HUMAN-RODENT INTERACTIONS AND RODENTS' CONTROL IN SHELLMINGO COMMUNITY, BO.

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ABSTRACT

This study investigates human-rodent interactions and the control measures employed to manage rodent populations in the Shellmingo community, Bo. Rodents, particularly rats, have become a significant pest in many communities, raising immediate concerns about public health, food security, and economic losses. The primary objective of this research was to examine the frequency and nature of interactions between residents and rodents, the perceived risks associated with these interactions, and the effectiveness of current control measures in place.

A mixed-methods approach was adopted, utilizing qualitative interviews with community members and quantitative surveys to gather data on the extent of rodent infestations, the types of damage caused (such as crop destruction, food contamination, and property damage), and control practices. Findings indicated that rodents are a persistent issue in the community, with reports of frequent infestations in homes, markets, and agricultural spaces.

The study revealed that most control efforts are informal and rely on local methods such as trapping and poisoning, but these measures have shown limited success. The research highlights the need for comprehensive rodent management strategies, including public education on preventive measures, improved sanitation practices, and practical, sustainable rodent control technologies. Recommendations for future interventions and policies are discussed, emphasizing the potential for collaboration between community leaders, health organizations, and local government bodies to address the growing rodent problem in Shellmingo.

1.0 INTRODUCTION

The most significant impact of rodents on humans began when agriculture started, and people chose to live in settled homes. At that time, some rodent species moved into human dwellings, primarily to eat stored grains and food scraps and to take advantage of the warm living spaces and protection from predators. The house mouse (Mus musculus), native to the Mediterranean area and China, and several species of rats (Rattus species), native to Southeast Asia, are the most successful and now live with humans worldwide. Rodents are mammals of the order Rodentia, which are characterized by a simple pair of continuously growing incisors in each of the upper and lower jaws. About 40% of all mammal species are rodents, and they are the most diverse mammalian order, living in various terrestrial habitats, including human-made environments.

In the US, rodents invade an estimated 21 million homes every winter. During the cold months, rodents like mice and rats seek food, warmth, and shelter indoors. They enter homes through small cracks and crevices. There are about 1,500 species of rodents, including mice, rats, squirrels, house mice, porcupines, guinea pigs, beavers, etc. (Nowak, 1983; UCMP 2007). In most of Europe today, the dormouse (Glis glis) is considered a delicacy and was also eaten in ancient Rome. From the earliest times, humans have consumed rodents. Even though rodents are not a primary food source today, people still eat them, especially South America's capybara and guinea pigs. Rodents are also crucial in clothing, as many North American industries use their fur. Some people rear rodents (beavers) as pets, primarily for their fur.

This is not an exception in West Africa. Rodents have been widely eaten and are believed to have medicinal properties. Most rodents feed on plants, including seeds, fruits, grasses, leaves, and bark of trees, insects, and small animals.

This belief (that rodents eat) is widely spread in Sierra Leone. The various ethnic groups in the country used to eat rodents (such as giant rats, cane rats, squirrels, mice, and porcupines) before this time. The people of the Shellmingo community, Bo, are no exception. Eating rodents is prevalent in the Shellmingo community, like in any other Bo town, Sierra Leone area. The human-rodent interaction can often be adverse, as rodents spread diseases and cause damage to property. Scientific research has shown that people can become infected through exposure to or inhaling infected urine, droppings (feces), or saliva from rodents. The chances increase, especially when people are near spaces where rodents live. In some instances, the consumption of rodents has decreased in the Shellmingo community due to the spread of diseases. Notwithstanding, rodents also destroy attic insulation and chew through wallboards, cardboard, furniture, and electrical wiring, which can cause home fires. This case is similar to that of the U S, as rodents cause 25% of house fires. Some rodents are believed to spread diseases like Lassa fever, particularly the multimammate rat, also known as Mastomys natalensis. It is believed to be the host of Lassa disease, according to studies conducted by researchers over the years. Mastomys rats infected with the Lassa virus do not become ill but can shed the virus in their urine and feces. Lassa fever is an acute viral hemorrhagic illness lasting 2-21 days in West Africa. This virus is transmitted to humans through contact with food or household items contaminated by rodents' urine and feces, person-to-person contact, or laboratory exposure. It can also occur in hospitals lacking adequate infection prevention and control measures. Lassa fever is known to be endemic in Benin, Ghana, Guinea, and Sierra Leone

1.1: The Level of Rodent Infestation in the Study Area

Rodents are a key mammalian group and are highly successful in many environments worldwide. Indeed, they constitute more than 42% of the known mammalian species (Bekele et al., 2003). Rodents are one of the largest and most interesting groups of mammals. They are essential components of virtually all of the Earth's terrestrial ecosystems. They are important herbivores that aerate the soil through their burrowing activities and assist in plant propagation by consuming and dispersing seeds. They are often the most critical food base for many predatory mammals and birds, acting to sustain populations of these species (Fall, 2015).

However, rodents are also essential vectors or reservoirs of numerous diseases that infect humans, domestic animals, and other wildlife species. They are significant economic pests that devastate crops, gardens, orchards, or landscape plantings, damage commercial forest plantations or impede reforestation efforts. Rodents burrow through dams and irrigation structures, gnaw through communications cables, damage electronics, and consume or contaminate stored food and other commodities (Fall, 2015). Rodents sometimes prey on the eggs or young of wild birds and compete with native wildlife species for food or habitat, making them significant concerns in managing and recovering threatened or endangered species, particularly in island environments. Rodent control refers to the processes people use to mitigate rodent damage, prevent the spread of rodent-borne diseases, reduce problem rodent populations, or eliminate rodent infestations. Depending on the species of rodents involved, the type of environment where the problem occurs, the nature of the problem, and the value of anticipated damage, various methods are available for controlling or reducing rodent populations (Fall, 2015).

1.1.1 Characteristics of Rodents

Rodents are a large group of mammals that include various animals, such as squirrels, chipmunks, prairie dogs, rats, and mice. Nearly 40% of all mammals are rodents. Two characteristics set rodents apart from other mammals. First is their two chisel-like incisor teeth (Çelik et al., 2018). The second is the absence of canine teeth. This tooth arrangement makes it easier for them to maintain their particular eating habits since rodents are primarily plant and seed eaters. In recent years, three specific species of rodents have become closely associated with humans for food and shelter (Çelik et al., 2018). Because of the diverse characteristics of rodent species for which rodent control may be a concern, only a general discussion is possible. The biology, ecology, and behavior of each species or the same species occurring in different environments must be scrutinized to develop successful rodent control programs. There are more than 2000 recognized species of rodents (Fall, 2015), many of which are described and pictured in Nowak (1999). A relatively few of these species, perhaps fewer than 250 worldwide, interact sufficiently with humans to cause economic, conservation, or health concerns sufficient to warrant rodent control efforts. Biologists often rename or combine different groups of rodents to better reflect relationships as new scientific information becomes available.

Current scientific names for rodents have been used whenever possible when citing information from older literature. Many readers are most familiar with "rats and mice" as the animals commonly associated with rodent control. The Norway rat (Rattus norvegicus), also known locally as the brown rat, wharf rat, sewer rat, or barn rat, has a nearly worldwide distribution and is almost always found living in close association with humans(Fall, 2015). The roof rat, also known as the black rat (Rattus rattus), and the house mouse (Mus musculus) are widely distributed and, together with the Norway rat, are commonly referred to as commensal rodents due to their close association with human habitation. Rodents range in size from the South American capybara (Hydrochaeris), which weighs more than 50 kg, to the harvest mouse (Micromys minutus) of Eurasia, which weighs 5 to 7 g. Most rodent species have thick fur, although their pelage has significant variations. The naked mole-rats

(Heterocephalus glaber) of Africa have only bare skin, while porcupine species, such as the North American porcupine (Erethizon dorsatum), have highly modified coats containing spines or quills that help protect them from predators.

Hearing, smell, taste, and touch are well-developed senses in rodents. However, as with many mammals, particularly nocturnal species, their vision is relatively poor, and they do not distinguish colors. Rodents detect sound at frequencies substantially higher than humans; some species may use ultrasound to communicate. Most rodents have long whiskers or vibrissae around their muzzles, which are highly sensitive and can be used to follow runways or burrows. Many rodent species are excellent climbers, using their long tails for balance and stability. Most rodents can swim; some, like beavers (Castor canadensis), nutria (Myocastor coypus), muskrats (Ondatra zibethicus), and web-footed rats (Holochilus sciureus), have modified appendages, such as flattened tails or webbed feet, that facilitate their use of freshwater aquatic habitats. Most species of rodents are born naked and helpless, but mature rapidly. For example, Norway rats (Rattus norvegicus) have a gestation period of about 3 weeks, become independent of the mother at about 3 weeks after birth, and can breed for the first time within another 3 weeks. Rodents are omnivorous, exhibiting choices and preferences in their diet, but often select the most abundant and palatable foods available (Fall, 2015). They readily learn to reject or avoid unpalatable foods or those containing toxins, which presents a problem for developing bait materials to deliver rodenticides effectively. The rodents' front teeth, or incisors, grow continuously and are constantly worn by gnawing on objects or food. Because of the ample space or diastema behind their incisors, rodents can use these front teeth to investigate or nibble on unfamiliar materials without actually taking them into their mouths (Fall, 2015).

1.2 Types of Rodent Problems

The diversity of problems caused by rodents worldwide is so great that only a few examples of some general categories of issues can be discussed. At the end of this chapter, we provide a list of additional readings for readers who want to learn more about rodent pest species and the problems they cause in various parts of the world.

Grain Crops

Rat damage to ripening rice crops in Asia, Africa, and Latin America can be a severe agricultural problem. However, economic losses are often difficult to estimate due to the complex patterns of growth and recovery of plants related to the developmental stage at which damage occurs (Fall, 2015). Rats can completely consume growing rice fields and sometimes prevent planting where crops could otherwise be grown. Wheat, sorghum, maize, and other grain crops are also extensively damaged by rodent species in different parts of the world, and damage patterns vary considerably depending on the behavior of the species involved. For example, Bandicota bengalensis in southern Asia cuts mature wheat and rice in large patches and establishes extensive underground food caches(Fall, 2015). Rattus tanezumi and Rattus argentiventer in the Philippines and other areas of Southeast Asia feed upon all stages of growing rice (Fall, 1977), while Sigmodon hispidus in Central America avoids wet regions of rice fields and causes damage after water is removed to dry the Crop Before Harvest.

Sugar Cane

Rodents cause extensive damage to ripening sugarcane wherever it is grown, including in Asia, Africa, Latin America, the Pacific region, and Australia. Rats gnaw on the internodes of growing stalks, thereby killing stalks, diminishing yields, or allowing infection by bacteria or fungi, which reduces cane quality and sugar yield(Fall, 2015). Losses are difficult to quantify but can be. The major depredating species vary from area to area and include: Rattus rattus, Rattus norvegicus, and Rattus exulans in Hawaii; Holochilus scuireus, Sigmodon hispidus, Oryzomys palustris, Mus musculus, and Rattus rattus in North and South America; Rattus tanezumi in Southeast Asia; Millardia meltada, Bandicota bengalensis, and Bandicota indica on the Indian subcontinent; Rattus losea and Bandicota bengalensis in China; Mus caroli and Apodemes agrarius in Taiwan; Rattus sordidus and Melomys burtoni in Australia; and Rattus rattus, Arvicanthis niloticus, and Thryonomys swinderianus in Africa(Fall, 2015).

Plantation Crops

Rodents in Africa, Asia, South America, and the West Indies open ripening pods of cacao and either take whole beans or feed only on the mucilage surrounding the beans, depending on the rodent species (Fall, 2015). Damaged pods are lost either directly to rodent damage or indirectly to ensuing fungus infection. Damage is often most incredible where cacao is grown in mixed culture with other crops such as coconut. Depredating species include Rattus tiomanicus, Rattus tanezumi, and Callosciurus notatus in Asia, and Hylomyscus stella, Praomys tullbergi, Stochomys longicaudatus, Dephomys defua, Praomys morio in West Africa(Fall, 2015). Commercial oil palm plantations in Malaysia and Africa sustain damage from rodents that feed on the crowns of trees and the oil-bearing tissue of developing fruitlets. In Africa, the major rodent species causing damage to oil palms include Dasymys incomtus, Lophuromys sikapusi, Tatera valida, Oenomys hypoxanthus, Praomys morio, Mus minutoides, Lemniscomys striatus, and Uranomys ruddi. Up to 80% of losses have been reported in Nigeria in one year(Fall, 2015).

Damages to Cables, Wires, and Electronics

Rodents gnaw on above and underground communications and power cables, resulting in service interruptions, fires, and other safety concerns (Fall, 2015). Rodents and other wildlife species often damage seismic wires on the ground surface for geologic mapping. These creatures usually spare electronic gadgets, like Televisions and radios. For this reason, researchers have developed rodent-resistant cables for home use.

Stored Products

Rodent consumption of stored food and grain, destruction of storage structures and containers, and indirect losses caused by spillage, spoilage, or contamination resulting in condemnation or rejection of shipments are essential global economic and public health problems (Fall, 2015). The great diversity of rodent species, storage structures, and environmental conditions, as well as the difficulty in estimating incremental or indirect losses, helps mask the economic impact of the problem. Since most rodent species involved in stored product damage are nocturnal, heavy infestations may persist unnoticed unless stores or premises are carefully inspected (Fall, 2015). In many situations, careful grain handling procedures, indoor and outdoor sanitation, immediate disposal of spillage and garbage, frequent inspection for rodent signs, and maintenance control programs are essential to prevent developing more serious and complex problems (Fall, 2015).

Forest Crops and Reforestation

Foraging by rodents can be a significant impediment to reforestation efforts worldwide. Direct predation on seeds by deer mice (Peromyscus sp.) and house mice (Mus musculus) in the USA (Fall, 2015) can preclude or reduce the success of direct seeding efforts. Clipping and girdling the roots and stems of young seedlings by various rodents is a significant source of tree mortality. Pest species include squirrels (Sciurus sp. and Tamiasciurus sp.) strip bark from trees in Europe and North America (Fall, 2015); voles (Microtus sp., Clethrionomys sp.) in the United States, Europe, and Asia; deer mice (Peromyscus sp.) in the United States; porcupines (Hystrix indica) in Asia and (Erethizon dorsatum) in the USA; pocket gophers (Thomomys sp.) in the USA; and mountain beavers (Aplodontia rufa) in the Pacific Northwest. In the western USA, pocket gophers (Thomomys sp.) damage or destroy hundreds of thousands of acres of forestland each year, severing stems and girdling the roots and stems of more conifers than any other wild mammal (Fall, 2015). Even when rodent control programs exist, pocket gophers may quickly re-invade cleared areas and reoccupy vacant burrow systems (Fall, 2015). Beavers (Castor canadensis) in North America, particularly in the southeastern United States, also cause considerable damage to trees, forests, and landscape plantings. This damage is caused directly by their feeding and dam-building activities and indirectly by flooding resulting from blocking streams and drainage structures with dams (Fall, 2015).

Hydraulic Structures

Although little has been published, several burrowing rodent species cause damage, water loss, and the attendant risks of flooding by excavating earthen dams, irrigation canals, or flood control structures (Fall, 2015). Notable species involved are beavers (Castor canadensis), muskrats (Ondatra zibethicus), gophers (Geomyidae), and ground squirrels (Spermophilus sp.) in North America; Bandicota bengalensis in southern Asia; and nutria (Myocastor coypus) in North and South America (Fall, 2015). A variety of other burrowing species cause problems on a localized basis. Determining the cause of breaks in hydraulic structures is often tricky because it is impossible to assess animal activity if the evidence has been washed away. However, failure to control rodent infestations can threaten human life, resulting in legal actions and repairs costing millions of dollars (Fall, 2015). High beaver (Castor canadensis) populations in many areas are now a cause of considerable concern for forest managers and those responsible for flood prevention and control. These large rodents move to areas with flowing water and cut down surrounding trees by gnawing around the circumference of their bases (Fall, 2015). Trees are used for dam building, constructing lodges, and as a food source. Beavers also excavate dens in the banks of reservoirs, streams, or canals, which can result in water loss and even structural failure. Beaver dams that block culverts, ditches, streams, or spillways can result in extensive flooding and damage to bridges, roads, and other structures, as well as flooding and death of trees in commercial plantations or reforestation and riparian areas (Fall, 2015)

2. 0 RELATED LITERATURE

2.1: The Causes of an Increase in Rodent Population among Humans

2.1.1: Rodent Population

Due to the high reproductive capacity of rodents, their populations can grow rapidly, utilizing available habitats and food. In stable environments, rodents self-regulate their populations. When a population reaches the carrying capacity of an environment, reproduction declines, and excess animals die (usually from disease, parasites, or predation) or emigrate to new areas (Fall, 2015). However, rodents survive very adverse conditions, even nuclear explosions, by living in underground burrows and rebuilding their populations when conditions become favorable again. Habitat disruption or climatic changes that lead to increases in food and habitat sometimes result in population outbreaks or irruptions of some rodent species, resulting in high populations that can cause severe crop damage (Fall, 2015). (Fall, 2015) observed densities of 1 adult rat per square meter (10,000 rats per hectare!) in a breeding population of Rattus tanezumi in a large marsh area in the Philippines adjacent to a rice field basin. Rattus argentiventer in Southeast Asia, the multimammate rats (Mastomys natalensis) in Africa, Mus musculus in Australia and Hawaii, the jirds, Meriones hurrianae and Meriones shawi, in South Asia and North Africa, the Microtines (voles and lemmings) in Eurasia and North America, and cotton rats (Sigmodon hispidus) in southern USA and Central America all undergo periodic population irruptions (Fall, 2015). Scientists continue to study ways to predict and prevent rodent outbreaks or at least reduce the associated damage. Surveillance of rodent populations, particularly in agricultural areas where outbreak species are present, is often essential for rodent control. Rodent population irruptions may result in noticeable and frequently spectacular damage and devastating crop fields over vast areas (Fall, 2015). However, chronic damage and the risks of rodent-borne disease are usually a more significant concern from economic and public health viewpoints. They can occur when rodent populations are relatively low or in cases of diseases carried by rodent feces or urine when rodents are absent (Fall, 2015). There are few places in the world where rodents are not closely associated with human enterprise. The potential for chronic crop losses, contamination of stored products, and transmission of rodent-borne diseases require careful monitoring to determine if rodent control programs are needed or appropriate (Fall, 2015).

2.2: Impact of human-rodent interaction on humans

2.2.1 Rodents and Disease

The list of diseases of humans and domestic animals for which rodents serve as vectors or reservoirs is long and growing. New diseases are described each decade, and new epidemiologic associations are made with particular rodent species. The commensal rodents, particularly Rattus rattus and Rattus norvegicus, are particularly important because of their close association with man. Research done in 1935 provided a fascinating account of the historical importance of louse-borne typhus in decimating human populations and influencing the outcomes of human conflicts over several centuries(Fall, 2015). Other research in 1985 similarly recounts the history and rodent-flea-human associations of plague pandemics, including the Black Death in 14th-century Europe (Fall, 2015). Plague remains a disease of local concern in several parts of the world. Leptospirosis, another rodent-borne disease of worldwide importance to humans and domestic animals, has been recently reviewed (Fall, 2015). Another research provides comprehensive reviews of diseases and rodent species associations for which rodent control programs may be indicated as management measures. Detailed summaries of communicable diseases for which rodents are implicated as vectors or reservoirs are available (Fall, 2015). These summaries include symptoms, treatment options, and prevention methods. Rodent control efforts that minimize close human and domestic animal exposure to rodent infestations and surveillance and monitoring in high-risk areas can help prevent rodent-borne disease outbreaks from spreading.

2.3 Control of rodent population

2.3.1 Control Methods

Many methods for controlling rodents or damage have been passed down through folklore or tested and proven effective in specific situations. Others are promoted or marketed as ultimate solutions to a gullible public but are impractical or ineffective. Some materials or methods that were once widely used are no longer available, having been recognized as unsafe or falling victim to increasingly stringent environmental regulations or changing cultural norms (Fall, 2015). Developing new rodent control methods remains an exciting subject for researchers. (Fall, 2015) summarized, in tabular form, the great variety of methods and techniques suggested, used, or tested for various rodent problems. Space allows us to discuss only a few diverse approaches to rodent control.

2.3.1.1 Manual Methods

Trapping and shooting are widely regarded as the most acceptable pest control methods. They are the most humane, species-specific, and environmentally friendly (Fraser, 2006). Trapping is less satisfactory than shooting, as it is perceived as less humane and less specific.

While manual methods are the most accepted, the public acknowledges that they are neither the most effective nor efficient means of control (Fraser, 2006).

The research noted that most focus group participants realized that shooting and trapping could not be used as the principal control method because of the high labor demands.

Some support for manual methods comes from their potential to create employment and other commercial opportunities—the public wishes to see productive gains from pest control. Fraser (2001) noted that 95% of respondents would prefer commercial use to be made of animals rather than 'killing to waste .'Commercial opportunities are not thought to exist using poisons and biological controls(Fraser, 2006).

Specialists widely use trapping for the surveillance and monitoring of rodent infestations, and it is the most selective technique for removing individual rodents from problem situations (Fall, 2015). Although trapping is very labor-intensive and requires skill to be used effectively, its relatively low cost compared to other approaches often makes it a primary method of rodent control. Trapping is also utilized where non-target animals are an essential concern or where the use of toxicants or other more effective methods is prohibited (Fall et al., 2015)

2.3.1.2 Integrated Pest Management

The diversity of rodent pests and pest problems worldwide requires various approaches to resolving site— and situation-specific issues. Controlling rat damage in Asian rice fields requires a different approach to prevent the spread of diseases transmitted by rats in urban environments. Controlling rodent damage to forest plantings in the North also requires a different approach.

America presents a decidedly different situation from controlling rodent depredations in African wheat fields (Fall, 2015). Smith and Calvert (1978) defined IPM as a broad, ecologically based control system that uses and manipulates multiple tactics effectively and coordinately. Smith's personal, concise definition, "…an ecological approach to pest control," conceptualizes the actions required to manage the multiplicity of plant and animal pests, including rodents, that lower the efficiency of humankind's production systems or reduce the quality of life for people worldwide. In its broadest sense, integrated rodent pest management (IPM) is the utilization of a variety of control methods appropriate to specific damage situations, emphasizing the use of environmental controls on population growth and continuously evaluating achieving levels of damage that can be tolerated economically and socially, to resolve specific problems (Fall, 2015). Decision support systems are available for a few rodent control problems (others are under development) that can help users process ecological information, evaluate the variety of options and techniques appropriate to the situation, and better predict when control actions need to be taken (Fall, 2015).

2.3.1.3 Habitat Management

All animals require food, water, and cover to survive and reproduce. Where these resources are abundant, rodents thrive; where they are in short supply, animals either emigrate or die. Whenever possible, control programs should focus on altering the habitat and reducing its potential to attract and support pest species (Fall, 2015). Otherwise, the effectiveness of rodent control measures will be short-lived and must be frequently repeated.

Widescale habitat alteration is often not feasible in tropical countries, where critical resources are ubiquitous and available year-round. The open construction of housing and storage structures allows rodents to easily move from fields to buildings (Fall, 2015). The resources needed to apply herbicides or other means of reducing rodent habitat are often out of reach for people in rural areas or densely populated human settlements that lack essential services and sanitation. The ecological consequences of significant habitat alterations to reduce rodent infestations may be far-reaching, impacting desirable wildlife and the lives of human inhabitants in an unacceptable measure (Fall, 2015).

Every effort should be made to reduce food and cover that attract commensal rodents. This includes heavy pruning of ivy, palm trees, berry thickets, or any densely growing plants adjacent to structures and maintaining sanitary conditions in homes, businesses, streets, and vacant areas (Fall, 2015).

Garbage cans and industrial trash containers should have tight-fitting covers, and trash should be collected frequently. A general removal of all rubbish and trash helps reduce food and harbourage for rats. The most effective way to limit rodent damage in buildings and structures is to prevent their initial entry. Rats can crawl through or under any opening higher or broader than 1.3 cm, and mice can gain entry through any opening larger than 0.6 cm (Fall, 2015). Rats and mice can run along or climb electrical wires, pipes, fences, poles, ropes, cables, vines, shrubs, and trees and climb almost any rough vertical surface, including wood, brick, concrete, weathered sheet metal, and many plastic products. Rats and mice can crawl horizontally along or through pipes, augers, conveyors, conduits, and underground utility and communication lines, as well as gnaw through a wide variety of materials, including lead and aluminum sheeting, window screens, wood, rubber, vinyl, fiberglass, plastic, and low-quality concrete blocks. Buildings should be scrutinized to detect any potential entry points. Cracks and openings in foundations should be sealed. All openings where water pipes, electric wires, telephone wires, sewer pipes, drain spouts, and vents enter a building should be tightly sealed to prevent rodent access. Doors, windows, and screens should be tight-fitting (Fall, 2015).

2.3.1.4 Rodenticides

Toxicants are frequently the most practical and cost-effective tools for reducing troublesome rodent populations over large areas. Rodenticides require a minimal workforce to apply and, when properly formulated and applied, have the potential to provide quick results with minimal impact on the environment and non-target animals (Fall, 2015). The effectiveness of rodenticide treatments varies significantly among toxicants, bait formulations, application methods, and timing. Fast-acting, single-feed toxicants like red squill, sodium fluoroacetate, strychnine, and zinc phosphide can potentially rapidly reduce a pest population. However, success often declines with repeated applications because animals that survive quickly learn not to eat the bait(Fall, 2015). Pre-treatment with non-toxic bait, or pre-baiting, is often used to help overcome this problem. Alternating toxicants and bait materials can also help forestall the development of bait shyness. Second-generation anticoagulant rodenticides, such as brodifacoum, bromadiolone, difenacoum, and difethialone, were developed in the 1970s and are much more toxic, typically requiring only a single feeding by commensal rodents to ingest a lethal dose. Genetic resistance to anticoagulant rodenticides emerged as early as 1958 and continues to concern second-generation anticoagulants (Fall, 2015).

Only trained specialists are allowed to use some rodenticides. Many rodenticide baiting programs fail not because of bait shyness or resistance to toxicants but because of improper bait application. Rodenticide baiting programs used by some Hawaiian macadamia growers were ineffective because rats spent most of their time in the orchard canopy and rarely consumed baits placed on the orchard floor (Fall, 2015).

2.3.1.4 Aerial 1080 and Other Poisons

Public attitudes to possums and the aerial 1080 debate parallel arguments about attitudes to biotechnology. Pest control agencies view poisons, especially 1080, as a cost-effective pest management tool that can be used at a landscape scale and kill multiple pests, including possums, rats, and stoats.

While this section focuses on public attitudes to the use of poison, most of the discussion is centered on the application of 1080. Although other poisons are currently used for pest control, public awareness of these alternatives is not high. Consequently, research has focused on attitudes to the use of 1080.

This section will review these studies but not include references to anecdotal or implied support or opposition generated by the media or particular stakeholder groups.

2.3.1.5 Biological Control

Biological control involves using biological means instead of chemical and physical means to control pest species. Traditionally, biological controls have involved introducing exotic species, such as predators, parasites, and diseases (Fraser, 2006). Advances in molecular biology and genetic engineering technology have recently broadened the field of biological control to include other alternatives. This technology is being developed to interrupt physiological processes and is almost entirely focused on fertility(Fraser, 2006). It has been suggested that 'biotechnological control' is more appropriate for the latter types.

Biological control, or introducing predators, parasites, or disease organisms to control pests, is an ecologically and conceptually appealing approach to reducing rodent pest populations(Fall, 2015). This tactic has been used successfully in many insect IPM programs to control insect crop pests. We know no examples of the successful introduction of predators or diseases that have effectively prevented rodent damage. Often, such attempts have been ineffective, resulting in serious environmental problems (Kannemeyer,2017). The role of natural predators in controlling rodent pests is an interesting but frequently misunderstood concept that is rarely effective in reducing pest populations to tolerable levels. Numerous studies have demonstrated the importance of rodents in the diet of selected predators and have encouraged the establishment of predator populations in crop areas(Fall, 2015). However, few have critically evaluated the utility of such predation for reducing pest populations or increasing crop yields. During the late 1800s, the small Indian mongoose (Herpestes javanicus) was introduced into both the West Indies and Hawaii to control rat populations in sugarcane fields. Although this predator survives in some areas on a diet mainly composed of rats (Fall, 2015), the introductions failed to achieve the desired result of reducing rat populations in sugarcane fields. Mongooses have severely impacted ground-nesting bird species in the West Indies and Hawaii by preying on their eggs and young. In some areas in the Caribbean, the species has become a reservoir for rabies. Most studies investigating predator-prey relationships have concluded that predators control their prey only under rare circumstances, such as when prey populations are already at low densities and alternative prey are scarce. More commonly, high rodent or prey populations attract and sustain predators, which relocate when prey animals become more challenging to find and capture (Fall, 2015). There is a need to be cautious when considering such approaches for rodent control, as many parasites and diseases that can affect rodents can also affect humans.

2.3.1.6 Reproductive Inhibition

Reproductive inhibition is a valuable method of reducing rodent populations. The rapid reproductive potential of most rodent species often enables them to quickly overcome other population reduction measures (Fall, 2015). Reproductive inhibition is a non-lethal alternative that has the potential to provide long-lasting control. During the 1960s and 1970s, researchers explored the possibility of various chemosterilants, including synthetic steroids, estrogens, and progestins, as reproductive inhibitors (Fall, 2015). More recent research has focused on immunocontraception to induce self-sterilization in pest populations(Fall, 2015). However, the only successful use of wildlife reproductive inhibitors has been in laboratories, pens, and limited field situations, where animals are captured, treated, released, or injected with darts at close range (impractical for small, nocturnal mammals). The effective control of free-ranging wildlife populations would require oral delivery systems or species-specific infectious carriers that could deliver reproductive inhibitors to a sufficiently high proportion of animals to achieve population control (Fall, 2015). The technologies for achieving such delivery systems are still being researched. The ultimate development of reproductive inhibitors for controlling free-ranging wildlife populations will require resolving many complex legal, biological, economic, and ethical issues (Fall, 2015). It may be practical only for long-lived animals with lower reproductive capacities.

2.3.1.7 Biological and Biotechnological Control

Research done by Fraser (2006) found variable attitudes to applying diseases and natural predators to control vertebrate pests. Approximately 51% of the respondents opposed introducing a natural predator or disease. However, when specific references were made to pest species that had a direct and identifiable impact on people, resistance to such control techniques lessened. For example, over 30% of those who were generally opposed to using diseases and introduced predators favored a virus or disease when possums and rabbits were named as the target species (Fraser, 2006). In addition, when the disease or control agent was known, support for its use increased. These results support the conclusion drawn from other research on the influence of individual characteristics of rodent species on perceptions and acceptability of proposed management actions (Fraser, 2006).

2.3.1.8 Ultrasonic

Many devices that emit high-intensity ultrasound (sound frequencies greater than 20 kHz) have been marketed for rodent control, usually claiming that the ultrasound is aversive to rodents or somehow interferes with their communication. However, many studies that have evaluated ultrasound as a practical means of rodent control have concluded that ultrasound has only a partial or transitory effect (Fall, 2015) or no effect at all on target species, citing work by (Fall, 2015)), contended the use of ultrasonic may be appropriate in some IPM programs to displace rodents from sensitive areas in structures to locations where traps or bait stations can be used. He cautioned that users of this tool need to be conversant with the technology.

2.3.1.9 Eliminating Food Sources.

If rodents cannot find a food source within your unit area, they will likely look elsewhere. Proper waste disposal and sanitation measures should be followed to prevent food waste from becoming a food source for these pests. Eliminate access to garbage by using tight-fitting lids and disposing of garbage regularly in approved sites.
Store all food in a tightly covered, metal, rodent-proof container. Although plastic bags may reduce the odors that attract rodents to your area, they are not rodent-proof.
Clean up any food spills that may occur. If you spill food on a dirt surface near your living area, use your E-Tool or a shovel to clean up as much of the spill as possible. Dispose of the food, dirt, and everything else in a tightly sealed trash container.

Eliminating water sources. Like the food sources, anytime you can reduce the rodents' access to a water supply, you will significantly reduce the likelihood that they will stay in the area.

(1) Drain run-off puddles that develop in low spots.

(2) Remove any items from the unit area that may hold water, such as old tires and Cans.

(3) Keep stored water in bottles or five-gallon cans that close tightly.

(4) Store cases of bottled water off the ground on pallets.

(5) In areas with indoor plumbing, check to see if there are any leaking pipes. Repair any leaks found as soon as possible.

2.4 Diseases Carried by Rodents

Rats and mice are harmful to both humans and domestic animals. They are carriers of diseases transmitted to humans through direct contact and contact with their feces and urine (Çelik et al., 2018).

2,4,1 Leptospirosis.

This disease is caused by a disease organism that is shed with the animal's urine. Humans are infected when their broken skin or mucous membranes come in direct contact with the urine or tissue of an infected animal. They may also contract the disease if their broken skin or mucous membranes come in contact with contaminated water or moist infected soil. Humans can also contract the disease if they eat food that has been 'marked' with the animal's urine or feces.

2.4.2 Salmonellosis.

This disease is caused by the disease organism being shed through the urine or feces of an infected animal. Infections most commonly occur when humans eat contaminated food or food prepared on a contaminated surface. Mice are more common carriers of this disease than rats.

2.4.3 Hanta virus.

There are various hantaviruses, but all are contracted in the same manner. These diseases are transmitted through the urine and feces of dried rats or field rodents. Infection occurs when particles from dried feces and urine are inhaled.

2.4.4 Rat bite fever.

As its name implies, rat bite fever is caused by the rat's bite. The organism that causes the fever is found on the rat's teeth and gums.

NOTE: Not only do rats and mice carry harmful organisms that cause human diseases, but they are also hosts for fleas and mites, known as ectoparasites, which also carry diseases (Çelik et al., 2018).

2.4.5 Plague.

This is the most familiar arthropod-borne disease known to man. It is transmitted to humans primarily when the infected rodent fleas bite them. Humans may also acquire the disease by exposure to infected animal tissue. This disease is found worldwide and can be passed from human to human, as is often the case in an epidemic.

2.4.6 Murine typhus.

This infection is transmitted through the feces of an infected flea. When a flea-bitten soldier scratches the bite, he rubs the flea feces into the skin, causing the infection.

2.4.7 Rickettsia pox.

This is a mild disease transmitted from mice to humans by the bite of the house mouse mite (Çelik et al., 2018).

2.5 Types of Rodents common in Sierra Leone with their associated consequences

Figure 1: Mus Musculus (House Mouse). Source: Berkenhout, J. (1769). Outlines of the Natural History of Great Britain. London: P. Elmsly.

They are small rodents frequently found in human dwellings, especially in food storage areas, where they cause crop damage and spread diseases. These rodents are primarily found in the provinces of Sierra Leone, where agricultural activities are visible. They are sometimes found in houses, mainly when agricultural products are transported to the town. There are various consequences, particularly regarding health, the economy, and environmental impact.

While Mus Musculus may seem harmless due to its small size, its presence can have far-reaching consequences, affecting human health, agriculture, the economy, and the environment. Effective control and prevention strategies are essential to mitigate the negative impact of these rodents. Regular sanitation, proper food storage, and professional pest management can help manage the risk posed by house mice.

Figure 2: Rattus Norvegicus (Brown rat or Norway rat). Source: Berkenhout, J. (1769). Outlines of the Natural History of Great Britain. London: P. Elmsly.

These are common in human settlements, such as sewers, warehouses, and dumpsites. Local farmers commonly hunt brown rats in most parts of Sierra Leone, particularly the Pujehun environment. They make a delicious meal amongst the Mende tribe in rural settings, especially in Pujehun. They are common and can wreak havoc in most homes. These rats pose significant risks to health, the economy, the environment, and society. Their infestation in any environment can spread diseases, cause property damage, and disrupt local ecosystems. Effective management strategies, including pest control, environmental sanitation, and awareness campaigns, are vital for mitigating the adverse effects of these rodents in both rural and urban areas.

3. METHODOLOGY

The study population includes residents of the Shellmingo Community in Bo, Sierra Leone. The estimated population of Shellmingo, which is the sample frame, is approximately 2,500 people. However, a targeted number of 120 was considered, and from this, a sample of 92 respondents will be drawn using a simple random sampling technique.

4. DISCUSSION OF RESULTS

4.1 Level of rodent infestation in the study area

A considerable number, 55%, of the dwellings in the study area were made of mud bricks, and wattle and corrugated iron sheets were the most common roofing materials. This description of the dwelling houses in the study area provides rodents with easy access to dwellings and allows them to breed there. In light of this, the targeted respondents described the rodent infestation in their community as very high (65%), high (27%), moderate (6%), and low (2%) (See Figure 3 below). This suggests that almost every household in this community has rodents living with humans.

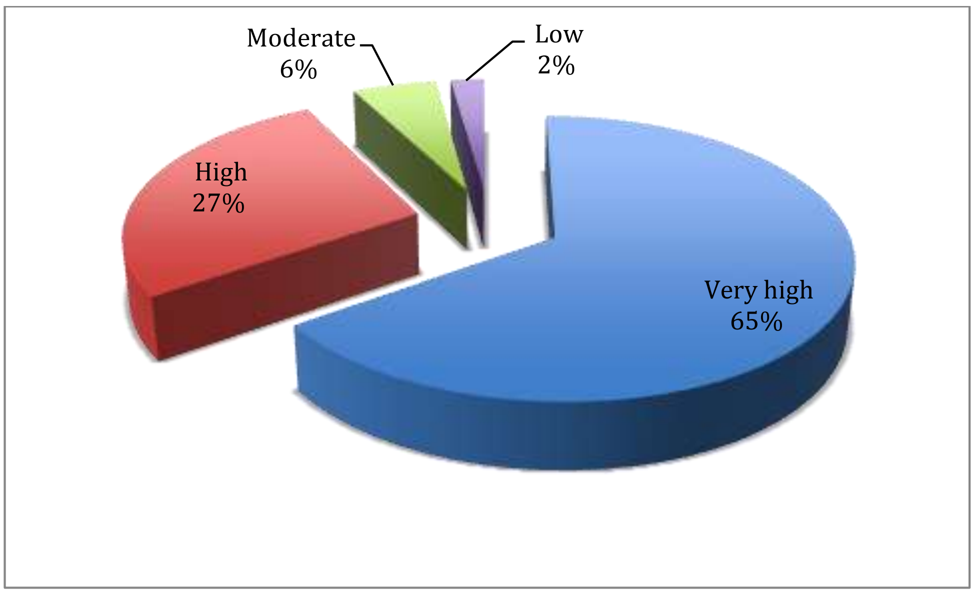


Figure 3: Description of rodent infestation at Shelmingo. Source: Field survey, 2024

The respondents' views further strengthen this fact; 76% confirmed that they always see rodents in their households, and 22% stated that they see them sometimes. Most % of the respondents, 76%, confirmed seeing holes created by rats in their homes. Furthermore, 87% of these people reported that rats had caused significant damage to their properties, which is very common in their community. Furthermore, 56% also reported losing money to rodents' feeding and living habits.

4.2 Peak period for rodent infestation in the study area

The majority, 59%, of the respondents believe that the rodent population in their household increases in the rainy seasons for several reasons, including the need for warmth and safety from flooded water in the nearby bushes and swamps, search for food, growing grasses and shrubs around homes, presence of garbage around homes that can't be burned down during the rains (see Figure 4 below)

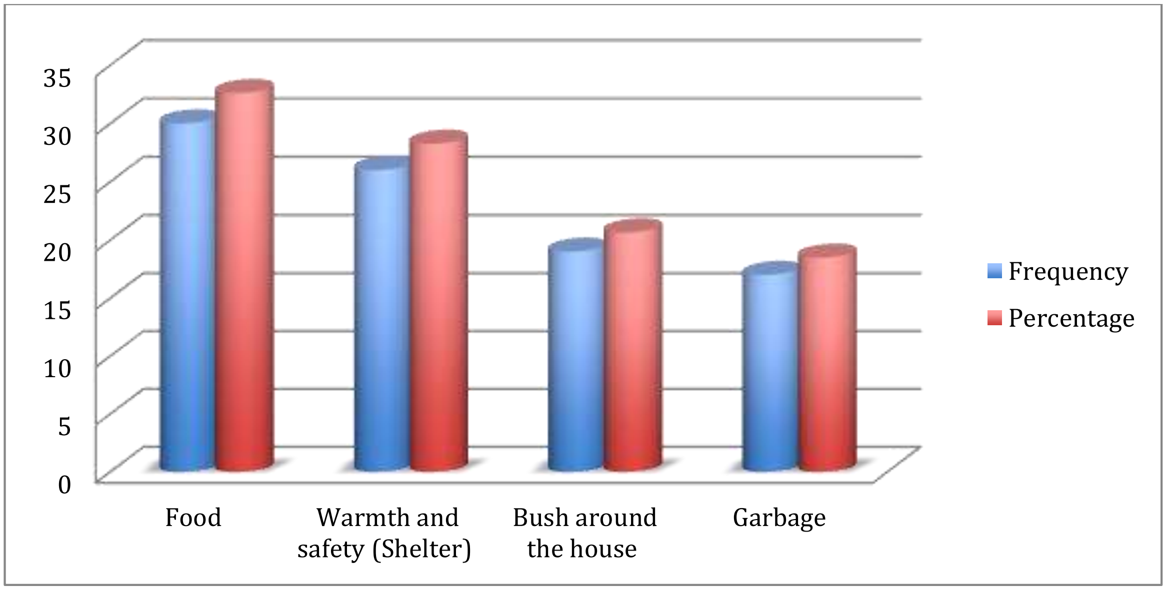


Figure 4: Causes of the increase in rodent population during the rains. Source: Field survey, 2024

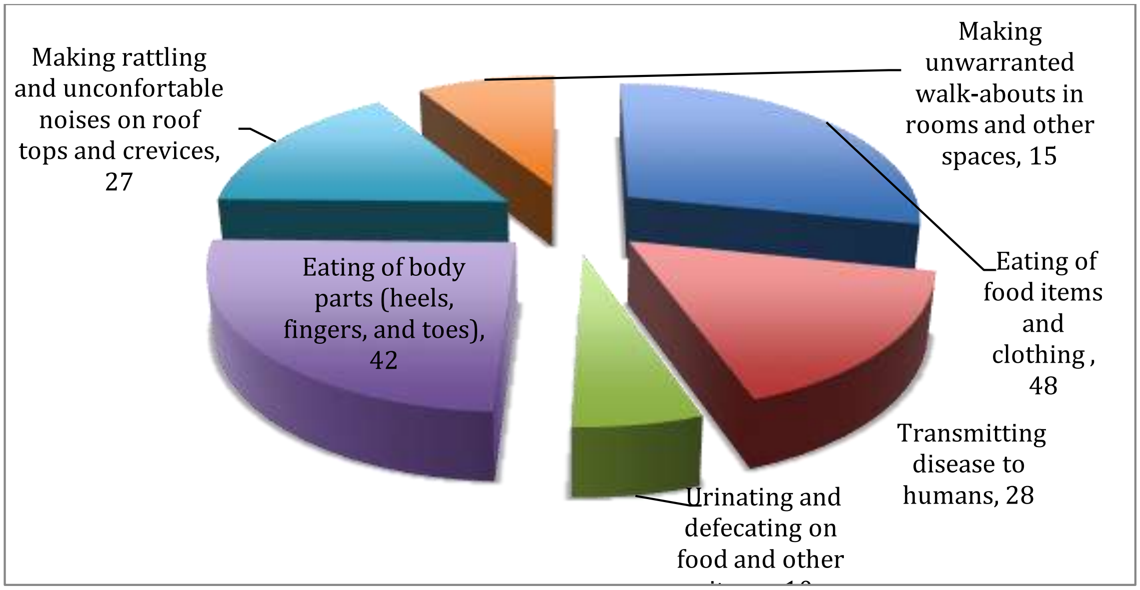
However, regardless of the season, rodents make their way into homes using several methods, including burrows dug from outside the building, open ceilings, overhead electrical cables running into the house, tall flower plants near buildings, open spaces underneath doors, and wall climbing. Considering the entry options for rodents and the types of buildings in the study area (see Figure 5 below), it is apparent that there is a high rodent infestation. This implies the well-being of the inhabitants in such communities, especially when there are improper food storage facilities. Thus, according to the study, only 10% of the respondents reported keeping their food items in sealed containers.

Sources: Field Survey 2024

Figure 5: Types of dwelling houses in the Shelmingo Community

4.3 Forms of human-rodent interactions

It was revealed that the most common form of interaction between the inhabitants of this community and the rodents that are present therein include the eating of food and clothing items, eating of body parts (such as the heels, the toes, and nails) of people, especially children; urinating and defecating on food and other items by the rodents in households (See Figure 6 below)



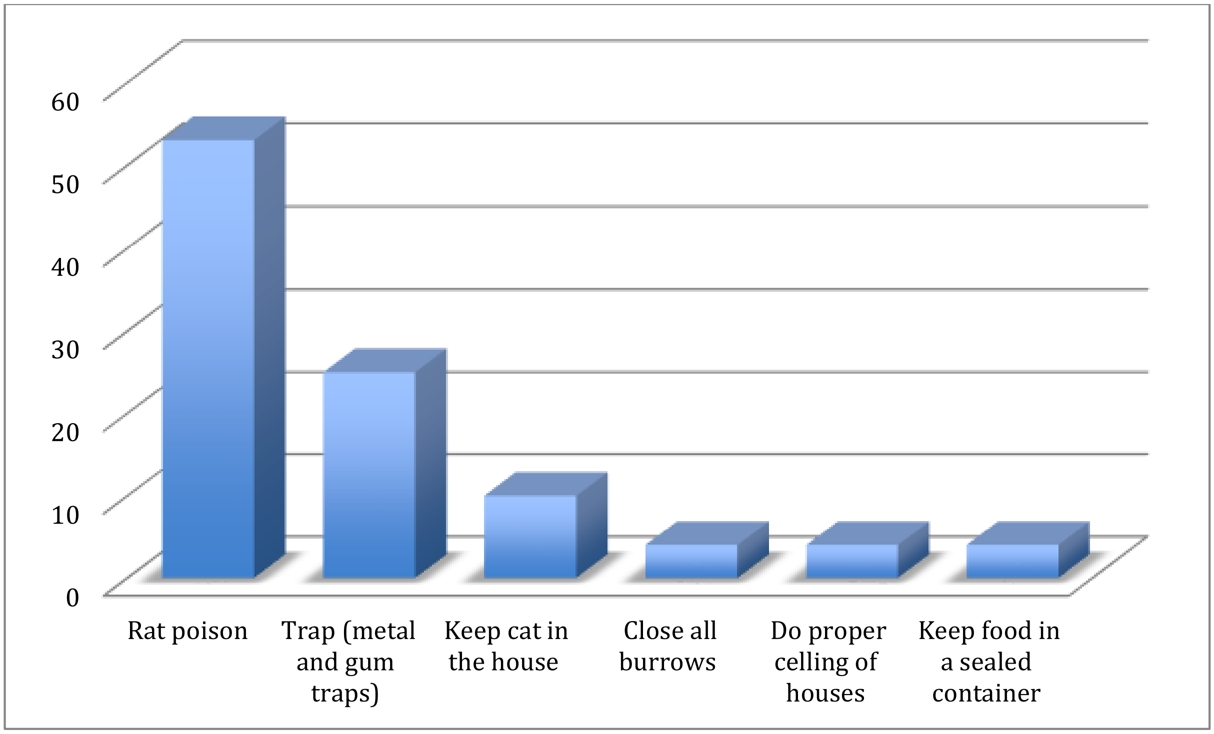
Source: Field survey, 2024

Figure 6: Forms of human-rodent interaction

Considering the poverty level in this community, like many others in Sierra Leone, 17.4% of the respondents either eat food that has been partly eaten by rodents or cut off the parts believed to have been eaten by rodents and eat the remaining parts. This situation puts the lives of these people at risk of contracting several deadly diseases, such as Lassa fever, hantavirus, leptospirosis, salmonellosis, and many more.

4.4 Control measures in dealing with rodents in the study area

It was noted that, despite the risks of interacting with rodents at these life-threatening levels, the awareness rate among the respondents regarding the dangers of dealing with rodents is minimal. Some efforts were noted to have been made by INGOs to control the rodent population in the community. A few techniques were shown to the inhabitants and are stated in Figure 7 below:



Source: Field survey, 2024

Figure 7: Control measures learned by respondents in dealing with rodents

Despite the control measures they have learned, the majority, 57%, of respondents confirmed that they still face challenges in handling the rodent situation in their community. Poor housing conditions, improper environmental management, uncontrolled waste disposal sites around the community, the massive presence of inland valley swamps, clogged drainage systems, poor household hygiene, and lack of awareness were key challenges in controlling the rodent population in this community.

4.5: The Level of Rodent Infestation in the Study Area

The level of rodents is very high, so they usually see them all the time, and the rodents burrow in their houses. The research summarizes that they had contact with rodent fluids (urine, sputum, blood, and feces), rodents permanently damaged their properties, stole their money, and also ate their toes and fingers.

5.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Summary

In the Shellmingo community of Bo District, Sierra Leone, human-rodent interactions are a significant public health concern, primarily due to the risk of Lassa fever transmission. The multimammate mouse (Mastomys natalensis), the primary reservoir for the Lassa virus, is commonly found in domestic spaces, leading to frequent and often unintended human contact.

Key Findings:

1. Rodent Infestation and Human Exposure

Rodents are prevalent in homes, kitchens, and storage areas, leading to contamination of food supplies and household items. Human exposure to rodents occurs through direct contact, such as handling dead rodents, and indirect contact, such as exposure to rodent urine and feces.

2. Rodent Control Practices

Community members employ various rodent control methods, including trapping and poisoning. These methods are often reactive and conducted individually, leading to limited effectiveness due to rapid rodent recolonization.

3. Challenges in Rodent Control

Lack of coordinated community efforts hampers effective rodent control. Inadequate housing structures and food storage practices contribute to persistent rodent infestations.

4. Health Implications

The presence of Mnatalensis in domestic spaces increases the risk of Lassa fever transmission to humans. Rodent infestations also lead to food spoilage and economic losses, exacerbating food insecurity.

Addressing human-rodent interactions in Shellmingo requires a multifaceted approach that combines community engagement, infrastructure improvements, and public health initiatives to mitigate the risks associated with rodent infestations.

5.2 Conclusion

The rodent infestation in this community has had many negative impacts, including damage to property and crops and the transmission of diseases. The interaction between humans and rodents poses a high risk of zoonosis, which could lead to numerous fatalities if not effectively addressed. Due to the severe rodent infestation, control measures are essential, with setting traps being the most commonly used method.

Based on the study conducted, there were more females than males during the questionnaire distribution, and most respondents fell within the 30 -35 age range. The research revealed that most individuals had lived in the community for over fifteen years, and many had attended secondary school. The majority were married with one spouse, and most identified as Muslims. Additionally, the research indicated that most participants were traders, earning between Le700,000 and Le1,000,000. They had an average of three dependents, contributing to their financial insufficiency.

The study highlighted a persistent problem with rodent sightings, as many respondents reported seeing rodents regularly. Most participants noted that rodent burrows were located within their homes and that they had come into contact with rodent fluids, including urine, saliva, blood, and feces. Rodents were reported to have damaged personal belongings, such as books and money, in the study area.

The research also showed that the rodent population tends to increase during the rainy season, primarily due to the availability of food sources. Rodents can enter homes through gaps in doors and windows. Additionally, participants mentioned storing food in their bedrooms because of a lack of proper storage facilities in the area.

The study found that many individuals unknowingly interacted with rodents by consuming food contaminated with their droppings. They would remove the visibly affected parts and eat the remainder, which led to illnesses like Lassa fever. Most respondents reported receiving information about rodents through the radio.

Furthermore, the research concluded that people often learn about rodent issues from medical practitioners. Standard methods for rodent control in the community include using rat poison and spring traps. Stakeholders have encouraged community members to maintain cleanliness as a proactive measure.

However, controlling rodent populations presents several challenges. One significant issue is the lack of proper hygiene and sanitation, which could be improved by enforcing better hygiene practices.

In summary, the study confirmed that rodents interact with the community in an ongoing manner and that effective rodent control measures are necessary. It urged the government and relevant agencies to conduct community sensitization and educational programs to address the issue in the study area.

5.3 Recommendations and solutions to the problem

Based on the findings of the study, the following recommendations are made to help reduce rodent interaction and rodent control in the study area;

- Frequent cleaning of the environment to combat or minimize rodent infestation.
- Keep all cooked and uncooked food in sealed containers away from our bedrooms.
- Trapping and keeping cats in every household can be a collective effort to eliminate rodents.
- Prepare rodent bait stations as an attractive food source for rodents to help monitor rodents' activity and develop indicators to inform rodent control strategies.
- Community sensitization/education to be conducted regularly

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