

INFORMATION SEEKING AND SHARING IN RURAL SRI LANKA: IDENTIFICATION  
OF CENTRAL INDIVIDUALS IN WILDLIFE, LIVESTOCK, AND HUMAN HEALTH  
INFORMATION NETWORKS

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By

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## ABSTRACT

Low-resource countries are disproportionately affected by infectious diseases and residents living in rural areas in these countries are more likely to experience geographic or infrastructural barriers that limit their access to formal health care or information. For health interventions in these areas to be most effective, information should be tailored for their audience and then disseminated through relevant communication channels. Interventions that utilize existing social networks and that learn about how their audiences talk about the topic of interest are more effective than those that do not. This thesis used a case study in Sri Lanka to 1) identify central actors in wildlife, livestock, and human health information networks and 2) to examine themes and topics that arise during discussions about wildlife, livestock, and human health.

One-hundred and forty-three rural residents were interviewed to identify their main sources of wildlife, livestock, and human health information and to identify to whom they would report these health issues. Social network analysis of the responses revealed that government agency staff, such as the Grama Niladhari and government physicians, were the most frequently cited source of wildlife and human health information and the most common place to report health cases. A local indigenous healer was the most common source of livestock health information, the most common person to report livestock health cases to, and best positioned in each of the health networks to disseminate information and receive reports within the community. Women were more likely to be unsure of who to talk to and were considerably less likely to be nominated as a source of health information than men. Locally relevant and central leaders that are seen as key contacts for wildlife, livestock, and human health issues should be engaged and used to effectively disseminate information to and from the community. Government agencies should also engage with and maintain relationships with rural communities to facilitate information sharing. The gender differences shed light on the importance of engaging and accommodating all groups within a Sri Lankan community, perhaps by identifying group-specific opinion leaders that will appropriately communicate information to and from the group.

To learn about health discussion topics, a structural topic model was used to identify main topics that emerged in 7,412 survey responses and to examine gender differences among the topics. Seven topics were identified by the topic model: 1) Cost/benefits of living near forest, 2) Reporting/asking about animal health, 3) Diseases caused by animals, 4) Wildlife visits and

consequences, 5) Issues and needs of the village, 6) Village societies, and 7) medicine. There were small but significant gender differences for Topics 1-6 which indicated that men and women were spending different amounts of time on different topics. However, given the small gender effect sizes, which ranged from 0.3%-1.6%, it was concluded that gender has a relatively very small influence on these topics. Further research should investigate the specific words and rhetoric males and females use to describe health topics to uncover small nuances that broader methods cannot.

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## CHAPTER 1: GENERAL INTRODUCTION

### 1.1 Introduction

The greatest risk areas for contracting infectious diseases occur in regions where human activity and high wildlife biodiversity coincide, which typically occurs in lower-latitude, low-resource countries, such as tropical Africa, Latin America, and Asia (Jones et al., 2008; Morse et al., 2012). Interdisciplinary, inclusive, and collaborative initiatives, such as One Health, have recently been promoted to address global health holistically (Bordier & Roger, 2013; Kuiken et al., 2005; MacPherson et al., 2013; Ryser-Degiorgis, 2013; Whitmee et al., 2014; Zinsstag, Schelling, Waltner-Toews, & Tanner, 2011). Such approaches encourage government and non-government organizations across all health and environmental sectors to cooperate, engage, and communicate with each other and with relevant communities. A recent case study in Sri Lanka led to the development of an interdisciplinary, holistic wildlife monitoring program called the Sri Lanka Wildlife Health Centre (SLWHC) aimed at generating, sharing, and mobilizing knowledge and practice about wildlife health to safeguarding public and animal health (Valeix et al., 2011). Wild animals play a significant role in public health by transmitting, hosting, or causing the emergence of new diseases (Bengis et al., 2004). Zoonotic diseases – diseases which are spread among animals and humans – make up 60% of all infectious diseases globally and 72% of new or emerging diseases (Jones et al., 2008) and are a significant threat to global health for humans, livestock, and wildlife (Taylor et al., 2001).

The SLWHC sought to address the threat to human and animal health by engaging stakeholders from the human, wildlife, and livestock sectors and rural communities throughout the country (Valeix et al., 2011). Infectious disease surveillance programs have historically rarely followed such an inclusive model, so effective communication and information-sharing systems among stakeholders are often underdeveloped or nonexistent (Morse, 2007; Ryser-Degiorgis, 2013). Gaps in communication can dramatically and negatively affect the success of programs aimed to monitor and manage disease. Due to this, the SLWHC sought to strengthen communication with rural communities, ensure that information disseminated to communities is relevant and effective, and to establish relevant channels for the community to send wildlife

health case reports. The research presented in this thesis was a partnership with the SLWHC in order to contribute to these goals.

## **1.2 Objectives**

Information dissemination and collection is more effective when it utilizes existing social networks and identifies a central individual to initiate information diffusion (Banerjee, Chandrasekhar, Duflo, & Jackson, 2013; Cai, de Janvry, & Sadoulet, 2015; Perkins, Subramanian, & Christakis, 2015). Initiatives that measure comprehensive social and information networks in low-resource countries are lacking (Perkins et al., 2015). Therefore, the primary purpose of this thesis was to identify central actors in rural wildlife, livestock, and human health networks and in particular, health information and reporting networks in rural Sri Lanka in areas with high wildlife-human conflict. In addition, dissemination programs also increase their success when they learn about their audience and tailor the information to specific subgroups (Freimuth, Linnan, & Potter, 2000; Goldstein, Cialdini, & Griskevicius, 2008; Rogers, 2003). Consequently, the secondary purpose of this thesis was to examine themes and topics that arise during discussions about wildlife, livestock, and human health to learn about how the community talked about these topics. Understanding how the community discusses health issues can have implications for how information about health are tailored. The specific objectives were to: (1) identify the central sources of wildlife, livestock, and human health information, (2) identify to whom individuals report wildlife, livestock, and human health issues, (3) examine the role of gender in the information and reporting networks, (4) identify topics that emerge in discussions about human and animal health, and (5) examine the gender differences among the discussion topics. The results will inform the SLWHC of the best routes to disseminate information about wildlife, livestock, and human health to rural communities, how best to obtain observations of disease events from these remote areas, and how to appropriately tailor health information for men and women.



### **1.3 Thesis structure**

This document follows the format of a manuscript style thesis as outlined by the University of Saskatchewan College of Graduate Studies and Research. In Chapter 1, I provide a general overview on the background, purpose, and structure of the thesis. Chapter 2 reviews the relevant literature. Chapters 3 and 4 are original data-based research chapters and are presented in a standalone manuscript format. In Chapter 5, I conclude the thesis by providing a summary and brief discussion and recommendations based on the results from Chapters 3 and 4.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 Wildlife disease surveillance

Emerging infectious diseases (EIDs) are arguably the most significant current threat to global health for humans, livestock, and wildlife (Jones et al., 2008). EIDs are infectious diseases that are increasing or have increased in prevalence over the past 20 years (Taylor et al., 2001).

Zoonoses, which are infectious diseases that are transmitted from vertebrate animals to humans, make up 72% of new or emerging diseases, and 60% of all infectious diseases (Jones et al., 2008; Taylor et al., 2001). They can largely be attributed to human-driven changes in the environment, the climate, and livestock and food production (Whitmee et al., 2014). Between 1940 and 2005, it is estimated that half of zoonotic diseases originated from changes in land use from agricultural and food production practices (Keesing et al., 2010). Human encroachment into rural areas has increased human and livestock contact with wildlife and therefore, the risk of zoonotic disease transmission (Bengis et al., 2004; Whitmee et al., 2014). Due to these changes, monitoring disease in wildlife is increasingly being acknowledged as an effective EID control strategy (Artois et al., 2009; Jones et al., 2008; Keusch, Pappaioanou, Gonzalez, Scott, & Tsai, 2009; World Health Organization, 2013). Surveillance of animals can be an effective strategy to control infectious disease outbreaks by limiting the time that the disease has to regenerate in the animal population and reducing the number of infected animals (Donnelly et al., 2003; S.S. Morse, 2007; Murphy, 2008).

Jones et al. (2008) identified high risk areas for EIDs by correlating past EID events with environmental and socio-economic variables. They proposed that the greatest risk areas for contracting infectious diseases lie in lower-latitude, low-resource countries and where human activity and high wildlife biodiversity meet (Hotez, 2014; Jones et al., 2008; Morse et al., 2012). Regions with these characteristics are of high prevalence in Africa and south-east Asia, where almost 80% of worldwide deaths by infectious diseases occur (World Health Organization, 2015). For these reasons, effective surveillance efforts in low-latitude, low-resource settings are necessary (Daszak, 2009; Keusch et al., 2009). A low-resource country refers to a country that has insufficient monetary resources, expertise, and political buy-in which limits the development of health infrastructure (Singer et al., 2007).

Developing an effective monitoring program can be a challenge in low-resource contexts.

In addition, infectious disease surveillance is fragmented globally and at the local level, with most systems focusing on specific diseases and lacking effective information-sharing mechanisms (Morse, 2007). System fragmentation occurs geographically, among health sectors (human, animal, environment), and by disease (Morse, 2007). Recent bodies of thought, such as One Health, call for inclusive, interdisciplinary, and collaborative solutions to address global health (Bordier & Roger, 2013; Kuiken et al., 2005; MacPherson et al., 2013; Ryser-Degiorgis, 2013; Whitmee et al., 2014; Zinsstag et al., 2011). This approach promotes cooperation across all health and environmental sectors by engaging government and non-government bodies, academics, grassroots organizations, and the public. An inclusive and interdisciplinary wildlife monitoring program was recently developed in Sri Lanka in 2011 called The Sri Lanka Wildlife Health Centre (SLWHC). A core principle driving the SLWHC is One Health, and as such, the key stakeholders are the Department of Livestock Production and Health, the Department of Wildlife Conservation, the Ministry of Health, and the Faculty of Veterinary Medicine and Animal Science at the University of Peradeniya, along with other communities and stakeholders across the country. The SLWHC's partners also span across international borders. With its base at the University of Peradeniya, the SLWHC was developed with the mentorship of two Canadian institutions - the Canadian Wildlife Health Cooperative (Saskatoon) and the Canadian Centre for Coastal Health (Nanaimo). The Sri Lankan and Canadian stakeholders came together to design and implement a program of research and capacity building that will generate, share, and mobilize knowledge about wildlife health with the overarching goal of safeguarding public and animal health and enhancing the sustainability of local socio-economic development.

## **2.2 Sri Lanka**

Sri Lanka is a diverse tropical island country in South-Asia with a population of 20 million people. It has 26 national parks that together cover almost 9% of its entire land mass. Sri Lanka was ravaged by civil war from the 1980s until 2009 but has since developed its key infrastructure and is quickly becoming a popular tourist destination. Due to increased development and a growing population, humans are encroaching on wildlife habitat more than ever before, which is causing negative outcomes for both humans and animals (Santiapillai et al., 2010). Wild animals, particularly those with large home ranges such as elephants, are losing vital habitat and are

travelling into villages and devastating crops, homes, and lives. The increased contact between humans and wildlife is also a health risk, where zoonoses such as tuberculosis and rabies can be transmitted from animals to humans. The study area for this thesis, a village near a national park and bordering an elephant corridor, was selected due to its high incidence of human-wildlife contact.

Sri Lanka is classified as a lower middle income country, but significantly outperforms other countries of the same status on many World Development Indicators (The World Bank, 2016). For example, in 2010, 90% of females 15 years or older in Sri Lanka were considered literate, compared to only 66% in other lower middle income countries. In addition, compared to other lower-income countries in 2014, Sri Lankans had a 7.6 years longer life expectancy and a gross national income per capita that was 1.7 times higher.

Ethnicity, religion, and language are closely tied in Sri Lanka, with Sinhalese Buddhists making up more than two-thirds of the national population (Geopolitics, 2015). The other main ethnic groups are Sri Lankan Tamil (11%), Sri Lankan Moor (9%), and Indian Tamil (4%). Hinduism (13%), Islam (10%), and Roman Catholic (6%) make up the other main religions (Statistics, 2014). Traditionally, religion dictated human-animal relationships, such as what animals humans can and cannot eat. For example, Hinduism doesn't support the consumption of beef, while Islam and Buddhism opposes pork consumption. Chicken consumption is less affected by ethno-religious beliefs, and in fact, has almost doubled in Sri Lanka over the past 10 years (Alahakoon, Jo, & Jayasena, 2016). There is little available information on what proportion of Buddhists in Sri Lanka are vegetarian, but a survey conducted in Southern Province found that only 1% of respondents did not consume meat due to religious, economic, or animal welfare concerns (de Silva, Atapattu, & Sandika, 2011). A core principle of Buddhism is that of non-harm, but it doesn't explicitly extend that to consuming animals (The Buddhist Society, 2017).

The implications of religion on wildlife conservation is also unclear. Elephants, in particular, have strong symbolism in Buddhism and Hinduism and have been used in celebrations and festivals in Sri Lanka for centuries (Choskyi, 1988). Bhatia, Redpath, Suryawanshi, and Mishra (2016) did a study in northern India to explore the relationship between religion, namely Buddhism and Islam, and attitudes towards carnivore conservation. They found no relationship between the religions and attitudes towards managing wolves and snow leopards. Geographical location may be a larger indicator of wildlife support than religion. Bandara and

Tisdell (2003) examined how living in urban versus rural areas in Sri Lanka influenced attitudes towards elephant conservation. Urbanites expressed greater support for elephant conservation, while rural dwellers suffered large financial strains due to crop damage from elephants and other serious consequences such as injury or death. Bandara and Tisdell (2003) also found gender differences among rural dwellers with women holding more negative attitudes towards conserving elephants. Women were more likely to agree that the elephant population should be reduced by 50% to provide more land for agriculture.

A large proportion of rural women in Sri Lanka work unpaid in family agriculture. The labor force is where the most blatant gender inequality exists in Sri Lanka (Asian Development Bank, 2008). The highest concentration of employed women are in low productivity and low-income positions, such as factories and plantations. In addition, unemployment rates for women are more than double that of men. Relative to other countries, Sri Lanka placed 72<sup>th</sup> among 188 countries in 2014 on the gender inequality index (as reference, Canada placed 25<sup>th</sup>, United States 55<sup>th</sup>, and Sweden 6<sup>th</sup>) (United Nations Development, 2015). Sri Lanka has reached gender parity in education with girls having a higher enrollment and retention rate in secondary education and perform higher on public exams. Sri Lanka elected the first woman prime minister in 1960, however, the proportion of woman in parliament has yet to exceed 6% (Commonwealth of Learning, 2015). Lastly, contraceptive prevalence rate is reported at 70% and life expectancy for women is more than 7 years longer than that of men (Asian Development Bank, 2008). Despite these significant advances in women's rights, violence against women and inheritance and settlement rights are still outstanding issues (Asian Development Bank, 2008).

Gender and sex are still intricately linked in Sri Lanka. Gender refers to the socially constructed characteristics of men and women, such as norms that are followed and roles that are learned (World Health Organization, 2017). Gender is not determined biologically but has traditionally been linked with biological sex in many cultures. For example, there are exclusive behaviors and norms that are taught only to biologically female children, such as how to paint fingernails, and the opposite is true for biological males. In this thesis, when I use the terms "man", "woman", "male," and "female", I am referring to the gender. The social fabric of a country and culture is important to take into consideration when developing a program that intends to engage the public, such as the SLWHCs. The human dimensions of animal disease surveillance is rarely addressed (Ryser-Degiorgis, 2013), which is unfortunate, because human

behaviour is complex and plays a fundamental role in infectious disease dynamics (Heesterbeek et al., 2015).

### **2.3 Effective information dissemination for wildlife disease surveillance**

The public plays an important role in wildlife disease surveillance by expanding the eyes and ears of the surveillance program and by detecting and reporting cases to officials (Ryser-Degiorgis, 2013). Early detection of a pathogen is essential to the control and rapid response of any pandemic (Morse, 2007; Murphy, 2008). Too often, cases go unreported, making under-reporting one of the key barriers to wildlife disease surveillance (Stallknecht, 2007). Effective information-sharing mechanisms among programs, sectors, and stakeholders are often lacking and rarely addressed (Morse, 2007; Ryser-Degiorgis, 2013). Increasing and enhancing communication infrastructure within health and surveillance programs is associated with several benefits, including an increase in disease reporting and a reduction in handling time for laboratory results (Fontaine, Ross, Zink, & Schilling, 2010; Robertson, Sawford, Daniel, Nelson, & Stephen, 2010). Mobile technology has been a popular way to improve information sharing capabilities for disease surveillance. Robertson et al. (2010) piloted a mobile-phone based surveillance system in Sri Lanka for field veterinarians to report clinical cases in livestock animals and documented a steady increase in disease reports throughout the 9-month trial. Mobile methods have also been tested in human healthcare settings in many low-resource countries, such as Tanzania, Malawi, and Indonesia (for review, see Braun, Catalani, Wimbush, & Israelski, 2013). In their review, Braun et al. (2013) conclude that mobile technologies (and their users) can collect and share high quality and timely data with fewer errors than paper-based or conventional oral methods.

Strengthening information-sharing systems increases the potential for disease surveillance programs to become more effective, efficient, and cohesive (Fontaine et al., 2010; Mesmer-Magnus & DeChurch, 2009; Robertson et al., 2010). Furthermore, improved information sharing can result in more informed, engaged, and effective public reporting (Ryser-Degiorgis, 2013). These net gains are particularly important for interdisciplinary surveillance programs that rely on cross-sectoral communication and cooperation (Khan et al., 2012). The theory of “Diffusion of Innovations” outlines four elements that influence the efficiency and

effectiveness of information flow and content (Rogers, 2003). Time, the message, the communication channel, and the social system should all be considered by surveillance programs when they're sharing and receiving information internally and externally with the public.

*Time.* The passage of time is necessary for the receiving agent to process new information and to decide whether to adopt or reject it. The passage of time, however, cannot be directly manipulated, whereas the next three elements can be.

*The Message.* The message refers to the content of the information. How the content of the message is presented and framed will influence how the audience responds to the information. For example, text coherence, illustrations, and varying degrees of emphasis will induce differences in knowledge uptake. Whittingham, Ruiters, Castermans, Huiberts, and Kok (2008) compared the uptake of information with two different brochures: an "original" version and one modified to increase text coherence, include an illustration, and to ensure that important information was strongly emphasized. The results showed that participants that read the modified brochure exhibited greater comprehension than those that read the original version. The framing of a message can also affect how an audience cognitively processes a message. As social creatures, humans are likely to follow social norms that closely match their surroundings and circumstances to reduce erroneous behaviours (Lieberman, 2014). Goldstein, Cialdini, and Griskevicius (2008) used this human tendency to frame messages with the intention of encouraging hotel guests to reuse towels. The message framed as

"JOIN YOUR FELLOW GUESTS IN HELPING TO SAVE THE ENVIRONMENT. Almost 75% of guests that are asked to participate...do so by using their towels more than once"

induced significantly more compliant behaviour than the message

"HELP SAVE THE ENVIRONMENT. You can show your respect to nature...by reusing your towels during your stay".

By framing the message as a social norm, guests were more likely to comply by matching their behaviour to that of others. This concept has implications for disease surveillance programs, where programs can induce social norms to increase desired behaviors, such as wildlife disease reporting.

*The Medium.* The medium, or mode in which the information is disseminated, can be split into two elements: the channel and the source (Rogers, 2003). The channel is the vehicle that information takes to reach the target audience, such as mass media outlets (television, radio, newspapers, billboards), press releases, posters, brochures, newsletters, the Internet, and in-person. The type of audience and the content of the message will determine the appropriate channel for information. Appropriate channel selection is essential because a well-crafted message is useless if it doesn't reach the intended audience (Freimuth et al., 2000). For example, an obvious mishap would be to provide health information on the Internet for an audience that is mostly computer illiterate. Therefore, audiences should be reached through familiar and accessible channels (Freimuth et al., 2000). Moreover, multiple channels can be combined to communicate more effectively or channels can be selected strategically. For example, mass media channels are more effective at increasing knowledge and awareness, but in-person channels are more effective at changing attitudes and behaviour (Rogers, 2003). The channel of information can also influence comprehension and persuasion of a message, depending on whether the information is simple or complex. For instance, Chaiken and Eagly (1974) presented an easy or difficult message to undergraduate students through three different channels – written, videotape, and audiotape – and measured which channel best facilitated comprehension and persuasion. Difficult messages were best understood and most persuasive through written form, while simple messages were understood equally through all modalities but most persuasive through video.

The source is the individual or institution that the message originates from. Source credibility is important and can influence how individuals respond to information. Highly credible sources are more persuasive than low-credible sources, induce higher behavioural compliance, and receive more favourable feedback from the audience (Pornpitakpan,



2004). Valente and Fosados (2006) stress that “who delivers the message, and in what interpersonal context, may be just as if not more important than the message itself, and may result in better, more relevant, and perhaps more effective programs” (p. S30).

*The Social System.* The social system, or the interrelated network of people that an idea travels through, is very influential over the information diffusion process. Katz (1962) observed the importance of studying social structures: “it is as unthinkable to study diffusion without some knowledge of the social structures in which potential adopters are located as it is to study blood circulation without adequate knowledge of the veins and arteries”. The structure or pattern of the social system can impede or facilitate the flow of ideas from person to person. Centralized systems, which are social networks that have a few people in the middle that most others are connected to, are efficient at spreading new ideas and information to everyone in a network (Rogers, 2003; Valente & Pumpuang, 2007; Valente, 2010). Centrally located individuals have an increased likelihood of hearing new information first, adopting ideas and behaviours before others, and being a driver of information diffusion (Valente, 2010). Identifying and utilizing central people can be a useful and effective tool for programs to improve the communication of information (Perkins et al., 2015; Valente, 2012; Valente & Fosados, 2006).

Rogers (2003) fourth element, the social system, is gaining more attention as an effective tool for programs and interventions. Programs aimed at disseminating information or changing behaviours can utilize and leverage existing social networks to reach more people and increase the impact of their programs (Valente, 2012).

## **2.4 Social networks and disease surveillance**

Taking a network-level approach to solving interdisciplinary management problems is an effective way to gain new perspectives on how people, variables, and behaviours are related to one another (Bodin & Prell, 2011). It is common to think of social networks as an individual’s set of social relationships, such as their friends and family, but some researchers refer to it as the larger social structure that individuals are embedded in (Perkins et al., 2015; Smith & Christakis,

2008). The structure is made up of individuals and their ties to other each other which make up a web of interactions. The ties are the important unit of measure since they connect people and allow the passage of information and other resources. A small number of studies have measured social networks in the context of natural resource management. Prell, Hubacek, and Reed (2009) used social network analysis to identify who the main stakeholders were in the management of Peak District National Park in the United Kingdom. They identified eight main stakeholders and measured the strength of communication among them. They also identify individuals who are centrally placed in the network which they believe are individuals who will have a more holistic view of issues and are better placed to diffuse information to others. Measuring social networks is also relevant for farm management. Wu et al. (2016) measured social learning networks in Sri Lankan shrimp farmers and found that they varied based on geographic location and ethnicity. Sinhalese farmers had fewer connections than Tamil and Moor farmers and Wu et al. (2016) concluded that additional efforts should be made to connect disconnected farmers to the larger knowledge network. Social network research directly relevant to wildlife disease surveillance was a study in Nepal with professionals responsible for Japanese encephalitis. Hecker, El Kurdi, Joshi, and (Stephen, 2013) measured whether experts' discussed JE within a socio-ecological framework and what they considered to be the greatest risk factors driving JE. They used social network analysis to examine the relationship between the different risk variables and concluded that experts viewed the cause of JE as a result of proximate physical factors, such as pigs and mosquitos, rather than the result of a complex system of interactions.

Social networks have been extensively measured in the context of human health and development. Examining the research in this context is useful for understanding the impact of individual placement in a larger network. For example, the pattern of ties in a network and where an individual is situated within them has implications for personal health outcomes.

Contraception use and other family planning methods can significantly improve women's livelihoods in low-resource countries and a woman's network position can be associated with whether she uses it or not (Gayen & Raeside, 2010; World Bank, 2012). In rural Bangladesh, (Gayen & Raeside, 2010) measured women's networks and contraception use and found that non-users were located at the outside or were disconnected from the network while women who were in the middle and well connected were more likely to be users. There was also a tendency for women to be connected to other women who used similar contraceptive methods. Similarly,

women who are particularly well connected to many individuals were less likely to die giving birth (Gayen & Raeside, 2007). Simply obtaining information about contraception can increase adoption and contraceptive use and increase the likelihood that that information is transmitted to peers (Comola, 2008).

Another health behavior that is affected by social network ties is latrine ownership (Liu et al., 2012). Individuals in India are more likely to own a latrine if their friends have a latrine and if they are more centrally located in their social network (Shakya, Christakis, & Fowler, 2014). This holds true even while controlling for caste, education, and income. Being central in a network most commonly refers to being connected to a large number of other individuals in a network and is associated with other advantages beyond health. When central people are the first people to receive a piece of information, they are more effective at spreading it through a network than individuals who are not central. In an experimental microfinance program in rural India, Banerjee, Chandrasekhar, et al. (2013) found that participants in advantageous central positions were the most effective at recruiting other participants and disseminating information through communities. Similarly, in rural Chinese villages, individuals that were central to finance discussion networks were most effective at eliciting take-up of weather insurance among rice farmers (Cai, de Janvry, & Sadoulet, 2013).

Identifying and utilizing central people can be a useful and effective tool for programs to improve the communication of information (Perkins et al., 2015; Valente, 2012; Valente & Fosados, 2006). In particular, interdisciplinary and inclusive wildlife disease surveillance programs need effective communication systems for obtaining and disseminating information to and from stakeholders and the public. This is particularly important in low-resource countries where individuals more often rely more their social networks for information and support (Apicella, Marlowe, Fowler, & Christakis, 2012). Measuring social networks in past research has revealed the implications of network placement on individual health and finances, and on farmer knowledge and stakeholder participation. In addition, insights on experts' knowledge and framework for understanding JE was examined with social network analysis. However, social network analysis has not yet been used to inform a wildlife disease surveillance program of best practices to disseminate and receive information. This thesis will fill that gap.

## 2.5 Social network analysis

Social networks are the web of individuals and ties that a person is embedded in. Social network analysis is a method to investigate the strength and patterns of connections among a set of individuals. The connections between people can represent a wide range of constructs, including the exchange of money, service, influence, social support, and information (Haythornthwaite, 1996; Marin & Wellman, 2011; Wasserman & Faust, 1994).

One of the core measures produced by social network analysis is centrality, which is an indication of how centered an individual is in a network (Scott, 2013). Social network analysis

calculates centrality by using the number and type of connections that an individual has. There are several centrality measures, but two of the most common are degree and betweenness (Freeman, 1979). Degree is the total number of people that any given person in a network is connected to (Scott, 2013). For example, if Amy is connected to 15 people in the network, she has a degree of 15. In Figure 3.1, nodes B and C have a degree of three, while node A has a degree of two. Degree is a simple measure of centrality and indicates who is popular or has many connections within a social structure. It does not, however, give an idea as to how well an actor is positioned relative to others in a network.

Betweenness centrality, on the other hand, is an indication of network position. Individuals with high betweenness are often positioned between two otherwise separated groups of people and play an important role in connecting and brokering between the two communities (Valente, 2012). An individual's betweenness centrality is calculated by first finding the shortest path between all possible pairs of people in a network (i.e., travelling through the fewest number of people to get from person A to B). The betweenness score of an individual is the number of shortest paths that it lies on (Scott, 2013). In Figure 3.1, node A in the middle has the highest

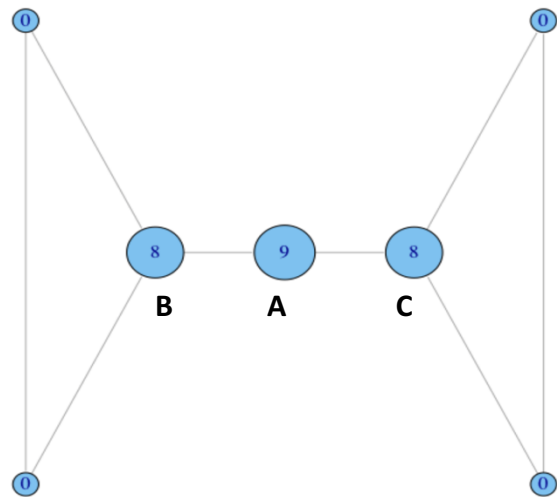


Figure 2.1 A demonstration of betweenness centrality using a fictional dataset. Node A has the highest betweenness because it lies on highest number of shortest paths.

betweenness score and plays an important role by connecting and brokering between nodes B and C and their group.

Social network analysis is playing an increasingly larger role in the understanding of how social position influences communication and information dissemination (Alvergne, Gibson, Gurmu, & Mace, 2011; Banerjee et al., 2013; Cai et al., 2015; D'Exelle & Holvoet, 2011; Jackson, 2014; Mertens, Saint-Charles, Lucotte, & Mergler, 2008; Mertens, Saint-Charles, & Mergler, 2012; Perkins et al., 2015; Stoebenau & Valente, 2003; Tsai, Bangsberg, & Weiser, 2013; Valente, 2012; Valente & Pumpuang, 2007). Individual's that hold central positions in social networks are more effective at disseminating information in communities and should therefore, be identified and incorporated into health intervention strategies (Banerjee et al., 2013; Cai et al., 2013; Valente, 2010, 2012). This is particularly important for areas and countries that experience reduced infrastructural resources and a higher rate of disease. It is for these reasons that the Sri Lanka Wildlife Health Centre was developed with the purpose to safeguard animal and public health and to mobilize and disseminate information effectively to vulnerable communities.

Also, important to implementing effective communication and dissemination strategy is understanding the nuances of how an audience is speaking about and describing the topics of interest. Social network analysis provides a view of how information and messages flow through network, but it doesn't provide insights into the rhetoric or language used to describe information. Gaining an understanding of these nuances will help craft effective messages for dissemination. Wildlife disease surveillance programs that need to inform the public of pertinent news will benefit from understanding their audience and crafting the message appropriately.

## **2.5 Effective messaging for wildlife disease surveillance**

To design an effective message and medium for dissemination, it is useful to learn about the contextual and demographic features of the target audience (Rogers, 2003). The personal and environmental characteristics of an individual can drastically influence how they use information, communicate about it, and where they fit within their social network (Perkins et al., 2015; Robson, 2013). Humans are experts at understanding and interpreting the actions of those around them and skillfully anticipate others' needs and wants (Lieberman, 2014). In other words,

humans are accomplished communicators. Communication is “the act or process of using words, sounds, signs, or behaviors to express or exchange information” (Merriam-Webster.com, 2016). Humans are effective at conveying general moods and feelings, it requires more tact and skill to effectively convey complex thoughts and ideas to others (Egeci & Gencoz, 2006). When communication is poor, the likelihood of misunderstandings and negative affect increases, both of which are associated with social dissatisfaction (Egeci & Gencoz, 2006; Tazelaar, Van Lange, & Ouwerkerk, 2004). There are several factors that influence how and why an individual communicates, such as the individual and environmental characteristics of the communicator and the attributes of the information itself. For example, men and women use different words, phrases, and communication styles. When asked to describe their strategy for playing a public goods game, Roberts et al. (2014) found that women were more likely to describe their intuition with doubt and to use words like “god” and “doubt”. On the other hand, men expressed much more certainty about their intuition with words like “gamble” and “certain”. Men and women also use different words and discourse to describe the same topic. Tvinnereim and Fløttum (2015) analyzed topics that emerged when men and women were asked ‘what comes to mind when you hear the words ‘climate change’?’. Women were more likely than men to describe climate change with weather and physical changes, such as the melting ice and rising temperatures. Men were more likely to talk about the causal effect of human actions on climate change and future generations. The specific speech patterns of men and women also differ. For example, women have been found to use more minimal responses, such as “mhm”, “right”, or “yeah”, to indicate support for the speaker and to use more tentative speech such as “you know”, “I think”, and “perhaps (Coates, 2004; Leaper & Robnett, 2011).

In general, there are nine key factors that affect how an individual seeks and communicates about information (Robson, 2013):

- 1) Context: The information user’s social situation, such as culture, social norms, geographic location, and available infrastructure.
- 2) Demographics: The information user’s sex, age, ethnicity, socio-economic status, etc.
- 3) Expertise: The information user’s level of education, knowledge, and training in the relevant subject area.
- 4) Psychological factors: The information user’s personality and cognitive processes, such

as their perceptions, thoughts, and feelings.

- 5) Needs and goals of information user: Whether the information user's information behaviour was internally or externally motivated, recognized or unrecognized, etc.
- 6) Needs and goals of information provider: Can influence how the provider communicates about information.
- 7) Encouraging or discouraging factors: The characteristics that motivate or inhibit the information user.
- 8) Information-seeking process: The overall experience of the information user.
- 9) Characteristics of information and sources: Are the sources useful or credible?

These nine factors can be combined to create an endless number of communication situations and experiences. What becomes most apparent are the individuals who are constrained in their ability to communicate and the situations that perpetuate miscommunication. For example, groups that are often marginalized, such as women or people of colour, are much less likely to share in a group setting, especially if the costs are high, the benefits are low, and there is a perceived lack of trust (Wang & Noe, 2010). In addition, the level of support, incentive structure, and the hierarchical organization of a system can easily become barriers to communication. In particular, low levels of support, a lack of intrinsic or extrinsic incentives, and a very hierarchical structure are not conducive to productive sharing spaces (Wang & Noe, 2010).

People living in rural areas, and particularly those living in countries with limited resources, are more likely to live in circumstances that limit how and where they can access information (Fletschner & Mesbah, 2011). Rural areas in low-resource countries often lack basic information resources due to a combination of poorly developed infrastructure, high telecommunication costs, lower household income levels, and lower literacy and education rates (Alemna & Sam, 2006; Dutta, 2009; Gyamfi, 2005). Dutta (2009) provides a review of research that investigates the information behaviour of urban and rural residents in low-resource countries. The information seeking behaviour of urban dwellers in Argentina, Malaysia, Uganda, and Ghana were similar to each other and to those in high-income countries. Both formally educated and less educated dwellers relied on the Internet as a source of health-related information, but also text books and printed journal articles were used. The information needs of rural dwellers in Botswana, India, Nigeria, and Malawi mostly revolved around day-to-day and

basic survival concerns. Most studies reported the use of radio, television, and newspaper as a source of information, but the largest barriers to these sources were illiteracy and distrust. As a result, informal networks with neighbours, coworkers, and village leaders were overwhelmingly the preferred and most utilized source of information for rural communities. Several other studies in low-resource countries document the use of informal social relationships as a source for several types of information, including health, agriculture, and employment (Bosompra, 1989; Ikoja-odongo, 2003; Islam & Ahmed, 2012; Mooko, 2005; Njoku, 2004; Nyambo & Ligate, 2013; Rodriguez, Kulpavaropas, Annamalai, Wright, & Evans, 2015; Saleh, 2011).

A large gap in the information behaviour literature is an overall lack of evidence documenting whether men and women living in low-resource countries have differing access to information (Fletschner & Mesbah, 2011). Gender equality has long been a goal for international development. It was Goal 3 of the Millennium Development Goals and it continues to be a part of the United Nation's agenda as Goal 5 of the new Sustainable Development Goals (United Nations, 2015). In almost all parts of the world, particularly in low-resource countries, women are subject to social, cultural, and gender norms that constrain their ability to thrive and succeed in the same ways as men. Women experience higher mortality rates, earn significantly lower wages, generally lack a voice and political representation, and spend more time doing domestic chores and less time at school than men (World Bank, 2012). Furthermore, women's mobility and social relationships are constrained due to socially-prescribed gender norms that restrict their interactions with members of the opposite sex. For these reasons, women often rely heavily on informal networks, such as close family and friends, for information (Fletschner & Mesbah, 2011; Mooko, 2005). Men also rely heavily on informal relationships as a source of information, such as fellow farmers (Thuo et al., 2013), but they are not restricted to them as their only source of information. Men can travel and interact more freely with extension workers and other formalized sources (Stoebenau & Valente, 2003; Thuo et al., 2014b). Understanding how men and women's access to information differs and the broader factors that influence how a person seeks and shares information can help any intervention select the best message, channel, and source to effectively disseminate information.



## 2.6 Techniques for analyzing language and communication

Drawing inferences about communication styles and differences from the nuances of language, such as whether women use more tentative language as men, is done through the analysis of written and spoken words (Harwood & Garry, 2003). Social scientists have analyzed text data collected through interviews, focus groups, or surveys, for decades to learn about communication style and human behaviour more broadly (Krippendorff, 2004). Traditionally, text analysis has been completed by manual coders who classify and map excerpts of text onto broader topics, count occurrences of words, and capture overarching discourses (Saldaña, 2013). Humans have an amazing ability to understand and categorize complex language, however, the downside of human coding is that it is time consuming and suffers issues of between coder reliability (Mikhaylov, Laver, & Benoit, 2012; Quinn, Monroe, Colaresi, Crespín, & Radev, 2010). Automated, or computer-assisted, coding methods have been developed to address the issues of manual coding and have been found to be just as, or more, reliable as human coders (King & Lowe, 2003; Neuendorf, 2011).

There has been a progression in the types of automated text analysis from minimal computer assistance to models that are solely automated. The first step towards automated text analysis was the development of dictionary methods, which involves building topics and lists of words for each topic and then using a computer to assigning excerpts of text to topics based on the dictionary words that they contain (Saldaña, 2013). The time and resources needed for dictionary methods are similar to that of manual coding and the dictionaries are often text-specific, so a new one would need to be created for each new corpus. The between coder reliability of dictionary methods is better than manual coding, however (Grimmer & Stewart, 2013).

The next progression in computer-assisted text analysis was supervised learning, which combines manual and computer coding. Supervised learning requires that a subset of corpus (i.e., a collection of text) be manually coded to “train” the computer to code the remaining text (Lucas et al., 2015). The time and resource investments for supervised learning are similar to that of manual methods but the amount of text that can be coded substantially increases. For example, it is not realistically feasible for one person to read, summarize, and identify topics for Canadian legislative transcripts from 1905-2005, for the entire New York Times database, or for every

Tweet about Donald Trump. However, the advantage of supervised learning is that it can quickly analyze large bodies of text after a fraction of them have been manually coded.

Lastly, the most recent progression in automated text analysis is unsupervised learning which requires no start-up cost or manual coding (Roberts, Stewart, Tingley, & Stewart, 2016). The first succession into unsupervised learning is principal component analysis (PCA), which optimizes and condenses several correlated variables into a smaller number of representative variables (James, Witten, Hestie, & Tibshirani, 2015). One of the most recent unsupervised methods is topic modelling, which automatically discovers topics and themes in a corpus of text (Blei, Carin, & Dunson, 2010). The general intuition of a topic model is that it assumes that each document within a corpus contains some distribution of topics, and then it assigns each word in a document to a topic. Words are assigned to topics based on how frequently they co-occur with other words and how often they appear in the rest of the document. The assignment of documents to topics and words to topics are estimated jointly in an iterative procedure (for proofs, see Grimmer & Stewart, 2013). Topic models do not require the user to predefine topics, so the start-up costs compared to manual, dictionary, and unsupervised methods are significantly lower. Topic model algorithms can vary from discovering themes in text to analyzing how themes are connected to each other and how they change over time (Blei et al., 2010; Roberts, Stewart, & Tingley, 2015). Furthermore, a structural topic model allows information about each document to be incorporated into analysis, such as the author's gender or political leaning. Unsupervised learning methods still require that the user have in-depth knowledge of the text to validate the model output and verify that the topics are accurate (Lucas et al., 2015). Automated text analysis can never fully replace humans for language processing but are rather a reliable tool that researchers can use in combination with manual methods.

## **2.7 Summary**

Wildlife disease surveillance programs are important to address the threat of EIDs and can benefit from strategizing on effective communication plans. Programs that utilize existing social networks to increase the reach and uptake of their message are more effective than programs that do not. In addition, learning about how the target audience discusses the relevant topics can inform strategy for message framing. By analyzing language and communication through topic

modelling, wildlife disease surveillance programs can craft effective messages that they can disseminate through central individuals that were identified through social network analysis.

## **CHAPTER 3: WILDLIFE, LIVESTOCK, AND HUMAN HEALTH INFORMATION NETWORKS IN RURAL SRI LANKA: IDENTIFICATION OF CENTRAL INDIVIDUALS AND GENDER DISPARITIES**

### **3.1 Abstract**

Residents living in rural areas in low-resource countries are more likely to experience geographic or infrastructural barriers that limit their access to formal health care or information, requiring them to rely on informal social connections. Health interventions should utilize existing social networks to increase information uptake and maximize the effectiveness of their programs. In particular, central individuals in a network can be especially effective at information dissemination. Therefore, the purpose of this thesis chapter is to identify central actors in wildlife, livestock, and human health information networks based on a case study in Sri Lanka. One-hundred and forty-three rural residents in Moneragala District, Sri Lanka were interviewed to identify their main sources of wildlife, livestock, and human health information and to identify to whom they would report these health issues. Social network analysis of the responses revealed that government agency staff, such as the Grama Niladhari and government physicians, were the most frequently cited source of wildlife and human health information and the most common place to report health cases. A local indigenous healer was the most common source of livestock health information and the most common person to whom livestock health cases were reported. In addition, the local indigenous healer was best positioned in each of the health networks to disseminate information and receive reports within the community. A comparison of responses by gender revealed that women were more likely to be unsure of who to talk to and were considerably less likely to be nominated as a source of health information than men. Furthermore, the majority of women that were nominated were named by other women. In conclusion, there were locally relevant and central leaders that were seen as key contacts for wildlife, livestock, and human health issues. They should be engaged and used to effectively disseminate information to and from the community, especially with regard to reporting potential disease outbreaks. Government agencies were also seen as an important source of health information and should therefore, engage with and maintain relationships with rural communities. Moreover, the gender differences shed light on the importance of engaging and

accommodating all groups within a Sri Lankan community, perhaps by identifying group-specific opinion leaders that will appropriately communicate information to and from the group.

### **3.2 Introduction**

Residents living in rural areas in low-resource countries are more likely to live in circumstances that limit how and where they can access formal health care or information (Fletschner & Mesbah, 2011). Often, significant geographic or infrastructural barriers necessitates the reliance on one's social connections, friends, and family for support (Apicella et al., 2012). Health interventions attempting to educate and disseminate information to the public should acknowledge the importance of social support networks to rural residents and learn about how they can incorporate them into their dissemination strategies (Valente, 2010). In general, programs that use social network information for disseminating information are more effective than those that do not (Valente & Pumpuang, 2007). To measure an individual's social support network, actor-focused studies have most frequently been employed (e.g., Zhang et al., 2012), which simply ask an individual who provides them with social support (Perkins et al., 2015). They then note the number and characteristics of the individuals that are named. Although informative about an individual's support network, these types of studies do not provide insights into the larger network structure or where an individual is situated within a network (Perkins et al., 2015). Sociometric network methods are an alternative to actor-focused methods that aim to capture the entire network structure by collecting data from everyone within a defined population (Valente, 2010).

Sociometric methods permit the exploration of how diseases or information are diffused through a network and which actors in a network are the most influential (Jackson, 2014). Understanding how information is disseminated through a network is particularly relevant for health or information interventions in low-resource countries where resources can be limited and health risks are higher. Health programs with limited resources should deploy the most cost-effective and successful strategies that will lead to the highest information uptake and behaviour change. One way dissemination programs can utilize networks is by "infecting" an individual with information and inducing the information to spread via word-of-mouth (Valente, 2012). The first individual to receive information can become very influential over the diffusion process.

People that are located centrally in a network due to their popularity or their role in connecting two otherwise disconnected groups, can be particularly useful and effective for information dissemination programs (Perkins et al., 2015; Valente & Fosados, 2006; Valente, 2012). In an experimental microfinance program in rural India, Banerjee, Chandrasekhar, et al. (2013) found that participants in advantageous central positions were the most effective at disseminating information through communities and recruiting other participants. In addition, among villages in China, individuals that were central to finance discussion networks were most effective at eliciting take-up of weather insurance among rice farmers (Cai et al., 2013).

There are several ways to define a central position in a network. Social network analysis quantifies the construct of centrality by using the number and type of connections that an individual has. Two of the most common centrality measures are degree and betweenness (Freeman, 1979). Degree is the total number of actors that any given actor is connected to (Scott, 2013). For example, if David is connected to 15 people, he has a degree of 15. Degree is a simple measure of centrality and indicates who is popular or has many connections within a network. It does not, however, give an idea as to how well an actor is positioned relative to others in a network. Betweenness centrality, on the other hand, is an indication of network position. Individuals with high betweenness are often positioned between two otherwise separated groups of people and play an important role in connecting and brokering between the two communities (Valente, 2012). An individual's betweenness is calculated by summing the shortest paths between all possible pairs of actors in a network (i.e., by travelling through the fewest number of people to get from person A to B). The betweenness score of a person is the number of shortest paths that they lie on (Scott, 2013).

To effectively and appropriately disseminate and receive health information, programs need to utilize existing social and information networks and the central individuals located within them (Valente, 2010, 2012). Research that measures comprehensive social and information networks in low-resource countries is lacking (Perkins et al., 2015), therefore, this research in partnership with the Sri Lanka Wildlife Health Centre (SLWHC) measures information networks for wildlife, livestock, and human health topics in a village in rural Sri Lanka. No sociometric studies have been conducted on the topics of wildlife or livestock health information. A main goal of the SLWHC's is to generate, share, and mobilize knowledge about wildlife health to safeguard the public and animal health. The purpose of this study was to

identify central actors in rural wildlife, livestock, and human health networks and in particular, health information and reporting networks in rural Sri Lanka, to inform the SLWHC of the best ways to disseminate and receive wildlife health information from areas with high wildlife-human conflict. The specific objectives were to: (1) identify the central sources of wildlife, livestock, and human health information, (2) identify to whom individuals report wildlife, livestock, and human health issues, and (3) examine the role of gender in the information and reporting networks.

### **3.3 Methods**

#### *3.3.1 Study Area*

The 6.25 km<sup>2</sup> study area was located on the western border of Moneragala District, Sri Lanka (Figure 3.1).<sup>1</sup> Sri Lanka is a small tropical island country in South-Asia with a population of 20 million people. It struggled with a civil war from the 1980s until 2009 when the Sri Lankan military defeated the Tamil Tigers. Since 2009, Sri Lanka has developed its key infrastructure and is quickly becoming a popular tourist destination. The World Bank classifies Sri Lanka as a lower middle income country, but according to many World Development Indicators, Sri Lanka significantly outperforms other low-middle income countries (The World Bank, 2016). For example, in 2010, 90% of females 15 years or older in Sri Lanka were considered literate, compared to only 66% in other low-resource countries. In addition, compared to low-resource countries in 2014, Sri Lankans had a 7.6 years longer life expectancy and a gross national income per capita that was 1.7 times higher.

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<sup>1</sup>The study area is within Thanamalwila Division (pop. 26,476) and crosses into two Grama Niladhari divisions: Aluthwewa (pop. 2,143) and Kandiyapitawewa (pop. 2,389). More specifically, it overlaps, but does not entirely encompass, five villages: Dahaiyagala, Burutagolla, Mahapellessa, Nebedapellessa, and Malakandura (Department of Census and Statistics, 2015).

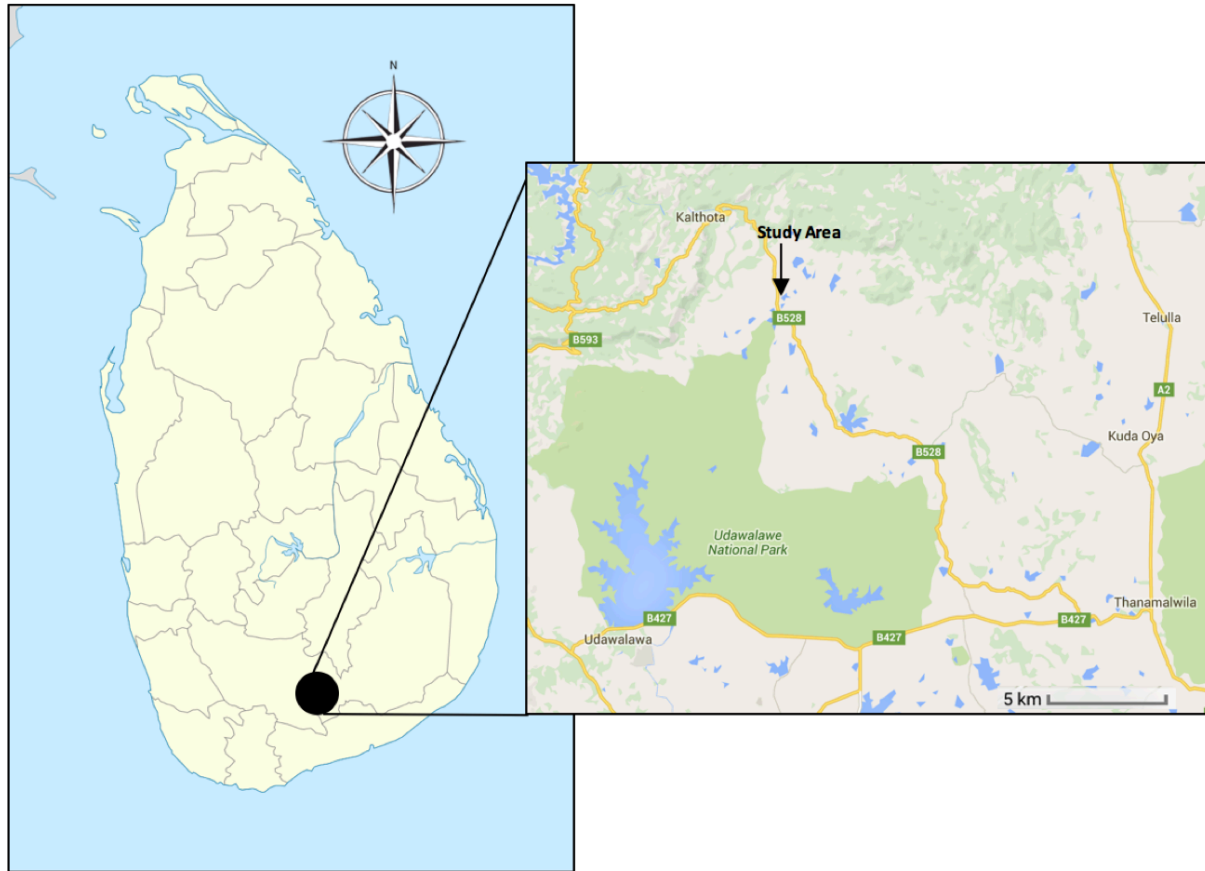


Figure 3.1 The location of my 6.25 km<sup>2</sup> study area was located on the western border of Moneragala District in south-central Sri Lanka. It was 2km north of Udawalawe National Park and bordered the Udawalawe-Bogahapattiya Elephant Corridor. Image sources: Google Maps and [https://commons.wikimedia.org/wiki/File:Sri\\_Lanka\\_location\\_map.svg](https://commons.wikimedia.org/wiki/File:Sri_Lanka_location_map.svg)

Moneragala District, located in south-eastern Sri Lanka, covers an area of 5,659 km<sup>2</sup> and has a population of 440,000 (77 people/km<sup>2</sup>). With 98% of people living in rural areas, it is one of the poorest districts in Sri Lanka with a poverty headcount index of 20.8% in 2012/13 (Department of Census and Statistics, 2015; Moneragala District Secretariat, 2011).<sup>2</sup> My study area was defined by the B528 highway to the west, Malakndura Ara river to the north, Welioya main irrigation canal to the east, and the Udawalawe-Bogahapattiya Elephant Corridor to the south (Figure 3.2). The Udawalawe-Bogahapattiya Elephant Corridor connects Udawalawe National Park with Bogahapattiya Reserve and is bordered with an electric fence that was built in

<sup>2</sup> The poverty headcount index is the proportion of the population that lives below the poverty line (Department of Census and Statistics, 2015).



hope of preventing elephants from entering the neighbouring villages. The electric fence, however, is largely ineffective and elephants frequently cross it to raid crops and homes. Farmers go through great lengths to protect their homes and crops from destruction, such as setting up scare traps, lighting fires, and staying up all night to keep watch. As many as 30 people have been injured or killed by elephants in the community in the past 10 years (M. Akalanka, personal communication, March 12, 2016). The high incidence of human-wildlife contact was the primary motivation for selecting this area for study. The close proximity to the environment and conflict with elephants is not unique to this area but is experienced around Udawalawe National Park and in other parts of the country, such as the villages near Wilpattu National Park. The primary livelihood of the study area is rice farming, supplemented by other crops such as banana, eggplant, and pepper.

### *3.3.2 Survey Methodology*

In May and June of 2014, 143 adults were surveyed from 85 homes. The survey was first piloted with staff at the University of Peradeniya and again near, but outside of, the study area. Two Sri Lankan enumerators, one male and one female, conducted the face-to-face interviews in Sinhalese. The enumerators were encouraged to keep the interview natural and conversational while they asked specific questions from an interview guide (see Appendix A). Interviews were the most appropriate tool, rather than questionnaires, to collect data because of the relatively low levels of infrastructure (i.e., limited public transport, limited access to post offices) and relatively low literacy rates in the rural areas.

The male enumerator had longstanding personal connection to the study area, which greatly facilitated the development of rapport with the community.<sup>3</sup> His established relationships and our approval from the Grama Niladhari and the head Buddhist priest assured that we were well-received by the participants. In addition, a friend of the male enumerator and someone who has several close relationships in the study area, travelled with us from house to house and introduced us to the families. All aspects of this research were approved by the University of Saskatchewan Behavioural Research Ethics Board (BEH 14-110; Appendix B).

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<sup>3</sup> He grew up, and his mother still lives, approximately 3 km north of the study area. This is where we stayed while we collected data.



Figure 3.2 The study area defined by the B528 highway to the west, a river to the north, a canal to the east, and the Udawalawe-Bogahapattiya Elephant Corridor to the south. We visited every household in this defined area. Image source: Google Earth.

Every house in the defined study area (Figure 3.2) was approached with the goal of interviewing both the male and female heads of household. Interviews were opportunistic and conducted when participants were home and available. We approached each house by a motorized three-wheeler or on foot, inquired to speak to the male and female heads of the household, and asked them to participate in our survey.<sup>4</sup> They provided oral consent to participate and again when asked to be audiotaped. Two enumerators, myself, and anyone else in

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<sup>4</sup> Head of household was defined as the primary working adults of the home. Most homes had one man and one woman as the heads of household, but a few situations were unique, such as four adults (two couples) and a woman with her adult son.

the home were present for each interview.<sup>5</sup> One enumerator asked questions while the other wrote down the responses on the interview guide in English (through real-time translation). The interview guide was primarily yes/no or one-word response questions, so real-time translation was quick and accurate. Transcription of the audio recordings for each interview provided more information and in-depth context about each interview. The male enumerator asked the questions for 117/143 interviews (56 women and 61 male) and the female enumerator for the remaining 26 (22 women and 4 male). In some cases, when the male and female heads of household were both home, the enumerators would conduct separate interviews. The interviews lasted 10-20 minutes and the participants were thanked at the end with a small gift of a notebook and pen. We returned to homes as frequently as possible to reach heads of households that we knew we had missed.

Completing a census of a defined area is required for sociometric methods because they aim to capture and analyze patterns among all relationships. If people are missing from the sample and important connections are missing, then the results might not reflect reality, but since a complete census is rarely achieved, a representative sample of 50-80% can be reliable at identifying central leaders (Costenbader & Valente, 2003). An estimated 166 heads of households (86 women and 80 men) lived in the defined study area, so we surveyed approximately 86% of the total desired population. The 23 missing individuals (15 men and 8 women) were not interviewed for various reasons: 11 worked out of town, 4 were sick, 3 declined, 3 were travelling, and 2 were deemed inaccessible after 5 visits to the home.

### 3.3.3 Variables

*Social Network Measures.* The two variables used to measure individuals' social networks were 1) who people sought information about health topics from, and 2) who people talked to about health events related to each health topic. The two variables were measured for each of three health topics: a) wildlife health, b) livestock health, and c) human health.

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<sup>5</sup> It was very difficult to control who was present for the interviews due to the organic flow of family and neighbours through the home and to the excitement and curiosity that our work created in the village. Children, spouses, relatives, and neighbours were frequently present in the interviews and almost certainly influenced some participants' responses. The enumerators did their best to overcome vocal visitors by only speaking to the participant and recording down responses that were uniquely the participant's. However, the mere influence of another person's presence could not be avoided and was not overtly discouraged to maintain rapport with the community and align with social and cultural norms.

Table 3.1 lists the questions that were asked in order to measure the six networks. These questions served as a guideline for the enumerators who translated the questions to Sinhalese in the interviews. If participants did not know how to respond, they were encouraged to think back on their own experiences or, if that did not work, they were asked to imagine a situation. For example, they were told to imagine seeing a sick wild animal and then asked where they would go to for more information about its disease (or who they would talk to about it). In regards to the reporting questions, they weren't explicitly asked who they reported issues to in an attempt to try and capture more realistic discussion networks and to avoid biasing responses towards official reporting processes. In the interviews, wildlife and livestock health was typically referred to vaguely (e.g., "who would you talk to about a sick wild animal?") and most frequently referred to elephants and cows. Human health most often referred to the participant's most recent illness.

Participants were encouraged to focus on their experience first before imagining situations because experience-based questions produce responses with higher validity than situational questions (Pulakos & Schmitt, 1995). In addition, keeping the questions specific, such as referring to their own illnesses rather than their overall health, was an attempt at reducing confusion and avoiding misinterpretations.

*Other Variables.* Several descriptive variables about each participant were also collected, such as sex, age, and education.

### *3.3.4 Data Preparation*

*Social Network Data.* The key data of interest were the names generated by the social network measures. The names were recorded on the guides in English during the interviews so translations were not necessary to construct the networks. An important step for preparing the names was validating who the nominated people were. This step involved determining whether the nominations were people within or outside of the sample and whether they matched any of the other participants' nominations. For example, if participant A and participant B both said that they talked to Bhagya about wildlife health, I needed to determine whether both participants were referring to the same Bhagya and whether Bhagya was the same Bhagya as the one in the

Table 3.1 Interview questions to measure the two network variables of interest: 1) who people go to for information about health topics and 2) who people talk to about health events related to each topic

Information-Seeking Questions
1) If you wanted more information about wild animal health, who would you ask?
2) If you wanted more information about livestock animal health, who would you ask?
3) If you wanted more information about something you were ill with, who would you ask?
Health Reporting Questions
1) Thinking about the most recent time when you saw a sick or dead wild animal, who was the first person you talked to?
2) Thinking about the most recent time when you saw a sick or dead livestock animal, who was the first person you talked to?
3) Thinking about your most recent serious illness, who was the first person you talked to?

sample. This process involved cross-checking names, sex, age, occupations, residents, and field notes. If names could not be matched with each other or with a person in the sample, they were considered to be two different people. I confirmed my conclusions with the enumerators to validate my assumptions, such as when two names were spelt similarly (i.e., only 1-2 letters different) and I suspected them to be the same person.

The names were then entered into edge tables such that the participants were listed in column A and their nominations were listed beside them in column B (Table 3.2). This process was repeated for each question to create six different edge tables for the six different networks. The edge tables were imported into and used by social network analysis (SNA) software to construct the networks and calculate the network centrality measures.

*Supplementary Data.* The audio from each interview was translated and transcribed from Sinhalese to English.<sup>6</sup> Since translating content from one language to another is subject to misinterpretation and loss of meaning, the primary purpose of the transcripts were to enrich my

<sup>6</sup> The Sri Lankan transcribers listened to the Sinhalese audio and wrote the transcript in English.

understanding of the content of the interviews. There were also some quotes selected to complement the quantitative analysis.

### 3.3.5 Data Analysis

*Social Network Analysis.* The edge tables created for each network were converted to .csv files and imported one by one into the SNA software *Gephi* (Version 0.8.2-beta; Bastian, Heymann, & Jacomy, 2009). *Gephi* summarized and illustrated who the most popular nominations were and computed degree and betweenness centrality scores for each person in the networks.

*Other Analysis.* The statistical software R was used for all analyses (R Core Team, 2015). Welch two sample t-tests, which adjusts for unequal variance, were used to assess differences in means between males and females in the sample for age, education, and number of nominations. Binary logistic regression was used to evaluate relationships between being nominated (binary dependent variable) and gender. The log odds coefficients from the logistic regression were transformed to express percent change ( $percent\ change = (e^{\beta} - 1)100$ ).

Table 3.2 An example of how the sociometric data were prepared in an edge table. The names were then entered into edge tables such that the participants were listed in column A and their nominations were listed beside them in column B

Column A: Participant	Column B: Nomination
Participant A	Participant D
Participant B	Participant S
Participant C	Government agency

## 3.4 Results

### 3.4.2 Sample Demographics

*Age and Sex.* A total of 143 people were interviewed: 78 women (19-71 years old) and 65 men (22-79 years old) (Figure 3.3). Mean ages did not significantly differ,  $t(130) = 1.86, p = 0.06$ . The average age of the entire sample was 42.4 years. The field research team was unable to interview 23 people (15 men, 8 women) for various reasons: 3 declined to participate, 4 were sick, 5 were travelling or unreachable, and 11 worked away from home. I calculated, based on word of mouth and the participants' knowledge of who lived in each house, that the research team reached 86% of the eligible population (based on a total of 166 men and women heads of households living in the study area).

*Formal Education.* Overall, 55% of the sample received their General Certificate of Education.<sup>7</sup> Women in the sample were more formally educated than men with an average of 8.7 years of school, while men had an average of 6.9 years of school ( $t(134) = -2.865, p = 0.005$ ) (Figure 3.4). Also, twice as many women (50%) completed high school compared to men (25%) and twice as many men were educated at a grade 6 level or lower (46%) compared to women (23%).

*Livelihoods.* Eighty-nine percent of the sample cited their main source of income as rice farming alongside other supplementary crops, such as banana, eggplant, and pepper. Other occupations included civil servants, garment factory workers, livestock farmers, and meson work.

*Religion, ethnicity, and language.* The sample was 100% Buddhist, 100% Sinhalese, and only 5% (7 people) cited that they can, or could, speak another language (5 Tamil, 2 English).

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<sup>7</sup> The General Certificate of Education in Sri Lanka has 2 levels. The Ordinary Level (OL) examinations occur after the 11th grade and qualify students for the Advanced Level (AL). AL includes grades 12 and 13 and is required for admission to university. Completing the AL serves the same purpose as a high school diploma in Canada.

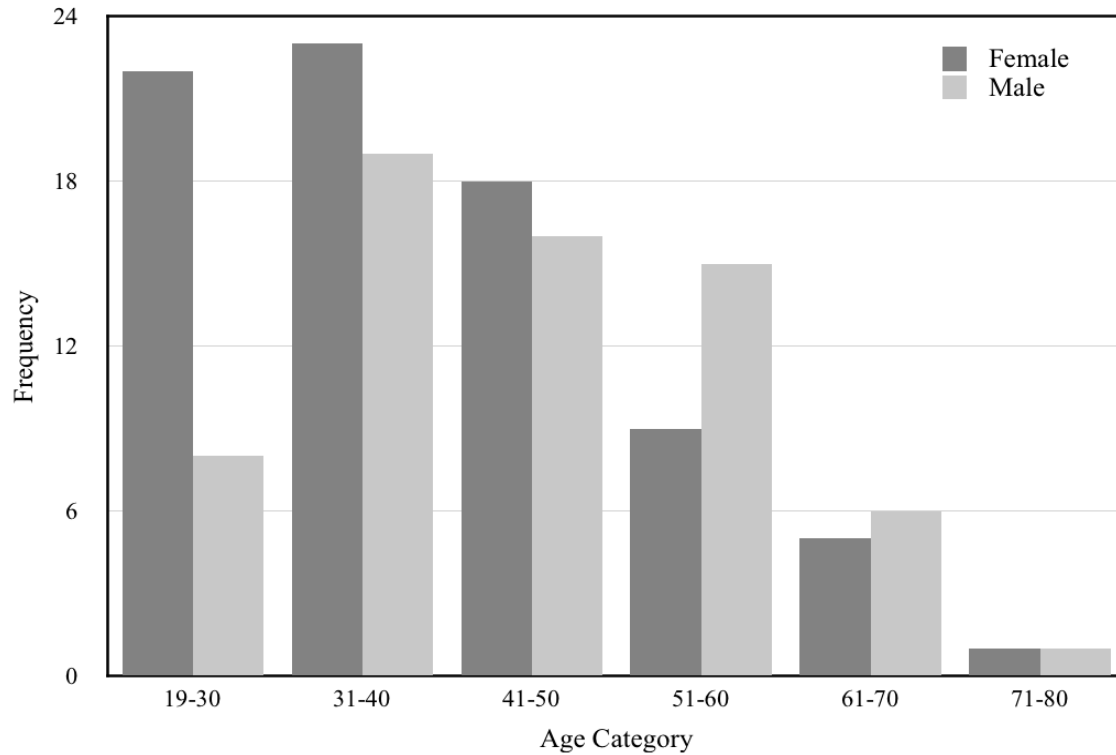


Figure 3.3 A total of 143 people were interviewed (78 women and 65 men). The overall mean age was 42.4 years. Females were younger on average (39.4 years) than males (43.5 years), but this difference was not significant,  $t(130) = 1.86, p = 0.06$ .

### 3.4.3 Information-Seeking Networks

*Wildlife Health.* The government wildlife agency was the most frequently cited source of wildlife health information (number of nominations/in-degree = 57) (Figure 3.5 and Table 3.3). The second most popular cited source of wildlife health information was a local indigenous healer (in-degree = 15). Third most popular was the local government representative (in-degree = 10). The local indigenous healer's betweenness centrality score, which identifies people that are best positioned in the network, was the highest at 14. The government wildlife agency and the local government representative both had a betweenness centrality score of 0. Participants often cited both the government wildlife agency and the local indigenous healer as a source of wildlife health information. When asked where they would get wildlife health information from, one participant said, "either from the department of wildlife or from somebody who does Ayurvedic [indigenous] medicine in the village".



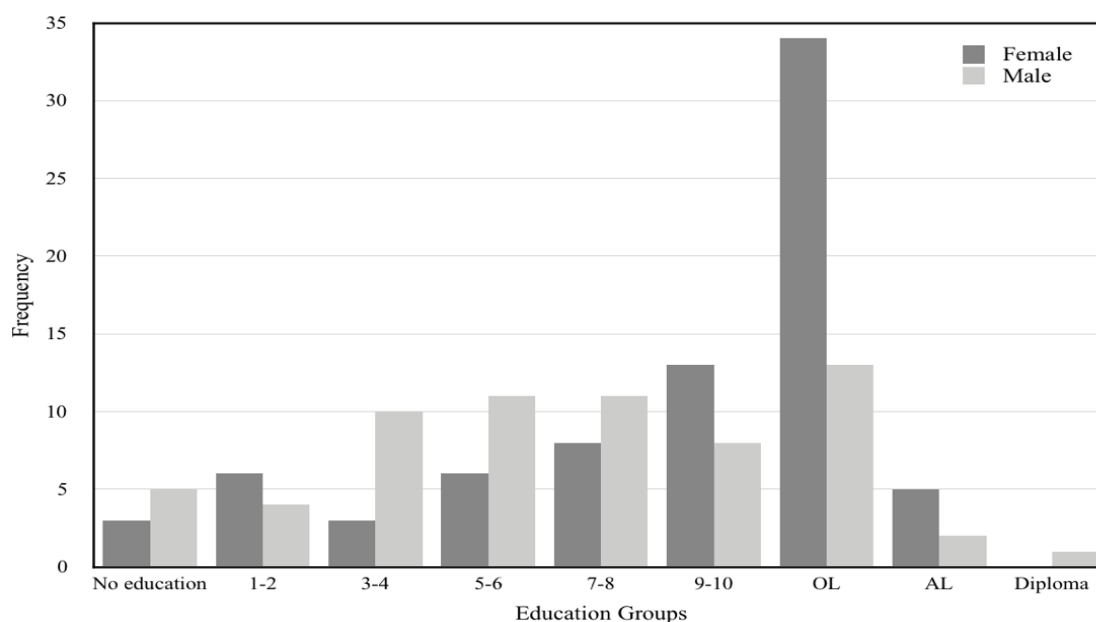


Figure 3.4 Women in the sample were significantly more formally educated than men, with an average of 8.7 years of school, while men had an average of 6.9 years of school ( $t(134) = -2.865, p = 0.005$ ). Twice as many women completed high school compared to men and twice as many men were educated at a grade 6 level or lower compared to women.

*Livestock Health.* The local indigenous healer was the most frequently cited source of livestock health information (in-degree = 48) and also had the highest betweenness centrality of 94 (Figure 3.6 and Table 3.4). The second most cited source of livestock health information was the government veterinarian (in-degree = 27, betweenness = 0). The third most frequently cited source of livestock health information was a local community leader (in-degree = 22, betweenness = 0). Compared to the other networks, the livestock information-seeking network was fairly de-centralized. This is due to participants nominating a broader range of people rather than the majority of people naming only one person, which is the case for the human health information-seeking network. In addition to the local indigenous healer, participants frequently named neighbours or community members that owned a few livestock animals as someone they would go to for information.

*Human Health.* The government physician was overwhelmingly the most frequently cited source of human health information (in-degree = 106, betweenness = 0) (Figure 3.7 and Table 3.5). The

second most frequently cited source of human health information was the local indigenous healer (in-degree = 27), who also had the highest betweenness centrality of 20. The third most frequently cited source of human health information was a midwife (in-degree = 3, betweenness = 0).

Table 3.3 The most popular nominations for sources of wildlife health information. The wildlife government was the most frequently cited source of wildlife health information, followed by the local indigenous healer, the local government representative, and the government veterinarian. The local indigenous healer and the local agriculture instructor had the highest betweenness scores.

Nominee	In-degree	Betweenness
Wildlife government agency	57	0
Local indigenous healer	15	14
Local government representative	10	0
Government veterinarian	8	0
Local agriculture instructor	3	8.5
Police	2	0
Civil defense force	2	0

Table 3.4 The most popular nominations for sources of livestock health information. The local indigenous healer was the most frequently cited source of livestock health information, followed by the government veterinarian, a local community leader, and the government wildlife agency. The local indigenous healer had the highest betweenness score.

Nomination	In-degree	Betweenness
Local indigenous healer	48	94
Government veterinarian	27	0
Community leader	22	0
Government wildlife agency	2	0

Table 3.5 The most popular nominations for sources of human health information. The government physician was overwhelmingly the most popular choice for human health information, followed by the local indigenous healer, a midwife, and a private doctor. The local indigenous healer had the highest betweenness score.

Nomination	In-Degree	Betweenness
Government physician	106	0
Local indigenous healer	27	20
Midwife	3	0
Private doctor	2	0

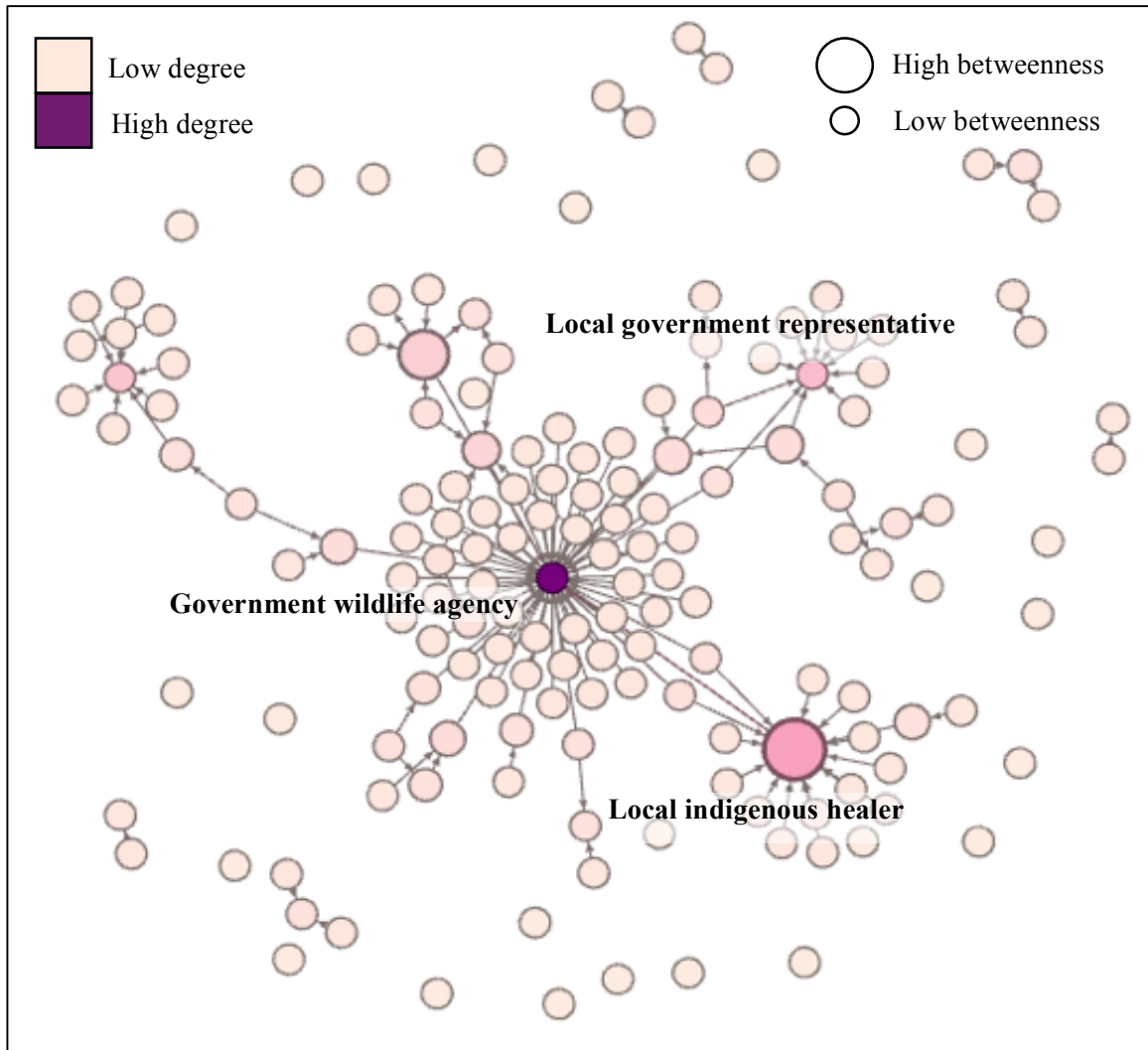


Figure 3.5 The wildlife health information-seeking network. The most frequently cited sources of wildlife health information were the government wildlife agency, (in-degree = 57), the local indigenous healer (in-degree = 15), and the local government representative (in-degree = 10). The local indigenous healer had the highest betweenness score (14), while the government wildlife agency and the local government representative both had a betweenness centrality score of 0.

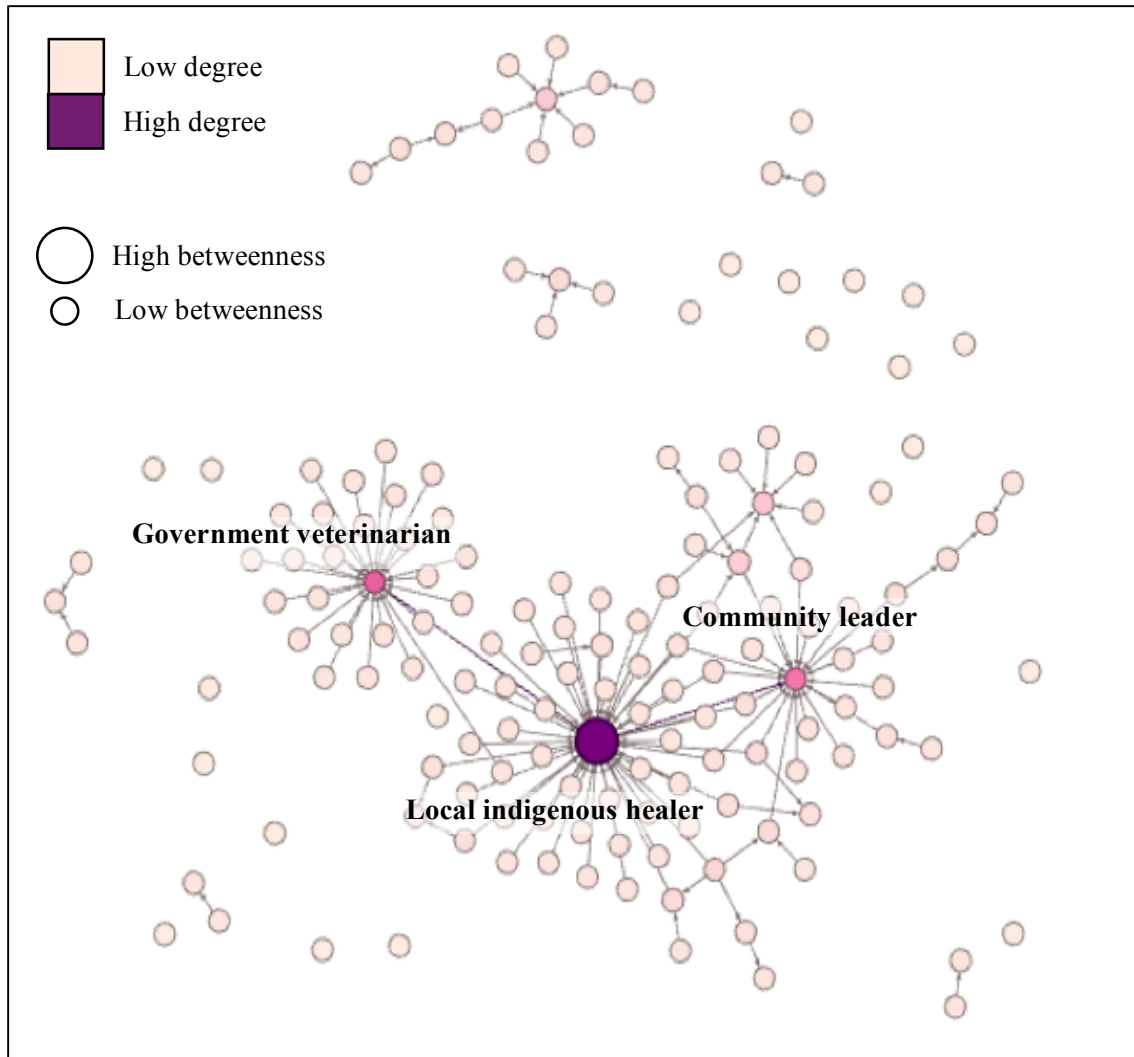


Figure 3.6 The livestock health information-seeking network. The most frequently cited sources of livestock health information were the local indigenous healer (in-degree = 48), the government veterinarian (in-degree = 27), and a local community leader (in-degree = 22). The local indigenous healer had the highest betweenness score of 94.

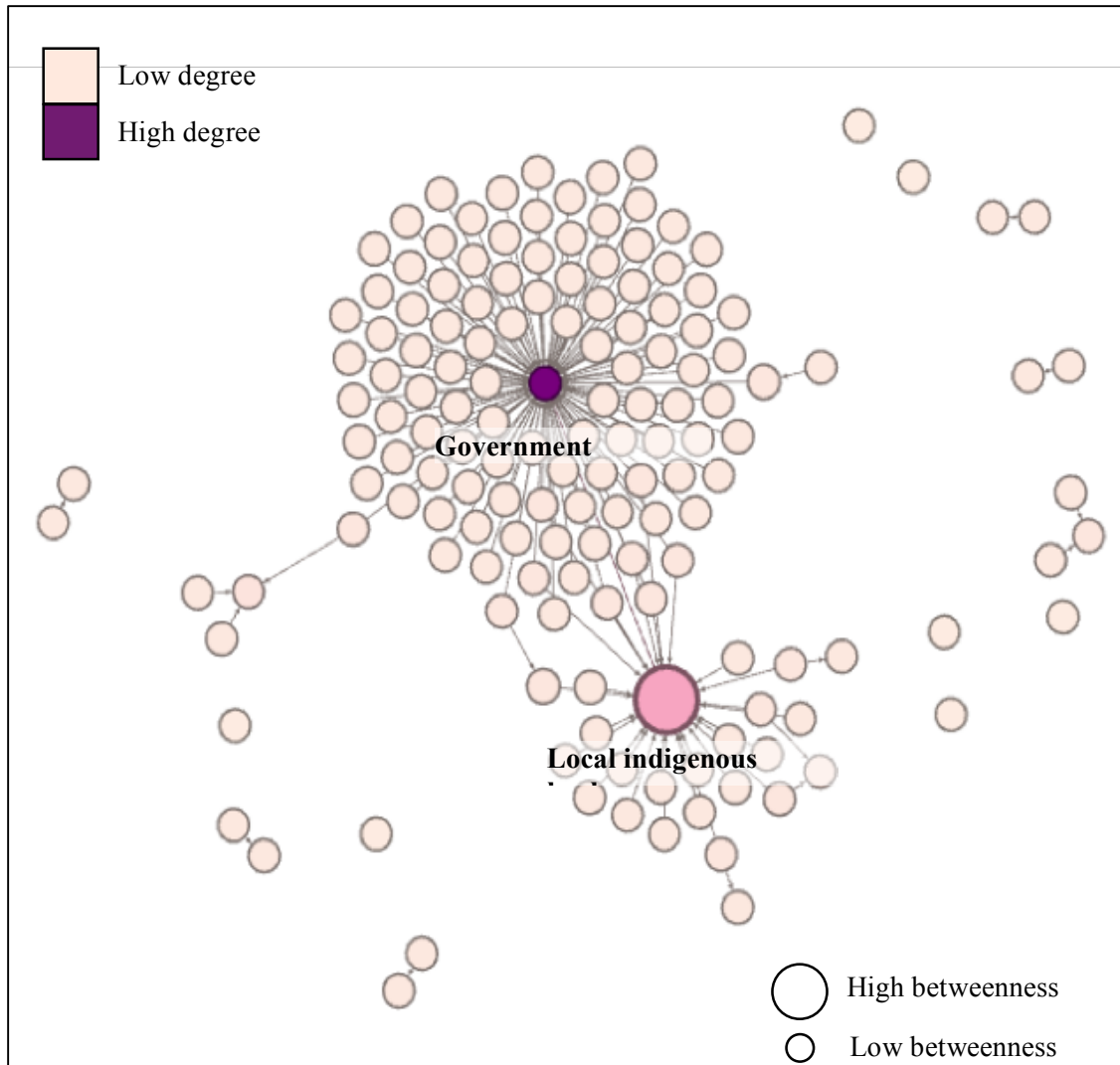


Figure 3.7 The human health information-seeking network. The government physician was the most frequently cited source of human health information (in-degree = 106) followed by the local indigenous healer (in-degree = 27), who also had the highest betweenness centrality of 20.

### 3.4.4 Gender Characteristics of Information-Seeking Networks

Men and women named a similar number of people when asked who they would go to for wildlife, livestock, and human health information (Table 3.6). Women were more likely, however, to be unsure of who to go to for information for the three health topics. In each of the information-seeking network figures (Figure 3.5, 3.6 and 3.7), there were nodes that were not connected to the larger network component. This disconnectedness is a result of participants not citing anyone as a source of health information, most often because they did not know who to go to. A disproportionate number of the disconnected nodes were women. One would expect that if the relationship between gender and being a disconnected node was purely random, then 55% of the disconnected nodes would be women and 45% would be men. However, this was not the case: 77% of the disconnected people in the wildlife health information network were women, 73% in the livestock health information network were women, and 86% in the human health information network were women (Table 3.7). Furthermore, very few women were considered a source of health information: only 20% of unique nominations for wildlife health information were women, only 14% for livestock health information, and only 25% for human health information (Table 3.8). The few women that were nominated as a source of health information were predominantly nominated by other women (Table 3.9). Men were 384% more likely to be nominated as a source of wildlife health information than women, 312% more likely to be nominated as a source of livestock health information than women, and 57% more likely to be nominated as a source of human health information than women (Table 3.10).

Table 3.6 The average number of nominations made by males and females for each information-seeking network did not significantly differ. On average, males nominated 1.03 people as a source of health information and females nominated 1 or slightly less people as a source of health information.

	Average number of nominations		Welch's <i>t</i> -test		
	Males	Females	<i>t</i> -value	<i>df</i>	<i>p</i> -value
Wildlife health	1.00	0.83	-1.7599	141	0.0806
Livestock health	1.03	0.95	-0.8066	141	0.4213
Human health	1.05	1.04	-0.1224	141	0.9028

Table 3.7 The number of disconnected nodes in the three information-seeking networks. Disconnectedness is a result of participants not citing anyone as a source of health information, most often because they did not know who to go to. A disproportionate number of the disconnected nodes were women, suggesting that women were more likely to be unsure of where to go to for health information.

	Number of disconnected people		Number of connected people		Welch's <i>t</i> -test		
	Total	Proportion female	Total*	Proportion female	<i>t</i> -value	<i>df</i>	<i>p</i> -value
Wildlife health	26	76.9%	126	47.6%	-3.076	40.39	0.0038
Livestock health	24	72.7%	132	47.7%	-2.3467	30.13	0.0257
Human health	7	85.7%	145	51.0%	-2.3305	7.06	0.0523

\* The totals do not include nominations where the gender is unknown, such as wildlife officers, civil defence force, and police. The wildlife network had 6 nominations with unknown genders, the livestock network 4, and the human network 2.

Table 3.8 The proportion of unique nominations that are female for the three information-seeking networks. Females were underrepresented as sources of wildlife, livestock, and human health information.

	Number of unique nominations*		Other people in network (not nominated)		Welch's <i>t</i> -test		
	Total**	Proportion female	Total	Proportion female	<i>t</i> -value	<i>df</i>	<i>p</i> -value
Wildlife health	25	20.0%	127	59.1%	-4.2149	39.19	0.0001
Livestock health	21	14.3%	133	57.1%	-4.7983	33.49	< 0.0001
Human health	12	25.0%	140	55.0%	-2.1865	12.41	0.0471

\* Unique nominations differs from absolute nominations. For example, one person could be nominated 100 times but only be counted as one unique nomination.  
 \*\* The totals do not include nominations where the gender is unknown, such as wildlife officers, civil defence force, and police. The wildlife network had 6 nominations with unknown genders, the livestock network 4, and the human network 2.



Table 3.9 The proportion of female nominations that were nominated by other females for the three information-seeking networks. The majority of female nominations for each network were nominated by other females.

	Absolute number of female nominations*	Proportion nominated by other females
Wildlife health	7	71.4%
Livestock health	5	80%
Human health	5	100%

\* This number does not represent unique nominations such that one woman who was nominated by two different people would be counted as two nominations.

Table 3.10 The summary of results for logistic regressions that evaluate the relationship between being nominated (binary dependent variable) and gender. The log odds coefficients were transformed to express percent change ( $percent\ change = (e^{\beta} - 1)100$ ). After controlling for age and education (Model 2), males were still more likely to be nominated as a source of wildlife, livestock, and human health information than women.

	Wildlife health		Livestock health		Human health	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Intercept	-93.3***	-99.7***	-96.1***	-99.0**	-96.1***	-99.9*
Gender (male)	476.9***	384.5*	700.0**	312.4	266.7	57.5
Education	-	1.3	-	-10.5	-	-19.1
Age	-	6.3*	-	4.2	-	12.2

\*\*\* $p < 0.001$    \*\* $p < 0.01$    \* $p < 0.05$

### 3.4.5 Health Reporting Networks

*Wildlife Health.* In the event that an individual saw a sick or dead wild animal, the most frequently cited person to talk to was the Grama Niladhari, or local government representative (in-degree = 106, betweenness = 0) (Figure 3.8 and Table 3.11). The second most frequently cited person to talk to was the wildlife government agency (in-degree = 71, betweenness = 0). The third most frequently cited person to talk to was the police (in-degree = 26, betweenness = 0). The local indigenous healer had the highest betweenness centrality at 39.5 (in-degree = 20). Many participants believed that multiple people should be informed about an ill wild animal, for

example, *“first, we should inform the Grama Niladhari...apart from that, if there was a dead elephant, we call 111. If we don’t have the telephone numbers of the police, we call 111”*.

*Livestock Health.* In the event that an individual saw a sick or dead livestock animal, the most frequently cited person to talk to was the local indigenous healer (in-degree =70), who also had the highest betweenness centrality of 54.8 (Figure 3.9 and Table 3.12). The second most frequently cited person to talk to was the government veterinarian (in-degree = 36, betweenness= 0). The third most cited person to talk to was another local community leader (in-degree = 26, betweenness = 0). Many participants understood that the government veterinarians should be informed of a sick or injured livestock animal, but only a few people in the community have access to the vet’s contact information. One participant said *“we should tell it to the veterinary doctors, [but] first we will tell to [the local indigenous healer], then he will inform the veterinary surgeon”*.

*Human Health.* As with the human health information network, the government physician was the most frequently cited person that participants would talk to in the event of a serious illness (in-degree = 136, betweenness = 0) (Figure 3.10 and Table 3.13). The second most frequently cited person to talk to was the local indigenous healer (in-degree = 67) and the third most frequently cited person was another local community member (in-degree = 4). There is not one particular person with a high betweenness centrality score, but rather, there were several community members that have low betweenness centrality scores of 1 or 2. Often, the type of illness determined whether someone would talk to the government physician or the local indigenous healer. One participant said that, *“if it is a snake bite or something like that we go to [the local indigenous healer]. If it is a cough we go to the hospital”*.

Table 3.11 The most popular nominations to report issues about wildlife health to. The local government representative was the most frequently cited person to report health issues to, followed by the wildlife government agency, the police, the local indigenous healer, and a community leader. The local indigenous healer, the community leader, and the local agriculture in structure had the highest betweenness centrality scores.

Nomination	In-degree	Betweenness
Local government representative	106	0
Wildlife government agency	71	0
Police	26	0
Local indigenous healer	20	39.5
Community leader	13	18.5
Local agriculture instructor	8	8.5
Civil defense force	7	0

Table 3.12 The most popular nominations to report issues about livestock health to. The local indigenous healer was the most frequently cited person to talk to, followed by the government veterinarian, a community leader, and the local government representative. The only nomination with a betweenness centrality score was the local indigenous healer with a score of 54.8.

Nomination	In-degree	Betweenness
Local indigenous healer	70	54.8
Government veterinarian	36	0
Community leader 2	26	0
Local government representative	9	0
Government wildlife agency	3	0

Table 3.13 The most popular nominations for reporting human health issues. The government physician was the most frequently cited person to talk to about human health issues, followed by the local indigenous healer, and two community members. Not one person has a high betweenness centrality score.

Nomination	In-Degree	Betweenness
Government physician	136	0
Local indigenous healer	67	0
Community member 3	4	1
Community member 4	2	2
Private doctor	2	0

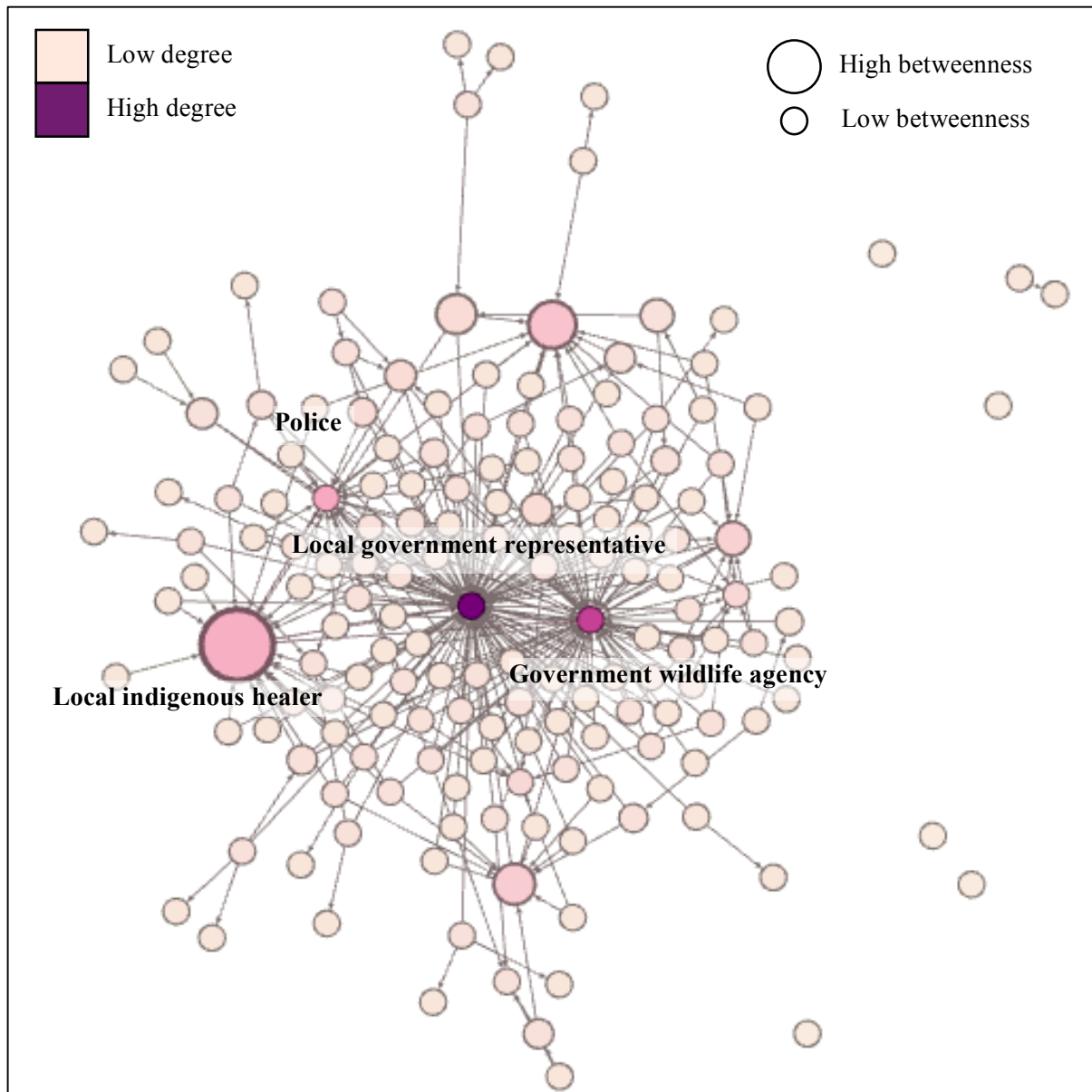


Figure 3.8 The wildlife health reporting network. When asked who they would talk to if they saw a sick or dead wild animal, participants most frequently cited the local government representative (in-degree = 106), followed by the wildlife government agency (in-degree = 71) and the police (in-degree = 26). The local indigenous healer was also a popular choice (in-degree = 20) and had the highest betweenness centrality score of 39.5.

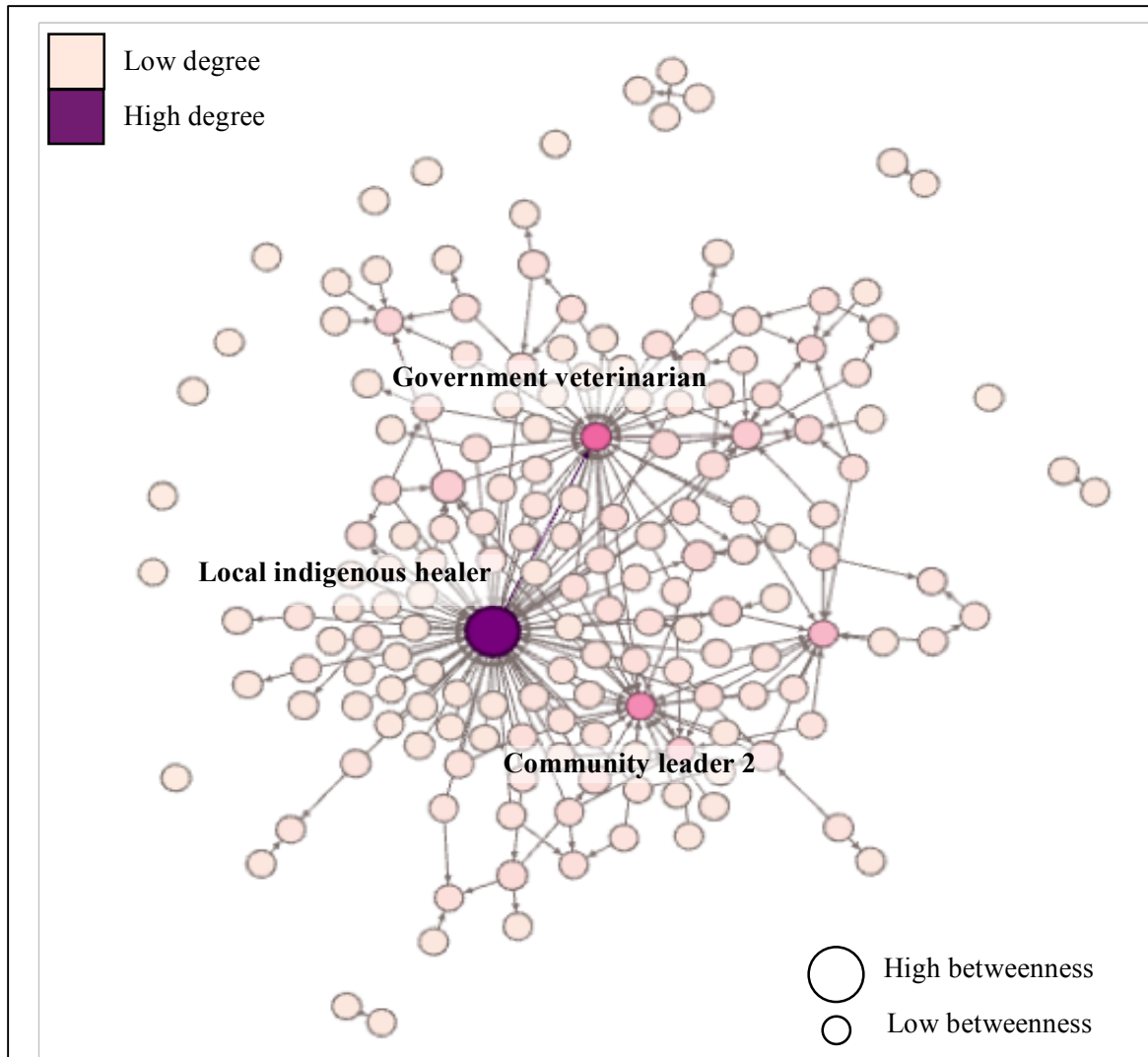


Figure 3.9 The livestock health reporting network. When asked who they would talk to if they saw a sick or dead livestock animal, participants most frequently cited the local indigenous healer (in-degree =70), followed by the government veterinarian (in-degree = 36), and another local community leader (in-degree = 26). The local indigenous healer had the highest betweenness centrality score of 54.8.

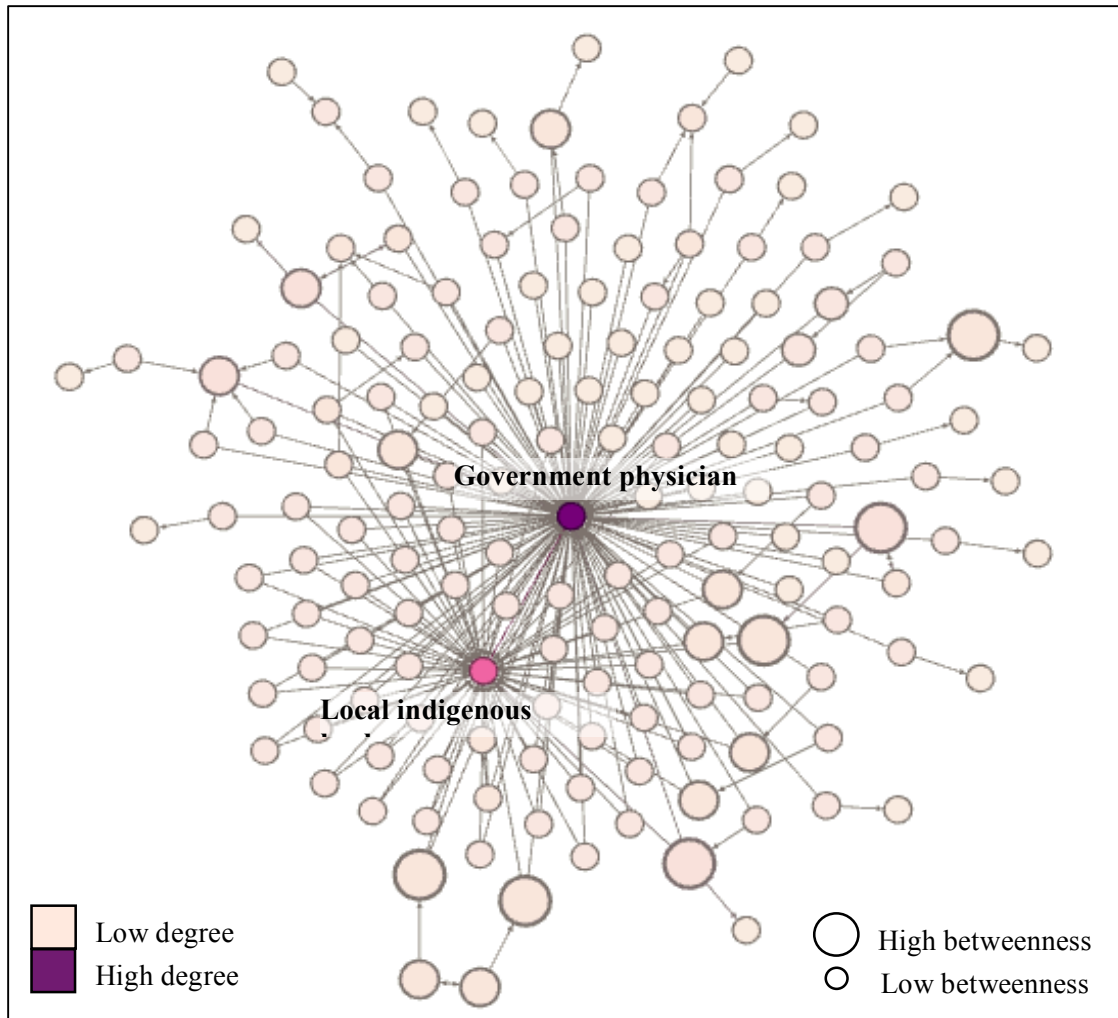


Figure 3.10 The human health reporting network. When asked who they would report their own illnesses to, participants most frequently cited the government physician (in-degree = 136). The second most frequently cited person to talk to was the local indigenous healer (in-degree = 67), followed by another local community member (in-degree = 4). There was not one particular person with a high betweenness centrality score, but rather a few peripheral community members with scores of 1 or 2.

### 3.4.6 Gender Characteristics of Health Reporting Networks

On average, men nominated 2.05 people for each health reporting network, which was higher than the average for women across all three reporting networks (Table 3.14). Just like the information-seeking networks, women were more likely to be unsure of who to talk to about health issues, but only for wildlife and livestock (Table 3.15). Sixty percent of disconnected nodes in the wildlife health reporting network and 91% of disconnected nodes in the livestock health reporting network were women. There were no disconnected nodes for the human health reporting network which suggests that every participant knew who they would talk to about their own health issues. Again, women were nominated very infrequently. Only 12.5% of the unique nominations for the wildlife health reporting network were women and all were nominated by other women (Table 3.16 and 3.17). A similar story exists for the livestock health reporting network: only 9.3% of unique nominations were women and 83% of them were nominated by other women. A higher proportion of women were nominated for the human health reporting network at 38.1% and a high proportion of them were nominated by men at 47%. Men were 846% more likely than women to be nominated as someone to report wildlife health issues, 393% more likely than women to be nominated as someone to report livestock health issues, and only 20% more likely to be nominated as someone to report human health issues to (Table 3.18).

Table 3.14 The average number of nominations made by males and females for each health reporting network. On average, males nominated slightly more people than females for who they would report health issues to.

	Average number of nominations		<i>Welch's t-test</i>		
	Males	Females	<i>t-value</i>	<i>df</i>	<i>p-value</i>
Wildlife health	2.34	2.14	-1.4247	141	0.1564
Livestock health	1.97	1.41	-3.9363	141	0.0001
Human health	1.85	1.77	-0.9026	141	0.3683

Table 3.15 The number of disconnected nodes in the three health reporting networks. Disconnectedness is a result of participants not citing anyone as who they would report health issues to, most often because they did not know to talk to. A disproportionate number of the disconnected nodes were women, suggesting that women were more likely to be unsure of who to talk to about health-related events. There were zero disconnected people in the human health reporting network, which suggests that everyone would know who they would talk to about their own health.

	Disconnected People		Connected People		Welch's <i>t</i> -test		
	Total	Proportion female	Total*	Proportion female	<i>t</i> -value	<i>df</i>	<i>p</i> -value
Wildlife health	5	60%	156	49.4%	-0.4287	4.22	0.6891
Livestock health	10	100%	156	43.6%	-14.163	155	< 0.0001
Human health	0	NA	159	51.6%	NA	NA	NA

\* The totals do not include nominations where the gender is unknown, such as wildlife officers, civil defence force, and police. The wildlife network had 4 nominations with unknown genders, the livestock network 6, and the human network 4.

Table 3.16 The proportion of unique nominees that are female for the three health reporting networks. Females were underrepresented as someone to talk to about wildlife, livestock, and human health. The highest representation of females was in the human health reporting network, suggesting that more people (male and female) would talk to females about their health.

	Number of unique nominations*		Other people in network (not nominated)		Welch's <i>t</i> -test		
	Total**	Proportion female	Total	Proportion female	<i>t</i> -value	<i>df</i>	<i>p</i> -value
Wildlife health	40	12.5%	121	62%	-7.1661	97.24	< 0.0001
Livestock health	43	9.3%	123	60.2%	-8.0687	123.62	< 0.0001
Human health	42	38.1%	117	56.4%	-2.0643	73.27	0.0425

\* Unique nominations differs from absolute nominations. For example, one person could be nominated 100 times but only be counted as one unique nomination.  
 \*\* The totals do not include nominations where the gender is unknown, such as wildlife officers, civil defence force, and police. The wildlife network had 4 nominations with unknown genders, the livestock network 6, and the human network 4.



Table 3.17 The proportion of female nominations that were nominated by other females for the three health reporting networks. The majority of female nominations for the wildlife and livestock networks were nominated by other females. However, males and females almost equally nominated females for the human health reporting network.

	Total number of female nominations*	Proportion nominated by other females
Wildlife health	6	100%
Livestock health	6	83.3%
Human health	19	52.6%

\* This number does not represent unique nominations such that one woman who was nominated by two different people would be counted as two nominations.

Table 3.18 The summary of results for logistic regressions that evaluate the relationship between being nominated (binary dependent variable) and gender. The log odds coefficients were transformed to express percent change ( $percent\ change = (e^{\beta} - 1)100$ ). After controlling for age and education (Model 2), males were still more likely to be nominated as someone to report wildlife, livestock, and human health issues to than women.

	Wildlife health		Livestock health		Human health	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Intercept	-93.3***	-98.6**	-94.6***	-95.3*	-75.8***	-86.5
Gender (male)	1041.3***	846.4***	1372.4***	393.6**	110.3*	20.7
Education	-	0.5	-	-10.9	-	-8.1
Age	-	2.5	-	2.5	-	2.4

\*\*\* $p < 0.001$    \*\* $p < 0.01$    \* $p < 0.05$

### 3.5 Discussion

This study used sociometric methods to identify central individuals in human and animal health information and reporting networks. The key findings are 1) government agencies were the primary and most frequent choices for reporting health concerns and for seeking health information; 2) a local indigenous healer emerged as a key figure for wildlife, human, and livestock health; and 3) there were gender disparities among disconnected people in the networks and among who people would talk to. Utilizing individuals that are centrally located in a network is a valid tool for health interventions to improve the effectiveness of their strategy by facilitating

the spread of information via word-of-mouth (Valente, 2012). Successful and cost-effective strategies are particularly important for programs in low-resource countries where resources can be limited and health risks are higher (Perkins et al., 2015).

Several social networks studies have been conducted in low-resource countries on the topic of human health, such as contraceptive use (Alvergne et al., 2011; Comola, 2008; Gayen & Raeside, 2010), family planning (Stoebenau & Valente, 2003), mercury consumption (Mertens et al., 2008, 2012), and HIV/AIDS (D'Exelle & Holvoet, 2011; Fu et al., 2011). No sociometric studies have been conducted on the topics of wildlife or livestock health information. Stoebenau and Valente (2003) investigated the role of community-trained family planning experts in social networks in Madagascar. The community-trained expert was central for male and female networks as someone to go to for general lifestyle advice and for family planning information. The community-trained family planning expert was named 11 times more than any other individual in the advice network making it a highly centralized network. Such a centralized structure, where one popular person in the centre is connected to most others in the network, is a similar pattern of communication found by the health information and reporting networks of the current study. The health information-seeking networks were the most centralized networks with the most frequently nominated person being nominated 2-4 times more often than the second most nominated person. The health reporting networks were not as centralized with the most popular person only nominated 1.5-2 times more frequently than the second most popular person. Centralized networks can be efficient patterns for information dissemination. If the central person is "infected" with information, they can quickly disseminate it to others in the network who are connected to them (Valente & Davis, 1999; Valente, 2012).

Government agencies were hubs in the centre of wildlife and human health networks. The local government representative was well centered to receive reports about wildlife health issues from the community and the government wildlife officers were well positioned to be a central source of wildlife health information. The government physician was the hub for both reporting about and seeking human health information. Since government agencies were seen as an important source of health information, they should engage with and maintain relationships with rural communities. A non-government person, the local indigenous healer, was nominated most frequently for the livestock health reporting and information networks. The local indigenous healer was prominent in all six networks and therefore, could act as a hub for wildlife, livestock,

and health information and reporting. The local indigenous healer also had high betweenness centrality for five out of six networks making them well-positioned to broker between and connect groups that would otherwise be disconnected. The identification of an important community leader is a common trend in past research. In addition to Stoebenau and Valente's (2003) identification of a community-trained family planning experts as leaders, Hurley, Warren, Doumbia, and Winch (2014) found that midwives in Mali were natural opinion leaders in their communities by playing an important role in friendship and health networks. Also, Mertens et al. (2008) explored discussion networks about mercury contamination in the Brazilian Amazon and found a very dense network structure with one well-connected community leader in the centre. The community leader played an important role in community discussion networks and had also been a collaborator with research activities in the village for years acting as a broker between the community and researchers. The local indigenous healer's importance, position, and expertise for all three health topics could make them a vital facilitator for collaborations between the community and government sectors by acting as a connecting agent for the human, wildlife, and agriculture departments to the community. Rogers (2003) refers to the ability of an individual to act as a leader in several different contexts as polymorphism.

### *3.5.3 Information behaviour*

The results of the current study also contribute to the literature of information behaviour in low-resource countries. Past studies have documented the importance of both formal and informal sources for human health information for residences of low-resource countries. In Ghana, Bosompra (1989) found that informal conversations with family and friends were the most popular channel to receive information about cholera, AIDS, immunizations, and oral rehydration therapy. The second most popular interpersonal channel of health information were Ministry of Health workers. Similarly, Chakrabarti (2001) found that residents in a village in West Bengal, India obtained information on various topics, including health, from community headmen, religious leaders, and community elders, but that formal sources, such as administrative offices and health centres, were also used. Local government offices, extension workers, and primary health care workers were also a key source of health information for rural dwellers in Nigeria (Saleh, 2011). The current study lends support to these findings because the

government physician and the local indigenous healer were the first and second most popular sources of human health information. The key difference is that government physicians were the first choice to obtain health information from, compared to government agencies being the secondary choice in previous research in Ghana, India, and Nigeria.

To date, there has not been any research that documents where rural dwellers in low-resource countries get information about livestock animal health. However, there has been extensive research on agriculture information behaviour in low-resource countries which investigates how people seek information about food crops and animal agriculture. Ikoja-Odongo and Ocholla (2003) found that the preferred information-seeking methods of fishermen in Uganda were primarily informal, including methods such as contacting knowledgeable people, listening and talking to people, and asking a friend or neighbour. Amongst the least popular methods to seek information were contacting extension workers or area councillors. Likewise, fishermen in Nigeria relied primarily on friends, relatives, neighbors, and opinion leaders for work-related information and rarely relied on government extension officers (Njoku, 2004). The similarity between the livestock health information behavior of the current study and fishermen in Uganda and Nigeria is the reliance on informal community members for information. The local indigenous healer and a local community leader were the primary sources of livestock health information. However, government veterinarians were also a popular source of livestock health information, which differs from fishermen in Uganda and Nigeria where there was little reliance on information from government agencies. Although livestock and agriculture are in similar domains, the comparison between livestock health and work-related agriculture information may not be an appropriate comparison.

There is a need for more research into the sources of livestock health information from the perspective of the general public. In addition, there is also a demand for research that investigates the sources of wildlife health information in low and higher income countries. Currently, there is little research available that examines where the public gets information about wildlife health. Therefore, this study is a novel contribution to the wildlife health literature and finds that the government wildlife agency was the main source of wildlife health information in rural Sri Lanka, followed by the local government representative and the local indigenous healer.

The results for the health reporting networks were almost identical to those from the information-seeking networks. Government agencies were the most popular place to report

wildlife and human health issues to and the local indigenous healer was the most common place to report livestock health issues. The separation of “information-seeking” and “information-reporting” questions may not be equivalent because when an individual is seeking information about health, it is likely that an illness prompted their information search. For example, an individual would rarely visit a doctor to seek information about an illness if they were not experiencing symptoms from the illness. The same could be said for livestock and wildlife health such that a person would unlikely be compelled to search for animal health information if they did not first see a sick animal. So “health information searching” and “illness reporting” instances may be one in the same if people are asking for information about health at the same time as they are reporting health issues.

### *3.5.2 Gender and social networks*

Several social network studies have investigated the differences in connections between men and women in low-resource countries. Alvergne et al. (2011) investigated the spread of contraception use in rural Ethiopia by measuring how an individual’s social network related to contraception uptake. They constructed friendship networks for men and women and found qualitative differences in the number of friends that each gender had. On average, women named 2.7 friends and men named 3.8. The current study found statistically significant differences in the livestock reporting network where men named an average of 1.97 people and women named an average of 1.41. This finding does not provide support that women had fewer friends than men, but only indicates that women reported livestock health issues to fewer people. In the other five networks, the average number of people that women nominated was slightly lower than for men, and although these differences were not statistically significant, it is supportive of a trend that women talked to fewer people than men did. D’Exelle and Holvoet (2011) measured several types of networks for men and women in Nicaragua, including friendship, economic, neighbor, family, and support networks, and found that men had larger networks of friends and neighbours compared to women. However, they did not find a difference in the size of economic networks between men and women. Mertens et al. (2012) also did not find a difference in the size of men and women’s discussion networks, but they did find other gendered patterns, such as the tendency for men and women to discuss mercury issues with same-sex individuals than opposite-

sex individuals. This well-known trend, called homophily, was also discovered in the current study where the majority of female nominations in all six networks were nominated by other females (Jackson, 2014; Mcpherson, Smith-Lovin, & Cook, 2001). Homophily is the tendency for people to interact and associate with others that are similar to themselves (Mcpherson et al., 2001). Homophily can impede or facilitate the diffusion of information through a network (Jackson, 2014). Grouping with similar others can facilitate diffusion because once one person adopts an idea or behaviour, similar others in the group are also likely to adopt. However, homophily can impede diffusion when groups become too tight-knit and closed off to share or spread information to outside groups.

Mertens et al. (2012) found that 25 out of 130 individuals in their mercury contamination discussion network were disconnected from the larger network component. This number is similar to the current study where the number of disconnected people varied from 0-26. The disconnected nodes in the current study were disproportionately female, but the gender of the disconnected nodes is not mentioned for Mertens et al. (2012). Women's higher disconnectedness is an indication that they were more likely than men to be unsure of where to go to for information or where to report health issues to for all three health topics. Detached nodes in the networks were a result of participants indicating that they do not know who they would go to for information or who they report health issues to. The wildlife and livestock health information networks had the highest number of disconnected nodes, which is an indication that a knowledge gap about animal health in general may exist within the community. Fewer nodes were disconnected in the human health information network, which suggests that people are more knowledgeable about what to do with their own health concerns. The number of nodes that were disconnected was lower for the reporting networks, but women still outnumbered men. No one was disconnected in the human health reporting network indicating that both men and women knew who they would talk to about their own illnesses. Individuals that are disconnected from the larger network structure are at a disadvantage because information disseminated into the network is less likely to reach them and the information that originates with them is less likely to penetrate the larger network (Scott, 2013).

The gender disparity among disconnected nodes is a reminder for information dissemination programs to create strategies targeted to population subgroups. Women in low-middle income countries frequently experience social and cultural constraints that can change the

way they behave and access information (Fletschner & Mesbah, 2011; Mooko, 2005). In addition, women rely heavily on informal relationships and face-to-face contact as a source of information (Rodriguez et al., 2015). These tendencies emphasize the need for health interventions to take a gendered lens when developing their programs to ensure that the most relevant channels are being used to disseminate information. Fu et al. (2011) provided an example for which tailoring gender-specific programs for HIV-at-risk men and women in China was very important. Men's risk for contracting HIV increases with the use of drugs while women's risk increases by having multiple sexual partners. The difference in risks between men and women requires two different targeted programs each containing unique information for men and women. Dissemination programs should recognize these constraints and tendencies and tailor the information and the channels accordingly. So instead of utilizing one local leader, key leaders for relevant subgroups should be identified, such as one leader for males and one leader for females.

#### *3.5.4 Limitations*

There are several other challenges associated with collecting network data. First, participants are subject to recall bias when asked to remember who they have spoken to or who they know in their network (Alexandra Marin & Hampton, 2007). In addition, social desirability may affect how people respond to questions by prompting them to answer with what they think is the correct answer, rather than an accurate answer. Recall bias and social desirability limits the ability to capture an accurate and complete network. Second, given the observational and cross-sectional nature of this research, it is uncertain as to whether health information actually travels – or will travel – through the observed networks. A third limitation is that the networks represent the intentions of the participants, not their objective actions. That is, the cited sources of health information and places to report health issues to are merely what people said they would do, not what they actually did. Since I did not measure objective actions, I can only assume that people would, for the most part, do what they said and that information would actually flow through the cited channels. This assumption can be risky because people are known to sometimes act differently than their intentions (Netemeyer, Ryn, & Ajzen, 1991). For example, Sawford (2011) found that in her interviews with veterinarians in Sri Lanka, a main concern was that farmers did

not report when a livestock animal was ill. Her research area and population differed from the current study, but still offers the perspective that farmer inaction can be an issue. A fourth limitation is the external validity of my results and whether they can be generalized to other areas of Sri Lanka or to other countries. Since social networks are very specific and complex, it is highly unlikely that the same network is replicated elsewhere in the world (Scott, 2013). Furthermore, since social networks are adaptive and change overtime, the networks recorded through this research may only be relevant for a short period of time.

### *3.5.5 Future research*

There are several avenues for future research. First, an objective measure that could strengthen the current research is to look at who submitted reports for past health-related events, such as reports for sick or dead animals that were found. This would be useful as measure of validity for my analysis. Second, how does an individual's actual information-seeking behaviour differ from their intentions? This question is a natural progression from my research and could be answered by randomly selecting individuals, eliciting a desire in them to seek health information, and then tracking where they actually go to for wildlife, livestock, or human health information. These action-based, objective networks could then be compared to my research's intention-based networks to shed light on the difference between an individual's intentions and actions. Similarly, how does the spread of health information vary as a function of who in the community is initially provided with the information? This question has been answered in other contexts (see Banerjee, Chandrasekhar, Duflo, & Jackson, 2013) but not in Sri Lanka or for health information.

### *3.5.6 Conclusion*

This research demonstrated that social network analysis can be a viable tool for identifying central leaders to disseminate information and receive reports for an interdisciplinary and community-based wildlife monitoring program, the Sri Lanka Wildlife Health Centre. Government agencies were the primary and most popular choices for reporting health concerns and for seeking health information. A local indigenous healer emerged as the best positioned



person in the community to receive health reports and to disseminate information. The healer was also seen as an expert and key figure for wildlife, human, and livestock health. Lastly, there were gender disparities in the networks: women were less likely to be nominated and were more likely to be unsure of where to go for health-related matters. The gender differences shed light on the importance of engaging and accommodating all groups within a Sri Lankan community, perhaps by identifying group-specific opinion leaders that will appropriately communicate information to and from the group. Using individuals that are centrally located in a network can improve the effectiveness of health interventions by facilitating the spread of information via word-of-mouth (Valente, 2012).

Chapter 4 will examine whether information can be learned from the discussions of wildlife, livestock, and human health to inform the strategy for message framing. By analyzing the language used to discuss these health topics, information could be gleaned on how to craft effective messages that can then be disseminated through the effective channels identified in Chapter 3.

## **CHAPTER 4: DISCUSSIONS ABOUT WILDLIFE, LIVESTOCK, AND HUMAN HEALTH IN RURAL SRI LANKA: IDENTIFICATION OF KEY TOPICS AND GENDER DIFFERENCES**

### **4.1 Abstract**

Health interventions need to optimize the message, source, and channel of their information to ensure maximum information uptake and behaviour change. Understanding the target audience of an intervention and how they discuss the topic of interest is an important first step to learning how to adapt information to their needs. This study was a partnership with the Sri Lanka Wildlife Health Centre (SLWHC) and aimed to learn about one of their sub-target audiences to determine best ways to frame and disseminate information about wildlife, livestock, and human health to rural areas. This study used a structural topic model to analyze 7,412 survey responses from 143 rural individuals about human and animal health from rural Sri Lanka to identify topics that emerged and to examine gender differences among the topics. Seven topics were identified by the topic model analysis: 1) Cost/benefits of living near forest, 2) Reporting/asking about animal health, 3) Diseases caused by animals, 4) Wildlife visits and consequences, 5) Issues and needs of the village, 6) Village societies, and 7) medicine. There were small but significant gender differences for Topics 1-6 which indicated that men and women were spending different amounts of time on different topics. However, it was concluded that the gender effect sizes, which ranged from 0.3%-1.6%, would not translate into significant real-world gender differences or require the SLWHC to target men and women differently. Further research should be done into the words and rhetoric men and women used to describe each topic. Understanding how individuals talk about health topics can substantially improve the framing and content of health interventions and lead to higher information uptake, more behaviour change, and improved health outcomes.

### **4.2 Introduction**

Health interventions, with a goal of improving health through information dissemination or education, face the challenge of tailoring their messaging so that it is received and implemented

by as many appropriate people as possible across ages, gender, and education (Aboud & Singla, 2012). This is particularly true for programs that are working in areas where the health risks are high and geographic or infrastructural barriers exist to accessing formal information and health care, such as low-resource countries (Apicella et al., 2012; Fletschner & Mesbah, 2011). There are several aspects of a health intervention that can be tailored that will increase information uptake and behaviour change, including the framing of the message, the source of the message, and the channel in which the message is delivered (Rogers, 2003). The channel is the mechanism in which the message reaches the target audience, such as television, radio, leaflets, billboards, or face-to-face, and is important because a well-framed message is ineffective if it doesn't reach the appropriate audience (Freimuth et al., 2000). Interventions should use channels that are familiar and accessible to their audience (Freimuth et al., 2000). The source of a message is the organization or individual in which it is sent from. Sources with high credibility are more persuasive and lead to higher behavioural compliance than low credible sources (Pornpitakpan, 2004; Valente & Fosados, 2006). Lastly, the message is the information that is sent through a channel via the source. The content and framing of a message can have implications for how it is received (Goldstein et al., 2008; Krishnamurthy, Carter, & Blair, 2001).

To select the most effective and relevant message, channel, and source, program administrators should first research and learn about their audience (Aboud & Singla, 2012). This strategy is not new to market researchers who first learn about the demographics, attitudes, needs, and wants of their intended audience and then brand their product accordingly (Grier & Bryant, 2005). Segmenting the audience into subgroups, such as by gender or age, can provide insights into the way in which groups talk about a topic or which groups are lacking information. Roberts et al. (2014) examined the differences in words and topics men and women used to describe their strategy for playing a public goods game. They found that women were more likely to describe their intuition with doubt and with reference to their morality, whereas men expressed much more certainty about their intuition. Women used more words like “god” and “doubt” and men used words like “gamble” and “certain” more frequently. Similarly, Tvinnereim and Fløttum (2015) looked at main themes that emerged when men and women were asked ‘what comes to mind when you hear the words ‘climate change’?’. Women were more likely than men to discuss the topic of weather and the physical changes caused by climate change, such as the melting ice and rising temperatures (Tvinnereim & Fløttum, 2015). Men

were more likely to talk about the causes of climate change, the negative effects of consumer society, and future generations. Unless there is a systematically different way in which men and women are exposed to climate change information, the topical gender differences are evidence that there is a difference in the way in which men and women process or recall information.

To examine topic differences, Roberts et al. (2014) and Tvinnereim and Fløttum (2015) used an unsupervised machine learning tool called topic modelling which uses word frequency and co-occurrence to automatically discover topics and subgroup differences in written or spoken text. As a relatively new statistical method, topic modelling performs a similar task as traditional manual and dictionary text analysis methods, but with a significantly smaller number of resources (Quinn et al., 2010). The general procedure of a topic model is that it assumes that each document contains some distribution of topics and then it assigns each word in a document to a topic. Words are assigned to topics based on how frequently they co-occur with other words and how often they appear in the rest of the document. The assignment of documents to topics and words to topics are estimated jointly in an iterative procedure (for proofs, see Grimmer & Stewart, 2013). A similar method called structural topic modelling performs the same task as a topic model but allows information about documents or excerpts of text, such as the gender of the speaker, to be incorporated into the analysis.

Research investigating the differences in how men and women in low-resource countries discuss health topics is lacking. In particular, research investigating health topics with an interdisciplinary One Health perspective is even more sparse. One Health is an inclusive and collaborative initiative aimed at addressing global human and animal health holistically with collaborations across all health and environmental sectors and communities (Bordier & Roger, 2013; Kuiken et al., 2005; MacPherson et al., 2013; Ryser-Degiorgis, 2013; Whitmee et al., 2014; Zinsstag et al., 2011). Gaining a better understanding of how men and women talk about health topics in low-resource countries could substantially improve the framing and content of health interventions and lead to higher information uptake, more behaviour change, and improved health outcomes (Aboud & Singla, 2012; Briscoe & Aboud, 2012). Using a case from Sri Lanka, this study partnered with the Sri Lanka Wildlife Health Centre (SLWHC), a One Health initiative, to learn about one of their sub-target audiences to determine best ways to frame and disseminate information about wildlife, livestock, and human health to rural areas. The SLWHC's goal is to generate, share, and mobilize knowledge about wildlife health to

safeguarding public and animal health. The overall goal of this thesis chapter was to explore how rural dwellers are talking about health topics to inform the SLWHC how to best frame their health messaging. The specific objectives of this thesis chapter are to (1) use novel topic modelling methods to identify topics that emerge in interviews about human and animal health and (2) to examine the gender differences among the topics.

## 4.3 Methods<sup>8</sup>

### 4.3.1 Study Area

The data for this study were collected in a small village (6.25 km<sup>2</sup>) on the western border of Moneragala District, Sri Lanka (Figure 4.1).<sup>9</sup> Sri Lanka is a small, densely populated (20 million people) island country in South-Asia with rich biodiversity. Despite struggling with a civil war from the 1980s to 2009, Sri Lanka's GDP is steadily increasing and surpasses other lower middle income countries on many World Development Indicators. In 2010, 90% of Sri Lankan females 15 years or older were considered literate, compared to 66% of females in other lower middle income countries (The World Bank, 2016). Sri Lankans also had a life expectancy 7.6 years longer in 2014 and a gross national income per capita that was 1.7 times higher than other countries with a similar income (The World Bank, 2016).

Moneragala District covers an area of 5,659 km<sup>2</sup> in south-eastern Sri Lanka with 98% of its population of 440,000 (77 people/km<sup>2</sup>) living in rural areas (Moneragala District Secretariat, 2011). It is one of the poorest districts in Sri Lanka with a poverty headcount index of 20.8% in 2012/2013 (Department of Census and Statistics, 2015).<sup>10</sup> The specific study area was defined by the B528 highway to the west, Malakndura Ara river to the north, Welioya main irrigation canal to the east, and the Udawalawe-Bogahapattiya Elephant Corridor to the south (Figure 4.2).

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<sup>8</sup> The methodology for Chapter 4 was the same as what was outlined in Chapter 3. The key difference between Chapter 4 and Chapter 3 is the dataset and data preparation.

<sup>9</sup> The study area is within Thanamalwila Division (pop. 26,476) and crosses into two Grama Niladhari divisions: Aluthwewa (pop. 2,143) and Kandiyapitawewa (pop. 2,389). More specifically, it overlaps, but does not entirely encompass, five villages: Dahaiyagala, Burutagolla, Mahapellessa, Nebedapellessa, and Malakandura (Department of Census and Statistics, 2015).

<sup>10</sup> The poverty headcount index is the proportion of the population that lives below the poverty line (Department of Census and Statistics, 2015).

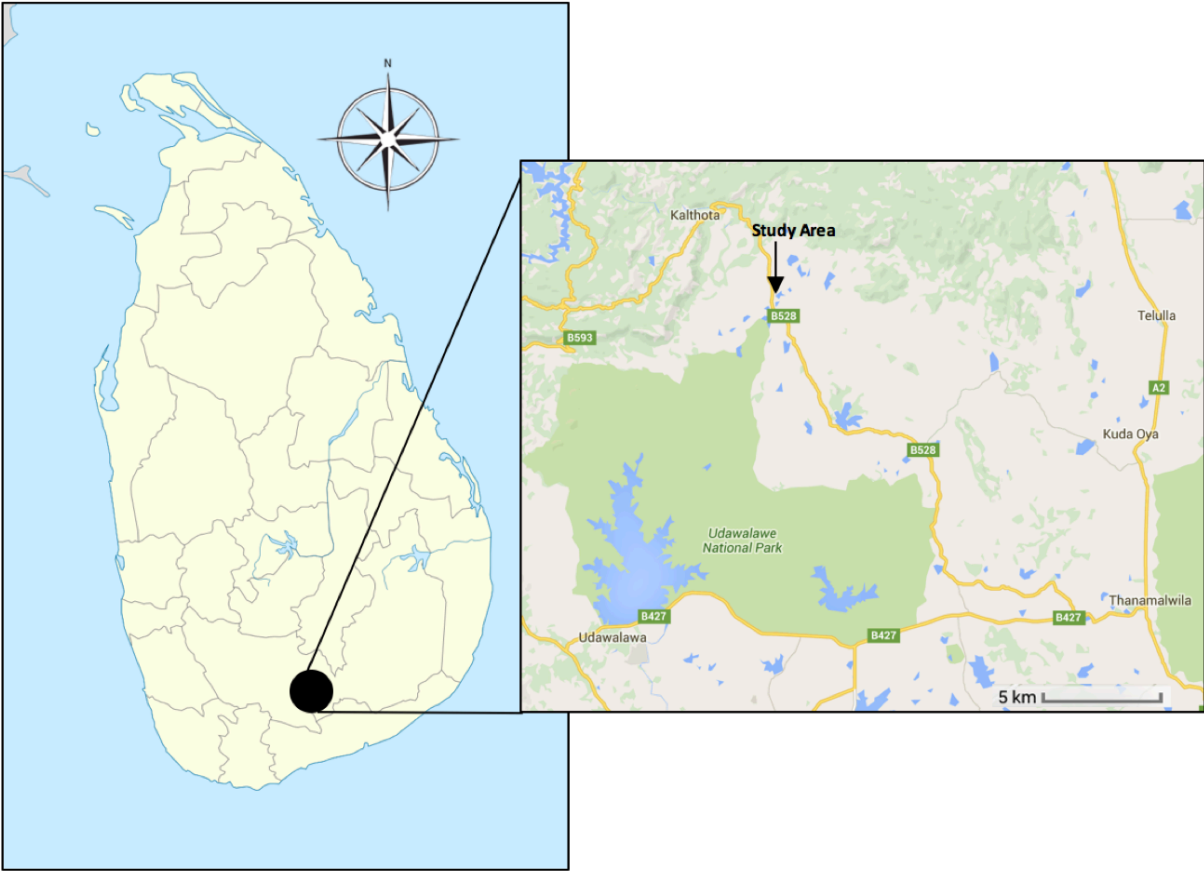


Figure 4.1 The location of my 6.25 km<sup>2</sup> study area was located on the western border of Moneragala District in south-central Sri Lanka. It was 2km north of Udawalawe National Park and bordered the Udawalawe-Bogahapattiya Elephant Corridor. Image sources: Google Maps and [https://commons.wikimedia.org/wiki/File:Sri\\_Lanka\\_location\\_map.svg](https://commons.wikimedia.org/wiki/File:Sri_Lanka_location_map.svg)

The primary livelihood of the study area is rice farming, supplemented by other crops such as banana, eggplant, and pepper. The neighboring Udawalawe-Bogahapattiya Elephant Corridor causes several issues for residents in the study area. It connects Udawalawe National Park with Bogahapattiya Reserve to allow elephants to move freely to and from the parks. Villages along the Elephant Corridor are separated from it by an electric fence to prevent the elephants from entering and causing damage in villages. However, the fence is largely ineffective because elephants regularly cross it to raid crops and homes. Farmers attempt to protect their homes and crops by the elephants by setting up scare traps, lighting fires, and keeping watch at night. In the past 10 years, as many as 30 people in the study area have been injured or killed by elephants (personal communication with Manoj). The high incidence of human-wildlife contact was the primary the motivation for selecting this area for study.

### 4.3.2 Survey Methodology

Data collection took place in May and June 2014. One-hundred and forty-three adults (19-79 years old, 78 women and 65 men) were surveyed from 85 homes. Interviews were structured and conducted face-to-face in Sinhalese by two Sri Lankan enumerators (one male and one female). The enumerators asked questions from an interview guide but were encouraged to keep the interviews conversational and natural (see Appendix A). The survey was piloted once with staff members at the University of Peradeniya and a second time near, but outside of, the study area. Structured interviews were deemed to be the best data collection tool because of the relatively low levels of infrastructure in the study area and to ensure that data collection was as inclusive as possible. Individuals with lower literacy rates cannot participate in questionnaires. In addition, in



Figure 4.2. The study area defined by the B528 highway to the west, a river to the north, a canal to the east, and the Udawalawe-Bogahapattiya Elephant Corridor to the south. We visited every household in this defined area. Image source: Google Earth.

this context, interviews were a quicker form of data collection. All parts of this research were approved by the University of Saskatchewan Behavioural Research Ethics Board (BEH 14-110; Appendix B).

Before data collection began, we took several steps to ensure that appropriate rapport was established in the study area. We met with the Grama Niladhari and the head Buddhist priest to gain their approval to conduct research in the community. The male enumerator had a longstanding personal connection to the area so his relationships were key in the development of rapport with the Grama Niladhari and the priest.<sup>11</sup> Furthermore, a friend of the male enumerator who had several friends in the study area travelled with us to each interview and introduced us to the homeowners. The goal was to interview all members of the community, but interviews were opportunistic and conducted when participants were home and available. We approached the homes on foot or by motorized three-wheeler, inquired to speak to the male and female heads of the household, and asked them to participate in our survey.<sup>12</sup> If agreed upon, the participant provided oral consent to participate and to be audiotaped. One enumerator asked questions while the other wrote down the responses in English (through real-time translation). The male enumerator asked the questions for 117/143 interviews (56 women and 61 male) and the female enumerator for the remaining 26 (22 women and 4 male). In some cases, when the male and female heads of household were both home, the enumerators would conduct separate interviews. The interviews lasted 10-20 minutes and the participants were thanked at the end with a small gift of a notebook and pen. We returned to homes as frequently as possible to reach heads of households that we knew we had missed. Homes were visited up to ten times before we considered the individual unavailable.

#### *4.3.3 Data Preparation*

The audio from each interview was translated and transcribed from Sinhalese to English. Two transcribers who did not conduct the interviews listened to the Sinhalese audio clips and wrote

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<sup>11</sup> He grew up, and his mother still lives, approximately 3 km north of the study area. This is where we stayed while we collected data.

<sup>12</sup> Head of household was defined as the primary working adults of the home. Most homes had one man and one woman as the heads of household, but a few situations were unique, such as four adults (two couples) and a woman with her adult son.



the transcripts in English. A senior Sri Lankan researcher on the team performed two back translations to ensure that the translations were accurate. Of the 143 interviews conducted, 139 interviews were in the finalized transcript database (61 male documents and 78 female documents). Two interviews were not recorded due to human error in the field, two transcripts were unavailable due to incompleteness, and one interview was split into two audio recordings thereby creating two transcripts. The smaller nuances of language, such as tone or sentiment, can be lost during translation from one language to another. However, this issue is less of a concern in with this study because the analysis does not rely on understanding the tone or sentiment of the response, but rather on using word frequency and co-occurrence to explore the primary topics of discussion.

The transcripts were prepared for analysis in R (R Core Team, 2015). The interviewer's questions and comments were removed so that all that remained were the responses by participants. It is helpful to imagine that instead of each interview being contained in one document, each response was contained in one document. Each response was labelled as being said by a male or female. Next, the responses were prepared for analysis by removing capitalization, punctuation, and stop words, such as "and", "it", and "the", and by reverting larger words to their root. For example, "elephants" was converted to "elephant", "talking" to "talk", and "called" to "call". Lastly, words that only appeared once in the corpus were dropped. This is considered advantageous because there is little information added by these words and the cost of including them in the model can be large by slowing it down significantly (Roberts et al., 2016). The final data structure consisted of 7,412 responses labelled as being spoken by a male or female.

### *3.3.4 Data Analysis*

The 'stm' R package was used to estimate a structural topic model (STM) with the interview responses (Roberts et al., 2015). The STM identifies a specified number of topics in a corpus of text and each word is given a probability of being associated with each topic (James et al., 2015). As a hypothetical example, the topic of "pigs" would have the words "oink", "snout", and "pink" associated with it at high probabilities. The advantage to using an STM rather than a latent

Dirichlet allocation (LDA) topic model, for example, is that STM allows information about each document, such as gender, to be incorporated into the analysis.

There are several advantages to using automated text analysis methods, such as an STM, over manual methods. Automated methods are significantly faster than manual methods, especially with large amounts of text. In addition, automated methods are more reliable because the same model can be applied to any corpus of text. Manual methods are inherently subjective, even if the method is well-documented for replication, which makes it difficult for one person to interpret text the exact same way as another. Humans have an incredible ability to understand and interpret text that is not yet matched by automated methods, but the slower speed and reduced reliability of manual methods make automated methods a viable option for text analysis.

One component of the STM that is at the researcher's discretion is the number of topics that are discovered in the text. That is, the researcher needs to decide how many topics they want the STM to discover. I took several steps to select the appropriate number of topics for the best model fit for the data. There are no set rules for selecting the topic number but there are guidelines that researchers can take into consideration. A higher number of topics (e.g., 50-100) will give a more fine-grained representation of the data at the cost of lowering the estimated precision of the model (Roberts et al., 2016). Roberts et al. (2016) recommended that for short corpora focused on specific subject matter, such as survey experiments, 3-10 topics is a good starting place. Therefore, I initiated eight models, each one with between 3 and 10 topics. To determine the best model, I examined the residuals of each model and manually cross-examined each model with the transcripts and the results of a principal components analysis (PCA). PCA optimizes and condenses several correlated variables into a smaller number of representative variables (James et al., 2015). By running a PCA, I could see the number of representative variables that the corpus of text condensed to and use that as a reference point for the appropriate number of topics to discover in the text.

A model output includes words from the corpus that are highly associated with each topic. I manually cross-examined the words associated with each topic for each model with the content of the interviews and the questions asked in the interviews. I looked for the model that yielded the most semantically coherent topics and that most accurately represented the interview

content.<sup>13</sup> It was essential to read and have a comprehensive understanding of the interviews to ensure that the topics were an accurate representation of the data. Having in-depth knowledge about the content of the interviews also prevents the conflation of words (e.g., homonyms) because the researcher gains an understanding of the contexts in which words are used. The STM does not replace the qualitative aspect of text analysis but rather enhances and validates the process. Cross-checking the topics with the interviews was an iterative process throughout analysis but also served as a final step to find quotes that appropriately embodied each topic.

Lastly, the gender differences of each topic was explored by calculating the proportion of male and female responses that were categorized under each topic. Welch two-sample t-tests, which adjusts for unequal variance, were used to determine whether the gender differences within each topic were of statistical significance.

## 4.4 Results

There were 7,412 responses in the corpus with 1,299 unique words. Fifty-four percent of the responses were said by females (4,038) and 46% were spoken by males (3,372). Considering only words that were spoken more than once, males spoke 976 unique words and females spoke 891 unique words.

### 4.4.1 Interview Topics

The STM of best fit categorized the interviews into seven topics (Table 4.1).<sup>14</sup>

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<sup>13</sup> I performed a sensitivity check by removing some key words, such as “elephant” and “talk”, to investigate whether I would arrive at the same model. The similarity of the test model and the selected model suggested that the selected model was robust and could be replicated under different conditions and by different users. The selected model was chosen because it most accurately represented the interview content.

<sup>14</sup> The topic model assumed that each participant response contained some distribution of topics and then it assigned each word in a response to a topic. Words were assigned to topics based on how frequently they co-occurred with other words and how often they appeared in the rest of the response. The assignment of responses to topics and words to topics were estimated jointly in an iterative procedure (for proofs, see Grimmer & Stewart, 2013). In particular, a structural topic model was used, which allowed the gender of each participant’s response to be incorporated into the analysis.

*Topic 1: Cost/benefits of living near forest.* Encompasses the advantages and disadvantages to living near the Udawalawe-Bogahapattiya Elephant Corridor. Responses under this topic were to the interview question “what are the positive/negative aspects of living near the elephant corridor?”. Advantages included water and other resources and being close to nature. Disadvantages included destruction of crops and livelihoods by animals. See Figure 4.3 for quotes that are most representative of this topic.

*Topic 2: Reporting/asking about animal health.* Contains entries that focus on the responses to questions “if you saw a sick or dead livestock/wild animal, who would you talk to?” and “if you wanted more information about a sick or dead livestock/wild animal, who would you ask?”. Responses varied from being unsure of who to talk to or ask to naming specific people in the village. See Figure 4.3.

*Topic 3: Diseases caused by animal.* Comprised of the knowledge that people hold about diseases that are caused by animals. Includes responses to the questions “can humans get sick from livestock or wild animals?” and “can livestock animals get sick from wild animals?”. Seventy-four percent of participants indicated that they knew that humans could get sick from wild animals, 68.5% knew that humans could get sick from livestock animals, and 22.5% knew that livestock animals could get sick from wild animals (Table 4.2). A smaller proportion of people in each of these cases could name a specific animal that caused an illness. Some responses were questions seeking confirmation from the interviewer, such as “*We don’t get diseases from cows right?*” and “*Normally diseases like leptospirosis are transmitted from wild animals right? That means from rats?*”. For more quotes that represent this topic, see Figure 4.3.

*Topic 4: Wildlife visits and consequences.* Encompasses the types of wild animals that visit the village, the frequency of their visits, and the consequences associated with each animal. Reported frequent animal visitors include elephants, monkeys, and peacocks, all of which destroy farmers’ cultivation. Most participants reported that they cultivated 1-3 acres of paddy (rice) and other crops such as bananas, eggplant, and pepper. See Figure 4.4 for quotes related to this topic.

*Topic 5: Issues and needs of the village.* Includes responses to the question “what are the biggest issues facing the village that the government should address?”. Common responses included the failure of electric elephant fence, a lack of roads, schools, temples, and other infrastructure, and a lack of a clean water source. See Figure 4.4 for other quotes.

*Topic 6: Village societies.* Contains responses that describe the various societies that people in the village are members of. Most people in the village are members of a Farmer’s Society and Funeral Aid Society. Some members of the community hold formal positions, such as Secretary or President, in the Societies. See Figure 4.4 for responses capturing this topic.

*Topic 7: Medicine.* Captures where respondents would go for personal health issues. It also captures how some people feel about the role of western and traditional medicines. Responses indicate that many people seek aid from both western and Ayurvedic doctors depending on their particular ailment. For example, “*if we get a stomach ache or if we become frightened for something we would seek for [indigenous healer] who will do charms...but other than that if it is for some kind of medicine I would go to Kalthota [western doctor]*”. See Figure 4.5 for more quotes related to this topic

Table 4.1 The most discriminating words, proposed labels, and topic proportion for the seven topics identified by the topic model. The most discriminating words are the most representative words for each topic based on their high frequency in the given topic combined with low frequency in other topics. Topic proportion is the proportion of survey responses that map onto a given topic.

Topic	Most discriminating terms (frequency and exclusivity)	Topic label	Topic proportion
1	animal, peacock, disadvantage, live, destroy, advantage, land, phone, anything, isn't	Cost/benefits of living near forest	0.1386
2	cow, inform, person, call, wild, name, rare, life, another, shot	Reporting/asking about animal health	0.1167
3	elephant, disease, cause, use, grama, haven't, got, niladhari, dead, radio	Diseases caused by animals	0.1463
4	time, month, pig, acre, two, everyday, fever, around, week, old	Wildlife visits and consequences	0.1513
5	village, fence, need, road, often, sick, electrified, much, hambegamuwa, season	Issues and needs of the village	0.1452
6	doctor, [indigenous healer], since, meet, usual, societies, uncle, grade, everyday, vet	Village societies	0.1521
7	hospital, medicine, wildlife, tell, see, ask, say, take, first, went	Medicine	0.1497

Table 4.2 The proportion of participants that indicated they had knowledge about disease transmission from wild animals to humans, from livestock animals to humans, and from wild animals to livestock animals.

Knowledge question	Proportion that said yes	Proportion that named a contagious animal
Can humans can get sick from wild animals?	74.8%	58.7%
Can humans can get sick from livestock animals?	68.5%	51.0%
Can livestock animals can get sick from wild animals?	22.5%	14.0%

#### 4.4.2 Topic Gender Difference

There were significant differences in the proportion of male versus female responses that were comprised of Topics 1-6 (Figure 4.6 and Table 4.3). A larger, and statistically significant, proportion of male responses mapped onto Topics 1, 2, and 5 compared to female responses, however, these differences were small. The male corpus was comprised of 0.4% more of Topic 5, 1% more of Topic 1, and 1.6% more of Topic 2 than the female corpus. The female corpus contained a higher proportion of Topics 3, 4, and 6 than the male corpus. Female responses were comprised of 1% more of Topic 3, 0.3% more of Topic 4, and 1.2% more of Topic 6 than male responses. There were no significant differences between male and female responses for Topic 7.

#### 4.4.3 Verboseness check

Females spoke 891 unique words and males spoke 976 unique words (considering only words spoken more than once) despite the fact that the corpus had a larger proportion of female texts (54% vs 46%). This 10% difference in verboseness could be due to male interviews being 2.5 minutes longer, on average, than female interviews ( $t(104.5) = -3.28, p = 0.001$ ). The combined average length of interviews was 18.8 minutes, with a female average of 17.7 minutes and a male average of 20.3 minutes (Table 4.4). The difference in interview lengths between males and females could be an artefact of the enumerators' gender and/or interview style. The male enumerator, who interviewed 82% of the sample (56 females and 61 males), interviewed men for an average 3 minutes longer than women ( $t(102.28) = -3.46, p = <0.001$ ). On the other hand, the female enumerator interviewed women for almost 2.5 minutes longer, on average, than men ( $t(10.35) = 2.28, p = 0.0454$ ). The female only interviewed four males and 20 females.

Topic 1	Topic 2	Topic 3
<p>Interviewee: There isn't any advantage or any disadvantage. Animals do damage a lot but we should be able to protect.</p>	<p>Interviewee: No one is there. But there is a person in [REDACTED]. We call him the 'mason'. I don't know his name.</p>	<p>Interviewee: I haven't heard that cows cause diseases to humans. But I have heard that cocks cause diseases to humans</p>
<p>Interviewee: We go on planting onions and if we fail to cover it with hay, once we go back we find all the onions gone. They swallow everything. They don't allow anything to be planted. Brinjal and cucumber plantations all of them are destroyed.</p>	<p>Interviewee: There is no person in particular but would inform a knowledgeable elderly person.</p>	<p>Interviewee: Haven't heard of a particular disease as such and we haven't diagnosed it as such and such a disease but we have heard that such diseases occur.</p>
<p>Interviewee: We don't have any special disadvantages. We are privileged to have natural resources, water when compared to those who live in the city. We can live comfortably and freely. The disadvantage is the harm caused by animals.</p>	<p>Interviewee: There is one called [REDACTED]. He knows about these things. There's another one named [REDACTED].</p>	<p>Interviewee: I have heard that they cause heart and kidney diseases. If those animals have those kinds of diseases and if we eat their meat, we get it. I have heard that mosquitoes too cause diseases to humans. Things like fever.</p>

Figure 4.3 The most representative survey responses for Topics 1-3. Topic 1 is *the cost/benefits of living near forest*, Topic 2 is *reporting/asking about animal health*, and Topic 3 is *diseases caused by animals*. These responses were selected as the most representative quotes because they loaded the highest onto each topic according to the



Topic 4	Topic 5	Topic 6
<p>Interviewee: Monkeys eat the crops. Elephants turn over and devour the coconut trees. They also roll over the plaintain trees and peel off their skin and eat them.</p> <hr/> <p>Interviewee: I of course have two acres sir and there are ones with two acres and three acres.</p> <hr/> <p>Interviewee: Yes, they devour everything. If the paddy is ripe, they eat it and if there are plantains they eat it too or else they pull down the coconut trees and go back.</p>	<p>Interviewee: It's like this now, the fence is not properly maintained that's it. If not the electrified fence is successful the problem is that there's no maintenance. It should be properly maintained. If it is properly maintained it's successful.</p> <hr/> <p>Interviewee: There's this temple in Dahaiyyagala. If we receive aids for that temple we can upgrade it. There's a monk in that temple who tries to get help but If we get a big donation we can build the preaching hall and the shrine which will be of immense help for the people since all that belong to public property.</p> <hr/> <p>Interviewee: Although we go to talk of those things with them, they are not often done. If we are to talk, we need to talk with the provincial council.</p>	<p>Interviewee: 10 years. We will hope to join with the funeral society again, after other son passed from the university. He is in Peradeniya University.</p> <hr/> <p>Interviewee: [redacted] the vendor, brother [redacted] is there. He is the secretary. There is the president or someone in Daladamankada or somewhere as well. Even [redacted] from Mahapalassa.</p> <hr/> <p>Interviewee: We have two societies until now. One is the farmers' society and the other is the funeral aid society. Now the president of both the farmers' society and the funeral aid society is [redacted]. Actually there isn't an educated person to hold the position. Most of them have learnt only upto ordinary levels.</p>

Figure 4.4 The most representative survey responses for Topics 4-6. Topic 4 is *wildlife visits and consequences*, Topic 5 is *issues and needs of the village*, and Topic 6 is *village societies*. These responses were selected as the most representative quotes because they loaded the highest onto each topic according to the topic model.

## Topic 7

Interviewee: Not at all the times, once I had a stomachache, I took medicine from Doctor, he gave medicine for gastritis, but not cured, then again I went, again gave medicines for high blood pressure, then I went for a local doctor, he said that I didn't have high blood pressure. If I took all the medicines what would happen to me...

Interviewee: When I go to the hospital the Doctors say that this is an eczema and according to my knowledge there are several types of eczemas. I have it in my legs as well. I have applied some oil on them. It produces itchiness. This is not an eczema there is a Malta owa worm that bites. Although we tell it, they don't accept it. The Doctors believe it as an eczema. The things that the Doctors applied are mostly unsuccessful. It is from [redacted] medicine that we can cure this. I did English medicine throughout and since it didn't work I started doing Ayurveda medicine where I found consolation to a large extent. So, I think both these sides should be developed.

Figure 4.5 The most representative survey responses for Topic 7, which is *medicine*. The response was selected as the most representative quotes because it loaded the highest onto the topic according to the topic model.

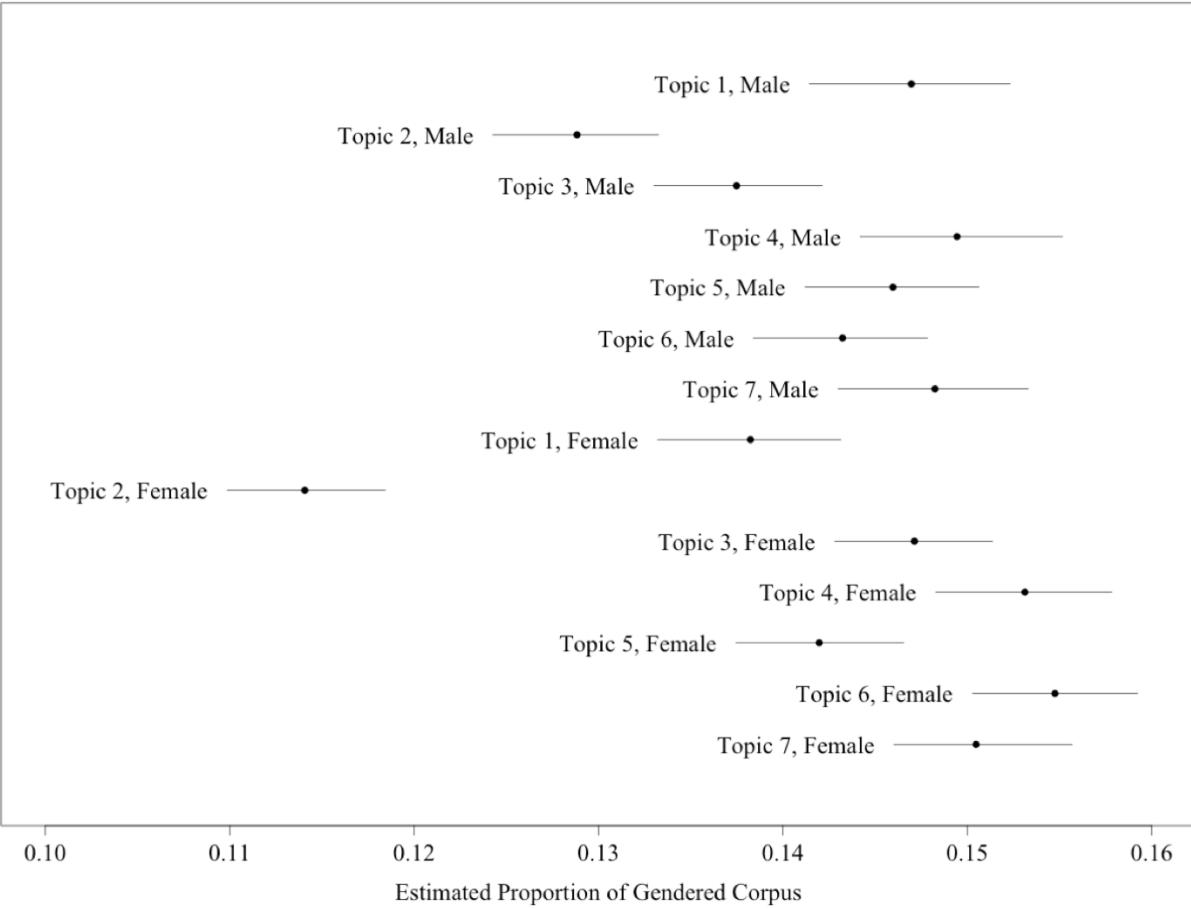


Figure 4.6 The proportion of male and female responses that map onto each topic with 95% confidence intervals. Please refer to Table 4.1 for a description of each topic.

Table 4.3 The difference between male and female topic proportions. Topics 1, 2, and 5 contained significantly more male than female responses and Topics 3, 4, and 6 contained significantly more female than male response at  $p < 0.05$ . The proportion of male and female responses were significantly different, except for Topic 7.

Topic	Topic proportion		Effect size	Welch's <i>t</i> -test		
	Male	Female		<i>t</i>	<i>df</i>	<i>p</i> -value
1	0.1438	0.1343	0.0095	5.2976	6976	< 0.0001
2	0.1255	0.1094	0.0161	11.155	6889	< 0.0001
3	0.1403	0.1514	-0.0111	-7.576	7239	< 0.0001
4	0.1483	0.1537	-0.0031	-2.928	7156	0.0034
5	0.1473	0.1435	0.0038	2.354	7084	0.0186
6	0.1457	0.1575	-0.0118	-7.662	7267	< 0.0001
7	0.1490	0.1503	-0.0013	-0.750	7151	0.4534

Table 4.4 The average length of the interviews in minutes conducted by the male and female enumerators for all participants, male participants, and female participants ( $n = 137$ ). Note the interaction between the gender of the enumerator and the gender of the participants on the interview length. The female enumerator interviewed females longer than males and the male enumerator interviewed males longer than females.

	All participants	Male participants	Female participants	Welch's <i>t</i> -test		
				<i>t</i>	<i>df</i>	<i>p</i> -value
Combined	18.83	20.32	17.71	-3.28	104.5	0.001
Male enumerators	19.13	20.65	17.60	-3.46	102.28	0.0008
Female enumerators	17.77	15.75	18.14	2.28	10.35	0.05

## 4.5 Discussion

This study used a structural topic model (STM) to identify topics in interviews about human and animal health in rural Sri Lanka. Seven topics emerged: 1) cost/benefits of living near forest; 2) reporting/asking about animal health; 3) diseases caused by animals; 4) wildlife visits and consequences; 5) issues and needs of the village; 6) village societies; and 7) medicine.

Significant, but small, gender differences on Topics 1-6 were identified. Men were found to talk more about the advantages and disadvantages to living near a forest, about who to report and ask information from about animal health, and about the issues and needs facing the village. Women were found to talk more about diseases caused by animals, wildlife visits to the village and their consequences, and the village societies.

### *4.5.1 Number of topics*

Past research have applied topic models to identify topics in political texts (Grimmer, 2010, 2013; Grimmer & Stewart, 2013; Quinn et al., 2010), online content (Reich, Tingley, Leder-luis, Roberts, & Stewart, 2015; Roberts et al., 2015), scientific journals (Blei et al., 2010), and survey responses (Roberts et al., 2014; Roberts, Stewart, Tingley, & Airoidi, 2013; Tvinnereim & Fløttum, 2015). The number of topics that past research has identified has varied significantly (see Table 4.5). Blei et al. (2010) analyzed the themes of 17,000 articles from the journal *Science* and identified 100 topics. They did a similar analysis to an unspecified number of *Yale Law Journal* articles and found 20 topics. The significant difference in the number of topics between these analyses is likely due to the broader array of topics published in *Science* compared to the narrower focus of the *Yale Law Journal*. Grimmer (2013) and Quinn et al. (2010) analyzed different types of text from the US Senate but each found roughly the same number of topics. Grimmer (2013) identified 44 topics in over 64,000 press releases from US Senate offices and Quinn et al. (2010) analyzed over 118,000 transcripts of speeches from the US Senate and identified 42 topics. These four studies identified significantly more topics than the current study – 100, 20, 44, and 42 versus 7 – but the datasets that were analyzed were larger and qualitatively and contextually different.

Roberts et al. (2014) analyzed 384 responses from an experimental survey measuring attitudes towards immigration and identified three topics. Similarly, Tvinnereim and Fløttum (2015) asked 2,115 participants what came to mind when they thought about climate change and found that four coherent topics emerged. These two studies were smaller and qualitatively different than the current study, but the data collection method and contexts are more similar (i.e., a question and answer format). The comparable number of topics and data collection methods of the current study to Roberts et al. (2014) and Tvinnereim and Fløttum (2015) provides some evidence that the model performed within an acceptable range. There is considerable variance in topic selection because it depends on data collection methods, data structure (data type and size, number of words, number of unique words, etc.), the researcher's familiarity with the corpus, the researcher's purpose and objectives, and the researcher's methods for topic selection (Blei et al., 2010; Grimmer & Stewart, 2013; James et al., 2015; Quinn et al., 2010; Roberts et al., 2015). As such, the number of topics identified across different studies are difficult to compare and should not be used as the only benchmark for model performance.

A cross-check of the topics with the questions asked in the interviews verifies that the seven topics identified are accurately capturing topics from the interviews. It is clear which topics map onto which questions. For example, responses categorized under Topic 1 are from the question "what are the advantages and disadvantages to living near the forest?" and responses under Topic 5 are from the question "what are the biggest issues facing the village that the government should address?". There are some interview questions that were not captured by the topic model, however. For example, the questions "what should be done with sick wild animals?" and "what are the most convenient methods of receiving information about wild animal health?" are not clearly represented by the topics. Examining the responses to these questions reveals that they were frequently very short or similar to the responses of other questions. Therefore, the responses could have been too insignificant to influence topic formation or could have gotten categorized into one of the seven topics alongside other responses. The topics accurately capture the vast majority of questions and responses from the interviews which verifies that a model with seven topics was an appropriate selection.

#### 4.5.2 Gender effect sizes

The current study found small but significant differences between men and women for Topics 1-6. To determine whether these differences are meaningful, it is useful to review the gender effect sizes of past research. Tvinnereim and Fløttum (2015) found significant gender effect sizes that ranged from 2-11%. Thirty-five percent of women's discussion about climate change was categorized as the topic of weather/ice compared to only 24% of men's responses. The smallest reported effect size (2%) in favour of men for the topic of money/consumption. Reich et al. (2015) investigated the different motivations that men and women had for registering for an online course and, like the current study, found small but significant effect sizes. Men's

Table 4.5 The type of text, number of topics identified, and effect sizes reported by previously published topic model studies.

Article	Corpus	Topics	Reported effect sizes
Blei et al. (2010)	17,000 Science articles	100	NA
Blei et al. (2010)	Yale Law Journal articles (unspecified number)	20	NA
Grimmer and Stewart (2013)	65000 press releases from Senate offices from 2005-2007	44	NA
Quinn et al. (2010)	118,065 US Senate speeches	42	NA
Reich et al. (2015)	240,208 responses from a survey about motivations for taking online course	12	Gender, 0.2-1%
Reich et al. (2015)	1600 discussion posts from online course	8	NA
Roberts et al. (2015)	13,000 posts from 6 political blogs	20	Political leaning, 1-6%
Tvinnereim and Fløttum (2015)	2,115 responses from a survey about climate change	4	Gender, 1.6-24%

responses contained around 1% more of the following reasons compared to female responses: professional development, acquiring computer science and programming knowledge, and the course is offered by an elite institution. Women's responses contained 0.2% more of the motivation of lifelong learning. Other studies have looked at topic differences on other covariates, such as Roberts et al. (2015) comparison of political leaning of blog writers. They found that the text of liberal writers contained 6% more of the topic "Bush presidency" whereas conservative writers were more likely to talk about Obama (2%) and Sarah Palin (1%).

It is evident that differences as large as 11% between gender and other covariates can be detected within topics. However, the largest effect size reported in the current study was 1.6% for Topic 2 (reporting/asking about animal health) in favour of men and the smallest difference was 0.3% for Topic 4 (wildlife visits and consequences) in favour of women. Is it reasonable to conclude that men were more likely to talk about who they would report animal health cases to or that women spent more time talking about wildlife visits to the village? All of the reported differences were statistically significant at a  $p$ -value  $< 0.05$ , but it is important to take the effect size into consideration (Sullivan & Feinn, 2012). As an example, imagine randomly sampling 100 responses each from the male and female corpus. It could be predicted that approximately 15 responses from the male and female corpuses would be from Topic 4 (14.8% vs 15.3%). This is a null or trivial difference and is difficult to image how this would translate to meaningful communication differences between men and women. The same could be said of the gender differences for Topic 5 (0.4%). Topic 1, 3, and 4 had approximately 1% differences between men and women, which would amount to a one response difference in the randomly sampled 100 responses. Topic 2 could generate a response difference closer to two with 13 (or 12.6%) of male and 11 (or 10.9%) of female responses mapping onto it. Sullivan and Feinn (2012) purported that a very small difference, even if it is significant, is often inconsequential. When a sample size is large enough, small, negligible differences can be detected and reach significance at the 0.05 level. Therefore, it is important to assess  $p$ -values alongside effect sizes to determine whether the results are meaningful. The current study had a sample size of over 7,000 which is considered large for social science research and permits the power to detect small effect sizes (Sullivan & Feinn, 2012). Taking this into consideration, the effect sizes for gender for Topics 1-6 are likely



inconsequential and unlikely to translate into meaningful topic differences between men and women.

Small detected effect sizes between men and women is not out of the ordinary. Hyde (2014) conducted a meta-analysis of research examining gender differences and concluded that there are null or small effect sizes in more domains than there are domains with moderate to large effect sizes. Communication is one of the domains in which effect sizes are small between men and women, particularly for the use of tentative speech, tag questions, and hedges (Leaper & Robnett, 2011). These effect sizes, however, are dependent on how the data were collected, such as whether it was written or spoken language and whether it the study took place in a lab or group setting (Leaper & Robnett, 2011; Newman, Groom, Handelsman, & Pennebaker, 2008). In regards to other aspects of speech, larger differences have been found. Roberts et al. (2014) found differences in the words that men and women use to describe their strategy for playing a public goods game. They found that women were more likely to describe their intuition with doubt and with reference to their morality and to use words like “god”, “doubt”, and “change”. Men expressed much more certainty about their intuition by using words like “good”, “reason”, and “certain”. In addition, women are more likely to talk about other people, their thoughts, emotions, and senses and to use verbs, while men are more likely to talk about external events and objects and to use technical linguistic features such as numbers and prepositions (Newman et al., 2008).

Based on Newman et al.'s (2008) findings, categorizing the topics in the current study based on whether they involve 1) talking about other people or 2) talking about external events could help determine whether the topical gender differences are meaningful in the current study. One could hypothesize that since Topic 2 (reporting/asking about animal health) and Topic 6 (village societies) are the topics that most clearly involve talking about other people, that they will capture more of women's responses. Most of the topics could be construed as involving discussions about external events, but Topics 1, 4 and 5 appear to be the most impersonal (i.e., not relating to the self) and most external-facing and therefore, could encompass more of men's responses. Topic 3 is particularly self-reflective, requires introspection about one's own knowledge, and doesn't clearly map onto the tendencies of men or women identified by Newman et al. (2008). Based on the five categorized topics, Newman et al.'s (2008) framework only correctly predicted the gender differences for 3/5 topics, which isn't much better than chance. In

my analysis, women's responses were found to contain more of Topic 6 than men's responses but the opposite is true for Topic 2. Men's responses contained more of Topic 1 and 5 but women spoke more about Topic 4. The integration of the current study with Newman et al.'s (2008) findings is challenging because it is difficult to classify the broad topics as being focused on external events or people-centred. The unsuccessful comparison, however, does not mean that there aren't more nuanced differences between men and women that the topics do not capture.

There was a difference in the number of unique words spoken by males and females. Males spoke 85 more unique words (976) than females (891), despite the corpus containing 8% more female responses than males (54% vs 46%). Past research has found that men use more numbers, articles, and prepositions, which could translate into a higher number of unique words (Newman et al., 2008). Men's verbosity could also be a result of their interviews being longer, on average, so even though there were a fewer total number of male responses in the corpus, the length of each individual response may be longer for males. There was an interaction between the gender of the enumerator and the gender of the participant where the interviews lasted longer if the participant was talking to a same-sex enumerator. The male enumerator interviewed male participants for 3 minutes longer, on average, than female participants. Similarly, the female enumerator interviewed female participants for an average of 2.5 minutes longer than male participants. This finding lends significant support to the concept that the gender of enumerators or other field workers need to be the same gender as the participant, particularly in rural areas of low-resource countries where gender roles are particularly prominent (World Bank, 2012).

#### *4.5.3 Limitations*

A limitation with comparing the current study to past research is that the current study was conducted in Sinhalese and transcribed to English for analysis. The processes of translating and transcribing can both result in a loss of meaning in the survey responses. In addition to the loss of specific semantic information, cultural differences between Sri Lanka and higher income countries, where the cited topic model and gender research was conducted, could limit the comparability of the results. The patterns of speech and communication found between men and women in the United States may not be generalizable to Sri Lanka or other international contexts. Women in rural areas of low-resource countries are more likely to be constrained by

restrictive social norms and unable to attend social outings where the bulk of community communication would occur (Fletschner & Mesbah, 2011; Mooko, 2005; Thuo et al., 2014a). Such restrictions could shape the language and communication style of women in low-resource countries to be much different than that of women in higher income countries who are not as restricted by gender roles.

Furthermore, the STM used in the current study is limited in the extent to which it can detect specific word and semantic differences between men and women. The model that was used allows the topics to vary across gender but it does not allow for the content within each topic to vary by gender (Roberts et al., 2015). As such, I was unable to look at the specific words that men and women used to talk about each topic, which could have revealed more nuanced and meaningful differences. This is one limitation of automated text analysis that can be addressed by conducting manual coding and in-depth text reviews alongside the automated methods (Grimmer & Stewart, 2013). Roberts et al. (2014) compared the results of a topic model and human coders and found that there was a significant correlation between the two. However, the topics from the model did not perfectly align with the categories created by the manual coders. A difference emerged because the topic model categorized at the document-level while the manual coders coded specific excerpts of text within each document. Understanding how the topic model's methods differ from that of a manual coder's is essential to assessing the validity of automated methods and drawing inferences from them (Neuendorf, 2011). Automated text analysis methods can increase text analysis reliability, but they cannot yet fully replace human experts (Mikhaylov et al., 2012).

#### *4.5.4 Future research*

Next steps in research could include a content-focused topic model, which would allow the content within each topic to vary, could reveal the different words that men and women used to talk about a topic. In addition, human expert coders could analyze the data to further explore nuanced gender differences of the survey responses. Furthermore, concrete behavioural data could be collected to verify whether some of the topical gender differences translate to noticeable communication style differences. For example, men spent significantly more time talking about who they would reporting animal health issues to and who they would ask for more information

about animal health (Topic 3). An investigation into official reports written by government wildlife officials or veterinarians could reveal who first informed them about the issue. If men were more likely to report animal health issues, then it would lend support to the gender difference identified in Topic 3.

#### *4.5.5 Conclusion*

This study's purpose was to identify the topics that emerged during interviews about human and animal health and to examine whether there were gender differences among the topics. The results would inform the messaging strategies for health interventions, such as the Sri Lanka Wildlife Health Centre, of the best ways to frame health messages for men and women. Statistically significant results were found between men and women for six of the seven topics, but due to the small effect sizes ranging from 0.3% to 1.6%, it is concluded that the differences are not large enough to translate to a meaningful communication differences about health between men and women. There could be other qualitative differences, however, that the topic model used cannot summarize, such as specific framing of issues or the words used to describe each topic. Males spoke more unique words than females but this could be due to male interviews being longer than female interviews, on average. The interaction between the gender of the enumerators and the gender of the participants brings forth the importance of making sure that the channel and source of information of health interventions are gender appropriate. To ensure that females are most comfortable and receptive to information, they should be contacted by female field workers or opinion leaders, and males should be contacted by males. In conclusion, there were no meaningful differences in how many time males and females spent talking about health topics. However, it cannot be concluded that there are no differences in how males and females talked about the topics. Before further conclusions can be made, more research should be done into the words and rhetoric males and females used to describe each topic.

## CHAPTER 5: GENERAL DISCUSSION

### 5.1 Review

The purpose of this thesis was to learn about identify central actors in rural wildlife, livestock, and human health information and reporting networks in rural Sri Lanka and to explore how rural residents talk about health topics. Programs that learn about their audience and utilize existing social networks for information dissemination are generally more effective than ones that do not (Banerjee et al., 2013; Cai et al., 2015; Perkins et al., 2015; Valente, 2010; Valente & Pumpuang, 2007). The findings of this research can inform the SLWHC of the best routes to disseminate information about wildlife, livestock, and human health to rural communities, how best to obtain observations of disease outbreaks from these remote areas, and how to appropriately tailor health information for men and women. The specific objectives were to: (1) identify the central sources of wildlife, livestock, and human health information, (2) identify who individuals report wildlife, livestock, and human health issues to, (3) examine the role of gender in the information and reporting networks, (4) identify topics that emerge in discussions about human and animal health and (5) examine the gender differences among the discussion topics. In this chapter, I will review key findings and recommend best practices for the SLWHC.

### 5.2 Key findings

#### *5.2.1 Chapter 3: Wildlife, livestock, and human health information networks in rural Sri Lanka: Identification of central individuals and gender disparities*

In this paper, I used social network analysis to analyze 143 survey responses to identify central actors in rural wildlife, livestock, and human health information and reporting networks to inform the SLWHC of the best ways to disseminate and receive wildlife health information from areas with high wildlife-human conflict.

There were three key findings. First, government agencies were the primary and most popular choices for reporting health concerns and for seeking health information. The local government representative was well centered to receive reports about wildlife health issues from

the community and the government wildlife officers were well positioned to be a central source of wildlife health information. The government physician was the hub for both reporting about and seeking human health information. The large role of government agencies in providing human health information in low-resource countries has been demonstrated in past research (Bosompra, 1989; Chakrabarti, 2001; Saleh, 2011). Currently, there are no studies that examine where the public gets information about wildlife health. Therefore, this study is a novel contribution to the wildlife health literature.

Second, a local indigenous healer emerged as the best positioned person in the community to receive health reports and to disseminate information for wildlife, human, and livestock health. The local indigenous healer had high betweenness centrality for five out of six networks making them well-positioned to broker between and connect groups that would otherwise be disconnected. The identification of an important community leader is a common trend in past research (Hurley et al., 2014; Mertens et al., 2008; Stoebenau & Valente, 2003). The local indigenous healer's importance, position, and expertise for all three health topics could make them a vital facilitator for collaborations between the community and government sectors by acting as a connecting agent for the human, wildlife, and agriculture departments to the community.

Third, there were gender disparities in the networks where women were less likely to be nominated and were more likely to be unsure of where to go for health-related matters. The gender differences shed light on the importance of engaging and accommodating all groups within a Sri Lankan community by identifying group-specific opinion leaders that will appropriately communicate information to and from the group. So instead of utilizing one local leader, key leaders for relevant subgroups should be identified, such as one leader for males and one leader for females.

#### *5.3.3 Chapter 4: Identifying topics in survey responses about wildlife, livestock, and human health to inform information dissemination strategies of the Sri Lanka Wildlife Health Centre*

This study used a structural topic model to analyze over 7,400 survey responses about human and animal health from rural Sri Lanka to identify topics that emerged and to examine gender

differences among the topics. This study partnered with the SLWHC to learn about their target audience to determine best ways to disseminate and receive information about wildlife, livestock, and human health from rural areas.

Seven topics emerged from the interviews: 1) cost/benefits of living near forest; 2) reporting/asking about animal health; 3) diseases caused by animals; 4) wildlife visits and consequences; 5) issues and needs of the village; 6) village societies; and 7) medicine. It is difficult to compare these topics to those found in past research, but seven topics is in the same range as other studies that have analyzed survey responses with topic models (Reich et al., 2015; Roberts et al., 2014; Tvinnereim & Fløttum, 2015). The seven topics were very representative of the questions and topics that were discussed in the interviews.

Significant, but small, gender differences were found for Topics 1-6. Small effect sizes between gender were found in other topic model analyses (Reich et al., 2015; Tvinnereim & Fløttum, 2015), and small effect sizes between men and women is common in other communication research (Coates, 2004; Leaper & Robnett, 2011). Taking this into consideration, the effect sizes for gender for Topics 1-6 are likely inconsequential and unlikely to translate into meaningful topic differences between men and women. There could be other qualitative differences, however, that the topic model used cannot summarize, such as specific framing of issues or the words used to describe each topic.

This paper also identified that males spoke more unique words than females and this could be due to male interviews being longer than female interviews. However, the interaction between enumerator and participant gender, where the male enumerator interviewed males for longer than females and female enumerators interviewed females longer than males, brings forth the importance of making sure that the channel and source of information of health interventions are gender appropriate. Overall, this paper identifies key interview topics but does not detect any meaningful gender differences across the topics.

## **5.3 Recommendations**

### *5.3.1 Sri Lanka Wildlife Health Centre*

The SLWHC is particularly innovative in their pursuit of an interdisciplinary and inclusive wildlife monitoring program. The results of this thesis offer several recommendations to ensure that their programming is as effective as possible.

- 1) The results indicate that people are engaging with – or understand that they should engage with – existing government infrastructure as source of wildlife, livestock, and human health information. Moreover, government agencies are a common target for reports of health issues. These results suggest that the SLWHC should continue to partner with the Department of Wildlife Conservation, the Department of Livestock Production and Health, and the Ministry of Health and utilize their existing infrastructure in rural areas. Existing infrastructure, such as offices and employees, could be used to disseminate relevant health information and act as reporting hubs for community members to report health issues to.
- 2) Grama Niladhari's (local government representatives), who were a common place to report wildlife health issues to, could be useful and viable partners for the SLWHC in rural areas. The Grama Niladhari is often located in, or near, the community, making very accessible for community members. In addition, they are uniquely situated to develop close social relationships with community members while maintaining their formal government status. Such a unique combination could make them good candidates for disseminating information and receiving reports from the community about wildlife health.
- 3) The local indigenous healer emerged as a well-respected and established member of the community who is a key figure in wildlife, livestock, and human health. Such a local leader is an even closer point of contact to a community than the Grama Niladhari and the other government agencies (i.e., the SLWHC's partners) and could therefore, be a first link in a chain of communication. For example, reports of dead wild animals could first go to the local indigenous healer, then to the Grama Niladhari, then to the SLWHC or one of its partners. The local indigenous healer could be an easy, convenient, and relevant points of contact for both the community and the SLWHC.
- 4) The wildlife and livestock health networks had the highest number of disconnected nodes, which is an indication that more people in those networks were unsure of what to



do (i.e., where to go to for information and where to report health events to). This is evidence that there is a need for the SLWHC to engage and educate this community, and perhaps ones similar to it, about wildlife and livestock health issues.

- 5) Women were more likely to be unsure of who to talk to than men and were also nominated less by both men and women. When information needs to be disseminated to a community, relevant and appropriate channels should be used for men and women (i.e., a respected man and woman leader) and women should be encouraged to participate in community discussions or to hold women-only meetings.
- 6) An interaction between enumerator and participant gender was found, where the male enumerator interviewed males for longer than females and female enumerators interviewed females longer than males. This finding builds off of Recommendation 5 by providing further evidence that people are more comfortable talking to others of similar sex. Future community based research should use male and female field workers to ensure that safe and comfortable environments are provided for men and women.
- 7) This research demonstrates that sociometric methods can be used as a tool for identifying sources of health information and determining central individuals that can assist in effectively disseminating and receiving information. The SLWHC could successfully replicate these survey methods in new communities to ensure that their dissemination and monitoring strategies are relevant across the country. This study only investigated one community and it isn't clear how generalizable the findings are to communities of different land types, culture, location, and language. The diverse nature of Sri Lanka necessitates replication of this study's methods in multiple communities.

### *5.3.2 Future research*

There are several avenues of future research for Chapter 3. First, to assess the external validity of the reporting networks, future research could look at who submitted reports for sick or dead wild animals. Second, a key limitation of measuring social networks is that they rely on self-reported data and can suffer issues of reliability (Alexandra Marin & Hampton, 2007). To determine whether the information-seeking networks are more than just "intention" networks, future research could randomly select individuals from the network, elicit a desire in them to seek

health information, and then track where they actually go to for wildlife, livestock, or human health information. These action-based, objective networks could then be compared to my research's intention-based networks to shed light on the difference between an individual's intentions and actions. Similarly, how does the spread of health information vary as a function of who in the community is initially provided with the information? This question has been answered in other contexts (see Banerjee, Chandrasekhar, Duflo, & Jackson, 2013) but not in Sri Lanka or for health information. Last, what are the gender-specific health networks and how does information travel differently among men and women?

Chapter 4 would benefit from additional research to determine whether the small effect sizes between men and women are meaningful. An in-depth, qualitative analysis of the Sinhalese interviews and transcripts by human expert coders could reveal nuanced gender differences in the survey responses that are lost in translation or that the topic model cannot detect. Secondly, just like Chapter 3, concrete behavioural data could be collected to verify whether some of the topical gender differences translate to noticeable communication style differences. An investigation into official reports written by government wildlife officials or veterinarians could reveal who first informed them about the issue. If men were more likely to report animal health issues, then it would lend support to the gender difference for Topic 3.

## **5.4 Concluding remarks**

This research, in partnership with the SLWHC, identified central actors in rural wildlife, livestock, and human health information and reporting networks in rural Sri Lanka and investigated how rural residents talk about health topics. It also examined the gender differences among the information and reporting networks and the interview discussion topics. It found that government agencies and local community members can play an important and central role in health networks by acting as a source of information and a hub to report health issues to. It also demonstrated the disadvantages that women face in the networks, shedding light on the importance of gender-appropriate dissemination channels.

This research also identified seven topics that were discussed in the interviews about wildlife, livestock, and human health and detected significant, but inconsequential, gender differences in six of them. There was an interaction between the gender of the enumerator and

the gender of the participant where the enumerators interviews same-sex participants for longer. This finding provides further evidence that men and women need to be reached by relevant, same-sex leaders.

This thesis highlights two methods – social network analysis and topic modelling – that health interventions can use to learn about their target audience and help them develop relevant and effective information dissemination programs. Programs that use characteristics from their audience to tailor information and use social networks to disseminate information are often more effective than those that do not (Banerjee et al., 2013; Cai et al., 2015; Perkins et al., 2015; Valente, 2010; Valente & Pumpuang, 2007).

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## APPENDIX A

### CHARACTERIZING INFORMATION FLOW ABOUT WILDLIFE AND HUMAN HEALTH SURVEY

Hello, we are from the University of Peradeniya. We are working in the village to ask community members information about wild animal, livestock, and human health. Would you be willing to talk to us?

Our questions will take approximately one hour to complete. You do not have to answer any questions that you are uncomfortable with and you can stop the interview at any time. We will ask you some personal information but it will be kept completely confidential and will not be shown to anyone. We would also offer a small gift at the end to show our gratitude for your participation.

Your participation will help the Sri Lanka Wildlife Health Centre effectively get health information to rural areas in Sri Lanka and hopefully benefit you and your community in the future.

Will you answer our questions?

---

Are you willing to be audio-recorded? Recording our conversation will ensure that we don't miss anything that you say. Everything that you say is very important to us.

YES or NO

(circle response)

---

Sign below to signify that the participant understands what was outlined above and agrees to answer the questions.

---

*Interviewer's signature*

**START TIME OF INTERVIEW** \_\_\_\_\_

1 In the past one year, what wild animals have you seen in the areas that you live and work? (fill in table below)

1a. How often do you see each animal? (fill in table below)

1b. In what months are they most frequently seen? (fill in table below)

1c. What are the consequences of each animal? (fill in table below)

1d. Are the consequences Low, Medium, or High? (fill in table below)

Species	Frequency	Months	Consequence	
	Yearly/Monthly/Weekly/ Daily			Low/Medium/ High
	Yearly/Monthly/Weekly/ Daily			Low/Medium/ High
	Yearly/Monthly/Weekly/ Daily			Low/Medium/ High
	Yearly/Monthly/Weekly/ Daily			Low/Medium/ High
	Yearly/Monthly/Weekly/ Daily			Low/Medium/ High
	Yearly/Monthly/Weekly/ Daily			Low/Medium/ High
	Yearly/Monthly/Weekly/ Daily			Low/Medium/ High
	Yearly/Monthly/Weekly/ Daily			Low/Medium/ High

- 2 Do you grow crops? Yes.....1 -GO TO 2A  
No.....2 -GO TO 3

2a. If Yes, please list all crops grown in one year.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2b. If Yes, how many acres of land do you cultivate?

\_\_\_\_\_

\_\_\_\_\_

- 3 Do you rear livestock? Yes.....1 -GO TO 3A  
No.....2 -GO TO 4

3a. If Yes..... What species?

(fill in table below)

3b. How many do you currently own of each species?

(fill in table below)

3c. What are they currently vaccinated against?

(fill in table below)

	Species	Number	Vaccinations
<input type="checkbox"/>	Cattle		
<input type="checkbox"/>	Buffalo		
<input type="checkbox"/>	Goats		
<input type="checkbox"/>	Poultry		
<input type="checkbox"/>	Other_____		

4 What are your main sources of income? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5 In your opinion, what are the biggest issues facing the village that the government should address? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5a. If you had to select ONE as the most important issue, which one would it be? (Circle the option from above)

6 In your opinion, what are the positive aspects living near the elephant corridor? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

7 In your opinion, what are the negative aspects about living near the elephant corridor? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- 8 How often do you enter a forested area? (select only one)
- |                           |   |           |
|---------------------------|---|-----------|
| Never.....                | 1 | -GO TO Q9 |
| Once a Month.....         | 2 |           |
| Once a week.....          | 3 |           |
| Several times a week..... | 4 |           |
| Once a day.....           | 5 |           |
| Several times a day.....  | 6 |           |

- 8a. For what purposes do you enter a forested area? (select multiple)
- |                  |   |
|------------------|---|
| Livestock.....   | 1 |
| Cultivation..... | 2 |
| Foraging.....    | 3 |
| Pleasure.....    | 4 |
| Other.....       |   |

- 9 In the past one year, have you seen any sick or dead wild animals in the areas that you live and work?
- |          |   |           |
|----------|---|-----------|
| Yes..... | 1 | -GO TO 9A |
| No.....  | 2 | -GO TO 10 |

9a. If Yes, what species? \_\_\_\_\_

\_\_\_\_\_

9b. What were the symptoms or cause of death? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Often, when people see sick or dead wild animals, they will talk to their friends, neighbours, family, or government officials about it.

**(If the participant has not seen any sick wild animals, ask "If you saw a sick or dead wild animal, who would be the first person you would talk to?")**

- 10 Thinking about the most recent time when you saw a sick or dead wild animal, who was the first person you talked to?  
**(OBTAIN ALL INITIALS AND SURNAME OF NAMED PERSON)**

\_\_\_\_\_

10b. Who else did you talk to? Name up to 5 more people.  
**(OBTAIN ALL INITIALS AND SURNAME OF ALL NAMED PERSONS)**

_____	_____
_____	_____
_____	

11 If you wanted more information about wild animal health, who would you ask?  
**(OBTAIN ALL INITIALS AND SURNAME OF ALL NAMED PERSONS)**

_____	_____
_____	_____
_____	_____

12 For you, what are the most convenient methods of receiving information about wild animal health?  
 (select multiple)

Radio.....	1
Television.....	2
Mobile phone texts.....	3
Phone calls.....	4
Posters.....	5
Leaflets.....	6
Internet.....	7
Face-to-Face.....	8
Other _____	

12a. If you had to choose **ONE** as the most convenient, which would you choose?  
 (select one)

Radio.....	1
Television.....	2
Mobile phone texts.....	3
Phone calls.....	4
Posters.....	5
Leaflets.....	6
Internet.....	7
Face-to-Face.....	8
Other _____	

13 To your knowledge, can humans get sick from wild animals?

Yes.....	1	-GO TO 13A
No.....	2	-GO TO 14

13a. If Yes, from what wild animals can humans get sick from? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

13b. If Yes, please provide the symptoms and if possible, **names** of all possible diseases. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

14 In your opinion, what should be done with sick wild animals? Killed.....1  
(select multiple) Treated for illness.....2  
Segregated/Removed.....3  
Vaccinated.....4  
Nothing.....5  
I don't know.....6  
Other \_\_\_\_\_

15 To your knowledge, can livestock animals get sick from wild animals? Yes.....1 -GO TO 15A  
No.....2 -GO TO 16

15a. If Yes, from what livestock animals can wildlife animals get sick from? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

15b. If Yes, please provide symptoms and if possible, the **names** of all possible diseases. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



- 16 In your opinion, what should be done with sick livestock animals?  
(select multiple)
- |                          |   |
|--------------------------|---|
| Killed.....              | 1 |
| Treated for illness..... | 2 |
| Segregated/Removed.....  | 3 |
| Vaccinated.....          | 4 |
| Nothing.....             | 5 |
| I don't know.....        | 6 |
| Other.....               |   |

Often, when people see sick or dead livestock animals, they will talk to their friends, neighbours, family, or government officials about it.

(If the participant has not seen any sick wild animals, ask “If you saw a sick or dead livestock animal, who would be the first person you would talk to?”)

- 17 Thinking about the most recent time when you saw a sick or dead livestock animal, who was the first person you talked to?  
**(OBTAIN ALL INITIALS AND SURNAME OF NAMED PERSON)**

\_\_\_\_\_

- 17b. Who else did you talk to?  
**(OBTAIN ALL INITIALS AND SURNAME OF ALL NAMED PERSONS)**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- 18 If you wanted more information about livestock animal health, who would you ask?  
**(OBTAIN ALL INITIALS AND SURNAME OF ALL NAMED PERSONS)**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- 19 To your knowledge, can humans get sick from livestock animals? Yes.....1 -GO TO 19A  
 No.....2 -GO TO 20

19a. If Yes, what livestock animals can humans get sick from? \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_

19b. If Yes, please provide the symptoms and **name** of all possible diseases. \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_

Next, thinking about your own health...

- 20 Have you had any serious illness in the last one year? Yes.....1 -GO TO 20A  
 No.....2 -GO TO 21

20a. If Yes, what were the symptoms and/or diagnosis? \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_

Often, when people become ill, they will talk to their friends, neighbours, family, or doctor for support or advice.  
 (If the participant has never been seriously ill, ask “If you were seriously ill, who would be the first person you would talk to?”)

- 21 Thinking about your most recent serious illness, who was the first person you talked to?  
**(OBTAIN ALL INITIALS AND SURNAME OF NAMED PERSON)**

\_\_\_\_\_

21a. Who else did you talk to?

**(OBTAIN ALL INITIALS AND SURNAME OF ALL NAMED PERSONS)**

_____	_____
_____	_____
_____	

22 If you wanted more information about something you were ill with, who would you ask?

**(OBTAIN ALL INITIALS AND SURNAME OF ALL NAMED PERSONS)**

_____	_____
_____	_____
_____	_____

23 In general, would you say your health today is:

(select one)

- Excellent.....1
- Very Good.....2
- Good.....3
- Fair.....4
- Poor.....5

**BACKGROUND INFORMATION**

Next, we would like to ask you some background information about yourself.

24 What is your name? \_\_\_\_\_  
**(OBTAIN ALL INITIALS AND SURNAME)**

25 What positions do you currently hold in community organizations?

Mark all organizations that the respondent mentions and their corresponding position. If the respondent mentions an organization that is not on the list, please write it down in "Other".

	Organization	Position
<input type="checkbox"/>	Death Benevolent Society	
<input type="checkbox"/>	Women's Association	
<input type="checkbox"/>	Farmers Organization	
<input type="checkbox"/>	Milk Producers Co-op	
<input type="checkbox"/>	Fisheries Organization	
<input type="checkbox"/>	Civil Security Team	
<input type="checkbox"/>	Rural Development Society	
<input type="checkbox"/>	Other _____	

26 How long have you lived at your current address? Years \_\_\_\_\_

Months \_\_\_\_\_

27 How long have you lived in this village? Years \_\_\_\_\_

Months \_\_\_\_\_

- 28 Do you own a vehicle? Yes.....1 -GO TO 28A  
No.....2 -GO TO 29
- 28a. If Yes, how many? \_\_\_\_\_
- 28a. If Yes, what type(s)? \_\_\_\_\_  
\_\_\_\_\_
- 29 Do you own a cellphone? Yes.....1 -GO TO 29A  
No.....2 -GO TO 30
- 29a. Is it a smartphone? Yes.....1  
No.....2  
I don't know.....3
- 30 What is your age? \_\_\_\_\_  
(record in years)
- 31 Gender (**DON'T ASK**) Male.....1  
Female.....2
- 32 What is your civil status? Single.....1  
Married.....2
- 33 What is your highest level of education? No formal education.....1  
School Grade.....2  
OL.....3  
AL.....4  
Vocational.....5  
University.....6  
(select one)  
Other\_\_\_\_\_

- 34 What is your religion?  
(select one)
- Buddhist.....1  
Hindu.....2  
Muslim.....3  
Christian.....4  
Do not know.....5  
Refuse to say.....6
- Other \_\_\_\_\_
- 35 What is your mother tongue?  
(select one)
- Sinhalese.....1  
Tamil.....2  
English.....3  
Do not know.....4  
Refuse to say.....5
- Other \_\_\_\_\_
- 36 Do you speak any other languages?
- Yes.....1 -GO TO 34A  
No.....2 -GO TO 35
- 34a. If Yes, which ones?
- \_\_\_\_\_
- \_\_\_\_\_
- 37 What is your ethnicity?  
(select one)
- Sinhala.....1  
Sri Lankan Tamil.....2  
Indian Tamil.....3  
Sri Lanka Moor.....4  
Burgher.....5  
Malay.....6  
Do not know.....7  
Refuse to say.....8
- Other \_\_\_\_\_

### NAME INTERPRETERS

For each name given for Questions 10, 10b, 11, 17, 17b, 18, 21, 21b, and 22, ask the participant these questions for EACH name.

- |   |  |  |
|---|--|--|
| 1 | What is their relationship to you?<br><br>(select multiple)                        | Relative.....1<br>Neighbour.....2<br>Friend.....3<br>Co-worker.....4<br>Acquaintance.....5<br>Stranger.....6<br>Grama Niladhari.....7<br>Public Health Inspector.....8<br>Community Health Worker.....9<br>Veterinary Livestock FS.....10<br>Physician.....11<br><br>Other _____ |
| 2 | How long have you known them?<br><br>(select one)                                  | 0-3 months.....1<br>3-12 months.....2<br>1-5 years.....3<br>5-10 years.....4<br>Over 10 years.....5  |
| 3 | How close do you live to them?<br><br>(select one)                                 | In the same household.....1<br>Neighbour.....2<br>Live in the same village.....3<br>Live in a different village .....4   |
|   | 3a. If 4, what village do they live in?  | _____  |
| 4 | Thinking about a typical month, how often do you talk to them?<br><br>(select one) | Never.....1<br>Once a year.....2<br>Several times a year.....3<br>Once a month.....4<br>Several times a month.....5<br>Once a week.....6<br>Several times a week.....7<br>Everyday.....8   |

5	How much do you believe the information that you receive from them?	Not at all.....1 Some of the time.....2 Most of the time.....3 All of the time.....4
6	What is their occupation?	
7	What are their primary sources of income?	
8	What is their gender?	Male.....1 Female.....2
9	What is their age?	
10	What is their civil status?	Married.....1 Single.....2 Do not know.....3
11	What is their ethnicity?	Sinhala.....1 Sri Lankan Tamil.....2 Indian Tamil.....3 Sri Lanka Moor.....4 Burgher.....5 Malay.....6 Do not know.....7 Refuse to say.....8 Other_____
12	What is their religion?	Buddhist.....1 Hindu.....2 Muslim.....3 Christian.....4 Do not know.....5 Refuse to say.....6 Other_____



<b>NAME INTERPRETER RESPONSE SHEET</b>						
Mark responses from NAME INTERPRETER questions on this sheet.						
	<i>Name</i>	<i>Name</i>	<i>Name</i>	<i>Name</i>	<i>Name</i>	<i>Name</i>
Q1	1 2 3 4 5 6 7 Other _____	1 2 3 4 5 6 7 Other _____	1 2 3 4 5 6 7 Other _____	1 2 3 4 5 6 7 Other _____	1 2 3 4 5 6 7 Other _____	1 2 3 4 5 6 7 Other _____
Q2	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Q3	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Q3a						
Q4	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
Q5	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Q6						
Q7						
Q8	1 2	1 2	1 2	1 2	1 2	1 2
Q9						
Q10	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
Q11	1 2 3 4 5 6 7 8 Other _____	1 2 3 4 5 6 7 8 Other _____	1 2 3 4 5 6 7 8 Other _____	1 2 3 4 5 6 7 8 Other _____	1 2 3 4 5 6 7 8 Other _____	1 2 3 4 5 6 7 8 Other _____
Q12	1 2 3 4 5 6 Other _____	1 2 3 4 5 6 Other _____	1 2 3 4 5 6 Other _____	1 2 3 4 5 6 Other _____	1 2 3 4 5 6 Other _____	1 2 3 4 5 6 Other _____

**Interviewer Only Questions**

Interviewers Present \_\_\_\_\_

---

- 1 END TIME OF INTERVIEW \_\_\_\_\_
- 2 Date \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_  
(DD/MM/YEAR)
- 3 Who was asking questions? \_\_\_\_\_
- 4 Who was recording answers? \_\_\_\_\_
- 5 GPS Coordinates of Household N \_\_\_\_\_  
E \_\_\_\_\_
- 6 GPS Device \_\_\_\_\_
- 7 GPS Coordinate Name \_\_\_\_\_
- 8 In the interview, other than the respondent, were others present? Yes.....1 -GO TO 8a.  
No.....2 -GO TO 9
- 8a. Who were they? (Multiple answers allowed) Respondent's spouse  
Children  
Parents  
Others (specify) \_\_\_\_\_
- 9 Has the respondent ever refused to be interviewed during the whole process? Yes. At the beginning.....1  
Yes. In the middle.....2  
Yes. Near the end.....3  
Never.....4
- 10 Has the respondent ever felt impatient during the interview? Never.....1  
Occasionally.....2  
Sometimes.....3  
Always.....4
- 11 How cooperative was the respondent during the interview? Highly cooperative.....1  
Fairly cooperative.....2  
Not very cooperative.....3