Preventive Veterinary Medicine 193 (2021) 105412

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Perceptions of pastoralist problems: A participatory study on animal management, disease spectrum and animal health priorities of small ruminant pastoralists in Georgia

Erika Chenais[a,*], Patrick Wennström[b], Natia Kartskhia[c], Klara Fischer[d], Guillermo Risatti[e], Tengiz Chaligava[c], Tea Enukidze[f], Karl Ståhl[a], Nino G. Vepkhvadze[f]

[a] National Veterinary Institute, Uppsala, Sweden
[b] Uppsala University, Uppsala, Sweden
[c] National Food Agency, Tbilisi, Georgia
[d] Swedish University of Agricultural Sciences, Uppsala, Sweden
[e] University of Connecticut, Storrs, USA
[f] State Laboratory of Agriculture, Tbilisi, Georgia

ARTICLE INFO

Keywords:
participatory epidemiology
focus group discussions
thematic analysis
transhumance
livelihoods
sheep

ABSTRACT

Small ruminants support the livelihoods of millions of poor pastoralist and sedentary households around the world. While pastoralists are generally not amongst the poorest in terms of assets, they are frequently marginalised in terms of their access to political power, health and education. This study was undertaken among pastoralist households keeping small ruminants in four regions of the country of Georgia. Small ruminants are an important cultural, social and economic asset in Georgia and are mainly managed in a transhumant pastoralist system. Georgia suffered its first, and so far only outbreak of peste des petits ruminants (PPR) in 2016. This qualitative interview study was designed to acquire contextual understanding of local small ruminant husbandry and the livelihood situations of the participating pastoralists, and to detect historical, unreported PPR outbreaks. Focus group discussions comprising participatory epidemiology tools and other forms of interviews were used to explore small ruminant management, disease spectrum and management, and animal health priorities.

The participants had experienced a wide variety of animal health constraints, with intestinal worms, braxy, piroplasmosis, pasture-related problems, predators and lameness emerging as priorities. No historic, unreported PPR outbreak was detected in this study, and PPR was not a priority for participants. Instead, the day-to-day reality of animal health for the pastoralists was characterised by co-infections of mainly endemic pathogens, and problems related to other challenges such as access to land, feed and genetic resources. The rationale behind the participants' prioritisation of animal health problems was supported by the need to pay extra attention to animals in order to avoid risk factors, keep animals healthy and minimise the negative impact of diseases or management problems; the various epidemiological and clinical parameters of the prioritised diseases; the economic impact of the specific problems and the zoonotic potential of diseases and predation. Even within regions, and within seemingly socially and culturally homogenous groups, there were important local differences in the problems faced by pastoralists that affect their livestock management. This study underlines the importance of a contextualised understanding of the local disease panorama and complexities in the livelihood situations of rural people when designing actions to improve animal health in general or, more specifically, passive surveillance as well as prevention or control measures. Finally, it is concluded that to achieve such an understanding, there is a need for participatory, scoping-style studies that specifically acknowledge diversity and power relations.

* Corresponding author.
E-mail addresses: erika.chenais@sva.se (E. Chenais), patrick.wennstrom@pcr.uu.se (P. Wennström), natia.kartskhia@nfa.gov.ge (N. Kartskhia), klara.fischer@slu.se (K. Fischer), guillermo.risatti@uconn.edu (G. Risatti), tengiz.chaligava@nfa.gov.ge (T. Chaligava), tea.enukidze@lma.gov.ge (T. Enukidze), karl.stahl@sva.se (K. Ståhl), nino.vepkhvadze@lma.gov.ge (N.G. Vepkhvadze).

https://doi.org/10.1016/j.prevetmed.2021.105412
Received 12 January 2021; Received in revised form 8 June 2021; Accepted 9 June 2021
Available online 11 June 2021

1. Introduction

Among the many rural poor practising animal husbandry the livelihood situations of pastoralists are unique in many ways (Schelling et al., 2005). Pastoralists use vast grazing lands and residuals of crops that would otherwise not be used productively (Thornton, 2002), and are particularly vulnerable to weather challenges as the land is non-irrigated and often located at high altitudes (Kerven et al., 2012). While pastoralists may own a relatively large number of animals, they are nevertheless often marginalised in terms of their access to political power, health and education (Schelling et al., 2016). The animal species kept by pastoralists varies depending on the local climate, environment, culture, traditions and household poverty level (Steinfeld et al., 2006). Small ruminants are better adapted to harsh environments and more effective feed converters than cows, for example, and constitute the main asset and source of income for millions of poor pastoralist and sedentary households around the world (OIE and FAO, 2015). Sustained animal health is crucial to the livelihoods of families relying on animal husbandry (Perry and Grace, 2009), with acute animal disease outbreaks acting as livelihood shocks (Wagstaff and Lindelow, 2010) and chronic or subclinical disease steadily reducing animal productivity (Randolph et al., 2007, Grace et al., 2017).

The Caucasus is an area between the Black Sea and the Caspian Sea, mainly occupied by Armenia, Azerbaijan, Georgia and Russia. Georgia is a middle-income country[1] and is home to almost one million sheep and around fifty thousand goats[2] . The majority of these small ruminants are kept in smallholder, pastoralist or semi-pastoralist management systems, with a dominance of transhumant pastoralist systems featuring seasonal migration (of either entire households, parts thereof, or only the animals) to summer pastures at high altitudes and both people and animals spending the winters at the owners' permanent residence in lower valleys (Didebulidze and Plachter, 2012, Liechti and Biber, 2016). In this study, all people engaged in transhumance are referred to as pastoralists.

In January 2016, the first, and so far only outbreak of peste des petits ruminants (PPR) in Georgia was reported (Rajko-Nenow et al., 2017, Donduashvili et al., 2018). This contagious viral disease is typically manifested with high case fatality rates in naïve populations and can have major implications for national and household economies (OIE and FAO, 2015). PPR is included in the Food/Feed Safety, Veterinary and Plant Protection Code of Georgia (Parliament of Georgia, 2012) and outbreaks involve immediate restrictions including a ban on trade and animal movements. The outbreak in 2016 affected three animal holdings outside the Georgian capital, Tbilisi (Donduashvili et al., 2018). It was never concluded how the infection had reached Georgia and the affected farms. The identified virus was similar to PPR viruses from northern and eastern Africa (Donduashvili et al., 2018). PPR is endemic in Turkey (Özkul et al., 2002), but it has never been reported in the other countries neighbouring Georgia (Armenia, Azerbaijan, Russia) (EFSA Panel on Animal Health and Welfare, 2015). In Georgia, small ruminant trade with neighbouring countries and with the countries of the Arabian Peninsula is a frequent and important economic activity. Official reports from 2016-2019 of other listed diseases that can affect small ruminants includes anthrax, brucellosis, haemorrhagic septicaemia and rabies[3], occurrence patterns of endemic diseases are largely unknown.

Experience from global outbreaks of infectious diseases other than PPR, such as for example Ebola and African swine fever (Roca et al., 2015, Chenais et al., 2019a, Abramowitz et al., 2015, Lysholm et al., 2020b), show that in order to reduce disease occurrence, local disease drivers need to be identified and understood, local livelihood contexts and disease spectrums taken into account, and situated knowledges of stakeholders comprehended (Chenais and Fischer, 2018, Tasker, 2020). This kind of understanding requires multidisciplinary research, combining veterinary epidemiology and social science, using for example participatory epidemiology (PE) techniques adapted to local contexts and study purposes (Fischer and Chenais, 2019, Fischer et al., 2016, Chenais and Fischer, 2018, Barnett et al., 2020, Mariner and Paskin, 2000, Allepuz et al., 2017).

This qualitative interview study, carried out in four regions of Georgia, was an integrated part of a regional project on PPR in Georgia and Armenia. The study was designed to achieve contextual understanding of local small ruminant husbandry and the livelihood situations of animal owners, and to detect historical, unreported PPR outbreaks. To achieve these objectives the study used focus group discussions (FGD) comprising PE-tools and other forms of interviews. While keeping an initial focus on PPR, the study allowed an open and inclusive exploration of small ruminant management, disease spectrum, disease management and animal health priorities of pastoralists in the study area.

2. Materials and Methods

2.1. Study area and study design

The study was carried out in four regions (Kakheti, Kvemo Kartli, Samtskhe-Javakheti, Tbilisi) in Georgia in June 2019 (Fig. 1 and Table 1). Small ruminant populations in Georgia are concentrated in the mountainous regions of Kakheti, Kvemo Kartli and Samtskhe-Javakheti in the east and south, where agricultural land is mostly non-irrigated grassland up to an altitude of 4000 metres. The animals are mostly crosses and pure-breeds of the indigenous Imeretian and Tushetian sheep and Megrelian goats respectively (Kunelauri et al., 2019, Gonashvili et al., 2013). **Kakheti** comprises all parts of Georgia east of the capital Tbilisi. The Greater Caucasus mountains and a parallel mountain ridge run through the middle of Kakheti, forming the Alazani Valley, which is home to most of Kakheti's population and is Georgia's primary wine-growing region. The western and southern parts of Kakheti comprise large areas of pasture and semi-arid grasslands. **Kvemo Kartli**, located in southern Georgia, includes areas with grasslands, highlands and the Lesser Caucasus mountains. The mountains of Kvemo Kartli are ridges characterised by steep ravines and canyons. Most small ruminants in Kvemo Kartli are kept by the minority Azeri population. **Samtskhe-Javakheti** is dominated by a mountainous topography, harsh climate and geographical isolation from the rest of Georgia. The northern portion of the region is formed by densely forested mountain ranges with steep, rocky slopes. The region also has large barren plateaus formed by vulcanism, valleys, lakes and rivers. The **Tbilisi** region is located in the South Caucasus around the eponymous capital city.

These four regions were selected based on the location of the PPR outbreak in 2016 (Tblisi region) (Rajko-Nenow et al., 2017, Donduashvili et al., 2018) and the perceived risks of unreported PPR occurrence, based on the density of small ruminants[2], location of the reported outbreak, migration routes and national borders with areas with a known presence of PPR. In each study region one, two or three districts, and in each district one or two villages, were selected. The selection of districts and villages within the study regions was undertaken purposively, striving to include study locations with a high density of small ruminants, as well as differences in geography and small ruminant husbandry traditions, in order to include participants with diverse experiences. In each selected village, one or two FGDs were held. FGD participants were selected on the basis of purposive sampling strategies (McCracken et al., 1988) and recruited by the state veterinarian for the respective district. The requirements for participation were that participants lived in the selected villages, were over 18 years old, and owned or tended small ruminants. The researchers also instructed the recruiters to arrange groups of between three and eight

[1] https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/DAC_List_ODA_Recipients2018to2020_flows_En.pdf

[2] https://www.geostat.ge/en

[3] https://wahis.oie.int/

Fig. 1. Map of Georgia, with the locations of focus group discussions held in a study of small ruminant pastoralists' perceptions of problems in Georgia in 2019 depicted in yellow.

Table 1
Selected regions, districts and villages and some regional characteristics from a study of small ruminant pastoralists' perceptions of problems in four regions of Georgia in 2019.

Region (number of FGDs)	District	Villages (number of FGDs)	Total population of small ruminants[1] (number)	Average herd size[1] (number)	Small ruminant density[1] (number/km2)	Altitude in villages (meters)	Other
Kakheti (8)	Sagarejo	Keshalo (2) Tibaani (1)	12,9954	520	86	480	Mountain ridges, valleys with pasture and grasslands, wine-growing region.
	Sighnaghi	Akhalsopeli (1) Zemo Machkhaani (2)	56,150	435	44	290-840	
	Dedoplistskaro	Nukriani (2)	89,550	367	36	810	
Kvemo Kartli (6)	Gardabani	Kumisi (2) Djandara (2)	57,600	384	54	290-510	Mountains, highlands and grasslands. Small ruminants mainly kept by the Azeri minority population.
	Marneuli	Algeti (2)	41,000	299	43	350[2]	
Samtshke-Javakheti (7)	Borjomi	Dgvari (1) Tadzrisi (1) Tsikhisjvari (2)	15,900	58	13	1320-1640	Forested mountains, volcanic plateaus, harsh climate, geographical isolation.
	Akhaltsike	Sakuneti (2) Zikilia (1)	1,040	27	1	960-1010	
Tblisi (6)	n/a	Gldanula (1) Varketili (2) Shindisi (2) Tabakhmela(1)	7,790	144	15	630-950	Peri-urban region, PPR outbreak 2016.

[1] Source: National Food Agency, Georgia.
[2] Additional interviews were performed at summer pastures on >2100 m altitude.

participants, and in every village to have one group of only men and one of only women. After the pilot, 27 FGDs were held with a total of 149 participants, of whom 47 were women and 102 men. Despite the recruitment instructions, there was just one group comprising only women, nine of only men and the remaining 17 groups were mixed. Cultural traditions limiting women's external contacts in some of the communities, especially prevalent in the minority Azeri population, might have contributed to the gender-skewed recruitment. The representation of women in the FGDs increased during the course of the field study because the researchers repeatedly reminded the recruiters of the recruitment instructions. Nevertheless, fewer women than men were included. To achieve a broader inclusion of population strata that were deemed important for the objectives of the study but nevertheless had been underrepresented in the FGDs, additional interviews were carried out. These interviews included people with fewer animals, women and shepherds, as well as traders. These participants were not recruited in advance, but purposively sought out by the research team at different locations. Fourteen such interviews were carried out, some with individual participants and some with two, three or at most six participants. Nine women, three men with a relatively small number of animals, eight male shepherds and two male traders were included in these additional interviews.

Triangulation was performed both between respondents (sources) and through the use of different methods. When triangulation indicated discrepancy between respondents' descriptions, this was taken as a point of departure for further investigation e.g. if different groups of respondents had different experiences and what the basis of this was, rather than with the purpose of finding one single truth. We also cross-checked data with key informants such as field research team members, state veterinarians, co-authors and colleagues.

To contextualise the problems emerging as prioritised for the participants a brief summary description was formulised for each problem based on a combination of interview data and search of secondary literature and included in the results.

2.2. Data collection

Data collection was guided by a pre-defined topic guide (Supplementary material 1). The topic guide included PE-tools, such as listing, seasonal calendar (in the form of a time line) and proportional piling using the time line (Mariner and Paskin, 2000). Before carrying out the study, the field research team – consisting of the first and second author, the facilitator, the interpreter and two note-takers – jointly translated the interview topic guide from English into Georgian. A pilot FGD was subsequently conducted to test the translation, set-up, PE tools and local relevance of the topics.

Most FGD participants spoke Georgian and some spoke Russian. The FGD participants who spoke Russian had Azeri as their first language, but were sufficiently fluent in Russian to fully participate in the discussions. Most FGDs were held in Georgian, some in Russian, and some in both languages. Some participants in the additional interviews only spoke Azeri. In these cases, an intermediate translation was achieved by a bilingual or trilingual FGD participant or key informant. The facilitator and note-takers were fluent in Georgian and Russian, while the interpreter was proficient in English and Georgian and could fully comprehend and translate Russian. In the FGDs, there were simultaneous translations into English, and in the additional interviews the translations were carried out sentence by sentence. The translations were recorded on audiotape for back-up, but not transcribed verbatim. Notes were taken by the note-taker and by the first and/or second authors. The notes and audio recordings were compared and discussed with the field research team and key informants during the fieldwork.

At the start of each interview and FGD, the research team provided information about the study and its objectives, in particular pointing out that it was a research project, rather than a needs assessment or similar that might have immediate benefits for the community. All the respondents were asked for their oral or written consent (including for audio recordings and photographs) and informed that they could refuse to answer questions and withdraw from the interview at any time. The facilitator ensured that the discussion was not dominated by one or more individuals. Adhering to the main principals of PE, the facilitator followed the topic guide while at the same time letting participants direct the discussion towards areas of importance for them (Allepuz et al., 2017, Ebata et al., 2020) and retaining an initial focus on PPR. The first and/or second author were present at all FGDs, giving them an opportunity to intervene, ask follow-up questions or provide feedback if deemed necessary. All additional interviews were facilitated by the first or second author and were largely guided by the same topics as the FGDs, although in each situation they were adapted to specifically capture the views and personal circumstances that had not been covered in the FGDs. The PE tools were not used in the additional interviews due to their complementary function, ad-hoc nature and time constraints.

During all interviews and FGDs, the facilitators ensured that the terminology preferred by participants was used, e.g. for diseases or disease syndromes. In some cases the participants used local names, sometimes English or Latin, and sometimes descriptive explanations including clinical signs. A translation of the terms used were triangulated with state district veterinarians, field team members and the third author, while avoiding forcing local terminology into formal disease classifications.

The quotations given in this paper should not be considered exact translations, but rather as illustrations intended to give life to the findings. The FGDs are identified below as Kakheti FGD1-8, Kvemo Kartli FGD1-6, Samtshke-Javakheti FGD1-7 and Tblisi FGD1-6.

2.2.1. Exploration of topics

Data on **small ruminant management** were collected as timelines constructed in each FGD. The facilitator prepared an empty timeline with the months of the year depicted horizontally on a large sheet of paper before each discussion, and the participants were asked to allocate all events concerning small ruminant management that had taken place during a year to a specific time period (month) on the timeline. One group member noted down the events on the paper with a marker. Photographs were taken of each timeline, and the timelines were recreated in English by the note-takers (Figs. 2 and 3).

Data on **disease prevention and management** were collected by listing all the measures mentioned and taking notes on related discussions.

The topics of local **disease spectrum** and **priority problems** were explored using a stepwise approach. In a first step, the participants were asked to mention all the diseases or health problems they had experienced in their small ruminant herds in the past three years. The time limit of three years was established with the purpose of including the PPR outbreak in Tbilisi in 2016, while minimising recall bias that can confound historical data if longer time periods are considered. No external calendar event was used to help participants relate to the three-year time limit. In order to remain open to the participants' main concerns, all the problems mentioned (i.e. not only diseases or disease syndromes) were included and listed. Next, participants were asked to prioritise among the mentioned problems, singling out five problems that were of greater importance to them. These priority problems were subsequently discussed in more detail, focusing on the **underlying reasons for each of them being conceived as a priority**. Any mention of PPR, diseases with a common differential diagnosis to PPR, clinical signs that can be seen in PPR such as stomatitis, rhinitis and diarrhoea or otherwise fit the pneumoenteritis syndrome case definition (Balamurugan et al., 2014), were investigated further, focusing on a more detailed exploration of the clinical signs and epidemiological parameters (morbidity, mortality and contagiousness) to confirm or exclude the occurrence of PPR. If PPR was confirmed, the local epidemiology was investigated further using the time line and proportional piling (data not included in this paper).

Similar to the local disease spectrum, the topic on **disease outbreaks** was explored in a stepwise approach, starting with an open question regarding any events that the participants could remember of numerous small ruminants being sick at the same time in the last three years. If participants could remember any such events, these were discussed to identify the disease. Subsequently, to describe the distribution of the outbreaks over time and relate them to the timeline events, participants were asked to distribute 100 beans, representing all disease cases in the outbreak, along the timeline of small ruminant management that the group had drawn. Mentions of PPR or its usual differential diagnoses were excluded or confirmed in the same way as that described for the exploration of the local disease spectrum.

If no outbreak-type diseases were identified, participants were asked to distribute the beans along the timeline to describe total herd morbidity over an average year, again considering the last three years. In those cases, the participants were asked to indicate which disease or syndrome was represented by each pile of beans after having finished the exercise (Fig. 4). The timeline thus provided an additional data source and triangulation concerning the topic local disease spectrum.

Finally, the participants were shown pictures showing clinical signs of PPR (see Supplementary material 2 (FAO, 1999)) and were asked whether they recognised the signs and if they had experienced or heard of outbreaks with such signs.

2.3. Data analysis

Notes from the note-taker and the first and/or second authors were compiled into one master set of notes per interview or FGD. Master notes of the FGDs were imported into NVivo (NVivo qualitative data analysis software; QSR International Pty Ltd. Version 12, 2018) and coded. The initial coding was guided by the FGD topics and followed a thematic, bottom-up analysis inspired by grounded theory where participants and the local context guide the focus of the research and the empirical material forms an inductive analysis (Bowen, 2006). Applying axial coding to the topic "priority problems" issues were allowed to emerge

Fig. 2. Creation of a timeline of small ruminant management events in a focus group from a study of small ruminant pastoralists' perceptions of problems in Georgia in 2019.

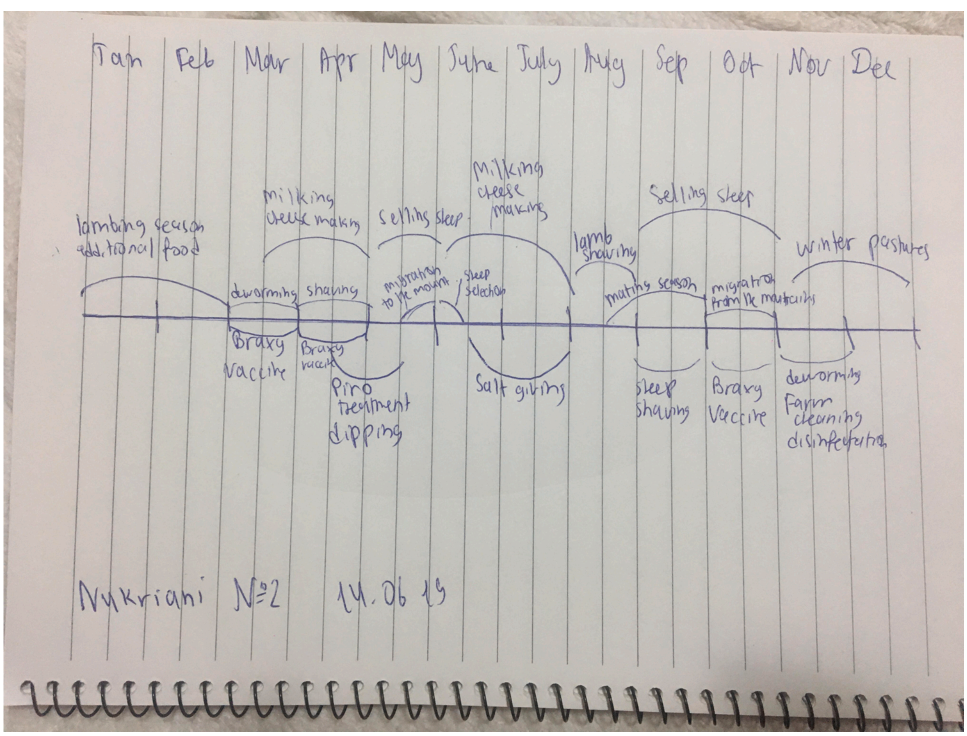

Fig. 3. Example of a timeline of small ruminant management from a study of small ruminant pastoralist perceptions of problems in Georgia in 2019.

inductively through repeated reading of the data, while forming theories and hypotheses that were subsequently tested against the data and refined in repeated rounds of analysis. Emerging issues regarding the rationale for problems being a priority were collected in related themes (Table 2a and 2b) (Moghaddam, 2006, Goulding, 1999).

Quantitative data (gender separated number of participants, mentions of problems, mentions of priority problems, number of beans from proportional piling) were transferred from the master notes to Microsoft Excel (2014) and summarised. Graphic data (timelines) were analysed visually, discussed with the field research team, and summarised.

Data from the additional interviews and informal talks with key

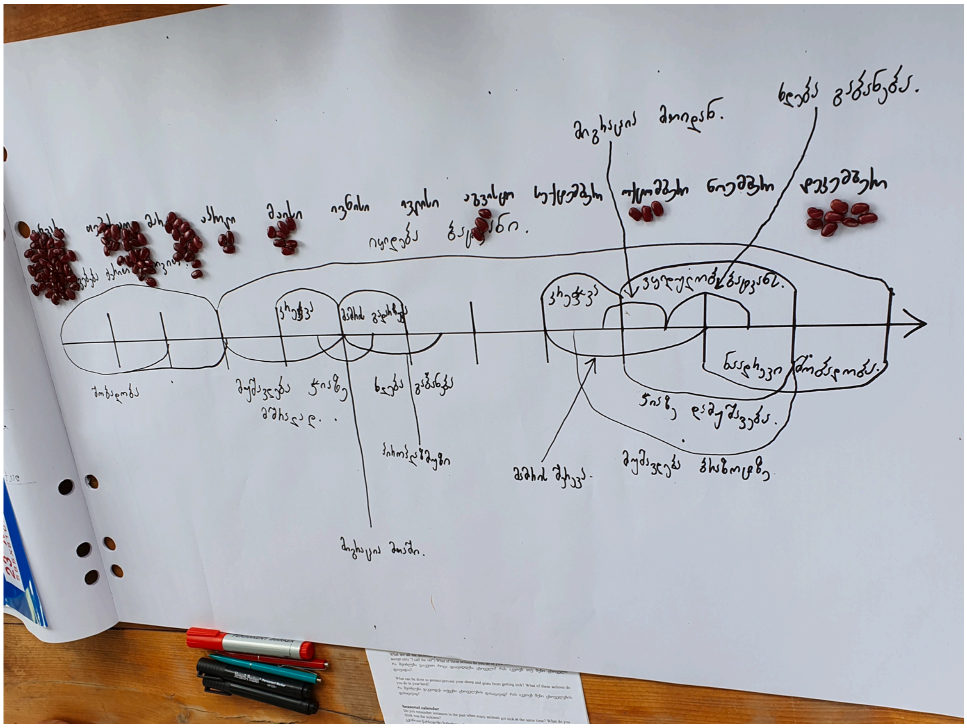

Fig. 4. Example of exploration of seasonal occurrence of problems related to small ruminant health using proportional piling with beans on a timeline from a study of small ruminant pastoralists' perceptions of problems in Georgia in 2019.

Table 2a
Emerging issues concerning rationale for prioritisation of problems related to small ruminant health and management from focus group discussions in a study of small ruminant pastoralists' perceptions of problems in four regions of Georgia in 2019.

Priority problems	Worms	Braxy	Piroplasmosis	Pasture-related problems	Predators	Lameness
Emerging issues	attention, cannot eat meat, contagious, deaths, disease properties, economic impact, frequent, peracute	attention, cannot eat meat, contagious, deaths, disease properties, economic impact, frequent, peracute, pasture-related	attention, cannot eat meat, contagious, deaths, disease properties, economic impact, frequent, peracute	attention, economic impact, good grass, growth, restricted access	attention, cannot eat meat, deaths, frequent	attention, cannot walk, contagious, deaths, disease properties economic impact, frequent, growth, caused by mud and rain

Table 2b
Emerging themes concerning rationales for priority problems related to small ruminant health and management from focus group discussions in a study of small ruminant pastoralists' perceptions of problems in four regions of Georgia in 2019.

Emerging issues	Themes
attention	attention
contagious, cannot walk, caused by mud and rain, deaths, disease properties, frequent, growth, peracute, pasture-related	disease parameters
cannot eat meat, deaths, economic impact, good grass, growth, restricted access	economic impact
cannot eat meat	zoonotic potential

informants were used to contrast, compare and triangulate the results.

3. Results

All FGD participants owned small ruminants, either personally or with their families. Herds frequently consisted of both sheep and goats, but with a dominance of sheep (often ten times as many sheep as goats). The number of sheep owned by FGD participants ranged approximately from three to 1200, and goats from zero to 80.

3.1. Small ruminant management

The species dominating and guiding the husbandry system was sheep, with goats being fewer and seemingly receiving less attention. Unless stated otherwise, all management issues and disease spectrums described below therefore concern sheep. Small ruminants were kept in a semi-pastoralist system, with the norm being yearly transhumance to mountain areas in spring (May) and returning to the home villages in autumn (October). Migration was reported to take between two hours and two weeks for the different regions and locations. All FGDs revealed that daily animal care during migration and on site on the summer pastures in the mountains was provided by salaried shepherds. Some families (mostly those with fewer animals) described taking care of the animals themselves during the winter and only using shepherds (shared by several flocks) during the migration and on summer pastures, whereas others relied on shepherds all year around. Some families with very few animals kept them at home all year around, letting them out to graze under the supervision of family members during the day. In some cases, the families who owned the animals followed them to the mountain pastures and stayed there during the grazing period. In Kakheti, Kvemo Kartli and Tbilisi, some of the participants said that they milked their animals and/or made cheese, but none of the participants from Samtshke-Javakheti did this. Participants from Samtshke-Javakheti also had relatively few animals, with several participants not engaging in transhumance. Cheese-making was mostly the women's responsibility, whereas other aspects of animal care, including milking, were performed by men. All the shepherds included in the study were male. The owners were actively involved in sheep management and care even if they had hired shepherds. With a few exceptions, women and girls were less involved than men and boys: *"The whole family is involved in this business. We and our children are actively involved in sheep farming. Husbands go on migration, and when they come back from the mountains we take care of the sheep* [...] *Our sons go there and have contact with the shepherds. It's mostly men's work"* (Kakheti FGD5). The husbandry system further included a number of fixed events and routines that were performed at approximately the same time every year, dependent on sheep biology (lambing), the local environment (availability of grass and related migration) and the disease ecology (preventive and curative treatments applied accordingly). Fig. 3 provides an example of a timeline. The timing of these events was generally similar for FGDs in the same region, but differed somewhat between the four regions. A summary timeline for all regions is given in Fig. 5.

3.2. Disease prevention and management

Participants mentioned undertaking several measures to keep their flocks in good health. Two aspects frequently mentioned were the importance of good feed and pastures and being attentive to the needs of the sheep. These two aspects also related to the themes emerging from the analysis of the problem prioritisation rationale (see below). The importance of performing preventive treatments, such as vaccination, deworming and dipping on time, was also frequently mentioned. Other aspects raised were protecting the sheep from cold in the winter and heat in the summer, as well as keeping the farm clean and performing disinfection before the animals returned from the mountain pastures. Having good shepherds, sheering the sheep on time and contacting a veterinarian as required were also mentioned as preventive measures.

Diseases were managed in fundamentally different ways by the various participants. Some reported calling a veterinarian only for contagious or "serious" diseases, others mentioned that accessing veterinarians was easy and consultations frequent, while many said they mostly or only used traditional methods and self-administered treatments. The most commonly reported traditional method was to let out blood by puncturing the skin near the eyes, ears or nose of the sheep. Other traditional remedies included the use of fat on wounds and tea or sugar for eye infections. The practice of bloodletting was frequently reported, but seemingly without practitioners being sure about the underlying reasons, traditional beliefs or benefits. The way the practice was described in this study (cutting the skin (i.e. not a vein) to let out some blood) also seemed somewhat different from the bloodletting that is extensively described as a traditional treatment for various diseases for both animals and humans in many cultures (Risse, 1979). This led to the hypothesis that a generational shift might be taking place in the use of traditional methods, with the knowledge accompanying them becoming lost. Taking good care of the animals and being attentive in management and husbandry practices was also mentioned as a treatment method, as was the slaughter of sick sheep for home consumption.

3.3. Local disease spectrum and problem prioritisation

In both FGDs and the additional interviews, the first reaction to the topic of diseases that the participants had experienced in the last three years was often that there had been no diseases in that period and that the flock had had no health problems: *"We don't really have any diseases or problems here, it's a very good environment"* (Samtskhe-Javakheti FGD5). The importance of taking good care of sheep to keep them healthy was also frequently underlined: *"If you take good care, it is impossible to get sick sheep"* (Kvemo Kartli FGD2). After allowing some time for discussions, despite these initial declarations of good health, the FGD participants mentioned a rather large number of diseases, syndromes or other problems related to small ruminant management. In total, 64 different problems were mentioned, ranging from six to 18 problems per FGD (Table 3). Of these, 35 were mentioned as a priority problem in at least one FGD (Table 4). The animal health problems experienced in the last three years most frequently mentioned were piroplasmosis (mentioned in all groups), followed by intestinal worms (mentioned in 25 FGDs), braxy (19), predators (19), lameness (17) and pasture-related problems (14) (Table 3). Those most frequently prioritised were intestinal worms (18 FGDs), braxy (14), piroplasmosis (13), pasture-related problems (10), predators (9), lameness and psoroptic mange (both 7) (Table 4). When summarising the total number of beans attributed by all FGDs to each disease during the exploration of the seasonality of disease outbreaks and general distribution of morbidity using proportional piling with the timeline tool, intestinal worms (507), piroplasmosis (434), predators (260), braxy (238) and lameness (113) received the highest scores (Table 5). Similar to the husbandry system

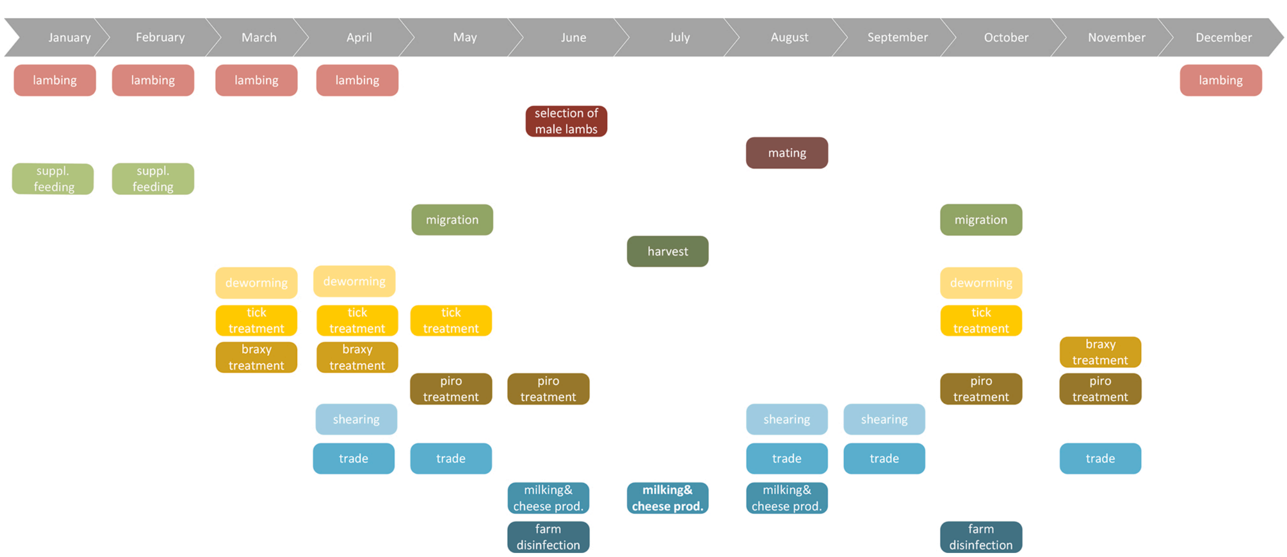

Fig. 5. A generalised yearly timeline representing small ruminant husbandry and management activities created from focus group discussion in a study of small ruminant pastoralists' perceptions of problems in four regions of Georgia in 2019. Each group of activities are represented by a colour, and each activity by a shade. Reproduction = pink, preventive treatments = yellow, feed = green and general husbandry = blue.

Table 3
Problems (64 different) related to health and management of small ruminants mentioned in focus group discussions (n = 27) in a study of small ruminant pastoralists' perceptions of problems in four regions of Georgia in 2019.

Item	Number of FGDs that mentioned
Animal health	
piroplasmosis	27
intestinal worms	25
braxy	19
lameness	17
liver flukes	16
psoroptic mage	13
external parasites including ticks, grass poisoning *(Chlostridium* perfringen*s),* obstetric complications	12
ticks	10
acting crazy, trauma	9
upper respiratory infection, foot root	8
abortions	7
diarrhoea, poisoning	5
heat stroke	4
reproductive failure, lice, pasteurellosis, head worms	3
mastitis, fever, antiacaricide and antiparasitic treatments[1], conjunctivitis, mastitis	2
black leg, bloat, brucellosis, cataract, dry udder, need for hoof trimming[1], leptospirosis, liver problems, lung affection and fever in rambs, malformed lambs, overeating of barley, sheep eats a spider in the grass and gets swollen in the face, snake bite, stomatitis, traumatic udder injuries, wool bezoar	1
Other problems	
predators	19
pasture- related problems	14
financial constraints, problems related to shepherds	10
problems related to migration roads	9
lack of water	8
feed provision	7
hot weather and droughts, low wool prices	6
harsh winter climate	4
access and costs of medicines	3
electric power delivery, logistic difficulties with milking, national borders in grazing lands, natural disasters, not being attentive enough, price of sheep dogs, radiation from power lines, sheep theft, wild dogs	1

[1] These are curative or preventive treatments but were mentioned as problems by participants and are therefore included here.

Table 4
Problems related to the health and management of small ruminants that were put forward as priorities during focus group discussions in a study of small ruminant pastoralists' perceptions of problems in four regions of Georgia in 2019.

	Number of FGDs that mentioned the problems as being a priority for them				
Location/item	Kakheti (n = 8)	Kvemo Kartli (n = 6)	Samtshke-Javakheti (n = 7)	Tblisi (n = 6)	Total (n = 27)
intestinal worms	4	5	4	5	18
braxy	5	5	-	4	14
piroplasmosis	2	5	-	6	13
pasture-related problems[1]	6	3	1	-	10
predators[1]	3	1	5	-	9
lameness	-	2	2	3	7
psoroptic mage	1	2	1	3	7
liver flukes	-	2	3	-	5
problems related to migration roads[1]	5	-	-	-	5
upper respiratory infection	-	-	2	3	5
lack of water[1]	2	-	2	-	4
ticks	-	-	3	1	4
diarrhoea	-	1	2	-	3
heat stroke	-	-	3	-	3
low wool prices[1]	3	-	-	-	3
problems related to shepherds[1]	1	1	1	-	3
acting crazy	-	1	-	1	2
head worm	1	-	1	-	2
abortions	1	-	-	-	1
brucellosis	-	-	-	1	1
dry udder	-	1	-	-	1
electric power delivery[1]	1	-	-	-	1
feed provision[1]	-	-	1	-	1
financial constraints[1]	1	-	-	-	1
grass poisoning *(Chlostridium perfringens)*	-	-	-	1	1
harsh winter climate[1]	1	-	-	-	1
hot weather and droughts[1]	-	-	1	-	1
leptospirosis	1	-	-	-	1
lice	-	1	-	-	1
mastitis	-	1	-	-	1
overeating of barley	-	-	1	-	1
pasteurellosis	1	-	-	-	1
poisoning	1	-	-	-	1
stomatitis	-	-	-	1	1
obstetric complications	-	-	-	1	1

[1] Non-disease priority problem.

and management routines, the general distribution of morbidity during a year seemed to be connected to the biology of the sheep (lambing/obstetric complications), the local environment (availability of grass/migration and related problems, such as lameness or ingestion of frozen grass leading to braxy) and disease ecology (parasite infections and tick-borne disease occurring if preventive treatments were not performed on time) (Fig. 6).

In the interviews with shepherds, the hesitation at volunteering any animal health problems was even more noticeable. The researchers frequently had to use diverting interview techniques (Britten, 1995) such as asking about which medicines the shepherds carried and what diseases they were used for to learn about the disease spectrum in the herd. The same situation occurred for the interviews held in Azeri using a secondary interpreter, but on these occasions the interview situation did not allow techniques to be used that might fill the void in communication.

Participants sometimes mentioned diseases using English or Latin terminology (e.g. piroplasmosis, pasteurellosis, brucellosis), sometimes using a specific term in their local languages (e.g. "kotori" translated as "wool falling off" and triangulated to represent psoroptic mange) and occasionally a description of the syndrome (e.g. "sheep eats a spider in the grass and gets swollen in the face" and "acting crazy"). In Tables 2 –5 and in Fig. 6, English/Latin names are given for diseases if the translation could be confirmed, otherwise the descriptive form is used. Some of the terms used are clearly not exclusive. For example, some FGDs mentioned intestinal worms, head worms and liver flukes separately, whereas others probably included head worms and/or liver flukes in the broader sense of "worms" and "parasites". Similarly, "dry udder", "mastitis" and "traumatic injuries to the udder" were listed as separate problems, although the first could very well be a consequence of either of the latter two.

Methodologically, it should be noted that the same diseases and problems (with some minor variations in order of magnitude) emerged as important for the participants in open discussions about the occurrence of general animal health problems, their prioritisation and the quantitative and explorative description of yearly morbidity using the timeline tool. Despite the topic focusing on disease, twenty of the problems mentioned and eleven of the issues prioritised were not directly related to animal health. Problems related to pastures did not

Table 5
Total number of beans attributed to diseases while exploring seasonality of disease outbreaks and yearly, general, distribution of morbidity using proportional piling on a timeline in focus group discussions in a study of small ruminant pastoralists' perceptions of problems in four regions of Georgia in 2019.

Location/item	Total number of beans allocated[1]				
	Kakheti (n = 7[2])	Kvemo Kartli (n=5[2])	Samtshke-Javakheti (n = 7)	Tblisi (n = 6)	Total (n=25[2])
intestinal worms	133	95	220	59	507
piroplasmosis	123	164	68	79	434
predators	39	21	200	-	260
braxy	123	57	-	58	238
lameness	-	39	23	51	113
lambing	76	11	-	8	95
grass-poisoning	51	-	-	41	92
upper respiratory infections	14	10	27	30	81
unspecified morbidity/ mortality	-	-	-	79	79
peste de petits ruminants	-	-	-	75	75
ticks	29	-	46	-	75
migration	-	24	-	45	69
lack of feed	-	59	-	-	59
grass-poisoning, shearing[3]	51	-	-	-	51
psoropitc mange	-	-	19	17	36
abortions	34	-	-	-	34
poisoning	34	-	-	-	34
diarrhoea	-	-	28	-	28
heat stroke	-	-	26	-	26
acting crazy	24	-	-	-	24
pregnancy	-	-	19	-	19
pasteurellosis	17	-	-	-	17
liverflukes, acting crazy	-	-	-	16	16
head worms	-	-	15	-	15
lameness, shearing	-	-	-	14	14
barley poisoning	-	-	14	-	14
liver flukes	14	-	-	-	14
braxy, worms	-	11	-	-	11
mastitis	-	9	-	-	9
piroplasmosis, grass-poisoning	-	-	-	7	7
braxy, wool falling off	-	-	-	4	4

[1] Each focus group were given 100 beans to be distributed over a timeline with the months of the year depicted to illustrate the seasonality of outbreaks (if any) or the yearly average general herd morbidity. Subsequently, participants described which disease or a combination thereof each pile of beans represented. All groups did not utilise exactly/all 100 beans. On some occasion the piles represented several diseases or problems that occurred during that specific month. Sometimes, but not always, such combined piles could be further divided to illuminate the occurrence of separate disease. Because of these complications the total number of beans allocated per region are not 100 times the number of groups.

[2] In one of the seven focus groups in Kakheti and one of the six groups in Kvemo Kartli proportional piling was not done.

appear in the proportional piling using the timeline tool as the focus on disease was emphasised more strongly during that exercise. The six problems emerging as most important for the participants based on the three different interview tools (open discussions about the occurrence of general animal health problems, their prioritisation and the quantitative and explorative description of yearly morbidity using the timeline tool) are briefly described below in general terms, with reference to the local disease context discovered during the study and the reasons given for their prioritisation.

3.3.1. *Intestinal worms*

Almost all the FGDs mentioned internal parasites as an animal health problem experienced in the last three years. It was also the most frequently prioritised problem in four to five FGDs in each region, and the disease receiving most beans in the proportional piling using the timeline tool (Tables 3,4 and 5). Internal parasites are frequent in sheep and can cause severe problems unless preventive or curative antiparasitic treatments or other management strategies are applied. Several different nematodes (round worms) and cestodes (tape worms) can cause gastritis and enteritis, for example (Aiello and Mays, 1998). From the data collected in this study, it was not possible to determine which parasites were being referred to, but liver flukes (treamtodes, in some FGDs described as “liver butterflies”), lungworms (*Dictyocaulus filaria)*, intestinal worms and head worms (*Paralaphostrongylus tenuis)* were specifically mentioned. Among the intestinal worms, *Haemonchus contortus, Ostertagia circumcincta* and *Trichostrongylus axei* are among the most important nematode species in sheep globally (Aiello and Mays, 1998). Infection with *Haemonchus contortus* mainly manifests as anaemia with gradual weight loss, whereas infections with *Ostertagia circumcincta* and *Trichostrongylus axei* result in watery diarrhoea, weight loss and anorexia (Jackson and Coop, 2007). The reasons given for prioritising this problem mainly concerned the impact parasite infections had on growth and the subsequent impact on profitability. Infection outcomes, such as morbidity (mainly weakness and diarrhoea), mortality and having to discard meat (some participants mentioned discarding the entire carcass and some just affected intestines or organs), as well as the costs and effort involved in preventive treatments were also mentioned. One participant summarised this as follows: *“Why is it important? The sheep doesn’t grow and get fat and it also kills the sheep. It blocks the guts. It’s a financial problem because we feed them a lot and they don’t gain weight and we also need to buy expensive medicine“* (Kakheti FGD5).

3.3.2. *Braxy*

Braxy was the third most frequently mentioned animal health problem and the second most frequently prioritised problem (Tables 3 and 4). Notably, while it was mentioned as a priority problem in four or five FGDs in each of Kakheti, Kvemo Kartli and Tblisi (out of eight, six and six FGDs respectively), none of the FGDs in Samtshke-Javakheti considered braxy a priority. The same patterns of importance and regional variations were visible in the results of the proportional piling using the timeline tool (Table 5 and Fig. 6). This difference might reflect the prevalence of the pathogen, access to prophylactic treatments, other problems being more pressing, or regional differences in sheep husbandry. As not engaging in transhumance was most frequently reported in Samtshke-Javakheti, these regional patterns might be linked. Generally, braxy was most frequently reported to occur in October, the same month most commonly reported for the return from summer pastures. However, it was not possible to deduce from the data whether braxy usually occurred before, during or after migration. Braxy, more commonly referred to as bradsot, is caused by *Clostridium septicum* (Radostits et al., 2006). The bacterium is considered a commensal in soil and in the ovine gastrointestinal tract in certain geographical areas. On ingestion of frozen grass or other feeds that disturb the gastrointestinal milieu, it can penetrate the abomasal mucosa and cause acute toxaemia and severe, often fatal, illness, expressed as abdominal pain and recumbency (Lewis, 2007). As for other *Clostridium* spp, it is often the best sheep (that eat most and thus are most exposed) that are clinically affected. This aspect, *“It hits the best sheep”* (Kakheti FGD4), as well as disease properties, such as a peracute clinical course and high case fatality rate, were also frequently mentioned as reasons for considering this disease important: *“It kills quickly and in large quantities”* (Tbilisi FGD1). The disease can be prevented by management strategies avoiding frozen grass in particular, and by vaccination (Lewis, 2000). In Georgia, a polyvalent clostridial vaccine (Coglavax, Ceva, France) is used that provides protection against *Cl. oedematiens, Cl. septicum, Cl.*

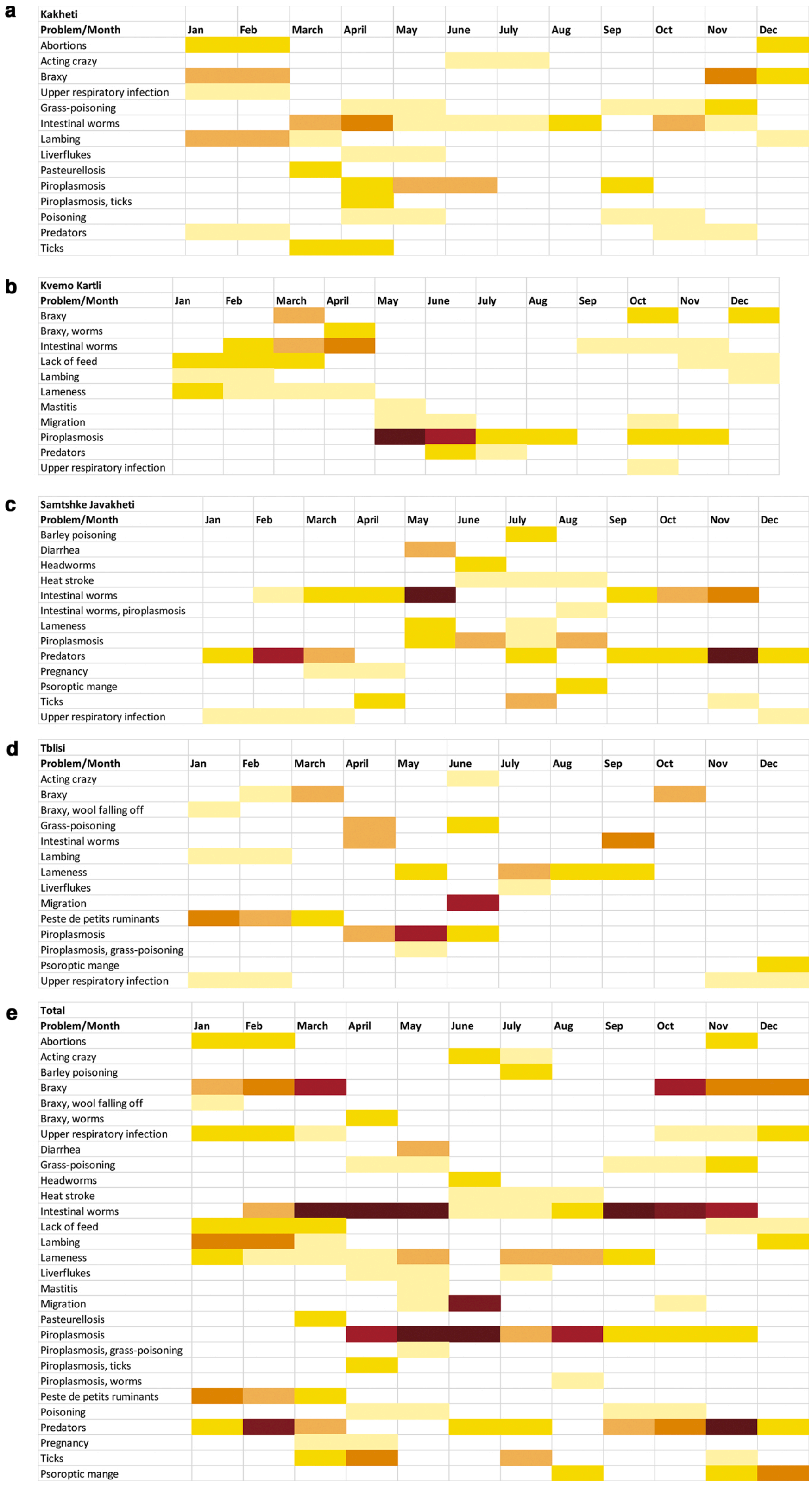

Fig. 6. a-e: Temporal distribution of general animal health problem occurrence in small ruminants in a participatory exercise from focus group discussions in a study of small ruminant pastoralists' perceptions of problems in four regions of Georgia in 2019. The colours represent the total number of beans distributed for each animal health problem in each region (Fig. 6a-d) and a summary of all regions (Fig. 6e) according to the following colour-code.
a: Sum of distribution of animal health problem occurrence for seven focus group discussions in Kakheti.
b: Sum of distribution of animal health problem occurrence for five focus group discussions in Kvemo Kartli.
c: Sum of distribution of animal health problem occurrence for seven focus group discussions in Samtshke-Javakheti.
d: Sum of distribution of animal health problem occurrence for six focus group discussions in Tbilisi.
e: Sum of distribution of animal health problem occurrence for 27 focus group discussions.

tetani and *Cl. chauvoei*.

3.3.3. Piroplasmosis

Piroplasmosis was mentioned by all FGDs as an animal health problem that had occurred in the last three years, and was the third most frequently prioritised problem (Tables 3 and 4). It was mentioned as a priority by two to six focus groups each in Kakheti, Kvemo Kartli and Tblisi (out of eight, six and six FGDs respectively), but for none of the FGDs in Samtshke-Javakheti. The same patterns of importance and regional variations were visible in the results of the proportional piling using the timeline tool (Table 5 and Fig. 6). As with braxy, this difference might reflect the geographical occurrence of the pathogen, the tick vector, access to prophylactic treatments, other problems being more pressing, or regional differences in sheep husbandry such as transhumance. Ovine piroplasmosis is caused by intra-erythrocytic protozoan parasites of *Theileria* and *Babesia* spp, transmitted by ticks (Altay et al., 2012). Prophylaxis can be achieved either by anti-acaricide treatments or through repeated (every four weeks) parental prophylactic treatment against the parasites with diminazene aceturate or imidocarb dipropionate. Clinical signs include a high fever (frequently $\geq$ 41 °C), accompanied by inappetence, an increased respiratory rate, muscle tremors, anaemia, jaundice and weight loss (Woldehiwet, 2007). When referring to piroplasmosis, many participants used the Georgian word "nabarevi", translated as "overheating", referring to the high temperature seen in the animals. Others used "piro" or "piroplasmosis". Another disease syndrome ("reti" in Georgian) was translated as heatstroke. "Reti" and "nabarevi" could in some cases possibly have referred to the same disease, but heatstroke was generally described as being caused by the sun: *"It is caused by the sun. During hot days they get heatstroke and it's very common"* (Samtshke-Javakheti FGD1). Heat and hot temperature were also occasionally mentioned in connection with "nabarevi/overheating", but for the majority of these accounts, ticks were mentioned as disease vectors, and the two syndromes could thus be separated: *"Dipping is important because pastures are full of ticks. It causes piroplasmosis and I have to treat it. I make sure ticks don't get on my sheep"* (Kvemo Kartli FGD2). The need for repeated prophylactic treatment and the costs and time associated with this, as well as the disease occurring frequently, affecting many sheep with a high case fatality rate as well as jaundice and thus rendering the meat unfit for human consumption, were frequently given as reasons for prioritising this disease: *"If you are late with vaccination the sheep dies and you cannot eat it"* (Tbilisi FGD 4).

3.3.4. Pasture-related problems

Problems related to pastures were the second most commonly mentioned non-animal health-related problem (Table 3). The problem statement included accounts of the quality of grass as well as land availability and perceived high costs of using private land. The importance of pasture properties, such as large quantities of high-quality grass, shade and water for sheep production and keeping the animals healthy, was frequently underlined: *"We don't have enough water or pastures, it's a problem. All diseases are caused by problems with pastures, and no rainy weather. If we don't have enough water or pastures we need to give supplementary feed"* (Kvemo Kartli FGD3). Whether or not pastures were considered a problem clearly differed by geographical location. It was considered a priority for six out of eight FGDs in Kakheti, three out of six in Kvemo Kartli, but only one out of seven in Samtskhe-Javakheti and none in Tbilisi (Table 4). Before independence, all land in the Soviet republics including Georgia was communal (Mushkelishvili et al., 2012). Grazing lands could cross over several borders of the republics (Neudert et al., 2013). Since independence in 1991, land in Georgia has become increasingly privatised, leading to more limited access to grazing land for pastoralists in some areas (Mushkelishvili et al., 2012).

3.3.5. Predators

Predators were the most frequently mentioned non-disease problem (Table 3). Predator abundance was also a localised problem, with a large impact in areas reporting high densities. Remoter areas and areas at higher altitudes seemed to be more affected, as manifested by predators not seeming to be a problem in Tbilisi and for only one out of six FGDs in Kvemo Kartli, but considered a priority for three out of six FGDs in Kakheti and five out of seven in Samtskhe-Javakheti (Table 4). The same patterns of importance and regional variations were visible in the results of the proportional piling using the timeline tool (Table 5 and Fig. 6). The Caucasian mountains are home to several species of predators that could potentially attack small ruminants: brown bears (*Ursus arctos*), foxes (*Vulpes vuples*), golden jackals (Canis aureus), leopards (*Panthera pardus)* and wolves (*Canis lupus*) (Khorozyan and Abramov, 2007, Kikvidze and Tevzadze, 2015, Rutkowski et al., 2015). Kikvidze and Tevzazde (2015) discuss reports of wolf attacks increasing sharply in some parts of Georgia, and highlight a positive correlation between this increase and changes in local economies from exported agricultural goods to subsistence livestock production. The reported correlation is greater for households without a cultural tradition of livestock husbandry (e.g. use of large shepherd dogs to deter predators). In this study, the participants mostly mentioned predator attacks by wolves, two FGDs in Kakheti mentioned bears and one wild cats, and one FGD in Kvemo Kartli mentioned wild dogs. Those FGDs that prioritised predators reported that attacks often occurred and that many sheep could be killed in one attack: *"Attacks on the sheep are very frequent. They kill a lot of sheep at the same time"* (Kakheti FGD7). The fact that the participants did not want to eat meat from sheep killed by predators because of a fear of rabies, for example, contributed to this problem being prioritised.

3.3.6. Lameness

Lameness was the fourth most frequently mentioned disease syndrome, prioritised by two or three FGDs in all three regions apart from Kakheti, where it was not a priority for any group (Tables 3 and 4). The priority given to this disease syndrome, and the regional differences, were equally demonstrated by the results of the proportional piling using the timeline tool (Table 5 and Fig. 6). Lameness in sheep is frequent, often caused by a combination of environmental factors (hard, uneven or wet surfaces) hurting the claws or the interdigital space and thus facilitating access of opportunistic bacteria. This can result in foot abscesses, interdigital dermatitis or foot root/necrobacillosis. Ovine (virulent) foot root caused by *Fusobacterium necrophorum* (normally present in the sheep's environment) in combination with *Dichelobacter nodosus* is especially serious. The latter is highly contagious and dependent on a warm and moist environment for its persistence (Egerton, 2007). Reasons for prioritising lameness frequently touched upon the importance of sheep being able to walk during migration, lame feet hindering sheep from eating enough, lower sale prices for lame sheep, and the extra attention needed for hoof care, particularly if the ground is wet. The associations between muddy ground, rain and lameness were expressed almost with a sense of hopelessness and as a problem beyond the owner's control: "*Rainy days are really a problem, but we cannot do anything about it"* (Kvemo Kartli FGD4). The high morbidity of foot root was also put forward as a reason for it being an important disease.

3.4. Problem prioritising rationales

Out of the six problems prioritised, four were endemic diseases or syndromes caused by an earth commensal bacterium (braxy), a protozoan tick-borne parasite (piroplasmosis), a combination of environmental factors and specific pathogens (lameness), and unspecified internal parasites, and two were not diseases but related to small ruminant management (pastures and predators). From the thematic analysis of the underlying principles for prioritising these problems, 13 different issues emerged (Table 2a). Despite the diversity in the causative background of the prioritised problems, many of the emerging issues were shared. An issue including the need to give extra attention to the animals to manage, avoid or cure the problem was present for all problems, and an issue relating to meat not being fit for human consumption was present in all the problems apart from issues with pasture and lameness. Some of the emerging issues could be conceptualised together, resulting in four themes: attention, disease parameters, economic impact and zoonotic potential (Table 2b).

The need to take good care of the animals and pay **attention** to their needs in order to avoid or cure the problems and reduce their negative impact was highlighted in various ways for all six problems. Regarding worms, one participant said: "*The sheep die if we don't pay attention to these problems*" (Samtshke-Javakheti FGD3); in relation to braxy: "*It takes a lot of treatment and effort to keep braxy sheep alive and healthy*" (Kvemo Kartli FGD1); and for pastures: "*It is difficult to take care of the sheep*" (Kvemo Kartli FGD6). In this respect, this theme also seemed to convey a collective pride in their profession and pastoralist lifestyle, as well as the skills needed to be a successful sheep farmer in terms of attention, observation and vigilance. Animal owners further expressed the importance of having good shepherds in relation to this. The sense of pride might have been an underlying factor for their initial unwillingness to talk about problems or diseases. This theme further included the aspect that for the four diseases most frequently prioritised, the preventive treatments needed to be repeated, thus requiring constant attention to treatment regimens, hoof care and the availability of dipping stations along the migration roads, for example. The themes also included aspects of extra time and workload in mastering, managing or avoiding the problems.

Several emerging issues described **disease parameters** in the flock (epidemiological measures and risk factors) or in the individual animal (description of the clinical course). Such emerging themes were present for the four disease problems (contagious, unable to walk, caused by mud and rain, deaths, disease properties, frequent, reduced growth, peracute, related to pastures), but also for problems with predators (death, frequent) and pasture (reduced growth, signs of malnutrition). Epidemiological measures that influenced the importance attributed to the problems were related to the diseases being contagious, for worms specified as vertically transmitted, and the disease prevalence or incidence expressed as the frequency of disease occurrence, or that of predator attacks. The sheer fact that disease or problems were occurring frequently seemed to be a reason for their importance to the participants: *"It's a frequent problem, that's why it's important to us"* (Tbilisi FGD 3, on worms). High morbidity and/or case fatality rate were also important for prioritisation in this regard. The emerging issue "death" contained subjects belonging to several themes, representing the different annotations of death. One of these annotations referred to the number of animals dying from a specific disease event (case fatality rate) or in total (mortality). Death as the disease outcome contributed importance to the problems, especially death occurring peracutely, as described for braxy and piroplasmosis. One participant described braxy as follows: *"It kills the sheep very fast. It's a terrible disease"* (Kakheti FGD3). Sudden death of animals, and possibly particularly if many are affected at the same time, can also have a psychological impact on animal owners (Chenais et al., 2017a). This kind of impact was indicated in some of the descriptions of predator attacks. Others referred to the economic loss incurred by the death of an animal (economic impact). Additional specific disease traits contributing to prioritisation included if diseases affected reproduction, lambs or the best sheep on pasture (as for braxy), or caused pain, as with lameness: *"In the case of lameness, the sheep might lose their claws completely [...] it hurts"* (Kvemo Kartli FGD4). Affected growth was frequently mentioned as a reason for prioritising worms, lameness and problems related to pasture. Reduced growth is a clinical sign of parasitic infection, and reduced or stunted growth has significant impacts on the opportunity to make a profit on the sheep.

Both "growth" and "death" contain subjects belonging to both the themes disease parameters and **economic impact**. Other aspects of economic impact were costs for preventive and curative treatments, costs of hiring extra shepherds to take care of sick sheep, costs of extra feed if sheep are sick, and having to pay high rents for summer and winter pastures.

Not being able to eat or market meat from dead sheep because of a fear of or real **zoonotic potential** of disease also contributed to an economic impact that was expressed for all the priority problems apart from lameness and problems related to pastures. This fear also constituted a theme of its own as it has an impact wider than just economics. Wasting important protein by throwing away meat from dead animals is often avoided at all costs by resource-constrained communities. Here, having to waste the entire animal was a harsh experience: *"Dead sheep cannot be eaten, they have to be thrown away, you cannot even give them to dogs. You bury them, it's a total loss"* (Tbilisi FGD2). None of the diseases included as priority problems are in fact zoonotic diseases. Some sheep parasites can be zoonotic if meat is ingested without being thoroughly cooked, the main threat being ingestion of meat containing viable larvae of *Toxocara canis*. The jaundice seen in piroplasmosis was frequently associated with the meat being unfit for human consumption: *"If you don't give piro treatment, it's impossible to eat it, the meat goes yellow"* (Kakheti FGD2).

3.5. Disease outbreaks

Generalised disease outbreaks affecting many animals at the same time seemed to be unusual, as illustrated by quotes such as: *"No, not in my case. Why would that happen?"* (Kakheti FGD2) and *"No, not really. There have been occasions when predators killed a lot of sheep"* (Samtshke-Javakheti FGD2). Historical outbreaks of foot and mouth disease were mentioned, as were clustered occurrences of braxy and lameness. Outbreaks of PPR were only described in FGDs in communities in Tbilisi that had reported outbreaks in 2016. All FGDs in Tbilisi were aware of the historical outbreak and recognised the clinical signs in the pictures illustrating classical clinical signs of PPR. Furthermore, all mention of diseases that have a common differential diagnosis to PPR, or clinical signs that can be seen in PPR, could be excluded from being PPR during discussions with the participants. Pictures illustrating clinical signs of PPR were used in this process. No FGDs apart from those in Tbilisi recognised the signs in the pictures, but they frequently prompted memories of a disease that participants had heard people discussing in the market or on the television news.

4. Discussion

This study identified a range of issues and concerns related to small ruminant health and management in the studied communities, and correspondingly a broad range of problems that were prioritised as important for the participants. This diversity in both aspects was present despite the limited geographical coverage of the study, the rather small number of communities involved, and the fact that these communities, at least from the perspective of outside researchers, superficially appeared quite similar, representing a homogenous stratum of rural people combining small-scale subsistence farming with small ruminant transhumant pastoralism. Furthermore, many of the problems mentioned, as well as those prioritised, were not diseases, despite the discussion topic specifically referring to "animal health problems". Together, these observations highlight several important issues that have a bearing on the interpretation of the results of this specific study, as well as for other PE and development research studies.

Firstly, the sheer diversity of problems mentioned and prioritised revealed a considerable day-to-day complexity in the participants' livelihood situations, demonstrating that they faced multiple challenges in their small ruminant management. The study was part of a larger project on PPR epidemiology and virology, however the results showed that PPR was not a priority disease for the communities involved. In accordance with recent discussions about the development of PE (Fischer and Chenais, 2019), the study was indeed designed to capture the necessary information concerning PPR while concurrently allowing the participants to guide the discussion towards issues that were important to them (within the broader topic of small ruminant health). As it was not a priority for the participants, obliging groups to discuss PPR in more detail would not, however, have produced meaningful results in this study (Chambers, 1983). Ebata et al. (2020) and Barnett et al. (2020) both discuss the diverging, and sometimes even opposing objectives of multinational or national research agendas versus the needs of local participants and poor smallholders that should be the obvious focus of development research. In this regard, individual researchers as well as international or national research initiatives often concentrate on a single disease or infectious agent, driven by specific interests, the disease's impact on national economies and trade, or international regulations concerning certain diseases. As the results here showed, the needs of rural communities are often different and much more diverse, with animal health needs relating to complex livelihood situations marked by subclinical co-infections of "undramatic" microbiological agents or other challenges relating to access to land, feed and genetic resources (Ebata et al., 2020, Barnett et al., 2020, Chenais and Fischer, 2018, Gertzell, 2020).

How animal owners prioritise diseases and animal health constraints provides important information about their day-to-day reality, can increase understanding of local livelihood situations, inform actions directed at improving animal health, and thus be an important part of first-stage scoping studies in development research with an animal health focus (Barnes et al., 2020). For regulated diseases such as PPR, surveillance schemes or control measures are often imposed on animal owners in a top-down manner (Jori et al., 2020). Animal owners' willingness to report or adhere to such measures is linked to their perception of the specific disease (Barnett et al., 2020). If the disease is not considered a priority problem, the reporting rate and compliance with control or preventive measures are likely to be low (Hutchison et al., 2019). Similarly, it has been shown that the implementation rate of biosecurity measures is dependent on the local context and how well the measures are adapted to the end users' livelihood situations (Chenais et al., 2017b, Chenais et al., 2017a, Chenais et al., 2019b). A contextualised, deep understanding of the complexities of livelihood situations of local rural people are thus paramount for improving the implementation of control measures and reporting regulated disease, as well as for achievements of action research aiming to improve animal health. In this regard, it can be noted that even in the FGDs in Tbilisi that had experienced PPR, this was not being put forward as a prioritised disease. The reported habit to only call veterinarians for certain diseases (perceived as serious or contagious) might also delay diagnosis and the control of infectious disease outbreaks.

Similarly to the diversity of problems and their prioritisation, the rationale supporting their prioritisation offered important information about the participants' livelihood situations. The importance of paying close attention to animals in order to avoid animal health risk factors, keep animals healthy and minimise the negative impact of diseases or management problems such as pasture quality and quantity was tangible in all topics. This reflects the economic, social and symbolic value of the animals, and their sustained health, in the pastoralist lifestyle (Liechti and Biber, 2016, Zinsstag et al., 2016). Two themes in this study correspond with themes from a similar study with cattle pastoralists in Uganda (Chenais and Fischer, 2018): economic impact and disease parameters (in this study including both epidemiological parameters and the clinical course), indicating a universality in the problem prioritisation rationale for animal keepers in different contexts. In both these studies, diseases being contagious, occurring frequently, expressing peracute clinical courses and having deadly outcomes supported their prioritisation. The death of animals can induce both a livelihood shock for households (Wagstaff, 2005) and a psychological shock for individuals (Chenais et al., 2017a). In some cultures, meat from animals that have died is still used for home consumption or trade, lessening the financial shock (Dione et al., 2017, Lysholm et al., 2020a). This practice was not reported among the communities studied here, mainly, it appeared, out of fear of zoonotic harm caused by the disease that had killed the animal. In this regard, zoonotic implications emerged as a theme on their own. The theme of economic impact included the significance attributed by the participants to pasture, mentioning it as an important resource for sustaining the herd health and animal growth, and thus being of specific importance for the profitability of sheep keeping. The contribution of animals to household income is significant, especially in poor families (Perry and Grace, 2009), and even if animals in pastoralist systems are also kept for other reasons (Zinsstag et al., 2016), the economic impact of animal health problems emerged as a strong rationale for their prioritisation.

4.1. Methodological reflections

Participatory epidemiology studies rely almost exclusively on groups for data collection, but very often ignore the plurality and power relations that are present in all communities, as well as in FGDs and other group interview situations (Fischer et al., 2020). Among the few previous exceptions to this modus operandi are two studies from Kenya and Uganda, both of which used individual interviews to complement FGDs for the purposes of accessing the voices of those who do not come to meetings, are reluctant to speak or are silenced by others (Bedelian et al., 2007, Chenais and Fischer, 2018). This model for accessing minority voices in interview studies was used here. For that purpose, the initial listing of animal health problems was an open process designed to capture heterogeneous problem formulations within the groups, i.e. all the problems mentioned were listed (even if not being primarily related to animal health), and the facilitator sought to engage all the participants in the formulation of individual problems. In the subsequent prioritisation of all the problems mentioned and listed, however, the group was meant to arrive at a common priority list. In this process, the facilitator was consciously not forcing consensus, e.g. more or fewer than five problems could be listed, and problems could be listed as a priority even if only one participant considered that specific problem a priority. This way of promoting plurality and a broader inclusion of problem descriptions compared with other PE studies probably contributed to the diverse list of problems emerging in this study.

Research based on group interviews is always influenced by social relations imbued with power, e.g. within the studied communities, between study participants in a group, and between researchers and participants. Such relations will impact the data collected, for example in the form of what is said and not said, how things are said and by whom, and which voices are heard (Gaventa and Cornwall, 2008, Ebata et al., 2020). There is an obvious power difference between foreign researchers and local participants, but also between local people and local researchers who often represent the elite, with a high level of education and working for national authorities and research institutions (Ebata et al., 2020). Participants in this study were mobilised by the local veterinarian employed by the state and the facilitator was an employee of the National Food Agency. This might have had an impact on the participants' ease of expression, possibly mirrored in the initial strong hesitation to mention any animal health problems. This hesitation was most pertinent when interviewing shepherds and Azeri women, where there was an even greater power imbalance between the interviewer and interviewee. A power imbalance between animal owners and shepherds could also be felt during discussions on the "problems with shepherds", in which the importance of having good shepherds was expressed concurrently with surprise that the shepherds demanded pay rises and improved living conditions. Apart from the limitation posed by these power relations in data collection, the study featured some other limitations and biases that are also worthy of mention. The fact that FGDs were not always held in the mother tongue of all participants probably hampered the discussions, and some details could also have been lost in translation, particularly in the FGDs held in dual languages. The value of the additional interviews with participants who only spoke Azeri was greatly diminished as the intermediate translators had difficulties taking a step back and only acting as a translator, letting the interviewees' opinions and knowledge emerge without intervention. These intermediate translators were all male, whereas the interviewees in these cases were mostly women. Ensuring that facilitators and translators are similar to the interviewees regarding for example gender and social status is a recognised method for reducing power imbalance and improving the reliability of the results (Borchgrevink, 2003). This methodological aspect could have been improved here. Instructions with clear inclusion criteria for recruitment to FGDs were given to the recruiters, nevertheless the majority of the participants were men. This is a clear example of "mobiliser bias" (Fischer et al., 2020), common in veterinary PE, in which FGD participants are recruited by a senior, male, often veterinary professional typically inviting people he already knows or who he expects to be knowledgeable about animal husbandry, thus excluding women, people owning few animals, the poor or otherwise marginalised people. The representation of women in the FGDs increased during the course of the field study as the researchers repeatedly pointed out the skewed gender balance, but even so fewer women than men were included. The researchers tried to compensate for the recruitment bias with the additional interviews, but some of those attempts were hampered by language barriers. These biases and limitations were taken into account when analysing the data, ensuring conclusions were not drawn that went beyond the quality of the data. Extrapolation of the results of the study to entire pastoralist communities in other contexts needs to be undertaken while taking the context specificities, limitations and biases into consideration. In future studies, some of these limitations, such as mobiliser bias and language barriers, could be overcome by performing longer fieldwork using anthropological research methods and ensuring that there is no need to rely on intermediate translations.

Designing studies that overcome the mismatch between the needs of rural communities and the research objectives mentioned above, and thus that address the needs of participants and are truly participatory, is a challenge (Barnett et al., 2020). Researchers (both national and international) often have limited knowledge about the communities' needs and situations at the start of research projects. Longer development research projects with the objective of sustainably alleviating poverty while embracing participation and local ownership thus need to allow for participatory scoping-style studies in the start-up phase. This study was part of a project with a specific focus on the single disease of PPR. Despite that focus, an open study design acknowledging diversity, plurality and participants' animal health priorities was achieved by adhering to the main PE principles (Allepuz et al., 2017).

5. Conclusions

Epidemic and transboundary diseases such as PPR are a major concern for national and international veterinary authorities, but just one of many problems facing pastoralists. The day-to-day reality of animal health for pastoralists is characterised by co-infections of mainly endemic pathogens, and problems related to other challenges such access to land, feed and genetic resources. In this study, intra-method triangulation confirmed the participants' priorities as well as the validity of the methodology.

A contextualised, deep understanding of the local disease panorama and the complexities of the livelihood situations of local rural people are paramount for improving the implementation of passive surveillance, biosecurity, control measures, and ultimately any actions aimed at improving animal health. To achieve such an understanding, longer development research projects need to allow for participatory scoping-style studies acknowledging diversity and plurality in the start-up phase. Even within one region and among seemingly socially and culturally homogenous groups, there can be significant local differences in the problems experienced by pastoralists as affecting their livestock management. Special effort needs to be made in the study design to acknowledge this diversity and avoid the power relations in communities and between participants and researchers having an impact on the results.

The rationale for the participants' prioritisation of animal health problems was supported by the need to pay extra attention to animals in order to avoid risk factors, keep animals healthy and minimise the negative impact of diseases or management problems, different disease parameters, the economic impact and the zoonotic potential of diseases and predation.

No historic, unreported PPR outbreak was detected in this study. The outbreak around Tbilisi in 2016 was familiar to participants from that region.

Funding

This work was performed within the project "Comprehensive Research for Detecting Origin and Distribution of Peste des Petits Ruminants (PPR) in Georgia and Armenia" funded by the Defence Threat Reduction Agency (DTRA), USA, reference number BAA-PPR #HDTRA11810053/HDTRA11910022.

Ethical Statement

All research activities under the project "Comprehensive Research for Detecting Origin and Distribution of Peste des Petits Ruminants (PPR) in Georgia and Armenia" has been approved by the Funding Organization Defense Threat Reduction Agency (DTRA) under the project number HDTRA11910022 and by the Government of Georgia, Decree of the Government of Georgia #2326.

Declaration of Competing Interest

The authors report no declarations of interest.

Acknowledgements

First and foremost, all the interviewed participants are acknowledged for generously sharing their experience and time. Ms Maia Kanchelashvili is duly acknowledged for excellent translation services, Ms Tamuna Chkhikvishvili and Mr Mishka Samkurashvili for taking detailed field notes, Mr Beka Meskhi for facilitating the FGDs and Ms Linda Svensson for compiling Fig. 1.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.prevetmed.2021.105412.

References

Abramowitz, S.A., Mclean, K.E., Mckune, S.L., Bardosh, K.L., Fallah, M., Monger, J., Tehoungue, K., Omidian, P.A., 2015. Community-centered responses to Ebola in urban Liberia: the view from below. PLoS neglected tropical diseases 9 (5). https://doi.org/10.1371/journal.pntd.0003767.

Aiello, S., Mays, A., 1998. Gatrointestinal parasites of sheep and goats. In: AIELLO, S. (Ed.), The Merck veterinary manual. Whithouse station. Merck&co, New Jersey, USA.

Allepuz, A., De Balogh, K., Aguanno, R., Heilmann, M., Beltran-Alcrudo, D., 2017. Review of participatory epidemiology practices in animal health (1980-2015) and future practice directions. PloS one 12.

Altay, K., Dumanli, N., Aktas, M., 2012. A study on ovine tick-borne hemoprotozoan parasites (Theileria and Babesia) in the East Black Sea Region of Turkey. Parasitology research 111, 149–153.

Balamurugan, V., Hemadri, D., Gajendragad, M., Singh, R., Rahman, H., 2014. Diagnosis and control of peste des petits ruminants: a comprehensive review. Virusdisease 25, 39–56.

Barnes, T.S., Alvaran, P.J.J., Lantican, T.L.D., Lapuz, E.L., Ignacio, C., Baluyut, A.S., Parke, C.R., Palaniappan, G., Cameron, D., Ancog, R.C., 2020. Combining conventional and participatory approaches to identify and prioritise management and health-related constraints to smallholder pig production in San Simon, Pampanga, Philippines. Preventive Veterinary Medicine, 104987.

Barnett, T., Pfeiffer, D.U., Hoque, M.A., Giasuddin, M., Flora, M.S., Biswas, P.K., Debnath, N., Fournié, G., 2020. Practising co-production and interdisciplinarity: Challenges and implications for one health research. Preventive Veterinary Medicine 177, 104949.

Bedelian, C., Nkedianye, D., Herrero, M., 2007. Maasai perception of the impact and incidence of malignant catarrhal fever (MCF) in southern Kenya. Preventive veterinary medicine 78, 296–316.

Borchgrevink, A., 2003. Silencing language: Of anthropologists and interpreters. Ethnography 4, 95–121.

Bowen, G.A., 2006. Grounded theory and sensitizing concepts. International Journal of Qualitative Methods 5, 12–23.

Britten, N., 1995. Qualitative research: qualitative interviews in medical research. British Medical Journal 311, 251–253.

Chambers, R., 1983. Rural development : putting the last first. Longman, London.

Chenais, E., Boqvist, S., Sternberg-Lewerin, S., Emanuelson, U., Ouma, E., Dione, M., Aliro, T., Crafoord, F., Masembe, C., Stahl, K., 2017a. Knowledge, Attitudes and Practices Related to African Swine Fever Within Smallholder Pig Production in Northern Uganda. Transbound Emerg Dis 64, 101–115.
Chenais, E., Depner, K., Guberti, V., Dietze, K., Viltrop, A., Stahl, K., 2019a. Epidemiological considerations on African swine fever in Europe 2014-2018. Porcine Health Manag 5, 6.
Chenais, E., Fischer, K., 2018. Increasing the local relevance of epidemiological research: situated knowledge of cattle disease among basongora pastoralists in Uganda. Frontiers in Veterinary Science 5, 119.
Chenais, E., Lewerin, S.S., Boqvist, S., Stahl, K., Alike, S., Nokorach, B., Emanuelson, U., 2019b. Smallholders' perceptions on biosecurity and disease control in relation to African swine fever in an endemically infected area in Northern Uganda. BMC Vet Res 15, 279.
Chenais, E., Sternberg-Lewerin, S., Boqvist, S., Liu, L., Leblanc, N., Aliro, T., Masembe, C., Stahl, K., 2017b. African swine fever outbreak on a medium-sized farm in Uganda: biosecurity breaches and within-farm virus contamination. Trop Anim Health Prod 49, 337–346.
Didebulidze, A., Plachter, H., 2012. Nature conservation aspects of pastoral farming in Georgia. Pasture Landscapes and Nature Conservation 87.
Dione, M.M., Akol, J., Roesel, K., Kungu, J., Ouma, E.A., Wieland, B., Pezo, D., 2017. Risk factors for African swine fever in smallholder pig production systems in Uganda. Transboundary and emerging diseases 64, 872–882.
Donduashvili, M., Goginashvili, K., Toklikishvili, N., Tigilauri, T., Gelashvili, L., Avaliani, L., Khartskhia, N., Loitsch, A., Bataille, A., Libeau, G., 2018. Identification of peste des petits ruminants virus, Georgia, 2016. Emerging infectious diseases 24, 1576.
Ebata, A., Hodge, C., Braam, D., Waldman, L., Sharp, J., Macgregor, H., Moore, H., 2020. Power, Participation and their Problems: A consideration of power dynamics in the use of Participatory Epidemiology for One Health and zoonoses research. Preventive Veterinary Medicine, 104940.
Efsa Panel On Animal Health And Welfare, 2015. Scientific Opinion on peste des petits ruminants. EFSA Journal 13, 3985.
Egerton, J., 2007. Diseases of the feet. Diseases of sheep 4, 273–281.
FAO, 1999. Reconizing peste des petits ruminants: a field manual Rome.
Fischer, K., Chenais, E., 2019. What's in a name: participatory epidemiology. Prev. Vet. Med. 165, 34–35.
Fischer, K., Chenais, E., Torsson, E., Wensman, J.J., 2016. Where is the Participation in Participatory Epidemiology? How Engagement with Social Science could lead to Improved Understanding and Control of Peste des Petits Ruminants.
Fischer, K., Schulz, K., Chenais, E., 2020. "Can we agree on that"? Plurality, power and language in participatory research. Preventive Veterinary Medicine, 104991.
Gaventa, J., Cornwall, A., 2008. Power and knowledge. The Sage handbook of action research: Participative inquiry and practice 2, 172–189.
Gertzell, E., 2020. Veterinary Herd Health Management in Ugandan smallholder pig farms. Lic Lic, Sveriges lantbruksuniv.
Gonashvili, B., Mosiashvili, M., Sisvadze, N., 2013. Perspectives on Sheep Farming & The Sheep Market System in Georgia. Marneuli, Georgia.
Goulding, C., 1999. Grounded Theory: some reflections on paradigm, procedures and misconceptions. Working Paper Series. Wolverhampton Business School, Wolverhampton.
Grace, D., Lindahl, J., Wanyoike, F., Bett, B., Randolph, T., Rich, K.M., 2017. Poor livestock keepers: ecosystem–poverty–health interactions. Philosophical Transactions of the Royal Society B: Biological Sciences 372, 20160166.
Hutchison, J., Mackenzie, C., Madin, B., Happold, J., Leslie, E., Zalcman, E., Meyer, A., Cameron, A., 2019. New approaches to aquatic and terrestrial animal surveillance: the potential for people and technology to transform epidemiology. Preventive veterinary medicine 167, 169–173.
Jackson, F., Coop, R., 2007. Gastrointestinal helminthosis. Diseases of sheep 4, 185–195.
Jori, F., Chenais, E., Boinas, F., Busauskas, P., Dholllander, S., Fleischmann, L., Olsevskis, E., Rijks, J., Schulz, K., Thulke, H., 2020. Application of the World Café method to discuss the efficiency of African swine fever control strategies in European wild boar (Sus scrofa) populations. Preventive Veterinary Medicine, 105178.
Kerven, C., Steimann, B., Dear, C., Ashley, L., 2012. Researching the future of pastoralism in Central Asia's mountains: Examining development orthodoxies. Mountain Research and Development 32, 368–377.
Khorozyan, I.G., Abramov, A.V., 2007. The Leopard, Panthera pardus,(Carnivora: Felidae) and its resilience to human pressure in the Caucasus. Zoology in the Middle East 41, 11–24.
Kikvidze, Z., Tevzadze, G., 2015. Loss of traditional knowledge aggravates wolf–human conflict in Georgia (Caucasus) in the wake of socio-economic change. Ambio 44, 452–457.
Kunelauri, N., Gogniashvili, M., Tabidze, V., Basiladze, G., Beridze, T., 2019. Georgian cattle, sheep, goats: are they of Near-Eastern origins? Mitochondrial DNA Part B 4, 4006–4009.
Lewis, C., 2000. Vaccination of sheep-an update. In Practice 22, 34–39.
Lewis, C., 2007. Clostridial diseases. Diseases of sheep 4, 156–167.
Liechti, K., Biber, J., 2016. Pastoralism in Europe: characteristics and challenges of highland–lowland transhumance. Rev Sci Tech Int Off Epiz 35, 561–575.
Lysholm, S., Johansson Wensman, J., Munyeme, M., Fischer, K., 2020a. Perceptions and practices among Zambian sheep and goat traders concerning small ruminant health and disease. PloS one 15, e0233611.
Lysholm, S., Malmberg, M., Chenais, E., Lindahl, J., 2020b. Better than a ban: preventing the next pandemic with stronger biosecurity at live animal markets [Online]. Available: https://www.siani.se/news-story/better-than-a-ban-preventing-the-next-pandemic-by-improving-biosecurity-at-live-animal-markets/ [Accessed 16 September 2020].
Mariner, J.C., Paskin, R., 2000. Manual on participatory epidemiology. Methods for the colection of action-oreinted epidemioligical intelligence. FAO Animal Health Manual. Food and Agriculture Organization of the United Nations, Rome.
McCracken, J., Pretty, J., Conway, G., 1988. An Introduction to Rapid Rural Appraisal for Agricultural Development. IIED Sustainable Agriculture Programme, London, UK.
Moghaddam, A., 2006. Coding issues in grounded theory. Issues in educational research 16, 52–66.
Mushkelishvili, M., Mezvrishvili, L., Natsvlishvili, B., Elizbarashvili, M., 2012. The role of social capital in rural community development in Georgia [online] URL: https://www.researchgate.net/publication/235218072_The_Role_of_Social_Capital_in_Rural_Community_Development_of_Georgia. Centre for Social Studies, Tbilisi, Georgia.
Neudert, R., Etzold, J., Münzner, F., Manthey, M., Busse, S., 2013. The opportunity costs of conserving pasture resources for mobile pastoralists in the Greater Caucasus. Landscape Research 38, 499–522.
Oie And Fao, 2015. Global strategy for the control and eradication of PPR.
Parliament Of Georgia, 2012. . Food/feed safety, veterinary and plant protection code [Online]. Legislative herald of Georgia. Available: https://matsne.gov.ge/en/document/view/1659434?publication=8 [Accessed 16 September 2020].
Perry, B., Grace, D., 2009. The impacts of livestock diseases and their control on growth and development processes that are pro-poor. Philosophical transactions of the Royal Society of London. Series B, Biological sciences 364, 2643–2655.
Radostits, O.M., Gay, C.C., Hinchcliff, K.W., Constable, P.D., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences.
Rajko-Nenow, P.Z., Cunliffe, T.G., Flannery, J.T., Ropiak, H.M., Avaliani, L., Donduashvili, M., Baron, M.D., Batten, C.A., 2017. Complete genome sequence of peste des petits ruminants virus from Georgia, 2016. Genome Announc. 5, e01091–17.
Randolph, T.F., Schelling, E., Grace, D., Nicholson, C.F., Leroy, J., Cole, D., Demment, M., Omore, A., Zinsstag, J., Ruel, M., 2007. Invited review: Role of livestock in human nutrition and health for poverty reduction in developing countries. Journal of animal science 85, 2788–2800.
Risse, G.B., 1979. The renaissance of bloodletting: a chapter in modern therapeutics. Journal of the history of medicine and allied sciences 34, 3–22.
Roca, A., Afolabi, M.O., Saidu, Y., Kampmann, B., 2015. Ebola: a holistic approach is required to achieve effective management and control. Journal of Allergy and Clinical Immunology 135, 856–867.
Rutkowski, R., Krofel, M., Giannatos, G., Ćirović, D., Männil, P., Volokh, A.M., Lanszki, J., Heltai, M., Szabó, L., Banea, O.C., 2015. A European concern? Genetic structure and expansion of golden jackals (Canis aureus) in Europe and the Caucasus. PLoS One 10.
Schelling, E., Greter, H., Kessely, H., Abakar, M., Ngandolo, B., Crump, L., Bold, B., Kasymbekov, J., Baljinnyam, Z., Fokou, G., 2016. Human and animal health surveys among pastoralists. The future of pastoralism. In: Zinsstag, J., Schelling, E., Bonfoh, B. (Eds.), Rev. Sci. Tech. Off. Int. Epiz 35, 659–671.
Schelling, E., Wyss, K., Bechir, M., Moto, D.D., Zinsstag, J., 2005. Synergy between public health and veterinary services to deliver human and animal health interventions in rural low income settings. Bmj 331, 1264–1267.
Steinfeld, H., Wassenaar, T., Jutzi, S., 2006. Livestock production systems in developing countries: status, drivers, trends. Rev Sci Tech 25, 505–516.
Tasker, A., 2020. Exploring power and participation through informal livestock knowledge networks. Preventive Veterinary Medicine, 105058.
Thornton, P., 2002. Mapping poverty and livestock in the developing world. ILRI (aka ILCA and ILRAD).
Wagstaff, A., 2005. The Economic Consequences of Health Shocks. World Bank Policy Research Working Paper. World Bank, Washington DC, USA.
Wagstaff, A., Lindelow, M., 2010. Are health shocks different? Evidence from a multi-shock survey in Laos. The World Bank.
Woldehiwet, Z., 2007. Tick-borne diseases. Diseases of sheep 5, 347.
Zinsstag, J., Bonfoh, B., Zinsstag, G., Crump, L., Alfaroukh, I., Abakar, M., Kasymbekov, J., Baljinnyam, Z., Liechti, K., Seid, M.A., 2016. A vision for the future of pastoralism. Rev Sci Tech 35, 693–699.
Özkul, A., Akca, Y., Alkan, F., Barrett, T., Karaoglu, T., Dagalp, S.B., Anderson, J., Yesilbag, K., Cokcaliskan, C., Gencay, A., 2002. Prevalence, distribution, and host range of Peste des petits ruminants virus, Turkey. Emerging infectious diseases 8, 709.