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## **Analysis of Effects of House Rodents among Farmers in Jos North Local Government Area of Plateau State, Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author PGK designed the study, performed the statistical analysis and wrote the literature review of the manuscript. Authors ETY and TEO managed the analyses of the study. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The study analyzed the effects of house rodents among farmers in Jos North Local Government Area of Plateau State, Nigeria. Data were collected from primary source through the administration of structured questionnaire on 190 farmers' selected using a purposive random sampling technique. Data were analyzed using descriptive statistics and Logit regression. Results revealed that females were 66.3%, 61.6% aged 20-30 years, 51.1% were married, 47.7% had the household size of 6-10 people, 53.3% had an estimated annual income of < ₦100,000.0. The results further indicated that 46.3% were civil servants, 49.5% occupied 4 rooms apartment, 84.2% furniture was destroyed, 76.3% used rodent glue pad for control, inconveniences ( $\bar{x} = 3.04$ ) was one of the major factors that influenced the method used for control of rodents and lack of finance ( $\bar{x} = 3.15$ ) was one of the major constraints faced in controlling house rodents. The results of Logit regression showed that sex (4.216) and major occupation (3.328) positively and significantly influenced the choice of

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method used for control at  $p < 0.005$  and  $p < 0.010$ . It is recommended that public enlightenment on proper sanitation and methods of control should be carried out regularly to reduce the menace.

**Keywords:** House rodents; farmers; Nigeria; Logit regression.

## 1. INTRODUCTION

Rodents belong to the Order Rodentia and it comprises over 2,000 species, which are subdivided into many families. The *Capromyidae*, *Castoridae*, *Cricetidae*, *Erethizontidae*, *Sciuridae*, *Dipodidae* and *Muridae* are some of the common families. The Family *Muridae* is the largest, containing nearly two-thirds of all rodent species. This family includes several sub-families like sand rats, gerbils, crested rats and old-world rats and mice [1]. They are generally viewed as pests due to the economic losses caused to agriculture and the prospects of the spread of diseases from them. However, they play an important ecological role as prey of numerous small carnivores [2].

Illinois Department of Public Health (IDPH) (2006) the house mouse, *Mus musculus* is considered one of the most troublesome and economically important pests. These rodents live and thrive under a variety of conditions in and around homes, they are black or brown rodents with relatively large ears and small eyes. An adult weigh about 1.2 kg and is about 51.2 to 71.2 inches long, including 3 to 4-inch tail, they feed on cereal grains. In a single year, a female may have five to 10 litters of usually five or six young, each young is born 19 to 21 days after mating, and they mature in six to ten weeks. The life span of rodent is about nine to twelve months.

Rodents are warm-blooded mammals that are found throughout the world, they have oversized front teeth for gnawing and the teeth are adapted for chewing. They chew on a variety of items available to them and cause great damage in and around homes. Prevention measures may include cleaning efforts and landscape alteration because they produce odour and contamination. On an individual level, homes can be rodent-proofed through identifying and sealing many possible entry points [3].

According to Agriculture and Horticulture Development Board [4], rodents present a significant risk to human health, animal health and welfare, food hygiene, structural integrity and

safety. Some of the diseases, parasites and bacteria that they harbour are transmissible to humans, companion animals and farm livestock. World Health Organization (WHO) noted their internationally accepted significant public health pest status. Rodents require three major things for infestation, and they include food, water and harbourage. Rodents are widespread in nearly all parts of the globe, except in north-eastern and eastern parts of Asia and northern Canada. The Norway rat *Rattus norvegicus* and black rat *Rattus rattus*, is the most important rodent pest in stored products in Nigeria [5].

Rodents are a common problem in human living and working environments since humans began living in permanent dwellings. Even today, many people believe that rodent infestations are inevitable. However, the recent appearance of hantavirus (also known as sin hombre virus, hantavirus pulmonary syndrome, HPS) has re-awakened the public to the serious health consequences posed by rodents and has prompted new inquiries into more effective ways to manage infestations [5].

House rodents are considered one of the most troublesome and economically important pests; they live and thrive under a variety of conditions in and around homes and farms. House rodent consume food meant for humans or pets. They contaminate food-preparation and surfaces with their faeces which can contain the bacterium that causes food poisoning (salmonellosis) [6]. Controlling rodents in buildings is very important from the perspectives of both their potential effects on human health and their possible damage to physical structures. Rodent control can be an attainable goal, but it always demands more than randomly setting out a few traps. The most important consideration of all is that rodents must be prevented from entering the building (or room). This demands cooperative efforts among all involved persons-that is, building occupants, pest management professionals, maintenance staff and site managers, in frequently inspecting buildings and promptly closing small, seemingly unimportant holes. The importance of good sanitation practices and effective trapping and monitoring programmes cannot be overstated.

These measures are neither complicated nor excessively difficult; however, rodent control is usually unsuccessful when these critical actions are not fully undertaken [5].

There are two very important reasons for controlling rodent populations in and around structures occupied by humans: Rodents can be responsible for spreading disease and rodents can damage buildings and building contents. The most important reason to control rodents is potential health risks from human contact with rodents or rodent debris. Rodents are known to be capable of carrying over 200 disease organisms, many of which can be transmitted to man. Many of these diseases are spread while rodents wander about in buildings at night searching for food and mates. During those activities, they continually drop feces, urine and hairs, which can come in contact with human foodstuff, eating utensils and bedding, or can be responsible in other ways for the spread of diseases.

Rodent food caches and nests and dead rodent carcasses (i.e., poisoned animals or animals dying from natural causes) cause secondary health issues when they attract parasites, flies, carpet beetles and other pests; all of which can cause serious problems in buildings and act as agents of human diseases. The nighttime activities of rodents inside buildings can result in sleep disturbances to human occupants and in rare cases; they have been associated with paranoid fears and even serious accidents.

Rodents often build nests and store large amounts of food (e.g., acornseeds, etc.) behind walls or in attics and such storage can cause structural damage and attract other pests. They often burrow into and re-arrange wall and damage insulation because of their habit of gnawing on objects, they may damage upholstered furniture, museum collections, paper and leather goods, clothing and electrical lines and equipment (including computers). Many structural fires are thought to result from electrical wiring damaged by rodents.

The mere presence of rodent burrows attracts large predatory animal that enlarges the burrows, resulting in additional structural damage. Rodent-associated damage to buildings increases the potential for deterioration from weathering, moisture and other sources. Rodents frequently enter and make nests in parked machinery and vehicles and damage electrical wiring and hoses.

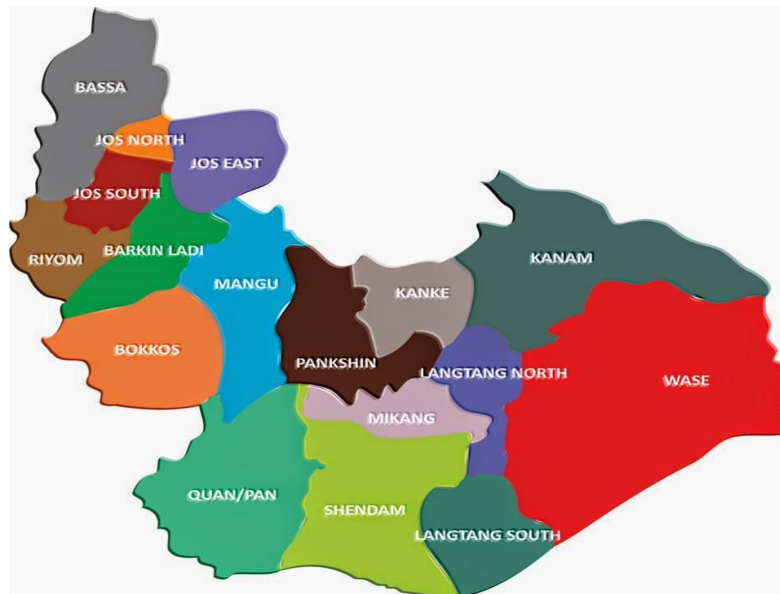
According to Stenseth et al. [6], some are endangered and need measures to protect their populations. However, a few species mainly of rats and mice can present threats to human interests. They are controlled for various reasons including prevention of diseases in humans, farmed livestock and companion animals, prevention of loss or damage to growing crops and stored foodstuffs, prevention of structural damage to property and installations and protection of biodiversity among others. Rodents thrive on the rich food supply provided by the agricultural production system. The application of rodent control is often poorly timed or inadequate so that populations recover quickly, or else control is performed in response to high rodent numbers, after the damage has been done [6].

The efficacy of control has been limited, not only by the cost of rodenticides, but also because farmers tend to apply control actions independently of each other in their homes leading to rapid reinvasion of the rodents. Unified control at a community level is clearly required [6].

## 2. METHODOLOGY

The study was carried out in Jos North Local Government Area (LGA), Plateau State. The State lies in North-Central Nigeria. The LGA is located in the north-eastern part of the State. Plateau State is bordering Bauchi State on the north and Kaduna State on the south. Plateau State has 17 LGAs with a landmass of 291km<sup>2</sup> and a population of 429,300 [7]. The LGA is located between latitudes 9°91 to 8°1N and 8° to 8°4E [8].

The Jos North LGA has (13) council wards [9]. It is predominantly occupied by Jarawas (a local tribe in the area). Other tribes residing in the area include Hausa, Igbo, Yoruba and Idoma. The topography of the area varies from rocks, hills and plain lands. The population of the study consisted of all farmers resident in Jos North Local Government Area of Plateau State. For this study, data were collected from 190 residents in Jos North Local Government Area, Plateau State. A multi stage sampling technique was used to select 190 respondents. In the first stage, Jos North LGA was purposively selected because of the intensity of house rodents damage to domestic items. In the second stage, ten (10) out of the thirteen (13) council wards were purposively selected, they included Lamingo, Fudawa, Tudun Wada, Furaka, Jos



**Fig. 1. Map of Plateau State showing the study area**

Keys: Shows the study area

Source: Jotscroll [9]

Jarawa, Jenta Apata, Angwan-Rogo, Gangare, Naraguta A, Naraguta B. In each of the wards selected, simple random sampling was used in selecting (19) respondents, making a total of 190 respondents. Primary data were used in this study. The primary data were collected using a structured questionnaire. The data collected were analyzed using descriptive statistics and multinomial logistic regression analysis.

### 3. MODEL SPECIFICATION

#### 3.1 Multinomial Logistic Regression Model

The multinomial logistic regression analytical technique was used in this study for testing hypothesis. The multinomial logistic regression model is appropriate because the dependent variables, numbers of control methods are qualitative in nature. The multinomial logistic regression model is a binary choice technique, which allows for the prediction of effects of independent variables on the dependent variable. The multinomial logistic regression model is chosen as the best approach used for handling multinomial dependent variable (Aidrich and Nelson, 1987). In estimable form, the model is expressed as:

$$\text{Log } Y = B_0 + B_1 X_1 + B_2 X_2 + B_3 X_3 + B_4 X_4 + B_5 X_5 + \dots + B_8 X_8 + U_i$$

Y = Probability that a farmer used a least two control methods measures = 1, otherwise = 0

X<sub>1</sub> = Age (years)

X<sub>2</sub> = Sex Estimated annual income

X<sub>3</sub> = Marital status

X<sub>4</sub> = Major occupation

X<sub>5</sub> = Household size

X<sub>6</sub> = Estimated cost of a control in a year (Naira)

X<sub>7</sub> = Number of rooms occupied

X<sub>8</sub> = Estimated annual income

B<sub>0</sub> = Constant term

B<sub>i</sub> = i = 1, 2, ..., 8, parameters to be estimated

U<sub>i</sub> = Independent distribution error term.

#### 3.2 Socio-economic Characteristics of the Respondents

Results in Table 1 show that 66.3% of the respondents were females. This implies that control of house rodents in the study area was not based on gender as both males and females carry out control practices. However, females as home front keepers were more involved than males. The results further depict that 61.1% of respondents were between 21-30 years old. This is an indication that the respondents were young/in their active age.

The distribution of respondents according to marital status revealed that 51.1% were married. Married people are more responsible and may

have more items kept in their apartments which may attract rodents attack and destruction. Married people are also more careful with items kept in their apartments to avoid destruction of the household items. The results in Table 1 indicate that 70.5% of the respondents acquired tertiary education. Education is very important as it widens the horizon of an individual. Educated people can also manage their home more carefully in terms of elimination/eradication of

house rodents. Rodents are very dangerous organisms, they are very smart, sensitive and above all very destructive which require very careful person in attempting to eliminate them from the house. Education also exposes people to different ways of eliminating the rodent menace. An educated person also can read and understand instructions on how to formulate rodent bait among others for the elimination of house rodents.

**Table 1. Socio-economic characteristics of respondents (n=190)**

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Sex</b>		
Female	126	66.3
Male	60	33.7
<b>Age</b>		
20-30	117	61.6
31-40	49	25.8
≤ 20	16	8.4
< 40	8	4.2
<b>Marital status</b>		
Married	97	51.1
Single	83	43.7
Divorced	7	3.7
Separated	3	1.6
<b>Household size</b>		
6-10	90	47.4
1-5	78	41.1
11-15	13	6.8
16 and above	9	4.7
<b>Level of education</b>		
Tertiary	134	70.5
Secondary education	25	13.2
Non-formal education	21	11.1
Primary education	10	5.3
<b>Estimated annual income</b>		
< 100,000.0	101	53.2
> 301,000.0	64	33.7
100,000.0 – 200,000.0	21	11.1
201,000.0 – 300,000.0	4	2.1
<b>Major occupation</b>		
Civil service	88	46.3
Artisan	47	24.7
Farming	33	17.4
Petty trading	22	11.6
<b>Number of rooms occupied</b>		
Four rooms	94	49.5
Three rooms	63	33.2
Two rooms	16	8.4
One room	15	7.9

The result of the estimated annual income shows that majority (53.2%) earned ₦100,000. The amount of annual income obtained by a household determines to some extent the purchasing power and the quality of life of an individual or the entire household. Households with low annual income may find it difficult to acquire very effective means of controlling house rodents. On the other hand, households with a reasonable amount of income can be able to acquire very effective means of controlling household rodents even if they are costly.

Result of respondents' occupation reveal that 46.3% were civil servants. Civil servants are people who are educated to a certain level, therefore they should be able to read instructions on packages of rodenticides, understand and apply these correctly. In Nigeria, civil servants are poorly and irregularly remunerated. If they do not have any other source of income, they may find it difficult to acquire rodenticides and other preventive measures that may not be effective.

The results in Table 2 show that 84.2% of the items destroyed were furniture. Furniture is one of the basic items required in a house for the household comfortable living. All human beings require and use furniture. Furniture like chairs,

when rodents enter into the house they perforate and occupy it, thereby making it very difficult to be completely eliminated except very effective methods are used. House rodents present a significant risk to human health, animal health and welfare, food hygiene, structural integrity and safety.

Many kinds of physical damage are incurred when rodents infest buildings. The rodents often build nests and store large amounts of food (e.g., acorns, nuts, seeds, etc.) behind walls, inside furniture or in attics and such storage can cause structural damage and attract other pests [10].

The results in Table 3 show that 76.3% of respondents used rat and glue pad to control rodents. There are several methods of controlling house rodents; some of them are very safe for use in the house while others are not good to be used in the house inhabited by human beings. The use of rat and glue pad for rodents control is environmentally safe. The method when applied has a side effect only on the rodent that comes in contact with it. The rat and glue pad can also be used where there are pets. However, the application of chemicals cannot be used where there are pets in the house. This implies that the use of rat glue pad for controlling house rodents should be encouraged.

**Table 2. Distribution of respondents by domestic items destroyed by house rodents**

Items destroyed	Frequency*	Percentage*
Furniture	160	84.2
Books and stationeries	149	78.4
Cereals	147	77.4
Kitchen utensils	140	73.7
Footwears/clothes	125	65.8
Poultry/poultry products	92	48.4
Electrical fittings	68	35.8
Ceilings	64	33.7
Mattresses	64	33.7
Curtains	34	17.9

\*Multiple responses

**Table 3. Distribution of Respondents based on Methods used in Controlling House Rodents**

Method of control	Frequency*	Percentage*
Rat glue pad	145	76.3
Rodenticides	120	63.2
Sanitation	106	55.8
Cats and dogs	55	28.9
Use of traps/baits	53	27.9
Repellents	21	11.1
Anticoagulants	12	6.3
Fabricated rodent proof	12	6.3
Integrated pest management	6	3.1

\* Multiple responses

**Table 4. Mean scores of factors influencing methods used in rodent control**

Factor	Mean	Std. Deviation
Inconveniences	3.04	0.872
Rodenticides resistance	2.80	0.862
Lack of information	2.71	0.935
High cost of rodenticies	2.35	1.02
Damage to domestic items	1.97	0.727
Ignorance	1.78	0.961

*Cut-off mean=2.50*

Results in Table 4 indicate that (inconveniences, rodenticides resistance, lack of information and high cost of rodenticies) were all factors that influenced methods of rodents control except damage to domestic items and ignorance. House rodents are very difficult to control for many reasons. There are two major ways of controlling rodents, physical and chemical methods. In making use of any of the methods, inconveniences are experienced. For instance, if a house occupant uses chemical control, the chemical may produce a pungent smell that could make the occupants uncomfortable. If a trap is used, it may obstruct free movement of pets in the house. Similarly, if a chemical is wrongly applied, the rodents may become resistant to the chemical and they become more difficult to eliminate. This implies that some of the control measures have negative effects.

This finding confirms Mian et al. [11] who stated that home owners, farmers and extension personnel are often confused as to how a product may be effectively used to effectively control rodents. Local labels typically lack adequate use directions and provide only generic instructions that leave users guessing or improperly improvising untested application methods.

Results in Table 5 indicate that (lack of finance, lack of direction on rodenticides application,

wrong bait formulation and lack of efficacy of rodenticide) were all constraints to the control of house rodents except fear of contamination of the house. This implies that there were many constraints associated with the control of house rodents. For example, if a bait is not properly prepared it cannot be effective. Similarly, if someone is not aware of a control measure he/she cannot apply it. The finding corroborates that of the Rural Development Service [12] which stated that for welfare reasons, only traps with the appropriate size and design to kill the target animal should be used, they should be well-maintained, set and positioned to minimize the risk of causing sub-lethal injuries.

Results in Table 6 show the multinomial logistic regression on socio-economic characteristics on choice for methods used in controlling house rodents. Sex significantly and positively (4.216) affected the propensity of respondents to choose a method of controlling rodent within 5% statistical significance ( $0.0400 < 0.05$  standard error). This implies that a unit increase in males in use of a particular control method than female increases the probability of that control method by 70.6% of a unit. Major occupation has positive (3.328) and significant effect on choice of a method for controlling rodent within 10% statistical significance ( $0.068 < 0.10$  standard error). This implies that a unit increase in civil service decreases the probability of use of more control methods by 81.9% of a unit.

**Table 5. Mean scores of constraints to controlling house rodents**

Constraints	Mean	std. deviation
Lack of finance	3.15	0.829
Lack of direction on rodenticides application	3.08	1.105
Wrong bait formulation	2.98	1.003
Wrong preparation of bait	2.87	1.007
Lack of awareness on control measure	2.81	1.037
Lack of efficacy of rodenticides	2.67	0.878
Fear of contamination of the house	1.82	0.749

*Cut-off mean = 2.50*



**Table 6. Multinomial logistic regression of socio-economic characteristics of respondents on choice of control methods of rodents**

Variable	B	S.E	Wald	Df	Sig.	Exp(B)
Age	-0.364	0.317	1.317	1	0.251	0.695
Sex	0.706	0.344	4.216	1	0.040**	2.026
Marital status	0.429	0.407	1.112	1	0.068	0.441
Major occupation	-0.819	0.449	3.328	1	0.068	0.441
Household size	-0.031	0.207	0.022	1	8.82	0.970
Estimated cost of control in a year	-0.016	0.021	0.585	1	4.44	0.984
Number of rooms occupied	0.157	0.184	0.720	1	3.96	1.169
Estimated annual income	0.000	0.000	1.591	1	2.07	1.000
Constant	6.56	8.09	6.57	1	4.18	1.927
Cox and Snell R <sup>2</sup> = 53						
Chi-square = 10.211						
Nagelkerke R <sup>2</sup> = 0.73						
-2 log likelihood = 231.754*						

\*, \*\* Significant at 5% and 10% levels respectively

The chi-square statistics ( $X^2$ ) value of the multinomial logistic regression model is 10.21 and was significant at 5%. This implies that the socio-economic characteristics of the respondents have a significant effect on choosing a method of controlling rodents. The cox and Snell R<sup>2</sup> value of the multinomial logistic regression model indicate that 53% of the variations of the dependents variables were explained by the logistic regression model. The result also shows that Nagelkerke R<sup>2</sup> for regression is 0.73 indicating that the variables tested attributed to the error term.

#### 4. CONCLUSION AND RECOMMENDATIONS

House rodents are one of the most troublesome and costly rodents in Nigeria. It thrives under a variety of conditions; they are found in and around homes and commercial structures as well as in open fields and on agricultural land. House rodents consume and contaminate food meant for human consumption, pets, livestock and other animals. In addition, they cause considerable damage to structures and property and they can transmit pathogens that cause diseases. House rodents cause more destruction to furniture and glue and pad was used in controlling them. It is recommended that public enlightenment on proper sanitation and methods of control should be carried out to reduce the menace.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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