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Public attitudes, perceptions, and suggested strategies for managing free-roaming dogs in selected urban and rural settings in Uganda

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Introduction: Uganda ranks among the top ten countries globally for reported dog bites, with an average of 14,865 cases annually, and records an estimated 486 human rabies deaths per year—partly due to the overwhelming number of free-roaming dogs (FRDs). Given that FRDs stem from societal mismanagement, sustainable control strategies must be rooted in meaningful community involvement. However, such community-based data remains largely unavailable in Uganda, hindering efforts to manage the growing FRD population.

Methods: We conducted a structured survey of 3,307 participants split between selected urban and rural areas in Uganda in 2023 to assess public attitudes and perceptions toward FRDs. Respondents were also asked to suggest appropriate control measures. We used chi-square tests to analyze sociodemographic differences and logistic regression to identify factors associated with attitudes toward FRDs.

Results: The results showed that 81.9% of urban and 64.9% of rural respondents encountered FRDs daily. Attitudes toward FRDs were predominantly negative: 81.8% of respondents considered them a public health threat, and 57.1% viewed them as a nuisance. However, 76.3% also expressed empathy toward roaming dogs. Multivariable logistic regression analysis revealed that positive attitudes toward FRDs were associated with having a religious background, higher income, lower education levels, and residence in rural areas. Community-suggested

control strategies included sterilization, public education on responsible dog ownership, and, controversially, poisoning.

Discussion: The findings highlight strong community awareness of the FRD issue, particularly as two of the top proposed measures—sterilization and public education—align with the World Organisation for Animal Health’s (WOAH) recommended strategies for managing roaming dog populations. Authorities can leverage the prevailing negative perceptions to design and implement humane, community-supported control strategies. Simultaneously, those who express empathy toward FRDs can be encouraged to translate their concern into proactive measures that reduce roaming behaviour.

KEYWORDS

perceptions, attitudes, dog population management, free-roaming dogs, urban settings, rural settings, Uganda

Introduction

A free-roaming dog (FRD) is defined as a dog that lives and moves with minimal or no direct human supervision or confinement for extended periods, allowing it to navigate public and private spaces freely (Totton et al., 2011; World Organisation for Animal Health, 2023). This definition, however, excludes owned dogs that are temporarily off-leash but remain under close supervision by their owners, such as when they are within sight in a park (Lee et al., 2009). According to widely recognized literature, free-roaming dogs can be broadly categorized into four groups (World Organisation for Animal Health, 2023). The first group comprises owned roaming dogs, which are animals that have identifiable owners but are allowed to roam freely due to the owner’s inability or unwillingness to provide adequate confinement or supervision (Tayebwa et al., 2024b). The second group consists of stray dogs, which are previously owned dogs that have either been abandoned or lost (Totton et al., 2011). The third category is made up of feral dogs, which are born and raised in the wild and therefore have little to no contact with humans (Boitani and Ciucci, 1995; Hughes and Macdonald, 2013). Lastly, there are community dogs, which are unconfined animals cared for collectively by members of a community rather than by an individual owner (Tiwari et al., 2019). This latter category is particularly common in countries where strict dog ownership regulations are not enforced (Corfmat et al., 2023; Tayebwa et al., 2024b).

Free-roaming dogs constitute approximately 75% of the estimated 700 million dogs worldwide (Smith et al., 2019; Sykes et al., 2020). High populations of FRDs have been reported in countries such as India, China, Turkey, and Brazil (Matter and Daniels, 2000; Hughes and Macdonald, 2013), while in Africa, nations including Nigeria, South Africa, Kenya, Tanzania, and Uganda record some of the largest numbers (Hambolu et al., 2014; Czupryna et al., 2016; Sambo et al., 2018; Muinde et al.,

2021; Tayebwa et al., 2024b). In many of these countries, the persistence of large FRD populations is largely attributed to the absence of effective policies and management frameworks (Jackman and Rowan, 2007; Dalla Villa et al., 2010; Corfmat et al., 2023; Sensharma et al., 2024). In Uganda, for instance, legal provisions such as the *Straying Animals Act* place restrictions on roaming dogs; however, weak enforcement, poor dog ownership practices, and a range of socio-ecological factors continue to sustain the FRDs (Hyeroba et al., 2017; Warembourg et al., 2021a; Warembourg et al., 2021b; Tayebwa et al., 2024b).

Where roaming dogs thrive, they pose significant health and socioeconomic challenges including bites (Zhu et al., 2020), spreading diseases (Mendoza Roldan and Otranto, 2023; Udainiya et al., 2024), nuisance and distress to the communities (Mohanty et al., 2021; Nujum et al., 2024). In Uganda, 86% of reported human bites are attributed to FRDs (Kisaka et al., 2020). This statistic is particularly alarming given that rabies is endemic (Hampson et al., 2015). For example, we recently documented a case in Central Uganda where a single rabid FRD went on a rampage, biting 37 people and animals within one community (Tayebwa et al., 2025). The factors contributing to the high prevalence of FRDs in Uganda are complex and multifaceted. Previous studies indicate that roaming among owned dogs is widespread, largely because over 65% of dog owners in Uganda are both irresponsible (Tayebwa et al., 2024b) and economically disadvantaged (Wallace et al., 2017) which limits their ability to properly confine or care for their dogs.

Dog Population Management (DPM) strategies used globally include sterilization, capture (for removal or return), and, in some cases, culling (Smith et al., 2019). However, their implementation depends on a country’s policies, economic standing, and socio-cultural context (Smith et al., 2019). For instance, affluent countries prioritize capturing, sterilizing, and rehoming stray animals, resulting in a steady reduction in their numbers (Tasker, 2007; Aloba et al., 2020). However, such approaches are often impractical for poor countries, due to high costs and weak enforcement (Smith

et al., 2019). In Uganda, DPM strategies are limited, often relying on reactive measures such as culling by poisoning with strychnine (Alobo et al., 2020). In some cases, community-driven mass killings of dogs by mobs have also been documented (Tayebwa et al., 2025). However, such methods have faced widespread criticism for being unsustainable and inhumane (Smith et al., 2019). More humane alternatives, including sterilization and the provision of shelters, remain underutilized due to financial constraints, limited public awareness, and insufficient technical capacity within district veterinary services (Tayebwa et al., 2024b).

To develop sustainable strategies for roaming dog control, it is essential to first understand the cultural, religious, and socio-economic perspectives of the communities involved (Smith et al., 2019; Corfmat et al., 2023; World Organisation for Animal Health, 2023). These factors are critical for tailoring existing measures or designing new ones to fit the local context (Smith et al., 2019; Corfmat et al., 2023; World Organisation for Animal Health, 2023). Unfortunately, no study of this nature has been conducted in Uganda. To address this information gap, we explored the attitudes and perceptions of selected urban and rural communities in Uganda regarding FRDs. Respondents were asked to propose control measures for managing FRDs in their areas. The findings from this study provide valuable insights into community attitudes and offer community-driven recommendations for control of FRDs in Uganda and other socio-economically similar settings.

Materials and methods

Study area

This study was conducted in the Kampala Metropolitan Area (KMA) to represent urban settings and in the Kabarole and Bundibugyo districts to represent rural areas (Figure 1). KMA, located in Central Uganda is a densely populated urban area that includes the capital city and its neighboring districts (Wakiso and Mukono). Residents of the KMA provide a valuable insight into urban community perceptions, as they come from diverse socio-economic backgrounds and keep dogs mainly as pets or for security. Kabarole and Bundibugyo districts are located Western Uganda near the Rwenzori Mountain ranges and are partly occupied by Kibale and Semuliki national parks, respectively. The communities in these districts represent a typical rural setting where agriculture and livestock keeping are the main economic activities, and dogs are used for herding livestock and hunting wildlife (Hyeroba et al., 2017).

Study design and data collection

We conducted a cross-sectional study between November 2022 and November 2023 to assess attitudes and perceptions, and to

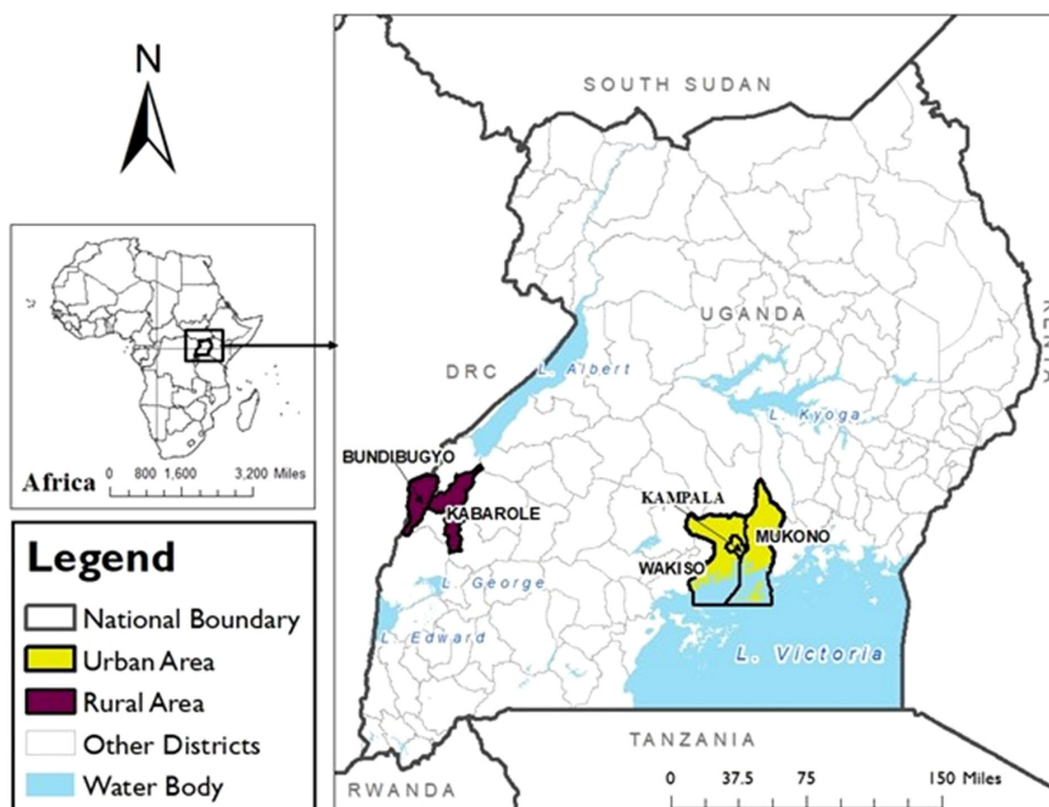


FIGURE 1

Map of Uganda showing the selected study areas. The light green shaded region indicates the three urban districts, namely Kampala (the capital), Mukono, and Wakiso, while the dark purple region highlights the rural districts of Bundibugyo and Kabarole in Western Uganda.

gauge respondents' suggestions for the control of roaming dogs in their areas. In this study, FRDs were defined as dogs observed moving freely in the community without human control. This category included owned roaming dogs (strays), unowned roaming dogs, community dogs, and feral dogs. Participants were identified from the study area using convenient sampling. Briefly, the respondents were invited to complete an online questionnaire as previously described (Wright et al., 2021; Smith et al., 2022; Sparkes et al., 2022). The structured questionnaire was disseminated through online channels, specifically Facebook pages and WhatsApp groups, and further circulated via email through the personal and community networks of the research team. To enhance coverage, respondents were also encouraged to share the questionnaire link within their own networks, thereby extending participation beyond the immediate contacts of the research team.

To ensure representation of individuals without access to social media or email, including those in rural communities, markets, and informal settlements ("slums"), the research team administered a parallel version of the questionnaire through a door-to-door approach. The team collaborated with local animal husbandry officers to support community mobilization, and eligible participants were identified through convenience sampling and invited to complete the questionnaire on-site.

The questionnaire was a modified version of one adopted from a previous study (Smith et al., 2022). Following the modifications, it was pretested with 20 participants from Luweero District. Questions or response options which were unclear were modified, those deemed irrelevant were removed and additional important questions were added, and the final version was subsequently approved by both the research team and the ethics committee. The finalized questionnaire comprised four sections (Supplementary File 1):

1. The first section gathered the respondents' sociodemographic characteristics, the frequency of their interactions with FRDs, and the estimated number of roaming dogs in the area.
2. The second section included questions to gauge respondents' perceptions regarding the source of the FRDs, their shelters, how they access food, recorded attacks from FRDs, and how respondents interacted with the FRDs.
3. The third section comprised 15 items aimed at assessing respondents' attitudes toward FRDs, utilizing a 5-point Likert scale format. For example, one question read, "All roaming dogs should be removed from the street," with response options ranging from *strongly agree* (1), *agree* (2), *neutral* (3), *disagree* (4), to *strongly disagree* (5).
4. The fourth section inquired about respondents' interest in either ultimately removing or controlling FRDs in their community. Respondents were also asked to suggest measures for controlling FRDs and to indicate who or which authority should be responsible for their management. These questions were presented as

multiple-choice, with an option for respondents to provide additional suggestions beyond the items listed.

Sample size estimation

A sample size was calculated according to Leslie Kish's formulae $n = Z^2 * P(1 - P) / e^2$. Where N is the sample size, Z is the standard normal deviation at a confidence interval of 95% (1.96). P is the proportion of dog owners in a population, e is the level of precision or margin of error. Since no prior studies of this kind had been conducted in Uganda, the expected prevalence (P) was set at 50% as a conservative estimate. The level of significance was set at 5%, the margin of error at 10%, and a design effect of 1 was applied. Hence: $n = (1.96^2 * 0.50(1 - 0.5)) / 0.05^2$. $n = 384$ respondents. Allowing a non-response rate of 10%, the sample size was adjusted by the formula $((10/100) * n) + n$. Adjusted $n = 422.4$ participants per study site, totaling 845 participants as the minimum sample size for both rural and urban settings.

Statistical analysis

STATA version 14.2 was used for analysis. Descriptive statistics were used to summarize respondents' sociodemographic characteristics and other study variables, while differences between rural and urban settings were examined using the Chi-square test.

Attitudes towards FRDs were assessed using 15 Likert-scale items with responses ranging from *strongly agree* to *strongly disagree*. For the analysis, each response was assigned a numerical weight ranging from +2 to -2 (+2 for strongly agree, +1 for agree, 0 for neither, -1 for disagree, and -2 for strongly disagree), with reverse scoring applied to negative statements. An overall attitude score for each participant was obtained by averaging the weighted responses across all 15 items. Participants with a positive average score were categorized as having a positive attitude, while those with a negative or zero average score were categorized as having a non-positive attitude. This approach yielded a binary outcome variable.

To capture specific dimensions of attitudes, the items were further grouped into three domains: public health risk, dog welfare concerns, and nuisance. Domain-specific scores were calculated by averaging the weighted responses within each domain. Domain-specific scores were calculated by averaging the weighted responses within each domain and categorizing them as positive (score > 0) or non-positive (≤ 0).

To assess the socio-demographic factors associated with the different attitude domains, a modified Poisson regression model with backward elimination was used. This approach was chosen because the prevalence of responses in each domain exceeded 50%, making adjusted prevalence ratios more appropriate than odds ratios from logistic regression, which can overestimate associations when outcomes are common.

To identify sociodemographic factors associated with positive attitudes, we employed logistic regression. Bivariate analysis was first performed using simple logistic regression to explore associations between each independent variable and the binary outcome. Variables with a p -value < 0.25 in the bivariate analysis, as well as those with established theoretical relevance, were considered for inclusion in the multivariable model. Multicollinearity among the selected variables was assessed using the Variance Inflation Factor (VIF), with $VIF > 10$ as the threshold for exclusion; no variable met this criterion. For multivariable analysis, we used a manual backward elimination procedure rather than relying on automated stepwise algorithms. This approach allowed for epidemiological reasoning at each step, guided by both statistical significance (Wald's test) and theoretical importance of variables.

To assess confounding, we monitored changes in regression coefficients after removal of each variable and adopted a conservative threshold of $>10\%$ change to indicate potential confounding. None of the excluded variables produced such changes, suggesting that confounding was unlikely. Adjusted Odds ratios, their 95% confidence intervals, and p -values were reported. Model adequacy was evaluated using Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), where lower values indicated better fit. Additionally, a Hosmer–Lemeshow goodness-of-fit test was conducted ($p = 0.651$), indicating that the final model adequately fit the data.

Results

Socio-demographic characteristics of the respondents

A total of 3,307 respondents participated in the study. Of those, 2,294 (69.3%) were urban dwellers and 1,013 (30.6%) were from rural settings. Most respondents were male, non-dog owners, low-income earners and predominantly aged between 20 and 39 years. Most urban respondents had tertiary education (58.6%), while most rural respondents had completed secondary education (37.1%) ($p < 0.001$). Residential status also varied significantly ($p < 0.001$): 56.4% of urban respondents rented or lived in apartments, compared to 57.4% of rural respondents who owned their homes (Table 1).

Reported interactions of the community with free-roaming dogs

Most respondents, both in urban (81.9%) and rural (64.9%) settings, reported sighting FRDs daily (Figure 2). Most respondents in urban areas (61.8%) and rural areas (47.5%) estimated the number of FRDs in their area to be between 5 and 20.

Most respondents (83.1% urban, 82.9% rural) and their immediate family members (83.1% urban, 84.1% rural) had never been attacked by FRDs in their lifetime (Table 2). Attacks on

livestock were reported by 29.9% of respondents in the urban and 30.3% in the rural areas. Regarding the community's interaction with FRDs, 92.1% of urban respondents and 79.8% of rural respondents continued with their activities upon sighting a FRD in their vicinity. When such a dog attempted to approach them, most respondents either ignored it or attempted to chase it away (Table 2).

Perceptions of the community members towards free-roaming dogs

There were significant differences ($p < 0.05$) in perceptions of urban and rural community members towards FRDs (Table 3). Most urban respondents (37.3%) perceived that FRDs were feral, while 50.4% of rural respondents indicated that the dogs had escaped from their owners. In terms of shelter, most respondents in both urban (61.7%) and rural (47.4%) areas reported that FRDs found shelter wherever they could. Similarly, many respondents in urban (55.9%) and rural (64.8%) stated that dogs obtained their food from rubbish dump sites.

Community attitudes towards free-roaming dogs

The majority of respondents (86.7%) reported negative attitudes, while 10.3% reported positive and 3% reported neutral attitudes. Most respondents in urban areas (90.8%) and rural areas (77.3%) held negative attitudes toward FRDs, primarily due to public health risks (81.8%), followed by concerns about dog welfare (76.3%) and nuisances (57.1%).

Table 4 summarizes the profiles of individuals associated with attitudes toward public health risks, dog welfare, and nuisance. Respondents significantly more likely to perceive FRDs as a public health risk included urban residents, educated individuals, and those living in rentals or with family/friends. Those more likely to express concerns about dog welfare included urban residents, educated individuals, and low-income earners. Regarding the perception of dogs as a nuisance, urban residents were more likely to hold this view, whereas adults aged 20–39 years were less likely than teenagers to consider dogs a nuisance. Compared to homeowners, individuals living with family/friends or in rentals reported fewer nuisance concerns.

In this study, 9.2% of respondents from urban areas and 22.7% from rural areas expressed positive attitudes toward FRDs. Multivariable analysis revealed that religious individuals, rural residents, teenagers, those with no formal education, people who were dating, higher-income earners, and those who reported FRDs to authorities or shelters were more likely to have positive attitudes toward FRDs (Table 5). Individuals whose poultry or livestock were attacked by FRDs were more likely to have positive attitudes, but this was not the case for those who were personally attacked or whose family members were attacked.

TABLE 1 Socio-demographic characteristics of respondents.

Variable	Parameter	Urban, n (%)	Rural, n (%)	χ^2 P-value
Dog ownership status	Dog owner	648 (28.3)	358 (35.3)	<0.001
	Not dog owner	1,646 (71.7)	655 (64.7)	
Age category	Teen (18–19 years)	231 (10.1)	97 (9.6)	<0.001
	Adults (20–39 years)	1,732 (75.5)	580 (57.2)	
	Senior adults (>40)	331 (14.4)	336 (33.2)	
Sex	Female	803 (35.0)	304 (30.1)	0.005
	Male	1,491 (65.0)	709 (69.9)	
Level of education	None	65 (2.8)	94 (9.3)	<0.001
	Primary	211 (9.2)	311 (30.7)	
	Secondary	668 (29.1)	376 (37.1)	
	Tertiary	1,350 (58.9)	232 (22.9)	
Relationship status	Single	896 (39.1)	289 (28.6)	<0.001
	Dating	637 (27.8)	61 (6.0)	
	Married	713 (31.1)	573 (56.7)	
	Divorced/widowed	44 (1.9)	88 (8.7)	
Religious faith	Anglican	668 (29.1)	345 (34.1)	<0.001
	Born Again	471 (20.5)	144 (14.2)	
	Catholics	754 (32.9)	309 (30.5)	
	Muslims	312 (13.6)	78 (7.7)	
	Others	43 (1.9)	13 (1.3)	
Employment status	Casual laborer	119 (6.8)	94 (10.1)	<0.001
	Employed	1,566 (89.6)	763 (81.9)	
	Self-employed	62 (3.5)	74 (7.9)	
Monthly income [‡]	Low income (UGX<1m)	1,732 (75.5)	892 (87.9)	<0.001
	Middle income (UGX 1–3m)	450 (19.6)	113 (11.1)	
	Upper class (UGX >3m)	112 (4.9)	9 (0.9)	
Residential status	Housed by family or friends	451 (24.9)	167 (16.5)	<0.001
	Privately owned home	336 (18.6)	582 (57.4)	
	Rental/apartment	1,020 (56.4)	264 (26.1)	

[‡]1 million UGX \equiv 263 USD (exchange rate of 3800:1).

Community-proposed approaches for control of free-roaming dogs

Most of the respondents in urban (91.2%) and rural settings (82.7%) wanted the population of FRDs controlled. The respondents were asked to suggest measures for controlling FRDs through an open-ended question. The most proposed measures were encouraging dog owners to sterilize their pets, elimination by poisoning FRDs, and educating the public on responsible pet ownership (Figure 3A). When asked who should be responsible for controlling FRDs, the respondents

mainly assigned that role to municipal authorities, community members, and the National government (Figure 3B).

We sought to identify the sociodemographic factors associated with the proposed interventions for managing FRDs (Supplementary File 2). Results showed the following associations (Figure 4): Sterilization of owned dogs was more likely recommended by individuals in higher-income groups and middle-income groups. Poisoning FRDs was more likely to be recommended by males, urban residents, individuals with low income, homeowners, and apartment renters. Educating dog owners on responsible ownership

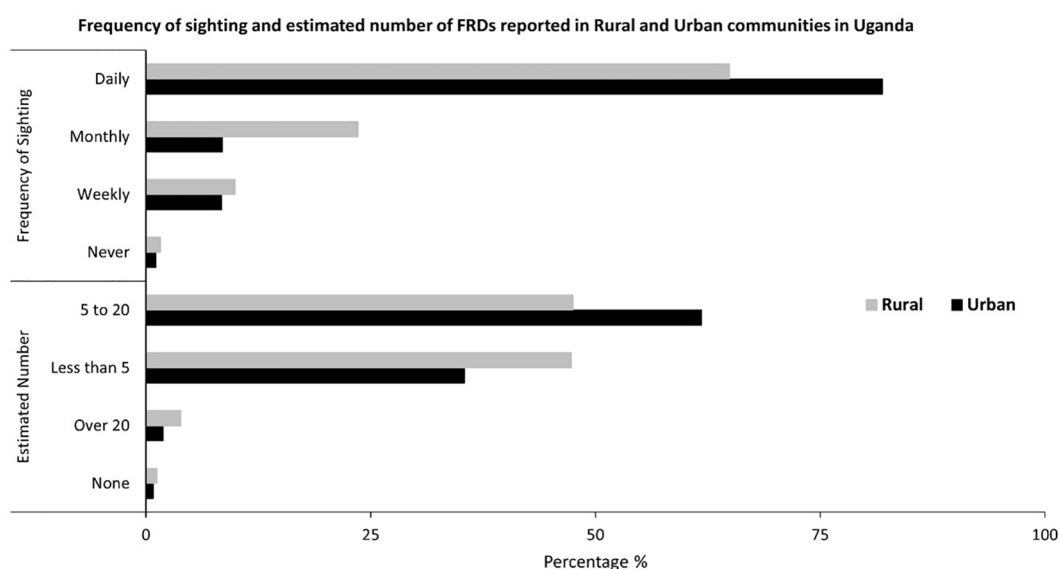


FIGURE 2

Frequency of sightings of roaming dogs and estimated numbers in urban and rural communities in Uganda. Black bars denote urban responses, and gray bars denote rural responses. In both settings, most respondents reported daily sightings of roaming dogs and estimated their numbers at between 5 and 20 per community.

was supported by non-dog owners, urban residents, individuals with higher education, those housed by family or friends, and homeowners. Capturing and removing FRDs was more likely supported by non-dog owners, urban residents, individuals in middle-income and upper-income groups, as well as those housed by family or friends.

Discussion

This is the first study in Uganda to document community perceptions and attitudes toward FRDs and to generate community-derived recommendations for their control. This study was premised

TABLE 2 Reported interaction of the respondents with free-roaming dogs within the urban and rural communities in Uganda.

Question	Responses (options)	Urban, n (%)	Rural, n (%)	χ^2 P-value
Have you ever been attacked by FRDs?	No	1,894 (86.3)	855 (82.9)	0.012
	Yes	301 (13.7)	176 (17.1)	
Have any of your family members ever been attacked by FRDs?	No	1,573 (83.1)	838 (84.1)	0.511
	Yes	320 (16.9)	159 (15.9)	
Have FRDs ever attacked/killed your livestock or poultry?	No	1,536 (70.0)	719 (69.7)	0.876
	Yes	658 (29.9)	312 (30.3)	
What do you do when you see FRDs on the street?	Go about my business	2,017 (92.1)	822 (79.8)	<0.001
	Warn family members	196 (8.9)	204 (19.8)	
	Report to authorities	32 (1.5)	104 (10.1)	
	Chase the dog	41 (1.9)	23 (2.2)	
What do you do when a free-roaming dog approaches you?	Go about my business	1,491 (68.1)	505 (49.0)	<0.001
	Chase the dog	531 (24.3)	398 (38.6)	
	Run away	287 (13.1)	229 (22.2)	
	Call for help	106 (4.8)	57 (5.5)	
	Touch and play with it	65 (2.9)	17 (1.7)	
	Throw food to the dog	31 (1.4)	20 (1.9)	

TABLE 3 Perceptions of the community members towards free-roaming dogs in urban and rural areas in Uganda.

Question	Responses (options)	Urban, n (%)	Rural, n (%)	χ^2 P-value
Where do the FRDs seen in your community come from?	Escape from their owner's home	537 (24.5)	520 (50.4)	<0.001
	They are stray animals (feral)	818 (37.3)	258 (25.0)	
	Some escape from their owner's home but others are stray/wild	591 (26.9)	199 (19.3)	
	Not sure	165 (7.5)	33 (3.2)	
Where do you think the FRDs find shelter?	Anyplace they can find	1,050 (61.7)	489 (47.4)	<0.001
	Keep roaming day and night	443 (26.0)	306 (29.7)	
	Trenches and abandoned buildings	161 (9.5)	190 (18.4)	
	Not sure	142 (8.3)	48 (4.7)	
Where do you think they obtain the food they eat	Rubbish dumps	960 (55.9)	667 (64.8)	<0.001
	Roadside food stalls	693 (40.3)	419 (40.7)	
	Kind people feed them	174 (10.1)	88 (8.5)	
	Not sure	34 (1.9)	12 (1.2)	

TABLE 4 Multivariate analysis of factors associated with attitudes (public health, dog welfare and nuisance) towards free-roaming dogs in urban and rural areas in Uganda.

Parameter	Variable	aPR (95%CI) P-value		
		Public health risks	Dog welfare concerns	Nuisance
Setting	Urban	1.13 (1.08, 1.18) <0.001	1.12 (1.07, 1.19) <0.001	1.39 (1.29, 1.49) <0.001
	Rural	1.00	1.00	1.00
Dog ownership	Dog owner			1.00
	Not a dog owner			1.03 (0.97, 1.09) 0.307
Age category	Adults (20–39 years)			0.89 (0.81, 0.98) 0.020
	Teen (18–19 years)			1.00
	Senior adult (>40)			0.95 (0.77, 1.17) 0.626
Sex	Male		1.01 (0.97, 1.06) 0.553	
	Female		1.00	
Level of education	None	1.00		
	Primary	1.24 (1.08, 1.42) 0.002		
	Secondary	1.25 (1.09, 1.42) 0.001		
	Tertiary	1.28 (1.12, 1.46) <0.001		
Monthly Income	Low income (<1m)		1.00	
	Middle income (1–3m)		0.93 (0.88, 0.99) 0.017	
	Upper class (>3m)		0.95 (0.85, 1.06) 0.327	
Residence	Privately owned home	1.00	1.00	1.00
	Housed by family/friends	0.94 (0.89, 0.99) 0.011	0.87 (0.82, 0.93) <0.001	0.88 (0.81, 0.96) 0.003
	Rental/apartment	0.92 (0.88, 0.96) <0.001	0.94 (0.90, 0.99) 0.031	0.89 (0.83, 0.95) <0.001

aPR, adjusted Prevalence Ratio. The significant P values are highlighted in bold.

TABLE 5 Multivariable analysis of factors associated with positive attitudes towards free-roaming dogs in urban and rural settings in Uganda.

Parameter	Variable	aOR (95%CI) P-value
Setting***	Urban	1.00
	Rural	4.21 (3.00, 5.90)<0.001
Dog ownership status	Not a dog owner	1.00
	Dog owner	1.29 (0.97, 1.71) 0.076
Age category**	Adult (20–39 years)	1.00
	Teen (18–19 years)	1.78 (1.24, 2.53) 0.001
	Senior adult (>40)	2.99 (1.54, 5.80) 0.001
Sex	Male	1.00
	Female	1.05 (0.78, 1.39) 0.741
Level of education**	Tertiary	1.00
	None	2.14 (1.21, 3.78) 0.008
	Primary	1.38 (0.91, 2.09) 0.120
	Secondary	1.39 (0.99, 1.96) 0.057
Relationship status*	Married	1.00
	Single	1.22 (0.87, 1.69) 0.235
	Dating	1.61 (1.08, 2.41) 0.019
	Divorced/widowed	0.97 (0.54, 1.73) 0.935
Religious faith***	Anglican	1.00
	Born Again	2.57 (1.73, 3.83)<0.001
	Catholics	1.84 (1.29, 2.62) 0.001
	Muslims	1.90 (1.17, 3.10) 0.010
	Others	3.65 (1.52, 8.75) 0.004
	SDA	2.18 (1.30, 3.65) 0.003
Employment status	Un-employed	1.00
	Casual laborer	3.43 (1.78, 6.58)<0.001
	Employed	0.90 (0.50, 1.61) 0.733
Monthly Income***	Low income (<1m)	1.00
	Middle income (1–3m)	1.78 (1.24, 2.53)<0.001
	Upper class (>3m)	2.99 (1.54, 5.80)<0.001
Have you ever been attacked by FRDs?	No	1.00
	Yes	0.77 (0.50, 1.17) 0.219
Have FRDs ever attacked/killed your livestock/poultry?***	No	1.00
	Yes	0.54 (0.39, 0.74)<0.001
Have any of your family members been bitten by FRDs?	No	1.00
	Yes	0.75 (0.51, 1.12) 0.166

(Continued)

TABLE 5 Continued

Parameter	Variable	aOR (95%CI) P-value
What do you do when you see FRD on the street?		
1. Do nothing	No	1.00
	Yes	0.92 (0.56, 1.51) 0.753
2. Report to the animal rescue shelter***	No	1.00
	Yes	3.07 (1.75, 5.37)<0.001
3. Report to the local council chairperson	No	1.00
	Yes	1.39 (0.76, 2.55) 0.275
4. Report to the city authority**	No	1.00
	Yes	3.17 (1.37, 7.36) 0.007

The significant P values are highlighted in bold.

on the fact that communities are best positioned to identify feasible and context-specific solutions tailored to their unique challenges (Casey, 2018; Cullen et al., 2018; Coy et al., 2021).

Sightings of free-roaming dogs in urban and rural Uganda

The findings of this study reveal that both rural and urban residents frequently encounter roaming dogs. This is consistent with our earlier research (Tayebwa et al., 2024b) and with previous studies documenting substantial numbers of roaming dogs in both urban and rural areas of Uganda (Hyeroa et al., 2017; Wallace et al., 2017). A key observation, however, is that urban residents reported more encounters with roaming dogs compared to their rural counterparts. This disparity is likely explained by differences in human–dog population dynamics. Previous studies have shown that the human-to-dog population ratio is higher in urban areas than in rural areas (Wallace et al., 2017; Tayebwa et al., 2024b), which certainly increases the likelihood of urban residents encountering roaming dogs. In addition, the physical environment may play an important role. Rural areas are typically characterized by extensive farmlands, and in our study districts, the landscape in Bundibugyo and Kabarole districts is largely forested due to the presence of wildlife reserves and game parks (Hyeroa et al., 2017; Tayebwa et al., 2024a). These features provide roaming dogs with wider dispersal space, thereby reducing their visibility to humans. Therefore, the observed disparities suggest that strategies for controlling roaming dogs may need to be tailored differently for rural and urban settings.

Community’s attitudes towards free-roaming dogs in urban and rural Uganda

Overall, most respondents expressed negative attitudes toward FRDs. Notably, the primary concern was public health, particularly the fear of dog bites and the transmission of diseases by FRDs. Globally,

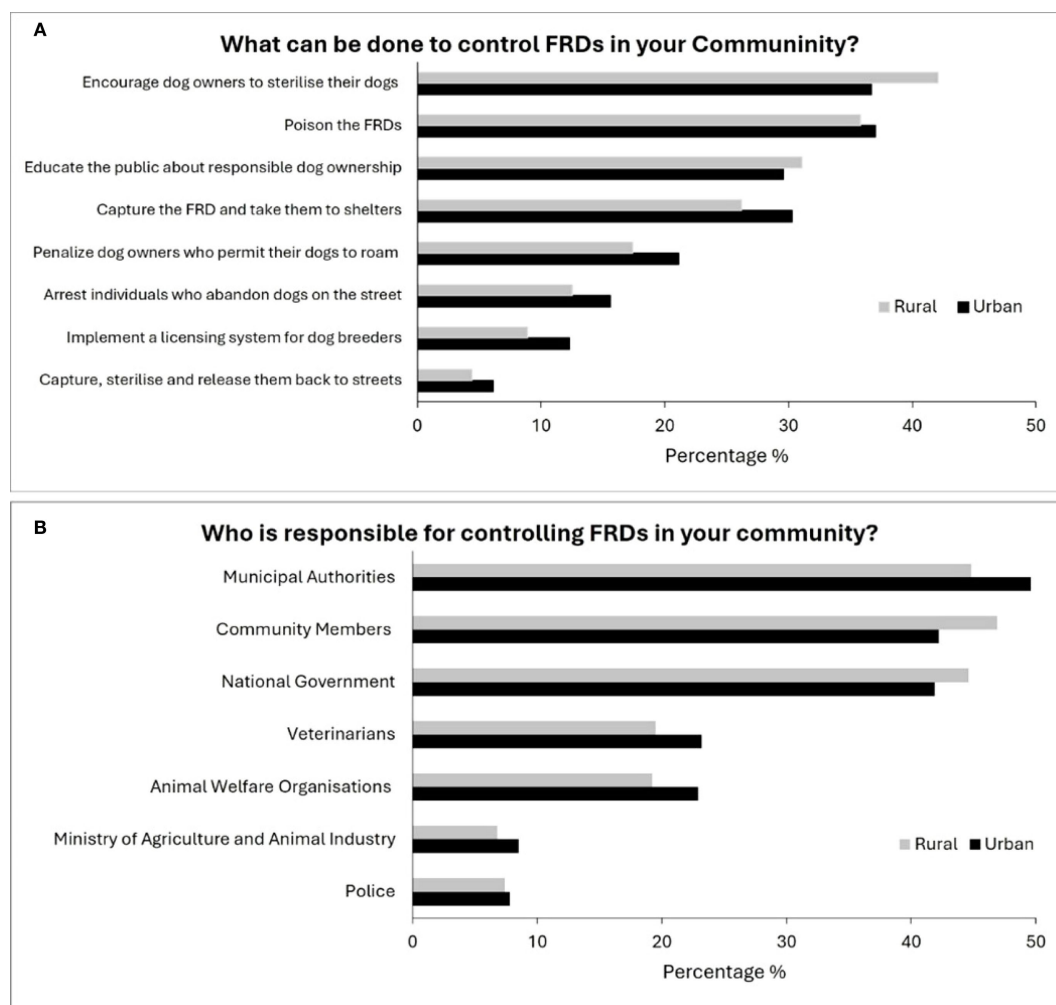


FIGURE 3

Graph (A) shows the roaming dog control measures suggested by the community while Graph (B) shows which authorities the community thinks are responsible for controlling roaming dogs. Black bars denote urban responses, and gray bars denote rural responses. In both settings, the most suggested approach was to encourage dog owners to sterilize their dogs. Urban respondents assigned responsibility for roaming dog control to municipal authorities, while rural respondents assigned it to community members, although this difference was not statistically significant.

rabies is the most feared dog-associated disease (Hampson et al., 2015), and in Africa, dogs are responsible for approximately 95% of human cases (Nyasulu et al., 2021). It is, therefore, understandable that public health concerns are a top priority for community members in Uganda. On the positive side, such negative attitudes toward FRDs could be instrumental in advocacy efforts aimed at discouraging roaming or improving control measures for FRDs.

When discussing FRDs, the issue of bites often takes precedence. However, we were surprised to find that only 13.7% of urban respondents and 17.1% of rural respondents reported being bitten by FRDs. This contrasts with the findings of Kisaka et al. (Kisaka et al., 2020), which attributed 86% of dog bites to roaming dogs. Notably, whereas that study focused exclusively on dog bite victims, our study surveyed the general population, providing a more comprehensive perspective. Nevertheless, a substantial number of people were bitten by FRDs, and as previous studies have shown, encounters such as dog bites or being chased can foster negative attitudes (D'ingeo et al., 2021; Westgarth et al., 2024).

Negative attitudes driven by the nuisance of FRDs were reported by 57.1% of respondents. These findings are consistent with a 2022 study conducted in India, which found that 58% of the households viewed FRDs as a nuisance. This similarity in attitudes is likely due to the high roaming dog population in Uganda, as in India, which increases the likelihood of dog-related nuisances (Corfmat et al., 2023). As dogs roam, they inevitably cause road accidents (Mohanty et al., 2021), noise through behavior such as howling, instilling fear, or creating unsightly environment for the locals (Flint et al., 2014), as well as tourists (Beckman et al., 2014). Findings from this study revealed that certain groups of people perceived FRDs as a nuisance. These included individuals who frequently interacted with FRDs, such as urban residents, homeowners in areas with high roaming dog densities, and those with a tendency to fear dogs (e.g., women) (Boyd et al., 2004). Such individuals are more likely to support roaming dog control measures; however, they may also engage in hostile behaviors toward the dogs, including chasing or physically harming them (Tayebwa et al., 2025).

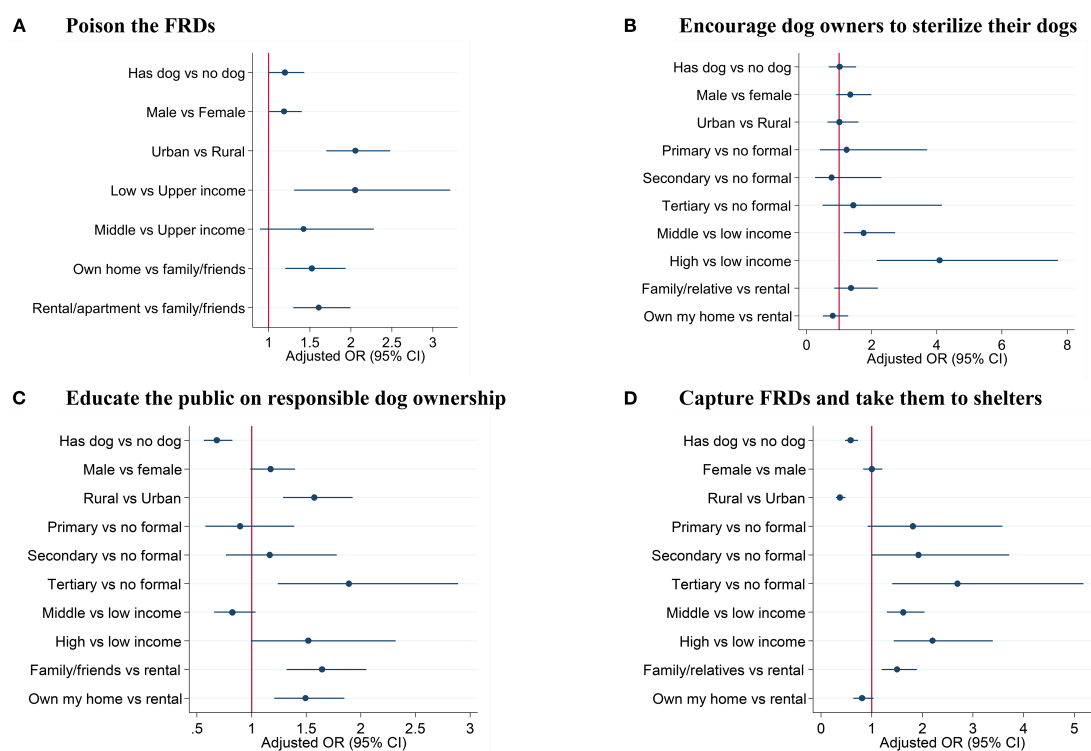


FIGURE 4

Forest plots showing sociodemographic factors associated with community-recommended approaches to controlling free-roaming dogs (FRDs). The panels illustrate: (A) poisoning FRDs, (B) encouraging dog owners to sterilize their dogs, (C) educating the public on responsible dog ownership, and (D) capturing FRDs and taking them to shelters. Explanatory variables include dog ownership, sex, place of residence (urban vs. rural), education level, income level, and housing type. Adjusted Odds ratios (ORs) with 95% confidence intervals (CIs) are plotted on the x-axis, with the vertical red line indicating the reference value (OR = 1).

In this study, 76.3% of participants expressed concern for the welfare of FRDs. While some FRDs may appear healthy, sick ones often endure extreme hardships due to the lack of veterinary care (Hyeroba et al., 2017), which likely elicits empathy from individuals who observe them (Massei et al., 2017; Corfmat et al., 2023). This may explain why educated individuals, who can capably recognize signs of poor dog health, and urban dwellers, who frequently interact with FRDs, were especially concerned about their welfare. In addition, some individuals expressed positive attitudes toward FRDs, particularly among specific demographic groups such as religious individuals, teenagers, the elderly, those with lower education levels, higher-income individuals, and rural residents. While this empathy aligns with animal welfare principles, it may hinder control efforts, as compassionate individuals are more likely to feed and shelter FRDs (Sensharma et al., 2024; Tayebwa et al., 2024b). Therefore, educational programs should prioritize these groups, aiming to channel their empathy into responsible dog care to prevent dog roaming.

Community perspectives on free-roaming dogs in urban and rural Uganda

Most community members perceived that FRDs originate from their owners' homes, a view supported by previous studies (Wallace

et al., 2017; Tayebwa et al., 2024b). In the same regard, community members perceived that FRDs either took shelter wherever they could or roamed continuously without a specific home. This perception likely stems from the way community members interact with FRDs; it is improbable that anyone would follow an FRD just to observe where it resides. Furthermore, the majority reported simply ignoring FRDs and continuing with their activities upon sighting them. In contrast, previous research has shown that FRDs often establish predictable roaming patterns and routines, typically favoring areas where food is available or sheltering in abandoned buildings and unused infrastructure where they feel safe (Muinde et al., 2021; Warembourg et al., 2021b; Astorga et al., 2022; Cunha Silva et al., 2022). In Uganda, the Kampala metropolitan area and many upcoming towns are characterized by informal settlements and unplanned infrastructure (Ministry of Lands Housing and Urban Development, 2017), which serve as concentration areas for FRDs.

The community members perceived that FRDs obtained food primarily from rubbish dumps, roadside stalls, or through the kindness of individuals who fed them. These findings support earlier reports that availability of food from poorly managed waste is a major attractant for FRDs (de Melo et al., 2023). In Uganda, poor waste disposal remains a significant issue, especially for urban centers and slums. However, addressing the issue of garbage disposal especially in resource constrained countries like

Uganda requires concerted municipal efforts and full community engagement (Castellani et al., 2022). To date, these efforts have been largely unsuccessful due to limitations in policies, weak enforcement, and poor community attitudes, which has contributed to the persistent problem of roaming dogs.

With regard to the implementation of FRD control, understanding community perspectives provides a crucial foundation for designing effective interventions (Corfmat et al., 2023; Sensharma et al., 2024). Such insights help clarify the pathways through which roaming dogs are sustained and, in turn, guide appropriate strategies. For instance, this study identified the primary sources of food for roaming dogs as street-side food vendors and certain community members who actively feed them. Additionally, perceptions of FRDs varied by setting: in urban areas, they were often regarded as feral, whereas in rural areas, they were generally believed to originate from households. This information is critical, as it not only indicates how communities are likely to interact with roaming dogs but also identifies potential entry points for interventions and highlights whether community members are likely to support or undermine control measures.

Control strategies for roaming dogs suggested by the community in urban and rural Uganda

Majority of respondents from both urban and rural communities wanted FRDs removed from the streets. The most common proposal was to encourage dog owners to sterilize their pets, showcasing the community's ability to propose practical solutions to their challenges. Worldwide, sterilization is recognized as the most effective strategy for reducing dog populations by directly lowering the number of unwanted puppies (Kutzler, 2020; Perdomo et al., 2021), while also reducing sex hormone-induced roaming behavior (Bacon et al., 2017; Dolan et al., 2017). However, the main challenge to its implementation is the cost, which many poor communities may not be able to afford without support from the government and non-governmental organizations (Tayebwa et al., 2024b; Ghimire et al., 2025; Murungi et al., 2025).

Beyond the prohibitive cost of surgical sterilization of dogs, findings from the initial phase of the present study (Tayebwa et al., 2024b) identified additional limitations, including low community awareness of available sterilization services (particularly in rural areas), cultural beliefs that discourage the practice such as the notion that dogs should be allowed to reproduce and the desire among some community members to sell puppies for income. Although the community proposed appropriate measures for controlling roaming dogs, their realistic implementation still requires substantial effort in community education, enforcement of responsible dog ownership, increasing veterinary access especially in rural areas and mobilization of funds to support and scale up spay and neuter programs, among other interventions.

Culling FRDs through poisoning emerged as the second most proposed management strategy. Further analysis indicated that this recommendation was more commonly associated with male respondents, urban residents, and individuals who owned homes. The

preference for poisoning may be attributed to negative personal experiences or frequent interactions with roaming dogs. Respondents who suggested this method are likely those who encounter dogs more often in their daily lives. For instance, men who spend considerable time outdoors for work, urban residents whose limited living spaces increase the likelihood of contact with dogs, and homeowners residing in areas with high roaming-dog populations. Alternatively, this perspective may also reflect the enduring influence of historical practices in Uganda, where mass culling with strychnine was widely employed as a primary strategy for dog population control (Alobo et al., 2020).

Previously, strychnine was a restricted chemical, managed and procured exclusively by the Ministry of Agriculture, Animal Industry, and Fisheries. It was only accessible through the District Veterinary Authority, where it was used for the mass poisoning of dogs during rabies outbreaks, as permitted under the Rabies Act, or in response to community complaints regarding large populations of stray dogs or high numbers of dog bites. In 2001, the National Drug Authority classified strychnine as a prohibited substance in the Essential Veterinary Drug List of Uganda. Despite this ban, communities have continued to request access to it, and anecdotal evidence indicates that existing stocks remained in circulation and use as late as 2025 (personal experience). This may explain why respondents in the present study still proposed it as a top choice for controlling FRDs. However, given the limitations of strychnine and its prohibition (Pest Management and Regulatory Agency Canada, 2020; World Organisation for Animal Health, 2023), authorities must sensitize communities about the ban and begin implementing ethical and sustainable alternatives, such as sterilization and the promotion of responsible dog ownership.

This study has several limitations that should be acknowledged. First, the use of convenience sampling may limit the generalizability of the findings, as participants who were more accessible or willing to respond may not fully represent the broader Ugandan population. This could have introduced selection bias, particularly in urban areas where respondents were more easily reached. Second, reliance on self-reported data introduces the risk of social desirability bias, whereby participants may have provided responses they considered more acceptable rather than their true views. Third, the cross-sectional design precludes establishing causal relationships between sociodemographic factors and attitudes toward FRDs. Despite these limitations, the study also has important strengths. It represents one of the largest community-based surveys on FRDs in Uganda, capturing perspectives from both rural and urban contexts and thereby enhancing the applicability of the findings to diverse settings.

Conclusion

The respondents from the urban and rural communities in Uganda largely held negative attitudes toward FRDs due to public health risks, welfare concerns, and nuisances. As a result, they advocated for preventive measures such as sterilization, poisoning, and public education on responsible pet ownership. These findings highlight strong community awareness of the FRD issue, particularly as two of

the top proposed measures (sterilization and public education) align with the WOA's recommended strategies for managing roaming dog populations. Authorities can leverage the prevailing negative perceptions to design and implement humane, community-supported control strategies. Simultaneously, those who express empathy toward FRDs can be encouraged to translate their concern into proactive measures that reduce roaming behavior.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Makerere University School of Veterinary and Animal Resources Research and Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

DT: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Methodology, Writing – original draft, Writing – review & editing, Investigation. CS: Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. SN: Data curation, Validation, Writing – original draft, Writing – review & editing. RD: Formal Analysis, Investigation, Writing – original draft, Writing – review & editing. IL: Investigation, Writing – original draft, Writing – review & editing. NR: Investigation, Methodology, Writing – original draft, Writing – review & editing. MK: Investigation, Writing – original draft, Writing – review & editing. KB: Data curation, Formal Analysis, Validation, Visualization, Writing – original draft, Writing – review & editing. HK: Methodology, Writing – original draft, Writing – review & editing. JK: Writing – original draft, Writing – review & editing. DM: Writing – original draft, Writing – review & editing. SB: Conceptualization, Supervision, Writing – original draft, Writing – review & editing. RT: Conceptualization, Writing – original draft, Writing – review & editing. JA: Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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SUPPLEMENTARY FILE 1

presents the questionnaire that was used to collect information on community attitudes, practices, towards of roaming dogs and recommendations for their control in both urban and rural settings in Uganda. The questionnaire was structured into four main sections. The first section focused on gathering sociodemographic data to provide background information on the respondents. The second section explored perceptions, while the third section examined attitudes toward roaming dogs. The final section included questions aimed at assessing the measures that respondents proposed for controlling roaming dogs.

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