 'Township' | 20.25 | 11.25 | 5 | 0.24 | Nkpor – Atani – Ikem Streets | Abakpa |
| | | | | 6 | 0.18 | Inyi – Obioma – Umunwakum Streets. | Achalla Layout |
| | | | | 7 | 0.40 | Agbani Road – Umueze Street | Awkunanaw |
| | | | | 8 | 0.14 | Colliery Quarters | Coal Camp |
| | | | | 9 | 0.36 | Chima Avenue – Kano Street | New Haven |
| | | | | 10 | 0.46 | Agbani Road – Gold Smith Ave. | Ogbete |
| | | | | 11 | 0.26 | Edinburgh Road – Kenyatta St. | Ogui New Layout |
| | | | | 12 | 0.22 | Zik's Ave – Christ Church – Agbani Rd. | Uwani |
| Medium density areas | 'Low-cost' | 7.19 | 4.00 | 13 | 0.38 | Ichida Street – Osina Street | Federal Housing |
| | | | | 14 | 0.28 | Ogui Rd – 1st – 4th Avenue | Artisan Quarters |
| | | | | 15 | 0.86 | Imoke Street – Ekulu St – Nwodo Ave. | Trans-Ekulu Housing |
| | | | | 16 | 0.60 | NCO Blocks | Army Barracks |
| Low density areas | 'GRA' | 9.50 | 5.27 | 17 | 0.16 | Abakaliki Rd – Army Barracks | Army Officers' Qtr. |
| | | | | 18 | 0.30 | Rangers' Ave – Ezzikwo Street | Modern Residential |
| | | | | 19 | 0.38 | Abakaliki Lane – Charles Street | "GRA" |
| | | | | 20 | 0.26 | Riverside Estate – Air Force Base | Thinkers' Corner |
| | | | | 21 | 0.20 | ESUTH – WTC - UNEC | Campus Residential |
| Commercial areas | 'Industrial' | 26.44 | 14.70 | Livestock census was not carried out in 'Industrial' &'Open' (Uninhabited Urban Enugu) where no permanent livestock existed | | | |
| Undeveloped lands/Farms | 'Open' | 106.93 | 59.40 | | | | |
| Stratified Urban Enugu | | 180.00 | 100.00 | | | | |

**Total area of sample blocks in 'Village' = 2.66 $Km^2$ (27.45 % of 'Village'),Total area of sample blocks in 'Township' = 2.26 $Km^2$ (11.16 % of 'Township'); Total area of sample blocks in 'Low-cost' = 2.12 $Km^2$ (29.48 % of 'Low-cost'); Total area of sample blocks in 'GRA' = 1.30 $Km^2$ (13.68 % of 'GRA'); Total area of sample blocks = 8.34 $Km^2$ (17.88 % of inhabited Enugu); Area of inhabited Enugu = 46.63 $Km^2$ (25.90 % of stratified Enugu); Area of uninhabited Enugu = 133.37 $Km^2$ (74.10 % of stratified Enugu)*

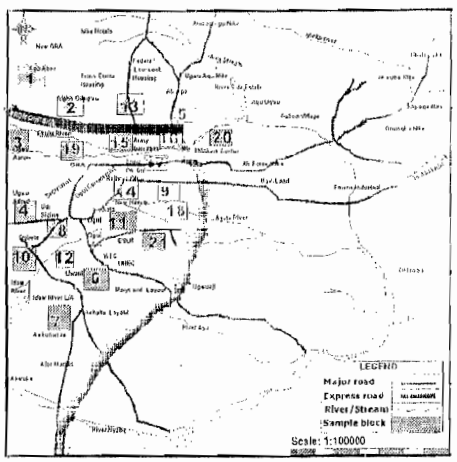


**Figure 1: Map of Enugu urban showing the principal suburb and 21 sampled blocks**

**Livestock Enumeration:** Three pairs of livestock assistants and a livestock superintendent served as enumerators and field supervisor respectively, while the researcher coordinated all activities. Field workers, provided with logbooks, were guided through the extent of the sample blocks. There were seven sample blocks per pair of enumerators.

Enumeration in each sample block required only two days (i.e., Saturday and Sunday) of a week, so that the entire fieldwork lasted for 14 working days spread in-between 7 weeks from February to April 2005. Data on every sample size (household) and species (livestock) enumerated were entered differently in the logbooks.

**Collation and Analysis of Data:** All data entries in the logbooks were collated and analyzed to obtain the estimated populations and population densities of each species of livestock in Enugu. Absolute numbers of animals in a stratum were obtained after multiplying the totals for the sample blocks in that stratum by 'a factor', which was the percentage area of that stratum represented by the sample blocks. The average livestock population density for Enugu (including commercial and farm lands) was obtained by dividing the 'total' for that livestock species by the area of stratified Enugu Urban.

## RESULTS AND DISCUSSION

The stratification of Enugu is illustrated in Figure 1. Six stratification zones (Strata) described for Enugu were unplanned Village set-up ('Village'), High-density areas ('Township'), Medium density areas ('Low-cost'), Low-density areas ('GRA'), Commercial areas ('Industrial') and Undeveloped lands/Farmlands

**Table 2: Livestock species enumerated from 21 sample blocks in stratified Enugu**

| Strata | Sample Blocks | Principal Suburbs | Households | | | | Livestock | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NR* | NL | LA | TH | Goat | Sheep | Pig | Dog | Cat | Chicken | Turkey | Duck |
| Village | 1 | Agu Abor | 5 | 4 | 113 | 122 | 93 | 35 | 15 | 40 | 8 | 211 | 30 | 50 |
| | 2 | Ugbo Odogwu | 3 | 3 | 121 | 127 | 58 | 24 | 25 | 35 | 5 | 521 | 51 | 42 |
| | 3 | Ugwu Aaron | 4 | 5 | 104 | 113 | 76 | 49 | 19 | 37 | 16 | 152 | 23 | 21 |
| | 4 | Ugwu Alfred | 9 | 3 | 108 | 120 | 68 | 61 | 29 | 29 | 9 | 273 | 18 | 28 |
| Township | 5 | Abakpa | 5 | 1 | 182 | 188 | 36 | 18 | 40 | 54 | 5 | 610 | 51 | 128 |
| | 6 | Achalla Layout | 4 | 3 | 156 | 163 | 53 | 42 | 18 | 45 | 7 | 421 | 20 | 92 |
| | 7 | Awkunanaw | 12 | 1 | 170 | 183 | 116 | 73 | 37 | 28 | 8 | 720 | 210 | 281 |
| | 8 | Colliery | 3 | 2 | 70 | 75 | 75 | 38 | - | 19 | 5 | 241 | 53 | 51 |
| | 9 | New Haven | 7 | 4 | 149 | 160 | 43 | 14 | - | 23 | 17 | 308 | 61 | 30 |
| | 10 | Ogbete | 2 | - | 165 | 167 | 143 | 70 | 16 | 76 | 21 | 652 | 43 | 69 |
| | 11 | Ogui New Layout | 2 | 15 | 80 | 97 | 204 | 96 | - | 35 | 10 | 446 | 52 | 45 |
| | 12 | Uwani | 11 | 2 | 210 | 223 | 127 | 74 | 10 | 23 | 15 | 390 | 95 | 109 |
| Low-cost | 13 | Fed. Housing | 8 | 20 | 121 | 149 | 71 | 33 | - | 41 | 8 | 271 | 110 | 15 |
| | 14 | Artisan Qtr | 9 | 14 | 110 | 133 | 144 | 81 | - | 59 | 7 | 188 | 232 | 25 |
| | 15 | Trans Ekulu Hous. | 2 | 12 | 124 | 138 | 77 | 35 | - | 65 | 18 | 171 | 181 | 39 |
| | 16 | Army Barracks | 10 | 11 | 80 | 101 | 120 | 57 | - | 14 | 13 | 280 | 25 | 43 |
| GRA | 17 | Army Offs' Qtr | 3 | 2 | 78 | 83 | 28 | 13 | - | 16 | 9 | 75 | 56 | 13 |
| | 18 | Mod. Residential | 3 | 1 | 125 | 129 | 58 | 29 | - | 46 | 16 | 63 | 27 | 9 |
| | 19 | "GRA" | 9 | 5 | 167 | 181 | 71 | 33 | - | 88 | 21 | 81 | 46 | 18 |
| | 20 | Thinkers' Cn. | 5 | - | 130 | 135 | 45 | 28 | - | 71 | 11 | 121 | 37 | 12 |
| | 21 | Campus Residential | 15 | 3 | 122 | 140 | 30 | 12 | - | 44 | 13 | 208 | 50 | - |
| TOTAL | | | 131 | 111 | 2685 | 2927 | 1736 | 915 | 209 | 888 | 242 | 6403 | 1471 | 1120 |

**NR = No response from Household (4.5 %); NL = No livestock owned by household (3.8 %); LA = Livestock owned by household (91.70 %); TH = Total number of households visited (2927)*

**Table 3: Estimated livestock population and population density of stratified Enugu**

| Species | Total Sample Blocks | | | | Estimated Livestock Population Stratified Urban Enugu | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 'Village' | 'Township' | 'Low-cost' | 'GRA' | Village (27.45)* | Township (11.16) | Low-cost (29.48) | GRA (13.68) | Total | Population Density |
| Goats | 295 | 797 | 412 | 232 | 8097 | 8894 | 12145 | 3173 | 32309 | 179 |
| Sheep | 169 | 425 | 206 | 115 | 4639 | 4743 | 6072 | 1573 | 17027 | 95 |
| Pigs | 88 | 121 | - | - | 2415 | 1350 | - | - | 3765 | 21 |
| Dogs | 141 | 303 | 179 | 265 | 3870 | 3381 | 5276 | 3625 | 16152 | 90 |
| Cats | 38 | 88 | 46 | 70 | 1043 | 982 | 1356 | 957 | 4338 | 24 |
| Chickens | 1157 | 3788 | 910 | 548 | 317 | 42274 | 26826 | 7496 | 108354 | 602 |
| Turkeys | 122 | 585 | 548 | 216 | 3348 | 6528 | 16155 | 2954 | 28985 | 161 |
| Ducks | 141 | 805 | 122 | 52 | 3870 | 8983 | 3596 | 711 | 17160 | 95 |

** **Absolute numbers of livestock in a stratum were obtained after multiplying the totals for all the sample blocks in each stratum by 'a factor (in brackets)', i.e., the percentage area of that stratum represented by the sample blocks. The average population density was obtained by dividing the 'Total' column by 180 Km$^2$, which was the area of stratified Enugu.***

('Open'). Iyioku, Nyaba, Asata, Ayo, Ekulu and Idaw rivers and Awa stream drain the Coal City, which is traversed by the Onitsha-Enugu-Port Harcourt Expressway.

Principal Suburbs and twenty-one (21) sample blocks are represented in Figure 1 while Table 1 shows the extent of the six (6) stratification zones (strata) and the twenty-one (21) sample blocks surveyed in Enugu Urban (180 km$^2$). Unplanned village set-ups (9.69 km$^2$ or 5.38% of stratified Enugu Urban) are nearly as old as the city and are located mostly on the outskirts of the city. 'Village' included Agu Abor, Agu Ugwu, Gabon, Obinagu, Onu Ogba Nike, Ugbo Odogwu, Ugwu Aaron, Ugwuaji and Ugwu Alfred. High-density townships (20.25 km$^2$ or 11.25 % of stratified Enugu) included Abakpa, Achalla layout, Asata, Awkunanaw, Idaw-river layout, Mainland, Mary land, New Haven, Ogbete (Coal camp), Ogui, Ogui New layout, Udi Siding (PWD and P and T Quarters), Ugwu Ago Nike, and Uwani. Medium-density areas (7.19 km$^2$ or 4.0 % of stratified Enugu) included the Federal low-cost houses, Trans Ekulu layout, Army barracks, and Railway quarters. Low-density 'GRA' category (9.50 km$^2$ or 5.27 % of stratified Enugu) included the Abakaliki Road GRA, Independence Layout, Government House, Modern and Campus

residential areas, Senior Army Officers quarters, and Thinkers corner.

Commercial areas (26.44 $km^2$ or 14.70 % of stratified Enugu) included the Air Force base, Emene industrial, Markets, Nike Lake Hotels, Ogui commercial, Secretariat, and WTC/Queens/ESUT/IMT areas. Undeveloped areas (106.93 $km^2$ or 59.40 % of stratified Enugu) were made up of farmlands and undeveloped plots at Akwuke, Amaoji, New GRA, Nkwubo Nike, Obinagu, Onu Ogba Nike, Ubaha Nike, and Ugwuaji, where permanent livestock were not observed. About 46.63 $km^2$ (25.90 %) of Enugu was regarded as inhabited and from which the 21 sample blocks (8.34 $km^2$ and about 17.88 % of inhabited Enugu) were located. Permanent livestock were observed here.

Data on household and livestock enumeration are presented in Table 2. 2927 households were visited during the exercise. Occupants of 131 (4.5 %) were either absent or did not respond. Occupants of 111 (3.8 %) had no livestock while those in 2685 (91.70 %) had one type of livestock species or the other.

Table 3 showed the estimated livestock population census figures for stratified Enugu (including 'Industrial' and 'Open' areas). The average population densities of the different livestock species (number per $km^2$) were estimated to be in the order of chickens (602) > goats (179) > turkeys (161) > sheep and ducks (95) > dogs (90) > cats (24) > pigs (21).

Large herds of nomadic cattle and many commercial poultry farms encountered during the survey, no doubt contributed to urban environmental contamination and pollutions but were not included in this pilot study, which was limited to small animals and ruminants that were usually kept in the 'back yard', allowed on free range and which frequently strayed within the urban city.

This study effectively tested the instruments of urban livestock population census, assessed the reliability and usability of the demarcation maps and ascertained the time that may be required to conduct livestock population census for Enugu Urban. Since the percentage of non-cooperation was $\leq$ 5%, the result may not contain any great 'unknown' within its figures. The study was also productive of results without waste of labour. The model for this pilot survey could also be adapted for use in other cities of the country and in the developing countries of the world where livestock population statistics are either unavailable or unreliable.

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