International Journal of Animal Health and Livestock Production Research
Vol.4, No.1, pp.41-54, 2020
Published by ***ECRTD-UK***
Print ISSN: ISSN 2059-903X
Online ISSN: ISS2059-9048

A TWO-STAGE SAMPLING DESIGN TO STUDY SMALL SCALE PRODUCTION OF LIVESTOCK OF HOUSEHOLDS IN UNWANA, NIGERIA: TOWARDS REDUCTION OF POVERTY

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ABSTRACT: *In this study, a statistical survey on small scale domestic livestock production of households in Unwana, Nigeria was carried out. The community was first partitioned into eight enumeration demarcation areas (EADs), two EADs were selected by simple random sampling method. Primary data were then collected from the selected areas (a two – stage sampling method). Data obtained were analyzed using sampling estimation theory to ascertain the actual population of livestock reared in the community, again, the chi- square goodness of fit test showed that fowls, goats and sheep are the most kept livestock among the households with estimated population of 56,790, 117,090 and 30240 respectively. The research recommended a modernized method of livestock keeping to maximize production. Engaging veterinary doctors to improve on the animal healthcare, productivity, food safety and safer environment. The work also observed that training of local livestock keepers and incentives from government will ensure a well-developed sector.*

KEYWORDS: livestock, chi-square, households, population, sampling.

INTRODUCTION

Food is one of the fundamental requirements of a family, meaning that access to quality food ensures active and healthy life. It is the basic necessity of life and it is a veritable weapon of war and peace (Ajiji & Ashom, 2015). As long as human exists, there will always be the need for food and the two major sources of food for mankind are crops and animals.

Livestock production is an integral part of food supply and can make a major contribution to food security. Access to adequate and balance food constitutes the most serious problems for most Nigerian households' today. A balance diet should furnish adequate amount of energy; protein, minerals and vitamins, and a substantial amount of it are derived from animal products. The greatest challenge facing any government especially in the developing countries like Nigeria is how to provide sufficient food both in quantity and in quality to her citizens and evidences abound in these countries, there is wide spread malnutrition and under nourishment. The energy and protein intake in these countries are grossly inadequate and this is particularly severe in vulnerable groups like children where it in low weight, various degrees of stunting growth, higher

susceptibility to dieses infections, high pre-weaning morbidity and mortality. About 45% of Nigeria children (3-36 months) are under-nourished and infant mortality rate of 8.5% in Nigeria is also partly caused by under nutrition and malnutrition since nutrition and health are closely related (Orwell, Clayton and Dugdale, 1984), (Kazimi and Kazimi, 1979).

Inadequate protein and energy intake among adults manifest in higher morbidity, susceptibility to diseases, weakness. Lack of concentration, various vitamin and mineral deficiency (poor vision symptoms, osteomalacia, anaemiasskin lesions), low life expectancy and immobilized labour force. In women, there may be pregnancy complications and high maternal deaths as a result of severe protein and energy malnutrition and babies born to such mothers are likely to have lower chances of survival. Protein- energy malnutrition refers to various degrees of nutritional disorders caused by inadequate quantities of protein and energy in the diet. Sufficient energy but insufficient protein leads to a condition called kwashiorkor; a disorder characterized by growth failure, swelling of belly, legs, etc. Livestock production in the developing countries is in the hands of small holders who are mainly found in the rural areas. Livestock production is a major component of the agricultural economy of Nigeria Agriculture bank, Micro-finance banks and bank of Industry and Ministry of Agriculture for improved species) for local livestock farmers.

Many scholars have carried out independent researches on domestic animals reared in households both in Nigeria and other countries of the world.

Clutton-Brock (1999) carried out a research on history of domesticated mammals, he showed in his work that animal husbandry is the branch of Agriculture concerned with animals that are raised for meat, fibre, milk, eggs or other products, it also includes day-to-day care of the animals. He equally observed that some organization in recent years, have raised livestock to promote the survival of rare breeds. Horst (1991) studied the keeping of native fowls the gene and adaptability, and found that indigenous chicken meal and egg are preferred in majority of the rural dwellers mainly because of their toughness, pigmentation, taste, leanness and suitability for special dishes and also for moderate/affordable prices. On performance of indigenous and exotic chickens, Ibe (1993) showed that the growth performance of normal, frizzle and naked neck chicken in tropical environment and observed that the Nigerian indigenous chickens possess small size and grows slowly and reach point of inflection earlier than the exotic chickens. Even work carried out by (Olawunmi, Salako and Afuwape, 2008) on morph metric differentiation and assessment on Fulani and Yoruba indigenous chickens showed that the Fulani ecotype chicken was bigger in size than the Yoruba ecotype chicken 1.76 ± 0.4 and 0.79 ± 0.21kg for Fulani and Yoruba respectively. A study on growth pattern of local and exotic chickens in Nigeria was also observed to have relationship with body size and growth rate (Nwosu, Obiorah, Fred, Belonwu, Onuora & Omeje, 1980). Nigerian Indigenous chicken as a resource for meat and egg production as easy way of growing employment and providing income when properly run, the findings revealed that, it is very lucrative and helps in feeding the nation and as a source of export income for the country (Ajayi,2010). Okenwu & Iheanacho (2015) in their study tried to determine the profitability of

fowl marketing in Benue State, Nigeria, multi-stage sampling technique was adopted. Two zones (B and C) were purposely selected out of the three agricultural zones in the state on bases of accessibility and relevance to the study. Antonid & Silver (2011) predicted that the demand for livestock products like goats will be doubled in the next 20 years due to world population increase, urbanization and economic growth. Fowl distribution and abundance quoted that Nigeria got population total (combining estimates both the 1990 traditional sector and the 1992 survey of commercial livestock enterprises) to be 34,500,000 livestock. The estimates based on standardized, systematic methods of sampling with population figure currently available, with standard error margins of less than 5 percent (Blench, 1993). Endeshaw (2007) emphasized on marketing aspect of livestock system. He said that marketing include all the activities required to support the movement of animals and animal products from the site of production to the end users.

Ogbeh (2016) the minister of Agriculture and Rural Development released census of goats, sheep, pigs and other livestock in Nigeria. National Agricultural Sample Survey, indicated that Nigeria was endowed with an estimation of 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs, 28 thousand camels 145 million chickens, 11.6 million dogs, 1.2 million turkeys and 974,499 donkeys. This impressive statistics made Nigerian number one in livestock rearing in Africa had not met the national demand of animal protein or contributed to the GDP over the years, the results also shows that Nigeria cows produced one litre of milk a day while a cow in Saudi Arabia or Brazil produced 30 to 40 litres per day. Saudi Arabia produces 4.7 litres of milk daily, while Nigeria imports about 1.3 billion worth of milk annually to make up deficit. The enterprise in the livestock sector showed only poultry industry has achieved an appreciable level of commercialization. Other industries in the livestock sector were predominantly in the hands subsistence farmers with pastorialistic system of production contributing over 90% of cattle production in the country. Nigeria livestock resources report on systematic sample survey which covered the whole of Nigeria. The aerial survey involved more than 650 hours flying at only a few hundred feet above ground level, using two locally registered light aircraft. Ground teams visited 2148 villages to characterize local livestock production system and record the livestock holding of 58162 households. He conducted urban livestock survey in 24 major towns and cities throughout the country. Among other livestock in the country with Camels, Horses, Cattles, Sheep, Chickens and Goats had a total of 90,000,200,000,900,000,139,000,000,22,100,000,82,400,000 and 39,800,000 respectively. Sales of livestock and their products provide direct cash income to farmers. Livestock are living bank for many famers and have a critical role in the agricultural intensification process through the provision of manure for crop production. There are also closely linked to the social and cultural lives of millions of poor famers. Animal products are source of disposable income for many small famers in developing countries; in fact, livestock production is the most important cash-cow in many small holders' mixed farming systems. Disposable income is important for purchase of food, agricultural inputs and other family needs. Cash can be generated from sales of livestock products regularly (milk, eggs) or sporadically (live animals, manure, meat, hides) or from service (draught, transport). Livestock represents liquid asset which can be realized

at any time adding stability to production system, higher employment generation. Major animals reared in Nigeria for consumption are cow, goat, pig and several others while poultry birds include chicken, turkey, and duck, fish with emphasis on cat fish breed.

Unwana is a city on the hill, is located in Afikpo North Local Government Area of Ebonyi State, Eastern Nigeria.it is located in latitude 5.7833' and longitude 7.9333'. Altitude 354 feet (107m), it has a total area of 190km2, 200m above sea level, it has one vegetation belt which is the fresh water swamp. Akanu Ibiam Federal Polytechnic is located in this city. (Wikipedia, 2019)

This paper is aimed at obtaining from the survey a more reliable up-to-date information about livestock resources and production system among households in order to establish a sound foundation for livestock development and planning. These were achieved though the following objectives:

1. Partitioning Unwana into Enumeration Area Demarcation's.
2. Estimating the population of livestock in the community
3. Establishing the most kept livestock among households.
4. And to know the economic potential of livestock keeping.

1.0 Materials and Methods

The community was first partitioned into eight EADs and sample of two EADs were selected by simple random sampling, thereafter data on livestock keeping were collected from households in these areas.

The target population for this research were drawn to include the households and domestic livestock kept in Unwana.

In this study, the accessible population comprised all the households and domestic livestock in the two (2) randomly selected villages in Unwana.

The technique was employed to ensure a fairly equal representation of the variable for the study with aid of table of random numbers.

The data collected is analyzed using Two – stage sampling. In two – stage sampling we first select a sample of units, called the primary units (PU) and then select a sample of second – stage units called secondary unit (SU), from each selected primary units. This techniques is also called sub – sampling.

The analysis made use of:

(i) Two – stage sampling with units of Equal sizes
(ii) Two – stage sampling with units of Unequal sizes

(a) Two – Stage Sampling with Units of Equal Sizes

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In these case, when n primary units are selected from N primary units in the population. Let a simple random sample of m secondary units be drawn without replacement from the M secondary units in each selected primary unit.

The primary units in this case contain equal number of secondary units. The characteristic of interest y is then obtained for each SU in the sample.

(b) Estimation of the Population Total and Variance

The unbiased sample estimator of the population total is

$$\hat{Y} = \frac{NM}{nm} \sum_{i=i}^{n} \sum_{j=i}^{m} Y_{ij}$$

$$\hat{Y} = \text{NM } \bar{\bar{Y}}$$

The variance of $\hat{Y}$ is

$$\text{V}(\hat{Y}) = \frac{N^2M^2}{n}[(1 - f_1)S_1^2 + (\frac{1-f_2}{m})S_2^2]$$

Where,

$$S_1^2 = \frac{\sum_{i=1}^{N} (Yi - \bar{\bar{Y}})_2}{N-1}$$

$$\boldsymbol{S_2^2 = \frac{\sum_{i=1}^{N} \sum_{j=1}^{M} (Yij - \bar{Y}i.)_2}{N\,(M-1)}}$$

$f_1 = \frac{n}{N}$ and $f_2 = \frac{m}{m}$

(C) Two – Stage Sampling with Units of Unequal Sizes

In this case, the primary units vary in size.

(d) Estimation of the Population Total and Variance

The unbiased estimator of the population total is

$$\hat{Y} = \frac{N}{n} \sum_{i=1}^{n} \frac{Mi}{mi} \sum_{j=1}^{m} y_{ij}$$

The variance is

$$V(\hat{Y}) = \frac{N2(1-F1)S_1^2}{n} + \frac{N}{n} \sum_{i=1}^{n} M_1^2 \left(\frac{1-f_{2i}}{mi}\right) S_{wi}^2$$

The sample estimator is

$$\hat{V}(\hat{Y}) = \frac{N^2(1-f_1)S_1^2}{n} + \frac{N}{n} \sum_{i=1}^{n} M_1^2 \left(\frac{1-f_{2i}}{mi}\right) S^2_{wi}$$

Where

$$\mathbf{S^2_{wi}} = \frac{\sum_j^m (yij - \bar{Y}i)^2}{mi-1}$$

$$\mathbf{S^2_1} = \frac{\sum_i^n (Mi\, yi - 1/n \sum Mi\, \bar{y}_i)^2}{n-1}$$

(e) Estimation of the Population Mean per Element

$Y = Y/M_0$

$M_0 = \sum_1^N M_i$

SAMPLING VARIANCE IS

$$V(Y) = \frac{N^2(1-f_1)S_1^2}{n\, M_0^2} + \frac{N}{nM_0^2} \sum_i^N M_1^2 \frac{(1-f_{2i})}{m_i} S_{wi}^2$$

Notations

N = Number of primary units (FSU)

N = Number of sample size for the FSU

M = Number of Sub – units (SSU)

M = Sample size for the SSU

For $i = 1,2, \dots, n$

$j = 1,2, \dots, m$

y_{ij} = Value obtained from the jth sub-units in the ith FSU (primary units)

$y_i = \sum y_{ij}$ in the total for all sampled sub-units in the ith FSU

$\bar{y}_i = \frac{1}{m} \sum y_{ij}$ is the sample mean per sub units in the ith FSU

$\bar{\bar{y}}_i = \frac{1}{mn} \sum y_{ij} = \frac{1}{n} \sum y_i$ is the overall sample mean per sub-unit.

$Y_i = \sum y_{ij}$ is the population total for all sub-units in the ith FSU

$\bar{\bar{Y}} = \frac{1}{NM} \sum \sum y_{ij}$ is the overall population mean per sub-unit

$\hat{Y}$ = NM$\bar{\bar{y}}$ is the population total

RESULTS AND DISCUSSION

This section contains the simple random sampling of 2 (two) EAD's Selected form a total of Eight (8) EAD's (i.e. First Sample Unit) using a random table of numbers. In each selected EAD's a list of households was prepared (i.e. Second Sample Unit) which is presented in the table below.

EAD VIII

Total Population = 81

Sample population = 25

Where, N = 1 to 81

EAD II

Total Population = 55

Sample population = 20

Where, N = 1 to 55

Estimation of the Total Number of Goat / Variance

EAD's	**Households**	**Number of Sample**	**Number of Goats (y_{ij})**
1	81	25	3,2,6,3,0,0,0,3,2,0,2,5,2,2,3,3,2,2,0,8,0,0,0,5,2
2	56	20	2,3,3,2,2,2,2,2,3,4,2,2,1,4,0,5,3,3,2,2

EAD's	M_i	m_i	$\bar{y}_i$	$M_i\bar{y}_i$	S_w^2	f_{2i}	$M_i^2\ (1 - f_{2i})\ S^2_w/m_i$
1	81	25	2.2	178.2	4.42	0.31	800.39
2	56	20	2.45	137.2	1.21	0.36	121.43
				315.4			921.82

$Y = \frac{N}{n}\sum_i^n M_i y_i$

$= \frac{8}{2}(315.4)$

$= \frac{2523.2}{2}$

= 1,261.6

= 1262 Goat

$V(y) = N^2 \frac{(1-fi)}{n} S_1^2 + \frac{N}{n} \sum M_i^2 \frac{(1-F_{2i})}{mi} S_w^2$

$= \frac{8^2}{2}(1 - {}^2/_8)\ 840.5 + \frac{8}{2}(921.82)$

= 32 X 0.75 X 840.5 + 4 X 921.82

= 20,172 + 3687.28

= 23,859.28

Standard Error = $\sqrt{v\ (Y)}$

$= \sqrt{23{,}859.28}$

= 154.46

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Estimation of the Total Number of Fowls / Variance

EAD's	**Households**	**Number of Sample**	**Number of Goats (y_{ij})**
1	81	25	14,13,7,14,5,5,0,4,0,0,5,0,0,5,0,0,0,6,0,11,0 ,8,8,0
2	56	20	3,5,6,8,10,8,4,3,6,0,4,6,8,0,4,7,4,5,6,10

EAD's	M_i	m_i	$\bar{y}_i$	$M_i\bar{y}_i$	S_w^2	f_{2i}	$M_i^2\ (1-f_{2i})\ \frac{s_w^2}{m_i}$
1	25	25	4.4	356.4	23	0.31	4164.92
2	20	20	5.35	294	7.61	0.36	763.68
				650.4			4928.6

$\hat{Y} = \frac{N}{n}\sum_i^n M_i y_i$

$= \frac{8}{2}(650.4)$

$= \frac{5203.2}{2}$

$= 2601.6$

$= 2602$ Fowls

$\hat{V}(\hat{y}) = \frac{8^2}{2}(1 - {}^2/_8)\ 1946.88 + \frac{8}{2}(4928.6)$

$= 32\ (0.75)(1946.88) + 4\ (4928.6)$

= 46725.12 + 19714.4

= 66,439.52

Standard Error = $\sqrt{\text{v}\,(\hat{Y})}$

= $\sqrt{66{,}439.52}$

= 257.76

Estimation of the Total Number of Fowls / Variance

EAD's	**Households**	**Number of Sample**	**Number of Goats (y_{ij})**
1	81	25	2,1,2,2,0,0,0,8,0,0,0,0,0,0,2,4,0,0,0,3,0,4,2,2,0
2	56	20	2,2,1,0,0,0,0,2,1,0,0,3,0,0,6,0,0,2,4,0

EAD's	**M_i**	**m_i**	$\bar{y}_i$	**$M_i\bar{y}_i$**	S_W^2	**F_{21}**	$M_1^2\,(1 - f_{21})\,S^2_w/mi$
1	81	25	1.28	103.68	3.71	0.31	671.82
2	56	20	1.15	64.4	2.77	0.36	277.98
				168.08			949.8

Y = $\frac{N}{n}\sum_i^n M_i y_i$

= $\frac{8}{2}$ (168.08)

= $\frac{1344.64}{2}$

= 672.32

= 672 Sheep

$\hat{V}(\hat{y})= \frac{N^2}{n}\ (1 - f_{2_i})\ S_1^2 + \frac{N}{n}\sum_i^n\ M^2\ (1 - f_{2_i})\ S_w^2\ /\ m_i$

$= \frac{8^2}{2}(1 - {}^{2}/_{8})\ 771.46 + \frac{8}{2}(949.8)$

= 32 (0.75)(771.46) + 4 (949.8)

= 18515.04 + 3799.2

= 22314.24

Standard Error = $\sqrt{v\ (Y)}$

$= \sqrt{22314.24}$

= 149.38

Conclusions

From the estimation of the total number of livestock, the following result were obtained. Multiplying the estimated means and the population shows that:

Total number of Fowls is 117,090, total number of goats is 56,790, and, total number of sheep is 30240 and their respective result on variance / standard error are Goat = 23859.28 & 154.46, Fowls = 66439.52 & 257.76, Sheep = 22314.24 & 149.3

The population of livestock had become stably more important in economy of the country and have a positive impact on rural household food security and decreasing poverty levels.

It is concluded that population of goats and fowls are the most kept livestock in all the three kind of livestock under study.
In Unwana, there are large households who keep more goat and fowl as compared to sheep and average household farmers keeping large number of goats compared to fowl and sheep. The reason is not far from the fact that sheep survive in dry zones hot or cold, while goat can survive in differing climatic conditions.

The paper recommends a modernized method of livestock keeping to maximize production, engaging veterinary doctors to improve on the animal healthcare, productivity, food safety and

safer environment. Training of livestock keepers and incentives from government will ensure a well-developed sector.

There should always be a provision for insurance for small famers, so as to avoid erratic livestock pricing systems.

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