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Recruitment and satisfaction of commercial livestock farmers participating in a livestock guarding dog programme

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Abstract. Livestock guarding dogs (LGDs) are used to prevent livestock depredation and used in a number of conservation programmes as a human-wildlife coexistence tool. Although the livestock protection outcomes of LGD use are well studied, relatively little is known about the motivations or perceptions of the farmers involved. This mixed-methods study investigated recruitment and satisfaction in 108 South African commercial livestock farmers participating in an LGD programme. A semi-structured interview schedule and existing dataset were used to collect both qualitative data (analysed according to the principles of thematic analysis) and quantitative data (summarised using descriptive statistics). Word-of-mouth was the predominant source of programme awareness (n = 69), with direct recruitment by programme managers reducing proportionally over time, indicating programme self-perpetuation. Satisfaction was 'high' for most farmers (n = 90) and trust between farmers and programme managers was important in recruitment, motivation and satisfaction, along with perceived reductions in livestock losses. Concern for wildlife only motivated 21 farmers. LGD behavioural problems were reported by 49 farmers, but 95 would still use an LGD again. These novel findings demonstrate the importance of inter-stakeholder dialogue for obtaining crucial knowledge for LGD program development. Where non-conservation-related motivators predominate for key stakeholders, greater emphasis on these other factors during programme recruitment, advocacy and/or evaluation may improve stakeholder engagement and retention.

Key words: farming, human-carnivore interaction, livestock protection, motivation, perception, predator

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Introduction

Livestock depredation by free-ranging carnivores represents a key threat to the sustainability of agricultural practices and global food security (Inskip & Zimmermann 2009). At the same time, the conservation of some free-ranging carnivores, such as cheetahs (*Acinonyx jubatus*), relies heavily on coexistence with human stakeholders on unprotected land, such as agricultural areas (Durant et al. 2017). We define coexistence here as a state in which people and wildlife are able to live in the same area, each with a respective right to endure (Lucas et al. 2022). This definition emerged following inductive inquiry with our stakeholder group (albeit a slightly different sample group) as part of a separate study (Lucas et al. 2022) and is therefore in keeping with the requirement for stakeholder input and avoidance of researcher-biased perceptions (Glikman et al. 2021).

Where conservation initiatives occur on privately owned land, stakeholder (interested parties) engagement is crucial and therefore requires that stakeholders are firstly motivated to participate and, secondly, satisfied to remain a participant. Logically, this motivation to participate will initially manifest as an awareness and knowledge base that is predominantly positive towards the project, before translating into the impetus and action of participating. Both knowledge and attitude are well described as 'necessary but not sufficient' for eliciting human behaviour change (reviewed in Nilsson et al. 2020). Likewise, satisfaction with participation may be influenced by a range of variables including social norms and perceived behavioural control (Ajzen 1991). Understanding social drivers of participation in conservation initiatives, and the influence these have on stakeholder engagement, is therefore important for ensuring effective, sustainable conservation (Carvalho et al. 2021, König et al. 2021, Volski et al. 2021).

Coexistence initiatives generally focus on reducing the causes or instances of interactions between people and carnivores which have negative outcomes for people and/or carnivores. This typically involves either changing the way the interaction takes place so that there is reduced harm to the people (or their property) and carnivores, or preventing the interaction in the first place (Treves & Karanth 2003). One method used to facilitate coexistence is livestock-guarding dogs (LGDs). Historically commonplace in Europe (Rigg 2001), LGDs are now used on livestock

farms across the world (van Eeden et al. 2017). Until recently, most studies evaluating LGD initiatives have focused on using farmer surveys to quantify perceived changes in livestock depredation (Eklund et al. 2017, van Eeden et al. 2018). Whilst these studies have determined that LGD use has a largely positive outcome for farmers, including substantial economic savings (Rust et al. 2013, Marker et al. 2020), the human factors involved in LGD use are not well established. The human dimension to any human-wildlife interaction is integral to success (Volski et al. 2021) and often extend beyond simple economics.

Farmer LGD-satisfaction studies (e.g. Potgieter et al. 2013, Marker et al. 2020, van der Weyde et al. 2020) have primarily focused on quantifying perceptions of LGD utility and economic cost-benefit assessments. Moreover, comprehensive evaluations of recruitment, participation and retention of LGD-using stakeholders are rare.

Species conservation generally requires a change in behaviour on the part of the human stakeholders (Nilsson et al. 2020) and stakeholder motivation is a critical challenge faced by conservation programmes (Carvalho et al. 2021). Moreover, attending to factors that limit or prevent stakeholder involvement in mitigation schemes can increase participation rates (Moon & Cocklin 2011). Additionally, increased understanding of the drivers of participation in conservation schemes can inform strategies to improve uptake rates, and subsequently, the sustainability of programmes (Volski et al. 2021), especially those that are heavily reliant on extensive and perpetuated land-user engagement.

In this study, we address the knowledge gap in regards stakeholder motivation, recruitment and use of LGDs using a mixed-methods approach. Our study posed the following research questions; 1) what was the extent and source of participant knowledge of LGDs and the programme prior to enrolment? 2) what are the most successful methods of recruitment? 3) what are the motivating factors for farmer participation? and 4) how satisfied are participants with the LGD programme? The overall aim of the research was to understand farmers' experiences with an LGD programme in South Africa.

Study area

This study focuses on the largest and longest-standing LGD programme in South Africa. Anatolian shepherds are the predominant breed of LGD used,



and placements of the dogs occurs primarily along the northern border with Botswana and Zimbabwe. This area is characterised by semiarid savannah agricultural habitat. Land use is predominantly agricultural production of sheep and goats, with some mixed livestock, game ranching and nature reserves. Both large commercial farms and small subsistence farms comprise the agricultural sector. Free-ranging carnivores in the region include leopard (*Panthera pardus*), brown hyena (*Hyaena brunnea*), spotted hyena (*Crocuta crocuta*), cheetah, caracal (*Caracal caracal*), African wild dog (*Lycaon pictus*) and black-backed jackal (*Canis mesomelas*) (Findlay 2016, Spencer et al. 2020). Farmers experience livestock losses to carnivores, ranging from minor to severe, and employ a range of protection systems, including non-lethal and lethal control methods (Rust et al. 2013, Lucas et al. 2020).

All dogs are placed and monitored through on-farm visits and telephone calls with a project manager (PM) employed by a non-government organisation (NGO), Cheetah Outreach Trust, herein referred to as the NGO. The logistics of the LGD programme operations have been described elsewhere (Rust et al. 2013, Whitehouse-Tedd et al. 2020), but, in brief, includes coverage of the first year's costs, regular and on-going monitoring and support. Farmer participants are asked to cease the use of lethal control methods whilst an LGD is operating and are responsible for the dog's health and welfare (with the exception of health and feeding costs in the first year), as well as regular completion of monitoring surveys and feedback interviews.

Material and Methods

A mixed methods approach was used, involving collection of both quantitative and qualitative data from participants of the LGD programme, via semi-structured interviews and an existing dataset (quantitative and qualitative data obtained from historic routine monitoring reports held by the NGO).

The study was designed to maximise ecological validity, defined as the relevance of findings to everyday settings (Bryman 2012), by producing a comprehensive insight into the perceptions of the LGD programme held by programme participants. The study was approved by the School of Animal, Rural and Environmental Sciences Ethical Review Group (protocol ARE88; Nottingham Trent University, UK).

Primary data collection

Primary data were collected via a semi-structured interview involving both open and closed questions about the farmers' experiences prior to, and during, participation in the LGD programme. Semi-structured interviews provided the participants with some control over the interview process, allowing them to express what they believed to be important (Bryman 2012).

The interview question guide (Table S1) was arranged around three main constructs: knowledge of LGDs and the LGD programme, recruitment onto the LGD programme, and satisfaction with the LGD and LGD programme. The open questions provided responses for the qualitative element of the study. Closed questions were focused on sources of information about the LGD programme (selection of options to choose from), LGD training, future use of LGDs, and a 5-point rating scale of satisfaction with changes in livestock losses since LGD introduction (where 1 was "not satisfied" and 5 was "highly satisfied").

The interview schedule was piloted with five programme participants to assess understanding of the questions, determine the average time required to complete an interview, and to ensure the questions generated data suitable for analyses. As per Arnott et al. (2014), advice was also sought from the PMs with regards to wording of the questions. Only minor changes were made to one question to improve understanding, therefore data collected from the pilot interviews (excluding those from the question that was modified) were included in the final analyses to maximise stakeholder group representation.

The NGO database of programme participants was used to identify potential interviewees and consisted of 136 farms; of these, 106 farms (each represented by one person) agreed to participate. Reasons for non-participation included invalid contact details ($n = 7$), no reply ($n = 6$), death ($n = 4$), lack of time ($n = 2$), uninterested ($n = 1$), or inclusion in a concurrent study and our desire to avoid response fatigue in these farmers ($n = 10$). For ethical reasons, no further details were requested from non-responders or those declining the interview. In the case of two farms, two interviews were conducted with different individuals representing the farm; both people were involved in the decision to join the LGD programme and assumed equal responsibility for the LGD during participation. As we wished to be as inclusive as possible and maximise stakeholder



group representation, interview data from both were included in analyses (providing a total $n = 108$ interviews), with the exception of recruitment analyses, which were restricted to those provided by the person named in the NGO database ($n = 106$). The interviews were conducted via telephone ($n = 79$) for participants in remote areas, or face-to-face ($n = 29$).

The method of recruitment into the programme (described in detail under 'data processing and analysis') for each farm was determined from interviews with either the participant, or the PM responsible for the LGD's placement. In the latter case, PMs were asked to recall data surrounding recruitment for every placement between 2005 (when the programme started) until the end of 2018, regardless of whether the farmer participated in an interview or not. This way, an additional 63 farmers were identified as having received an LGD, but had not been interviewed (e.g. through unavailability or received their LGDs after the interview data were collected). Two types of recruitment data were subsequently analysed; farmer-derived data from interview responses about discovery of the NGO programme ($n = 106$), and PM-derived data generated entirely by PM-recall ($n = 169$). Duplicate records (i.e. those in both datasets) were cross-checked through the process of triangulation, and instances of discrepancies (20% of cases) resolved according to PM-recall as this was typically supported by written records or other similar evidence and therefore considered the most reliable. Subsequently, the farmer-derived data for recruitment were analysed in a cross-sectional manner and facilitated assessment of recruitment type on a finer scale than PM-derived data, which were analysed on a longitudinal basis using only broad categories of recruitment type (see below).

Although every attempt was made to interview those individuals primarily responsible for joining the programme according to the NGO, in some instances ($n = 11$) a spouse was interviewed instead, ten of which were female. In four cases, the task was actively delegated to a spouse, and in other cases the spouse was the only person available for an interview. In all cases, the spouse had detailed knowledge of the LGD and its placement. Interview length did not vary significantly between telephone and face-to-face interview techniques (median 14 minutes and 15 minutes, respectively: $U(1) = 979.5$, $z = -1.153$, $n = 108$, $P = 0.249$) but interview length varied considerably (3–42 minutes). All responses were manually recorded.

Nine participants required the use of a translator (a native Afrikaans-speaking educator) to complete the interview in Afrikaans. Responses were translated into English whilst the participant was answering, but these interviews were both initiated and concluded by the first author, in English. When necessary, the translator was asked to rephrase questions, except for the rating scale measuring satisfaction, which was scripted to ensure that meaning and rating criteria were consistent between English and Afrikaans.

Secondary analysis of existing data

Qualitative and quantitative data on the livestock farmed, the status of all LGD placements, and participant status within the programme for the interviewed participants were extracted from monitoring reports generated by the PMs. Participant status referred to their current form of engagement with the programme. Status was based on whether the oldest surviving LGD on their farm was working, or not, at the time of the study, as determined from qualitative information in progress reports. Interview participants were categorised as 'active' when their LGD was working, whilst other LGD conditions (retired, dead, removed, sold) were used to categorise a participant as 'inactive' within the programme. Extraction and analysis of existing data occurred concurrently with the interviews but was not used to inform primary data collection or sample selection; the intention was to interview as many farmers as possible and to supplement interview data with existing data where necessary. Reasons for LGD retirement, death, removal, or sale have been explored previously (Whitehouse-Tedd 2020).

Data processing and analysis: qualitative data

The data obtained via the semi-structured interviews were analysed using principles of thematic analysis (Braun & Clarke 2012). Responses were grouped by common themes and NVivo (QSR International Pty Ltd. Version 12, 2018) was used to code statements relevant to satisfaction, motivation and recruitment. The themes identified were also verified by co-authors (KWT and JS). Responses were initially categorised at the semantic level, identifying key phrases and words that link to a specific theme. This was used to generate the over-arching thematic structure, followed by analysis at the latent level, picking up on the underlying conceptualisations, opinions and ideologies in relation to the questions/statements.

Data processing and analysis: quantitative data

The participants' responses to closed-ended questions (including demographic and scale items) were



coded numerically, and quantitatively described using descriptive statistics. Length of time in the programme was calculated as the difference between placement date of the first LGD and end date (LGD removal, death, or interview date).

Recruitment type was categorised from farmer-derived data as either direct or indirect (Oldenburg & Glanz 2008) followed by further classification (Fig. S1). A participant was classed as a direct recruitment if they initially learned about the LGD programme from a representative of the programme (the NGO or project partner) and subsequently decided to join. This category includes participants that may already have known about the programme but did not join until contact was made by the NGO. Indirect recruitment refers to cases where the participant initially found out about the LGD programme via means unrelated to direct contact with an NGO representative and the participant subsequently contacted an NGO representative to request an LGD.

Recruitment data from PM sources which were not concurrently available in the farmer-derived dataset ($n = 63$) could only be classified as either 'direct' or 'indirect'. As such, analysis of recruitment type over time using PM-derived data ($n = 169$) was restricted to these two categories alone.

The majority of participants provided more than one motivating factor, and some participants provided more than one point of concern regarding joining the LGD programme. Therefore, each statement relating to motivation ($n = 162$) or concern ($n = 36$), rather than each participant, was treated as the unit of analysis. Statements that referred to the present situation only (hence deemed unrelated to motivation prior to receiving an LGD) were excluded. Categories of motivations were labelled using terms as similar to the original statement as possible, with minimal inferences made by researchers. Occasionally statements relating to motivation were assigned to more than one category ($n = 12$) when they included distinct components. The satisfaction scale was divided into low (1-2), medium (2.5-3.5) and high (4-5) for analysis, accounting for participants ($n = 4$) that provided fractional ratings.

In some cases, more than one theme or category of response was provided per question. Likewise, for some interviews, some questions were unanswered because of a lack of participants' time (and unavailability for follow up), inability to formulate a response or understand the question, or preferred

not to answer. As such, the number of units of analysis varied across sets of results.

Results

Demographics

All 106 farms represented by interviewed participants were using private land for the purpose of commercial livestock production and had LGDs placed with sheep ($n = 45$), goats ($n = 41$), cattle ($n = 11$), mixed small stock ($n = 8$) or game ($n = 1$). Apart from two black, Tswana-speaking farmers, all participants were white, Afrikaans-speaking farm owners or managers. Whilst the majority of participants ($n = 108$) were male ($n = 88$), 20 were female. For participants responding to questions about their status in the programme ($n = 103$), the time they had been involved in the programme ranged from 1-100 months (mean 35 ± 24 months). Sixty participants were active in the programme at the time of the interview. The remainder's LGD had died ($n = 19$) or been retired, removed, or sold ($n = 24$).

Knowledge of the NGO programme and the use of dogs to protect livestock

Of those participants asked about the use of dogs for livestock protection ($n = 100$), 72 were already aware of this function of dogs prior to joining the NGO programme, while 32 had used LGDs previously, 28 of which used a breed other than Anatolian shepherds. When asked about livestock protection methods ($n = 101$), 26 volunteered that they had used lethal methods to control carnivores, and 17 stated the methods used (poison, shooting, pitfall traps and leg-hold (gin) traps).

Of 99 participants responding to questions about their awareness of the programme prior to joining, 85 had heard someone else (other than the NGO) speak about the programme before they joined. Word-of-mouth was the most frequently cited source of information ($n = 69$) about LGDs and the NGO programme among the 108 participants. Of these, 65 provided information about whom they had heard information from, but only 64 provided sufficient detail to permit classification of the information as positive or negative. Most referred to another person by name ($n = 22$; many of whom named the same person/people). Others had either spoken to neighbours ($n = 17$), farmers of unspecified relationship to the participant ($n = 11$), friends ($n = 7$), family ($n = 5$), or colleagues ($n = 3$); none of these data overlap. In regards the detailed nature of the information shared, it was more often wholly positive about the programme ($n = 36$),

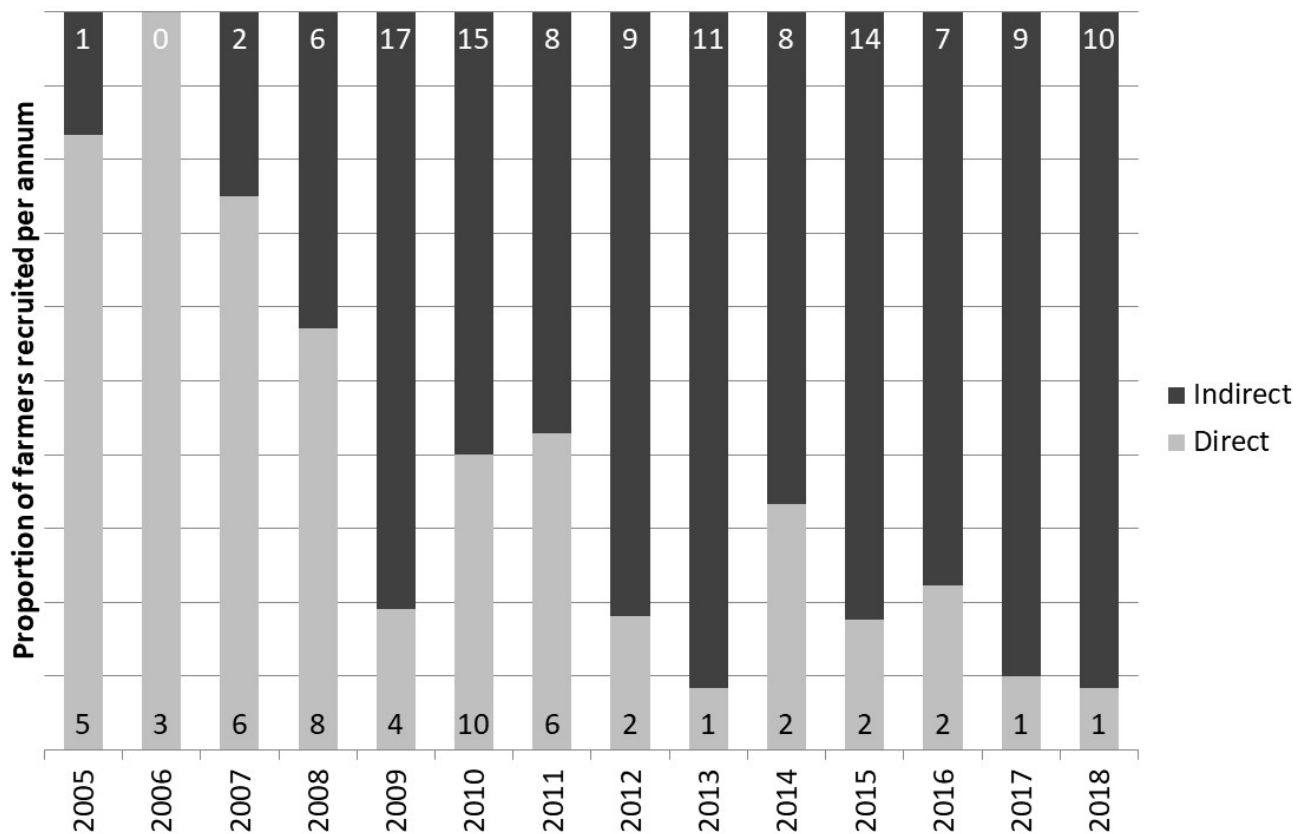


Fig. 1. Recruitment type, as recalled by Cheetah Outreach Trust project managers, for all Livestock-Guarding Dog programme participants ($n = 169$), from inception in 2005 until end of 2018. The numbers in each column represent newly recruited participants (either directly or indirectly) per year.

whereas the number of mixed responses ($n = 13$) was approximately equivalent to the number of wholly negative ($n = 15$) ones. Participants sometimes did not provide specifics about positive feedback they had heard, but used terms such as, 'good', 'positive' and 'happy'. Negative feedback heard by participants most often included anecdotal reports of behavioural problems with the dogs, e.g.: "some people said they were prone to hunting and roaming" (T031); and "I have heard negative things: that the dogs are lazy when it's hot" (T104). Eleven participants indicated that they were not affected by negative word-of-mouth, e.g.: "if they complain, I listen to how they've treated the dog" (T105) and, "there are people talking but they say a lot of nonsense. They are the people who don't have the dogs" (T082).

When asked for sources of information perceived to be best in regards the LGD programme ($n = 96$), 68 named the NGO and specific persons representing the organisation. Participants were not asked about PMs but a sense of trust was evident between them, as reflected in participants' statements, such as, "I trusted (PM), he has good knowledge and background" (NW018).

Recruitment type

Three quarters ($n = 80$) of participating farms involved in interviews ($n = 106$), first joined the programme through indirect means, whilst 26 had been recruited directly (Fig. S2). Of the interviewed participants, one could not remember how they first joined the programme such that NGO records and PM recall were used to classify their recruitment for inclusion in this analysis.

Using PM-recalled data ($n = 169$), direct recruitment decreased relative to indirect recruitment, from programme initiation in 2005 until 2018 (Fig. 1).

Motivation for using an LGD

The importance of having an LGD was predominantly related to prevention of livestock-carnivore interactions (Table 1). A further ten participants also made reference to livestock theft by humans. These types of motivation accounted for 102 of the 162 recorded motivation statements.

Twenty-one participants stated they disliked using lethal methods and expressed a desire to 'farm with nature'.

Table 1. Reasons cited as motivation to join a Livestock Guarding Dog programme by South African farmers (n = 104) and relating to respondent satisfaction of reduction in losses (n = 100).

Theme (n)	Sub-theme (n)	Supporting data (example quotes, respondent number in parentheses)
Motivation for joining the LGD programme		
Livestock protection (56)	Livestock and predator (specified or not) (56)	“to protect my cattle. As a farmer, cattle are important to my livelihood” (T042)
Predator prevention (46)	Keep predators away (17) Prevent predation (specified) (13) Theft prevention (humans) (10) Prevent predation (unspecified) (6)	
Environmental (21)	Dislike lethal methods (12) Farming with nature (9)	“I don’t want to use poison to kill the predators; it’s bad for the natural system” (NW028) “you can kill the predators or live with them. I would rather live with them” (T081)
Financial (16)	Business and economic reasons (16)	“I had nothing to lose” (T104)
Additional Comments (23)	Prevent worry and/or for peace of mind (8) Affinity for dogs (7) Influenced by others (3) Predator control takes time (2) Other ¹ (3)	“it was out of desperation” (T070)
Respondent satisfaction		
Loss prevention (40)	No losses (21) Livestock losses (16) Losses to predators (2) Losses without the LGD (1)	“we have never lost one goat with the dog” (L002)
Predator deterrent (27)	Livestock (11) Predators (13) Livestock and predator (both specified) (3)	“most predators are shy, and the barking scares them” (L008)

Table 1. continued

Theme (n)	Sub-theme (n)	Supporting data (example quotes, respondent number in parentheses)
Dog behaviour (8)	Loyal to livestock (5) Still in training (2) Well-behaved (1)	
Loss reduction (8)	Some losses (7) Livestock and predator (both specified) (1)	
Not satisfied (22)	LGD behaviour issues (17) Dissatisfied (not specified) (2) Finances (not LGD-related) (2) Costly to keep the LGD (1)	<p>“during lambing the dog would help to move lambs around – was too protective. In my own experience (LGDs) sometimes don’t stay (with the flock that they are guarding)” (T069)</p> <p>“when they started going into the veldt they started chasing and biting.” (T039)</p> <p>“the dog did not help at all. It caused us lots of problems” (T087)</p> <p>“you have to train them, and it takes a lot of time” (T074)</p>
Additional Comments (22)	Satisfied (not specified) (19) Other ² (3)	<p>Willingness to use an LGD in the future related to –</p> <p>“if I had a better neighbour” (L017)</p> <p>“if I’ve got a predator problem” (L008)</p> <p>“if the dog was already trained” (T075)</p> <p>“I would get a different breed” “if they had a shorter coat” (T068)</p> <p>“No, I wouldn’t try them again, I have too few sheep” (T064)</p>

¹Respondents joined the LGD program for reasons of “curiosity”, they “thought it could help” and to reduce fencing the livestock.

²Respondents were satisfied because they saw the “dog as a worker”, because of the support from the NGO” and “for peace of mind”.

For some farmers, adopting an LGD was a last resort. These participants demonstrated concern or dependency through their responses.

Of the 98 participants, 28 had prior concerns with LGDs while 68 did not. Despite all participants subsequently deciding to obtain an LGD, 18 of 98 participants providing a response stated they initially had fears about LGD exhibiting poor behaviours. Thirty four reasons for these concerns were provided; of these, the most frequently cited (n = 13) concerns

were behaviour harming (biting) the livestock, roaming away from the herd, or being difficult to train behaviour. Other responses (n = 9) showed concern for wildlife (predominantly game) being affected by LGDs. In contrast, one participant indicated concern for the carnivores, e.g. “if the predators move away from my farm, I’m worried they will be killed by a neighbour” (T060). Additional responses included scepticism about whether the LGD programme would be successful (n = 6), and perceived negative attributes of Anatolians (n = 3) as being “too big” (T094) or “very



aggressive" (L014). Two responses detailed concern for how an LGD would interact with existing farm dogs, and one response revealed a fear that the LGD could "get killed by the neighbour" (T106).

Satisfaction with LGDs and the programme

Of the 105 participants asked about their satisfaction with the LGD and programme, 90 rated their satisfaction with changes in livestock losses as 'high', whilst two each rated it as 'medium' or 'low' (Table 1). The mean rating was 4.7 out of 5. A few ($n = 11$) felt unable to give a satisfaction rating, but provided qualitative feedback; some held mixed views ($n = 2$), e.g. "I had lots of problems: he killed a couple of sheep and impala. Sometimes it worked well – whilst there he was effective" (L081). Some participants with positive comments ($n = 4$), e.g. "she was definitely doing a good job" (T077), could not assign a numerical rating. Likewise, some with negative feedback ($n = 3$), e.g. "I was a bit disappointed with the dog, I still lost lambs to caracal" (T047), did not provide a numerical rating.

Participants who provided a numerical rating also often supplemented this with qualitative detail indicating that satisfaction was related to there being a cessation in livestock losses with an LGD and also the ability of the LGD to deter predators. Seventeen commented on negative behaviours of their LGDs. These negative comments appeared unrelated to the rating score provided for changes in livestock losses.

As an indicator of satisfaction, when asked if they had ever recommended an LGD to anyone else, 93 (of 99) said 'yes', and four participants expressed a willingness to recommend LGDs, although they had not done so yet. The remaining two participants would not recommend an LGD.

Ninety five (of 107) participants said 'yes' they would use an LGD in the future, although 15 of these indicated that it would depend on certain conditions, either related to their farm ($n = 12$) or factors relating to the dogs ($n = 3$) (Table 1). Despite saying that they would use an LGD again, six raised concerns; two were about having more than one LGD at the same time, two were concerned about hunting, one had experienced roaming behaviour, and one had experienced livestock damage.

Of the nine participants who stated they would not use an LGD in future, two alluded to the intense training required but only one indicated this was due to LGD behavioural problems. Four reported circumstances around farming and one participant explained that

they were "too sad to get another" (T061), since both LGDs were lost to predators early in the training period. One participant did not elaborate as to why they would not use an LGD in future, and a minority ($n = 3$) remained undecided.

Forty-nine (of 108) participants referred to negative LGD behaviours (without specific questioning) at least once during their interview; behaviours included harming livestock, chasing wildlife, and not staying with the herd. Of these participants, 32 had experienced such behaviours with their own LGD, while the remaining 17 had either heard of others experiencing these concerns or were worried that they may experience these issues in future. Two participants had nothing positive to say about the dogs. One had suffered depredation despite experiencing two LGD placements. The other stated that, "it caused us lots of problems. It killed lambs" (T087) and demonstrated animosity, through their answers, towards Anatolian dogs and their neighbouring farmer, who used LGDs.

Discussion

Stakeholder perceptions are potentially of even greater importance than empirical evidence as these perceptions influence engagement and support for an intervention (Volski et al. 2021). Therefore, although proving the effectiveness of LGDs may require more than subjective accounts from users (Eklund et al. 2017, van Eeden et al. 2018), the "believed effect", as evaluated here, is central to any method's adoption (Eklund et al. 2020, Natrass et al. 2020). Studies of 'social effectiveness' (combining measured effectiveness and social acceptability) have revealed that even when effectiveness is weak, the social acceptability and feasibility of a tool may be sufficient to motivate its use (Volski et al. 2021), aligning with the Theory of Planned Behaviour (Ajzen 1991).

Hereby, we have determined the importance of psychosocial constructs and factors beyond the benefits and costs of using LGDs, most notably social communication, trusted information sources, the nature of the relationship with LGD placement organisations, practical challenges to managing the dogs, and emotional factors associated with farming and dog ownership.

Inter- and intra-stakeholder knowledge transfer and trust

Project managers played a major role in adoption of LGDs because they were trusted by farmers as sources



of information. Inter-stakeholder trust is beneficial for efforts toward human-wildlife coexistence (Anthony et al. 2010) and considered essential for conservation initiative sustainability (Madden & McQuinn 2014) and participation (Bogezi et al. 2021).

Three quarters of farmers were recruited via indirect means, generally involving word of mouth; importantly, specific individuals were referred to on multiple occasions. Individuals with a high social status and the drive to implement conservation can act as “local champions” (Young et al. 2018, Niemiec et al. 2019); these “model landowners” are generally trusted amongst their peers because of their shared experience and values (Niemiec et al. 2019). In contrast, conflicts with neighbouring farmers were also reported in our study, emphasizing the significance of both negative and positive experiences or communications (Bhatia et al. 2020, Volski et al. 2021).

LGD programme recruitment and satisfaction

Given the importance of word of mouth in recruitment, high programme satisfaction likely explains the increasing proportion of indirect recruitment observed over time for this programme. The increasing role of indirect recruitment reduces NGO effort (temporal and financial) in marketing and advocacy (not measured), allowing for greater focus on delivery and refinement. Overall, this is likely to yield a more sustainable and optimised programme.

Satisfaction is likely related to the ability of a technique to meet user expectations (Pannell et al. 2006, Greiner et al. 2009, Bogezi et al. 2021). Here, farmer expectations appear to have been largely met and high satisfaction was reported. Similar findings have previously been reported for other LGD programmes (e.g. Marker et al. 2020, van der Weyde et al. 2020). However, our approach elucidated a complexity in determining overall satisfaction, whereby both costs and benefits may be equally weighted, or difficult to untangle for some participants. Additionally, despite being unable to assign a numeric value to their level of satisfaction, some participants clearly wished to express their personal views and have their voice heard. The extraction of qualitative data overcame the barrier posed by score-based measures.

Practical challenges to participation and retention

Dog behavioural problems were a recurring theme throughout our study. Although negative hearsay affected only a small proportion of farmers, this may bely its social significance in regards LGD use given

the importance of word of mouth in recruitment. The need for appropriate training, along with suitable care of the dogs, has been highlighted previously in relation to LGD effectiveness and behavioural management (Potgieter et al. 2013, Whitehouse-Tedd et al. 2020). Whilst considered a cost or concern by some farmers, this also reflects an acknowledgement of responsibility and the important role that farmers play in optimizing programme success. Behaviour emphasising the importance of farmer involvement in dog training would ensure stakeholders were aware of their respective responsibilities prior to joining the programme, and likely reduce the occurrence of problem behaviours in the dogs during the placement.

Tangible motivators

Despite concerns for wildlife occasionally being apparent, most farmers were motivated to obtain an LGD for livestock protection reasons. Nonetheless, participation represents a success for both conservation and farmer stakeholders, regardless of motivation. Conservation goals achieved as indirect or secondary outcomes to primarily economic or other goals are still achievements and such differences in stakeholder objectives are not necessarily mutually exclusive.

Limitations

Reliance on participant recall may have limited the accuracy of our findings, but the high degree of agreement between farmer recall and PM recall indicates this to be negligible. Additionally, despite changes made following the pilot study, some questions were not answered by all participants, in part because of poor understanding, thereby contributing to missing data.

Since all interviewed farmers were participants of the programme, it is possible that a noteworthy number of farmers were sufficiently deterred by negative hearsay that they consequently did not participate in the LGD programme, and were thereby unavoidably excluded from our study. This limitation is common across intervention studies (in this region and internationally), whereby sampling is inherently biased towards recruited farmers. However, a number of participants provided frank and detailed comments in our survey, reflecting negative perceptions of LGDs and animosity towards the programme overall, suggesting an absence of social desirability bias, at least in these cases. Additionally, participants for whom an LGD placement was not successful were included in our sample, confirming our sample representativeness.

Conclusions

Overall, findings from our study provide novel insight into the human dimension of LGD use by commercial livestock farmers in South Africa. Essentially, inter-stakeholder (e.g. word of mouth among farmers) and intra-stakeholder relationships (between conservation organisations and farmers) were critical conduits for information and establishing trust, as seen previously (Anthony 2010, Bogezi et al. 2021), and are in turn vital to farmer decision-making and retention. Whilst livestock protection was the overarching motivator for LGD use, appreciation for the conservation benefits was apparent for some farmers, which is encouraging. However, where non-conservation-related motivators predominate for key stakeholders, greater emphasis on these factors during programme recruitment, advocacy and/or evaluation may improve stakeholder engagement and retention. Acknowledging inter-stakeholder differences when setting goals and success metrics may mean the difference between achieving conservation outcomes as a by-product, or not at all.

The high level of farmer satisfaction with this programme, alongside a likely predominance of compliance with the agreement to cease using lethal predator control methods, suggests the programme is helping to facilitate farmer-carnivore coexistence. Improvements are, nonetheless, required to reduce instances of undesirable LGD behaviours, which will serve to increase farmer satisfaction, and to assess the on-going use of lethal control by a minority of farmers.

Given the critical importance that word-of-mouth was shown to have on stakeholder recruitment in

our study, negative perceptions warrant equal if not greater consideration than positive perceptions during any programme's evaluation. In this regard, qualitative data were vital complements to quantitative measures and should be incorporated in future evaluations of LGDs or other human-wildlife coexistence interventions.

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Author Contributions

Co-authors C.G. Stannard and D. Cilliers are employed as project managers for Cheetah Outreach Trust. These authors were involved in study design, assisted in facilitating farmer interview appointments, and contributed to the preparation of this manuscript. However, these authors were not involved in data collection, analyses or interpretation; these tasks were performed independently by the other authors. The study was designed by R. Wilkes, K. Whitehouse-Tedd and H. Prozesky, with contribution from D. Cilliers and C.G. Stannard. Data collection was performed by R. Wilkes, data analysis and interpretation were performed by R. Wilkes, with contribution from K. Whitehouse-Tedd, H. Prozesky and J. Stiller. The manuscript was drafted by R. Wilkes and finalised by K. Whitehouse-Tedd, H. Prozesky and J. Stiller. All authors approved the final manuscript for submission.



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Supplementary online material

Table S1. Interview question guide used to explore major themes in a study of Livestock Guarding Dog (LGD) participants, South Africa, during semi-structured interviews.

Fig. S1. Process of categorizing recruitment type for participants in a Livestock-Guarding Dog (LGD) programme operated by Cheetah Outreach Trust in South Africa. Direct recruits were further classified according to whether recruitment occurred through chance (termed “opportunistic”) or intentional contact (termed “targeted”). Indirect recruitment was classified according to how they heard about the programme, e.g. hearing from a neighbour or encountering an information source not created by the NGO (termed “lay”), or via another conservation organisation (another NGO or governmental department; termed “other organisation”). There were two exceptions in which farmers did not obtain their LGD from the NGO but were included in the NGO programme; these farmers purchased their LGD from another farmer (who was in the programme).

Fig. S2. Recruitment type for interviewed participants (n = 106) in a livestock guarding dog programme in South Africa. Classifications were based on farmer description of their recruitment being either direct (via a “targeted” approach by Cheetah Outreach Trust (the non-government organisation that placed the dogs) or through an “opportunistic” meeting with a representative of Cheetah Outreach Trust), or indirect (acting on information provided by a “lay” person or “other organisation” and subsequently approaching Cheetah Outreach Trust themselves). Data were generated via farmer recall, with the exception of one case in which the farmer could not recall their recruitment; in this case the method recalled by the project manager for Cheetah Outreach Trust was utilised.

(<https://www.ivb.cz/wp-content/uploads/JVB-vol.-72-2023-Wilkes-et-al.-Table-S1-Fig.-S1-S2.pdf>)