Wageningen University - Department of Social Sciences

MSc Thesis Chair Group Communication, Philosophy and Technology

Framing tick management

The influence of science on human-livestock-wildlife interaction

March 2017

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Thesis code: CPT-81324

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Acknowledgment

As a student in Animal Sciences, conducting a minor thesis within the Communication, Philosophy and Technology group was a new experience. The original plan for this thesis was to be part of a PhD study and travel to Laikipia in Kenya to interview different actors. As the research permit seems to give obstacles, the plan changed. The second plan was to go to Cairngorms national park in Scotland to interview different actors. However, also this idea did not come to a successful sequel. So, since half November I started with this current thesis.

I would like to thank my supervisor, Prof. P.H. Feindt, for his guidance and positivity. For me, this support meant a lot, since performing this thesis did not go without setbacks. Besides, I would like to thanks the PhD students of the EVOCA project who helped me during the preparations. At last, I would like to thank Richard Chepkwony and Sarah Morton for their experts' view on the topic in the case study areas. Without their help and their feedback, this study could not have been conducted.

Abstract

Disease transmission is occurring in almost every human-livestock-wildlife area. Ticks are among the most important vectors and cause tick-borne diseases and mortality for livestock, wildlife, humans, and companion animals. To combat ticks and tick-borne diseases, several decisions on tick management practices are made by stakeholders. While going through the different decision making phases, searching information is a process that decision makers do during all phases. However, decision makers have a higher preference for accessibility rather than quality information sources and people use barely formal sources, but prefer to obtain and apply information from informal sources. Written information is communicated with different stakeholders and can contribute to the decision making process of stakeholders consciously or unconsciously. Framing theory analysis how the content is presented to an audience and is used to construct, refine and deliver messages. Framing is applied in both the academic literature and in practice-oriented sources and can influence tick management in human-livestock-wildlife interfaces.

Therefore, the objective of this research is to understand how framing influences tick management in a human-livestock-wildlife interaction. For this analysis, data was collected from scientific articles (=23), practice-oriented sources (=10) and expert interviews (=2). The practice-oriented sources were selected in two case study areas, Cairngorms national park in Scotland and Laikipia county in Kenya. Problems, causes, moral judgements, prescriptions and authors were analysed through inductive coding with Atlas TI.

In the academic literature, a fragmented framing analysis concerning tick management was found, since meta-frames were synthesized from a broad range of different frames. Overall, in the academic literature, tick management was framed by the troublemaker-meta-frame, the chemical solution meta-frame, the monitoring and prevention meta-frame, unknown prevention method meta-frame, the tick induced meta-frame and the spread of ticks and tick-borne diseases meta-frame. In the practice-oriented sources, tick management was framed more coherent. In the practice-oriented sources, tick management was framed by the troublemaker meta-frame, the human health meta-frame and the chemical solution meta-frame, which consisted of overlapping frames. With regard to Laikipia, the practice-oriented sources framed tick management more in the direction of social and economic problems and social solutions, while in practice, the chemical solution meta-frame was confirmed by the expert. With regard to Cairngorms, the practice-oriented sources framed tick management more in the direction of social problems and technical and chemical solutions. In practice, the human health meta-frame was confirmed by the expert. In the comparison between the scientific literature and the practice-oriented sources, four overlapping frames were found. However, in all these four frames, at least one linked frame element was different. Besides, two overlapping meta-frames were found. However, it can be concluded that also these meta-frames were not overlapping completely. Still many gaps were present in these meta-frames from the academic articles and practice-oriented sources. For example, the troublemaker meta-frame, found in the practice-oriented sources, included mainly culling as solution, while in the academic literature, many alternative prescriptions were mentioned. Besides, the chemical solution meta-frame consisted different problems and causes in the academic articles and practice-oriented sources. So, this meant that chemical solutions were framed as the answer to all types of problems and causes concerning ticks and tick-borne diseases, as long as there are no good other tick management practices available.

Overall, these framing perspectives showed the difficulties and challenges of tick management in the human-wildlife-livestock interaction. Therefore, it is recommended to reframe the scientific literature to communicate one clear message to practitioners. Also a better cooperation between science and practitioners will help to address the same problems.

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1. Introduction

In this chapter the description of the problem will be described, followed by the research questions, expectations and conceptual framework.

1.1. The description of the problem

Worldwide ticks are a problem, since they cause tick-borne diseases in humans and animals. Problems got more complicated in areas where humans and animals interact. Therefore, first the characteristics of a human-livestock-wildlife interaction are described. In addition, the role of ticks and tick management are defined.

1.1.1. Characteristics of a human-livestock-wildlife interaction

When looking at human-livestock-wildlife interaction, conflicts occur and problems need to be solved. Conflicts are increasing, because of the increased pressure on land and the overlap of territories of human, livestock and wildlife (Aranaz et al. 2004). Wildlife population increased due to loss of predators and since game became part of agriculture due to increased recreation hunting industries (Aranaz et al. 2004, Boadella et al. 2011). Besides, more livestock are kept by farmers worldwide (FAO 2013). Conflicts between human, livestock and wildlife that can occur are about the predation of livestock, forage competition, damage and spread of diseases (Mizutani et al. 2005; Denney 1972; Gadd 2005). Although predation of livestock is not the case in all human-livestock-wildlife interfaces, disease transmission is.

Diseases are the biggest cause of mortality of livestock and a bigger problem than predation, accidents, plant poisoning, snake bites or theft for as well sheep, goat and cattle. Besides mortality, costs associated with prevention and treatment of diseases is high (Denney 1972; Mizutani et al. 2005). Diseases can easily spread between livestock and wildlife because of the movement of infected animals, which result in direct contact between infected and susceptible animals. Secondly, indirect contact can be a cause of spread of diseases, since viruses from infected animals can be transported mechanically by persons, animals, vehicles or fomites. Thirdly, the feeding of contaminated animal products to livestock contribute to the spread of diseases. At last, for short distances, wind can also be a factor (Alexandersen et al. 2003).
It is difficult to eradicate diseases, since livestock can act as reservoir themselves, but wildlife can also act as host for most livestock diseases. This is because many wildlife is susceptible for the same diseases as livestock (Aranaz et al. 2004). When disease eradication programs reduced incidence of diseases in livestock, still disease outbreaks occur, since wildlife can act as a source of infection for livestock (Little et al. 1982; Aranaz et al. 2004). For example, several disease outbreaks of the Avian influenza virus were reported in different countries since 1996. Avian influenza causes mortality in poultry, and wild and domestic birds. Carriers of the avian influenza H5N1 virus that were detected were domestic pigs, domestic cats, ducks and waterfowls (Dudley 2008). Another example is Foot-and-Mouth Disease (FMD), a viral disease affecting both domesticated and wild cloven-hoofed animals worldwide (Alexandersen et al. 2003). It is established that the African buffalo can carry the virus for up to five years and carrier animals play a role in disease outbreaks (Condy et al. 1985; Alexandersen et al. 2003).

1.1.2. The role of ticks

After the tsetse fly, ticks are the main cause of diseases and mortality of livestock (ASDSP 2014). Besides, ticks are among the most important vectors of diseases affecting livestock, humans, and companion animals. They affect 80% of the world cattle population and are widely distributed throughout the world, particularly in tropical and subtropical countries (Ghosh 2007). However, also in colder climate regions, ticks and reported tick-borne disease cases are increasing due to climate change and increasing numbers of hosts (Sargison and Edwards 2012; Mierzejewska et al. 2015). For

example, Jaenson et al. (2012) did a research about the geographical distribution and abundance of the Ixodes ricinus tick in Sweden during the past thirty years. They found that between 1990 and 2009 this tick has expanded its range in the Northern part of Sweden and had become more abundant in the Southern and Central parts of Sweden.
Nevertheless, ticks can best survive in places with a medium till high rainfall and a dense mat of vegetation. Ticks can therefore easily survive in hill, upland and rough grazing areas, but also in drier, low ground districts like filed margins, hedgerows, woodlands, conservation areas and along the banks of streams and drainage ditches (Sargison and Edwards 2012). Moreover, places with big herbivores have a higher tick abundance than areas without big herbivores (Keesing et al. 2013).

Ticks are complicated species and difficult to prevent. They are vector-host species who feed themselves with the blood of a host. Hosts can be small and big mammals, birds and humans (Cleaveland et al. 2001). Ticks have several life stages, egg, larvae, nymph and adult. In the last three live stages, they take up to three meals from a host to feed themselves. During these meals, ticks spread pathogens which can infect multiple host species. Dependent on the tick species, they use one till three hosts and infect human, livestock and wildlife (Knopf et al. 2002; Randolph 2004; Keesing et al. 2013). Ticks spend the start of their life, as well as the intermedium time between the meals, in the environment. They depend on their habitat and the existing climate. The development from egg to larvae is most favourable during the warm wet season, while the intermedium periods are favourable during warm temperatures (Randolph 2004).

Overall, tick species are divided in hard ticks and soft ticks. Eighty percent of the total tick population consist of hard ticks (Ixodid ticks) and the other 20% of soft ticks (Argasid ticks). The most important genera of Argasid ticks are Argas, Ormithodoros and Otobius. They cause diseases like Aegyptianellosis, Avian borreliosis, African Swine Fever and Severe otitis (Jongejan and Uilenberg 2004). The most important genera of Ixodid ticks are Amblyomma, Boophilus, Dermacentor, Haemaphysalis, Hyalomma, Ixodes and Rhipicephalus. They cause diseases like Theileriosis including East Coast Fever, Corridor disease and January disease, Bovine babesiosis including Redwater and Tick Fever, Tick Borne Encephalitis (TBE) including Louping ill virus in sheep, Anaplasmosis, Cowdriosis (Heartwater), Sweating sickness, Lyme borreliosis, Tick Borne Fever and Nairobi Sheep Disease (Irvin 1987; Denney 1972; Jongejan and Uilenberg 2004; Randolph 2004; Osofsky et al. 2005). Exposure to ticks is the biggest cause of tick burden and, dependent on the disease, it can result in illness, productivity loss or even mortality in human, livestock and wildlife. (Knopf et al. 2002; Peeler and Wanyangu 1997). In Europe, the most common tick is the Ixodes ricinus. They use three hosts and the complete life cycle takes two till three years in Europe (Wolters 2010). In tropical countries, it is possible to observe more than one life stage change in one year (Knopf et al. 2002).

1.1.3. Tick management

Additional to those human, livestock and wildlife that got directly infected by tick-borne diseases, human also suffer indirectly. Human suffer when their livestock get sick or face mortality, because of productivity loss. Secondly, spread of diseases, sickness or mortality of wildlife result in economic losses, since lack of tourism. Thirdly, all human can be affected by ticks themselves, like Lyme disease and TBE (Jongejan and Uilenberg 2004).

During the last couple of years, many research has been done on ticks, tick-borne diseases and tick management in a livestock-wildlife interface, because of the rapid increase in the number of zoonotic diseases associated with wildlife (Decker et al. 2010). However, these researches can be equal or conflicting. Irvin (1987) and Dantas-Torres et al. (2013) mentioned that to control, eliminate or reduce ticks and the spread of tick-borne diseases, a coordinated action is needed. However, in the past, introduced disease control methods that relied on public goods failed, because these new

introduced technologies were not sustained over time. Local communities lost interest and willingness to make financial and other contributions, because of free riders (people who benefit without contributing). For example, different developing programs introduced traps and targets to prevent and eliminate tsetse flies. These programs were successful in eliminating tsetse flies at the start, but the tsetse flies came back, because of lack of maintenance of the traps (Barrett and Okali 1998). However, also some eradication programs were successive during the past. For example, the brucellosis and tuberculosis eradication campaign was conducted in Australia from 1970. Seven years later, bovine tuberculosis was successfully eradicated in Australia (Radunz 2006).

To combat ticks and tick-borne diseases, several tick management practices are used by stakeholders. In the case of combating ticks and tick-borne diseases, stakeholders who actively implement tick management practices are farmers. The decision making process of farmers is based on four phases; problem detection, problem definition, analyses and choice, and implementation (Ohlmer et al. 1998). The results of these phases are influenced by their knowledge and experience. So, every farmer makes its own decisions and therefore it is difficult to find a good coordinated practice in which all stakeholders want to contribute. The success of new introduced interventions often depends on the way in which individual decisions are made. However, intervention strategies can be made more successful by engaging local communities (Bentley and Ormerod 2010).
While going through the different decision making phases, searching information is a process that farmers do during all phases (Ohlmer et al. 1998). For obtaining proper knowledge, decision makers need to make use of information sources. However, decision makers have a higher preference for accessibility rather than quality information sources (O'Reilly 1982). Besides, decision makers use barely formal sources, like those of educational institutions, but prefer obtain and apply information from informal sources. Therefore, decision makers obtain their knowledge not always directly from educational institutions or research institutions, but also from sources like media (television programs, radio, internet discussions, Facebook updates, etc.) and trusted persons (veterinarians, national parks, friends, etc.) (Mai 2016). Media can act as the voice of the interests of society, but media is also the most important source of information for most people (Kleinschmit and Krott 2008).
However, media obtain their information from other sources. So, the knowledge from research is not directly interpreted by decision makers, like farmers, wildlife authorities, civilians and tourists, but are first translated by veterinarians, government, authorities, instances, websites, etc., into readable documents or oral information.

Only the sharing of information will not lead to a specific change in behavior and information provided by other instances or communities are not always accepted (Bentley and Ormerod 2010). However, information sources communicate knowledge to different stakeholders and can contribute to the decision making process of stakeholders consciously or unconsciously (Kleinschmit and Krott 2008).
This presentation of information is called framing and this influence the choices people make. Frames are used for all types of information and by all types of different sources. So, framing is applied in both the academic literature and in public sources and can have influence on tick management in human-livestock-wildlife interaction. Therefore, the objective of this research is to understand how framing influence tick management in human-livestock-wildlife interaction.

1.2. The research question

How is framing influencing tick management in human-livestock-wildlife interaction?

- How is tick management framed in academic literature?
- How is tick management framed in public-oriented sources by different actors in different human-livestock-wildlife areas?

- What are the differences and similarities in framing tick management between different human-livestock-wildlife areas?
- What are the differences and similarities between framing in scientific literature and in practice oriented contexts?

1.3. Expectations

I expect that I will find a broad range of frames in the academic literature, since researchers do research from different points of view. However, I expect that several researchers mention the same frames, because they probably read each other's research. For the different practice-oriented sources in human-livestock-wildlife areas, I expect that less frames will be found, as these practice-oriented sources use different academic articles as starting point and also use self-conducted studies. Therefore, I expect differences between scientific literature and practice-oriented sources.
Between the different human-livestock-wildlife areas, I expect that practice-oriented sources in Cairngorms national park will use less different frames, while in Laikipia county a broader range of frames is used. This because ticks and tick-borne diseases are a bigger problem in more humid warm climates and therefore, more different research is conducted in Laikipia considering ticks and tick-borne diseases. Besides, Cairngorms national park is located in Scotland, which is more developed and therefore better access to tools to combat ticks and tick-borne diseases are available. This can result in a relative smaller problem, since less alternative tick-control practices are needed, so less different research. Another point is that helping an African country with a problem is much more interesting than a developed country in Europe. This will result in researchers from all over the world going to Laikipia, while probably only European researches doing research in Cairngorms national park.

1.4. Conceptual framework

Framing theory reveals how a topic is presented to an audience and is used to construct, refine and deliver messages. Framing is described by Entman (1993) as:
'To frame is to select some aspects of a perceived reality and make them more salient in a communication text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described.'

So, frames define problems, analyse causes, make moral judgements and suggest solutions. Besides, frames can be seen in four different locations; the communicator, the text, the receiver and the culture. The communicator is the author or source who makes the frames by mentioning topics at a certain way. The text contains frames. The text consists of certain keywords or sentences that reinforce each other and can highlight a message or fact. The receiver is the reader who based their decision making on a certain text and may be influenced by this text or the author who wrote it. The culture is a set of common frames generated in the thinking of most people in a social grouping (Entman 1993).

Dewulf et al. (2009) constructed two approaches of framing in conflict research. Distinction can be made between frames as cognitive representations and as interactional co-construction. Framing as cognitive approach interpret frames as knowledge structures and is located in the individual mind and is dependent on how individuals understand, process and interpret information. The interactive construction of framing focussed on how groups co-construct meanings while they are communicating. So, Interactive framing is depending on the reaction of a group to each other's communication (Dewulf et al. 2009).
Another way to define framing was by the concept of Van Hulst and Yanow (2016). This concept is established in public policy, but can be used as well. This concept distinguish frames and framing. The concept of frames is more adequate to the cognitive representation of Dewulf et al. (2009), since

frames are seen as elements that are saved in peoples head and further developed and changed for strategic purposes. So, frames guide the way of thinking of people (Van Hulst and Yanow 20016). The concept of framing is more adequate to frames as interactional co-construction, since framing is more about how frames are constructed. It offers a more dynamic understanding of a situation, since interactive processes between people or groups of people are included (Dewulf et al. 2009; Van Hulst and Yanow 2016).
Since this research is conducted to find out how framing in the academic literature influence framing in practice-oriented sources, and less these groups solely, this research will focus more on the interactive construction of framing.
However, for this research, the conceptual approach of framing by Entman (1993) is selected, since this was most applicable to apply.

Therefore, problems, causes, moral judgements and prescriptions as frame elements are used to define frames. When combining these frame element, then a frame is formed. A frame should consist of at least two different frame elements linked by at least two different academic articles or practice-oriented sources, since it is important to find frames in academic literature or practice-oriented sources overall. After this is the case, other remaining linked frame elements were added. For example, when Article A and Article B mentioned a common cause is relation to a common problem, I searched for a linked prescription or moral judgment in these articles. The most complete frame is a frame where all four different frame elements are linked. This is showed in Figure 1.

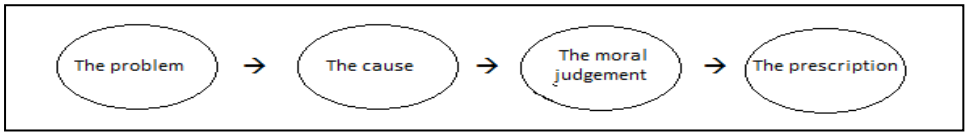

Figure 1: A frame

When more than one frame is available, patterns can be found. A pattern of frames is called a meta-frame. Examples of meta-frames are shown in Figure 2. Meta-frames are overarching frames which can be deficient and can have limited overly. They analyse and categorize events and processes related to various issue areas (Auerbach and Block-Elkon 2005). However these meta-frames are a combination of frames and can have influence on the consciousness of people, their decision making and at the end, will have effect on ticks, human, livestock and wildlife.

Framing → consciousness → decisions → effect on human/livestock/wildlife etc

The problem	**→ The cause**	**→ The moral judgement**	**→ the prescription**
Problem A	→ Cause A	→ Moral judgement A	→ Prescription A
Problem B	→ Cause A	→ Moral judgement A	→ Prescription A
Problem C	→ Cause B	→ Moral judgement A	→ Prescription A
Problem C	→ Cause B	→ Moral judgement A	→ Prescription C
Problem C	→ Cause B	→ Moral judgement C	→ Prescription C
Problem C	→ Cause B	→ Moral judgement B	→ Prescription A
Problem A	→ Cause C	→ Moral judgement B	→ Prescription B
Problem C	→ Cause C	→ Moral judgement B	→ Prescription B

Figure 2: Meta-frames

To implement this conceptual framework, the material and methods will be explained and followed by the results, discussion and conclusion.

2. Material and methods

This research is an exploratory study in which the first insights will be given about framing in academic literature and practice-oriented sources. This will help to uncover the further research needs. First the data collection is described, followed by the data analysis and research limitations.

2.1. Data collection

This research made use of multiple methods to take advantage of triangulation. Triangulations is the use of multiple data sources to produce understanding and to ensure that the results are consistent (Golafshani 2003). This research combined a literature research with expert interviews. The data collected were literature (academic articles), public available information (practice-oriented sources) and expert interviews.

2.1.1. Literature

Scientific articles were derived from the Wageningen University Library, because of the full access to this literature. They were sampled by full text search. First, all academic articles which contained at least one of the keywords: 'Livestock wildlife interface', 'Livestock wildlife human interface' or 'wildlife human interface' in relation to 'tick' or 'ticks', were selected. This resulted in 28 academic articles. Second, all academic articles where viewed and were manually selected. At least one paragraph should be focused on tick-borne diseases, ticks or tick management and the research should be conducted in an area where at least two out of three categories (livestock, wildlife or human) were interacting or in close contact. Third, all scientific articles that did not meet these criteria were excluded, because they were not expected to contain relevant statements for the analysis. Finally, 23 academic articles were selected for analysis.

2.1.2. Case studies

Study area

The original idea for this research was to conduct interviews about ticks, tick-borne diseases and tick management with actors in Laikipia county in Kenya, since the Environmental Virtual Observatories for Connective Action (EVOCA) study is conducted in cooperation with the Wageningen University and Research. One of the projects in this EVOCA study is about tick-born disease and livestock-wildlife management in Kenya and the idea was to be part of this case study. However, since it was not possible for me to do research in Kenya due to regulations, another area is searched for to do a comparative analysis. So, two human-livestock-wildlife areas were used as case studies; Cairngorms national park in Scotland and Laikipia in Kenia. These areas were chosen, since both have a human-livestock-wildlife interface and many researches on ticks and tick-borne disease were conducted in both areas. The differences between the problems and geography of the case study areas were interesting to do a comparative analysis.

Public available information

Ten practice-oriented sources were derived from the search tool Google, of which five in every area. Although the use of Google gave some additional problems, like Google gives personal search results and they make use of sponsored search results, Google is the most used searching tool. Every month 1.6 billion visitors were estimated (eBizMBA rank 2017). Therefore it is assumed that actors searching for information, collect it from the search tool Google as well. Hence, practice-oriented sources were collected by Google using the keyword 'tick' and the key phrase in the form of the name of the area ('Cairngorms national park' or 'Laikipia Kenya'). Second, the practice-oriented sources were selected manually on their consisting information on ticks, tick-borne diseases or tick management. Besides, the origin of the source was important, since different types of internet sources are used in daily life. Moreover, the place of the source was important, because only the first few mentioned sources were selected. This was for the reason that people read in a F-shaped pattern and select the first articles

available (Nielsen and Norman 2014). Third, all sources that did not report at least one paragraph on tick-borne diseases, ticks or tick management were excluded, because they were not expected to contain relevant statements for the analysis.

Interviews

To validate the results of the practice-oriented sources, two expert interviews were conducted with use of a semi-structured interview. For the expert interviews, two experts were selected, one for every area. The experts were selected based on their prolonged presence in the area, their knowledge about ticks and their intensive contact with different actors and therefore, had a good overview of what people considered as important in the area of interest. Interviewees were Sarah Morton for Cairngorms national park and Richard Chepkwony for Laikipia Kenya. During the search for a second case study area, contact was been made with the Cairngorms National Park Authority (CNPA) in which they linked me to Sarah Morton. She is a researcher doing research about ticks and Lyme disease in the Highlands of Scotland. Richard Chepkwony is one of the PhD students doing the case study about ticks that is part of the EVOCA study. Therefore connection was already made on an early stage of this research. Besides, being a researcher in this study, he also works for the Kenyan Wildlife Service (KWS) in Laikipia. Both interviews were conducted by Skype and recorded. Questions were asked about the different actors in the area and their perception about ticks, tick-borne diseases and tick management. Besides, questions were asked about their view of the results found in the practice-oriented sources.

2.2. Data analysis

The framing approach was used on the remaining academic articles and practice-oriented sources. All text was coded on two different levels; the frame elements and the actors. I revealed the frame elements by describing the problems, causes, moral judgements and prescriptions in relevance of ticks, tick-borne diseases or tick management. The definition of the problems was: 'What are the problems in relation to ticks, tick-borne disease or tick management?' The definition of the causes was: 'What are the causes mentioned in the articles in relation to the problems mentioned in the article?' The definition of moral judgements was: 'What does the author defines as wrong, good, bad, bizarre, surreal, ethical, etcetera?' The definition of the prescriptions was: 'What are the solutions mentioned in the articles in relation to the problems mentioned in the articles or to decline the causes?' The actors were coded by their group and by their tasks, obligation or function. 'So, what are the functions or obligations of the mentioned actor categories in the articles?'

All text sources were analysed with Atlas TI and inductive coding. Atlas TI is a technical tool for analysing data that is helpful for the coding of different text sources, audio fragments, figures and movies, and the analysis of them. Inductive coding is the selection of sentences or words that have the same topic. With inductive coding it is possible to make up codes immediately for the relevant text instead of describing all codes before.

The frame elements of both the scientific articles and practice-oriented sources were assembled. As it was important to find frames in scientific literature or practice-oriented sources overall and not for one particular academic article or practice-oriented source, for every common found problem, cause, moral judgement or prescription, I searched for linked frame elements. A common frame element should be described by at least two academic articles or two practice-oriented sources.

After describing all frames, I searched for patterns to find meta-frames. This was done for the academic literature and practice-oriented sources separately. After that, a comparative analysis was done to find out if the same frame elements, frames and meta-frames were used in academic literature and practice-oriented sources. Besides I did a comparative analysis between the two case study areas to find out if the same or different frame elements, frames and meta-frames were used

in both case study areas. The interviews were used to validate the results from the practice-oriented sources in the comparative analysis between the case study areas. The frame elements (problems, causes, moral judgements and prescriptions) and the authors were described from the interviews and compared with the analyse of the practice-oriented sources of their areas.

2.3. Research limitation

A few research limitations could be found for this research. Firstly, the research period was only four months. This meant that it was needed to select the academic articles and practice-oriented sources strictly. When more time was available a bigger data source could be used for as well academic literature as practice-oriented sources. This would probably have resulted in more found frames, since there is a higher change that certain problems, causes, prescriptions or moral judgements were confirmed by other academic articles or practice-oriented sources. Besides, now only five practice-oriented sources for every case study area were used, while when visiting the areas, probably poster, leaflets and brochures could be found as well in the areas themselves. Now, these practice-oriented sources were searched only on the internet. Moreover, visiting the area would enable me to interview the stakeholder or to start a focus group in the respective areas. To compensate this, the expert interviews were done to validate the data. In addition, due to the research period, only two case study areas were selected. More areas in one region or continent probably would have resulted in results that were stronger and had a higher validation.

Secondly, it was dependent on the search terms which academic articles and practice-oriented sources were collected. The academic articles were selected, since more specific search terms resulted in more specialised academic articles. This could have caused a bias, as the academic articles were chosen on their topics and so, indirectly, on their frames and frame elements. Besides, for the academic literature, I only used the Wageningen University library which can give a bias in literature. Due to the specific focus of the Wageningen University, a select group of research articles were selected which all had the same type of background. Besides, the selection of practice-oriented sources was manually, what gave a bias as well. This was done, since the diversity of the sources was important due to the different topics addressed by these websites. Lastly, these sources were found with use of English search terms. However, the use of the local language in Laikipia county had probably resulted in sources that the Kenyan actor read more often. However, this was not possible, since it is difficult to translate text correctly and probably important sentences will be translated wrongly.

For the analysis of the academic articles and practice-oriented sources, I used inductive coding. When deductive coding was used, then frame elements which were not common to use, would not be mentioned while they could be interesting as well. Besides, I coded all academic articles and practice-oriented sources myself. However, this way of analysis can still be subjective and sentences can be read over or wrong interpreted. Besides, sentences can be coded, while this should not be the case. In this way, there can be some bias.

With regard to this research limitations, the results are described in the next chapters. First, the literature is reviewed, followed by the review of the practice-oriented sources. In chapter five, the comparative analysis is described.

3. Review literature

In this chapter the results are described for the question: How is tick management framed in academic literature? In this chapter, first the common problem elements with their frames were described, followed by the cause elements and the frames, the moral judgement elements and the frames and the prescription elements with the frames. Every common mentioned frame element was used to search for other linked frame elements. All results were written in a particular order. First, the frequency of coding and the number of academic articles describing the frame element were mentioned. Second, the commonly linked frame elements were described, together with the corresponding other frame elements. At last, any other relevant connected frame elements were described. In the fifth sub-heading the authors were described and in the last sub-heading the found frames and meta-frames.

The 23 analysed scientific articles were described in Table 1.

Table 1: The analysed scientific articles

No.	Author(s)	Title
1	Miller et al. (2013)	Diseases at the livestock wildlife interface Status, challenges, and opportunities in the United States
2	Walker et al. (2014)	Disease at the wildlife livestock interface Acaricide use on domestic cattle does not prevent transmission of a tick borne pathogen with multiple hosts
3	Mbizeni et al. (2013)	Field and laboratory studies on Corridor disease in cattle population at the livestock game interface of uphongolo Mkuze area, South Africa
4	Smith and Parker (2010)	Tick communities at the expanding wildlifecattle interface in the eastern cape province, South Africa Implications for corridor disease.
5	Grootenhuis and Olubayo (1993)	Disease research in the wildlife livestock interface in Kenya
6	Munang'andu et al. (2009)	Detection of Theileria parva antibodies in the African buffalo in the livestock wildlife interface areas of Zambia
7	Wamuyu et al. (2015)	Molecular detection and characterization of Theileria infecting wildebeest in the Maasai Mara national reserve, Kenya
8	Ghai et al. (2016)	Limited sharing of tick-borne hemoparasites between sympatric wild and domestic ungulates.
9	Eygelaar et al. (2015)	Tick-borne haemoparasites in African buffalo from two wildlife areas in Northern Botswana
10	Burridge et al. (2002)	Increasing risks of introduction of heartwater onto the American mainland associated with animal movements.
11	Perez de Leon et al. (2010)	One health approach to identify research needs in bovine and human babesioses Workshop report.
12	Munang'andu et al. 2012	Detection of parasites and parasitic infections of free ranging wildlife on a game ranch in Zambia A challenge for disease control
13	Mwamuye et al. (2016)	Novel rickettsia and emergent tick borne pathogens A molecular survey of ticks and tick borne pathogens in Shimba Hills National Reserve, Kenya
14	Millan et al. (2016)	Molecular detection of vector borne pathogens in wild and domestic carnivores and their ticks at the human wildlife interface
15	Anderson et al. (2013)	Tick infestation patterns in free ranging African buffalo: Effects of host innate immunity and niche segregation among tick species.
16	Liyanaarachchi et al. (2015)	Ticks infesting wild and domestic animals and humans of Sri Lanka with new host records
17	Singh and Gajadhar (2014)	Role of India's wildlife in the emergence and re-emergence of zoonotic pathogens, risk factors and public health implications
18	Khatri-Chhetri et al. (2016)	Surveillance of ticks and associated pathogens in free ranging Formosan pangolins.
19	Boyard et al. (2008)	The relationships between ixodes ricinus and small mammals species at the woodland pasture interface.
20	Duscher et al. (2015)	Wildlife reservoirs for vector-borne canine, feline and zoonotic infections in Austria
21	Nakayima et al. (2014)	Detection and characterization of zoonotic pathogens of free ranging non-human primates from Zambia.
22	Haji et al. (2014)	Occurrence of haemoparasites in cattle in Monduli district, northern Tanzania.
23	Poo-Muñoz et al. (2016)	Fleas and ticks in carnivores from a domestic wildlife interface Implications for public health and wildlife.

3.1. Problem frames

In total 39 different problem frame elements were described by the academic literature of which all were described in relation to ticks, tick-borne diseases or tick management. These frame elements can be divided in three different topics; ecological problems, economic problems and social problems. Ecological problems are problems in where nature or animals face problems which human do not face directly. For the economic problems, human should face direct economic consequences. For social problems, humans should face direct consequences which are not economic. Afterward, for every common described problem, linked causes, moral judgements and prescriptions were described.

The most frequently described frame element was the sociological problem of 'human health' and the problems mentioned by most different academic articles were 'spread of pathogens', 'spread of diseases' and 'mortality in general' (Table 2).

Table 2: The problem codes mentioned by most different academic articles

Rank	Type of problem	Problem code	Articles	Frequency
1	Ecological	Spread of pathogens	12	25
2	Ecological	Spread of tick-borne diseases	12	22
3	Economic	Mortality general	12	21
4	Social	Livestock disease	11	18
5	Economic	Economic general	10	15
6	Social	Human health	9	26
7	Ecological	Emergence of diseases	9	17
8	Ecological	Introduction of tick-borne disease	8	20
9	Ecological	Infect multiple hosts	8	10
10	Ecological	Vector of tick-borne disease	8	9

3.1.1. Ecological problems

In total, twenty different ecological problems were mentioned of which six problems by more than eight different academic articles (Table 2).

The most frequently mentioned ecological problem was the 'spread of pathogens'. This problem was mentioned 25 times in total by twelve different papers. Five common causes were described by at least two different papers. The cause the 'vector origin' of ticks was mentioned by Poo-Muñoz et al. (2016), Ghai et al. (2016) and Smith and Parker (2010). Furthermore 'interaction' between livestock and wildlife was described by Walker et al. (2014) and Ghai et al. (2016), 'habitat overlap' between livestock and wildlife was described by Ghai et al. (2016) and Eygelaar et al. (2015), 'wildlife act as reservoir' was described by Walker et al. (2014) and Perez de Leon et al. (2010) and 'migration' of wildlife' was mentioned as common cause by Wamuyu et al. (2015) and Burridge et al. (2002). There were no prescriptions mentioned by at least two academic articles. However, Walker et al. (2014) described the prevention method of 'fencing' to avoid the interaction of livestock and wildlife and the 'use of acaricides' to combat the spread of pathogens. Perez de Leon et al. (2010) described 'vaccination' of tick hosts animals and 'treatment of wildlife' as prescriptions to reduce the number of wildlife reservoirs. The problem 'spread of pathogens' was linked with the problems of 'tick transmission' and 'spread of tick-borne diseases'.

The second most frequently described ecological problem was the 'spread of tick-borne diseases'. This problem was quoted 22 times in total by twelve different papers. Four common causes were mentioned for the problem by at least two academic articles. Smith and Parker (2010) and Mwamuye et al. (2016) mentioned the 'vector origin' of ticks as the cause of the spread of tick-borne diseases. Mwamuye et al. (2016) and Khatri-Chhetri et al. (2016) described that the possibility of pathogens to 'infect multiple hosts' causes a spread of tick-borne diseases, while Khatri-Chhetri et al. (2016) and Munang'andu et al. (2012) described the 'spill-over mechanism' between wildlife and livestock as the

cause. Eygelaar et al. (2015) and Khatri-Chhetri et al. (2016) described 'wildlife as reservoir' as cause for the problem. Besides, Eygelaar et al. (2015) prescript 'surveillance' as solution to the problem. Munang'andu et al. (2012) described 'developing prevention method' and the 'use of acaricides' as solution to the spill-over mechanism and as solution to the problem. In addition, Burridge et al. (2002) described 'chemical prevention methods' as solution to the problem, of which 'use of acaricides' is part of. Therefore one common prescription in relation to the problem was mentioned by Munang'andu et al. (2012) and Burridge et al. (2002). Other causes in relation to this common prescription mentioned by Munang'andu et al. (2012) were 'increase in wildlife population' and 'spill-over mechanism'. Burridge et al. (2002) described this common prescription in combination with the causes; 'import of animals', 'introduction of infected ticks' and 'infection of ticks by subclinical carriers'. Smith and Parker (2010), Mwamuye et al. (2016) and Khatri-Chhetri et al. (2016) mentioned no prescription to the problem. At last, the spread of tick-borne diseases was combined with other problems as 'productivity loss', 'economic problems in general', 'human health' and 'livestock health'.

Third, the 'introduction of tick-borne diseases' was stated. The 'introduction of tick-borne diseases' was described twenty times by eight academic papers. Of these eight papers, Mbizeni et al. (2013) and Perez de Leon et al. (2010) saw it as a social problem since 'mortality' can occur and can infect 'human health'. However, most papers noticed the problem of the introduced ticks and tick-borne diseases as that they can be easily maintained (or 'maintenance of tick population') and can lead to a 'disease outbreak' which cause 'mortality' in livestock and wildlife. Three common causes were connected. 'Wildlife as reservoir' was mentioned by Walker et al. (2014), Burridge et al. (2002) and Perez de Leon et al. (2010) as cause for the (re-)introduction of tick-borne diseases. Besides, Walker et al. (2014) also mentioned 'livestock as reservoir' for re-introduction. Next to this, the common causes 'import of animals', which was described by Eygelaar et al. (2015) and Burridge et al. (2002), and 'migration', which was described by Perez de Leon et al. (2010) and Burridge et al. (2002), were linked. The 'introduction of tick-borne diseases' can be prevented by a better 'screening' method, 'use of acaricides', 'treatment of wildlife', 'a combination of prevention methods' and even 'prohibit import' of specific species following Burridge et al. (2002). Besides, also one common prescription was mentioned by Mbizeni et al. (2013) and Burridge et al. (2002); 'use of acaricides', which is part of 'chemical prevention methods'. Mbizeni et al. (2013) did not mentioned a cause and Burridge et al. (2002) mentioned this in combination with the causes 'international trade', 'import of animals', 'absence of adequate screening' and 'migration'.

At the fourth place, the 'emergence of tick-borne diseases' was mentioned as problem. This problem was mentioned seventeen times by nine academic articles. The problem of tick-borne diseases is that they emerge and re-emerge in all localities at the livestock-wildlife interface. Two common causes were linked. The cause 'wildlife as reservoir' was mentioned by Munang'andu et al. (2009) and Duscher et al. (2015) and 'forest management' was mentioned by Singh and Gajadhar (2014) and Boyard et al. (2008). The 'encroachment of wildlife habitats' and the 'increase of wildlife population' were mentioned as cause as part of this forest management. No prescriptions were related to this problem or common causes.

As fifth, 'tick transmission' was framed as problem. This problem was mentioned fourteen times by seven papers. Two common causes were connected with the problem of tick transmission, 'the environment in general' and 'migration'. 'The environment in general' as cause was described by Liyanaarachchi et al. (2015), Boyard et al. (2008) and Duscher et al. (2015) and 'Migration' by wildlife or livestock was described by Singh and Gajadhar (2014) and Duscher et al. (2015). No prescriptions were mentioned for this problem. Eygelaar et al. (2015) and Liyanaarachchi et al. (2015) mentioned the problem 'spread of pathogens' in combination with tick transmission.

The sixth most frequently mentioned problem was the 'maintenance of the tick population'. This problem was coded twelve times by seven different papers. Two common causes were mentioned. Walker et al. (2014), Grootenhuis and Olubayo (1993), Perez de Leon et al. (2010) and Duscher et al. (2015) framed 'wildlife as reservoir' as cause and Perez de Leon et al. (2010) and Duscher et al. (2015) framed the 'environment in general' and 'ecological factors in general' also as common cause. Only Walker et al. (2014) gave a prescription for the problem of the 'maintenance of the tick population'. This academic article mentioned the 'use of acaricides' as solution.

The problem 'ecological in general' was mentioned three times by two different papers. Eygelaar et al. (2015) and Walker et al. (2014) both mentioned the 'ecological problem in general' in combination with the common problem 'economic in general'. Besides, they both framed the 'use of tick control method acaricides' as the common cause to this problem. No prescriptions were mentioned in relation to this problem.

Besides, the 'maintenance of tick-borne diseases' was described six times by five different papers. Grootenhuis and Olubayo (1993) and Wamuyu et al. (2015) both framed the common cause 'wildlife as reservoir'. No prescriptions were described by these authors in combination with this problem and common cause.

Furthermore, ecological problems as 'diseases outbreak', 'the vector of tick-borne diseases', 'increasing tick-borne disease infestations', 'infection rate', 'infection of multiple hosts', 'spread of parasites', 'development of resistance', 'recovering tick population', 'wildlife disease', 'distributed worldwide', 'change in epidemiology of tick-borne diseases' and 'wildlife health' were mentioned as ecological problems. However, these problems were not linked into more fully articulated frames

3.1.2. Economic problems

In total, five different economic problems were mentioned of which two problems by more than eight different academic articles (Table 2).

The most frequently mentioned economic problem was 'mortality in general'. This problem was described 21 times by twelve different papers. In total six papers - Walker et al. (2014), Smith and Parker (2010), Grootenhuis and Olubayo (1993), Munang'andu et al. (2009), Wamuyu et al. (2015) and Burridge et al. (2002) - mentioned the common problem 'economic in general' or similar in combination with 'mortality in general'. Only Smith and Parker (2010) mentioned this problem in combination with a social problem, 'sociological in general'. This makes mortality an economic problem. The problem of 'mortality in general' was mentioned for human by Perez de Leon et al. (2010), for livestock by Walker et al. (2014), Mbizeni et al. (2013), Smith and Parker (2010), Grootenhuis and Olubayo (1993), Munang'andu et al. (2009), Wamuyu et al. (2015), Ghai et al. (2016), Burridge et al. (2002) and Munang'andu et al. (2012), for wildlife by Wamuyu et al. (2015) and Khatri-Chhetri et al. (2016), for pets by Khatri-Chhetri et al. (2016) and Duscher et al. (2015) and for endangered species by Khatri-Chhetri et al. (2016). Furthermore, the problem of 'mortality in general' was most of the time a result of another problem occurring. Examples of other problems mentioned in combination with 'mortality in general' were, 'disease outbreak', 'introduction of tick-borne diseases' and the 'maintenance of the tick population' or 'maintenance of tick-borne diseases'. The common cause 'wildlife as reservoir' was framed by two papers, Grootenhuis and Olubayo (1993) and Ghai et al. (2016). No prescriptions in relation to the problem of 'mortality in general' were given. So to solve this problem, first the problems that result in mortality should be solved.

Secondly, 'economic in general' as problem was mentioned fifteen times by ten different academic articles. 'Human health', 'productivity loss', 'spread of diseases', 'mortality in general', 'ecological in

general' and 'livestock disease' were common problems linked with the problem 'economic in general'. Eygelaar et al. (2015) and Walker et al. (2014) both framed the common causes 'use of tick control method acaricides' or 'only livestock threatened with acaricdes' that are both part of the cause 'current control strategy'. Besides, Eygelaar et al. (2015) mentioned 'prevent contact', 'combination of prevention methods', 'raise awareness' and 'use of acaricides' as prescription. However, this was to mitigate economic impact of tick-borne diseases, while this author mentioned that the 'use of acaricides' also has economic consequences. No common prescriptions were mentioned.

Thirdly, 'costs' was mentioned seven times by five different papers. One common prescription was described in combination with this problem. Munang'andu et al. (2012) framed 'immunological control' and Walker et al. (2014) described 'vaccination' as prescription, that is part of immunological control. No causes were included in the frame. However, Munang'andu et al. (2012) and Walker et al. (2014) both described the problem high 'cost' as result of frequent or continue treatment of livestock.

At last, economic problems which were not included in a frame were 'productivity loss' and 'weight loss'.

3.1.3. Social problems

In total, fourteen different ecological problems were mentioned of which two problems by more than eight different academic articles. Overall, the social problem of 'human health' was mentioned most frequently in the academic articles.

'Human health' was the most regularly mentioned problem frame element. This problem was mentioned 26 times by nine different papers. By these papers, two common causes were framed. The common cause of 'vector origin' of ticks was mentioned by Mwamuye et al. (2016), Liyanaarachchi et al. (2015) and Nakayima et al. (2014) and 'wildlife as reservoir' was described by Anderson et al. (2013), Duscher et al. (2015) and Nakayima et al. (2014). This meant that the pathogens that infect human health are carried by ticks or by wildlife. Besides, the causes 'livestock as reservoir' and 'pet as transporter' were also mentioned in relation to the problem of 'human health'. Prescriptions framed by Mwamuye et al. (2016) in relation to the common cause 'vector origin' and the problem frame element were 'raise awareness', 'developing prevention method', 'more knowledge and 'risk mitigation in general'. The last was also mentioned as common prescription for the problem and was also mentioned by Liyanaarachchi et al. (2015). This common prescription was framed in combination with the causes 'multiple hosts' and 'vector origin' by Mwamuye et al. (2016) and with 'pet as transporter' and 'vector origin' by Liyanaarachchi et al. (2015).

Second, 'livestock disease' is most frequently mentioned with a total of eighteen quotations by eleven different papers. Three common cause elements were linked to this problem. 'Wildlife as reservoir' was mentioned by Miller et al. (2013), Wamuyu et al. (2015) and Eygelaar et al. (2015), 'vector origin' was described by Eygelaar et al. (2015) and Anderson et al. (2013) and 'multiple hosts' was mentioned by Wamuyu et al. (2015) and Anderson et al. (2013). No prescriptions were framed in combination with the problem of 'livestock disease'. However, four problems were connected by at least two different papers. 'Infection of multiple hosts', 'mortality in general', 'productivity loss' and 'economic in general'.

Furthermore, 'livestock health', 'current control method', 'control of tick-borne diseases', 'physical damage', 'pet health', 'mortality of endangered species', 'livelihood in general', 'threat to global

health', 'maintain eradication program', 'eliminate tick-borne diseases', 'program is limited' and 'sociological in general' were mentioned as social problem elements, but were not linked to common causes, moral judgements or prescriptions. So, no frames could be found.

3.1.4. Conclusion

To conclude, of the 39 mentioned problem frame elements, twenty problems had an ecological background. Besides, the two most frequently mentioned problems were ecological as well and six different ecological problem elements were described by at least eight papers. Moreover, fourteen different sociological problems were mentioned and five different economic problem frame elements were described. Finally, twelve different frame elements were linked to problem frames. The ecological problem frames were linked to all types of different causes and also connected with all types of prescriptions. The social problem frames were mainly linked to animal induced or tick induced causes and to social or technical prescriptions. The economic problem frames were connected with only human or animal induced causes and to all types of prescriptions.

3.2. Causal frames

In total, 57 different frame elements in relation to causes were mentioned in the academic literature. Despite the different causes mentioned in the literature, only eight causes were mentioned ten times or more often and nine causes were described by five or more different academic articles (Table 3). The frame elements were subdivided into human induced causes, tick induced causes, animal induced causes and ecologically induced causes. Human induced causes were causes that where directly carried out by human. Animal induced causes were directly caused by animals. Tick induced causes had to do with the characteristics and specific qualities of ticks and ecologically induced causes were causes that people or animals could not influence directly.
The most frequently used frame element was the animal induced cause 'wildlife as reservoir'. This code was also mentioned by most different papers.

Table 3: Cause codes mentioned by most different academic articles

Rank	Type of cause	Cause code	Articles	Frequency
1	Animal	Wildlife reservoir	16	57
2	Tick	Multiple hosts	10	16
3	Tick	Vector origin	10	14
4	Animal	Livestock reservoir	9	11
5	Animal	Migration	8	14
6	Animal	Interaction	8	11
7	Tick	Tick abundance	7	16
8	Ecological	Climate in general	6	9
9	Tick	Tick burden	5	8

3.2.1. Animal induced causes

In total, sixteen different animal induced causes were described, of which four causes by more than eight papers.

'Wildlife as reservoir' was the most frequently mentioned cause. 'Wildlife as reservoir' was mentioned 57 times by sixteen different papers. Eight common problems were linked to this frame element. The problem 'spread of pathogens' was mentioned by Walker et al. (2014) and Perez de Leon et al. (2010), 'livestock disease' by Miller et al. (2013), Wamuyu et al. (2015) and Eygelaar et al. (2015), 'maintenance of the tick population' by Walker et al. (2014), Grootenhuis and Olubayo (1993), Perez de Leon et al. (2010) and Duscher et al. (2015), 'mortality in general' by Grootenhuis and Olubayo (1993) and Ghai et al. (2016), 'emergence of diseases' by Munang'andu et al. (2009) and Duscher et al. (2015), 'spread of diseases' by Eygelaar et al. (2015) and Boyard et al. (2008),

‘introduction of tick-borne diseases’ by Walker et al. (2014), Burridge et al. (2002) and Perez de Leon et al. (2010), and the problem of ‘human health’ by Anderson et al. (2013), Duscher et al. (2015) and Nakayima et al. (2014). Walker et al. (2014) mentioned the common problems in combination with the prescription ‘use of acaricides’. Eygelaar et al. (2015) framed the linked common problems in combination with the prescriptions ‘developing prevention method’, ‘raise awareness’ and ‘surveillance’. Burridge et al. (2002) framed the connected common problem in combination with the prescription ‘screen animals’ and Perez de Leon et al. (2010) linked the common problems in relation to the prescriptions ‘treatment of wildlife’ and ‘vaccination’. No further common prescriptions were described.

Secondly, ‘migration’ was mentioned most frequently as animal induced cause. This frame element was mentioned fourteen times by eight different papers of which all papers mentioned this for the movement of livestock, wildlife or host species. Three different common problems were framed together with the cause migration. The problem of ‘spread of pathogens’ was mentioned by Wamuyu et al. (2015) and Burridge et al. (2002), ‘the introduction of tick-borne diseases’ by Burridge et al. (2002) and Perez de Leon et al. (2010) and ‘tick transmission’ by Singh and Gajadhar (2014) and Duscher et al. (2015). Remarkable was that Perez de Leon et al. (2010) described the cause ‘migration’ in combination with six other causes, named ‘animal husbandry practices’, ‘climate in general’, ‘acaricides resistance’, ‘smuggling’, ‘stray animals’ and ‘vector origin’. This meant that this paper mentioned ‘migration’ not as only cause to the problem of ‘the introduction of tick-borne diseases’. Striking was that no prescriptions were framed for the problem of ‘migration’. This meant that the academic literature did not provide a solution for migration of animals.

Thirdly, ‘interaction’ was mentioned as animal induced cause. This cause was quoted eleven times by eight different papers. ‘Interaction’ was framed with the problem ‘spread of pathogens’ due to Walker et al. (2014) and Ghai et al. (2016), of which Walker et al. (2014) framed ‘fencing’ as prescription. Ghai et al. (2016) described this in combination with other causes as ‘close related hosts’ and ‘vector origin’. Ghai et al. (2016) described ‘interaction’ as result of ‘translocation’ and ‘habitat overlap’, while Mbizeni et al. (2013) added the ‘sharing of grazing lands’.

Fourthly, ‘livestock as reservoir’ was mentioned most frequently as animal induced cause. This cause was mentioned by eight different papers, but no common problems or prescriptions were framed by these papers. Noticeable was that seven out of eight papers mentioned the cause ‘wildlife as reservoir’ in relation to ‘livestock as reservoir’.

In addition, ‘livestock-wildlife interface’, ‘small mammals as transporter’, ‘increase in wildlife population’, ‘abundance of wildlife species’, ‘age of the hosts’, ‘close related hosts’, ‘host body size’, ‘stray animals’, ‘host community composition’, ‘resistance of the host’, ‘pets as transporter’ and ‘share grazing lands’, were animal induced causes. But these causes were not linked into more fully articulated frames

3.2.2. Human induced causes

In total, eighteen different human induced causes were described, of which no causes were described by more than five academic articles.

‘Import of animals’ as cause was mentioned ten times by three papers, of which Burridge et al. (2002) mentioned this cause eight times in the paper. Furthermore, Eygelaar et al. (2015) and Perez de Leon et al. (2010) mentioned this cause as well. Eygelaar et al. (2015) and Burridge et al. (2002) both mentioned the common problem ‘introduction of tick-borne diseases’ as result of the ‘import of animals’, but Eygelaar et al. (2015) did not frame any prescriptions. Prescriptions framed by Burridge

et al. (2002) to combat the problem and the cause were ‘prohibit import’, ‘use of acaricides’ and ‘screening of animals’.

Second, the cause ‘use of tick control method acaricides’ was mentioned five times by two different papers. Two common problems were described in relation to this frame element by Walker et al. (2014) and Eygelaar et al. (2015); ‘economic in general’ and ‘ecological in general’. So the use of the tick control method acaricides result in economic and ecological problems. Walker et al. (2014) framed two prescriptions in relation to these problems and cause; ‘developing prevention method’ and ‘vaccination’. No common prescriptions or moral judgements were linked to the cause.

Third, ‘forest management’ was mentioned as cause three times by three different papers. The common problem ‘emergence of diseases’ was framed in combination with this cause by Singh and Gajadhar (2014) and Boyard et al. (2008). No prescriptions were mentioned by these papers in combination with the cause ‘forest management’.

Further mentioned human induced causes were; ‘encroachment of wildlife habitats’, ‘absence of adequate screening’, ‘animal husbandry practices’, ‘increase in livestock production’, ‘international trade’, ‘smuggling’, ‘only livestock treated with acaricides’, ‘absence of chemical tick control’, ‘current control strategy’, ‘lack of knowledge’, ‘lack of operational tools’, ‘introduction of infected ticks’, ‘land use’, ‘unknown’, ‘translocation’. However, these frame elements were not linked to common problems, moral judgements or prescriptions to create a frame.

3.2.3. Ecologically induced causes

In total, twelve different ecologically induced causes were found, of which only one causes by more than five scientific articles.

‘Climate in general’ was mentioned nine times by six different papers. The causes ‘temperature’, ‘humidity’ and ‘weather conditions’ are part of ‘climate in general’ and all these causes are part of the cause ‘ecological factors in general’. Furthermore the causes ‘rainfall’ and ‘vegetation’ were linked to ‘climate in general’ by Smith and Parker (2010) and the cause ‘environment in general’ was mentioned by Smith and Parker (2010), Liyanaarachchi et al. (2015) and Boyard et al. (2008). Furthermore, no common problems, moral judgements or prescriptions were linked to ‘climate in general’, so no frames could be found.

Secondly, ‘environment in general’ was mentioned as cause. This cause was mentioned seven times by four different papers. The cause ‘environment in general’ was resulting in the common problem of ‘tick transmission’ by Liyanaarachchi et al. (2015), Boyard et al. (2008) and Duscher et al. (2015). No prescriptions and moral judgements were included in the frame.

Other ecologically which were not included in a frame were; ‘habitat overlap in general’, ‘ecological factors in general’, ‘human-livestock-wildlife interface’, ‘rainfall’, ‘temperature’, ‘vegetation’, ‘weather conditions’, ‘humidity’, ‘geographical distribution’ and ‘acaricides resistance’.

3.2.4. Tick induced causes

In total, eleven different tick induced causes were found, of which four causes by more than five papers.

‘Multiple hosts’ as tick-induced cause was found sixteen times by ten different papers. Ten different problems were mentioned in relation to multiple hosts of which ‘livestock disease’ and ‘spread of diseases’ were mentioned by more than one paper. The common problem ‘livestock disease’ was

framed by Wamuyu et al. (2015) and Anderson et al. (2013) and 'spread of diseases' by Mwamuye et al. (2016) and Khatri-Chhetri et al. (2016). No prescriptions were framed by these authors and also no other common prescriptions or moral judgements were mentioned.

Second, 'tick abundance' was mentioned as cause sixteen times by seven different papers. 'Tick abundance' in itself was not resulting in any common mentioned problems. However, this cause was mentioned together with fourteen other causes of which five causes were at least mentioned by two papers in combination with 'tick abundance'. Furthermore, no common prescriptions were mentioned to combat the causes. Smith and Parker (2010) mentioned two prescriptions, 'short vegetation' and 'use of acaricides', to lower the tick abundance. However, other papers did not supported this. So no causal frames were found.

Third, the cause 'vector origin' as tick induced cause was framed. This frame element was mentioned fourteen times by ten different papers and resulted to ten different problems concerning ticks, tick-borne diseases and tick management of which four problems were mentioned regularly. The problem 'spread of diseases' was mentioned by Smith and Parker (2010) and Mwamuye et al. (2016) and the problem 'human health' by Mwamuye et al. (2016), Liyanaarachchi et al. (2015) and Nakayima et al. (2014). The problem 'spread of pathogens' was framed by Smith and Parker (2010), Ghai et al. (2016) and Poo-Muñoz et al. (2016) and the problem 'livestock disease' by Eygelaar et al. (2015) and Anderson et al. (2013). Mwamuye et al. (2016) also linked two prescriptions, 'higher understanding' and 'update information'. No other common moral judgements or prescriptions were mentioned in relation to the cause.

Other tick induced causes were; 'tick burden', 'tick distribution', 'habitat preference', 'behaviour parasite', 'different tick stages on individual host', 'spill-over mechanism', 'infection of ticks by subclinical carriers', 'host preference in general'. These causes were not related to common problems, moral judgements or prescriptions, so no frames could be found.

3.2.5. Conclusion

To conclude, of the 57 different causal frame elements, most were human induced causes. In total, eighteen human induced, sixteen animal induced, twelve ecologically induced and eleven tick induced causes were found. This meant that the academic literature mostly framed humans and animals for the problems concerning ticks and tick-borne diseases in human-livestock-wildlife areas. In total, nine different causal frame elements were linked into more fully articulated frames of which the human induced frames were connected to economic and ecological problems and with all types of solutions. The animal induced frames were related to mainly ecological problems and all types of solutions. The ecologically induced frames were linked with ecological problems and no prescriptions were found in these causal frames. The tick induced causal frames were connected to social or ecological problems and to social prescriptions.

3.3. Moral judgement frames

Two moral judgements were described by Miller et al. (2013), 'culling is untenable' and 'adaptive management offer opportunities'. The low number of moral judgement frame elements explained that it was not very common to mention moral judgements in academic literature. Probably since it is important to keep data and results free from personal opinions. These moral judgement frame elements were not included into more fully articulated frames. Probably there is no clear direction of what is right or wrong in tick management.

3.4. Prescription frames

In total, 29 different prescription frame elementss were mentioned in the academic literature of which Singh and Gajadhar (2014) and Poo-Muñoz et al. (2016) did not mentioned any prescriptions. Prescriptions were subdivided into chemical solutions, social solutions and technical solutions.

Table 4: Prescription codes mentioned by most different academic articles

Rank	Kind of problem	Prescription code	Articles	Frequency
1	Social	More research	11	12
2	Chemical	Use of acaricides	7	21
3	Social	Developing prevention method	7	12
4	Social	Higher understanding	7	7
5	Technical	Surveillance	5	8
6	Chemical	Vaccinations	4	12
7	Technical	Minimize wildlife reservoir	4	5
8	Social	Combination of prevention methods	4	4
	Chemical	Chemical prevention method	4	4

Chemical solutions are solutions which had a chemical or biological origin. Social solutions were solutions that needed to be solved by the human mind without any tools. Most of the times these solutions were to a developing or research direction. Technical solutions were all solutions in where tools were needed to perform. 'More research' as solution was mentioned by most different scientific articles, while 'use of acaricides' was mentioned most frequently.

3.4.1. Chemical solutions

In total, eight different chemical solutions were found, of which three solutions were mentioned by more than four papers.

The most frequently mentioned chemical prescription frame element was the 'use of acaricides'. This solution was mentioned 21 times by seven different papers. Ten of these quotations were from the paper of Walker et al. (2014). Walker et al. (2014) and Eygelaar et al. (2015) framed the common problem of 'economic in general' and Munang'andu et al. (2012) the problem of 'productivity loss', that is part of that problem. In contrast, Walker et al. (2014) mentioned the cause 'use of tick control method acaricides' in relation to the problem 'economic in general'. So Acaricides was a cause and a solution to the same problem. Munang'andu et al. (2012) framed two causes in combination with the common economic problem and the prescription 'use of acaricides'; the cause 'spill over mechanism' and 'increase in wildlife population'. No common causes, in relation with the prescription 'use of acaricides', were mentioned by more than one paper.

Second, 'vaccinations' was framed. This solution was mentioned twelve times by four different papers. 'Vaccinations' can be the prescription of the problem of 'costs', that is part of 'economic in general'. 'Costs' was mentioned by Walker et al. (2014) and 'economic in general' was described by Perez de Leon et al. (2010). Walker et al. (2014) linked this problem and prescription in combination with the cause 'use of tick control method acaricides' and Perez de Leon et al. (2010) in combination with the cause 'wildlife as reservoir'. No common causes or moral judgements were mentioned in combination with the prescription 'vaccinations'. So, 'costs' or 'economic in general' as problem can be solved by changing the 'use of acaricides' to 'vaccination'.

Third, 'treatment of wildlife' was mentioned eight times by three different papers. Burridge et al. (2002) and Perez de Leon et al. (2010) both described this solution in combination with the prescription of 'chemical prevention method' or 'acaricides as prevention method'. So the treatment of wildlife should be done by use of chemical prevention methods or acaricides due to these papers. Besides, they both framed this in combination with the problem 'spread of diseases', by Burridge et

al. (2002), or ‘spread of pathogens’, by Perez de Leon et al. (2010). Next to this, Perez de Leon et al. (2010) framed ‘wildlife as reservoir’ as cause. No moral judgements were mentioned in relation to the prescription ‘treatment of wildlife’.

‘Prevention method chemical’, ‘immunological control’, ‘resistance’, ‘control mechanism of hosts’ and ‘prevention method antibiotics’ were mentioned chemical solutions. However, these were not included in more fully articulated frames.

3.4.2. Social solutions

In total, ten different social solution frame elements were found of which four solutions by more than four scientific articles.

The prescription ‘more research’ was mentioned twelve times by eleven different papers. This meant that eleven papers did not solve the problem designed in their research. This was enhanced by Munang’andu et al. (2009) who mentioned this in combination with the prescription ‘developing prevention method’ and Ghai et al. (2016) in combination with the prescription ‘higher understanding’. No common problems, causes or moral judgements were mentioned in combination with this solution, so no frames were found.

Furthermore, ‘developing prevention method’ was mentioned twelve times by six different papers. No common problems, causes or moral judgements were mentioned, so no frames were found. However, this prescription was the solution for four different problems; ‘infection rate’, ‘maintenance of tick-borne diseases’, ‘spread of diseases’ and ‘human health’. Besides, there were two common prescriptions related to the prescription ‘developing prevention method’. Miller et al. (2013) and Mwamuye et al. (2016) mentioned ‘risk mitigation in general’ and ‘surveillance’. The last was also described by Eygelaar et al. (2015).

The social solutions, ‘higher understanding’, ‘raise awareness’, ‘eradication campaign’, ‘update information’, ‘more knowledge’, ‘combination of prevention methods’, prohibit import’ and ‘prohibit translocation’ were also not related to any common problems, causes or moral judgements, so no social solution frames were found.

3.4.3. Technical solutions

In total, eleven different technical solution frame elements were found of which two solutions by more than four scientific articles.

The most frequently mentioned technical solution was ‘surveillance’. This prescription was mentioned eight times by five different papers. Although no common problems, causes or moral judgements were mentioned in combination with this prescription, Miller et al. (2013), Eygelaar et al. (2015) and Mwamuye et al. (2016) mentioned this prescription in combination with the prescription ‘developing prevention method’. However, this prescription was not included in a more fully articulated frame.

Furthermore, the solution ‘minimize wildlife reservoir’ was mentioned five times by four different papers. Also this prescription was not included in a more fully articulated frame, since no common problems, causes and moral judgements were described in combination with this solution. However, three other prescriptions were mentioned by Mbizeni et al. (2013); ‘fencing’, ‘prohibit translocation’ and ‘quarantine measures’.

Other found technical solutions were; 'screen animals', 'culling', 'manual removal of ticks', 'short vegetation', 'fencing', 'risk mitigation in general', 'prevent contact', 'quarantine measurements' and 'burning of land'. However, these solutions were not linked to common problems, causes or prescriptions, so no frames could be found.

3.4.4. Conclusion

To conclude, all three types of solutions were given frequently. In total, eleven technical solutions, ten social solutions and eight chemical solution frame elements were mentioned in the academic literature. However, many variation of different technical solutions and social solutions were differed across the academic articles. This meant that still a lot of research is going on for what solutions is probably the best practice to implement. Remarkable was that only three prescription frame elements were included in the prescription frames, of which all chemical prescription frames. These solutions were combined with ecological or economic problems and the causes were animal, human or tick induced. No frames were found with social solutions or technical solutions.

3.5. Actor categories

Twenty-six different categories of actors were described in academic literature. In total, eight papers mentioned at least one actor. Of these, five actors were mentioned more than once. However, during the analysis, sometimes two or more actors were described in different ways. Therefore, 'livestock farmers', producers', 'livestock owners', and 'livestock producers' were all combined to the actor category 'farmers'. Secondly, 'cattle industry' and 'livestock industry' were combined to 'livestock industry'. Thirdly, 'the United states environmental protection agency', 'the United States department of agriculture', 'state and federal agencies', 'agencies' and 'government' were all combined to 'government'. This makes in total nineteen different categories of actors. In Figure 3, the different actor groups and the connection with their obligations or tasks are shown. The numbers show the quotations and the respective article can be found in Table 1.

When looking at the left part of figure 3, two main actor categories were in the centre, the government and farmers. The centre task in Figure 3, following the different papers, was to 'implement prevention methods'. This task should be done by the government, following Burridge et al. (2002) and Perez de Leon et al. (2010), and by farmers, following Smith and Parker (2010) and Grootenhuis and Olubayo (1993). Furthermore, other tasks and obligations for the government were to 'screen animals', 'prohibit import' 'shift in policy', 'cooperation' and 'pay the costs'. Other tasks and obligations for the farmers were 'make choices', 'need knowledge', 'make priorities', 'suffering' and 'pay the costs'. The last obligation was described for both the government as the farmers.

However, when going further downwards in the figure, it can be seen that also the livestock industry will have the obligation 'pay the costs' and that the livestock industry and rural farming majority 'suffers' together with the farmers. Miller et al. (2013) described 'make priorities' for as well the farmers as the health authorities.

When going further to the bottom right part of Figure 1, it can be seen that other tasks of the farmers were mentioned by Grootenhuis and Olubayo (1993) as to 'make choices' and Miller et al. (2013) by 'make priorities', together with the health authorities. Liyanaarachchi et al. (2015) mentioned the 'need of knowledge' also as obligation for the farmers, together with veterinarians, physicians, wildlife biologists and veterinary officials. That last was also confirmed by Eygelaar et al. (2015).

When going to the upper right in Figure 3, it can be seen that investigators should also 'cooperate' and 'seek solutions', according to Perez de Leon et al. (2010), while Grootenhuis and Olubayo (1993) mentioned that this were the tasks for land users.

Lastly, going back to the upper left, it can be seen that physicians should 'cooperate' together with entomologists, epidemiologist, health sciences experts and veterinarians according to Perez de Leon et al. (2010). However, Miller et al. (2013) mentioned 'cooperation' and 'shift in policy' in

combination with wildlife authorities, livestock authorities and the government. Besides, Mbizeni et al. (2013) and Burridge et al. (2002) also mentioned the shift in policy by the government.

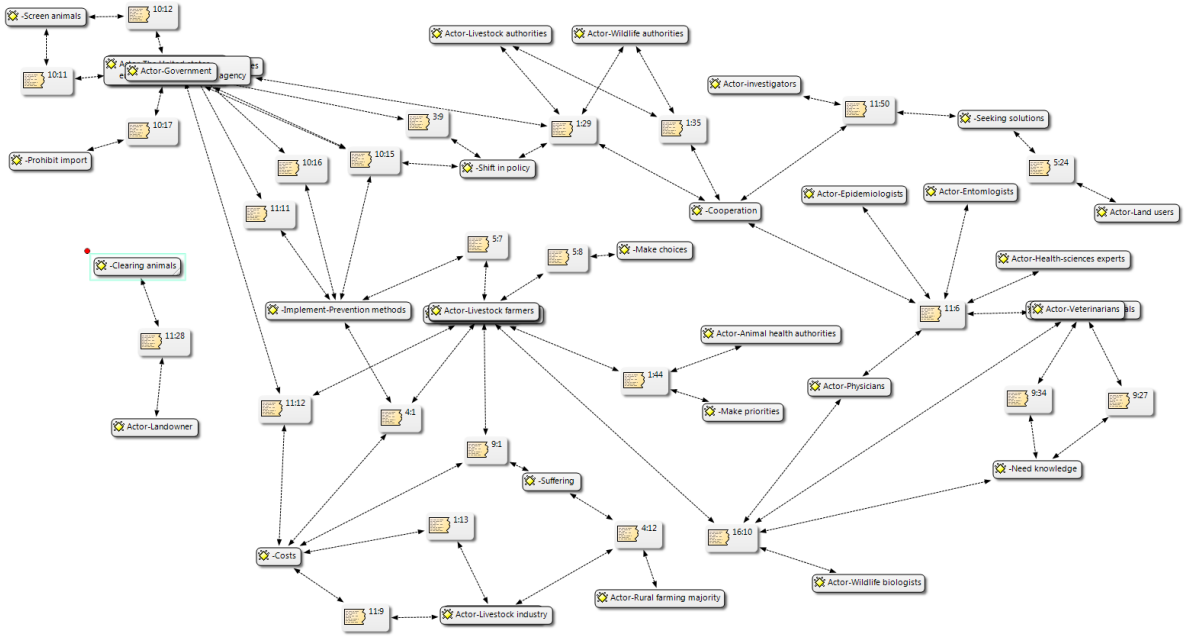

Figure 3: Actors and their tasks and obligations in academic literature

When looking at Figure 3, no clear patterns can be seen directly. However, a few coherent combinations were made by some papers. Miller et al. (2013), Mbizeni et al. (2013) and Burridge et al. (2002) combined 'shift in policy' with the government, while Burridge et al. (2002) and Perez de Leon et al. (2010) both mentioned the government in combination with 'implement prevention methods'. Smith and Parker (2010) and Grootenhuis and Olubayo (1993) mentioned livestock farmers in combination with 'implement prevention methods', Smith and Parker (2010), Eygelaar et al. (2015) and Perez de Leon et al. (2010) combined 'pay the costs' with livestock farmers and Miller et al. (2013) and Perez de Leon et al. (2010) combined 'pay the costs' with the livestock industry. At last, Eygelaar et al. (2015) and Liyanaarachchi et al. (2015) combined veterinarians with 'need knowledge'.
Overall, since most actor categories and their task or obligation were not linked together by more than one paper, the analysis of the actors was fragmented. So, no clear direction is given for practitioners.

3.6. Overall frames and meta-frames

In total, 39 different frames were found in the academic literature. In Figure 4, all frames found in academic literature were visualised. All 39 frames were sorted by their causes. However, in this section only synthesis of the frames into meta-frames are described.
Overall, remarkable was that no ecologically induced causes were linked to chemical solutions. Besides, economic problems were not connected with ecologically induced causes. Thirdly, all human induced causes were framed to ecological or economic problems and not with social problems.

Different meta-frames were found. First, the troublemaker meta-frame was found (frame 1 till 10 in figure 4). Particularly, wildlife can be seen as cause to many different problems. For all kind of different problems, economic, ecological and social, mainly wildlife was blamed. The prescriptions was not found yet since a few frames in the meta-frame did not gave a prescriptions and the others give a large number of different prescriptions.

Second, the chemical solution meta-frame was found (frame 2, 5, 7, 9, 19-22, 26, 29-37 and 39 in figure 4), since many different problem elements and cause elements were linked to chemical solutions. This meta-frame includes all chemical solution in general and use of acaricides as prescription frame elements. This prescription is linked to three main problem frame elements; spread of pathogens and tick-borne diseases, the introduction of tick-borne diseases and economic problems in general. So the problems in this meta-frame were ecological or economic problems and the causes were mainly human or animal induced. Chemical solutions are still one of the most used tick prevention measurements and therefore mentioned frequently.
Third, The monitoring and prevention meta-frame was found (frame 1, 5, 6, 11, 12, 15, 18, 21, 26 and 30 in figure 4). This meta-frame is about the social prescription elements. These solutions are linked with many different causes and problem elements. This meta-frame is constituted since searching for alternative prevention methods is difficult since the characteristics of a multi stakeholder area.
This is also noticed in the many frames that did not have a prescription. Also in the unknown prevention method meta-frame (frame 3, 4, 8, 10, 13, 14, 16, 17, 23-25, 27, 28 and 38 in figure 4), many different problems and causes are described without any solution. So this meta frame shows that still many problems and causes cannot be solved yet.
Fifth, the tick induced meta-framework was found (frame 12-20 in figure 4). The cause elements in this meta-frame were at the specification of ticks. These frame-elements possess problem frame elements as human health, livestock disease and spread of tick-borne diseases. However, not many prescription frame elements were linked and the prescription frame elements given were social solutions. So this tick induced meta-framework shows that still a lot is unclear about how to combat ticks, but that the characteristics of ticks play a huge role in the complexity of the problem.
Sixth, the spread of ticks and tick-borne diseases meta-frame was found (frame 6, 7, 14, 15, 17, 19, 27, 29 and 34-38 in figure 4). This meta-frame is related to the distribution of the ticks with their pathogens. Many different causes frame elements were used in this meta-frame, but the prescription frame elements were more overlapping in the form of chemical prevention methods. This meta-frame is probably established since the elimination of ticks and tick-borne diseases is not possible in an area. When clearing one part of the area from ticks and their pathogens, the area got infected soon. The use of chemical prevention methods can help with clearing a part of the area.

3.7. Conclusion and discussion

Overall, the academic literature showed a fragmented analysis. In the academic literature, 126 different frame elements were found and no clear patterns in the problem, causal, moral judgement and prescription frames were found. The problem frames were mainly ecological, however all types of causes and prescriptions were linked. The causal frames were mainly human, tick and animal induced, but also these causal frames were connected to different types of problems and prescriptions. Although technical and social solution frame elements were mentioned frequently, only chemical solution frames were found. These were linked to ecological and economic problems and to animal, human or tick induced causes. Moral judgement frames were not mentioned at all.
Finally, 39 different frames were found, and synthesised to six meta-frames. These six different meta-frames are the troublemaker meta-frame, the chemical solution meta-frame, the monitoring and prevention meta-frame, unknown prevention method meta-frame, the tick induced meta-frame and the spread of ticks and tick-borne diseases meta-frame. So there were some coherent meta-frames found and used in the academic literature.
However research should be implemented in practice. So, these frames and meta-frames found in the academic literature should be communicated towards practitioners. This will give some challenges for communication, since it is difficult to communicate such a fragmented analysis of frames and meta-frames. Also for practitioners, it is difficult to find the main message, since this is not clear. So, it is needed to find the direction and message of the available research. Reframing of the academic literature is needed to change the multiple messages found into one clear direction.

Several frames are mentioned, while the same topic was addressed. Besides, the framing of the actors needs improvements and reframing is needed to find more coherent tasks and obligations.

The problem	**→The cause**	**→The prescription**
1. Livestock disease	→Wildlife as reservoir	→Developing prevention method, raise awareness, surveillance
2. Maintenance of tick populations	→Wildlife as reservoir	→use of acaricides, treatment of wildlife, vaccination
3. Maintenance of tick-borne diseases	→Wildlife as reservoir	→?
4. Emergence of tick-borne diseases	→Wildlife as reservoir	→?
5. Introduction of tick-borne diseases	→Wildlife as reservoir	→Screen animals, prohibit import, treatment of wildlife, use of acaricides, combination of prevention methods, vaccination
6. Spread of tick-borne diseases	→wildlife as reservoir	→Surveillance, raise awareness, developing prevention method
7. Spread of pathogens	→Wildlife as reservoir	→Fencing, use of acaricides, vaccination, treatment of wildlife
8. Mortality in general	→Wildlife as reservoir	→?
9. Economic in general/ prod. loss	→Wildlife as reservoir	→Vaccination
10. Human health	→Wildlife as reservoir	→?
11. Human health	→Pet as transporter	→Risk mitigation in general
12. Human health	→Multiple hosts	→Risk mitigation in general
13. Livestock disease	→Multiple hosts	→?
14. Spread of tick-borne diseases	→Multiple hosts	→?
15. Spread of tick-borne diseases	→Vector origin	→Higher understanding, update information
16. Livestock disease	→Vector origin	→?
17. Spread of pathogens	→Vector origin	→?
18. Human health	→Vector origin	→Raise awareness, developing prevention method, more knowledge, risk mitigation in general, higher understanding, update information
19. Spread of tick-borne diseases	→Spill-over mechanism	→Chemical/use of acaricides, developing prevention method
20. Economic in general/ prod. loss	→Spill-over mechanism	→Use of acaricides
21. Economic in general/costs	→Prev. method acaricides	→ prevent contact, combination of prevention methods, raise awareness, use of acaricides, vaccination, developing prevention method
22. Ecological in general	→ Prev. method acaricides	→Developing prevention method, vaccinations
23. Tick transmission	→Environment in general	→?
24. Maintenance of tick population	→Environment/ecological	→?
25. Tick transmission	→Migration	→?
26. Introduction of tick-borne diseases	→Migration	→Chemical/use of acaricides, combination of prevention methods, treatment of wildlife, prohibit import, screen animals
27. Spread of pathogens	→Migration	→?
28. Emergence of diseases	→forest management	→?
29. Spread of tick-borne diseases	→Import of animals	→Chemical/use of acaricides
30. Introduction of tick-borne diseases	→Import of animals	→Screen animals, prohibit import, treatment of wildlife, chemical/use of acaricides, combination of prevention methods
31. Introduction of tick-borne diseases	→International trade	→Chemical/use of acaricides
32. Introduction of tick-borne diseases	→Absence of screening	→Chemical/use of acaricides
33. Economic in general/prod. Loss	→Increase in wildlife pop.	→Use of acaricides
34. Spread of tick-borne diseases	→increase in wildlife pop.	→Chemical/use of acaricides
35. Spread of tick-borne diseases	→intr. of infected ticks	→Chemical/use of acaricides
36. Spread of tick-borne diseases	→infection by sub. Carrier	→Chemical/use of acaricides
37.Spread of pathogens	→Interaction	→Fencing, use of acaricides
38. Spread of pathogens	→Habitat overlap in gen.	→?
39. Costs	→?	→Vaccination/immunological control

Figure 4: Frames in academic literature

4. Review cases

In this chapter the results are described for the questions: How is tick management framed in practice-oriented sources by different actors in different human-livestock-wildlife areas? and what are the differences and similarities in framing tick management between different human-livestock-wildlife areas? Therefore, the public sources were analysed using framing. Every problem, cause, moral judgement and prescription was divided into the same topics as in academic literature and the structure of the described codes was the same as well. After that, a comparison between the case study areas was done and discussed and validated with the experts interviews.
First the differences and similarities between Cairngorms national park and Laikipia County are described. Second, the problem frames, the causal frames, the moral judgement frames and the prescription frames are described. After that, the actor categories are described, followed by the found frames and meta-frames.

In total, ten practice-oriented sources were analysed, of which five for Cairngorms national park and five for Laikipia Kenya (see Table 5).

Table 5: Analysed practice-oriented sources

Source no.	Cairngorms national park
24	Cairngorms treks (n.b.). FAQ. This website organizes one day treks and multi-day trips through the Cairngorms national park. http://www.cairngormtreks.co.uk/about/faqs/
25	Peter Marren (2006). Eco catastrophe the cairngorms. In The Independent. http://www.independent.co.uk/environment/nature/eco-catastrophe-the-cairngorms-426485.html
26	Cairngorms government (2005). Targeting ticks http://cairngorms.co.uk/targeting-ticks/
27	Ted Wilson (2015.) Tick bites and Lyme disease: History and best practice for reducing risk of infection. Presentation by Ted Wilson http://cairngorms.co.uk/wp-content/uploads/2015/06/TedWilsonPresentation18Nov2015.pdf.
28	Mark Avery (2016). Mountain of mountain hares http://markavery.info/2016/03/13/mountain-mountain-hares/
	Laikipia County
29	Mpala (2016) All about ticks http://www.mpala.org/documents/Get_our_Newsletter_49_3058852009.pdf
30	Laikipia tourism (2013). Community and conservation http://laikipiatourism.com/about-laikipia/laikipia-wildlife-forum
31	Laikipia wildlife forum (2016) The fight against the little bug causing big problems in Laikipia http://www.laikipia.org/the-fight-against-the-little-bug-causing-big-problems-in-laikipia/
32	Daily Nation (2009) Herders hard hit as skies refuse to open up http://www.nation.co.ke/news/1056-661984-jldhrvz/index.html
33	AllAfrica (2011) Kenya East coast fever killing cattle in Laikipia, vet says http://allafrica.com/stories/201109291226.html

4.1. Case study areas

Cairngorms national park is located in the middle Eastern part of Scotland between Inverness, Aberdeen and Dundee. Around 18,000 people live and work in the national park and the park has 1.5 million visitors a year (Cairngorms national park 2015[a]). In total, 75% of the land is privately owned, 15% is owned by charities and 10% by public bodies. The total surface of the national park is 4,528 square kilometres (National parks UK 2016). The Cairngorms national park is on the Scottish highlands with its lowest altitude at 778 meters above mean sea level and its highest point is Ben Macdui at 1309 meters above mean sea level (Metoffice UK N.B.; National parks UK 2016). The average rainfall is lowest in February with a rainfall of 74 mm and highest in August with 115 mm. The annual average temperature is seven degrees during the day and 2.1 degrees during the nights of which the highest temperatures are in July and August and the lowest temperatures in December, January and February (Meteoblue 2017). Cairngorms national park has the largest area of native woodland in Britain and has three big rivers (Cairngorms national park 2015[a]). Besides, it has heather moorlands and peatlands, farmland, forest, wetlands and other small rivers (Cairngorms national

park 2015[b)]. Most of the farms in the Cairngorms National Park are livestock farms. Farmers and crofters keep beef cows, sheep and grow small areas of crops. Most of the crops are for feeding livestock (Cairngorms national park 2015[c]). Besides, red grouse is a big part of the economy for grouse shooting and the red deer for deer stalking (Cairngorms national park 2015[b]). Other wildlife available are mountain hares and birds, like crested tit (National parks UK 2016). The Cairngorms national park authority (CNPA) is present in the area.

Laikipia is a county of the Rift valley which is located North of Nairobi in Kenya. There is an annual population growth of 2.17% and a total population of almost 400,000 people (Citypopulation 2009). Laikipia has a total surface of 9,700 square kilometres and the altitude range between 1,260 meter at its lowest point and 2,400 meter at its highest point (Butynski and De Jong 2014). The annual rainfall is dependent on the area. Nanyuki, South-East of Laikipia, has an annual rainfall of 819 mm spread over two rain seasons, one long rain season between March and May with its peak in April with an average of 133 mm and one short rain season in October and November. The annual temperature range between 8.6 degrees Celsius on average at night and 23.8 degrees Celsius on average during the day (Climate-data n.d.). In Laikipia, the primary vegetation types are grassland, bushland, woodland and dry forest (Butynski and De Jong 2014). Ninety percent of the land is too dry for cultivation and therefore, livestock ranching is the primary economic activity (LWF 2013; Butynski and De Jong 2014). Main livestock are cattle, goats, sheep and camels and ranging takes place on government-owned, company-owned or community-owned rangeland (Butynski and De Jong 2014). Especially on community-owned rangelands, livestock and wildlife interact. Overall, 37 percent of Laikipia is used for large-scale ranging, 32 percent used by pastoralists, 21 percent used by smallholder farmers and five percent used exclusively for wildlife-based tourism. In Laikipia more than 62 larger mammals live, of which carnivores, ungulates and primates. Large mammals that can be found are buffalos, elephants, giraffes, black rhinoceros, wild dogs, cheetahs, leopards and lions (Butynski and De Jong 2014). Furthermore, the Kenya Wildlife Service (KWS) and the Department of Veterinarian Service (DVS) are located in Laikipia.

4.2. Problem frames

In total 24 different problem frame elements were mentioned by the ten different practice-oriented sources. Regarding to the practice-oriented sources from Cairngorms, sixteen different problem frame elements were mentioned and regarding Laikipia, twenty different problem frame elements. The problem frame elements can be divided in the same three different topics as in chapter 3; ecological problems, economic problems and social problems. Overall, the problem frame elements mentioned by at least two different practice-oriented sources in the two areas were given in Table 6.

4.2.1. Social problems

In total, nine different social problems were mentioned of which five different social problems were mentioned in both Cairngorms national park as Laikipia. The other four social problems were only mentioned in Laikipia.

The problem of ‘human health’ was described most often and found in both Laikipia and Cairngorms. The problem was mentioned nine time by six different practice-oriented sources of which Cairngorms treks (n.b.), Peter Marren (2006), Cairngorms government (2005) and Ted Wilson (2015) mentioned it in Cairngorms and Mpala (2016) and Laikipia wildlife forum (2016) in Laikipia. Besides, no causes related to this problem were mentioned. However, three common prescriptions linked to this problem were given. The common prescription ‘antibiotics’ was mentioned by Cairngorms treks (n.b.) and Ted Wilson (2015), the prescription ‘raise awareness’ was described by Cairngorms treks (n.b.) and Laikipia wildlife forum (2016) and the prescription ‘share knowledge’ was mentioned by Laikipia wildlife forum (2016) and Mpala (2016). Other common mentioned problems related with

'human health' were 'wildlife health', 'livestock health', 'infect multiple hosts' and 'vector of tick-borne disease'.

The second most frequently mentioned social problem was that of 'livestock health'. This problem was mentioned seven times by four different practice-oriented sources of which Peter Marren (2006) and Cairngorms government (2005) mentioned it for Cairngorms and Mpala (2016) and Laikipia wildlife forum (2016) for Laikipia. No common causes, moral judgements or prescriptions can be found in relation to this problem, so this problem was not included in a more fully articulated frame. Three common problems can be found for as well Cairngorms as Laikipia; 'wildlife health', 'vector of tick-borne disease' and 'human health'.

The problem 'control of tick-borne diseases' was mentioned four times by four different practice-oriented sources of which two in Cairngorms, Cairngorms government (2005) and Mark Avery (2016), and two in Laikipia, Laikipia tourism (2013) and Laikipia wildlife forum (2016). No common problems, causes or prescriptions were mentioned in relation to this problem, so no frames were found. However, the moral judgement 'no evidence for undertaking culls' was mentioned by Mark Avery (2016) in relation to the problem, while in contrast Laikipia tourism (2013) mentioned 'culling' as prescription.

The problem of 'livestock disease' was mentioned three times, by Peter Marren (2006), Mark Avery (2016) and AllAfrica (2011). Peter Marren (2006) and Mark Avery (2016) mentioned 'wildlife as reservoir' as common cause. Besides, Peter Marren (2006) framed 'culling' as prescriptions, however, criticizes this as well, because the problem of 'wildlife health' arise.

Social problems that were only mentioned in Laikipia were 'animals not used to dipping', 'control method', 'implementing tick prevention method' and 'mortality if dipped'. The problem 'physical damage' to animals was mentioned both in Cairngorms as Laikipia. These problems did not have any linked causes, moral judgements or prescriptions, so no frames were found.

Table 6: Problem codes mentioned by most different practice-oriented sources by area

Rank	Kind of problem	Problem codes in Laikipia	sources	Frequency
1	Economic	Mortality general	3	7
2	Social	Human health	2	3
	Social	Livestock health	2	3
	Ecological	Tick transmission	2	3
3	Social	Control of tick-borne disease	2	2
	Economic	Economic in general	2	2
	Ecological	Spread of tick-borne diseases	2	2
	Ecological	Emergence of tick-borne diseases	2	2

Rank	Kind of problem	Problem codes in Cairngorms	sources	Frequency
1	Social	Human health	4	6
2	Ecological	Increase in tick population	2	4
3	Social	Livestock health	2	3
	Ecological	Activity of tick during the year	2	3
	Ecological	Wildlife health	2	3
4	Social	Control of tick-borne diseases	2	2
	Social	Livestock disease	2	2
	Ecological	Vector of tick-borne disease	2	2

4.2.2. Economic problems

In total, two different economic problems were mentioned of which one problem was mentioned in both Cairngorms national park and Laikipia and one problem was only mentioned in Laikipia.

The problem ‘mortality in general’ was the most frequently mentioned problem. This problem was mentioned seven times by three different practice-oriented sources of which all were located in Laikipia. Although Laikipia wildlife forum (2016) mentioned this problem for livestock and wildlife, Daily Nation (2009) and AllAfrica (2011) only mentioned mortality for livestock as problem. One common cause, ‘migration’, was described by Daily Nation (2009) and AllAfrica (2011). Due to migration of herders, livestock face tick-borne diseases they had never faced before and that resulted in mortality. Daily Nation (2009) framed two prescriptions, one to solve the problem and one to solve the cause. Locals and the ministry of livestock mentioned dipping of animals as solution. In contrast, herders see rain and going back home as the solution. They see a problem with dipping; ‘animals are not used to dipping’ and ‘face mortality if dipped’. Besides, Daily Nation (2009) mentioned ‘encroachment of wildlife habitats’ and ‘tick burden’ as cause of mortality. Causes mentioned by AllAfrica (2011) were ‘rainfall’, ‘tick abundance’, ‘vegetation’ and ‘lack of knowledge’. The problem of ‘emergence of diseases’ in combination with ‘mortality in general were given by Laikipia wildlife forum (2016) and AllAfrica (2011).

Another economic problem that was mentioned but did not have common linked causes, moral judgements or prescriptions was ‘economic in general. This problem was mentioned both in Cairngorms as Laikipia.

4.2.3. Ecological problems

In total, thirteen different ecological problems were mentioned of which six different ecological problems were mentioned in both Cairngorms national park as Laikipia. Four problems were only mentioned in Cairngorms and three other problems only in Laikipia.

The problem ‘activity of ticks during the year’ was mentioned five times by three different practice-oriented sources of which Peter Marren (2006) and Ted Wilson (2015) in Cairngorms and Mpala (2016) in Laikipia. No common causes or prescription were mentioned. Ted Wilson (2015) mentioned ‘ecological factors in general’ and ‘habitat preference’ as causes to the problem, while Mpala (2016) did not mention any causes at all. However, this practice-oriented source mentioned ‘share knowledge’ as solution. Besides, no common problems in relation to the ‘activity of ticks during the year’ were given. However, Mpala (2016) mentioned the problem of ‘livestock health’ and ‘human health’ more than one time in combination with the ‘activity of ticks during the year’. However, this problem was not included into more fully articulated frames.

Secondly, the problem of ‘wildlife health’ was mentioned four times by three different practice-oriented sources, of which both Cairngorms as Laikipia mentioned this as problem. No common causes or prescriptions were mentioned, so no frames were found. Peter Marren (2006) mentioned the problem of ‘wildlife health’ as result of the prescription ‘culling’. Cairngorms government (2005) mentioned ‘heather management’ as the solution and Laikipia wildlife forum (2016) mentioned ‘livestock management’ as solution. So both mentioned social solutions for this problem. Common problems mentioned in relation to wildlife health were ‘human health, by Peter Marren (2006) and Cairngorms government (2005), and ‘livestock health’ mentioned by all.

Thirdly, ‘increase in tick population’ was mentioned four times by two different practice-oriented sources both in Cairngorms. Peter Marren (2006) and Cairngorms government (2005) both mentioned ‘climate in general’ as common cause for this problem. Of these, Cairngorms government (2005) framed ‘heather management’ as solution to the problem. Other causes mentioned by Cairngorms government (2005) were ‘wildlife as reservoir’ and ‘livestock as reservoir’.

Other ecological problems were ‘increasing tick-borne disease infestations’, ‘wildlife disease’ and ‘ecological in general’, which were only mentioned in Cairngorms. ‘Tick transmission’, ‘emergence of diseases’ and ‘spread of diseases’ which were only mentioned in Laikipia. ‘Vector of tick-borne disease’, ‘distributed worldwide’, ‘infect multiple hosts’,’ and ‘spread of pathogens’ were mentioned both in Cairngorms and Laikipia. These problems were not linked to common causes, moral judgements or prescriptions, so no frames were found.

4.2.4. Comparison

In Laikipia, the most frequently described problem frame element was the economic problem of ‘mortality in general’. Another economic problem that was mentioned by at least two practice-oriented sources was ‘economic in general’. Social problems that were mentioned by at least two practice-oriented sources were ‘human health’, ‘livestock health’ and ‘control of tick-borne diseases’, and ecological problems were ‘tick transmission’, ‘spread of diseases’ and ‘emergence of diseases’.
During the interview, the expert told that the biggest problem concerning ticks and tick-borne diseases was livestock health and the mortality and economic problem of it, since people depend on them for their livelihood. So, the economic and social problems were the most important. Also because the high costs for the application of acaricides. However, in the practice-oriented sources, human health was also mentioned as important social problem. However, the expert felt that this was not really the case, since farmers would not see the danger of ticks and tick-borne diseases for themselves and only a handful of people were bitten, but this was dependent on the area. Another social problem mentioned by the expert was the lack of awareness in the area. This could be a reason why the farmers did not see the problem of human health. The control of tick-borne diseases is a problem that concerns the farmers in the area, but only because of the high costs of applying acaricides and since acaricides cannot always be applied regularly. Lastly, the ecological problems mentioned in the practice-oriented sources were confirmed, like tick transmission, transmission of tick-borne diseases, high tick load, maintenance of ticks, high tick infestation and tick abundance, environmental issues and disease outbreaks.

In Cairngorms national park, the main problem arranged was the social problem of ‘human health’. Other social problems that were mentioned by at least two practice-oriented sources were ‘livestock health’, ‘livestock disease’ and ‘control of tick-borne diseases’. Ecological problems that were mentioned by at least two practice-oriented sources were ‘increase in tick population’, ‘activity of ticks during the year’, ‘wildlife health’ and ‘vector of tick-borne disease’. No economic problems were mentioned by at least two practice-oriented sources in Cairngorms national park.
The expert selected for the Cairngorms national park did much research on the Ixodes tick and Lyme disease. The main tasks for different actors in the Cairngorms national park were to protect people who visit the area and protect themselves and their employees. Besides more people are getting tick bites. Therefore, human health was an important problem. Moreover pet health was also mentioned by the expert, since pet owners felt that the health of their pet was important. However, this was not mentioned in the practice-oriented sources in Cairngorms. Furthermore, social problems like livestock disease and livestock health were seen as important as well, since farmers lost their lambs due to the Louping ill virus outbreak a few years ago. This would mean that mortality could be also an important economic problem, while this was not mentioned in the practice-oriented sources in Cairngorms. Besides, the national park relied on income from tourism. When people stopped going to the park because they were afraid of ticks or a tick bite, that would have a huge economic impact on the area. From the ecological problems mentioned in the practice-oriented sources, increase in tick population was also mentioned by the expert. Besides, other ecological problems mentioned by the expert were that ‘ticks are common’ and that some areas have ‘loads of ticks’.

4.2.5. Conclusion

To conclude, thirteen different ecological, nine different social and two economic problems were found in the practice-oriented sources. Four of these frame elements were combined to problem frames. Most ecological problems were not linked to a common cause, moral judgement or prescription, so they were not linked into more fully articulated frames. Only one ecological problem frame was mentioned in the practice-oriented sources, which meant that it was fragmented. Besides, also one economic problem frame was found, which was linked to a human induced cause and to different types of prescriptions. In total, three social problem frames were found and all linked to animal induced causes or no causes were mentioned at all. All types of prescriptions were connected to these social problem frames, but when no cause was linked, the prescriptions were mainly social as well.

In Laikipia, most problems addressed were economic, while in Cairngorms, most problems addressed was social (Table 6). This can be due to the priority of the area. In Cairngorms national park, tourist play a important role in the local economy and therefore social problems addressed are more important, while in Laikipia, people try to get an income to survive.

4.3. Causal frames

In total, 26 different causes were mentioned of which Cairngorms treks (n.b.) did not mention any cause at all. Nineteen different causes were described in Cairngorms and thirteen different causes were mentioned in Laikipia. In Table 7, the causal frame elements that were mentioned by most different practice-oriented sources in the two areas were described. The causal frame elements were divided in the same four different topics as in literature; animal induced, human induced, tick induced and ecologically induced.

Table 7: Cause codes mentioned by most different academic articles by area

Rank	Kind of cause	Cause codes in Laikipia	sources	Frequency
1	Tick	Habitat preference	2	3
	Tick	Tick abundance	2	3
	Human	Migration	2	3
2	Animal	Small mammals as transporter	2	2

Rank	Kind of cause	Cause codes in Cairngorms	Sources	Frequency
1	Animal	Wildlife as reservoir	3	5
2	Ecological	Climate in general	2	2

4.3.1. Animal induced

In total, five different animal induced causes were mentioned of which three different animal induced causes were mentioned in both Cairngorms national park as Laikipia. The other two causes were only mentioned in Laikipia.

'Wildlife as reservoir' as cause was mentioned six times by four different practice-oriented sources, of which one quotation was found in Laikipia by Laikipia tourism (2013). The other quotations were found in Cairngorms by Peter Marren (2006), Cairngorms government (2005) and Mark Avery (2016). Peter Marren (2006) and Mark Avery (2016) mentioned 'livestock disease' as common problem in relation to the cause of which latter framed 'dipping' and Peter Marren (2006) framed 'culling' as solution for this (which he also criticizes, because of the problem of 'wildlife health'). 'Culling' as prescription was also a common prescription and also described by Laikipia tourism (2013). They framed this cause and prescription in combination with the problem 'control of tick-borne disease', while Peter Marren (2006) mentioned it in combination with problem of 'livestock health'.

‘Small mammals as transporter’ and ‘livestock as reservoir’ as cause, were mentioned both in Cairngorms and Laikipia and the causes ‘pets as transporter’ and ‘other tick-bearing mammals’ were only mentioned in Laikipia. All did not have connections with other common problems, moral judgements or prescriptions, so no frames were found.

4.3.2. Ecologically induced

In total, eight different ecologically induced causes were mentioned of which one cause was mentioned in both Cairngorms national park as Laikipia. Also one ecologically induced cause was mentioned only in Laikipia and the other six causes were only mentioned in Cairngorms.

The cause ‘climate in general’ was mentioned two times by two different practice-oriented sources in Cairngorms. Both Peter Marren (2006) and Cairngorms government (2005) mentioned this in combination with the common problem of ‘increase in tick population’. No prescriptions or moral judgements were connected.

The cause ‘vegetation’ was mentioned in both Cairngorms and Laikipia. The causes ‘ecological factors in general’, ‘environment in general’, ‘habitat overlap’, ‘temperature’ and ‘human-livestock-wildlife interface’, were only mentioned in Cairngorms as causes, while ‘rainfall’ was only mentioned in Laikipia as cause. These causes were not linked to common problems, moral judgements or prescriptions, so no frames were found.

4.3.3. Human induced

In total, eight different human induced causes were found of which one cause was mentioned in both Cairngorms national park and Laikipia. Four other different human induced causes were only mentioned in Cairngorms and three different causes only in Laikipia.

The cause ‘encroachment of wildlife habitat’ was mentioned three times in total of which Ted Wilson (2015) mentioned this in relation to human and Daily Nation (2009) in relation to livestock. Therefore it could be a human induced cause or animal induced cause. However, since livestock is the responsibility of human, it is seen as human induced cause. No common problems, prescriptions or moral judgements could be found, so this cause was not included into a more fully articulated frame.

The cause ‘migration’ was mentioned three times by two different practice-oriented sources in Laikipia. Both Daily Nation (2009) and AllAfrica (2011) mentioned the cause as human migration with their livestock. Both practice-oriented sources mentioned ‘mortality in general’ for livestock as common problem. Daily Nation (2009) framed this in combination with the prescriptions of the veterinarians and government, ‘dip the animals’, while the herders mentioned ‘go home’ and ‘rain’ as prescriptions. AllAfrica (2011) did not mention any prescriptions at all.

‘Forest management’, ‘improved diagnostics’, ‘reporting of infection’ and ‘social reasons in general’ as causes, were only mentioned in Cairngorms, but these causes were not connected to any common problems, moral judgements or prescriptions. ‘Cattle threatened with chemicals’ and ‘lack of knowledge’ were only mentioned in Laikipia as cause, but also these causes were not included in more fully articulated frames.

4.3.4. Tick induced

In total, five different tick induced causes were mentioned of which one cause was mentioned in both Cairngorms national park as Laikipia. Also one tick induced cause was mentioned only in Cairngorms and the three causes were only mentioned in Laikipia.

‘Habitat preference’ was the most frequently mentioned tick induced cause. This cause was mentioned nine times by three different practice-oriented sources, Ted Wilson (2015), Mpala (2016) and Laikipia wildlife forum (2016). No common problems, moral judgements or prescriptions were mentioned, so no frames were found. Only Laikipia wildlife forum (2016) mentioned one prescription; ‘livestock management’. Other common causes mentioned in relation to ‘habitat preference’ were ‘small mammals as transporter’, by Ted Wilson (2015) and Laikipia wildlife forum (2016), and ‘ecological factors in general’ such as ‘temperature’. However, no frame was found.

‘Tick abundance’, ‘reproduction biology’ and ‘tick burden’ as causes, were mentioned only in Laikipia. ‘Tick distribution’ was only mentioned in Cairngorms. All these causes were not linked to common problems, moral judgements or prescriptions, so no frames were found.

4.3.5. Comparison

In Laikipia, the main causes found were the tick induced causes ‘tick abundance’ and ‘habitat preference’, and the human induced cause ‘migration’ of herders with their livestock. Another cause mentioned by at least two practice-oriented sources was the animal induced cause ‘small mammals as transporter’. Furthermore, three out of five tick induced causes were only mentioned in Laikipia.
The expert told that the movement of domestic livestock and wildlife was the biggest cause to the problems of ticks and tick-borne diseases. So, the human induced cause of migration was the main cause since these animals were the most important factor for the transmission of ticks and tick-borne diseases, the prevalence of ticks and high tick infestation. Besides, the prevalence of ticks could also be caused by not frequently applying acaricides to the animals or their habitat. In addition, the transmission of tick-borne diseases and ticks can also be caused by lack of management of wildlife and domestic animals. In addition, the problem of tick abundance was seen as a cause in the practice-oriented sources, while the expert saw it as one of the problems which was caused by the environment, since it was presumed that savannah grassland contained more ticks, by places without real livestock and wildlife management due to several communities in an area, and not fully enclosed places have a higher tick abundance. Other causes mentioned by the expert were related to acaricides. So, the high stock of livestock was emphasised as a cause for the not frequently application of acaricides but the application of acaricides was also a cause for environmental issues. Nevertheless most farmers would know the ecological consequences, but still apply acaricides because it was the cheapest solution available for them.

In Cairngorms national park, two causes were mentioned by at least two different practice-oriented sources. The animal induced cause ‘wildlife as reservoir’ and the ecologically induced cause ‘climate in general’. Other ecologically induced causes mentioned in the practice-oriented sources relating to Cairngorms national park were ‘environment in general’, ‘increase in temperature’ and ‘habitat overlap’, these were mentioned by one source. Five out of seven ecologically induced causes were only mentioned in Cairngorms. Other human induced causes mentioned by one practical source were ‘improved diagnostics’ and ‘better reporting’ of infections. However, there were no animal induced causes and only one tick induced cause that was only mentioned in relation to Cairngorms.
During the interview, the expert told that eradication of ticks was probably not possible since you only need one deer or other mammal that has tick attached to walk through the land and the ground would be covered with ticks again. So wildlife was framed as a reservoir for ticks. Other possible animal induced causes mentioned by the expert were the local mammal population and increase in deer population. Besides, the expert confirmed ecological causes to the problems as well, like vegetation, altitude and climate. However, in the practice-oriented sources the human induced causes forest management, improved diagnostics, reporting of infection and social reasons in general were mentioned. Nevertheless, the expert mentioned human induced causes, e.g. that more people spent more time outdoors, so more people were exposed to ticks. Besides, the expert confirmed that

more effort had been paid in reporting Lyme disease. However, just like the practice-oriented sources, she mentioned that not only environmentally induced causes were important, but also social induced causes.

4.3.6. Conclusion

To conclude, eight different human induced, eight ecologically induced, five tick induced and five animal induced causal frame elements were mentioned in the ten practice-oriented sources. Most different causal frame elements found were human induced, what meant that practice-oriented sources mostly frame human activities as cause of the problems concerning ticks and tick-borne diseases. However, three causal frame elements were connected into more fully articulated frames of which only human induced cause was linked in a frame and was related to an economic problem and to a chemical, ecological and social prescription. Besides, many different ecologically induced causal frame elements were mentioned, but again only one of these frame elements was used in a frame. This cause was related to an ecological problem, without prescription. The two animal induced frames were both connected to social problems and to chemical and technical solutions. No tick induced frames were found.

Regarding Laikipia, the most important causes were human, tick induced and animal induced, while in Cairngorms the main causes were animal or ecologically induced. The high number of different ecologically induced frame elements in Cairngorms is probably because of the changing weather conditions due to climate change, that results in a larger problem concerning ticks and tick-borne diseases.

4.4. Moral judgement frames

Three moral judgements were mentioned in practice-oriented sources. Regarding Cairngorms national park, Mark Avery (2016) mentioned 'culling is untenable' and 'no evidence for undertaking culls' and regarding Laikipia county, Daily Nation (2009) mentioned that veterinary officials 'blame others'. So, three moral judgements were described, of which two are about culling. Probably this was mentioned since people are against culling of animals. Moral judgements about culling were only mentioned in Cairngorms and not in Laikipia. This can be explained since culling is done as sport activity in Cairngorms and therefore it attracts tourist and is publically known, while in Laikipia, tourist are attacked by the living animals. So there is no public awareness about culling.

4.5. Prescription frames

In total, 28 different prescriptions were mentioned of which AllAfrica (2011) did not mention any prescription at all. Nineteen different prescriptions were found related to Cairngorms and nine different prescriptions related to Laikipia. In Table 8, the prescriptions which were found in at least two practice-oriented sources are showed. The prescription frame elements were divided in the same three different topics as in literature; chemical solutions, social solutions and technical solutions. However, one extra group was added, the ecological solution. This group contains one solution that was naturally processed and therefore did not fit in one of the other groups.

Table 8: prescription codes mentioned by most different academic articles by area

Rank	Kind of prescription	Prescription codes in Laikipia	Sources	Frequency
1	Social	Share knowledge	2	2

Rank	Kind of prescription	Prescription codes in Cairngorms	Sources	Frequency
1	Technical	Manual removal of ticks	2	5
2	Social	More knowledge	2	3
	Chemical	Use of antibiotics	2	3

4.5.1. Chemical solutions

In total, five different chemical solutions were mentioned of which none chemical solution was mentioned in both Cairngorms national park and Laikipia. Of the chemical solutions, four were only mentioned in Cairngorms and one solution was only mentioned in Laikipia.

The chemical solution 'use of antibiotics' was mentioned three times by two different practice-oriented sources, both in Cairngorms. Cairngorms treks (n.b.) and Ted Wilson (2015) mentioned both one common problem and no causes in relation to this solution. The common framed problem mentioned was 'human health'.

'Dip the animals' was mentioned in Laikipia and 'use of acaricides', 'blood test' and 'chemical in general' were mentioned in Cairngorms as chemical solutions. However, these prescription were only mentioned by one source, so no common frames could be found.

4.5.2. Social solutions

In total, thirteen different social solutions were described of which one social solution was mentioned in both Cairngorms national park and Laikipia. Five social solutions were only described in Cairngorms and seven other social solutions only in Laikipia.

The prescription 'raise awareness' was mentioned three times by two different practice-oriented sources. Both Cairngorms treks (n.b.) and Laikipia wildlife forum (2016) mentioned this prescription in combination with the problem of 'human health'. No causes were mentioned in direct relation with this problem or solution.

Secondly, 'share knowledge' as prescription was found two times in two different practice-oriented sources in Laikipia. The common problem 'human health' was described by both Mpala (2016) and Laikipia wildlife forum (2016). Mpala (2016) mentioned this in combination with the problem of 'livestock health', but did not elaborate on any causes or other prescriptions. Laikipia wildlife forum (2016) did not link this common prescription and problem with a cause.

'More knowledge', 'check for ticks', 'inform people', 'be aware of ticks' and 'developing prevention method', were only mentioned in Cairngorms and 'go home', 'higher understanding', 'livestock management', 'grazing plans', 'range management' and 'sell animals' were only mentioned in Laikipia as social solution, but were not linked to common problems or causes. So, no frames were found.

4.5.3. Technical solutions

In total, nine different technical solutions were found of which only one in practice-oriented sources related to both Cairngorms national park and Laikipia. The other eight technical solutions were only mentioned in Cairngorms.

The most frequently mentioned technical solution was 'manual removal of ticks'. This prescription was mentioned five times by two different practice-oriented sources, both in Cairngorms. Cairngorms treks (n.b.) and Ted Wilson (2015) did not mention causes and common problems. Only Cairngorms treks (n.b.) mentioned this prescription in relation to the problem of 'human health'. So, no frames were found.

'Culling' was found as solution two times in two different practice-oriented sources. Peter Marren (2006) and Laikipia tourism (2013) both mentioned this prescription in combination with the common cause 'wildlife as reservoir'. Peter Marren (2006) framed this together with the problem

‘livestock disease’. Laikipia tourism (2013) framed this cause in combination with the problem ‘control of tick-borne diseases’.

‘Short vegetation’, ‘screen animals’, ‘cover with clothing’, ‘prevent contact’, ‘risk mitigation’, ‘combination of prevention methods’ and ‘heather management’ were technical solutions only found in practice-oriented sources related to Cairngorms, but were not included into more fully articulated frames. No other technical solutions were found in relation to Laikipia.

4.5.4. Ecological solutions

Only one ecological solution was found. It was described in relation to Laikipia. ‘Rain’ was an ecological solution given by herders in Laikipia, since draughts force them to migrate with their livestock into areas where ticks are abundant. However, this solution cannot be implemented through human action and is only an indirect solution.

4.5.5. Comparison

With regard to Laikipia, only one prescription was mentioned by at least two different practice-oriented sources. This was the social prescription ‘share knowledge’. Besides, prescriptions given were mainly social solutions instead of chemical solutions or technical solutions. From the practice-oriented sources, many different social solution were given like ‘share knowledge’, ‘raise awareness’ and ‘higher understanding’, but also solutions such as ‘livestock management’ and ‘grazing plans’.
The expert did not mention these prescriptions literally, but told that farmers were open to listen to information and for cheaper alternative tick-control methods than acaricides. However, currently acaricides were seen as a solution by farmers for high tick infestation and tick load and they were easy to apply and the most cost effective tick management tool. Farmers mentioned acaricides as effective when they were frequently used, but this could be a problem due to the costs. So farmers want subsidy to reduce the price of acaricides as a solution for the control of ticks and tick-borne diseases. According the expert, other alternatives available would have some negative consequences. For vaccination there should be a trial first and that is expensive, fences or barriers are working because then no movement of livestock and wildlife take place what reduces tick load in vegetation and tick infestation. However, this could be a problem for livestock incursion, also because of the migration of herders with their livestock from outside Laikipia. Also livestock management is not possible, since draught caused feed scarcity.

Relating to Cairngorms national park, three prescriptions were mentioned by two different practice-oriented sources. The technical solution in the form of the ‘manual removal of ticks’, the chemical prevention method ‘antibiotics’ and the social solution ‘more knowledge’. Besides, many different social solutions were given by one practical source like ‘raise awareness’, ‘check for ticks’ and ‘inform people’.
Also during the expert interview mainly social prescriptions were mentioned. People with knowledge about ticks needs to ‘provide awareness raising information’ to ‘help educate people’, since people facing ticks ‘need information’, to ‘protect themselves’. The chemical solution antibiotics was not discussed during the expert interview, however she mentioned that today not the same chemicals were used on sheep for pest control as thirty years ago, because of neurological problems. Besides, the expert mentioned that some researchers were interested in developing a vaccine. Furthermore, technical prescriptions like deer management and culling were mentioned as well by the expert of which culling was mainly for sport and the tourist industry and less for tick management.

4.5.6. Conclusion

To conclude, thirteen social, nine technical, five chemical solutions and one ecological prescription element were mentioned in the practice-oriented sources. In total, four prescription frame elements

were connected into more broadly articulated frames, of which two social solution frames. The social and chemical prescription frames linked to social problems without any causes. This meant that practice-oriented sources try to change human behaviour to combat ticks and tick-borne diseases. The technical solution frame was linked to social problems and an animal induced cause. Regarding to Cairngorms many different social, technical and chemical solutions were found. Regarding to Laikipia, mainly social solutions were mentioned, while the chemical solution of acaricides was mentioned by the expert as used tick control practice (Table 9). So, the solutions found gave a fragmented view.

Table 9: Mentioned problems, causes, moral judgements and prescription by area

Frame elements	Both	Only Cairngorms	Only Laikipia
Social problems	5/9	0/9	4/9
Economic problems	1/2	0/2	1/2
Ecological problems	6/13	4/13	3/13
Animal induced causes	3/5	0/5	2/5
Ecologically induced causes	1/8	6/8	1/8
Human induced causes	1/8	4/8	3/8
Tick induced causes	1/5	1/5	3/5
Moral judgements	0/2	2/2	0/2
Chemical solutions	0/5	4/5	1/5
Social solutions	1/13	5/13	7/13
Technical solution	1/9	8/9	0/9
Ecological solution	0/1	0/1	1/1

4.6. Actor categories

Twenty-four different actor categories were mentioned in the practice-oriented sources, of which only four actor categories more than once. Five practice-oriented sources mentioned more than one actor category, Cairngorms government (2005) and Ted Wilson (2015) in Cairngorms and Mpala (2016), Daily Nation (2009) and AllAfrica (2011) in Laikipia. However, sometimes two or more actors were described in a different way between the practice-oriented sources, but were added together as one actor category. 'Herders' and 'shepherds' were combined to 'herders'. 'Veterinarians' and 'veterinary officials' were combined, 'scientists' and 'research centre' were combined and lastly, 'civilians' and the 'rural community' were combined. This gave a total of twenty different actors. In Figure 5, the different actor categories with their tasks or obligations are showed. The numbers show the quotations and the respective practice-oriented source can be found in Table 5.

In total, eleven different tasks or obligations were mentioned of which five were mentioned more than once. When looking at Figure 5, most different actors were 'at risk' for tick-borne diseases. Ted Wilson (2015) mentioned 'occupational' actor categories like; forestry workers, deer managers, farmers, soldiers, outdoor educators, 'conservationists', gamekeepers, and the 'recreational' actor category tourists. Cairngorms government (2005) mentioned gamekeepers as well, but added the rural community, stalkers and herders.

When going upwards, it is seen that herders were also mentioned by Daily Nation (2009), only to 'implement prevention methods'. Cairngorms government (2005) also mentioned 'implement prevention method', only then for moorland managers, who should also 'benefit when problem is solved'.

When going to the upper right part of Figure 5, it is seen that Daily Nation (2009) combined this with the veterinary officials who should 'give advice'. Moreover, Daily Nation (2009) mentioned as tasks or obligation for the veterinary officials to 'treat animals', 'accusing others' and 'share knowledge', while AllAfrica (2011) mentioned 'warning' as task for the veterinary officials.

So, 'share knowledge' should be done by veterinary officials following Daily Nation (2009), but when going down, it is seen that following Mpala (2016) this should also be done by research centres. This

knowledge is needed by members of community ranches, ranch owners and the rural community, following Mpala (2016), and by land based businesses following Cairngorms government (2005). Of which the rural community is also at risk following Cairngorms government (2005).
Lastly at the most upper right part, the government should 'buy animals' and 'supply tick prevention method', following Daily Nation (2009).

When looking at Figure 5, no clear patterns can be seen directly and only one combination was mentioned by two practice-oriented sources. Cairngorms government (2005) and Ted Wilson (2015) combined gamekeepers with being 'at risk'. Besides, some actors and tasks or obligations are mentioned in both Cairngorms and Laikipia. Actors mentioned in both case study areas were herders and the rural community, and tasks and obligations mentioned in both areas were 'need knowledge' and 'implement prevention methods.
Overall, since most actor categories and their task or obligation were not linked together by more than one paper, and when looking at Figure 5, it can be concluded that the analysis seems fragmented and no clear frame is dominant.

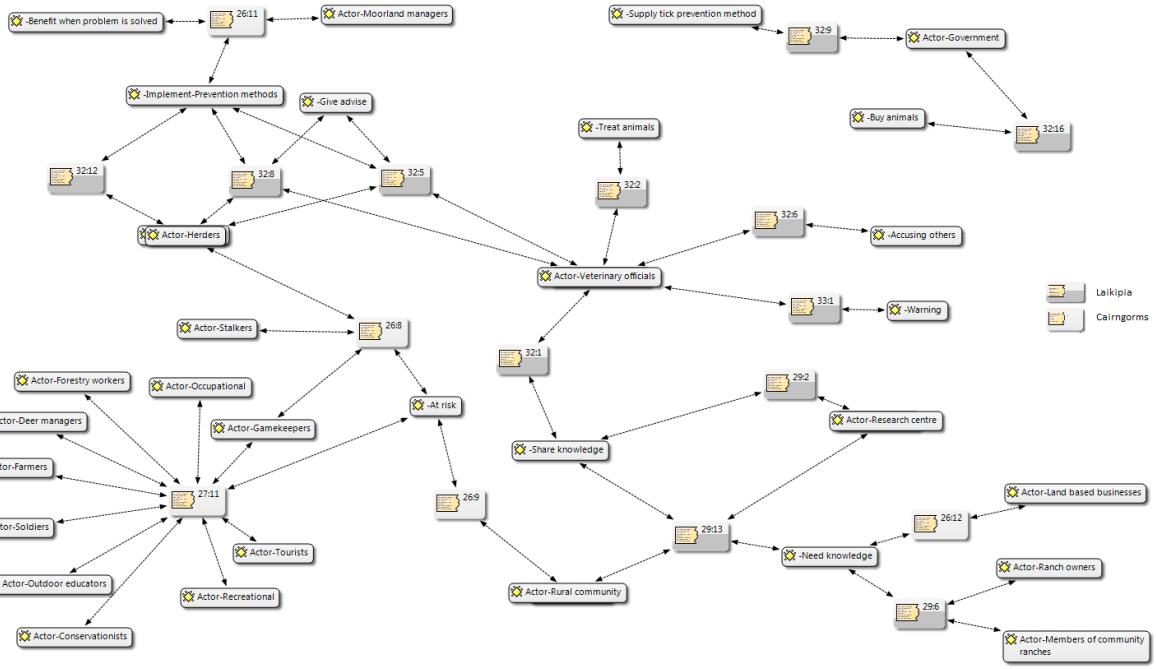

Figure 5: Actors and their tasks and obligations in practice-oriented *sources*

4.7. Overall frames and meta-frames

Different frame elements were used in the public practice-oriented sources. In figure 6, all eight frames from the different starting frame elements in practice-oriented sources were visualised. All eight frames were sorted by their causes. However, in this section only synthesis of the frames into meta-frames are described.
All social problems were either animal induced or not linked to a cause at all. Besides, they were connected with all different types of solutions (technical, chemical or social). Secondly, in most cases, social solutions were given to social problems.

In total, three meta-frames can be found in the eight frames. First the troublemaker meta-frame in which animals are framed as cause to social problems (frame 2-4 from Figure 6). Remarkable was that this meta-frame only mentioned wildlife as cause and also had the same prescriptions linked. Culling can be seen as prescription for the troublemaker.

Second, three frames, were synthesized to the meta-frame 'human health' (frame 6-8 from Figure 6). In this meta-frame, the problem of human health was always linked to an unknown cause and different prescriptions. This can be declared since ticks and tick-borne diseases were not coded as frame elements. All frame elements were related to ticks, tick-borne diseases and tick management and therefore the implicit causes are ticks or tick-borne diseases.
The third meta-frame was the chemical solution meta-frame (frame 4-6 from Figure 6). This frame consisted animal or human induced causes and social or economic problems which are linked to chemical solutions.

The problem	**→The cause**	**→The prescription**
1. Increase in tick population	→Climate in general	→?
2. Control of tick-borne disease	→Wildlife as reservoir	→Culling
3. Livestock health	→ Wildlife as reservoir	→Culling
4. Livestock disease	→Wildlife as reservoir	→Culling, dipping
5. Mortality in general	→migration	→Dip the animals, rain and go home
6. Human health	→?	→Use of antibiotics
7. Human health	→?	→Raise awareness
8. Human health	→?	→Share knowledge

Figure 6: Frameworks in practice-oriented sources

The frames found in the practice-oriented sources can be divided into frames mentioned completely with regard to Laikipia, frames only mentioned with regard to Cairngorms or frames mentioned with regard to both. In Figure 7, the frames that were completely found in relation to one case study area are showed. From this figure, it can be seen that frame 2-4 and frame 7 are build up with frame elements mentioned in different areas, while the other four frames are mentioned completely with regard to Cairngorms or Laikipia. The human health meta-frame is a combination of both areas (frame 6 and 8) and the chemical solution meta-frame as well (frame 5 and 6). The troublemaker meta-frame was mentioned in the practice-oriented sources.

Cairngorms:		
The problem	**→The cause**	**→The prescription**
1. Increase in tick population	→Climate in general	→Heather management.
6. Human health	→?	→Use of antibiotics
Laikipia:		
5. Mortality in general	→Migration	→Dip the animals
		→Rain and go home
8. Human health	→?	→Share knowledge

Figure 7: The frameworks in one particular area

4.8. Conclusion and discussion

In the practice-oriented sources, 81 different frame elements were mentioned and, since some frames were overlapping, finally combined to eight different frames.
All types of problem frames were found in the practice-oriented sources. However, most of the problem frames were social. These frames were linked to a animal induced cause or no cause at all and all types prescriptions were linked to the social problem frames. Furthermore, animal, ecological and human induced causal frames were found of which the causal frames were mainly animal induced. These were linked to social problems and technical or chemical prescriptions. Although social, chemical and technical solution frames were found, the chemical and social frames were all linked to the social problem of 'human health' and not linked to any cause. The technical solution frame was linked to social problems and an animal induced cause. Moral judgement frames were not found.

Finally, eight different frames were found and synthesised to three meta-frames. Overall, in the practice-oriented sources, tick management is framed by the troublemaker meta-frame, the human health meta-frame and the chemical solution meta-frame.
Besides, some differences between the case study areas were found. Laikipia framed tick management more in terms of social and economic problems, which were more linked to animal and tick induced causes. Besides, the prescriptions were for the biggest part social solutions. In contrast, Cairngorms framed tick management more in terms of social problems, which were more linked to animal or ecologically induced causes. The prescriptions were mainly technical and chemical solutions.
Overall, differences were found in the frame elements, but the frames found were coherent. Despite two case study areas were included, the frames and meta-frames were partly overlapping in the practice-oriented sources. No causes were linked to the problem of human health and mostly to social prescriptions in the human health meta-frame. Besides, culling was linked to wildlife as reservoir in the troublemaker meta-frame. The chemical solution meta-frame was linked to different problems and causes. The human health meta-frame was confirmed by the expert interview in Cairngorms national park, since many social solutions were mentioned for the problem of human health. Also the chemical prescription meta-frame was confirmed. The expert interview in Laikipia established that the use of acaricides is still the most important tick control method to all types of problems. However, the troublemaker meta-frame was not confirmed in any of the case study areas, since both expert interview did not mentioned culling as prescription to combat ticks and tick-borne diseases. However, two out of three meta-frames were indeed confirmed by the experts. So this means that the practice-oriented sources were overlapping with the practice.

In the next chapter, the comparison of the practice-oriented sources with the academic literature is done to find out if framing influence tick management in the case study areas.

5. Comparison

In this chapter the results are described for the question: 'What are the differences and similarities between the frames in scientific literature and in practice oriented contexts?' Therefore, a comparison was done between literature and practice-oriented sources in where the problems, causes, moral judgements, prescriptions, the frames and meta-frames were compared.

5.1. Differences and similarities in framing

First, the frame elements from the academic literature and practice-oriented sources are compared. For this, the problems, causes, moral judgements and prescription are compared.

5.1.1. Problem frame elements

In total, 44 different problems frame elements were found in academic literature and practice-oriented sources. Of these, the social problem frame element 'human health' was used most often by both the academic literature and the practical sources. Besides, the economic problem 'mortality in general' was also mentioned by both as one of the most frequently mentioned problems.
In academic literature as well as in the practice-oriented sources, around half of the different problem frames were ecological and more than one third of the problem frames social. However, the practice-oriented sources paid more quotation to social problems instead of ecological problems. Only a small percentage of the problem frames were economic for as well the academic literature as in the practice-oriented sources (see table 10).

Table 10: Types of problem frames

Problems	**Literature**		**Sources**	
	No. of different problems	No. of quotations	No. of different problems	No. of quotations
Ecological problems	20 (51%)	174 (58%)	13 (54%)	36 (47%)
Economic problems	5 (13%)	50 (17%)	2 (8%)	10 (13%)
Social problems	14 (36%)	74 (25%)	9 (38%)	31 (40%)
Total	39 (100%)	300 (100%)	24 (100%)	77 (100%)

In total, nineteen different problem frames were found across both literature and the practice-oriented sources. Twenty problem frames were mentioned in the literature but not in the practice-oriented sources. Of these twenty problems, most differences were found in the social problems. The academic literature paid more attention toward pets, endangered species, global health and tick prevention programs. Besides, the academic literature considered ecological problems like the spread and recovering of tick populations and high infection rates important and economic problems like costs and productivity loss. In contrast, five problems were only mentioned in the practice-oriented sources and not in the academic literature. The practice-oriented sources were more aware of the influence of tick prevention methods and ecological problems like the increase in tick population and their activity during the year.
So, probably this can be explained by the observation that the communication and cooperation between science and practitioners is not developed well. From the twenty problems frames that were not reaching the practitioners, it can be concluded that e communication from scientists can be improved. Besides, five problems mentioned in the practice-oriented sources were not found in the academic literature and the practice-oriented sources paid more attention towards social problems, while the academic literature paid more attention to ecological problems. Therefore a better communication between science and practitioners is needed, so that this is more corresponding.

5.1.2. Causal frame elements

In total, 63 different causal frame elements were found. When looking at the most frequently mentioned causes, the animal induced cause 'wildlife as reservoir' was mentioned frequently in the literature as well as in the practice-oriented sources. The cause 'migration' was also mentioned

frequently by both, but literature mentioned this for migration of animals, while in the practice-oriented sources 'migration' was seen as human induced cause.
In literature, almost one third of the causal frames featured human induced causes and animal induced causes, while in the practice-oriented sources almost one third of the causes were ecologically induced or human induced (See Table 11). One fifth of the causal frames were tick induced for the academic literature and practice-oriented sources. Besides, the academic literature focussed mainly on animal induced causes with 44 percent of the quotations, while in the practice oriented sources, this was equally divided between all types of causal frames. So, the academic literature focussed more on animal and human induced causes and the practice-oriented sources on human induced and ecologically induced causes.

Table 11: Types of different causes

Causes	**Literature**		**Sources**	
	No. of different causes	No. of quotations	No. of different causes	No. of quotations
Animal induced	16 (28%)	132 (44%)	5 (19%)	14 (26%)
Ecologically induced	12 (21%)	38 (13%)	8 (31%)	12 (22%)
Human induced	18 (32%)	50 (17%)	8 (31%)	13 (24%)
Tick induced	11 (19%)	77 (26%)	5 (19%)	15 (28%)
Total	57 (100%)	297 (100%)	26 (100%)	54 (100%)

In total, twenty different causal frames were found both in the literature and in the practice-oriented sources. However, thirty-seven different causal frames were mentioned in the literature, but not in the practice-oriented sources. Six different causes were described in the practice-oriented sources, but not in the literature. Of the differences in causal frames, mainly human, tick and animal induced causes were different and only the ecological induced causes were equal. Of the human induced causal frames, only three were overlapping between the academic articles and practice-oriented sources of which the academic literature focussed more on the active movement of livestock and tick prevention methods, while the practice-oriented sources focussed more on improved diagnostics and reporting of infections. In total, only four animal induced and four tick induced causes were found in both the academic literature and the practice oriented sources. The four common animal induced causal frames were wildlife and livestock as reservoir and small mammals and pets as transporter. In addition, the academic articles focussed more on the interaction between livestock and wildlife and on the host animals, while the practice-oriented sources mentioned other tick-bearing mammals as extra animal induced cause. The common tick induced causal frames were tick abundance, distribution and burden and habitat preference. Besides, the academic articles noticed more different tick characteristics like infection of multiple hosts and behaviour. The ecologically induced causes were all common to both the academic articles and the public-oriented sources, only the scientific articles mentioned four extra causes, namely weather conditions, humidity, geographical distribution and acaricides resistance. Finally, migration was mentioned as animal induced cause in the academic articles, but as human induced cause in the practice-oriented sources.
So, the academic articles and practice-oriented sources framed the tick problem in relation to different human, tick and animal induced causes. However, the fundament of the animal induced causal frames was equal, since all types of animals were framed both in the academic articles and the practice-oriented sources. The differences in tick induced causal frames was due to the more detailed articulation of knowledge on tick characteristics of researchers compared to practice-oriented sources.

5.1.3. Differences in prescription elements

In total, 43 different prescription frames were found. No common prescriptions were mentioned frequently in both literature and in practice-oriented sources.

In the practice-oriented sources, almost half of the prescriptive frame elements featured social solutions and almost one third technical solutions. In the literature, are larger number of different technical and social prescriptive frames were found, while chemical and social prescription frames were mentioned more frequently (see table 12). So, both the academic literature and the practice oriented sources used technical solution frames to the same extend, while literature used chemical solution frames more often and the practice-oriented sources social solution frames.

Table 12: types of different prescriptions

Prescriptions	**Literature**		**Sources**	
	No. of different prescriptions	No. of quotations	No. of different prescriptions	No. of quotations
Chemical solutions	8 (28%)	53 (37%)	5 (18%)	11 (19%)
Social solutions	10 (34%)	49 (35%)	13 (46%)	26 (45%)
Technical solutions	11 (38%)	40 (28%)	9 (32%)	20 (34%)
Ecological solutions	0 (0%)	0 (0%)	1 (4%)	1 (2%)
Total	(100%)	142 (100%)	26 (100%)	58 (100%)

In total, fourteen different prescription frames were mentioned in both the literature and in practice-oriented sources. Fourteen solutions were mentioned in the practice-oriented sources, but not in the literature. Other way around, fifteen solutions were mentioned in the literature and not in the practice-oriented sources. For all types of solutions, almost half was common and the other half was different between the scientific articles and practice-oriented sources. The chemical solutions had three overlapping solution frames, but the academic articles focussed more on immunological control like vaccinations, while the practice-oriented sources focussed more on available blood tests and dipping of animals. For the social solution frames, five were common and the academic articles paid more attention to more research and update available information and on prohibiting practices, while the practice-oriented sources put more emphasis on knowledge sharing to inform people what to do with ticks and on livestock management practices. Furthermore, the literature used more technical solution frames like surveillance and prevention methods, while the practice-oriented sources paid more attention to protection of tourists with heather management and own protection. Finally, the practice-oriented sources mentioned rain as solution. No ecological solutions were mentioned by the academic literature.
The differences in the solutions can be explained, since the academic literature is searching for new and more efficient solutions. The problem concerning ticks and tick-borne diseases still consist and available tick management practices are not satisfactory enough. On the other hand, the practice-oriented sources mentioned only already available prescriptions, because practitioners had to implement certain tick management practices. They could not implement management practices which were inefficient, expensive or difficult to apply.

5.1.4. Moral judgements

In total, four different moral judgement frames were found. The moral judgement ‘culling is untenable’ was mentioned in both the literature and the practice-oriented sources. The moral judgement ‘adaptive management offers opportunities’ was only mentioned in the literature, while ‘blame others’ and ‘no evidence for undertaking culls’ were only mentioned in the practice-oriented sources.

5.1.5. The common frames and meta-frames

In total, four common frames were found in both academic literature and practice-oriented sources (See Figure 8). No moral judgements were included in these frames, since they were not present. The cause between parenthesis was mentioned in the literature, but no cause was mentioned in practice in this framework. The prescription dipping/acaricides is combined, since dipping was the term used in practice, but this is with use of acaricides as well. ‘Different problems’ means that always a

problem was mentioned by both literature as in practice-oriented *sources* but these were not the same. This is also for different prescriptions.

The problem	**→The cause**	**→The prescription**
Livestock disease	→Wildlife as reservoir	→ Different prescriptions
Human health	→(Vector origin)	→Raise awareness
Different problems	→Wildlife as reservoir	→Dipping/acaricides
Different problems	→Migration	→Dipping/acaricides

Figure 8: The common frames

When looking at the meta-frames, two common meta-frames were found in the academic literature and in the practice-oriented sources; the troublemaker meta-frame and the chemical solution meta-frame. This shows that frames from the academic literature were incorporated by practice-oriented sources, since overlapping frames and meta-frames could be found. So the frames used in the research publications could indirectly reached the actors in the human-livestock-wildlife areas.
However, when looking more critically at these meta-frames, it can be seen that the human health meta-frame had an unknown cause in the practice-oriented sources, while in the literature this was not the case when looking at the frames where human health was involved as problem frame element. Different causes were given. The troublemaker meta-frame was found in both literature and in the practice-oriented sources, but in the practice-oriented sources this meta-frame included mainly culling as solution, while in the academic literature, many alternatives were mentioned. The chemical solution meta-frames consisted of different problems and causes in the academic articles and practice-oriented sources. So this meant that chemical solutions were framed as the answer to all types of problems and causes concerning ticks and tick-borne diseases as long as there were no good other tick management practices available.

5.2. Conclusion and discussion

To conclude, academic articles and practice-oriented sources both paid the most attention to ecological problems, and the problems mentioned were overlapping. However, the causes mentioned were more widespread across the scientific articles and practice-oriented sources, since many different causes were only mentioned either in the academic articles or the practice-oriented sources. The academic articles focussed more on animal induced causes, although the animals mentioned were equal (pets, wildlife, livestock and small mammals). The ecologically induced causes were also equal. Nevertheless, the human induced causes and the tick induced causes were divergent between the academic articles and practice-oriented sources. Moreover, in literature, more different types of chemical solutions were used and the practice-oriented sources paid more attention to social solutions, probably because researchers search for solution for the use of acaricides, while the practice-oriented sources presented solutions which are focussed on the implementation by the people living in the area.
When looking at the found frames and frameworks, in first opinion, it looks like four common frames and two meta-frames were found. So, four frames reach the practice-oriented sources. However, none of these frames was completely communicated to the public-oriented sources. In all four frames, at least one frame element linked was different. Besides, the other 35 frames mentioned in academic literature were not communicated to the practice-oriented sources at all. This can be explained, since fragmented frames described in the academic literature. The broad range of different frames made it difficult to communicate. Besides, other way around, it was difficult to find the main message from the academic literature. Besides, two common meta-frames were found. However, when looking more critically, it can be concluded that also these meta-frames were not overlapping completely. Still many gaps are present in these meta-frames from the academic articles and practice-oriented sources. So not all parts of the meta-frames are communicated to the practice-

oriented sources. So, the fragmented findings in the academic literature makes it difficult to find overlapping frames and meta-frames. So, the cooperation between the researchers and the practitioners could be improved, since gaps in the meta-frames in the practice-oriented sources were found which were filled by the academic literature. Therefore, reframing of the academic literature and cooperation between researchers and practitioners will help to find a direction and clear message and communicate that correctly to the practice-oriented sources.

In the next chapter, the results will be discussed and interpreted.

6. Discussion of the findings

In this section the results will be discussed, evaluated and interpreted. First the current tick research is discussed. Secondly, the expectations and the research limitations are discussed and last, the results are interpreted.

6.1. Current tick research

During the literature analysis, a few remarkable similarities and contradictions were found. First, thirteen out of 23 academic articles - Mbizeni et al. (2013), Haji et al. (2014), Munang'andu et al. (2009), Wamuyu et al. (2015), Anderson et al. (2013), Eygelaar et al. (2015), Nakayima et al. (2014), Munang'andu et al. (2012), Khatri-Chhetri et al. (2016), Ghai et al. (2016), Millan et al. (2016), Poo-Muñoz et al. (2016), Liyanaarachchi et al. (2015) and Boyard et al. (2008) - used similar material and methods. They all were collecting ticks or blood samples in domestic or wild animals to see what tick species were common or if they had antibodies against diseases.

Besides, it was very common to say that few studies have focused on this particular wild animal, this particular tick-borne disease or this particular area. However these studies all did more or less the same research, only with other animals, diseases or areas.

next, it is remarkable that many of the analysed academic articles focussed on the same types of topics, while other topics are under-represented, in particular how to find solutions to combat ticks and tick-borne diseases. This lack of trials for different tick prevention methods is also confirmed by the fact that 39 different problem frames, 56 different causal frames and only 29 different prescription frames were found in the literature. Few studies of trials of new possible solutions were done, while this can probably lead to new opportunities.

Also some contradictions were found. The most frequently mentioned causal frames were that wildlife act as reservoir and are host species for some tick-borne diseases in cattle or other livestock. However, Mbizeni et al. (2013) mentioned that buffalo as reservoir is generally accepted, but that livestock as reservoir is also plausible. Besides, Ghai et al. (2016) 'proved' that the majority of circulating tick-borne diseases may not be shared between gazelle and sheep and that wildlife do not carry the same tick-borne pathogens. So, passing tick-borne diseases by contact was not possible (Ghai et al. 2016). Wildlife as reservoir was also not very probable for zoonosis since Millan et al. (2016) proved that carnivores may not be reservoir hosts for zoonotic Rickettsia, but are probably only mechanical dispersers of infected ticks.

This contradiction is because of the different animals used in the different researches. Papers who did research on cattle with buffalo always found this buffalo as reservoir. Probably because these two animals have a close genetic relationship. However, also other wild animals are seen as reservoir by most researches. So probably with the research of Ghai et al. (2016) was that this research was only focussed on gazelle and sheep and these animals had no relation with each other and therefore did not carried the same ticks and tick-borne pathogens. Millan et al. (2016) did a comparison between carnivores and pets in peri-urban areas. However, carnivores may not be reservoir hosts for zoonotic Rickettsia, but are mechanical dispersers of infected ticks, so can still be the reservoir for the same ticks as human and for the same tick-borne pathogens as livestock. Mbizeni et al. (2013) only sampled cattle, at livestock-wildlife interfaces. The researcher only focussed on the sub-clinical carrier or cattle themselves.

6.2. Discussion of the hypothesis

The first expectation was considering the difference between the academic literature and public sources. The expectation was that many frames could be found in academic literature and less frames in public sources. Besides, differences in frames between the literature and sources were expected. Indeed more frames were found in the academic literature than in the public sources, but this was probably also because less public sources were used for the analysis. Besides, differences

were found. For example, the academic literature mentioned many ecologically induced and animal induced causes while public sources mentioned ecologically induced and human induced causes. So in the sources, human were blamed more for the problems than in research. Besides in literature, more different chemical solutions and technical solutions were described. Probably because researchers are looking for alternative tick prevention measurements.
The second expectation was about the difference between the human-livestock-wildlife areas. The expectation was that practice-oriented sources in Cairngorms national park will use less different frames, while in Laikipia county a broader range of frames is used. However this was not the case. Since for the case study areas, Laikipia and Cairngorms both had two frames that were unique for the areas. The other frames from public sources were mentioned in as well Laikipia as Cairngorms.

6.3. The influence of the research limitations

Three research limitations were addressed in this research. The first limitation was that this research was done in a research period of four months and that this had influence of the number of selected scientific literature and practice-oriented sources. Besides, only two case study areas were selected and visiting these areas was not possible. More different academic articles and practice-oriented sources would have had influence on the number of frame elements, frames and maybe meta-frames found. However, already a fragmented framing analysis was found in the academic literature and more academic articles would probably only make the frames more fragmented. When visiting the areas was possible, it would have resulted in a better fit between the practice-oriented sources and the practice. Since now 'culling' was mentioned in the frames in the practice-oriented sources, while this was not mentioned by the experts at all.

The second limitation was that the search terms for selecting the academic articles and practice-oriented sources had influence. For this research, I tried to use unspecific words to avoid a bias in the already selected academic articles. However, this could have resulted in the fragmented framing analysis in the scientific literature. So, when more specific search terms were used, probably a more coherent framing analyses was found. Besides, the practice-oriented sources selected were searched with English search terms. Especially in Laikipia, this practice-oriented sources were selected that were probably not even read by herders and farmers, since they only speak the local languages. Local practice-oriented sources would probably have a better fit with the practice, since now, different prescriptions were mentioned in the practice-oriented sources, while in practice mainly acaricides was used.

Third, inductive coding was conducted by one person. Besides, with manually coding of words or sentences, information can be misinterpreted and coded wrongly or it can be done more subjective than meant. Therefore, it would be more suitable to do a replica of the data collection. For the results, it can give a bias, since frames were built up with at least two common linked frame. So, when a sentence was misinterpret or not correct, a frame element could have been connected into a frame or other way around.

6.4. Interpretation of the results

The interpretation of the results is done at two levels. First the analyse of the frame elements is discussed, followed by the analyse of the meta-frames.

6.4.1. Frame elements

Remarkably, only four moral judgements were mentioned in total and they were not included in the frames. Although the low number of moral judgement present in the literature can be explained by the academic attitude that facts should be presented, in the practice-oriented sources it should have been more likely that the topic was framed in terms of moral judgements, given that it is linked to the treatment of animals as sentient beings. Probably, this had to do with the selected case study

areas. In the sources about Laikipia only one moral judgement was mentioned, while the sources about Cairngorms only consisted two other moral judgements. So obviously, tick management is not framed as a topic of moral judgements. Instead, the other types of frames tend to dominate, in particular social, technical and chemical prescriptions. Nevertheless, their application is more a question of effectiveness than moral obligation. Another explanation of the few moral judgements found in the sources from Laikipia is that it is not really the norm to give an opinion on this topic. In the African culture, religion and the communal life are important in where hierarchy plays a role (Verhoef and Michel 1997). Besides, moral judgements mentioned were not directly about ticks or tick-borne diseases. Probably since the knowledge of livestock farmers about ticks is missing (Brown et al. 2013).

A second remarkable frame element was that the prescription of vaccination was framed seven times in the academic literature. Although vaccination for most tick-borne diseases was not used in the case study areas, this prescription is mentioned frequently in the literature. Piesman and Eisen (2008) mentioned that a anti-tick vaccine for Lyme disease in humans is complicated. Besides, in North America, a vaccine against Lyme disease failed after four years. In addition, mass-vaccination against Lyme disease is only economically beneficial in a few communities (Piesman and Eisen 2008). However, a vaccine against tick-borne encephalitis already exists in Europe and Russia. Although tick control is an individual responsibility and mass vaccination is not very economically sustainable, this vaccine is mainly used by risk groups like travellers. However, these examples of working vaccines are only to protect human instead of animals. Nevertheless, laboratory tests and the vaccination of mice in a woodlot were promising (Piesman and Eisen 2008). In the framing analysis of the academic articles, vaccination is linked to economic and ecological problems and the causes 'wildlife as reservoir', 'prevention method acaricides' and an unknown cause. Therefore, vaccination is seen as best alternative for the use acaricides and to threat wildlife. However, the social problem of human health was most important in both case study areas. Therefore it can be explained that developing a vaccine for humans has a higher priority and is more likely than a vaccine for animals. This emphasizes again that the communication and cooperation between researchers and practitioners can be improved.

6.4.2. Meta-frames

A discourse can be found in the frames. The meta-frame of the troublemaker only included wildlife and pets as causes to several problems, but livestock was never mentioned. Although 'livestock as reservoir' was mentioned eleven times in the academic literature, it was never included in a frame. Probably, livestock is deliberately left out as a cause to the overall problem concerning ticks and tick-borne disease, even if it is plausible that livestock can act as reservoir just like wildlife (Mbizeni et al. 2013). When livestock was included as cause of problems in the frames and the troublemaker meta-frame, it would mean that the activities of livestock farmers would be framed as directly the cause of many problems, since the increase in the livestock population is induced by human activities (FAO 2013). Besides, decreasing the number of livestock in an area would have enormous economic consequences for the farmers in the areas.

In the scientific articles and practice-oriented sources, very few prescriptions for the behaviour of farmers towards livestock were found. Laikipia tourism (2013) mentioned grazing plans and range management as successful ways of controlling tick populations. However, due to draught this was not always possible to implement, since draught increases plant stress and reduces the amount of available plants (Thurow and Taylor Jr. 1999). High stocking densities need to be fed and therefore all feed sources are used.

On the other hand, culling of wildlife was included as prescriptive frame element in the troublemaker meta-frame in the practice-oriented sources, but not in the academic articles and in practice in the case study areas. The expert in Cairngorms mentioned hunting of deer and red grouse as tourist activity, but not as tick control method, and the expert in Laikipia did not mention culling at all.

However, the permanent removal of the deer population on an island did reduce the tick population (Rand et al. 2004). However, this will be more difficult on mainland due to migration of wildlife into new areas (Walker 2011).

Another discourse is that the chemical solutions meta-frame still used in the academic literature, although the negative consequences are known. Use of chemical prevention methods such as acaricides cause environmental damage and is toxic to mammalian species. Therefore some chemicals such at Dichloro-diphenyl-trichloroethane (DDT) were banned in the past (Piesman and Eisen 2008). Therefore, research developed less toxic approaches to control ticks, like use of soaps and desiccants, biological agents such natural enemies of ticks and the use of fungus (Patrican and Allan 1995; Samish and Rehacek 1999; Benjamin et al. 2002). Furthermore, several approaches to treat wildlife were tested, like feeding stations and bait boxes (Piesman and Eisen 2008). However, these tick control methods were not mentioned in the practice-oriented context and also the experts did not mention these practices during the interviews. The disadvantages of these practices are still too high, like high costs, low efficiency and negative effects for wildlife, like spread of diseases when using a feeding stations. Besides, the expert in Laikipia mentioned during the interview that currently the application of acaricides was still the cheapest and easiest way to control ticks. Although farmers and other stakeholders are open for new control methods, these should be cheaper, efficient and easy to apply.
The chemical solution meta-frame consisted different problems and causes in the academic articles and practice-oriented sources. So this meant that chemical solutions are presented as the answer to all types of problems and causes concerning ticks and tick-borne diseases as long as there are no suitable other tick management practices available. Concerning Laikipia, the chemical solution meta-frame seems dominant, since the use of acaricides is implemented by farmers to combat ticks and tick-borne-diseases.

6.4.3. A coherent frame

Since the frames and meta-frames found in the academic articles were fragmented, it was difficult to communicate a clear message to the practitioners. However, sometimes a problem cannot be solved. This is called a wicked problem (Rittel and Webber 1971). In framing tick management, it seems that this is not the case, since partly overlapping frame elements, frames and meta-framers were found. Besides, it looks like that science and practitioners both want a solution of the problem and the overlapping frames elements, frames and meta-frames gave perspective. Therefore, reframing was suggested for the academic literature. Reframing is a technique that can be applied when actors are willing to reflect on their frames and change the existing frames (Van Hulst and Yanow 2016). It is used when frames were opposite. With this technique, groups of people search for common ground and remove or change the language of the frames and shifting the way a message was described. (Gray 2005). Schön and Rein (1994) described reframing as coping with unavoidable problems and conflicts. So, opposite frames are not always opposite, since a shared interest is involved. So most of the times frames are just categorized in a different way and need to find common ground for reframing. (Schön and Rein 1994). At the end, problems might be resolved after all and was not a wicked problem at all (Van Hulst and Yanow 2016). So, reframing will help to communicate a more coherent frame in where the main dominant frame can be implemented by the practitioners.

The framing analysis is fragmented and this also explains the high number of different prescription frame elements mentioned in the scientific literature. Researchers are searching for new alternative methods to combat ticks and tick-borne diseases, but no cheap effective alternatives are present at this moment. Besides, gaps between science and practitioners need to be filled. Overall, a coherent framing analysis in the scientific literature, will help to implement tick management in the case study areas. When science will make use of reframing, one clear dominant frame and message can be

communicated to the practice-oriented sources and implemented by the practitioners. Framing will have influence on the consciousness of practitioners, who make decisions. These decision will have effect on ticks, human, livestock and wildlife in the areas.
For implementation, the conclusion and recommendations for both science and practitioners will be given in the next chapter.

7. Conclusions and recommendations

the objective of this research was to understand how framing influence tick management in a human-livestock-wildlife interaction. In academic literature, a fragmented frame concerning tick management was found. Overall, in the academic literature, tick management was framed by the troublemaker-meta-frame, the chemical solution meta-frame, the monitoring and prevention meta-frame, unknown prevention method meta-frame, the tick induced meta-frame and the spread of ticks and tick-borne diseases meta-frame. However, these meta-frames were synthesized from a broad range of different frames. In the practice-oriented sources, tick management was framed more coherent. Since eight frames were synthesized to three meta-frames, the troublemaker meta-frame, the human health meta-frame and the chemical solution meta-frame, which consisted of overlapping frames. With regard to Laikipia, the practice-oriented sources framed tick management more in the direction of social and economic problems, and social solutions, while in practice, the chemical solution meta-frame was confirmed. With regard to Cairngorms, the practice-oriented sources framed tick management as in terms of social problems and technical and chemical solutions. However, in practice, the human health meta-frame was confirmed. In the comparison between the scientific literature and the practice-oriented sources, four overlapping frames were found, but none of these frames was completely communicated to the public-oriented sources. In all four frames, at least one connected frame element was different. Besides, two overlapping meta-frames were found. However, it can be concluded that also these meta-frames were not overlapping completely. Still many gaps were present in these meta-frames from the academic articles and practice-oriented sources.

In this exploratory study, the framing perspectives showed the difficulties and challenges of tick management in the tick-wildlife-livestock interaction. In the academic literature, a fragmented frame was found. However, the practice-oriented sources showed a more coherent frame, but gaps were found in the frames.

Therefore, the recommendations are at two sides in the human-livestock-wildlife interaction, the scientific side and the practitioners side.

For the scientific side, it is recommended to start with trials of control practices that are better for human, animals and the environment, since acaricides are still the most frequently used practice. At this moment, the application of acaricides is already used for many years even though the negative effects are known and farmers and other stakeholders are open for new cheaper tick control methods.

Second, better communication from the scientific side is important. The scientific literature showed a fragmented frame concerning tick management and the frames and meta-frames between the scientific literature and practice-oriented sources were not overlapping. To improve this science communication, science should make use of reframing. Reframing will help to find common ground and communicate a more clear message.

Besides, the scientific side and the practitioners should search for more cooperation, since five problem frames were missing at the literature side and social problems were almost not overlapping. Moreover, six causal frames were not mentioned in the academic articles, and differences in human, tick and animal induced causal frames were found. For the prescription, fifteen solutions were not mentioned in the literature and no prescriptions were mentioned frequently. Reframing of the academic literature and also of the practice-oriented sources will help to find common ground.

At last, practitioners should implement found tick management practices from the academic literature. Although many successfully proved tick control methods had some disadvantages like ‘fencing’, ‘prohibit translocation’ and ‘treatment of wildlife’, it is important that practitioners look at the advantages, even when it is more difficult to implement.

8. References

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