



People's Perception about Plant-based Formulated Diets as a Non-chemical Method of Rodent Population Control in Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A total number of two hundred and thirty five (235) respondents responded to the self-structured (online Google form) questionnaires administered to them without being bias to sample their opinions on the performance of common rodent population control methods and their readiness to embrace plant-based formulated diets as a method of rodent population control in Nigeria. Statistical Package for Social Sciences (SPSS) was used to analyze the questionnaires. The results showed that rodent population should be controlled to reduce their damage to agricultural crops (97.4%), to reduce zoonotic diseases (94.9%), and for conservation reasons (82.6%) in Nigeria. It was also revealed that some of the common rodent population control methods were found to be humane, cost effective, acceptable, and effective but at different levels. The plant-based formulated diet as a method of population reduction would be humane (69.8%), acceptable (65.1%), and effective (68.5%) method. The plant-based formulated diet was viewed as a promising method and this indicated readiness to adopt the method as an alternative to the common methods of rodent population control.

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1. INTRODUCTION

Rodents are a group of vertebrates known to be ubiquitous and persistent in a different ecosystem especially agro-ecosystem. Some of the rodent species are regarded as small mammals whose adult body weights do not exceed 5 kg [1]. About 5-10% of the rodent species have been implicated globally as the most destructive pests due to the tremendous pre- and post-harvest damages they cause in the agricultural ecosystem [2]. Despite this understanding, accurate assessment of losses caused by the rodents in pre- and post-harvest agriculture is difficult to obtain for most sub-Saharan African countries [3]. Some rodent species also have health implications because of their close association with human habitation thereby causing zoonotic diseases such as leptospirosis, Lassa fever, plague, etc while some cause social problems due to the nuisance they constitute in the environment [4]. Unfortunately, little attention is given to rodent-to-human diseases which results in recording the considerable number of death due to rodent-borne diseases in Africa each year apart from the fact that they inflict tremendous damage to field crops and store produce.

The economic and social impact of such damage occasionally makes the news when, for instance, expensive hospital equipment is damaged or buildings burn down due to rodent damaged cables, but such damage is rarely quantified. Across the world, the order Rodentia has been identified as the largest mammalian order with over 42 percent of all mammalian species [5]. The success of this mammalian order is attributed to their high reproductive potential and high adaptive ability as they are indigenous to all continents except Antarctica [6]. They have various lifestyles ranging from terrestrial species e.g. Cane rats; to Aquatic species e.g. Beaver, Arboreal species e.g. Tree Squirrels; and fossorial species e.g. Giant rats [7].

At present, United Nations has come up with the 2030 Agenda for Sustainable Development which is part of the efforts to call for actions to change our world for better. Interestingly, the United Nations considered poverty and hunger eradication (Goal 1: End poverty in all its forms everywhere; Goal 2: End hunger to achieve food security and improved nutrition and promote sustainable agriculture) as the first two goals

needed to be achieved on or before year 2030. These two goals as highlighted by the United Nations could only be achieved if there are more people to promote sustainable Agriculture. Hitherto, rodent pests, being the most destructive pests to field crops and stored produce, are perceived to be one of the problems that could discourage prospective farmers who would come together to help achieve the goals of poverty and hunger eradication through promoting sustainable Agriculture. The best approach to managing and controlling pests effectively is the use of Integrated Pest Management (IPM).

There is an IPM approach to rodent management known as Ecologically-Based Rodent Management (EBRM) which involves minimizing the use of chemical rodenticides in the management and control of rodent pests. It is aimed at providing strategies which are economical, sustainable, and minimally damaging to the environment. Although chemical pesticides will continue to form an integral part of IPM for the foreseeable future if pest management is to remain rational, their use could be greatly reduced if consumers could be educated to accept lower cosmetic quality of products.

In addition, it is believed that if there are other alternative measures to chemical rodenticides which are acceptable, cost effective, and environmentally friendly, the choice of chemical rodenticides and their attendant health risks would be reduced. Therefore, there is need to sample people's Opinions on the performance of common rodent population control methods and their readiness to embrace plant-based formulated diets as a method of rodent population control in Nigeria.

2. MATERIALS AND METHODS

2.1 Description of Study Area

The present study was carried out in Nigeria with human population of about 200 million people. Nigeria is situated in the West African region and lies between longitude 3° and 14° and latitude 4° and 14°. It has a land mass of 923,768km². It is bordered to the north by the Republics of Niger and Lake Chad; it shares borders to the West with the Republic of Benin, while the Republic of Cameroun shares the Eastern borders right down to the shores of the Atlantic Ocean which

forms the southern limits of Nigerian territory. The 800km of coastline confers on the country the potentials of a maritime power. Land is in abundance in Nigeria for agricultural, industrial, and commercial activities [8]. There are two basic seasons; wet season which lasts from April to October; and the dry season which lasts from November till March [8].

2.2 Sample Size

The sample size for the present study was calculated using the formula below:

$$n = \frac{z^2 pq}{e^2}$$

where n = the required sample size,
z = the critical value (1.96) at 95% confidence level,
p = an estimated proportion,
q = 1-p,
e = the margin of error which is fixed at 0.05 [9]

An estimated proportion of 82% was used for sample size computation for this study because it was believed that people already had some levels of understanding of the common methods of rodent population control. The study only seeks to sample their opinions on the performance of the methods of control which might vary and to know their readiness to embrace a novel but alternative methods of control aiming towards fertility control using plant-based formulated diet. So, the calculated sample size was 227 but the number retrieved was 235.

2.3 Sampling Technique

Self-structured questionnaire which was reviewed by an expert in the Department of Agricultural extension and Rural Development, University of Ibadan, was sent to individuals who were Nigerians but without prior knowledge of their genders and geopolitical zones. However, the respondents were asked to provide their socio-demographic details such as sex, age, marital status, geopolitical zone, occupation, and level of Education. Other aspects of the questionnaires include whether the respondents have specific interest in Rodent management, categories of rodents considered as pests, views of respondents about reasons for rodents

population control, their perception about the commonly used methods of rodents population control in terms of their humaneness, effectiveness, acceptability, and cost-effectiveness, perception about adoption of plant-based formulation in reducing rodents fertility as a population control method.

The questionnaires were designed in Google form format and administered via social media using the form link. They were administered in such a way that respondents could only fill out the questionnaire form once. The questionnaires were then completed and submitted online which were downloaded in Microsoft excel format to have their responses analyzed.

2.4 Data Analysis

The questionnaires were analyzed using Statistical Package for Social Sciences (SPSS version 20.0). Frequencies and percentages of the responses as given by the respondents were computed for each of the questions in the questionnaire and data were presented using tables and figures. Test of significance was computed using Chi-square.

3. RESULTS

3.1 Socio-demographic Profile

The total number of respondents was 235. More males participated (69.4%) in the study than females (30.6%). The age category (years) that took part most (30.6%) in the study was 35-40 while the least participated age category (6.4%) was 18-22. As revealed from the result of the study, majority of the respondents (81.7%) were from South west geopolitical zone. More than half of the respondents were married (57.9%) while the remaining respondents were single (42.1%) as none of the respondents was separated, divorcee, or widow(er) (Table 1). Most of the respondents (94.5%) had attained tertiary level of education while none of the respondents was in the informal or primary education category (Table 1). The percentages of respondents whose their occupation were either students, self employed, or others were respectively 23.4%, 24.3%, and 23.4%. Only 11% of respondents were farmers while 10.6% were teachers. No respondents were Local Government employee (Fig. 1).

Table 1. Socio-demographic profile (figures in brackets are percentages)

Category	Frequency
Sex	
Male	163 (69.4)
Female	72 (30.6)
Age (years)	
18-22	15 (6.4)
23-28	52 (22.1)
29-34	57 (24.3)
35-40	72 (30.6)
41 and above	39 (16.6)
Geopolitical zone	
North central	16 (6.8)
North East	1 (0.4)
North West	11 (4.7)
South East	5 (2.1)
South South	10 (4.3)
South West	192 (81.7)
Marital status	
Single	99 (42.1)
Married	136 (57.9)
Separated	0 (0.0)
Divorce	0 (0.0)
Widow(er)	0 (0.0)
Education	
Informal	0 (0.0)
Primary	0 (0.0)
Secondary	4 (1.7)
Tertiary	222 (94.5)
Others	9 (3.8)

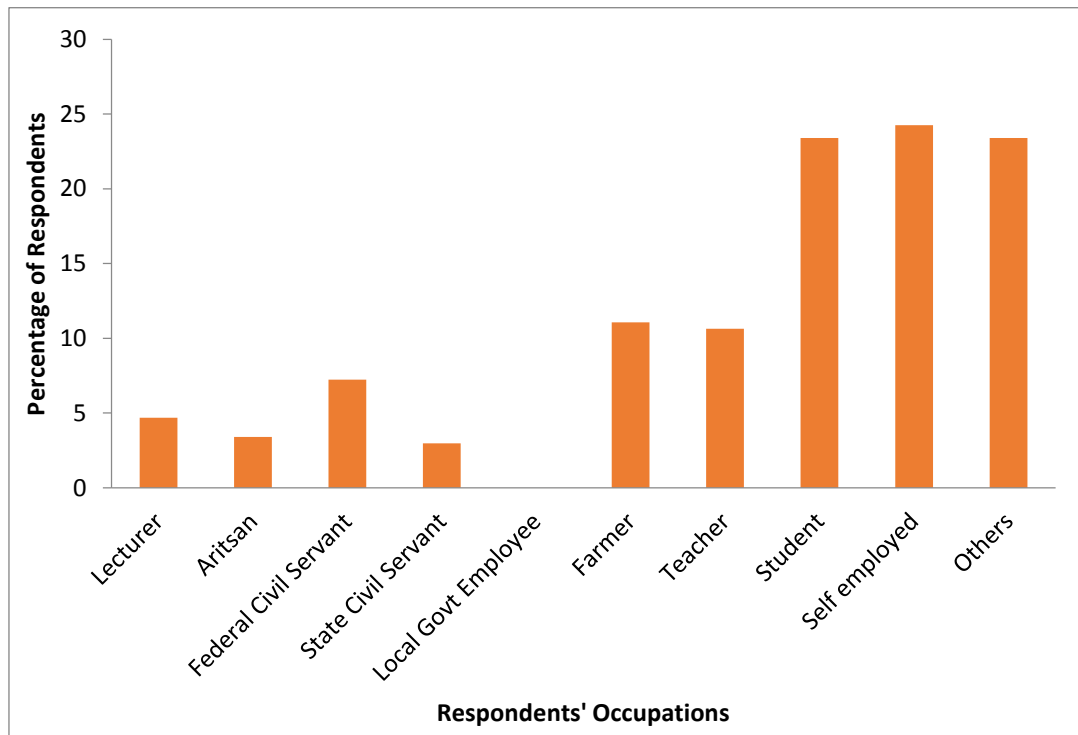


Fig. 1. Percentage of Respondents' occupations

3.2 Specific Interest of Respondents in Rodent Pest Management

Majority of the respondents (59%) indicated their specific interest in rodent pest management (Fig. 2). This could be due to the considerable level of awareness of rodent as pests among the respondents and therefore, need to be managed. There was statistically significant difference in the responses on specific interest of respondents in rodent pest management ($\chi^2 = 369.77$, $df = 2$, $p < 0.05$).

3.3 Categories of Rodents Considered as Pests

Based on the differences in the skull characteristics, rodents are classified as myomorphs (rats and mice), sciurormorphs (squirrels), and hystricomorph (porcupines). The

proportions of respondents considered Rats, mice, and squirrels as pests were respectively 80%, 36.2%, and 11.5% (Fig. 3). There was statistically significant difference in the categories of rodent considered as pests ($\chi^2 = 538.59$, $df = 6$, $p < 0.05$).

3.4 Respondents' Views on Reasons for Rodent Population Control

The present study revealed that almost all the respondents were aware that rodent population should be controlled to reduce damages to crops (97.4%) (Table 2). In the same vein, majority of them knew that some rodent species are carriers of zoonotic diseases (94.9%) (Table 3). Therefore, rodent population should be controlled to reduce zoonotic diseases. They were also of the opinion (82.6%) (Table 4) that they should be controlled for conservation reason.

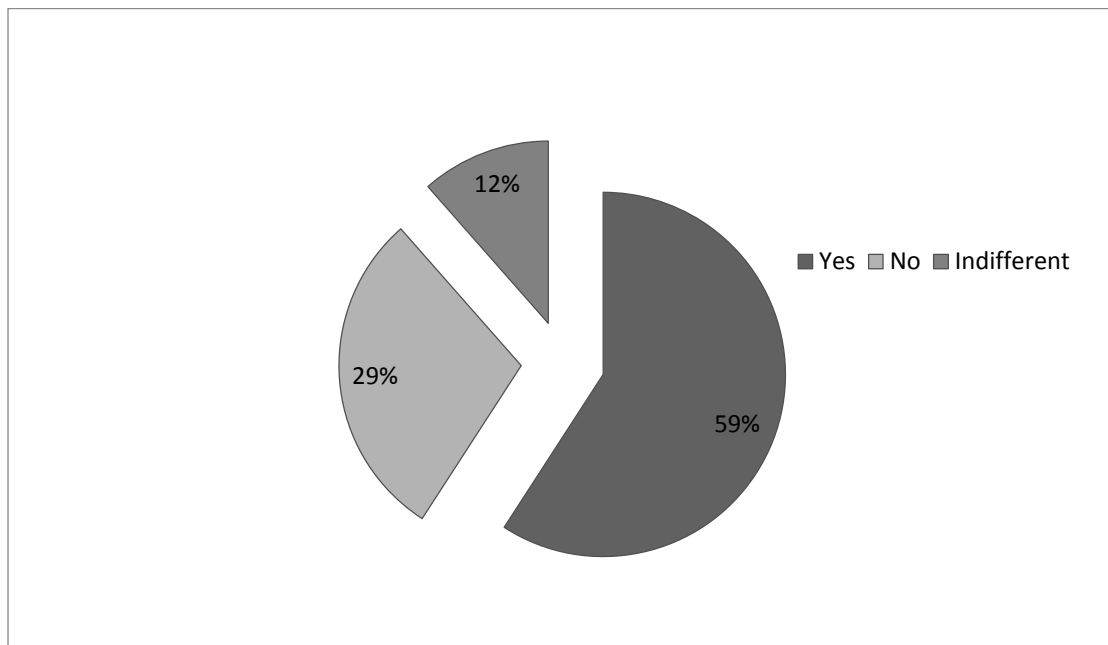


Fig. 2. Proportion of respondents with specific interest in rodent pest management

Table 2. Rodent population should be controlled to reduce damages to crops in Nigeria

	Number	Percent
Yes	229	97.4
No	4	1.7
Indifferent	2	0.9

Table 3. Rodent population should be controlled to reduce zoonotic diseases in Nigeria

	Number	Percent
Yes	223	94.9
No	3	1.3
Indifferent	9	3.8

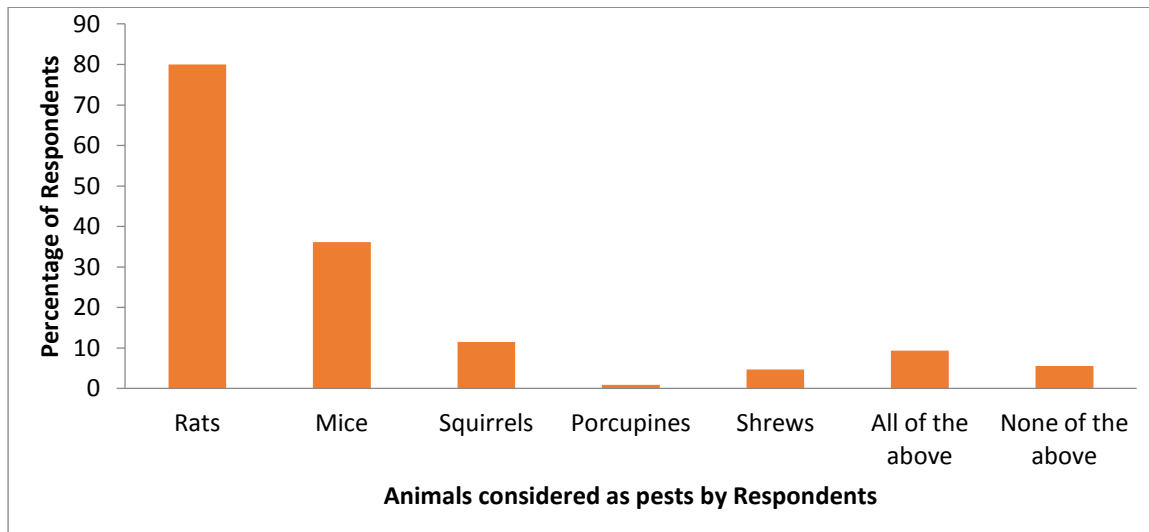


Fig. 3. Proportion of animals considered as pests

Table 4. Rodent population should be controlled for conservation reason in Nigeria

	Number	Percent
Yes	194	82.6
No	21	8.9
Indifferent	20	8.5

3.5 Perception about Different Methods of Rodent Population Control

The rodent population control methods commonly used include shooting, live trapping, poisoning (use of chemical rodenticides), snap trapping, glueboard trapping, and use of repellent (odour offensive chemicals). More than one-third of the respondents (43%) opined that shooting was not humane, cost effective, acceptable, or effective method of rodent population control (Fig. 4). Meanwhile, 19.6% of respondents considered shooting to be a humane method of rodent control (Fig. 4). It was indicated that shooting as an acceptable and effective method of rodent control received small proportion of respondents' opinions – 11.1% and 10.2% respectively (Figure 4). There was statistically significant difference in the responses on shooting as method of rodent control ($\chi^2 = 98.01$, $df = 5$, $p < 0.05$).

Live trapping as a method of rodent population control was perceived by respondents as acceptable (40.4%) and effective (30.2%) (Fig. 5). There was statistically significant difference in the responses on live trapping as method of rodent control ($\chi^2 = 55.18$, $df = 5$, $p < 0.05$).

Poisoning, as opined by more than one third of the respondents (44.2%), was effective,

acceptable (33.6%) and cost effective (25.5%) (Fig. 6). However, a few numbers of respondents (8.9%) stated that poisoning was a humane method of rodent control (Fig. 6). There was statistically significant difference in the responses on poisoning as method of rodent control ($\chi^2 = 92.21$, $df = 5$, $p < 0.05$).

Snap trapping was considered by the respondents as an acceptable (36.6%), effective (22.1%), and cost effective (15.3%) method of rodent control (Fig. 7). There was statistically significant difference in the responses on snap trapping as method of rodent control ($\chi^2 = 39.12$, $df = 5$, $p < 0.05$).

In the same vein, glueboard trapping was considered as an acceptable (45.1%), effective (28.1%), and cost effective (26.8%) method of rodent control (Fig. 8). However, glueboard trapping received least proportion of opinion from the respondents (17%) as a humane method (Fig. 8). There was statistically significant difference in the responses on glueboard trapping as method of rodent control ($\chi^2 = 67.79$, $df = 5$, $p < 0.05$).

Opinions received from the respondents regarding use of repellent were such that it was acceptable (35.7%), effective (26%), and

humane (22.1%) (Fig. 9). There was statistically significant difference in the responses on use of repellent as method of rodent control ($\chi^2 = 31.73$, $df = 5$, $p < 0.05$).

3.6 Comparison of the Different Methods of Rodent Population Control Based on Some Evaluation Criteria

Based on the evaluation criteria used in the present study to evaluate the different method of rodent population control, use of repellent was

viewed as the most humane (22.6%) among the methods of rodent control while poisoning was the least humane (8.9%) (Fig. 10). The most cost-effective method, as revealed by the study, was live trapping (28.1%) while the least was shooting (13.6%). Glueboard trapping was considered by the respondents as the most acceptable (45.1%) while shooting was the least acceptable (11.1%) (Fig. 10). The most effective among the methods of rodent control under consideration was poisoning (44.3%) while the least effective was shooting (10.2%) (Fig. 10).

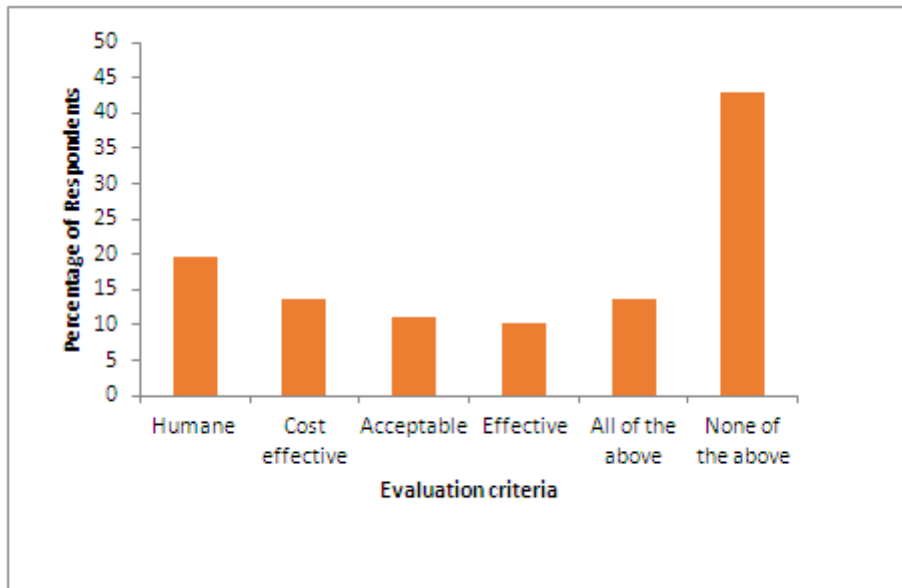


Fig. 4. Respondents' views about shooting as a method of rodent population control

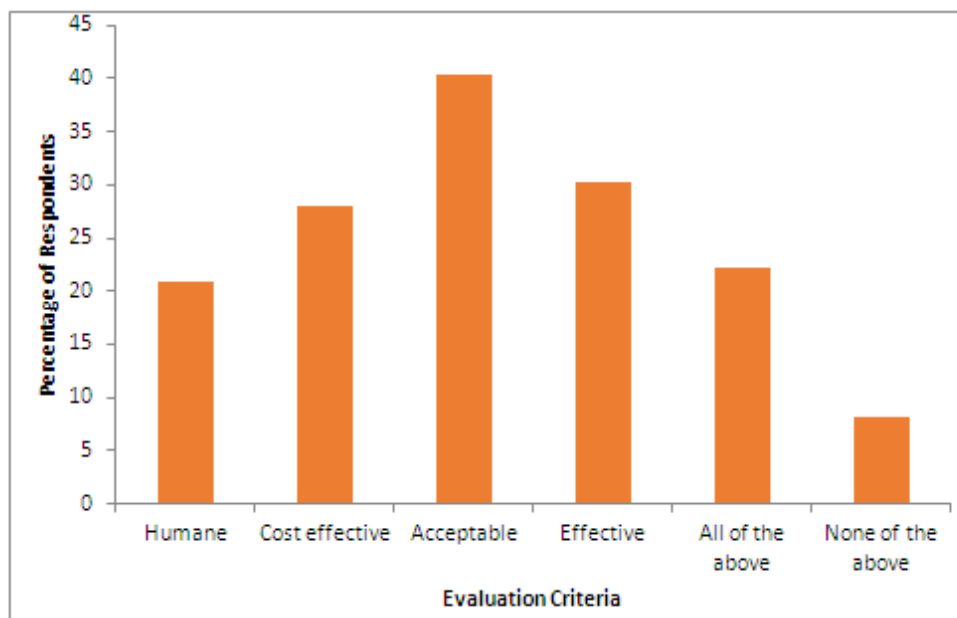


Fig. 5. Respondents' views about live trapping as a method of rodent population control

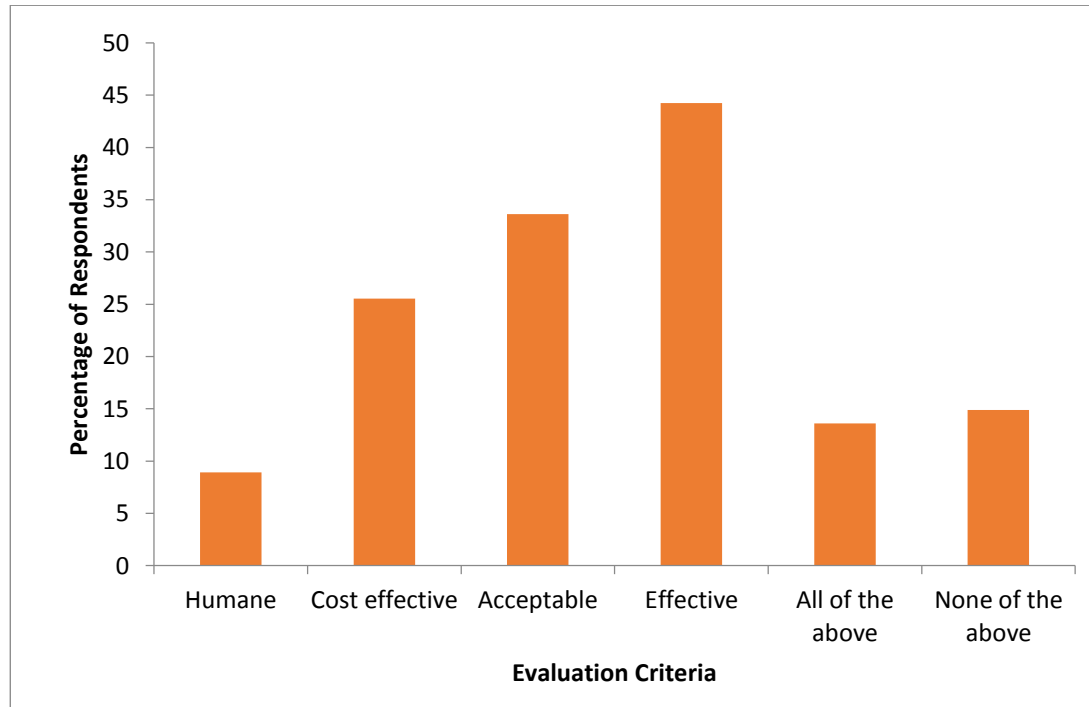


Fig. 6. Respondents' views about poisoning as a method of rodent population control

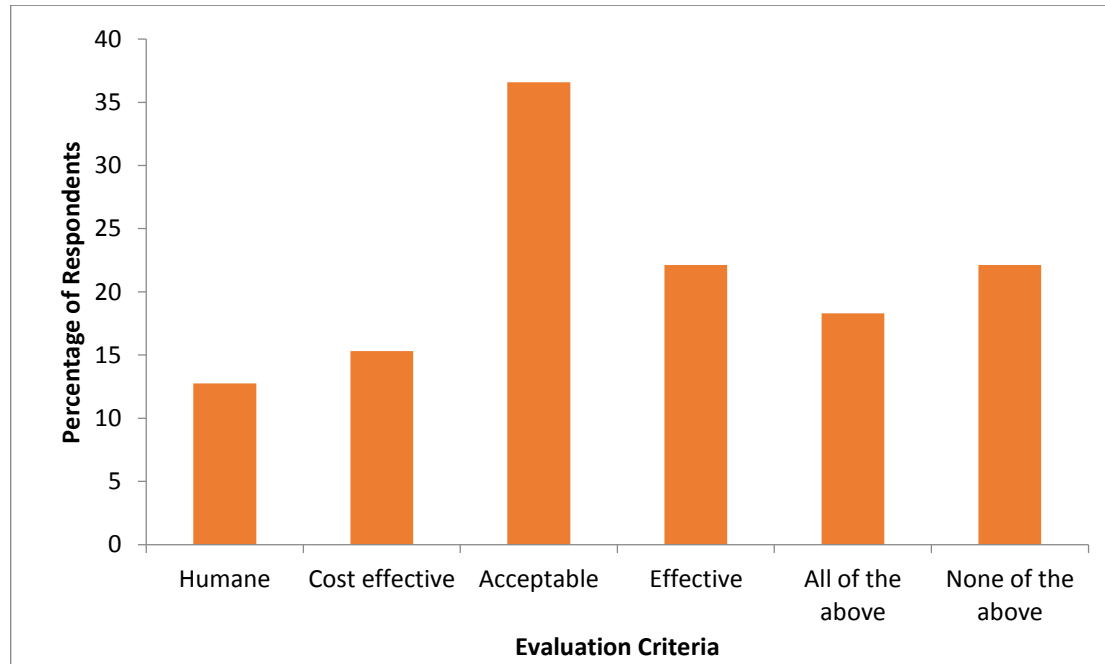


Fig. 7. Respondents' views about snap trapping as a method of rodent population control

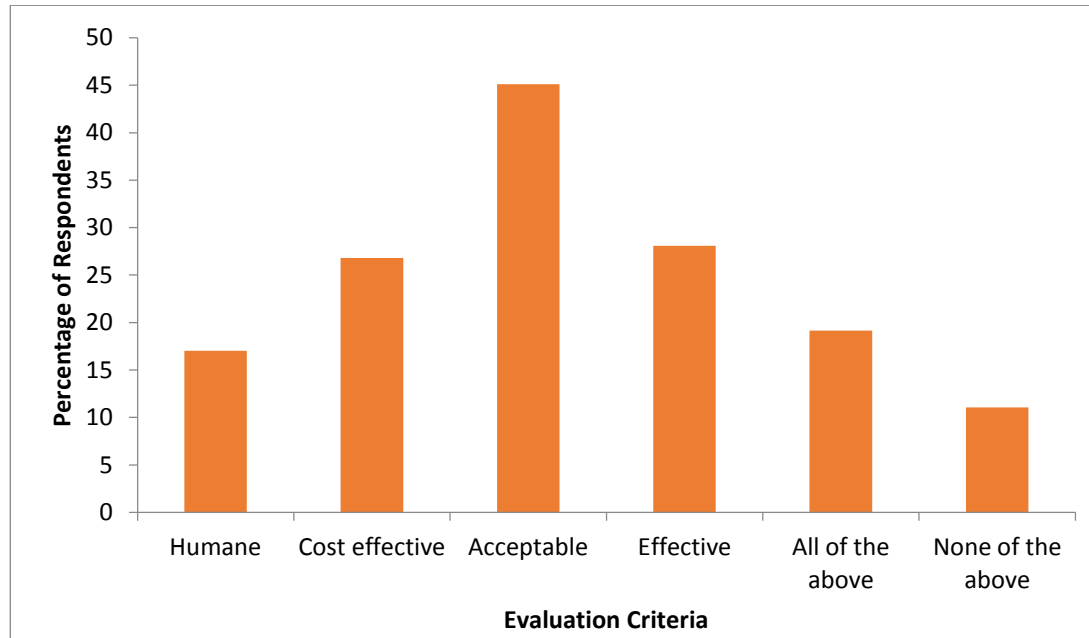


Fig. 8. Respondents' views about glueboard trapping as a method of rodent population control

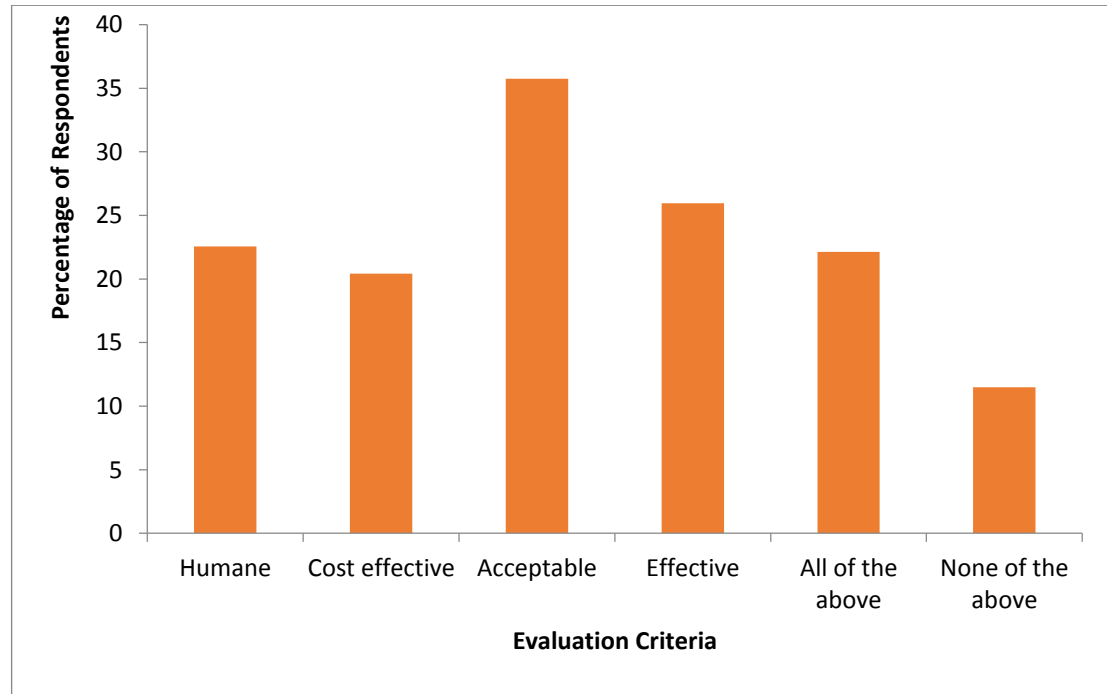


Fig. 9. Respondents' views about use of repellent as a method of rodent population control

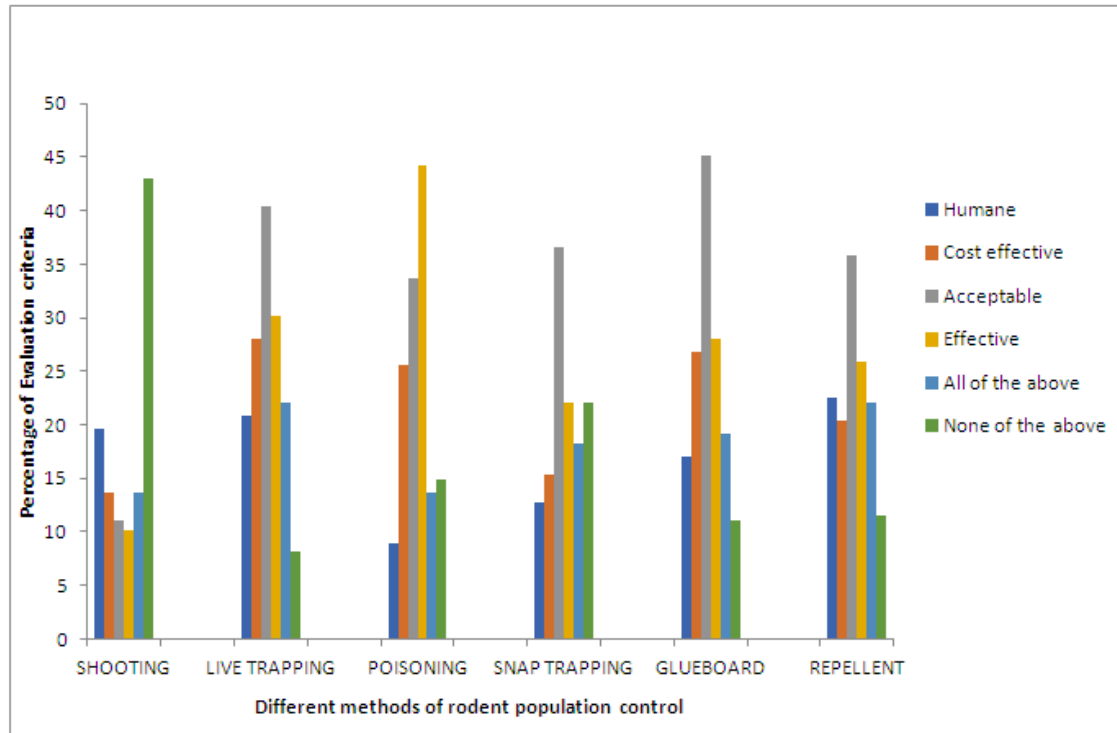


Fig. 10. Comparison of the different methods of rodent population control

3.7 Perception about Adoption of Plant-based Formulation Method of Rodent Population Reduction

Opinions of the respondents on the readiness of adoption of plant-based formulated diet were sought. It is an alternative method of rodent

control aimed at reducing the fertility or reproductive potential of rodent pests. More than half of respondents perceived that the plant-based formulated diet would be an acceptable (69.8%) (Table 5), humane (65.1%) (Table 6) and effective (68.9%) (Table 7) method of rodent population reduction.

Table 5. Plant-based formulation as an acceptable method of rodent population reduction

	Number	Percent
Yes	164	69.8
No	32	13.6
Indifferent	39	16.6

Table 6. Plant-based formulation as a humane method of rodent population reduction

	Number	Percent
Yes	153	65.1
No	43	18.3
Indifferent	39	16.6

Table 7. Plant-based formulation as an effective method of rodent population reduction

	Number	Percent
Yes	161	68.5
No	37	15.7
Indifferent	37	15.7

3.8 Other Opinions by the Respondents

Some respondents gave additional opinions that rodent population needs to be controlled to curtail the level of their destructive activities and that they should be controlled in order to prevent disease transmission. It was opined by some respondents that rodent population control can be effective only when the fertility control using plant-based formulation is made available as it will save time, money and other resources to achieve. Other opinion by some respondents was that fertility method could be applied for it is believed to be one of the proper and effective ways of rodent population control. It is not out of place that more environmentally friendly rodent control substances should be provided such as the use of plant-based formulation method to reduce the number of young produced by the rodent pests. Use of plant-based formulation was corroborated by some respondents that it would be better and effective in reducing fertility because it will help in reducing the population as well as preventing the case of accidental poisoning and reducing emotional concerns.

4. DISCUSSION

More males participated in the study than females. This could be because males are much more experienced in farming activities than females. This is similar to the report as given by Tomass et al [10] that the number of males who participated in the study was more than that of the females.

Most of the respondents had attained tertiary level of education while none of the respondents was in the informal or primary education category. This could mean that the participants in the present study were very enlightened. On the contrary, the similar study conducted by Meheretu et al [11] showed that majority of the respondents had no formal education.

Majority of the respondents indicated their specific interest in rodent pest management. This could be due to the considerable level of awareness of rodent as pests among the respondents and therefore, need to be managed. Badmus and Ala [12] gave similar reports that majority of the respondents had the knowledge of rodents as pests. Rodents are known to cause both pre-harvest and post-harvest losses to agricultural crops.

The respondents considered Rats, mice, and squirrels as pests with rats being of most serious concern followed by mice as revealed from the present study. Gratz [13] had earlier reported similar findings that the groups of rodents that have long been reported to be of serious concern for the society include rats and mice. They have been recognized as the carriers of more than 60 diseases to humans and other animals. They are also the major cause of food damage and sanitation problems.

The most cost-effective method, as revealed from the study, was live trapping while the least was shooting. Glueboard trapping was considered by the respondents as the most acceptable while shooting was the least acceptable. The most effective among the methods of rodent control under consideration was poisoning while the least effective was shooting. It was, however, reported by Barr *et al.* [14] that trapping was considered the most acceptable, effective, and humane control method. It was regarded as of average cost efficiency.

Respondents considered trapping to be the most effective grey squirrel control method as reported by Barr et al [14]. Trapping and shooting were both seen to be humane relative to poisoning. However, poisoning was perceived to be more cost effective than either of the other two methods. It was also stated by Barr et al. [14] that shooting and trapping were the most acceptable methods.

5. CONCLUSION

The plant-based formulated diet as a method of population reduction was viewed as a promising method that would be humane, acceptable, and effective method and this indicated their readiness to adopt the method as an alternative to the common methods of rodent population control.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by

the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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