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Community attitudes and perceptions towards free-roaming dogs in Goa, India

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Abstract

Free-roaming dogs (FRD) represent a large proportion of the canine population in India and are often implicated as a source of conflict with humans. However, objective data on the attitudes and perceptions of local communities towards FRD are lacking. This study collected baseline data from 1141 households in Goa, India, on FRD feeding practices and assessed people's attitudes towards FRD in urban and rural communities. Additionally, respondents identified problems caused by FRD and proposed potential solutions.

The study reported that 37% of respondents fed FRD with dog owners and Hindus being the most likely to feed. The majority of respondents agreed FRD were a menace (57%), a nuisance (58%) and scary (60%). Most respondents also agreed FRD were a vulnerable population (59%), that belong in communities (66%) and have a right to live on the streets (53%). Barking was the most commonly reported problem associated with FRD and the preferred solution was to impound FRD in shelters. This study reveals the complex and often misunderstood relationship between local communities and FRD and highlights potential strategies to reduce human-dog conflict.

Keywords

Dog, free-roaming, conflict, animal welfare

1 Introduction

2
3 The total domestic dog (*canis familiaris*) population in India is estimated at 118,902,760
4 (Wallace et al. 2017) and most of the dogs in both urban and rural areas are free-roaming. The
5 World Organization for Animal Health (OIE) (2020) defines a free-roaming dog (FRD) “to be
6 any dog not supervised or confined at a particular time, free-roaming with no owner or feral; a
7 domestic dog that has reverted to a wild state and is no longer directly dependent on humans”
8 (p.7). In India, many FRD are actually owned or semi-owned and fed by the community.
9

10 Although dogs have coexisted alongside people in India as working animals for thousands of
11 years and more recently as companion animals (Baskaran, 2017), human-dog conflict is
12 widespread. Irresponsible dog ownership, uncontrolled breeding of unowned dogs and the
13 indiscriminate dumping of food waste has likely contributed to FRD populations in India. FRD
14 welfare is often poor and many FRD do not reach adulthood (Pal, 2001; Paul et al., 2016). FRD
15 are neglected, abused and are susceptible to injuries from fighting with other dogs, adverse
16 weather, collisions with vehicles, infections, chronic disease and malnutrition (Totton et al.,
17 2011).
18

19 Understanding community perceptions and attitudes towards FRD may help in resolving
20 human-dog conflict in India and improving FRD welfare. However, this is an area of extremely
21 limited research and people’s perceptions and attitudes are likely to be strongly influenced by
22 a variety of factors including culture, religion (Doniger, 2014), companion animal ownership
23 (Paul, 2000; Taylor & Signal, 2005), gender (Herzog, 2007) and socio-economic status (Peek
24 et al., 1996). There is increasing concern regarding the FRD population in India and the risks
25 FRD pose to public health and safety which subsequently leads to direct conflict and complaints

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8 3 FRD transmit a wide range of viral and bacterial infections to humans (Sharma et al., 2017)
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10 4 and in India, people live with the threat of rabies. It is estimated that 17.4 million people in
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12 5 India are bitten by dogs every year (Gongal & Wright, 2011) with 20,000 people dying from
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14 6 canine-mediated rabies in India annually (Sudarshan et al., 2015). Further risks to public health
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16 7 associated with FRD include; environmental contamination from faeces (Cinquepalmi et al.,
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18 8 2013) and road traffic accidents (Slater et al., 2008). Although FRD in India have been found
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20 9 to chase moving vehicles and roam on busy highways, data is limited regarding how many
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22 10 people are injured in dog-related traffic accidents.
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28 12 In addition to the implications on public health and safety, the natural behavior of dogs
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30 13 including barking, howling and other vocalizations have been deemed a source of noise
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32 14 disturbance in some communities (Flint et al., 2014; Strickland, 2015). In a study undertaken
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34 15 in the Bahamas, Fielding (2008) found that barking was one of the most common nuisances
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36 16 associated with dogs, particularly at night. Barking and howling from dogs, also ranked well
37
38 17 above other noises (skill saws and lawn mowers) as sources of disturbance in New Zealand
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40 18 (Flint et al., 2014). Although barking has been suggested as a nuisance behavior, limited
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42 19 studies have been conducted in India investigating people's attitudes towards FRD and
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44 20 associated noise pollution.
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51 22 As FRD often live in close proximity to humans, other natural canine behaviors such as chasing
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53 23 and hunting are likely to be viewed negatively when they impact upon other animal
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55 24 populations. A study conducted by Home, Pal et al. (2017) in Himachal Pradesh, India,
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57 25 revealed that the number of dog attacks on livestock closely relate to that of leopard attacks
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3 1 resulting in substantial economic losses for farmers. It has also been reported that FRD in India
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5 2 were responsible for attacking 80 species of wildlife, 31 of which were IUCN Red List
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7 3 Threatened Species (Home, Bhatnagar et al., 2017).
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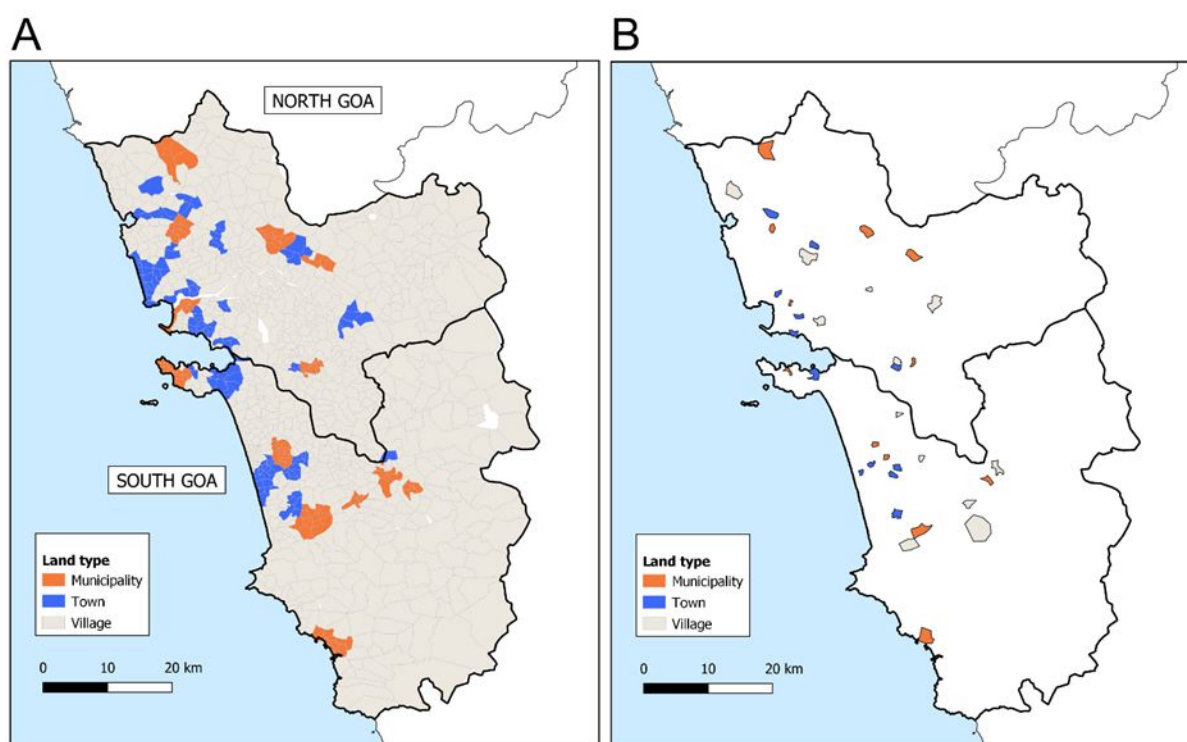
11
12 5 In an attempt to try to resolve problems associated with FRD, a number of methods are utilized
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14 6 for dog population management (DPM) including animal birth control (ABC), culling,
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16 7 relocation and placing dogs in shelters. Although illegal in India, culling and relocation of FRD
17
18 8 is still executed in some states as a ‘quick fix’ to reduce the dog population. Culling or mass
19
20 9 killing of FRD is now widely considered unethical and ineffective (Hiby & Tasker, 2018) and
21
22 10 ABC (surgical sterilization) is implemented as a humane alternative. Following sterilization,
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24 11 FRD are returned to their original locations to help maintain stable and healthy populations
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26 12 (Taylor et al., 2017).
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33 14 Despite attempts to manage FRD populations, human-dog conflict persists. In Goa, India there
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35 15 are many animal shelters and animal welfare organizations trying to resolve this conflict yet
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37 16 knowledge regarding how the community perceives the FRD population is currently limited.
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39 17 Most of the research conducted in India has assessed attitudes towards FRD in relation to rabies
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41 18 prevention and Tiwari et al., (2019) found that perceptions towards FRD in India were
42
43 19 influenced by incomplete or incorrect information regarding rabies. Other dog-related
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45 20 problems which can adversely impact society or the welfare of FRD have rarely been
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47 21 investigated. The purpose of our survey was to describe the public perception of FRD across a
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49 22 wide range of communities in Goa, India, in efforts to support the development of initiatives
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51 23 and reduce conflict between human and dog populations.
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1 2 3 1 **Methods** 4 5 2 6 7 8 3 *Survey location* 9 10 4 11 12 5 Goa is a state of India located on the southwest coast of the subcontinent with a human 13 14 6 population of roughly 1.458 million people (Government of India, 2011a). Of the total 15 16 7 population, 62% live in urban regions vs 38% in rural regions, with an overall sex:gender ratio 17 18 8 of 973 females per 1000 males (Government of India, 2011a). Goa state covers an area of 3702 19 20 9 sq. km and is divided into North and South districts. Within each district, areas are classified 21 22 10 as municipalities, towns and villages (Government of India, 2011b). 23 24 25 26 11 27 28 12 Survey site 29 30 31 13 32 33 14 The 412 administrative boundaries of Goa used in the 2011 National Census (Government of 34 35 15 India, 2011a) were subdivided into 1,083 working zones as part of the Goa Rabies Control 36 37 16 program. Working zones were stratified by district and by municipality, town or village 38 39 17 according to designation in the 2011 National Census (Figure 1A). Clustered random sampling 40 41 18 by district and land type strata was performed by assigning a unique consecutive number to all 42 43 19 zones. A random number generator in Microsoft Excel version 2016 (Redmond, WA) was then 44 45 20 used to randomly select 6 zones from each land type-district cluster, giving a total sample of 46 47 21 36 zones. Selected zones were visually reviewed on Google Satellite imagery and zone 48 49 22 selection was repeated for areas consisting entirely of forest or agricultural land due to lack of 50 51 23 human habitation. 52 53 54 24 55 25 56 26 57 58 59 60

1 Survey methodology

2
3 To examine how the public view the FRD population, a community-based cross-sectional
4 survey was conducted in the selected sites (Figure 1B) from April 2019 to June 2019. The
5 number of households surveyed in each area ranged from 30-40. In villages a rolling door-to-
6 door (every house) method was followed (Tiwari et al., 2019), whereas in towns and
7 municipalities, systematic sampling (1 in every 4 houses) was used to obtain a representative
8 sample across a larger geographic area with higher housing density. If a household member
9 declined to participate in the survey or if a household was unoccupied, the adjacent house was
10 selected. In municipalities and towns, the fourth house thereafter, was selected for inclusion in
11 the survey.



14
15 **Figure 1. Maps of Goa state showing the designation of land type according to the 2011**
16 **National India Census (A) and surveyed regions (n = 36) polygons coloured by land type**

1 **(B).**

2 To gather qualitative data regarding the perception of FRD in Goa, India one adult from each
3 household was invited to anonymously respond to the questionnaire in their preferred language
4 (Hindi, English, or Konkani). Those who were guests of the selected household, under the age
5 of 18 years, or were unable or unwilling to provide informed consent were not interviewed.
6 Consent was obtained verbally prior to commencing the survey and an information leaflet was
7 given to each respondent. Each leaflet displayed a barcode which was scanned in to the app
8 and contact information of the researcher so that participants could opt out of the survey at a
9 later date if they wished.

10

11 A total of twenty-eight students fluent in Hindi, English and Konkani were recruited from
12 Vidya Prabodhini College, Damodar College and Margao Government Industrial Training
13 Institute to conduct the door-to-door survey. Training for the survey was carried out over two
14 days which involved practicing- interview technique and role play to ensure students were able
15 to ask questions in a standardized manner and record responses accurately. To confirm students
16 had sufficient understanding of the terminology and translations, assessments were conducted
17 prior to commencing the survey.

18

19 The questionnaire (in English) was uploaded as a form in the WVS smartphone app (WVS
20 Data Collection App, Worldwide Veterinary Service, Version 5.8.) (Gibson et al., 2018) which
21 was installed on the student's mobile phones. All the respondents' answers were entered into
22 the app during the course of the survey. At the end of each survey session all data was encrypted
23 within the app and securely transferred to a password-restricted cloud-based server. All mobile
24 phones used during the survey were password protected and the app was deleted from the
25 phones upon completion of the survey.

1 *Questionnaire design*

2

3 The questionnaire was divided in to eight sections commencing with an introduction and
4 statement of consent. Questions focused on dog ownership, attitudes towards FRD, care and
5 feeding of FRD, problems associated with FRD, solutions and management of FRD. The
6 questionnaire concluded with a demographic section which gathered information regarding the
7 respondents age, gender, religion, education level, household size and income. Respondents
8 were required to complete all sections of the survey although certain questions were only
9 relevant for dog owners and feeders of FRD.

10

11 The questionnaire consisted of attitude rating Likert-type scale questions and multiple-answer
12 questions with pre-listed responses which were ticked accordingly and not read aloud by the
13 students. Multiple-answer questions also included an ‘other’ option for free-text. The
14 questionnaire was pre-tested by visiting 62 households outside the selected survey areas and
15 revised as necessary. Ethical approval to conduct the survey was granted by the University of
16 Edinburgh Royal (Dick) School of Veterinary Studies Human Ethical Review Committee in
17 March 2019.

18

19 *Data analysis and statistics*

20

21 Data collected through the questionnaire was summarized using Microsoft Excel version 2016
22 (Redmond, WA) and -R statistical software (R Core Team, 2019). Maps were created using
23 QGIS 3.16.9 (QGIS Development Team, Open Source Geospatial Foundation Project).
24 Multivariable logistic regression was used to understand the effect of different respondents’
25 characteristics on their attitudes towards FRD (7 response variables) and on the feeding of FRD

1 (1 response variable). Predictor variables considered for inclusion in each of the 8 final
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1 (1 response variable). Predictor variables considered for inclusion in each of the 8 final
2 multivariable models as fixed effects included, respondents age, gender, religion, educational
3 level, household income, number of occupants in the household, dog ownership, FRD feeding
4 and which type of area they lived in.

5
6 Using R package MuMIn (Bartori, 2019) models including all explanatory variable
7 combinations were fitted. The final model for each response variable was chosen based on the
8 lowest corrected Akaike Information Criterion (AIC). Variance inflation factor was computed
9 for each final model, in order to ensure there were no issues of collinearity or multicollinearity.
10 All questions describing attitudes towards FRD included in the regression analysis were in the
11 form of Likert-type questions. These were converted into 'yes' (strongly agree/agree) and 'no'
12 (agree nor disagree/disagree/strongly disagree) responses for ease of interpretation.

1 Results

2
3 To gather data on attitudes and perceptions towards FRD in Goa, India, 1450 households were
4 approached for the survey and 1141 people completed the questionnaire (79% response rate).
5 Of these respondents, 33% (n=378) lived in municipalities, 34% (n=393) in towns and 32%
6 (n=370) in villages. Slightly more females 55% (n=624), than males 45% (n=517) were
7 surveyed. The majority of respondents 47% (n=539) were aged 31-50 years and the
8 predominant religion of respondents was Hinduism 61% (n=698). Information relating to
9 monthly household income was also obtained although the majority of respondents 46%
10 (N=526) declined to answer. Full demographic data of the respondents is summarized in
11 supplementary Table 1.

12 13 *Dog ownership*

14
15 The majority of respondents did not own a dog (n=752). Of the 389 dog-owning households,
16 29% (n=110) were in municipalities, 40% (n=158) ~~were~~ in towns and, 33% (n=121) in villages,
17 and 29% (n=110) in municipalities. A total of 493 dogs were owned, of which 72% (n=356)
18 were male and 28% (n=136) were female (for 1 dog sex was unknown). Entire dogs 53%
19 (n=263), made up the largest category across all 3 land types. ~~(Figure 2)~~. Regarding
20 confinement of owned dogs 20% (n=101) were always free-roaming, 59% (n=290) sometimes
21 free-roaming and 20% (n=101) never free-roaming (for 1 dog confinement was unknown). Of
22 the 290 sometimes free-roaming dogs, 61% (n=178) were entire (Figure 23).

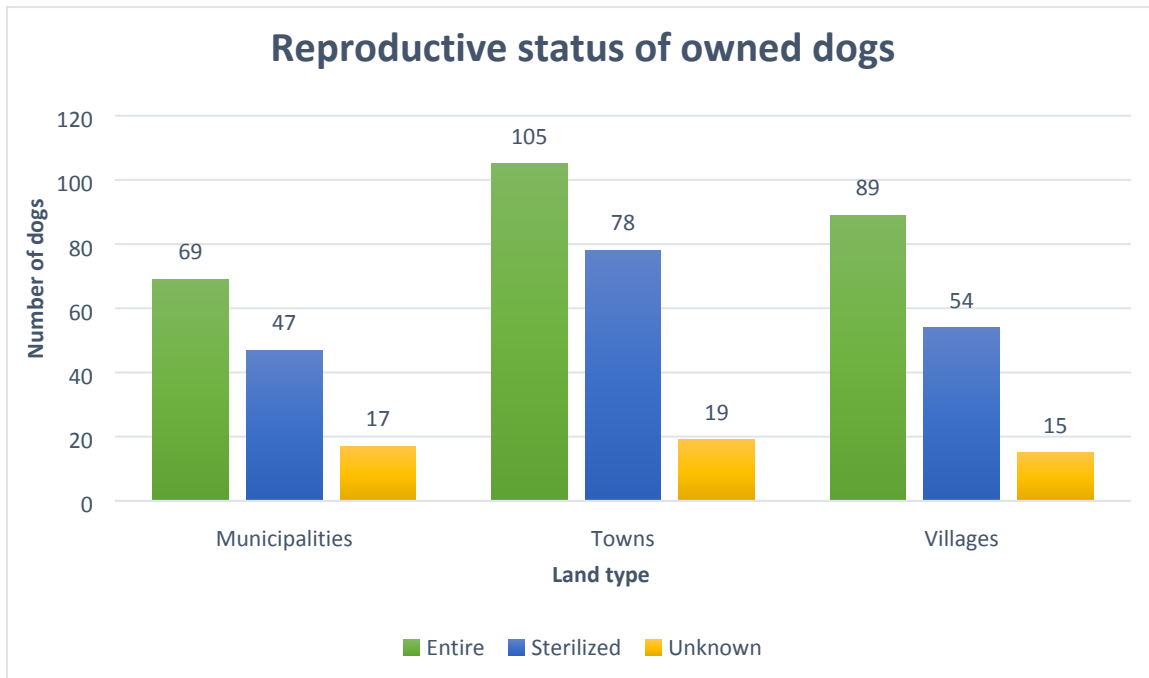


Figure 2. Reproductive status of owned dogs (n=493) in municipalities, towns and villages

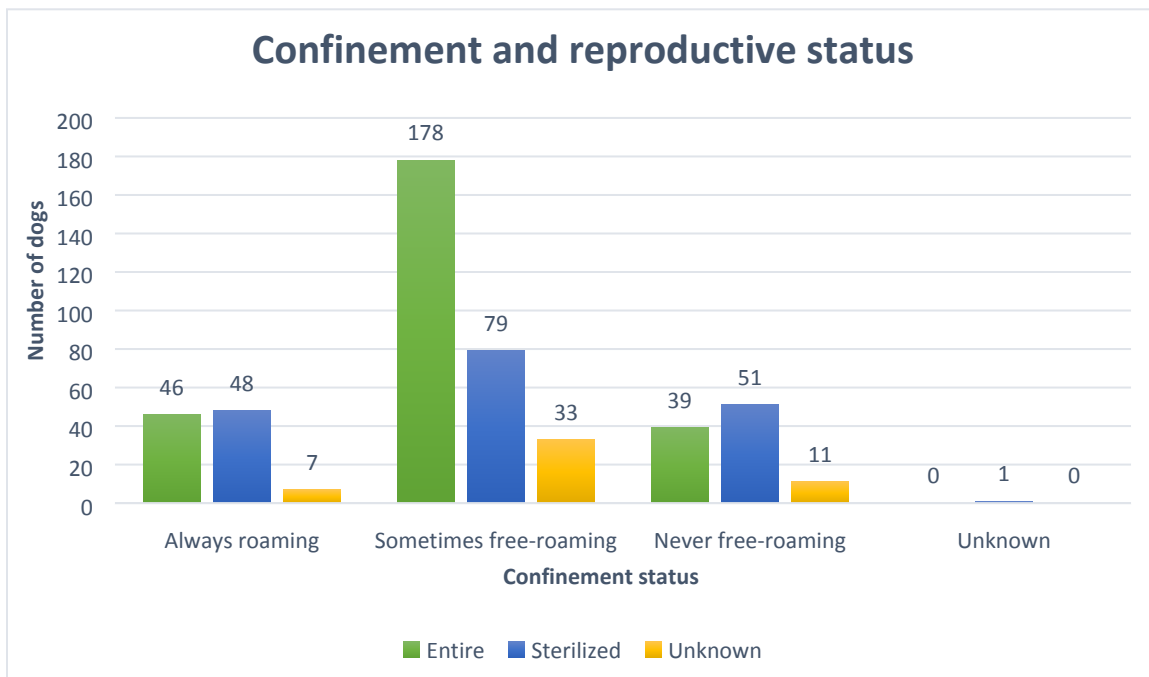


Figure 3. Confinement and reproductive status of owned dogs (n=493).

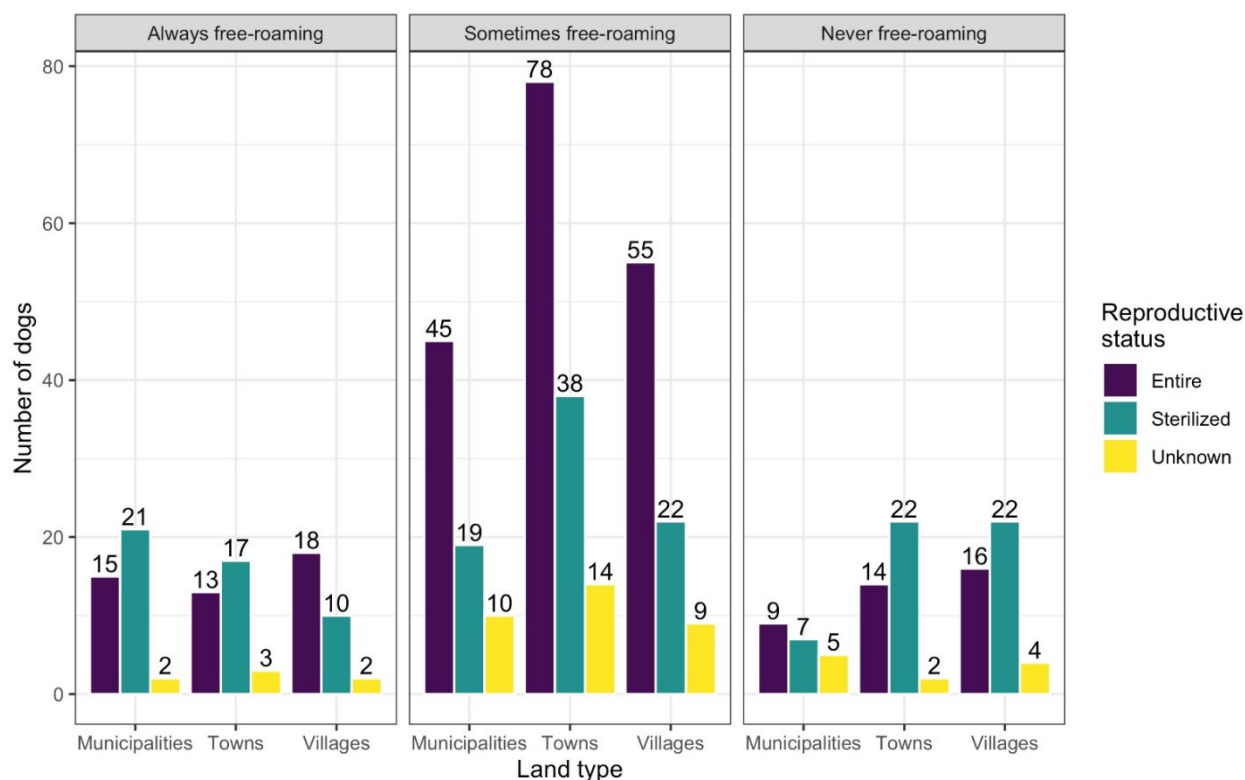


Figure 2. Reproductive and confinement status of owned dogs (n=492) by land type (municipalities, towns and villages) in Goa, India. For this analysis, 1 dog (neutered/town) was removed due to unknown confinement status

Respondents that owned dogs (n = 389) were asked to rate their level of agreement with a series of statements. Regarding 'my dogs are part of the family', 57% (n=223) of respondents strongly agreed, 41% (n=161) agreed, 1% (n=2) disagreed and 1% (n=3) neither agreed ~~or~~ disagreed. Regarding 'I feel affection for my dogs', 53% (n=205) of respondents strongly agreed, 44% (n=172) agreed, 2% (n=8) disagreed and 1% (n=4) neither agreed ~~or~~ disagreed. Regarding 'if my dog were to die, it would be easy to replace him/her', 7% (n=27) of respondents strongly agreed, 32% (n=126) agreed, 18% (n=72) neither agreed or disagreed, 30% (n=115) disagreed and 13% (n=49) strongly disagreed.

FRD feeding

The findings revealed that 37% (n=424) of respondents feed FRD and this result did not vary

1 significantly across municipalities 37% (n=141), towns 40% (n=156) and villages 34%
2 (n=127). In relation to gender, 39% (n=242) of female respondents feed FRD and 61% (n=382)
3 do not feed FRD; whereas 35% (n=182) of male respondents feed FRD and 65% (n=335) do
4 not feed FRD. With regards to religion, 41% (n=284) of Hindus, 32% (n=122) of Christians
5 and 30% (n=17) of Muslims feed FRD.

6
7 Additionally, 41% (n=163) of dog owners feed FRD and 58% (n=226) do not feed FRD;
8 whereas 35% (n=261) of non-dog owners feed FRD and 65% (n=491) do not feed FRD. The
9 mean number of dog's respondents reported to feed was 3 and of the 424 feeders, 40% (n=170)
10 feed every day, 25% (n=106) every other day, 27% (n=116) once or twice per week and 8%
11 (n=32) not every week. The majority 45% (n=190) of FRD feeders did not know if the dogs
12 they feed were sterilized, 31% (n=131) feed unsterilized FRD and 24% (n=103) feed sterilized
13 FRD.

14
15 Multivariable logistic regression was used to identify factors associated with FRD feeding
16 (Figure 34 and supplementary Table 2). Dog owners were more likely to feed FRD compared
17 to non-dog owners and Hindus were more likely to feed FRD compared to Christians. Lastly,
18 the odds of feeding FRD decreased with age.

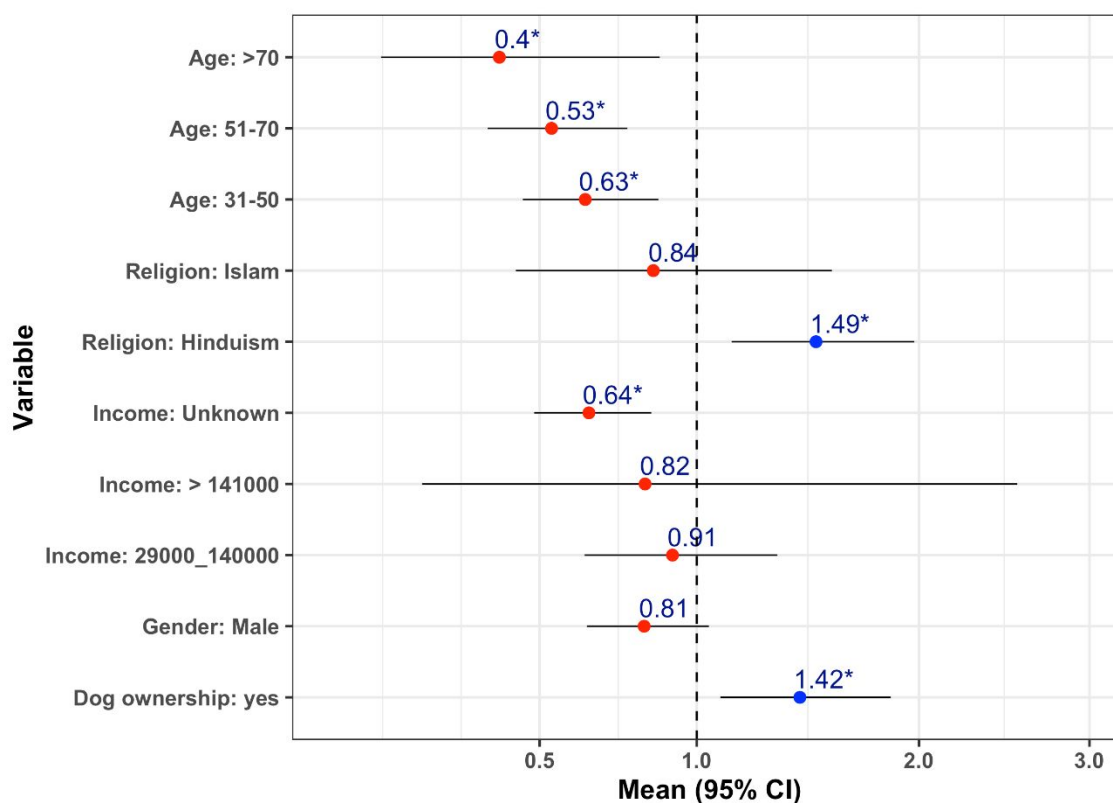


Figure 34. Final logistic regression model: FRD feeding as the outcome variable in Goa, India (n=412). Dots represent odds ratios (red = negative association, blue = positive association) and bars represent 95% confidence interval for each category compared to the baseline. The baseline category for age was 18 – 30 years, religion was Christianity, income was >28,000 INR, gender was female and for dog ownership, no. Respondents with missing information regarding their age (n=5), level of education (n=6) and religion (n=1) were removed from this part of the analysis.

Attitudes associated with FRD feeding

Respondents that feed FRD (n=424) were asked to rate their level of agreement regarding their sentiment toward FRD. Regarding if ‘FRD need to be cared for as they do not have a home’, 24% (n=101) strongly agreed, 57% (n=243) agreed, 12% (n=49) neither agreed nor disagreed and 7% (n=31) disagreed. Regarding if respondents ‘felt affection for FRD’, 18% (n=77) strongly agreed, 55% (n=233) agreed, 10% (n=43) neither agreed nor disagreed, 14% (n=60) disagreed and 3% (n=11) strongly disagreed. Regarding if ‘feeding FRD made respondents feel good’, 28% (n=120) strongly agreed, 54% (n=229) agreed, 10% (n=42) neither agreed nor

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3 1 disagreed, 6% (n=25) disagreed and 2% (n=8) strongly disagreed. Regarding if 'FRD would
4
5 2 starve to death if people did not feed them', 12% (n=49) strongly agreed, 39% (n=165) agreed,
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7 3 23% (n=98) neither agreed nor disagreed and 26% (n=112) disagreed.
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11 5 *Attitudes towards FRD*

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17 7 The five-point scale was also used to assess attitudes towards FRD by asking respondents to
18
19 8 rate their level of agreement with 7 statements (Figure 45). The majority of respondents 66%
20
21 9 (n=756) agreed FRD belong in their community, 59% (n=667) agreed they are vulnerable and
22
23 10 53% (n=599) agreed FRD have a right to live on the streets. The majority of respondents 57%
24
25 11 (n=651) also agreed that FRD were a menace, 58% (n=658) agreed FRD were a nuisance, 60%
26
27 12 (n=682) agreed FRD were scary and 53% (n=609) agreed FRD have no place in modern
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29 13 society. These results reflect some conflicting responses. To capture these, cross tabulations of
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31 14 each pair of these 7 attitude questions are presented in Figure 1 in the supplementary material.
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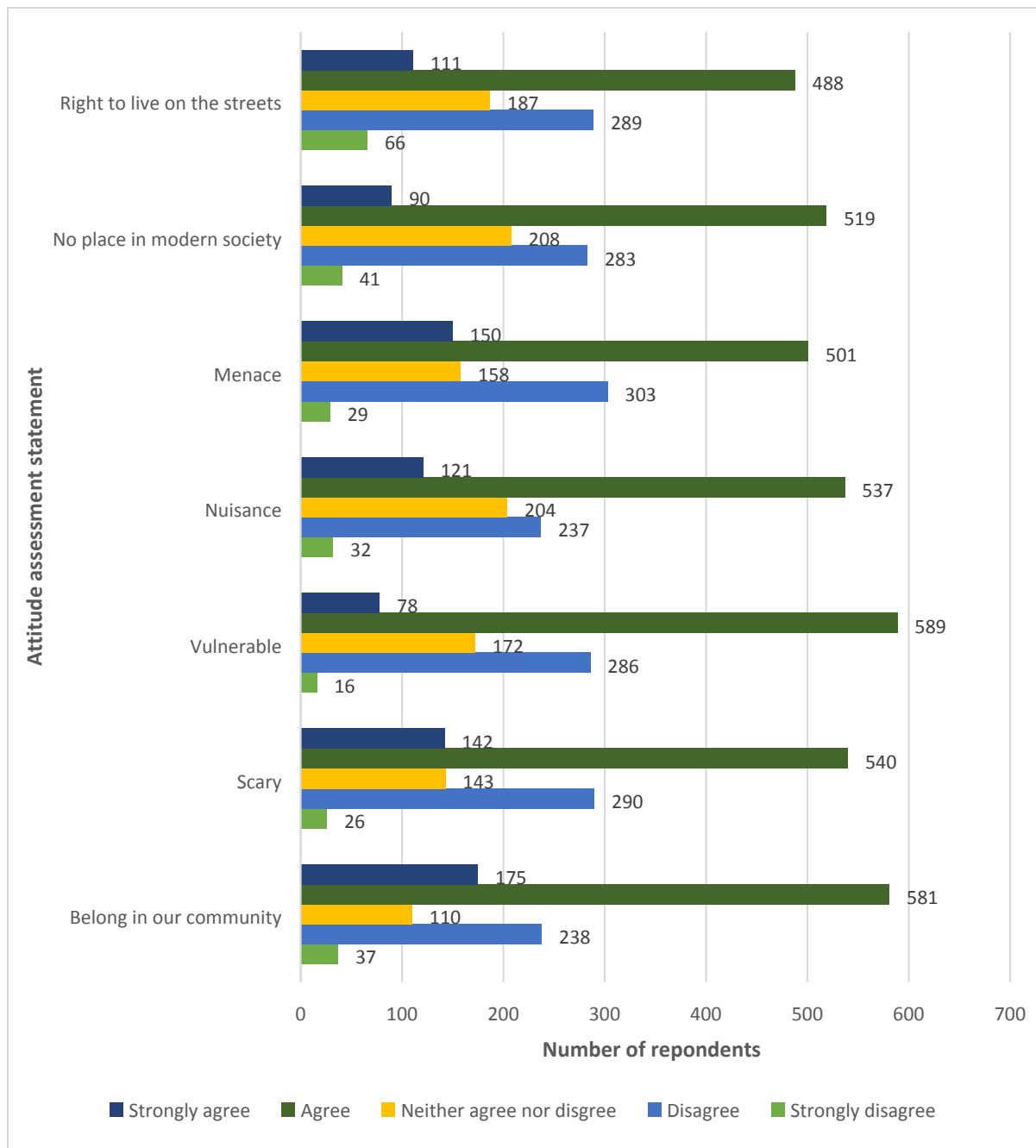


Figure 45. Community members (n=1141) attitudes towards FRD in Goa, India

Factors associated with the 7 attitude assessment statements were further investigated using multivariable logistic regression models. Three statements reflected positive attitudes towards FRD; 'FRD belong in our community' (supplementary Figure 2, Table 3), 'FRD have a right to live on the street' (supplementary Figure 3, Table 4) and 'FRD are vulnerable' (supplementary Figure 4, Table 5). Dog owners were more likely to agree with all three

1 statements, compared to those who did not own dogs. FRD feeders and Hindus (compared to
2 Christians) were also more likely to agree with the first two statements, but less likely to agree
3 that FRD are vulnerable. Additionally, the odds of respondents agreeing that FRD have a right
4 to live on the streets, decreased with age.

5
6 Four statements were used to capture negative attitudes towards FRD; 'FRD are a menace'
7 (supplementary Figure 5, Table 6), 'FRD are a nuisance' (supplementary Figure 6, Table 7),
8 'FRD are scary' (supplementary Figure 7, Table 8) and 'FRD have no place in modern society'
9 (supplementary Figure 8, Table 9). FRD feeders were less likely to agree that FRD are scary
10 and that they are a nuisance or a menace, compared to those who do not feed dogs. Both dog
11 owners and FRD dog feeders were more likely to agree that FRD have no place in modern
12 society compared to those who did not own dogs or feed FRD respectively. Hindus and
13 Muslims were less likely to agree with this statement. Additionally, compared to those who
14 live in municipalities, those who live in towns were more likely to agree FRD are a menace
15 and a nuisance. Lastly, the odds of agreeing that FRD are a menace and scary increased with
16 age, except for the oldest age group (>70 years), where the odds did not differ from the baseline
17 group (18-30 years).

18 19 *Problems associated with FRD*

20
21 Respondents were asked to identify the problems (Figure 56) and benefits (Figure 67)
22 associated with FRD and were able to give multiple answers. Responses from all 3 land types
23 were combined for this analysis. Of the respondents, 21% (n=237) stated that there were no
24 problems and 56% (n=643) stated there were no benefits. Barking was the most common
25 problem reported by 56% (n=635) of respondents, followed by chasing 37% (n=425) and dog

1 bites 36% (n=412). Guarding and security was identified as the main benefit associated with
2 FRD by 42% (n=484) of respondents.

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10 As some dog-related problems are influenced by human behavior, data was collected on
11 respondents' reactions towards FRD that bark and chase them on the street. If approached by
12 a barking dog respondents would; stand still 43% (n=486), walk slowly 15% (n=172), wave a
13 stick 13% (n=149), run away 13% (n=146), hit the dog with a stick 11% (n=129), ignore the
14 dog 8% (n=89), shout 6% (n=69), scream 6% (n=65) and try to make friends 1% (n=16). Such
15 an incident had not happened to 7% (n=77) of respondents so they did not know what their
16 reaction would be. If chased by a dog whilst riding a two-wheeler vehicle, respondents would;
17 slow down 39% (n=449), speed up 26% (n=299), stop 25% (n=282), ignore the dog 8% (n=87),
18 throw something 4% (n=50), scream 2% (n=25), shout 2% (n=23), raise legs 2% (n=21) and
19 kick out at the dog 2% (n=19). Of the respondents, 12% (n=138) did not know what their
20 reaction would be.

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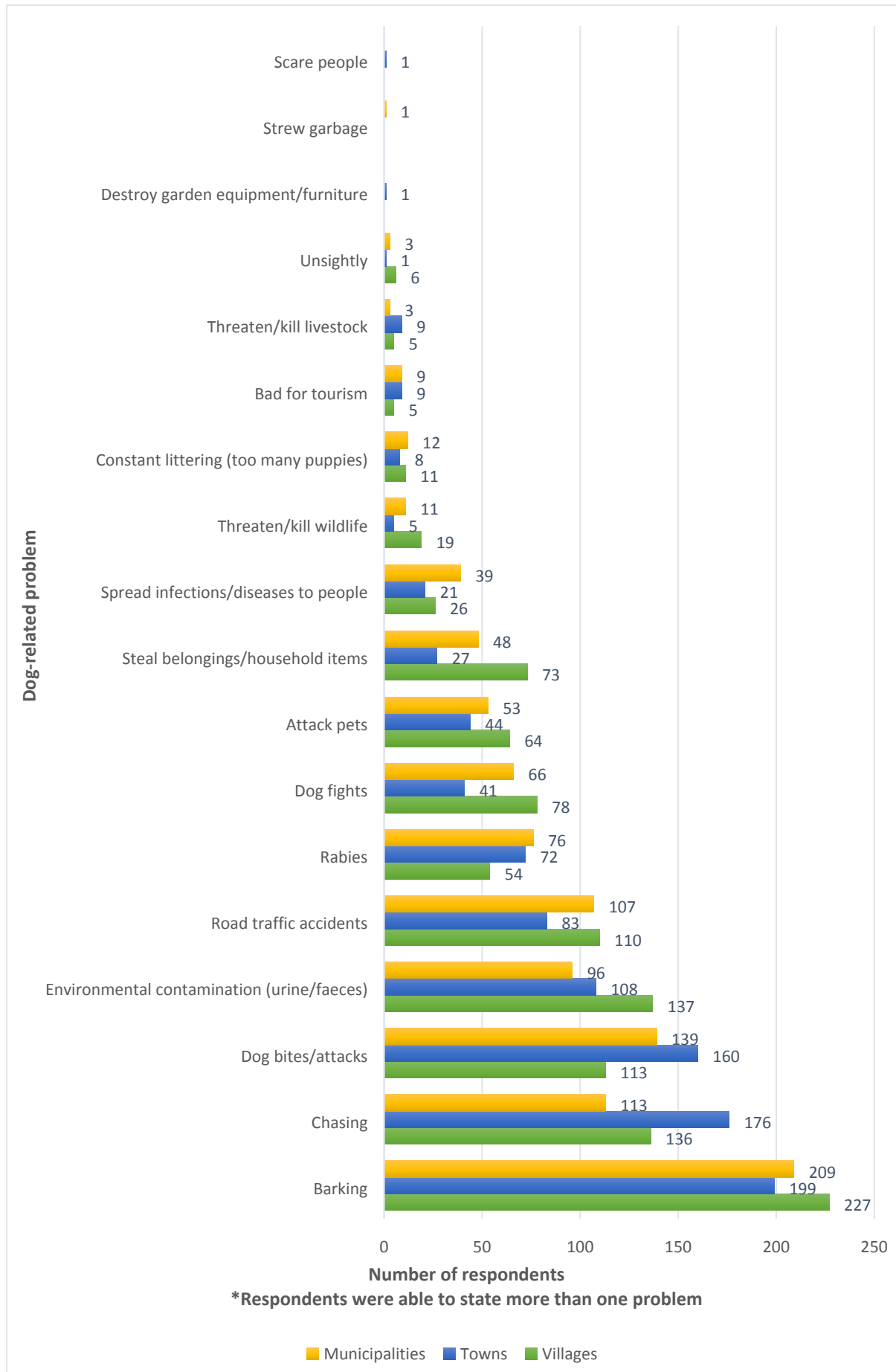


Figure 56. Problems associated with FRD from the community perspective in Goa, India

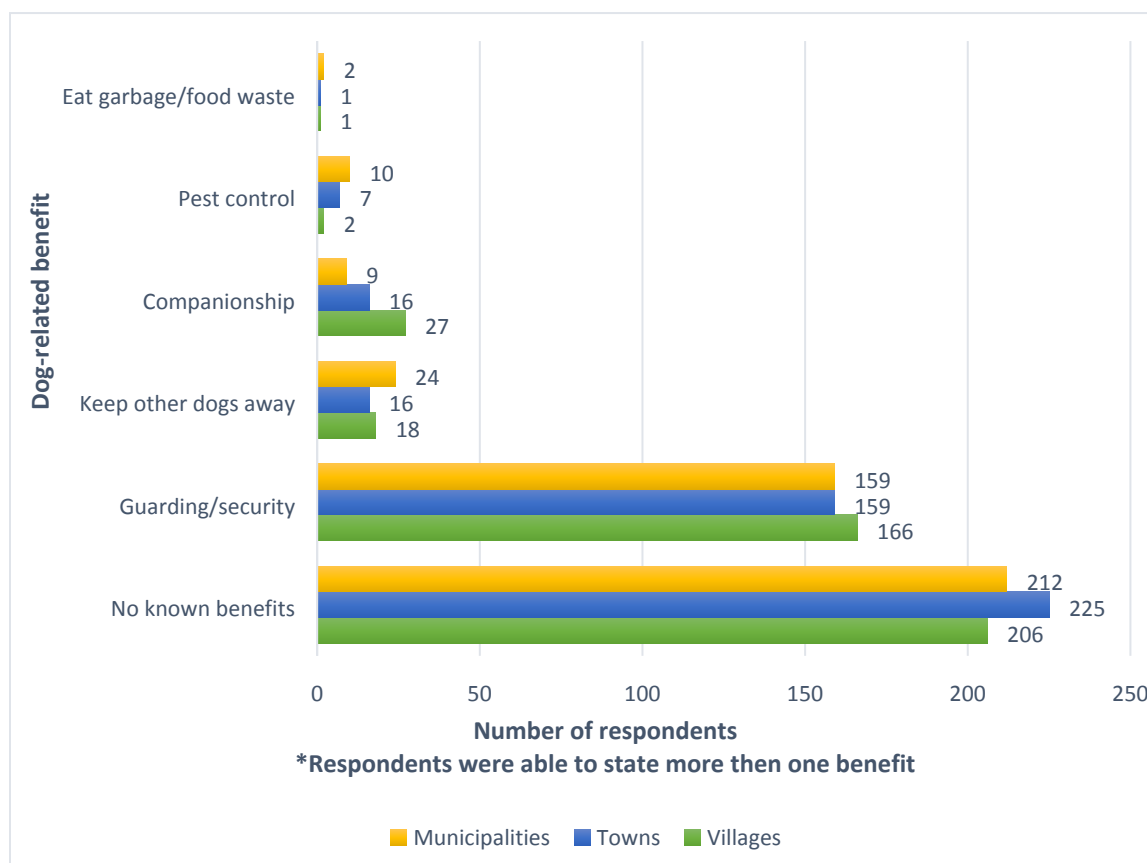


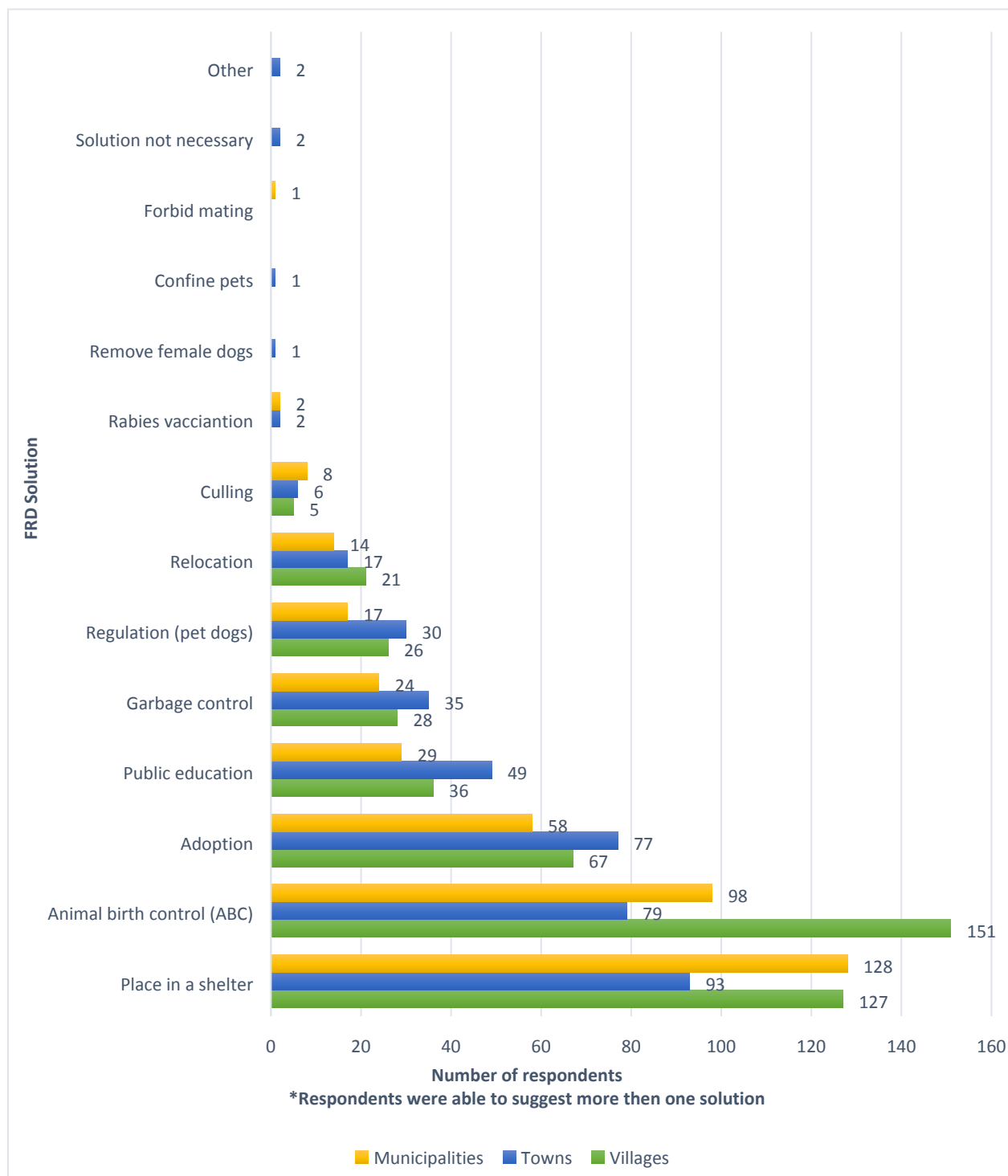
Figure 67. Benefits associated with FRD from the community perspective in Goa, India

All respondents were asked if they had ever been bitten by a dog; 74% (n=839) said no, 25% (n=283) said yes, 1% (n=19) could not remember. To determine if there was any correlation between dog bites and gender, further analysis revealed that of the 624 female respondents, 22% (n=139) had been bitten by a dog and of the 515 male respondents, 28% (n=144) had been bitten. Furthermore, 22% (n=82) of respondents in municipalities, 27% (n=106) of respondents in towns and 26% (n=95) of respondents in villages had been victims of dog bites.

FRD solutions

Community members identified potential solutions to manage FRD (Figure 78). Placing FRD in shelters was the most common solution put forward by respondents in municipalities 34% (n=128), and towns 24% (n=93). Respondents from villages 41% (n=151), suggested ABC

1 followed by placing FRD in shelters 34% (n=127). Although a number of different solutions
 2 were proposed, respondents from all 3 land types agreed that the FRD population in Goa needs
 3 to be reduced, 92% (n=349) in municipalities, 88% (n=347) in towns and 91% (n=337) in
 4 villages.



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3 **Figure 78. Possible solutions to manage FRD from the community perspective in Goa,**
4 **India**
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19 **Discussion**
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24 11 This survey is the first large scale study to investigate factors associated with people's attitudes
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26 12 and current practices towards FRD in India. This work reveals the complexity of the
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28 13 relationship between human and FRD populations, defines the problems caused by FRD in
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30 14 urban and rural communities and identifies potential solutions to manage FRD from the
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32 15 community perspective. Our results provide a crucial evidence base for future initiatives which
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34 16 aim to reduce the human-dog conflict.
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40 18 *Dog ownership and FRD feeding*
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45 20 Of the 493 owned dogs in this survey, male dogs were more popular than females. Biases
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47 21 towards male dogs have been observed in other countries including Taiwan (Hsu et al., 2003),
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49 22 Haiti (Fielding et al., 2012), Samoa (Farnworth et al., 2012) and Thailand (Kongkaew et al.,
50
51 23 2004). Male dogs are often considered more effective guard dogs and less of a nuisance than
52
53 24 females as they do not produce unwanted litters (Massei et al., 2017)- The abandonment of
54
55 25 entire female dogs and female puppies are a significant source of FRD therefore understanding
56
57 26 why gender biases exist and identifying any misconceptions may be beneficial in communities
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1 where there is a need to encourage responsible dog ownership and promote the adoption of
2 female dogs. Understanding factors associated with male dog ownership may be beneficial for
3 DPM where there is a need to increase the acceptance of female dogs to prevent female puppies
4 being abandoned (Massei et al., 2017).

5
6 Another factor which contributes to FRD populations and dog-related problems is the
7 confinement status of owned dogs. The majority of owned dogs in this survey were free-
8 roaming intermittently and a large percentage of these dogs were entire and thus, highly likely
9 to be contributing to the FRD population in Goa. To engage more dog owners in DPM
10 campaigns, misconceptions and cultural beliefs surrounding sterilization should be identified.
11 It may then be possible to address such beliefs through education and by using examples of
12 sterilized dogs in the community (International Companion Animal Management Coalition,
13 2007).

14
15 The majority of dog owners surveyed, felt affection for their pet dogs, considered them to be
16 part of the family and stated that if their dog was to die it would not be easy to replace him or
17 her due to the bond they had developed with their dog. These results are similar to a study
18 conducted in Haiti, by Fielding et al. (2012) wherein 88% of caregivers considered their dog's
19 members of the family. Although positive attitudes were identified, responsible dog ownership
20 must be promoted in communities across Goa to reduce some of the problems associated with
21 FRD.

22 23 *FRD feeding*

24
25 Dog owners and Hindus were identified as the predominant feeders of FRD. Companion animal

1 ownership has been suggested to positively influence people's actions and care towards
2 animals (Paul, 2000) and Hindus religious beliefs centerecenter around the concept of karma.
3 Dog owners and Hindus could be key stakeholders in making change and helping to resolve
4 the human-dog conflict in Goa. As religion and culture play an important role in peoples'
5 attitudes and beliefs, religious representatives and community leaders should be engaged in
6 DPM to explore how religious or cultural interpretation could hinder or support potential
7 interventions (ICAM Coalition, 2007).

8
9 The majority of feeders, reported to feed FRD on a daily basis which correlates with a study in
10 Israel where feeders of free-roaming cats were extremely dedicated to the cats and invested
11 considerable resources in their care (Finkler & Terkel, 2011). Whilst the majority of feeders in
12 this survey cared for and felt affection for FRD, they were more divided in their opinions on
13 whether or not FRD would starve to death if people did not feed them. Thus, these results
14 suggest that some feeders may feed purely out of affection for FRD rather than due to the belief
15 that dogs depend on humans for food. Furthermore, the act of feeding FRD may function as an
16 emotional or self-rewarding behavior as the majority of feeders reported that feeding FRD
17 made them feel good.

18
19 Although the motivations for feeding FRD may differ, changing attitudes and behaviors
20 associated with this activity can be extremely difficult as FRD feeders often form relationships
21 with the animals they feed (Taylor et al. 2017). The human-animal bond could be a major
22 advantage for DPM interventions in Goa, particularly in areas where feeders exist as they can
23 be utilized in handling and catching FRD for sterilization, vaccination and veterinary care.
24 However, the majority of feeders in our survey, did not know if the FRD they feed were
25 sterilized. Fielding et al. (2012) state that "feeding roaming dogs will improve their chances

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3 of reproducing” (p.248) therefore, it is important to educate and support feeders across Goa to
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6 maintain sterilized populations of FRD.
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10 *Community attitudes towards FRD dogs*

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15 6 FRD were perceived as a menace and a nuisance by the majority of respondents which
16
17 7 correlates with a study undertaken in Samoa, where 64% of those canvassed agreed that FRD
18
19 8 were a nuisance (Farnworth et al., 2012). Despite negative associations with FRD in Goa,
20
21 9 attitudes and perceptions are certainly not clear-cut. Whilst the majority of respondents believe
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23 10 FRD have no place in modern society, they also claim that FRD belong and have a right to live
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25 11 in their communities and even though people are scared of FRD they also view them as
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27 12 vulnerable.
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33 14 Although attitudes and perceptions associated with FRD in Goa are complex, influencing
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35 15 factors were identified; companion animal ownership and religion. Dog owners and Hindus
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37 16 were more likely to feed FRD, so it was expected to find they showed more positive attitudes
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39 17 towards FRD. Paul (2000), revealed that empathy for animals was directly linked to pet
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41 18 ownership and Taylor and Signal (2005), found that those living with a companion animal were
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43 19 more likely to score higher in animal-welfare attitude assessments than those living without. In
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45 20 India, dogs are not associated with any religious ceremony, yet Hindus are taught that the
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47 21 human soul can be reborn into an animal which leads to the belief that all life should be
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49 22 respected (Szucs et al., 2012).
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56 24 Additional factors influencing respondent’s attitudes and perceptions towards FRD in Goa
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58 25 were identified including, area, household income, and age. In villages, dog-related problems
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1 may be reduced due to lower populations of humans and FRD. This may explain why
2 respondents from villages were less likely to view FRD as a menace, than those in towns and
3 municipalities. Compared to respondents in municipalities, those from towns displayed
4 particularly negative attitudes towards FRD which also increased with age.

6 Respondents in the age group 51-70, were not only more likely to view FRD as a menace, they
7 were more likely to agree that they were scary indicating that their negative views were
8 possibly influenced by fear. Furthermore, respondents with lower household incomes
9 exhibited more negative attitudes towards FRD than those with medium-high household
10 incomes. Respondents from poorer communities may have greater exposure to FRD and
11 associated problems, leading to the perception that FRD are a nuisance.

13 Although respondents were able to select their preferred language to complete the survey, the
14 survey was not formally translated. Some of the statements used to assess attitudes were also
15 quite similar, for example, FRD are a menace and FRD are a nuisance. However, the
16 differences; menace (threat/danger) and nuisance (inconvenience/annoying) were clearly
17 explained to the surveyors during their training which enabled them to confidently translate to
18 the respondents.

20 Despite the limitations, our survey has provided an initial insight into community perceptions
21 and attitudes towards FRD in Goa which is essential when considering interventions to reduce
22 human-dog conflict. Although ABC is often recommended as a solution, it may not be enough.
23 The emphasis needs to be on campaigns that drive changes in human behavior and interventions
24 must be tailored to target different communities based on how they view FRD and the dog-
25 related problems that exist.

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5 2 *Problems caused by FRD from the community perspective*
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10 4 The most commonly reported problem caused by FRD across all land types was barking.
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12 5 Barking has also been identified as a social problem in New Zealand (Flint et al. 2014), the
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14 6 Bahamas (Fielding, 2007) and Bhutan (Strickland, 2015). Despite being a major source of noise
15
16 7 pollution information is lacking as to why barking is such an annoyance and on the adverse
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18 8 effects. It has however, been reported that barks connected to negative inner states in dogs are
19
20 9 more annoying than others and that men find high-pitched barks more annoying than women
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22 10 (Pongrácz et al., 2016). Furthermore, it has been suggested that ‘annoying’ barks evolved
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24 11 during the process of domestication to evoke the attention of humans (Jégh-Czinege et al.,
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26 12 2019).
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33 14 Additional information was obtained from the survey relating to people’s responses to the
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35 15 barking and chasing behavior of FRD. Although the majority of respondents would stand still
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37 16 when approached by a barking dog, other responses such as wave a stick, throw something at
38
39 17 the dog, run away and hit the dog with a stick were reported. This finding highlights the need
40
41 18 for public education in behaviors that ~~minimise~~minimize human-dog conflict. Standing still
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43 19 ‘like a tree’ and remaining calm is recommended to prevent dog bites and people are advised
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45 20 not to run, panic or make loud noises (Centres for Disease Control and Prevention, 2019).
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51 22 Chasing was the second most common problem of the land types combined and whilst most
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53 23 respondents stated they would slow down, a considerable number reported that they would
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55 24 speed up. Chasing is normal dog behavior, however, it is also part of the inherited predatory
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57 25 hunting sequence which makes it an extremely complex problem (Ryan, 2009). Although there
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3 1 are no recommendations on what to do if being chased by a dog whilst on a two-wheeler
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5 2 vehicle, the behavior is unlikely to stop if people speed up.
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10 4 With over 20,000 people receiving treatment for dog bites in Goa every year (Government of
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12 5 Goa, 2019) it was unexpected to find that barking ranked well above dog bites and rabies as a
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14 6 problem associated with FRD. Dog bites/attacks and rabies have been reported as the primary
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16 7 problem associated with FRD from OIE-member countries (Dalla Villa et al. 2010) and there
17
18 8 is no doubt that dog bites fuel the human-dog conflict. In this study, 1 in 4 respondents had
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20 9 been bitten by a dog and it was found that more males than females were victims of dog bites.
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22 10 In an extensive review of dog bites by Overall, (2001) males were bitten significantly more
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24 11 than females across all age groups and a survey in India revealed that adult males constituted
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26 12 the majority (71%) of human rabies deaths from dog bites (Sudarshan et al., 2007).
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33 14 Further data was collected on the benefits of FRD. Whilst most respondents stated there were
34
35 15 no benefits associated with FRD, 42% ~~recognised~~recognized their protection role. FRD often
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37 16 alert communities to intruders and future research should perhaps look in to the positive aspects
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39 17 of FRD and how they can be incorporated in to DPM campaigns to benefit more communities.
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43 44 45 19 *Solutions for managing FRD from the community perspective* 46

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49 21 This study has not only highlighted the problems associated with FRD in Goa but has laid the
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51 22 foundation for how to resolve them. The main challenge is to ensure that the solutions
52
53 23 implemented to manage FRD are not only practical, achievable and supported by the
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55 24 community but promote animal welfare. Almost all of the respondents in this survey agreed
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57 25 that the FRD population in Goa needs to be reduced. Impounding FRD in shelters was the most
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1 popular solution proposed by respondents in municipalities and towns which corresponds to a
2 study in Italy where the majority of participants suggested that new kennels should be built to
3 control FRD (Slater et al., 2008).

4
5 Although shelters are utilized as a component of DPM they represent an expense that most
6 countries cannot afford (Dalla Villa et al., 2010). India is a vast country with widespread
7 poverty and an extremely high FRD population. Rounding up all the FRD and placing them in
8 shelters is therefore, unlikely to be a practical or feasible solution even if this is what
9 communities want. Shelters alone, also cannot solve the problem as they do not address the
10 source of FRD. Dogs removed from the streets are likely to be quickly replaced by new puppies
11 if enough breeding female FRD remain and the situation may worsen as shelters provide an
12 easy route for people to dispose of unwanted pets and unplanned litters (Taylor et al. 2017).
13 People may see shelters as a safe-haven for FRD where they will be fed and cared for. In reality,
14 many of the shelters in India and other parts of the world lack resources and are over-crowded
15 due to high intake of sick and injured animals, low adoption rates and ‘no-kill’ policies.

16
17 ABC was the most popular solution suggested by respondents in villages, followed by
18 impounding dogs in shelters. In villages across Goa, ABC is rarely implemented whereas in
19 municipalities and towns there are many animal welfare organizations performing sterilization
20 for FRD. The success of existing ABC programs may influence people’s attitudes and
21 perceptions towards DPM and indeed there are mixed reports on the effectiveness of ABC
22 (Totton et al., 2010; Barnard et al., 2015; Belo et al., 2017; Reece et al., 2013). ABC requires
23 considerable resources and efforts must be sustained if programs are to be successful in
24 substantially reducing FRD populations. In the Indian city of Jodhpur, where intensive ABC
25 has been implemented, it was estimated that it would take between 13-18 years to stabilize the

1 dog population (Totton et al., 2010).

2

3 It is believed that ABC reduces some forms of aggression in both male and female dogs
4 (Warnes, 2015a; Warnes, 2015b) leading to less disturbance in communities and fewer injuries
5 incurred through dog fights. Although research on the behavioral outcome of sterilization is
6 limited, Garde et al. (2016) reported that no change was observed in the levels of dog-dog
7 aggression following sterilization of male FRD. This highlights that much more research is
8 needed in this area before claims can be made regarding the behavioral benefits of ABC
9 particularly where programs are implemented in a bid to reduce problems associated with male
10 FRD.

11

12 Although 10% of respondents felt there was no solution for FRD other solutions put forward
13 were; adoption and public education. If adoption programs are to be successful, the status of
14 the Indian dog, particularly females, needs to be raised and associated benefits highlighted
15 through public education. If people's perceptions towards FRD can be improved, it is likely
16 adoptions of FRD will increase. There is a growing trend across India, for obtaining expensive
17 pedigree breeds rather than adopting native Indian dogs yet previous studies have found that
18 FRD are adaptable, trainable and adjustable to domestic environments (Demirbas et al., 2014;
19 Demirbas et al., 2017).

20

21 **Conclusion**

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23 The problems associated with FRD and the somewhat conflicting attitudes identified in this
24 study, not only highlight the complexity of the human-dog relationship but also emphasize the
25 difficulties that are likely to be faced by those attempting to resolve the human-dog conflict.

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3 1 Although it can be concluded from the community perspective, that the FRD population in Goa
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5 2 needs to be reduced; both the preferred solutions of impounding FRD in shelters and ABC have
6
7 3 their limitations and implications for animal welfare. Our study highlights the need to further
8
9 4 explore the relationship between FRD and humans in all communities where conflict exists.
10
11 5 Developing a more comprehensive and detailed understanding of community perceptions and
12
13 6 attitudes towards FRD in Goa, India will support the development of more practical and
14
15 7 sustainable interventions to minimize human-dog conflict.
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40
41 18 rabies control and the Government of Goa for their continued commitment to developing
42
43 19 effective strategies for DPM and rabies control across the state.
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For Peer Review Only

Supplementary Material**Table 1. Demographic data of the respondents (n = 1141)**

Demographic data	Number of respondents			
	Municipalities n (%)	Towns n (%)	Villages n (%)	Total n
Gender				
Male	190 (37)	171 (33)	156 (30)	517
Female	188 (30)	222 (36)	214 (34)	624
Total	378 (33)	393 (34)	370 (32)	1141
Age				
18-30	93 (39)	84 (35)	64 (26)	241
31-50	154 (29)	179 (33)	206 (38)	539
51-70	113 (36)	112 (35)	91 (29)	316
> 70	15 (40)	15 (40)	7 (19)	37
Total	375 (33)	390 (34)	368 (33)	1133
Missing				8
Religion				
Hinduism	249 (36)	212 (30)	237 (34)	698
Christianity	92 (24)	166 (43)	124 (32)	382
Islam	35 (61)	13 (23)	9 (16)	57
Other (Atheism)	1 (100)			1
Total	377 (33)	391 (34)	370 (33)	1138
Missing				3
Education level (respondent)				
No education	6 (17)	14 (40)	15 (43)	35
Some primary	44 (30)	50 (34)	52 (36)	146
Complete primary	58 (43)	28 (20)	50 (37)	136
Some secondary	54 (29)	65 (34)	69 (37)	188
Complete secondary	98 (33)	94 (32)	105 (35)	297
College	66 (33)	84 (42)	49 (25)	199
Higher	47 (43)	36 (33)	27 (24)	110
Total	373 (34)	371 (33)	367 (33)	1111
Missing				30

Table 2. Final logistic regression model table: FRD feeding (n=412). Respondents with missing information regarding their age (n=5), level of education (n=6) and religion (n=1) were removed from this part of the analysis

This table accompanies Figure 4 in the results section.

Variable	Odds Ratio	SE	95% CI	P-value
Dog ownership: <u>no</u> yes	1		Baseline	
Dog ownership: yes	1.42	0.14	1.09-1.85	0.009**
Gender: Female	1		Baseline	
Gender: Male	0.81	0.13	0.63-1.05	0.107
Income:				
<28000	1		Baseline	
29000 - 140000	0.91	0.19	0.63-1.32	0.627
Income: > 141000	0.82	0.59	0.24-2.55	0.731
Income: Unknown	0.64	0.14	0.49-0.84	0.001**
Religion: Christianity	1		Baseline	
Religion: Hinduism	1.49	0.14	1.13-1.98	0.005**
Religion: Islam	0.84	0.32	0.44-1.57	0.601
Age: 18-30	1		Baseline	
Age: 31-50	0.63	0.16	0.46-0.86	0.004**
Age: 51-70	0.53	0.18	0.37-0.76	<0.001***
Age: >70	0.4	0.41	0.17-0.87	0.026*



Figure 1. Cross-tabulation of binary versions of responses to questions on attitudes towards FRD (n=1141). Original questions were in the form of Likert-type questions, which were converted into 'yes' (strongly agree/agree) and 'no' (agree nor disagree/disagree/strongly disagree) responses for ease of interpretation. The figure shows the number of answers (yes/no) distribution of questions for each questions (diagonal from top left to bottom right), as well as the cross-tabulation of each pair of questions (all other plots).

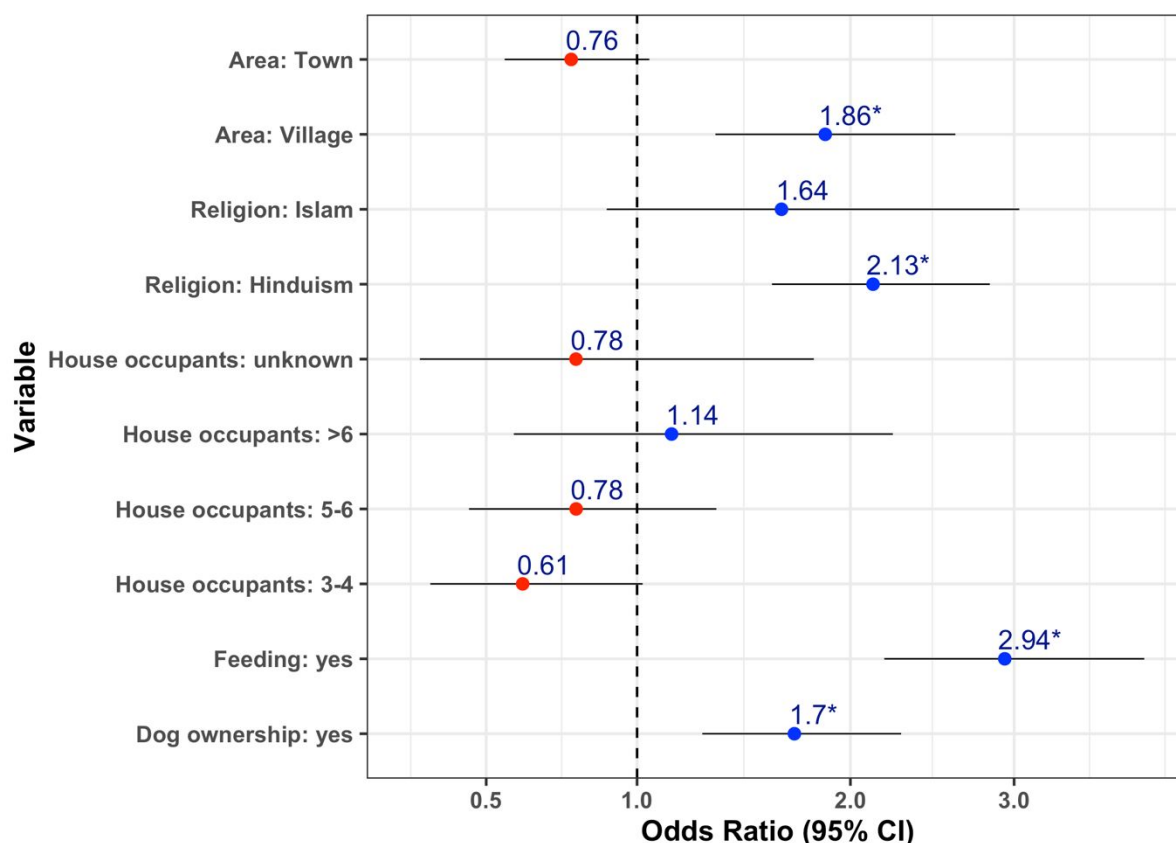


Figure 2. Final logistic regression model: FRD belong in our community (n=1129). Dog owners, FRD feeders, Hindus (when compared to Christians) and respondents from villages (when compared to municipalities) were more likely to agree with the statement 'FRD belong in our community'. Respondents from towns were more likely to disagree with this statement. Respondents with missing information regarding their age (n=8) and religion (n=4) were removed from this part of the analysis.

Table 3. Final logistic regression model table: FRD belong in our community (n=1129)

Variable	Odds Ratio	SE	95% CI	P-value
Dog ownership: no	1		Baseline	
Dog ownership: yes	1.70	0.15	1.27-2.29	<0.001***
Dog feeding: no	1		Baseline	
Dog feeding: yes	2.94	0.15	2.19-3.94	<0.001***
Area: Municipality	1		Baseline	
Area: Village	1.86	0.17	1.33-2.62	<0.001***
Area: Town	0.76	0.16	0.55-1.05	0.095
House occupants: 1-2	1		Baseline	
House occupants: 3-4	0.61	0.27	0.36-1.02	0.060
House occupants: 5-6	0.78	0.27	0.45-1.33	0.359
House occupants: > 6	1.14	0.35	0.58-2.24	0.707
House occupants: unknown	0.78	0.43	0.33-1.80	0.557
Religion: Christianity	1		Baseline	
Religion: Hinduism	2.13	0.15	1.59-2.84	<0.001***
Religion: Islam	1.64	0.31	0.89-3.04	0.116

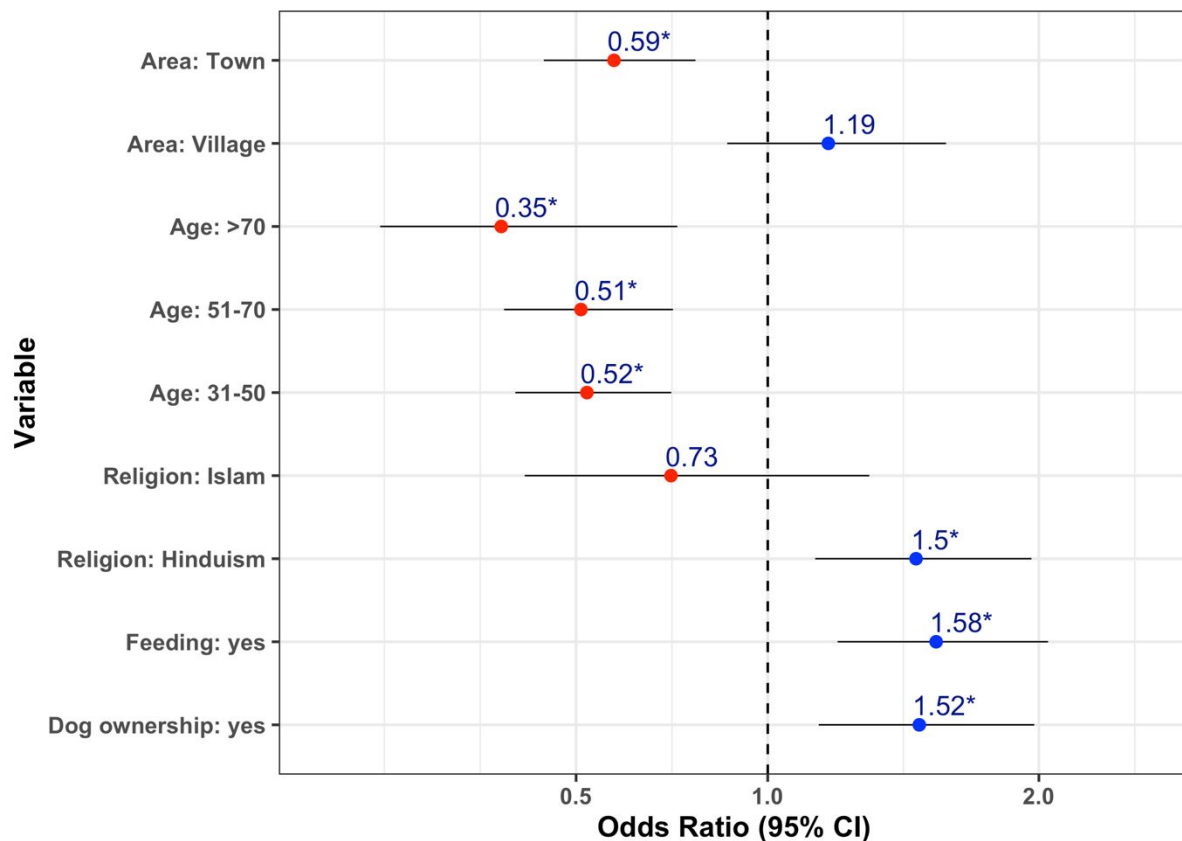


Figure 3. Final logistic regression model: FRD have a right to live on the streets (n=1129). Hindus (compared to Christians), dog owners and FRD feeders were more likely to agree that 'FRD have a right to live on the streets'. Respondents in towns were more likely to disagree compared to those in municipalities. The odds of the respondent agreeing that FRD had a right to roam freely decreased with age. Respondents with missing information regarding their age (n=8) and religion (n=4) were removed from this part of the analysis.

Table 4. Final logistic regression model table: FRD have a right to live on the streets (n=1129)

Variable	Odds Ratio	SE	95% CI	P-value
Dog ownership: no	1		Baseline	
Dog ownership: yes	1.52	0.14	1.16-1.98	0.002**
Dog feeding: no	1		Baseline	
Dog feeding: yes	1.58	0.13	1.22-2.04	<0.001***
Area: Municipality	1		Baseline	
Area: Village	1.19	0.16	0.88-1.62	0.255
Area: Town	0.59	0.15	0.43-0.79	0.001***
Religion: Christian	1		Baseline	
Religion: Hinduism	1.50	0.14	1.15-1.97	0.003**
Religion: Islam	0.73	0.31	0.40-1.33	0.303

Age: 18-30	1	Baseline		
Age: 31-50	0.52	0.17	0.38-0.73	<0.001***
Age: 51-70	0.51	0.18	0.36-0.73	<0.001***
Age: >70	0.35	0.38	0.17-0.74	0.006**

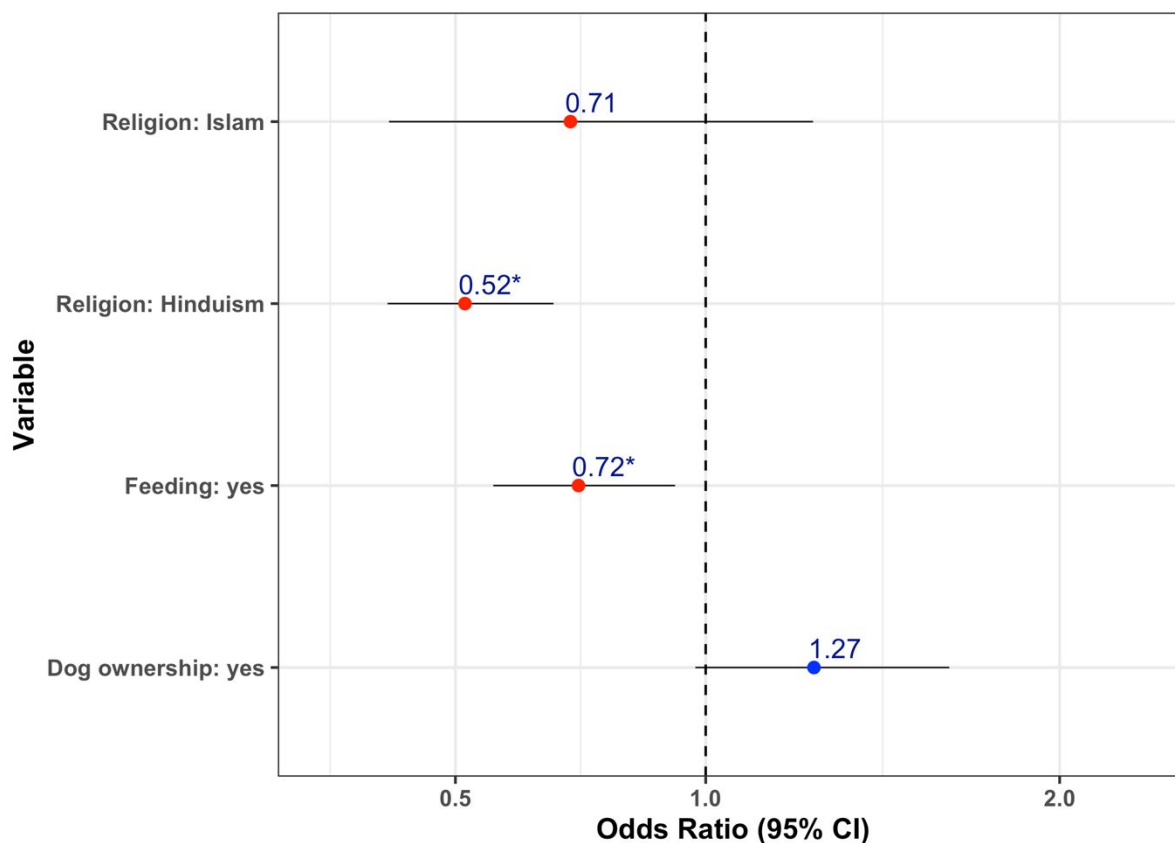


Figure 4. Final logistic regression model: FRD are vulnerable (n=1129). Dog owners were more likely to agree with the statement ‘FRD are vulnerable’. FRD feeders were less likely to agree with this statement and Hindus and Muslims were less likely to agree compared to Christians. Respondents with missing information regarding their age (n=8) and religion (n=4) were removed from this part of the analysis.

Table 5. Final logistic regression model table: FRD are vulnerable (n=1129)

Variable	Odds Ratio	SE	95% CI	P-value
Dog ownership: no	1		Baseline	
Dog ownership: yes	1.27	0.13	0.98-1.65	0.076
Dog feeding: no	1		Baseline	
Dog feeding: yes	0.72	0.13	0.56-0.93	0.011*
Religion: Christian	1		Baseline	

Religion: Hinduism	0.52	0.14	0.39-0.68	<0.001***
Religion: Islam	0.71	0.30	0.40-1.27	0.245

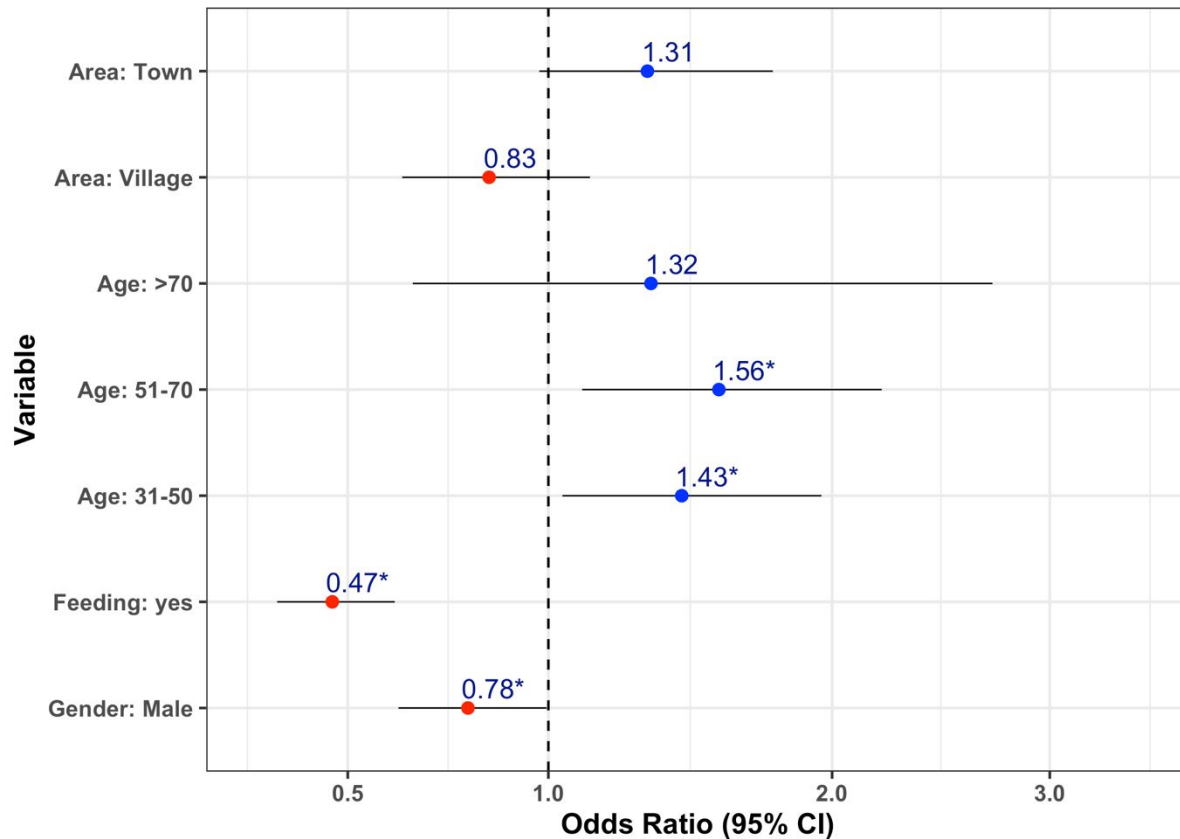


Figure 5. Final logistic regression model: FRD are a menace (n=1129). Respondents in towns (compared to municipalities) were more likely to agree 'FRD are a menace' and the odds of this opinion increased with age except for respondents aged 70 or above. FRD feeders and males were more likely to disagree with this statement. Respondents with missing information regarding their age (n=8) and religion (n=4) were removed from this part of the analysis.

Table 6. Final logistic regression model table: FRD are a menace (n=1129)

Variable	Odds Ratio	SE	95% CI	P-value
Gender: Female	1		Baseline	
Gender: Male	0.78	0.12	0.61-0.99	0.045*
Feeding: no	1		Baseline	
Feeding: yes	0.47	0.13	0.36-0.60	<0.001***
Area: Municipality	1		Baseline	
Area: Village	0.83	0.15	0.62-1.13	0.235
Area: Town	1.31	0.15	0.97-1.76	0.075
Age: 18-30	1		Baseline	

Age: 31-50	1.43	0.16	1.04-1.96	0.027*
Age: 51-70	1.56	0.18	1.10-2.21	0.012*
Age: >70	1.32	0.37	0.64-2.72	0.448

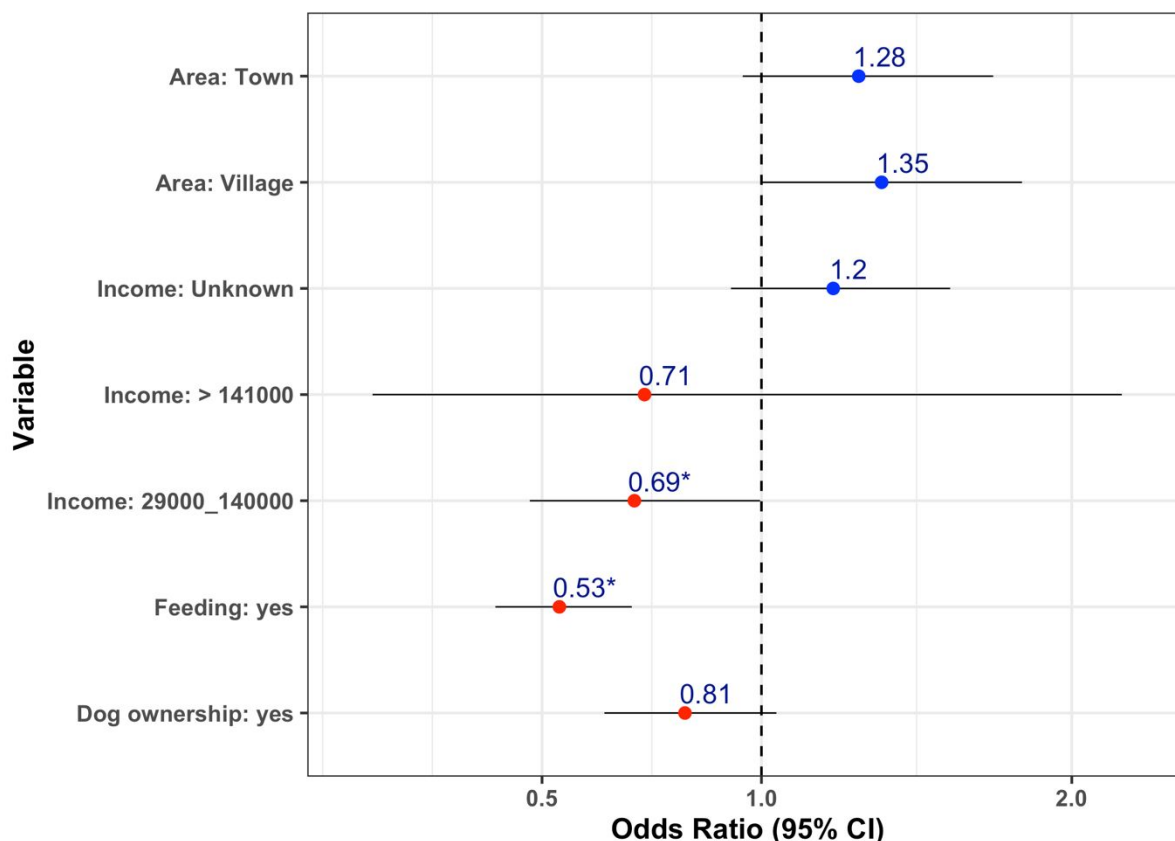


Figure 6. Final logistic regression model: FRD are a nuisance (n=1129). Respondents with medium-high (29,000-140,000/-) household incomes (compared to those with lower incomes), FRD feeders and dog owners were less likely to agree that ‘FRD are a nuisance’. Respondents from villages and towns (compared to municipalities) were more likely to agree with this statement. Respondents with missing information regarding their age (n=8) and religion (n=4) were removed from this part of the analysis.

Table 7. Final logistic regression model table: FRD are a nuisance (n=1129)

Variable	Odds Ratio	SE	95% CI	P-value
Dog ownership: no	1		Baseline	
Dog ownership: yes	0.81	0.13	0.62-1.04	0.098
Dog feeding: no	1		Baseline	
Dog feeding: yes	0.53	0.13	0.42-0.68	<0.001***
Income: < 28000	1		Baseline	

Income: 29000 -140000	0.69	0.19	0.48-0.99	0.048*
Income: > 141000	0.71	0.57	0.23-2.19	0.554
Income: Unknown	1.20	0.14	0.92-1.57	0.178
Area: Municipality	1	Baseline		
Area: Village	1.35	0.15	0.99-1.82	0.051
Area: Town	1.28	0.15	0.95-1.71	0.105

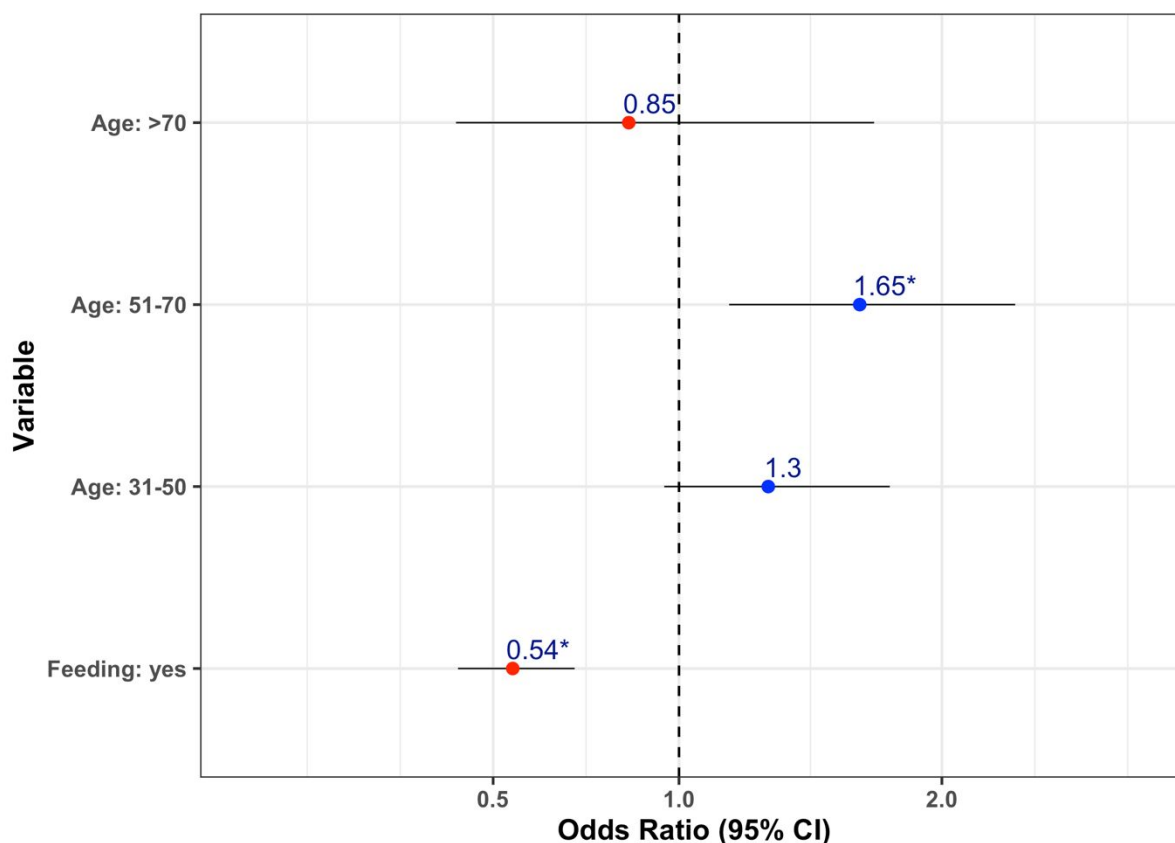


Figure 7. Final logistic regression model: FRD are scary (n=1129). The odds of the respondent agreeing that ‘FRD are scary’ increased with age except for respondents aged 70 or above. FRD feeders were less likely to agree with this statement. Respondents with missing information regarding their age (n=8) and religion (n=4) were removed from this part of the analysis.

Table 8. Final logistic regression model table: FRD are scary (n=1129)

Variable	Odds Ratio	SE	95% CI	P-value
Dog feeding: no	1	Baseline		

Dog feeding: yes	0.54	0.13	0.42-0.70	<0.001***
Age: 18-30	1	Baseline		
Age: 31-50	1.30	0.16	0.95-1.77	0.097
Age: 51-70	1.65	0.18	1.16-2.34	0.005**
Age: >70	0.85	0.36	0.42-1.71	0.645

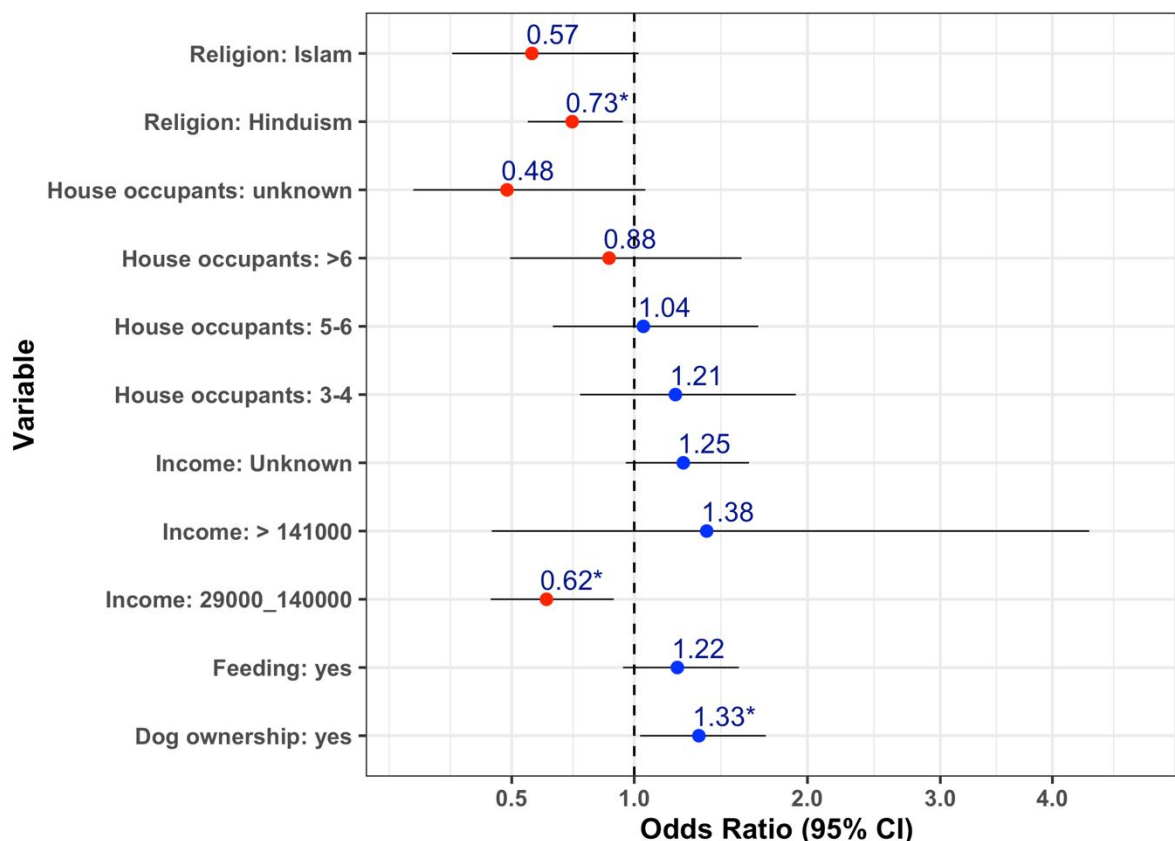


Figure 8. Final logistic regression model: FRD have no place in modern society (n=1129). Respondents with medium-high (29,000-140,000/-) household incomes (compared to lower incomes) were more likely to disagree that ‘FRD have no place in modern society’. Hindus and Muslims were more likely to disagree with this statement than Christians. Dog owners and FRD feeders were more likely to agree that ‘FRD have no place in modern society’. Respondents with missing information regarding their age (n=8) and religion (n=4) were removed from this part of the analysis.

Table 9. Final logistic regression model table: FRD have no place in modern society (n=1129)

Variable	Odds Ratio	SE	95% CI	P-value
Dog ownership: no	1		Baseline	
Dog ownership: yes	1.33	0.13	1.03-1.73	0.030*
Dog feeding: no	1		Baseline	
Dog feeding: yes	1.22	0.13	0.95-1.56	0.125
House occupants: 1-2	1		Baseline	
House occupants: 3-4	1.21	0.24	0.76-1.92	0.429
House occupants: 5-6	1.04	0.24	0.65-1.68	0.859
House occupants: >6	0.88	0.3	0.49-1.58	0.675
House occupants: unknown	0.48	0.4	0.22-1.05	0.068
Income: < 28000	1		Baseline	
Income: 29000-140000	0.62	0.19	0.43-0.90	0.013*
Income: > 141000	1.38	0.59	0.43-4.36	0.587
Income: Unknown	1.25	0.13	0.96-1.62	0.098
Religion: Christian	1		Baseline	
Religion: Hinduism	0.73	0.14	0.56-0.95	0.018*
Religion: Islam	0.57	0.30	0.32-1.02	0.059