

Social and Environmental Risk Factors for Trachoma: A Mixed Methods Approach in the
Kembata Zone of Southern Ethiopia

by

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B.Sc., University of Calgary, 2005

A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of

MASTER OF ARTS

in the Department of Geography

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Abstract

Trachoma is a major public health concern throughout Ethiopia and other parts of the developing world. Control efforts have largely focused on the antibiotic treatment (A) and surgery (S) components of the World Health Organizations (WHO) SAFE strategy. Although S and A efforts have had a positive impact, this approach may not be sustainable. Consequently, this study focuses on the latter two primary prevention components; facial cleanliness (F) and environmental improvement (E). A geographical approach is employed to gain a better understanding of how culture, economics, environment and behaviour are interacting to determine disease risk in the Kembata Zone of Southern Ethiopia. Specifically, mixed methods were used to investigate what social and environmental factors are influencing the distribution of active trachoma amongst children (aged one to nine) in the Kedida Gamela and Damboya *Woredas* of the Kembata Zone.

The research was completed in collaboration with ORBIS Ethiopia – an NGO providing ophthalmology services - and is a follow up to a baseline trachoma survey conducted in the region. ORBIS Ethiopia provided data on the household trachoma prevalence and the knowledge, aptitude and practices (KAP) of household heads. These data sets were linked in ArcGIS to the geographic coordinates for each household surveyed. Mixed effects logistic regression was used to investigate the strength of a set of fourteen predictor variables in 1) determining whether or not a child had active trachoma (TF or TI) and 2) determining the level of active trachoma (TF or TI) a child had, given that they had active disease. Younger age, an unclean face and low household

expenses were found to be significant risk factors for active trachoma ($p < 0.05$). Older age and an unclean face were found to be significant risk factors ($p < 0.05$) for TI, the more severe form, in children with trachoma. Next, the Kulldorff spatial scan statistic was used to identify and map clusters of each risk factor as well as clusters of active disease. The results identified areas of overrepresentation of cases (i.e. active disease, unclean faces, low monthly expenses and low latrine ownership) where the need for intervention is particularly high.

Qualitative data from in-depth interviews and focus groups with household heads, teachers and health care professionals were used to identify factors that were encouraging or impeding facial cleanliness and environmental improvement efforts to reduce the spread of trachoma. Lack of food, water and money were identified as important concerns amongst household heads. Based on the interviews with teachers, the study recommends that hygiene education be supported by appropriate access to water in schools. The results of the qualitative and quantitative analyses converged and support continued implementation of the facial cleanliness (F) and environmental improvement (E) components of the WHO's SAFE strategy.

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Glossary

Active Trachoma:	Includes both trachoma inflammation follicular (TF) and Trachomatous inflammation intense (TI) grades of trachoma
Blinding Trachoma:	Includes trachomatous scarring (TS), trachomatous trichiasis (TT) and corneal opacity (CO) grades of trachoma
Clean Face:	The absence of ocular and nasal discharge
Chlamydia Trachomatous:	The bacterial pathogen responsible for causing trachoma in humans
Gott:	A village or sub-division of a <i>kebele</i>
Household:	A person or group of people living in the same home or group of homes
Kebele:	The smallest administrative unit in rural Ethiopia that is sometimes referred to as a neighbourhood association
ORBIS Ethiopia:	A non-profit humanitarian organization working on eliminating avoidable blindness in the developing world
SAFE Strategy:	A strategy developed to eliminate blindness caused by Trachoma through surgery, antibiotic treatment, facial cleanliness and environmental improvement
Tukul:	A traditional Ethiopian house
Woreda:	An administrative area that is composed of a number of <i>Kebeles</i> and is comparable to a district

Acknowledgments

This thesis would not have been possible without the help, input, support and encouragement of several individuals both in Canada and in Ethiopia. First, I would like to thank Dr. Steven Lonergan for his supervision and guidance throughout the research process. I have appreciated your patience and support. I would also like to thank Dr. Denise Cloutier-Fisher, Dr. Eric Roth and my external, Dr. Micheal Prince for sharing their insight, expertise and feedback.

My sincerest thanks goes to the staff at ORBIS Ethiopia. In particular, I would like to thank Dr. Gabremaskal Habtemariam, Dr. Wondu Alemayehu and Dr. Assegid Aga for their willingness to collaborate with me and for their help in organizing this project. A special thanks to Asrat Gebre, ORBIS Project Coordinator, for helping me get set up in the field and for his incredible hospitality. Also, a special thanks is needed for Sintayehu Tiramo (my translator), Birhanu Bachore (my guide) and Gebregiyorgis Abay (my driver) for their hard work and great sense of humour. I will forever remember the long days in the field, good conversations and food we shared together.

I would also like to extend my sincerest gratitude to the people of Kembata for their friendly smiles, hospitality and willingness to share their culture with me. I was truly humbled by your kindness.

This project would not have been possible without the financial support of the University of Victoria. Thank you for giving me this incredible opportunity. Finally, I would like to thank my family and my husband Matt for their encouragement, love and support. Thank you.

Dedication

To my husband Matt for his
patience and understanding

1. Introduction

The use of maps to identify spatial patterns of illness is not new to geographical study. Maps often show patterns of a phenomenon clearer than other formats, making interpretation easier. During the mid-nineteenth century, John Snow traced the cholera outbreak in London to a single water pump by mapping the distribution of the disease (Foody, 2006). More recently, the growing emphasis on population-based health care has resulted in increased interest in geographic information systems (GIS) to aid in the delivery of health programs. In health related research, GIS have been used to map the incidence of disease, locate risk factors and identify access to health care services (Cromley & McLafferty, 2002). Advances in GIS technology have also aided in the detection of disease clusters (Foody, 2006). Once identified, researchers typically seek to find the cause of the cluster which, if discovered, can aid health care professionals and decision makers in effectively targeting the disease.

The focus of this thesis is trachoma, an infectious eye disease caused by ocular infection with the bacterium *Chlamydia trachomatis*. Trachoma is the world's leading cause of preventable blindness (International Trachoma Initiative, 2009). Historically, trachoma was found throughout most of the world. However, over the past century, as living conditions have improved, trachoma has gradually disappeared from Europe, North America and many other parts of the world. Today trachoma is a disease of poverty (Wright, Turner, & Taylor, 2007). It is prevalent in parts of Asia, Africa, the Middle East, South America and Australia (See Appendix 1 - The global distribution of active trachoma) (Polack et al., 2005a).

Trachoma is believed to be spread by hands, eye-seeking flies and clothing that has come in contact with the infective agent (*Chlamydia trachomatis*) which is present in the eye and nose secretions of infected individuals. The human immune response to *Chlamydia trachomatis* is poorly understood. The most important factor in the pathogenesis of clinical trachoma is believed to be the frequency of re-infection (Briscoe, Feachem, & Rahaman, 1989). However, some studies have also suggested that severity may be related to genetic variability (Conway et al., 1996; West, Munoz, Mkocho, Hsieh,

& Lynch, 2001). As a result, some children may have a different host response. Most people who live in trachoma-endemic areas are infected at some point in their life, yet few develop long-term sequelae.

Blindness from trachoma is thought to be a gradual process. Isolated incidences of infection usually have minimal lasting implications; however, repeated ocular infections can have more severe implications. Each successive infection with the bacteria *C.trachomatis* causes inflammation and further scarring of the conjunctival lining of the upper eye lid. After the first infection a hypersensitive state is produced, such that subsequent infection results in more intense inflammation and quicker clearance of the bacteria (Gambhir, Basanez, Turner, Kumaresan, & Grassly, 2007). Sub-conjunctival follicles, the characteristic sign of active disease, can persist for months after infection has been cleared (Mabey, 2008). Gradually, the upper eyelid begins to distort and shorten (entropion). Eventually the distortion will become so great that the eye lashes turn in and start to abrade the eye (trichiasis) (Emerson, Burton, Solomon, Bailey, & Mabey, 2006; Kasi, Gilani, Ahmad, & Janjua, 2004). If surgery or other interventions are not completed, the resulting continual abrasion of the eye will eventually lead to corneal opacification and ultimately blindness. Blindness from trachoma is completely avoidable if appropriate treatment is given (Turner et al., 1993). Table 1 shows the World Health Organizations (WHO) system for assessing trachoma.

Table 1 - The Simplified WHO System for the Assessment of Trachoma

Grade	Description
TF	Trachomatous inflammation – Follicular: Five or more follicles (>0.5mm) in the upper tarsal conjunctiva
TI	Trachomatous inflammation – Intense: Inflammation and thickening of the tarsal conjunctiva obscuring more than half of the deep normal vessels
TS	Trachomatous scarring: The presence of scarring in the tarsal conjunctiva
TT	Trachomatous trichiasis: At least one eye lash rubs on the eyeball
CO	Corneal opacity: Visible corneal opacity (the cornea will appear white or clouded over) over the pupil.

(Thylefors, Dawson, Jones, West, & Taylor, 1987)

Rural populations in developing countries where access to clean water and health care is limited are most vulnerable to this disease. Once blind, individuals are often forced to depend on society to fulfill basic needs because they are no longer able to participate in many regular economic activities. In 1998, the World Health Organization (WHO) adopted the acronym SAFE which stands for Surgery, Antibiotic Therapy, Facial Cleanliness and Environmental Improvement as a four part strategy to eliminate blinding trachoma. The following thesis is of particular relevance to the F and E components of this strategy as it takes a geographical approach towards understanding some of the behavioural, social and environmental factors that influence trachoma risk in the Kembata region of Ethiopia. It is hoped that this project will contribute to the larger base of trachoma risk factor studies that have been conducted in various regions of Ethiopia and other parts of the world.

1.1 Purpose of the Study

This study is a follow-up to ORBIS Ethiopia's baseline trachoma survey in the Kedida Gamela and Damboya *Woredas*¹ of Kembata. The primary objective of this project is to study the spatial distribution of trachoma and its relation to environmental, social, economic and behavioural factors in the Kembata Zone. It is also hoped that this study will aid decision makers in formulating a locally appropriate F and E strategy to reduce the prevalence of trachoma. This project will use data previously collected by ORBIS Ethiopia along with geographical coordinates and qualitative data. This project aims to address the following main research question;

What social and environmental factors are influencing the distribution of trachoma in the Kembata Zone?

In order to answer this question the following sub questions will be investigated:

¹ A *Woreda* is an administrative area that is composed of a number of *kebeles* and is comparable to a district. A *Kebele* or neighbourhood association, is the smallest unit of government in Ethiopia.

1. What environmental, social, economic and behavioural factors influence a child's risk of developing active trachoma?
2. How are these risk factors distributed / clustered in the study area?
3. Is there evidence of spatial clustering of active trachoma cases?
4. What factors are encouraging or impeding F and E efforts to reduce the spread of trachoma?

In the discussion of ORBIS Ethiopia's baseline survey report, Wondimu (2007) states the following:

The strong associations observed in this study, which is also substantiated by previous studies, allow us to make reasonable conclusions. However, further multivariate statistical analysis should have been employed to have a more precise interaction of risk factors for trachoma. Although the survey had good internal validity, the conclusions and recommendations of the study must be interpreted in light of the following limitations: It was a cross-sectional study which cannot reveal all determinants of trachoma, the findings were not standardized for age and sex to make more sensible comparison with other studies and it was not supported by qualitative data (Wondimu, 2007).

Consequently, it is hoped that by answering the above research questions some of these issues will be addressed since multivariate statistical analysis will be employed and qualitative data will be used.

1.2 Statement of the Problem

The effects of trachoma have been known for over 3500 years, yet scientists are still uncertain as to how it is transmitted (Melese et al., 2003). Forty one million people suffer from active trachoma infection (TF and TI) and over 8.2 million have trichiasis (International Trachoma Initiative, 2009). Globally, Trachoma is responsible for a loss of approximately \$2.9 billion in productivity per year (International Trachoma Initiative, 2009). This loss of workforce places a significant burden on already strained communities and families throughout the developing world.

In Ethiopia, 1.6% of the population is blind, 3.7% of the population has low vision and 40.1% of children aged one to nine have active trachoma (Berhane, Worku, & Bejiga, 2006). Assuming a population of 75 million, this means there are approximately 1.2 million people who are blind and 2.8 million people with low vision in the country (Berhane et al., 2006). Trachomatous corneal opacity is responsible for 11.5% (or approximately 138,000 of the 1.2 million) cases of blindness and 7.7% cases of low vision (or approximately 215,000 of the 2.8 million) (Berhane et al., 2006). Based on these statistics, Ethiopia is thought to be the most trachoma affected country in the world (Emerson et al., 2008). In some parts of the country almost every child has signs of active trachoma and almost every adult has signs of past infection (Cerulli, cited in Melese et al., 2003). In these areas, trachoma (a preventable disease) causes as much visual disability as cataracts (Melese et al., 2003). Further, an additional 3.1% of the population over 15 years of age has trachomatous trichiasis (TT) and is in danger of becoming blind (Berhane et al., 2006).

Active trachoma (TF and TI) tends to be the highest amongst children, whereas women, rural residents and adults have the greatest risk of becoming blind or having low vision due to this disease (Bejiga & Alemayehu, 2001; Berhane et al., 2006; Burton, 2007; Ngondi et al., 2009a; Regassa & Teshome, 2004; Solomon et al., 2003). According to the International Trachoma Initiative (2009), women are three times as likely as men to become blind from trichiasis. This may be due to the fact that women are more commonly responsible for child rearing. However, the difference may also reflect social inequalities in accessing health care, water and sanitation services (Berhane et al., 2006).

In 2006, the Federal Ministry of Health and a consortium of Non-Governmental Organizations (NGOs) conducted a national survey on blindness, low vision and trachoma in Ethiopia. The study concluded that the magnitude and severity of eye problems needs to be recognized as a major public health challenge (Berhane, Worku, & Bejiga, 2006). Further, the study recommended that this challenge needs to be acknowledged by both the federal and regional governments in order to build the capacity to provide preventive and curative eye care services. Specifically, “comprehensive and integrated prevention and treatment eye care programs” are needed to produce a long term reduction in eye disease (Berhane et al., 2006, p. 44).

Trachoma elimination depends on reliable information on disease characteristics, transmission methods and distribution. Control programs are typically implemented by ministries of health and are supported by NGO's such as the International Trachoma Initiative (ITI). In 2001, the London School of Hygiene and Tropical Medicine (LSHTM) was asked to evaluate ITI-supported trachoma control programs in eight countries (Ethiopia, Ghana, Mali, Morocco, Nepal, Niger, Tanzania and Vietnam). The goal of this evaluation was to identify the best practices so that they could be circulated to other areas where improvement was needed. The evaluation found a lack of reliable recent epidemiological data that shows the distribution and magnitude of the trachoma problem, variation amongst examiners in diagnosis of active trachoma, insufficient national coverage of control activities relative to the magnitude of the problem (except in Morocco) and a low number of trichiasis surgeries being performed in all countries (Kuper et al., 2005). Overall, the study concluded that widespread implementation of the SAFE strategy was hampered by financial and human resource barriers coupled with a lack of up to date reliable prevalence data (Kuper et al., 2005).

To date, control efforts have largely focused on the antibiotic treatment component of the WHO's SAFE strategy. Although mass antibiotic treatments have been shown to have a positive effect (Jha et al., 2002; West, Munoz, Mkocho, Gaydos, & Quinn, 2007), complete elimination is difficult in hyperendemic communities (Gill et al., 2008; Ngondi et al., 2009b). Mathematical models have suggested that in Ethiopia elimination is possible in 95% of hyperendemic communities if 90% of the community is given biannual treatments for five years (Ray et al., 2007). However, some feel it is unrealistic to think that such treatments are sustainable (Emerson, Cairncross, Bailey, & Mabey, 2000; Ngondi et al., 2009b). Yet, the majority of research thus far has focused on the surgery and antibiotic treatment components of the SAFE strategy (Courtright & West, 2004). Currently, azithromycin is donated free of charge. However, if this were to change the cost of distribution would be approximately U.S. \$0.50 per dose (Kumaresan & Mecaskey, 2003). Further, concern has been expressed that mass antibiotic distribution may lead to antibiotic resistance (Fry et al., 2002).

In general, more emphasis needs to be placed on the F and E components of the SAFE strategy (Kasi et al., 2004; Emerson, Simms, Makalo, & Bailey, 2005). Once

antibiotics are stopped, it is hoped that improvements in hygiene and environmental conditions will help prevent infection from returning (Gill et al., 2008). The ITI has stated that it is committed to building capacity for F and E activities (Kumaresan, 2005). Consequently, this study will focus on the latter two primary prevention components (facial cleanliness and environmental improvement) of the SAFE strategy by using a geographical approach to human health. Geographical study of disease can provide insight into understanding how culture, environment and behaviour interact with and influence health and disease. This in turn can provide insight for pro-active management interventions that are more sustainable and cheaper in the long-run.

1.3 ORBIS International

This research project was completed in collaboration with ORBIS Ethiopia. ORBIS is a non-profit humanitarian organization that aims to eliminate avoidable blindness and restore sight in the developing world (ORBIS, 2010). ORBIS operates the world's only flying eye hospital (a DC-10 that has been converted into a teaching facility and ophthalmic surgical center) and five permanent country offices, one of which is in Ethiopia (ORBIS, 2010). Country offices strive to improve the quality and accessibility of local eye care services through training of eye care professionals, introducing health financing systems, increasing public awareness of preventable or treatable forms of blindness, advocating for policies related to ophthalmic care, strengthening eye care institutions and providing ophthalmic equipment (ORBIS, 2010). In the past, ORBIS Ethiopia has collaborated with a number of educational institutions to conduct research on trachoma. ORBIS Ethiopia has been operating Rural Eye Care programs in the Southern Nations Nationalities and Peoples Region (SNNPR) since 2001 in partnership with the Regional Health Bureau. Ultimately, the goal of this project is to provide information that will assist decision makers such as ORBIS Ethiopia in implementing interventions that will improve the health of the local population.

1.4 The Study Area

Ethiopia is the oldest independent country in Africa and one of the oldest countries in the world. It has a population of 82,544,840, making it the second most populous country in Africa next to Nigeria (CIA - The World Factbook, 2008). Eighty three percent of this population is rural (Trading Economics, 2010). Ethiopia is also amongst the poorest countries in the world. Based on its Human Development Index (HDI), Ethiopia is ranked 171st out of the 177 countries in the world that have data (Human Development Reports 2009 - Ethiopia, 2009). The HDI is a composite measure that takes into consideration three areas of development - health (measured as life expectancy at birth), education (measured as adult literacy and school enrolment rates) and standard of living (measured as purchasing power parity). Ethiopia is plagued by frequent droughts, political turmoil and disease. Trachoma is just one of many diseases that afflict the country.

This project was conducted in the Kembata Tembaro Zone of Southern Ethiopia (Figure 1). The Kembata Tembaro Zone is located in the SNNPR. Overall, the SNNPR has a blindness rate (0.7%) that is lower than the national average; however, trachoma is still a major public health concern (Berhane et al., 2006). Within the Kembata Tembaro Zone two *Woredas*, Damboya and Kedida Gamela were surveyed. The estimated total land mass for these two *Woredas* is 276 km² (Wondimu, 2007). Kedida Gamela *Woreda* has 19 *kebeles* with a total population of 84,896 and Damboya *Woreda* has 17 *kebeles* with a total population of 78,194 (Wondimu, 2007). Thus, the total population of the two *Woredas* is 163,090 (Wondimu, 2007).

The administrative centre for the Kembata Tembaro Zone is Durame. Other significant towns include Shinshicho and Damboya. The majority of people in the area are Kembatas who speak Kembattegna. The region received heavy missionary activity in the 1960s and is now predominantly Protestant Christian. Largely due to this missionary activity, “the kembata-speaking highlands have a literacy rate of 41%, the highest for any rural area in the SNNPR” (Cohen, 2000). Nonetheless, access to schools is low.

The majority of houses in the region (outside of the towns) are traditional thatched-roof grass huts or tukuls. The tukuls are circular with a conical shaped roof.

Local wood is used to create the wall frame and roof supports. The walls are then reinforced with materials such as crop stocks, plastered with mud mortar and on occasion the exterior is painted. Inside a tukul there is often a part wall dividing the front and rear of the house. The floor is typically bare compacted earth. In contrast, slightly better off families (often those living in towns such as Damboya) may have square houses with walls made from similar materials, but with tin roofs instead of grass. The wealthiest of families living in the area have houses made from a combination of brick and wood, with tin roofs, gated windows and metal or wood doors.

The topography of the region is a mixture of mountains, hills and plains. Two prominent landmarks within the Kedida Gamela and Damboya *Woredas* are Mt. Dato and Mt. Ambericho. The region has three main agro-ecological zones with altitudes ranging from 1700 – 2300 m.a.s. (Wondimu, 2007). The mean annual temperature is 21⁰C and the mean annual rainfall is 1275 mm (Wondimu, 2007). The longest river in the area is the Lege Bora. For the most part the region is accessible by 4WD vehicles, with the exception of some of the highland *kebeles*.

The Kembata Tembaro Zone is one of the most densely populated regions in Ethiopia. In some *Woredas*, agricultural densities exceed 400 people / km² (About Kembata?, 2008). Nonetheless, historically the region has been relatively food secure. This is believed to be related to the fact that agriculture in the Kembata Tembaro Zone is dominated by enset-based cultivation (Brandt et al., 1997). Enset, also known as false-banana, is used for food, animal forage, construction materials and medicine (Brandt et al., 1997). It can be stored for long periods, harvested at any time during the year, harvested at any stage over a several year period and is drought resistant allowing it to survive stress years that other crops may not (Brandt et al., 1997). Consequently, enset-based cultivation is thought to have helped rural families in Southern Ethiopia avoid hunger periods when other regions in Ethiopia could not. Although the carrying capacity of enset-based farming is high, rapid population growth in the Kembata Tembaro Zone is causing landholding sizes per household to shrink. The consequent population / resource imbalance is now threatening food security in the area. Other crops grown in the Kembata Tembaro Zone include, but are not limited to wheat, haricot beans, sorghum, maize, peas, wheat and barley. Some farmers may sell a portion of their crop at major

markets such as those in Durame, Adilo and Damboya. Most household's cash income comes from crop sales, livestock and livestock product (butter) sales and casual employment (FEWS NET, 2006). Wealthier families tend to obtain a higher proportion of their food needs from their own crops than poorer families (FEWS NET, 2006).

Wealth at the household level in rural Ethiopia is generally based on a combination of land and livestock holdings. Very poor families rarely own more than a couple of sheep and maybe a few chickens. Poor households may own one or two cattle in addition and relatively wealthier households may own a plough ox. Those households that do not own a plough ox may work for others in exchange for the use of their oxen (FEWS NET, 2006). Some households may also own donkeys, horses and/or mules. Expenditure patterns for the different wealth groups living in the area vary. For example, the poor typically spend more on staple foods, whereas the better off spend more on inputs (fertilizer and agricultural labour) for their land (FEWS NET, 2006).

Agriculture in the Kembata Tembaro Zone is heavily dependent on two rainy seasons. The longer of the two, known as the Meher season, typically starts in early June and continues until the end of September. The second less important season, known as the Belg season, usually occurs between February and May. The remainder of the year, from October to January, is generally dry. Water supply, particularly during the dry season, is a problem in the Kembata Tembaro Zone. According to local reports in 2005, the water supply coverage² was only 24.6% (Wondimu, 2007). Consequently, Kembata women are often forced to spend considerable amounts of time in pursuit of water. More than 57.6% of households are using unprotected sources for their domestic water supply (Wondimu, 2007).

Health facilities in the Kembata Tembaro Zone include three health centres, eight health posts, two private clinics and one drug vendor. The district's referral hospital is located in the town of Durame. Malaria, intestinal parasites, upper respiratory tract infections, pneumonia, urinary tract infections, rheumatism, diarrheal diseases and eye disease are common health problems in the zone. In 2005, 40% of the region had health service coverage and 23.6% of the region had sanitary coverage (Wondimu, 2007).

² Water supply coverage refers to the percentage of people with access to an improved source of drinking water; such as public pipes, wells and boreholes.

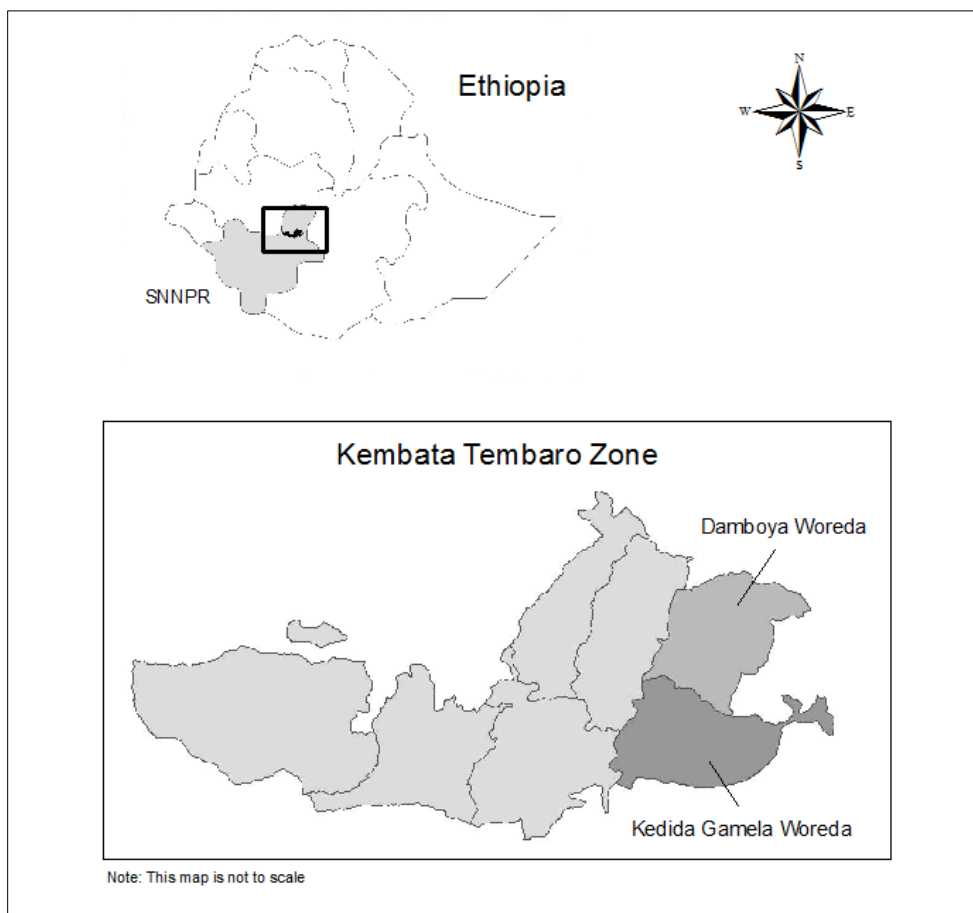


Figure 1 - Map of the Study Area

1.5 Organization of the Study

Chapter one introduced the purpose of the study and described the problem. Further, a description of ORBIS Ethiopia and the study area was provided. Chapter two presents a review of the literature highlighting past research on social and environmental determinants of trachoma. Chapter three describes the methodology and procedures used for data collection, preparation and analysis. It also provides a description of my experiences in Ethiopia, including a description of the community's response to me. Chapter four presents the results of the study. Finally, the study concludes with a discussion of findings, limitations and recommendations.

2. Literature Review

The following literature review will begin by summarizing the results of ORBIS Ethiopia's Baseline Trachoma Survey. It will then provide an overview of geography and health followed by a brief section on the concepts of health, risk and vulnerability. The majority of the chapter consists of an extensive section summarizing current research on social and environmental determinants of trachoma, a section on the SAFE³ strategy for trachoma prevention and a summary of past trachoma projects where geographical information systems have been employed (GIS). The review will then conclude with a few comments on the challenges and successes of trachoma interventions thus far.

2.1 Background Information: ORBIS Ethiopia's Baseline Trachoma Survey

In May 2007, ORBIS Ethiopia conducted a baseline trachoma survey in the Kedida Gamela and Damboya *Woredas* of the Kembata Zone. The goal of this study was to determine the baseline prevalence of active and blinding trachoma in the area as well as the associated environmental and individual risk factors for these conditions. To accomplish this, a sample of children aged one to nine and adults aged 15⁴ and older from 1020 households were assessed for clinical signs of active/blinding trachoma (see Appendix 2 - Clinical Assessment Form) and each household head was asked to answer a knowledge, attitude and practice (KAP) questionnaire on trachoma and its risk factors (see Appendix 3 - Household KAP Questionnaire). Further, individuals with trachomatous trichiasis (TT) were interviewed on their perceived barriers to surgery (see Appendix 4 - Questionnaire for KAP survey of Trichiasis Cases). In total, 4552 of the 4825 people enumerated for the survey were examined (97.5% of the 1873 children registered and

³ SAFE stands for Surgery, Antibiotic Treatment, Facial Cleanliness and Environmental Improvement.

⁴ These age ranges are based on the World Health Organization's recommendations for the comprehensive assessment of trachoma (WHO, 2006a)

93.2% of the 2952 adults, ≥ 15 years of age, registered); giving an overall response rate of 94.3%.

Out of the 1827 children surveyed, 34.5% had signs of trachomatous inflammation follicular (TF), 0.5% had signs of trachomatous inflammation (TI) and 10.2% had trachomatous scarring (TS). Based on these figures, the overall prevalence of active trachoma was found to be 37% of which 3.9% had both TF and TI. According to WHO guidelines, active trachoma is defined to include trachomatous inflammation follicular (TF) and/or trachomatous inflammation (TI) (Thylefors et al., 1987). Bivariate analysis found age and facial cleanliness to be the only individual risk factors significantly associated ($p \leq 0.05$) with active trachoma in children. More specifically, preschool children (aged one to six) were more likely than school aged children (from six to nine in this study) to have trachoma and children with unclean faces were twice as likely as those with clean faces to have trachoma. Sex of the child did not have a significant relationship. The survey also investigated the relationship between the following household/ environmental factors and trachoma in children:

- face washing
- family size
- parent's education
- compound cleanliness
- access to water
- household latrine
- household economy

Among these potential risk factors only the presence/absence of a household latrine and household economy (based on per capita monthly expenses) showed a significant relationship with the occurrence of trachoma.

Of the adults surveyed 48.5% had at least one sign of trachoma, 2.9% had trachomatous trichiasis (TT) and 0.7% had active trachoma. Consistent with several other surveys (Bejiga & Alemayehu, 2001; Turner et al., 1993), trichiasis was found to be three times more common in females than males in the region (82.3% of the 2.9% of individuals with trichiasis were female). Nonetheless, trichiasis levels in Kedida Gamela and Damboya *Woredas* were lower than those reported in other endemic areas of

Ethiopia (Mesfin et al., 2006). The prevalence of trichiasis was also significantly associated with increased age and illiteracy of household head. However, in adults household economy did not show any relationship with the disease.

A large majority (93.7%) of respondents with trichiasis reported that their day to day activities were impacted by their condition. However, only 25.3% of respondents had surgery and 50% of people did nothing for their trichiasis despite the fact that 57% knew surgery was an option for treating the condition. The most commonly reported reasons for not seeking surgery included: waiting for a good time to have the surgery, lack of awareness on the availability of surgery, presumed cost associated with the procedure and lack of transportation to shorten the distance to the service. If surgery was free, 96.1% of the people surveyed indicated they would be willing to have it.

In addition to the above findings, the KAP survey showed that 97% of household heads recognized trichiasis, 93.1% knew the cause of trichiasis was trachoma, 99% knew at least one symptom of trachoma and one method of transmission and 97% knew blindness could result from trachoma. Although 89.3% of the household heads knew trachoma could be controlled by a variety of methods, only 6.8% suggested the appropriate treatment. The most commonly reported sources of information on trachoma included health education at a health institute (70.3%) and information from their peer groups (62.5%). Overall, 61.8% of households used a latrine and more than 50% of households had to walk more than 30 minutes (round trip) to fetch their water. The average per capita water consumption was found to be 7.1 L. This is 12.9L less than the internationally recommended 20L/person/day (UNHCR, 2010). Thus, there is a clear need to improve the region's water supply. Even though 78.3% of household heads reported that they wash their children's faces at least once per day, 73.6% of the examined children had unclean faces. This disparity was likely a result of over reporting of positive behaviours by the participants when completing the survey.

Overall, ORBIS Ethiopia concluded that approximately 14,066 children in the region suffer from follicular trachoma and approximately 2,365 people are in need of trichiasis surgery. Further, although household heads have some knowledge of trachoma, they do not understand its root causes and solutions. Even though access to latrines and water is higher than other areas, the region has a low level of face washing and

environmental health practices. Based on these conclusions, the full SAFE strategy was recommended, since the prevalence of active and blinding trachoma exceeded the WHO limits of 10% and 1%, respectively. In particular, the recommendations emphasized the importance of free, village-based-trichiasis surgery services, extensive health education and combining trachoma control efforts with concurrent educational and poverty reduction activities that focus on women and children. A follow up survey was recommended after three years.

2.2 Geography and Health

Medical geography looks at the role that place plays in people's health. Health variation is often caused by differences in individual characteristics and the setting in which an individual lives (Curtis & Jones, 1998). Although the sub-discipline of medical geography is relatively new, Hippocrates saw the importance of context in health over 2000 years ago (Dubos, 1965). Consistent with the Hippocratic tradition, medicine was "concerned with geographic variations in air, water, soil, vegetation, animals and insects, diet, habit and custom, clothing and house type, government and economy" up until the development of germ theory in the mid-19th century (Meade & Erickson, 2005, p. 5). Germ theory grew from the scientific discovery that microbes can invade humans and cause disease. This discovery led to sterilization, vaccination, antibiotics and other modern medical treatments that have significantly increased average life spans (Meade & Erickson, 2005).

The late twentieth century has seen an increase in the emergence and re-emergence of infectious disease in many parts of the world (Weiss & McMichael, 2004). The emergence of new diseases and resurgence of old ones may be reflective of changes in human ecology such as; rural-to-urban migration, human-induced global changes (i.e. climate change), behavioural changes, war and conflict and increasing long-distance mobility and trade (Weiss & McMichael, 2004). In its report on the state of health and the environment, the WHO concluded that the poor quality of the environment was responsible for 25% of all preventable diseases (Forget & Lebel, 2001). Thus, there are

still many diseases with complex cultural and biological causes that a geographical approach, which attempts to relate the physical and social worlds, could help identify (Meade & Erickson, 2005). Consequently, after a period of rapid growth in the late 1970s and early 1980s, medical geography is now a more stable and integrated sub-discipline within the field (Kearns, 1993). According to Rosenberg (1998), an increasing number of medical geographers are beginning to prefer the terms health geographer, health geography or the geography of health as the field expands and becomes more recognized as a distinct area of human geography. This shift has been accompanied by a shift towards increased interest in well-being and a broader definition of health (Kearns & Moon, 2002).

Medical geography/ health geography has traditionally had two general areas of focus- health service delivery and mapping disease patterns (Mayer, 1982; Rosenberg, 2008). Health service delivery studies are concerned with spatial inequalities in health and access to health care (availability and accessibility). Disease pattern studies explore variations in disease incidence by looking at relationships between pathological factors (causative agents, vectors, intermediate hosts, reservoirs and man) and physical (climate, latitude, temperature, etc.), social (housing, income, population density, etc.) and biological (vegetable life, animal life, etc.) factors (May, 1950). Disease pattern studies may also attempt to track the spread of disease in order to help determine the source/methods of transmission so that its expansion can be slowed or eliminated. Disease occurs when an agent and host come into contact at the same time and in the same place (May, 1954). Therefore, social, cultural, political, environmental and behavioural factors are important since they can influence host-agent interaction and consequent susceptibility to disease (Mayer, 1996). For example, the construction of the Aswan High Dam on the Nile River created ecological changes that were believed to have resulted in an increase in breeding habitat for the snail hosts of urinary and intestinal schistosomiasis. Since human activity in Egypt is largely centered on the Nile River and its delta, this change to the landscape and its consequent influence on host-agent interaction has led to an increase in schistosomiasis in Egypt.

2.3 Key Concepts: Health, Risk and Vulnerability

According to the WHO (2006b), health is defined as “a state of complete physical, mental and social well-being, not merely the absence of disease or infirmity.” Therefore, health is not solely defined by physical ailments, but instead is influenced by an individual’s perception of their place within society and their ability to achieve pre-defined goals. Risk is defined as the likelihood that an individual will suffer harm or loss (WebFinance Inc., 2010). In relation to disease, an individual’s vulnerability refers to their susceptibility to injury or attack. According to Delor and Hubert (2000), the three co-ordinates of vulnerability are risk of being exposed to crisis situations (exposure), risk of not having the necessary resources to cope (capacity) and the risk of being subjected to consequences that result in crises (potentiality). These three risks are connected in time, but are influenced by different behavioural, social, economic, ecological and political factors. Overall, perceptions of health, risk and vulnerability vary amongst individuals. Consequently, variation in perceptions of health issues and variation in reactions to health issues should be expected. For example, in response to environmental damage some people may react apathetically (ignoring the threat) while others act in a purposive fashion taking steps to alleviate the problem (Digiulio, 1996).

2.4 Social and Environmental Determinants of Trachoma

2.4.1 Eye-Seeking Flies

Musca sorbens, an eye-seeking fly, is the most likely insect vector of trachoma (Emerson et al., 1999; Emerson et al., 2004). In 2001, a study was completed on how faeces (both human and other) serve as breeding media of the trachoma vector *M. sorbens*. Through this study, Emerson, Bailey, Walraven and Lindsay (2001) found that the preferred breeding medium of *M. sorbens* is isolated human faeces lying on the ground (although *M. sorbens* was also found to breed in calf, cow, dog and goat faeces). Further, it was found that female flies emerging from human faeces tend to have a larger head width than those emerging from other types of faeces and that this head width corresponded with the width observed in flies caught directly from children’s eyes. Based

on these findings, the construction of latrines was recommended in order to decrease fly density (by reducing the number of human faeces available for breeding), lower the corresponding number of fly to eye contacts and ultimately reduce trachoma prevalence.

Nonetheless, the overall value of fly control in trachoma prevention is still uncertain. For example, in the Gambia, Emerson et al., (2004) completed a community randomized trial to see if controlling the fly population could restrain the transmission of *C. trachomatis* using two methods of fly control: insecticide spraying and latrine provision. Both interventions significantly reduced the number of flies caught from children's faces; however, this reduction was only significant enough to reduce the prevalence of active trachoma in the villages that were sprayed with insecticide (Emerson et al., 2004). Similar studies completed in Tanzania, did not find that insecticide spraying after azithromycin distribution improved trachoma control (Munoz, Emerson, West, Mchiwa, & Mabey, 2005; West et al., 2006). The observed difference in results may be related to slight differences in study design, study location and/or season (Brechner, West, & Lynch, 1992). Either way, the variation in findings emphasizes the need for further investigation into the role of fly reduction in trachoma transmission and the consequent value of fly control through spraying or the construction of latrines.

In trachoma risk factor studies, both household fly densities and flies on the eyes of children have been found to be significantly associated with trachoma (Brechner et al., 1992; Cumberland, Hailu, & Todd, 2005; Ngondi et al., 2007). In particular, Brechner et al., (1992) found that houses surrounded by the most flies were nine times more likely to have a child with active trachoma than those with fewer flies. Fly densities are dependent on waste disposal, presence of cows, defecation site and altitude (Cumberland et al., 2008; Taye et al., 2007). In Gurage, Ethiopia, Lee et al., (2007), conducted a case-control study to examine how treating children with antibiotics affects the transmission of *Chlamydia* by flies. Six months after treatment *Chlamydia* was found on 23% of flies in the untreated villages and on 1% of flies in the treated villages (Lee et al., 2007). The results showed that trachoma prevalence in children was an excellent predictor of the prevalence of *Chlamydia* on flies. Therefore, in addition to reducing the number of flies, treating children may help reduce the role of flies as a vector.

In Niger, Abdou et al., (2007) found that children with clean faces, but with flies on their face, were more likely to have clinical trachoma in comparison to children with clean faces and no flies. However, no association between facial flies and infection was found. These results suggest that “the dose of Chlamydia imparted by a fly may be insufficient to establish an infection, but may be capable of eliciting the inflammatory response of clinical trachoma” (Abdou et al., 2007, p. 16). Although *M. sorbens* is expected to be the main insect vector of trachoma, *Musca Domestica* (a housefly) has also been observed to occasionally contact human eyes (Emerson et al., 1999). Therefore, although less studied, *M. Domestica* is also considered a potential vector of trachoma.

2.4.2 Climate

Trachoma infection has been found to be most common in hot, dry and dusty environments (Polack et al., 2005a; Schemann et al., 2002). Since trachoma is believed to be linked with poor water availability and poverty (both of which are typically problems of hot and dry environments), this is not surprising. Consideration of trachoma’s prevalence in relation to climatic factors is necessary because it may provide insight on how global warming will influence the future distribution of the disease. However, the ability to detect the effects of climate change may be hampered by the high degree of success of current strategies to decrease trachoma prevalence (Johnson, 2004).

Active trachoma has also been shown to be seasonal in parts of the world (Da Cruz, Dadour, McAllister, Jackson, & Isaacs, 2002; Jha et al., 2002). However, seasonality in trachoma prevalence may, at least in part, be related to corresponding seasonality in fly prevalence. This potential overlap highlights the fact that trachoma determinants do not exist as discrete entities, but interact with one another to determine the overall likelihood of an individual contracting the disease. Taye et al., (2007) found that densities of *M. sorbens* and *M. domestica* were higher during dry months than during rainy month in Gurage, Ethiopia. Despite seasonal differences in fly densities, this study did not find a corresponding seasonal difference in the prevalence of trachoma (Taye et al., 2007). In areas where trachoma prevalence has been observed to be seasonal (e.g. north-western Australia), it is likely that there are ideal target times for intervention

within the year. For example, stochastic simulations have shown that in order to increase the likelihood of local elimination antibiotic treatment should be administered three months before the trough of the low season of active trachoma (Lee, Chidambaram, Porco, & Lietman, 2005).

2.4.3 Altitude

A few studies have been conducted on the influence of altitude on trachoma prevalence. Consistently, these studies have found that low altitude (<2000 m.a.s) is a risk factor for trachoma infection (Alemayehu, Melese, Fredlander, Worku, & Courtright, 2005; Haileselassie & Bayu, 2007; Taye et al., 2007). In the Kembata zone of Southern Ethiopia TF was found in 17.3%, 33.5% and 42.3% of people at high, medium and low altitude zones respectively (Haileselassie & Bayu, 2007). Similarly, in the Gurage Zone of Ethiopia, Taye et al., (2007) found that the altitudinal trends in the number of eye-seeking flies caught at low (<2000 m.a.s.), mid (2200 – 2500 m.a.s) and high altitudes (>3000 m.a.s) matched the trend in the prevalence of active trachoma in children one to ten years of age. More specifically, almost all of the 13,147 eye-seeking flies caught in this study came from low and mid altitude villages, with only 0.7% coming from high altitude villages (Taye et al., 2007). The corresponding active trachoma prevalence in the low and mid altitude villages was found to be 81.6% and 78.7% respectively, but in high altitude villages the prevalence was only 1.7% (Taye et al., 2007). The hot and dry climate of the lowlands may favour the short life cycle of flies, leading to denser fly populations and potentially higher trachoma prevalence (Emerson et al., 2001). The findings of these studies suggest that altitude may be a useful marker for mapping trachoma and selecting priority areas for trachoma interventions in endemic areas (Alemayehu et al., 2005; Haileselassie & Bayu, 2007; Taye et al., 2007).

2.4.4 Access to Water and Sanitation

An individual's immediate hygienic and household environment is one of the most significant indicators of their health and well-being. Epidemiological studies have

found that children are at higher risk of trachoma infection if they have unclean faces⁵ (Abdou et al., 2007; Bogale & Bejiga, 2002; Ngondi et al., 2007; Regassa & Teshome, 2004; West et al., 1995). However, since trachoma can produce ocular discharge, it can be argued that a clean face is not protective of trachoma but is the result of its absence (West et al., 1995). Thus, caution must be taken during trachoma research that requires classification of faces as either clean or dirty.

In the developing world women often travel great distances to retrieve their water. West et al. (1989), found that children in developing countries are more likely to have unclean faces (and therefore trachoma) if they live more than 30 minutes from a water source. Although it may seem natural to associate distance to water source with quantity of water brought back to the house, discrepancy on this issue exists. In Tanzania, no association between distance to water source and quantity of water brought back was found (West et al., 1989). In the Gambia on the other hand, the amount of water collected per person showed a significant negative trend with increasing distance travelled to reach the water source (Bailey, Downes, Downes, & Mabey, 1991). Based on these findings two hypotheses have been developed: 1) Individuals living further from a water source place higher value on their water and are not willing to allocate as much of its use to hygiene as families living closer to water sources (West et al., 1989) and 2) Individuals living further from a water source collect less water and therefore the amount of water that they can use for washing is restricted. Both of these hypotheses emphasize the fact that the amount of water used for washing is the main factor, regardless of how this is related to the proximity of the water source (West et al., 1989). This is not surprising given that, on average, families with trachoma have been found to use less water per person per day than families without trachoma (Bailey et al., 1991; Luna et al., 1992; Pruss & Mariotti, 2000). There is also some evidence that trachoma may be associated with unsafe water sources (Luna et al., 1992; Ngondi et al., 2008). It is possible that houses using unsafe water collect less water overall and therefore use less for hygiene (Ngondi et al., 2008).

In general, the published evidence linking trachoma with water is not conclusive. Specifically, further study on how improved access to water influences trachoma

⁵ An unclean face was defined as the presence of nasal and ocular discharge.

transmission is needed. Nevertheless, it is generally accepted that increased washing (i.e. hands, face, clothing, etc.) reduces the frequency of this disease.

2.4.5 Household Cleanliness

In many developing countries, it is common for families to bring cattle into their homes at night for warmth and out of fear of thievery. Children living in households with an animal pen inside have been found to be more likely to have trachoma (Abdou et al., 2007). Similarly, in Sudan cattle ownership was found to be a risk factor for trachoma (Ngondi et al., 2007). This association is believed to be due to the fact that cattle attract flies and increase the number of faeces available for *M. sorbens* to breed. Although cattle faeces are not the preferred breeding medium for *M. sorbens*, *M. sorbens* may breed in cattle faeces (Emerson et al., 2001). Thus, to improve the domestic environment and lower trachoma transmission, alternative safe and secure strategies for keeping cattle are needed. Garbage within the compound and frequency of garbage collection has also been found to be associated with trachoma (Abdou et al., 2007; Luna et al., 1992).

2.4.6 Crowded Living Conditions

Assuming more person-to-person contact occurs in over-crowded conditions, the likelihood of coming in contact with the infective agent would be higher under such circumstances. Consequently, it is not surprising that families living in crowded conditions (Abdou et al., 2007), families with more than two children (Luna et al., 1992) and families where two or more children share a bed (Luna et al., 1992) are at higher risk of trachoma infection. Further, within households, those individuals living with someone with trachoma are more likely to have trachoma themselves (West et al., 1996; West et al., 2005). Similarly, Ngondi et al., (2009a) found that the risk of Trachomatous trichiasis (TT) in children aged one to 14 years increased with increasing proportion of children in the household with trachomatous inflammation-intense (TI) and with increasing number of adults in the household with Trachomatous trichiasis (TT).

2.4.7 Smoke, Dust and Light

Although cooking indoors is not believed to be a direct determinant of trachoma, there is evidence that smoke from cooking indoors further aggravates existing cases of the disease (Bogale & Bejiga, 2002; Turner et al., 1993). The irritation and pain caused by eye lashes rubbing the surface of the eyeball can also be exacerbated by dust and bright lights (Emerson et al., 2008). Thus, trachoma infection can interfere with activities such as cooking over firewood, farming in dusty environments and collecting water (Emerson et al., 2008).

2.4.8 Sanitation Facilities

In contrast to isolated human faeces, faeces in household pit latrines⁶ are not a source of the trachoma vector *M. sorbens* (Emerson et al., 2005). Thus, the installation of pit latrines to control the trachoma vector *M. sorbens* may be warranted. One study found that the installation of pit latrines without any additional health education reduced fly-eye contact by 30% (Emerson et al., 2004). Further, some trachoma risk factor studies have found lower odds of active trachoma in children living in households with latrines compared to households without latrines (Cumberland et al., 2005). However, community desire for latrines is often low. Therefore, health promotion is key to encouraging latrine construction (Kuper et al., 2005).

2.4.9 Socio-behavioural Factors

In the developing world, behaviour is closely related to economic circumstances. Often “poor populations do not have either the resources or the desire to maintain good community hygiene and priorities such as adequate food, shelter and warmth may take precedence” (Wright et al., 2007, p. 422). This statement is particularly relevant to trachoma transmission because trachoma presence and its severity appear to be related to an unclean face (Ngondi et al., 2008). Further, frequent washing of children, a clean environment and hygienic disposal of excrement have been found to be preventative

⁶ A pit latrine is a shallow hole dug in the ground to collect human waste. They often are partially covered with materials such as sticks, mud or concrete leaving a small opening for waste to enter.

factors for active trachoma (Cumberland, Hailu, & Todd, 2005). West et al., (1989) conducted a study on reasons mothers gave for their children's unclean face. Lack of water, insufficient time, a child's dislike for being washed, forgetfulness and the belief that their child was being adequately washed were reported (West et al., 1989). This shows that although hygiene may be dependent on larger economic issues, behavioural factors also play a role. It is often assumed that improvements in water supply and housing will lower trachoma morbidity. However, research has shown significant decreases in disease will only be observed if improved resources are coupled with appropriate education on their use (West et al., 1989). For example, a comparison of two villages with and without constructed water supplies (but no educational component on trachoma) showed no difference in trachoma prevalence (West et al., 1989).

Although education is essential, it may take a long time for educational efforts to translate into behavioural change (Edwards, Cumberland, Hailu, & Todd, 2006). Edwards et al., (2006) conducted a study on the impact of health education on active trachoma in hyperendemic communities of Ethiopia. Educational materials (i.e., radio programs, printed information and videos) were distributed along with mass antibiotic treatments. Although awareness of trachoma increased, little change in behaviour was observed. In contrast, in Tanzania, a significant reduction in nasal discharge (4.5% to 0.5%) and dirty faces (3.6% to 0.9%) as well as improvements in knowledge and behaviour were observed one year after implementing a school based curriculum (Lewallen et al., 2008).

Behavioural factors may also influence an individual's willingness to take advantage of available opportunities for surgery. Cost, the feeling that medical attention is not necessary (particularly among respondents with mild forms of trichiasis that had minimal discomfort and vision loss), distance to the hospital, fear and lack of an escort have all been reported as reasons that prevent trichiasis sufferers from seeking hospital treatment (Rabiu & Abiose, 2001).

2.4.10 Socioeconomic Factors

“Microbes frequently capitalize on situations of ecological, biological and social disturbance” (Weiss & McMichael, 2004, p. 574). Consequently, persistent poverty, conflict and warfare make a place particularly vulnerable to microbial colonization. Nonetheless, the evidence base for a relationship between socioeconomic status and trachoma is mixed. Trachoma severity was found to be significantly associated with thatch roof households and absence of electricity in Ethiopia (two indicators of low socioeconomic status) (Ngondi et al., 2008). Further, living in a wood/earth home during childbearing years (also linked with low socioeconomic status) was found to be associated with trichiasis in Tanzania (Turner et al., 1993). In contrast, in Sao Paulo, Brazil neither income nor socioeconomic status showed a significant relationship with the disease (Luna et al., 1992). Also, in Amhara, Ethiopia Ngondi et al., (2008) found no association between trachoma and household ownership. However, there is evidence of a correlation between lower levels of trachoma and higher educational attainment (Luna et al., 1992; Regassa & Teshome, 2004). Further, one study found that illiteracy was associated with the development of trichiasis (Bogale & Bejiga, 2002).

Socioeconomic status also impacts nutrition in children. In many cases, regions that struggle with malnutrition also struggle with trachoma. Consequently, Smith et al., (2007) conducted a study to investigate whether children with signs of chronic or acute malnutrition were more or less likely to have signs of trachoma and whether disease progression differed in malnourished children. Children with signs of chronic malnutrition were found to be more likely to have signs of active trachoma than children without signs of chronic malnutrition (Smith et al., 2007). However, no association was found between trachoma and acute malnutrition (Smith et al., 2007). Further, children with signs of chronic malnutrition were more likely to have TI than trachomatous inflammation follicular (TF) among the children with the active disease (Smith et al., 2007).

2.4.11 Individual Factors

In addition to the above factors, some individual characteristics may also influence trachoma risk. For example, it is well known that trichiasis is associated with increasing age (Burton, 2007; Ngondi et al., 2008; Ngondi et al., 2009a) and female gender (Ngondi et al., 2009a; Ngondi et al., 2008; Regassa & Teshome, 2004). The International Trachoma Initiative (2009) states that women are three times as likely to become blind from trachoma as men. Although research has not shown that women are more biologically susceptible to infection, some studies have suggested that infection loads are higher and that persistent infection is more common in females (Courtright & West, 2004). Further, women's close contact with children (the main source of active infection) in their role as caregivers may increase their risk of repeat infection and consequent blinding disease (Courtright & West, 2004; Turner et al., 1993). Women with trichiasis are also more likely to have had mothers with trichiasis, suggesting that trichiasis may be related to genetic predisposition or factors related to immune responsiveness (Courtright & West, 2004; Turner et al., 1993). However, this relationship could also be due to a shared environment component (Courtright & West, 2004).

Active trachoma is also related to age, with the prevalence of the disease being higher in children (Ngondi et al., 2008; Ngondi et al., 2007). More specifically, active trachoma typically peaks in pre-school children aged three to five and then declines to low levels amongst adults (Burton, 2007). Younger children (one to two years of age) are half as likely to have TF and TI as three to five year olds (Abdou et al., 2007). This may be because older children (three to five years of age) are more likely to spend time with older siblings and other children, whereas younger children stay closer to their mothers and therefore are less likely to be infected by other children (Burton, 2007). The duration of trachoma infection is also longer for children under five years of age than it is in adults over 15 (Bailey, Duong, Carpenter, Whittle, & Mabey, 1999; Abdou et al., 2007). Since the birth rate in trachoma endemic countries is often high, the large population of young people (particularly those under five) creates a large reservoir of infection.

2.5 Trachoma Elimination: The SAFE Strategy

In 1997, the WHO, the International Agency for the Prevention of Blindness and a group of non-governmental organizations (NGOs) started the Global Alliance for the Elimination of Blinding Trachoma by 2020 (GET 2020). The goal of GET 2020 is to eliminate blindness caused by trachoma through the use of the SAFE strategy. The SAFE strategy involves surgery, antibiotic treatment, facial cleanliness and environmental improvement.

2.5.1 Surgery

The S or surgery component of the SAFE strategy aims to correct TT and reduce the risk of progressive corneal opacity (CO) and blindness (Burton, 2007). In order to accomplish this various different surgical procedures are used. Bi-lamellar tarsal rotation (BLTR) is the endorsed method of the WHO as it is associated with lower TT recurrence rates (Reacher et al., 1992). The recurrence of trichiasis following surgery is common. Some studies have found the recurrence rate to be as high as 40 to 60 percent (Burton et al., 2005b; Khandekar, Mohammed, & Courtright, 2001). In addition to the type of procedure used, various other factors such as infection at the time of surgery and at follow up, suture type, inter-surgeon variability and disease severity may contribute to the recurrence rate (Khandekar et al., 2001; Zhang, Kandel, Sharma, & Dean, 2004). In many cases recurrent trichiasis is not found until three or four years following surgery (Burton et al., 2005b). Therefore, there is a need for on-going re-examination of surgery recipients.

Another problem with the implementation of the S component of the SAFE strategy is that there are too few ophthalmologists to deal with the demand for the procedure (Burton, 2007). Consequently, the surgery is increasingly being carried out by paramedics and nurses instead of ophthalmologists. Further, in some areas the majority of people with trichiasis do not seek medical attention. One Nigerian study found that over 90% of people with trichiasis went without medical attention (Rabiu & Abiose, 2001).

Cost was the most commonly reported barrier to surgery uptake in this study (Rabiou & Abiose, 2001). Other barriers that were reported included distance to the hospital, having no escort or the feeling that they did not need medical attention (those individuals with milder cases). Bowman et al., (2002) also found lack of time and money to be major barriers to surgery uptake in the Gambia.

Despite the challenges given above, a long term study on the outcome of trichiasis surgery in the Gambia found that improvements in the cornea can occur and the rate of visual loss is generally less amongst surgery recipients (Burton et al., 2005a). Further one economic model found trichiasis surgery to be a cost-effective way of restoring sight (Baltussen, Sylla, Frick, & Mariotti, 2005). Thus, surgery continues to be an important part of the WHO's strategy for eliminating blinding trachoma.

2.5.2 Antibiotic Treatment

Mass antibiotic treatment of all individuals in a community is recommended by the WHO when active trachoma prevalence in children aged one to nine years exceeds 10% (Mabey, 2008). If this is the case, a single oral dose of azithromycin or six weeks of twice daily tetracycline ointment (for infants under six months and expecting mothers) should be administered annually for three years (Burton, 2007; Mabey, 2008).

Azithromycin, the antibiotic most commonly used, is currently donated by the International Trachoma Initiative (ITI) and Pfizer (the manufacturer) to control trachoma in twelve endemic regions (Burton, 2007). Although resources may be wasted by treating individuals without infection, mass treatment of all individuals in the community is used due to difficulties in identifying infected individuals upon examination. In order to be effective the WHO recommends at least 80% of the population be given antibiotics.

The detection of *Chlamydia trachomatis* infection is problematic and poses problems for organizations trying to implement this portion of the SAFE strategy. Currently, clinical signs of trachoma are used by control programs to determine which communities should be treated (Burton et al., 2003). However, studies have found Chlamydial infection in individuals who do not show signs of clinical disease and an absence of Chlamydial infection in individuals with active trachoma (possibly due to an

incubation period where infection is present, but the disease still has not developed) (Burton et al., 2003; Wright & Taylor, 2005). Consequently, some communities may receive repeated mass treatments after transmission of the disease has ceased and other individuals or communities that need to be treated may be missed (Mabey, 2008).

Although infection loads have been found to be higher in individuals with clinically active disease, individuals without signs of clinically active trachoma also have been demonstrated to be a significant reservoir (Burton et al., 2003). In The Gambia, Burton et al., (2003) found that if treatment was only given to those with signs of active disease three quarters of infected individuals would go untreated. Several diagnostic tests exist, but are not appropriate for non-research use due to their expense and complexity (Burton, 2007). Resources could be saved or better used if a rapid point-of-care diagnostic test was available. Currently, such a test is being developed with the hope that it will be able to be used to aid trachoma control programs in the future (Michel et al., 2006).

Another problem associated with the implementation of the 'A' component is that there is uncertainty over the frequency and duration of treatment that is needed. Some studies have reported significant reductions in trachoma following a single dose (Burton et al., 2005b; Fry et al., 2002; Schachter et al., 1999; Solomon et al., 2004), whereas others have found rapid re-emergence of the disease (Bailey et al., 1999; West et al., 2005). Mathematical models have suggested repeated distributions of antibiotics can eliminate the disease (Ray et al., 2007). For example, in one hyperendemic area of Ethiopia the model estimated that biannual treatment with 90% coverage would result in trachoma elimination in over half of the communities within three years and in 95% of communities within five years (Ray et al., 2007). However, the model did not account for re-introduction of infection from neighbouring villages and thus far infection has never been eliminated from a hyperendemic area (Ray et al., 2007). After finding that trachoma persisted after three years of intervention in Amhara, Ethiopia, Ngondi et al., (2009) suggested that five year intervention plans should be adopted for hyperendemic settings. Other studies have found results somewhere in between, with significant reductions in the level of trachoma taking place in the short-term but not complete elimination over the long-term (Jha et al., 2002; West et al., 2007). Despite the above uncertainty, there seems

to be two things most studies agree on: 1) that any treatment strategy must ensure that children under 10 are targeted as they are a major source of *Chlamydia trachomatis* infection (Solomon et al., 2003; Taylor, 2009), and 2) that there is a need for treatment and multiple treatments will likely be needed for elimination (Burton et al., 2005b; Jha et al., 2002; Rodgers et al., 2007; West et al., 2005).

Finally, there is also concern that antibiotic resistance may occur if mass distribution is continued (Burton, 2007). Thus far, *Chlamydia trachomatis* has not shown resistance (Burton, 2007). However, there is larger concern that other bacteria such as *Streptococcus pneumoniae* will become resistant (Burton, 2007; Fry et al., 2002). Fry et al., (2002) conducted a study on antibiotic resistance of nasopharyngeal pneumococcal isolates in Nepal after one mass treatment with azithromycin. Although no azithromycin resistant pneumococci were isolated from children receiving one treatment, azithromycin-resistant isolates were found in 4.3% of children after two mass treatments. The results of this study support ongoing monitoring for resistance when multiple rounds of treatment are given. The benefits of mass treatment must be considered in light of these possibilities and their implications (Ray et al., 2007).

2.5.3 Facial Cleanliness and Environmental Improvement

The F and E components of the SAFE strategy are often grouped together because their primary purpose is prevention as opposed to treatment (Emerson, Cairncross, Bailey, & Mabey, 2000). One study in Vietnam comparing two communities - one where the full SAFE strategy was implemented and the other where just the S and A components were implemented - found an additional decline in trachoma prevalence of 5.8% due to the addition of the F and E components (Khandekar, Thanah, & Thi, 2006).

The F component involves increasing awareness of face washing and its relation to trachoma. Justification for the F component comes from risk factor studies that have found an association between unclean faces and trachoma in children (Burton, 2007; Ngondi et al., 2008). One problem with these studies is that ocular discharge can be a result of trachoma so that any association found between unclean faces and trachoma may actually be due to trachoma causing the unclean face (Kuper et al., 2003; West et al.,

1995). Nonetheless, reductions in severe trachoma have been observed in communities where face washing has increased as a result of facial cleanliness intervention activities (Lynch et al., 1994; Ngondi et al., 2008; West et al., 1995). Therefore, it is still believed that having a clean face can reduce autoinfection with trachoma as well as reduce transmission of *C. trachomatis* (Burton, 2007; Kuper, cited in Ngondi et al., 2008).

The major aspects of the E component are provision of sanitary latrines, provision of clean water and health education⁷. Currently, the use of insecticide to control eye-seeking flies is not typically incorporated into the E component of the SAFE strategy because there is mixed evidence on the impact it has on transmission (Emerson, Burton, Solomon, Bailey, & Mabey, 2006). Thus, the focus still seems to be on the provision of latrines for fly-control since their presence and use has been found to have a protective effect on trachoma (Ngondi et al., 2008).

Cumberland et al., (2008) investigated the impact of health education and community level treatment in the Gurage and Oromia regions of Ethiopia. Information, education and communication (IEC) materials were distributed and in the following year, a survey was conducted to investigate their impact. Although an increase in awareness was observed, corresponding changes in behaviour associated with the spread of *C. trachomatis* were minimal (Cumberland et al., 2008). In addition to antibiotic treatment and IEC materials, some communities also received video education interventions. This did not appear to further reduce the odds of active trachoma beyond that of antibiotic treatment and IEC materials alone. The antibiotic treatment and IEC materials jointly reduced active trachoma prevalence by approximately 50% from baseline (this reduction increased to 70% once age had been accounted for) (Cumberland et al., 2008). One and three years after baseline, a shift away from traditional beliefs to better understanding of infectious disease prevention and cures was observed. Yet, the percentage of individuals reporting correct treatment still remained low. Overall, the study concluded that the health education efforts seemed to have positive results, but can be time consuming and produce variable results. The conclusions also emphasized that although community based programs require more resources than mass media efforts, they may be required in

⁷ Note: although provision of clean water is part of the E component, in practice it is often overlooked as the associated costs are often beyond the budgets of trachoma control programs (Emerson et al., 2006).

order to achieve sustainable prevention measures in hyperendemic rural populations with limited access to media.

2.6 Geographic Information Systems (GIS) and Trachoma Research

To date, there is very little published literature using GIS to study and/or map the distribution of trachoma. In 2005, the first attempt to collect, analyze and report trachoma prevalence at the district level was published (prior maps did not show levels of trachoma prevalence within and between countries) (Polack et al., 2005a). This project used GIS as a database and cartographic tool to generate a global map showing the prevalence of trachoma and trichiasis based on 139 population-based surveys for 33 of the 55 countries suspected of having endemic trachoma (no reliable district-level population-based data was available for the remaining 23 countries) (Polack et al., 2005a). Once the distribution of trachoma was mapped, GIS were used to overlay Koppen climate classifications to calculate mean trachoma prevalence by climate zone. The highest prevalence was found in the savannah areas of East and Central Africa and the Sahel of West Africa (Polack et al., 2005a). The map resulting from this project remains to be the most detailed available on the current global distribution of trachoma.

GIS have also been used to map trachoma at the household level in KaheMpya and Rombo, Tanzania. The goal of GIS use in both cases was to improve understanding of the distribution of the disease in order to better understand the dynamics of transmission and target control interventions accordingly. In KaheMpya, GIS was used to look for evidence of clustering and to investigate the relationship between trachoma, distance to water source and latrines (Polack et al., 2005b). This study found between and within household spatial clustering suggesting inter-familial and intra-familial transmission of infection. Also, a significant relation between distance to water and active trachoma was found. In the Rombo district, GIS were used to investigate the relationship between distance to water source, altitude and active trachoma in children (Baggaley et al., 2006). Results of this study showed that increasing distance to the nearest water

source was significantly associated with increasing trachoma prevalence and altitude was significantly inversely associated with trachoma prevalence (Baggaley et al., 2006).

In Ethiopia, the International Trachoma Initiative (2006) conducted a project to map SAFE activities in three regions (Tigray, Afar and SNNPR). The goal of this project was to collect information in order to facilitate synergy among the organizations providing SAFE and to suggest ways to optimize coordination with partner and related organizations to ensure full SAFE coverage (Kello, Axelsen, & Kumaresan, 2006). In order to accomplish this, a database of organizations providing SAFE measures was developed and up to date information on SAFE projects and activities was collected. Using this information, maps for visualization and coordination purposes were created with the WHO's Healthmapper. The resulting maps identified areas of need and also showed that in many areas partner organizations were already working (Kello et al., 2006).

The above paragraphs summarize the few research projects that have been completed on trachoma with the aid of GIS. These projects illustrate some of the diversity of GIS applications to trachoma research. A major advantage of using GIS to study health issues is its ability to highlight the problem in a clear way so that the magnitude of the problem and priority areas can be established. Nonetheless, GIS is not yet a common working tool for officers in charge of national trachoma control programs (Polack et al., 2005b).

2.7 Conclusion

The strong relationship between an individual's immediate environment and their exposure to trachoma calls for a holistic approach to its prevention and treatment. The SAFE strategy for trachoma prevention seems to embrace this framework; however, in practice its implementation can be challenging. Some of the challenges in implementing the full SAFE strategy include the fact that trachoma is overshadowed by the 'big three' (malaria, tuberculosis and HIV/AIDS) when it comes to funding (Morales, 2005), the lack of reliable epidemiological data on trachoma's distribution and ineffective methods

for identifying priority areas for trachoma. Nonetheless, several countries are now on track to eliminate blinding trachoma by 2020 (WHO, 2006c). In 2006, the Islamic Republic of Iran, Mexico, Morocco and Oman all reported successful implementation of the SAFE strategy at the GET 2020 meeting in Geneva (WHO, 2006c). Further, as of 2009 trachoma is no longer a public health problem in Ghana (Yayemain et al., 2009). Due to the successful implementation of SAFE, active trachoma in children aged one to nine years is now less than 5% in all 18 districts within endemic regions in Ghana (Yayemain et al., 2009). Further, in the last five years, the number of people suffering from active trachoma has decreased from 84 million to 41 million (International Trachoma Initiative, 2008). Dr. Lee Jong-Wook, the WHO Director-General, stated that "if countries continue at this rate, the global goal to eliminate blinding trachoma as a public health problem by 2020 can be achieved" (WHO, 2006). However, greater political will, communication and advocacy will be needed (Kumaresan, 2005). In order to achieve the best results action plans must be open-minded, flexible and willing to adapt to change if the need arises.

3. Methodology

3.1 Introduction

The following chapter discusses my research methods. The chapter begins with a description of my research strategy and ethical considerations. Next, a comprehensive description of my data collection methods is provided. This section is broken into six components: baseline trachoma surveys, household coordinates, document collection, in-depth interviews, focus group discussions and participant observation. The remainder of the chapter discusses the steps taken to prepare the data for analysis and the analysis process itself. The section on data analysis is organized into two sub-sections reflecting the type of data collected - quantitative or qualitative. Finally, the chapter ends with a section on my experiences in the field.

3.2 Research Strategy

In this thesis a mixed methods approach was employed. Mixed methods research combines qualitative and quantitative research techniques, methods, approaches, viewpoints, concepts or language into a single study in order to increase its breadth and depth of understanding (Johnson, Onwuegbuzie, & Turner, 2007; Johnson & Onwuegbuzie, 2004). Mixed methods research is based on the principle that inductive and deductive reasoning can be complementary rather than mutually exclusive tools (Johnstone, 2004). Therefore, it is focused on bringing the two together rather than emphasizing one over the other. One of the strengths of mixed methods research is that the words and narrative can be used to add meaning to the numbers and the numbers can add precision to the words and narrative (Johnson & Onwuegbuzie, 2004). The use of mixed methods also allows the researcher to answer a broader or more complete spectrum of questions. Other strengths of mixed methods research include: it can produce more in-depth insight and more complete knowledge; it can produce complementary results (i.e. clarification of the results from one method with the results from another);

and it can use the strengths of one method to overcome the weaknesses of another (Greene, Caracelli, & Graham, 1989; Johnson & Onwuegbuzie, 2004).

Another strength of the mixed methods approach is it allows the researcher to triangulate the results through convergence and corroboration of findings (Johnson & Onwuegbuzie, 2004). Some of the advantages of triangulation are it allows the researcher to be more confident in their results, can highlight contradictions, can lead to the integration of theories, can create richer data and can lead to creative ways of collecting data (Jick, 1979). Morse (1991) identified two types of triangulation: simultaneous and sequential. Simultaneous triangulation refers to research in which there is limited interaction between the qualitative and quantitative sources of data during the data collection phase; however, the findings are used to complement each other in the interpretation phase (Morse, 1991). Sequential triangulation refers to research in which the results of one method are used in the planning for the next (Morse, 1991).

In this study both simultaneous and sequential triangulation were used. Since this study was a follow up to ORBIS Ethiopia's baseline trachoma survey, the design of this project and the questions asked were heavily influenced by the structure and findings of ORBIS Ethiopia's survey. For example, some focus groups were asked why they thought the trachoma prevalence was lower or higher in their *gott*⁸. This question was created after reviewing the results of the baseline trachoma survey and comparing the findings across the various *gotts* in order to identify areas of relatively high or low trachoma levels. In this way sequential triangulation was used. However, if you were to focus solely on the additional quantitative and qualitative data collected in this study, the triangulation process was largely simultaneous since the two data sets were collected concurrently. Consequently, the amount of interaction between the two sources of data (the interviews/focus groups and collection of spatial coordinates) was limited.

A major challenge of mixed methods research is figuring out how to genuinely incorporate the two approaches together (Yin, 2006). Yin (2006) argues that the more mixed methods are incorporated in a study's research questions, units of analysis, samples for the study, instrumentation and data collection methods and analytic strategies, the more that mixed methods research is taking place. The challenge lies in

⁸ A *gott* is a village or sub-division of a *kebele* in Ethiopia.

preventing the study from breaking into multiple studies using different methods (Yin, 2006). In order to help overcome this challenge, a mixed methods approach was used to frame the research questions. As suggested by Teddlie & Tahakkori (2008), I identified an overarching mixed research question⁹. This question was then broken down into separate quantitative and qualitative subquestions (see Chapter 1: Purpose of the Study). The overarching research question brings together the subquestions, which have either a qualitative or quantitative focus. Structuring the research questions in this way allowed me to address each of the subquestions separately before exploring the connections between them. According to Tashakkori & Creswell (2007), a well written mixed methods report should incorporate the qualitative and quantitative phases of the study into a coherent conclusion that is more comprehensive than either of the strands alone. To accomplish this both data sets are compared in the discussion to see if the findings converge.

Bryman (2007) highlighted nine additional challenges in integrating qualitative and quantitative methods. These challenges were identified by interviewing 20 social researchers who used mixed methods in the UK. These challenges were: dealing with different audiences (often results are written or presented emphasizing one component over the other depending on the audience the materials are for), methodological preferences (some researchers tend to highlight one set of findings more than the other because they have greater faith in the approach), structure of the project (in some cases projects are designed in a structured way so that either the quantitative or qualitative side provides the main point of orientation), role of timelines (ensuring the two are in sync with each other particularly when a research team is used), skill specialism's (making sure you have the right mixture in your research team), nature of the data (one set may be more interesting than the other set), bridging ontological divides, publication (some journals may favour one approach over the other and want that evidence highlighted) and the lack of an exemplary example of mixed methods being used.

⁹ The overarching research question is, what social and environmental factors are influencing the distribution of trachoma in the Kembata Zone?

3.3 Ethical Considerations

Ethics approval to conduct this project was given by the University of Victoria Human Research Ethics Board. Participation in this project was completely voluntary and written informed consent was required of all interview and focus group participants. Throughout the research process effort was made to protect the confidentiality of the individuals who participated.

Prior to commencing the field work, approval for this project was also sought from the local government health officials for Kedida Gamela and Damboya *Woredas*. In both cases the project was approved and a series of letters addressed to the chairman of each *kebele* were created. Upon arrival in each *kebele* the appropriate letter was given to the corresponding chairman in order to confirm that the project had been approved at the regional level. This letter was needed in order to conduct research in each *kebele*.

3.4 Data Collection Methods

3.4.1 Baseline Trachoma Survey

As mentioned in Chapter Two, ORBIS Ethiopia conducted a baseline trachoma survey in the Kedida Gamela and Damboya *Woredas* of the Kembata Zone over a two week period in April and May of 2007. Upon arrival in Ethiopia, I was given access to the original completed surveys which included the results of the clinical assessment (see Appendix 2 - Clinical Assessment Form), household KAP questionnaire (see Appendix 3 - Household KAP Questionnaire) and KAP questionnaire of trichiasis Cases (see Appendix 4 - Questionnaire for KAP survey of Trichiasis cases). The following paragraphs summarize ORBIS Ethiopia's data collection methods.

Two survey teams conducted the baseline survey. Each team consisted of an ophthalmic nurse, three enumerators and a supervisor. Enumerators were selected by the principal investigator and the field coordinator of ORBIS International - Ethiopia. Before conducting the baseline survey, the enumerators participated in two days of training and the ophthalmic nurses participated in a one-day orientation/ refreshing course. After the training was complete the rural program manager of ORBIS Ethiopia conducted an inter-

observer agreement test on the trachoma graders until the level of agreement reached 90% (as recommended by the WHO). These measures were taken in order to ensure the quality of the survey. Further, prior to commencing the survey, ORBIS sought approval from the Zone and *Woreda* authorities in the region.

The design followed the principles of a community-based cross sectional quantitative survey. Using the STATCALC function of Epi6 software it was determined that a sample size of 1020¹⁰ households for the clinical assessment of trachoma and 840¹¹ households for the KAP surveys was sufficient. In order to select this sample a multistage cluster sampling technique was used. In total 30 *gotts* from 28 *Kebeles* (15/19 from Kedida Gamela and 13/17 from Damboya) were selected using a systematic random sample method where the probability of a *Kebele* being selected was proportionate to its population size. Then 34 households were chosen from each *gott*. Households were selected using a random walk sampling method. Using this method, the central point of each *gott* was identified and the direction to walk was chosen by lottery. The nearest household in the chosen direction became the starting point. If 34 households were not present in the chosen direction, the survey team took a right and backward turn of 45 degrees and continued. An equal number of households in each *gott* were sampled because the population sizes were similar.

After explaining the goal of the survey and obtaining consent, all members aged one to nine and 15 and above were examined for trachoma. The clinical assessment was conducted by an ophthalmic nurse using torch lights and binocular loupes with 2x magnification. Both eyes of every individual were examined separately for signs of TF, TI, TS, TT and CO and everyone in the household who was found to have active trachoma was given two tubes of 1% tetracycline ointment. Those individuals needing further treatment for more severe forms of trachoma were referred to a health facility in the region.

¹⁰ This number is based on an expected TF prevalence of 26.4% and an expected TT prevalence of 3%.

¹¹ This number is based on an expected prevalence of latrine use / satisfactory knowledge of trachoma of 50%.

The household heads for the first 28¹² households of each cluster were also asked to complete a KAP survey. If the household head was not available the next person aged 18 or over was interviewed. Further, if any individual in the household was found to have trichiasis, two additional KAP surveys on trichiasis and barriers to surgery were conducted. Both KAP surveys were implemented by one of the enumerators, while the other enumerator conducted a census of the household members. The supervisor checked the completeness and accuracy of each of the completed surveys prior to moving on to the next household. After the examination and survey(s) were completed, the survey team educated the family members on trachoma, its cause and treatment options.

3.4.2 Household Coordinates

Coordinates for each household, latrine and water source were collected using a Garmin GPS 60 handheld global positioning system (GPS). With the assistance of a guide and translator I travelled to each of the households surveyed in ORBIS Ethiopia's baseline survey to collect waypoints¹³. The households were identified using family name. Each waypoint was given a code stating its cluster and household number. An L was added to the front of the code in order to distinguish latrines from households. For example, cluster one; household one would be labelled C1H1 and its corresponding latrine labelled LC1HI. Water sources were coded as the cluster number followed by the word 'water' and a number reflective of the order in which coordinates for water sources were recorded. For example, the waypoint for the first water source visited in cluster one would be labelled C1Water1. Household waypoints were collected approximately one metre directly in front of the main door of the household in order to ensure the overhang on the houses did not interfere with GPS reception. Latrine and Water source waypoints were collected directly at the site.

The GPS coordinates were not differentially corrected; however an external antenna was used to increase satellite reception and the average of a minimum of 50 waypoints was used to locate each point. Additionally, a waypoint record sheet was used

¹² A sample size of 840 households was determined to be sufficient using the STATCALC function of Epi6 software. As a result, only the first 28 households in each cluster were asked to complete the KAP survey.

¹³ A waypoint is a set of geographic coordinates that identify a point on the earth's surface.

to record information on the number of satellites; GPS reported accuracy and overhead coverage (i.e. trees, buildings, etc.) during each measurement. The reported accuracy ranged from 5.8m to 14.7m and the position of each point was calculated using a minimum of four satellites. Generally, there was little overhead coverage from buildings or trees when collecting the household and water source coordinates; however, several of the latrines were located in areas with an enset¹⁴ canopy that may have negatively impacted the accuracy of the measurements. The GPS was turned on 10 minutes prior to the first measurement of the day in order to give the unit time to receive ephemeris data from each of the detected satellites and left on for the remainder of the day. Verbal consent to survey and map each household was obtained from the household head and recorded on a Consent to Survey / Map Research Log (see Appendix 5). If no one was home or consent was not given, the household was skipped and no coordinates were obtained. Typically, one to two *gotts* were surveyed each day. At the end of each day the collected waypoints were downloaded from the GPS onto a laptop.

3.4.3 In-Depth Interviews

Depth interviews are appropriate for understanding social experiences and facets of everyday life that are unique to individuals and not to specific settings (Lofland & Lofland, 1984). In total, twenty interviews with household heads from twenty different *gotts* were conducted (see Appendix 8 - Interview Questions for Household Heads). All of the interviews were conducted in Amharic or Kembattegna (the local language) and a translator was used. Prior to participating in an interview all interviewees were required to review an information letter (see Appendix 6 - Participant Consent Information Letter) and then sign a consent form (See Appendix 7 - Consent Form). Both of these documents were translated into Amharic upon arrival in the study area. In those cases where the individual being interviewed was illiterate, the document was read to them. The interviews were typically conducted immediately after all the GPS coordinates for the *gott* had been collected. This system seemed to work best as it meant that we only had to

¹⁴ Enset is a crop found in many parts of southern Ethiopia. It is used for food, animal forage, construction materials and medicine in the Kembata Zone. It closely resembles a banana tree and as a result is commonly referred to as false banana.

visit each *gott* once. Interviewees were selected by my translator to participate. He would simply approach someone, explain the study and ask if they would be willing to do an interview. The first individual approached almost always agreed to participate. However, due to cultural norms men were easier to access and therefore made up a larger portion of the sample. In the end, 70% of the interviewees were male and 30% were female.

During the interviews it was often not possible to speak to an individual in private due to the lack of facilities (most interviews were conducted outdoors) and the amount of attention I drew as a foreigner. Consequently, often a crowd of individuals would be observing the interview which may have influenced the responses that I received (see Figure 2 - Conducting a focus group below). At first, we attempted to gain more privacy by asking the onlookers to move away. However, usually they gradually crept closer again. Given that we were the visitors, it was difficult to demand more privacy while conducting the interviews. Further, in some communities the people seemed to be suspicious of our activities.¹⁵ Given that the nature of most of the questions was not overly personal I did not feel that the presence of a crowd was significantly impacting the responses we received¹⁶.

In addition to interviewing household heads, five interviews with health care workers (two nurses, one doctor and two health extension workers) and two interviews with groups of teachers (two teachers from Damboya and three teachers from Kedida Gamela) were conducted (See Appendix 11 - Interview Questions for Health Care Professionals and Appendix 10 - Interview Questions for Teachers). Once again, prior to participating in an interview these individuals were asked to review an information sheet and required to sign a consent form. The health care professionals were interviewed independently; however, due to time constraints the teachers were interviewed as a group. Nonetheless, each teacher was asked to answer each of the questions independently (i.e. the questions were directed to each individual rather than opened up to the group as they would be when conducting a focus group). All, but one of the interviews with healthcare

¹⁵ More detail on the communities response to the research team and I is provided in the Reflections from the field section at the end of this chapter.

¹⁶ A discussion of potential biases introduced due to the lack of privacy and use of a translator is included in the limitations section of Chapter 5.

professionals and teachers were conducted at nearby health care facilities or health posts. The remaining interview was conducted at a local motel.

Each interview began with an introduction. I introduced myself and then my translator would introduce the research project and explain to the participants that any information they provided would be kept anonymous. The interviews had a somewhat flexible format. Although I came to each interview with a pre-written list of questions that I would like to ask, the order that the questions were asked was not consistent. Further, on occasion additional questions of interest were asked on the spot to find out more information. These questions were usually sparked by the participant's response to a previous question or something I observed in the community. In the interviews I tried to adopt a learner role. I showed interest in even seemingly obvious aspects of community life; however, also only prodded so far in order to avoid annoying the interviewee's with questions that seemed overly trivial. My goal was to be perceived as curious or interested, not ignorant. All the interviews were taped¹⁷ and a standard fact sheet was filled out at the beginning of each interview (See Appendix 9 - Interview Fact Sheet). Although the interviews were recorded and later transcribed, I also took notes on the interviewee's responses during the interviews.

3.4.4 Focus Group Discussions

A focus group is an organized group discussion that aims to gain information on the views and experiences of participants in relation to a specific topic that is supplied by the researcher. Focus groups allow the researcher to view collective human interactions and gather large amounts of information about such interactions in a limited period of time (Denzin & Lincoln, 2000). Further, focus group discussions allow the researcher to determine the degree of consensus on a topic and help reveal shared understandings of daily life. In this study, ten focus group discussions with five or six participants per session were conducted. Focus groups were conducted in the 10 *gotts* where interviews were not conducted. All of the focus groups were conducted in Amharic or Kembattegna and a translator was used. Further, all except one (it was held in one of the participants

¹⁷ Permission was given by each of the participants to tape them

households) of the focus groups were held outdoors. As with the interviews, the majority of the participants were male.

Prior to participating each individual was required to review an information letter and sign a consent form (See Appendix 7 - Consent Form). Each focus group began with an introduction and a brief overview of what to expect. Then I gradually took the group through the questions I had prepared (See Appendix 12 - Focus Group Guide). For the most part, the discussions were open ended. However, in order to maintain some structure the funnel down approach described by Morgan (1997) was used. Using this approach, discussions start broad and then funnel down to specific issues and questions. This approach gave the participants the opportunity to contribute anything they wanted to say at the beginning of the discussion, yet allowed me to narrow down the topic as the discussion progressed. During the interviews I also recorded the order in which the participants spoke using a number system. These numbers were later used to help distinguish / confirm who was speaking when the data was transcribed.

As with the interviews, there were often additional people observing the focus groups. Again, this may have influenced the responses I received. One strength of focus group discussions is that they open multiple lines of communication making it possible to view interactions among participants, determine the level of consensus in the group and obtain several perspectives on a topic (Denzin & Lincoln, 2000). Thus, a potential benefit of having a crowd of observers is that I could watch their facial expressions in response to what the participants were saying. In some ways I felt that this increased my confidence in the validity of the responses. In contrast, given that there was an audience, the experience may have been particularly intimidating for the women and shy participants. Nonetheless, I tried to give all participants a chance to speak without pressuring any individual to contribute.



Figure 2 - Conducting a Focus Group

3.4.5 Participant Observation

Observation is the fundamental basis of all research methods in social and behavioural sciences (Denzin & Lincoln, 2000). In this study, participant observation was used primarily to support and cross reference with the information obtained through the interviews and focus groups. Often an individual's actions do not correspond with what they say they do. Consequently, in behavioural studies interviews, focus groups and questionnaires alone can be unreliable. The additional use of observations (for comparison) can help overcome this problem by increasing the face validity of a study. When observing behaviour, it is also important to be aware of the possibility of the Hawthorne effect. The Hawthorne effect claims that people perform better under observation due to the added attention that is being given to them.

In this study, observations were made on cleanliness of living conditions, defecation practices, water use behaviours, cleanliness of children, daily chores and cattle storage practices (cattle attract flies). These observations were made while I was visiting households to collect the map coordinates. In order to minimize my influence on the

activities and environment being observed I attempted to be as discrete as possible when making observations. For example, I did not record observations in my field notebook until the end of each day.

Toward the end of my field work I spent one full day and night staying with a family in my study area in order to observe their daily activities. In this case being discrete was not possible since the family I was staying with was well aware that I was there to learn about their lifestyle. Unfortunately, I did not have time to stay longer or stay with another family. Nonetheless, this was a valuable opportunity to gain more in-depth knowledge of common daily tasks in the region.

3.5 Data Preparation

3.5.1 Baseline Trachoma Survey

Upon arrival in Ethiopia, ORBIS International gave me two boxes with the original paper copies of the results of the clinical assessment, household KAP questionnaire and KAP questionnaire of trichiasis cases. During my first month in the field I manually entered the data from these three surveys into a Microsoft Excel spreadsheet. Once all the data were entered, it was compiled and organized into a series of tables that were used in the analysis.

3.5.2 Spatial Data

Once coordinates for all the households were obtained the waypoints were downloaded and added as a layer in ArcMap. The waypoints were then projected using the World Geodetic System of 1984 (WGS 1984) datum. A transverse Mercator projection was used (UTM Zone 37N). Once projected the points were linked with the results of the baseline trachoma and KAP surveys using a spatial join. The join was completed using the code that was assigned to each waypoint when it was surveyed. The centre of the surveyed points for each *gott* was also located using the mean centre spatial statistics tool.

3.5.3 Interviews/ Focus Groups

While my guide and I collected the coordinates for each household, my translator would stay in the vehicle with the driver and transcribe the previous days interview/focus group. Consequently, all of the interviews and focus groups were transcribed while in the field. When I returned to Canada I compared the interviews/focus groups to my notes. In those circumstances where the two did not correspond I listened to the interview/focus group again and gave preference to the response that more closely matched what was said in English during the interview. Nonetheless, the inconsistency was still noted so that when the analysis was performed these responses were not blindly accepted without any doubt or reservation. Table 2 summarizes the types of data, both quantitative and qualitative, that were collected and used in this research.

Table 2 - Data Summary

Quantitative	Qualitative
<ul style="list-style-type: none"> • Household, latrine & water source coordinates • Household trachoma prevalence (Provided by ORBIS Ethiopia) • Household level knowledge, aptitude and practices survey (Provided by ORBIS Ethiopia) 	<ul style="list-style-type: none"> • In-depth interviews with household heads, teachers and health care professional • Participant observation • Focus groups with household heads

3.6 Data Analysis

3.6.1 Quantitative Analysis

3.6.1.1 Research Concern

The quantitative portion of this thesis was conducted in order to investigate the spatial distribution of trachoma and potential risk factors for the disease. More specifically, the quantitative analysis aims to address the following secondary research questions:

5. What environmental, social, economic and behavioural factors influence a child's risk of developing active trachoma?
6. How are these risk factors distributed / clustered in the study area?
7. Is there evidence of spatial clustering of active trachoma cases?

3.6.1.2 Distance to Closest Latrine / Water Source

The straight-line distances between each household and the nearest latrine / nearest water source was calculated using Hawth's Analysis Tools for ArcGIS (Beyer, 2004). Within Hawth's tools, the 'distance between points tool (between layers)' was used. This tool requires the user to input two point layers and specify the type of output desired. In this case the source point layer was households and the target point layer was either latrines or water sources¹⁸. Since I was only interested in the distance to the closest point the 'nearest neighbours for each source point' option was selected specifying that only 'the top 1 closest points' be found. In the case that two or more points are equidistant, the tool automatically arbitrarily selects one of the points as the closest. The output of this analysis is a comma delimited text file (.csv) showing the distance to and ID of the closest latrine/water source for each household. Although the straight-line distances obtained may not equal the actual distance traveled¹⁹, for the purpose of this analysis it was assumed that the two should be roughly proportional. It was also assumed that residents use the closest water source / latrine available to them.

¹⁸ The analysis for latrines and water sources was completed separately

¹⁹ Topography or physical barriers such as buildings en route would prevent straight-line travel

3.6.1.3 Multivariate Statistical Analysis

Multivariate statistical analysis was employed to explore the relationship between various environmental, social, economic and behavioural factors, at the individual and household levels, and an individual's risk of having active trachoma (TF - Trachomatous inflammation follicular or TI – Trachomatous inflammation). In particular, the analysis aimed to investigate the interaction of these risk factors in determining trachoma risk.

Traditional statistical analysis assumes independence of individual observations. In this data set some of the children are from the same household, cluster and/or region. Consequently, the traditional statistical analysis assumption of independence is violated since children from the same house; cluster; and region may share environmental, social, behavioural and economic circumstances. Further, since trachoma is an infectious disease, if one child has the condition the other children in the area (particularly the same household) will be at greater risk of contracting it as well. In order to account for the lack of independence a generalized multi-level model was needed²⁰. The analysis was completed using R, a free software program for statistical computing and graphics (The R Project for Statistical Computing, 2010).

The data consists of 1513 children aged one to nine from 306 unique households found within 30 clusters from two regions. Out of the 1513 children, 779 were female and 733 were male (one child was missing data for the sex variable). Nine hundred and seventy nine of the children were trachoma free, 477 had TF and 57 had TI. In the initial analysis of the data, an ordinal dependent variable with three levels of trachoma (Trachoma free, TI and TF) was used. However, since there are only 57 cases of TI in the data set, specifying the model in this way did not produce useful results for the TI outcome. Thus, it made more sense to build two generalized multilevel models. The first model was used to determine the strength of the predictor variables on whether or not the child had active trachoma and the second was used to determine the strength of the predictor variables in determining which level of active trachoma (TF or TI) the child had, given that they have trachoma. In the first model, children with TF and TI were both coded as having active trachoma to produce a binary 0/1 dependent variable. In the

²⁰ Due to my limited background in statistics and the difficulty I faced in finding someone familiar with multilevel modeling, I decided to hire a statistical consultant from Datassist to complete the analysis.

second model, only children with active trachoma were kept in the data set and TF and TI were coded separately. In both cases a generalized multilevel model which accounted for the correlation was used.

Mixed effects logistic regression was used for both analyses. Mixed effects models incorporate both fixed and random effects. The effect given to a particular explanatory variable depends on the nature of the data and the objective of the study. In this case the data has multiple levels in which observations are related; however, we are interested in the wider population for which the levels are representative (Krause, personal communication, July 6, 2010). Through the use of random effects it is possible to account for the correlation between observations within the same level so that proper conclusions about the explanatory variables of interest (the fixed effects) can be drawn (Snijders, 2005). After exploring several different options the household and cluster variables were given random effects in this analysis. Controlling for regions did not improve the model. Therefore, this level was omitted for the sake of parsimony. To qualify as a non-trivial level in a multilevel analysis, the dependent variable must not show any residual or unexplained variation associated with the unit (Snijders, 2005).

Mixed effects logistic regression is a commonly used generalized linear mixed model (GLMM) for multilevel dichotomous data. GLMM's are composed of three parts; a linear predictor which models the relationship between the fixed and random effects, a link function to model the relationship between the linear predictor and the conditional mean of the observed trait and a variance function to model the residual variability (Kachman, 2000). In this case a logistic link function was used relate the expected value of the outcome (i.e. the probability of developing the disease) to the linear predictor, which includes random effects for both household and cluster.

Fourteen potential predictor variables were included in the original analysis (see Table 3 - Predictor Variables). Gradually, the model was trimmed to create a model that was complex enough to answer the research question, but did not over fit the data. Overfitting occurs when the model is too complex for the amount of data available. The problem with overfitting is that although the model fits the data at hand very well, it becomes too rigid to fit any other sample. In this case the Akaike's information criterion (AIC) index, residual plots and observed vs. predicted plots were used to determine the

goodness of fit of the model. The model was trimmed using the Wald test. If the Wald test was significant, the variable was included and if it was not significant the variable was omitted.

The model was fit using penalized quasi-likelihood (PQL) estimation. “The penalized quasi-likelihood approach is the most common estimation procedure for the generalized linear mixed model (GLMM)” (Jang & Lim, 2006). Basically, it fits a sequence of linear mixed models with changing weights. One of the advantages of using PQL estimation is that it is not necessary to specify the distribution of the response variable and therefore it can be used when distributional information is not available. PQL estimation is an approximate fitting technique which uses Laplace approximation.

Table 3 - Predictor Variables

Variable	Data Source	Description
Age	Baseline Trachoma Survey	Recorded in years (one through nine)
Sex	Baseline Trachoma Survey	Male or Female
Facial cleanliness	Baseline Trachoma Survey	Defined as clean (0) or unclean (1)
Education of household head	KAP survey	The education of the household head was classified into one of the following categories: no education (0), non-formal education (1), religious school only (2), some primary (3), all primary (4), some secondary (5), all secondary (6), more (7)
Household density	KAP survey	Recorded as the number of people sleeping in each household
Ability to correctly identify trachoma	KAP survey	Response to the question “Do you know what this condition is called?” when showed a picture of an individual with trichiasis. If the individual responded trichiasis or trachoma they were coded as providing a correct response. If the individual gave a different response or did not know they were coded as providing an incorrect response (1 - correct response, 0 - incorrect response)
Source of water	KAP survey	River (1), unclean water (2), spring water (3), pipe (4), public pipe (5), well (6), collected water (7), hand pump (8), other (99)

Time needed to collect water	KAP survey	Response to the question “Can you go, collect water and come back in the time it takes to brew coffee?” (Yes - 1, No - 0) (Note: It take approximately 30 minutes to brew coffee)
Household latrine	KAP survey	Response to the question “Do you have a latrine on the premises?” (Yes - 1, No - 0)
Livestock	KAP survey	Response to the question “Do your livestock (sheep, cows, goats, horses or donkeys) sleep in the same room as any member of your family?” (Yes – 1 (unclean), No – 0 (clean))
Compound Cleanliness	KAP survey	Response to the question “Is there evidence of solid waste or garbage within 20 meters of the house?” (1 - Yes, 0 - No)
Monthly Expenses	KAP survey	Calculated as the total estimated monthly expenses in Ethiopian Birr (ETB ²¹) / person sleeping in the household.
Daily Water	KAP survey	Calculated as the number of liters (L) of water/ person sleeping in the household/day.
Distance to latrine	GPS coordinates from household, latrine and water survey	Distance in meters (m) to the closest latrine
Distance to water source	GPS coordinates from household, latrine and water survey	Distance in meters (m) to the closest water source surveyed

3.6.1.4 Spatial Clustering

Evidence of spatial clustering in the study area was investigated using the Kulldorff spatial scan statistic (Kulldorff, 2006). SaTScan is a free software extension that was developed by Martin Kulldorff alongside Information Management Services Inc. to perform geographical surveillance of disease (Kulldorff, 2006). The spatial scan statistic attempts to identify overrepresentation of cases by imposing a circular or elliptical window on the geographic space. The null hypothesis being tested is that cases²² are geographically randomly distributed. The window moves through the study space

²¹ At the time of writing one Canadian dollar is equivalent to 15 Ethiopian Birr

²² Cases are defined by the user in the case file

centering itself on a series of grid points. In this case the grid points corresponded to the coordinates of each household. For each point, the radius of the window varies continuously from zero to a user identified upper limit. This ensures that the program looks for both small and large clusters. At the end of this process, a likelihood ratio statistic is calculated for each location and scanning window size. The window with the maximum likelihood is the most likely cluster or the cluster least likely to have occurred by chance.

A P-value is obtained by Monte Carlo hypothesis testing and assigned to the cluster. In Monte Carlo hypothesis testing, SaTScan generates random replications of the data set under the null hypothesis that the prevalence is uniform both inside and outside the window (Kulldorff, 2006). Then the rank of the maximum likelihood from the actual data set is compared with the maximum likelihoods from the random replications in order to obtain a p-value. If the test statistic for the real data set is amongst the highest five percent then the test is significant at the 0.05 level (Kulldorff, 2009). The number of replications is set by the user. However, it must end with a nine and be equal to or above 999 in order to ensure sufficient power. The hypothesis test is unbiased producing a correct significance level (Kulldorff, 2009). Upon completing this process the program also identifies a most likely set of secondary clusters ranked according to their likelihood ratio test statistic. In SaTScan, secondary clusters will only be statistically significant if they are able to reject the null hypothesis on their own strength²³ (Kulldorff, 2009).

In this study, SaTScan was used to scan for areas of high and low active (TF & TI) trachoma prevalence in children aged one to nine²⁴. It was also used to investigate the distribution of trachoma risk factors. In all cases a circular scanning window was employed. Although it is also possible to use an elliptical scanning window, this option was not used because it is only available for data in Cartesian coordinates (the coordinate files used were in latitude and longitude). The Bernoulli model was chosen because each of the data sets were represented by a binary (0/1) variable (e.g. cases and non-cases or children with trachoma and children without trachoma). As recommended, the specified upper limit for the size of the scan window was set to be 50% of the population at risk

²³ They are evaluated as if there are no other clusters in the data set

²⁴ Individuals aged 10 to 14 were not surveyed in ORBIS Ethiopia's baseline trachoma survey

and 9999 Monte Carlo replications were completed. This gives somewhat higher power than the default of 999 replications. Any missing or incomplete data were removed from both the case and control files. Each of the analyses was restricted so that clusters could not have pairs of centers both in each other's clusters. Once the cluster analyses were completed, the buffer tool in ArcMap was used to map the outputs.

When using the Bernoulli model in SaTScan, categorical covariates can be adjusted for through the use of multiple data sets. In the scan for areas of high and low active trachoma, the data set was adjusted for age since only clusters that cannot be explained by this covariate were of interest. Age was broken into two categorical groups: one to six and seven to nine. These groupings were chosen because ORBIS Ethiopia found that preschool children (aged one to six) were more likely than school aged children (aged seven to nine) to have trachoma (Wondimu, 2007). No adjustments were made in the other cluster analyses.

When multiple covariates are included in the analysis, SaTScan searches for clusters that cannot be explained by differences in these covariates or the interaction between them (Kulldorff, 2009). When using multiple data sets to look for areas of higher than expected prevalence, SaTScan calculates the log likelihood ratio for each data set separately, multiplies all log likelihood ratios with less than the expected number of cases by negative one and then sums the log likelihoods for each window. The most likely cluster is the cluster with the maximum of all the combined log likelihood ratios in the study area (Kulldorff, 2009).

The benefit of the spatial scan statistic over traditional spatial auto-correlation tests is that it provides the location of the cluster and the statistical significance. Also, the program automatically adjusts for uneven geographical density of the background population (Kulldorff, 2006). Other local cluster analysis methods include generalized additive models (GAM) and Bayesian disease mapping (BYM). SaTScan uses a likelihood ratio test to identify areas of higher incidences, while GAM and BYM are based on estimations of relative risks (Aamodt, Samuelsen, & Skrondal, 2006). Aamodt et al., (2006) conducted a study comparing the three methods and found that the performance of each depends on the relative risks. In general, all of the methods performed well if the relative risk exceeded 1.5 (Aamodt, Samuelsen, & Skrondal, 2006).

However, if the relative risks were lower than 1.5 (as they were found to be in most cases for this data set) SaTScan performed the best (Aamodt, Samuelsen, & Skrondal, 2006). In addition, SaTScan is readily available, does not rely on prior knowledge of any cluster, accounts for multiple testing (false positives), can be used for point level data and is easy to use. Further, the Kulldorff spatial scan statistic has previously been used to study trachoma clusters in KaheMpya, Tanzania (Polack et al., 2005b).

3.6.2 Qualitative Analysis

3.6.2.1 Research Concern

The qualitative portion of this thesis was conducted in order to gain greater insight into how/if trachoma was impacting the lives of community members, the communities' knowledge of the disease, current lifestyle/ behaviours, barriers to accomplishing change and what the community members saw as the solution to the problem. This information was used to help address the following sub research question:

1. What factors are encouraging or impeding F and E efforts to reduce the spread of trachoma?

3.6.2.2 Interviews and Focus Groups of Household Heads

Description of the Sample Population

As suggested by Varkevisser, Pathmanathan & Brownlee (2003), the first step in the qualitative data analysis was to describe the informants. In order to accomplish this, the information from the interview fact sheets was entered into an Excel spreadsheet and the male/female split, average educational attainment, average age and average number of children of the interview participants was calculated. Unfortunately, the interview fact sheet was not used during the focus groups and this information was not collected for the participants. However, I did record the sex of the focus group participants in my field notebook and therefore was able to calculate the male / female split.

Data Coding

Data coding is a step by step process that involves reducing the data into manageable piles and then imposing order to gain greater understanding of the text (Neuman, 2007). In this case successive approximation or iterative analysis was used. In successive approximation the researcher analyzes the data multiple times with each analysis becoming more focused. The goal of iterative analysis is to gain an in-depth understanding of the data set in order to move towards a final analysis (Neuman, 2007). In this study, a four step process was used to code the data. This process involved organizing and summarizing the data, identifying repeating ideas, organizing these ideas into themes and grouping the themes into constructs. This process is similar to that described by Auerbach & Silverstein (2003) in *Qualitative Data: An Introduction to Coding and Analysis*. Each of these steps is described in more detail below.

Displaying and Summarizing the Data

After all the interviews and focus groups were typed, they were printed and the responses were manually sorted by question. In order to ensure that the origin of each comment could be traced back to its original source, a labelling system was used. For example, the label Q1- I1C21 would refer to question one in the first interview conducted in cluster 21. These labels were attached to each piece of text.

Once sorted by question, the range of responses for each question were reviewed again and further sorted into rough categories of similar responses within the question. The number of times each response was given for a question was then tallied. In addition to sorting individual responses within each question, the questions themselves and their corresponding responses were also grouped into broad topics. For example, some of the key topics were livestock, flies, water, latrines, knowledge of trachoma and washing. These key topics were then used as headings and the question numbers as subheadings to organize the text onto a poster board to make visualization easier.

The analysis process was slightly different for the focus groups. In addition to categorizing responses within questions, the responses from all questions were also sorted into a set of broad categories on the poster board. These categories were: diet, smoke, separate housing, behaviour, water, money, electricity, education, flies, mosquitoes, tablets/treatment, dirt, weather, local light, cleanliness and latrine. These categories highlight key topics that were consistently mentioned in one question or another across all of the focus groups. Responses that did not fit into any of these categories were recorded as miscellaneous responses.

Once the data from both the focus groups and interviews was organized it was reviewed again and summarized by question and by topic in a word document. Further, text that was unreliable or irrelevant to the research questions was left out of the analysis. These steps were taken to familiarize myself with the data, organize/condense the data into a format that would make interpretation easier and simplify the next steps in the coding process. This concluded the first pass through the data, often called open coding (Neuman, 2007).

Identification of Repeating Ideas

Repeating ideas are those which are mentioned by more than one participant using the same or similar words (Auerbach & Silverstein, 2003). In total, 46 repeating ideas were identified through hand coding (see Figure 17 - Coding Process). The analysis began by looking for repeating ideas within each interview/focus group and then expanding the analysis to look across all the interviews. In order to be considered a repeating idea the item must have been mentioned at least twice. The repeating ideas were identified using the summary files. Once identified, the full text was revisited to review precisely how the idea was stated by each participant. From this a name or tagline was chosen. For example, one repeating idea that came from the focus groups was “lack of water”. Lack of water or insufficient water supply was mentioned in six of the ten focus groups. Since it was mentioned by multiple people across different focus groups, it was considered to be a repeating idea. Once the initial list of repeating ideas had been

created, each idea was reviewed to see if it should be narrowed down or joined with another idea. After this was complete, a final list was created.

Theme Creation

This step involved organizing the repeating ideas into groups or themes. The themes were identified by focusing on the coded ideas from the last step, rather than the data itself. The process began by sorting the repeating ideas into rough categories. Once this was complete, the categories were reviewed several times to look for similarities and differences within and between them. Ultimately, the goal was to organize the ideas into higher level groupings or categories reflecting common themes. Through this process eleven themes were identified using 44 of the repeating ideas (see Figure 17 - Coding Process). Each theme was given a title. The remaining two repeating ideas were grouped as miscellaneous ideas.

Developing Constructs

The final phase in the data coding process involved creating constructs. The 11 themes were systematically grouped into five constructs (see Figure 17 - Coding Process). This final pass through the data was used to draw conclusions, build arguments and develop /organize the participant's comments in the results section. Further, this last step was used to begin to develop theory, where theory is defined as a description of a pattern found in the data (Auerbach & Silverstein, 2003).

3.6.2.3 Interviews with Teachers and Health Care Workers

Since only five interviews were conducted with both teachers and health care workers (10 total) these interviews were analyzed separately and used primarily to provide context / gain more information. The responses were compiled and organized by question in a word document so that common themes could be drawn. In the case of these

interviews the analysis was minimal. Instead the goal was to allow the data to speak for itself rather than explain it in abstract concepts or theories. Neuman (2007) refers to this as ‘the Narrative’ approach to presenting qualitative data. Given that a limited number of interviews were conducted this approach seemed to be appropriate since the amount of text involved was minimal in comparison to that from the interviews/ focus groups with household heads.

3.7 Reflections from the Field

This section aims to describe my experiences in Ethiopia with the hope of providing a richer description of the context within which this project was conducted. The content in this section may provide some insight into what future researchers can expect when conducting similar research in Ethiopia and in particular in the Kembata Zone.

3.7.1 Arrival in the Field

I arrived in Addis Ababa, Ethiopia on August 21, 2007. After taking a few days to get settled I made my way over to the ORBIS Ethiopia office to meet Dr. Wondu Alemayehu and Dr. Gabremaskal Habtemariam whom I had been communicating with over the internet for the past year about my project. While at the office, I was also introduced to Asrat Gebre, Field Coordinator for the KAT Zone who would be my main contact from ORBIS while I was in the field. After meeting some of the other staff and reviewing some of the logistics I was on my way along with two boxes containing the original paper copies of the clinical examination forms, Household KAP Questionnaire and the Questionnaire for KAP survey of Trichiasis Cases from ORBIS’s baseline trachoma survey conducted earlier in the year (May 2007).

At this point I still had not received my ethics approval from the University of Victoria and therefore was not able to go into the field. Further, it was still the rainy season in the KAT Zone and I was told the roads to some of my study *gotts* would be

impassable until late September. While I waited for the approval and for the rains to end my mother and I travelled to Lalibela and Bahir Dar in Northern Ethiopia and did a tour of tribal groups in the Omo Valley in Southern Ethiopia. On the way back from the Omo Valley we asked our tour operator to stop in Alaba Kulito, the town I would be living in while I conducted my field work. In Alaba Kulito we briefly visited the hotel I would be staying at and spoke to the owner about reserving a room. A day later we were back in Addis Ababa and a couple days after that my mother flew home. Although our travels around Ethiopia were largely recreational in intent, they did broaden my understanding of Ethiopian culture and history. Further, travelling also helped me understand the diversity and richness the country has to offer in terms of culture and landscape. Following our travels, I spent a few weeks in Addis Ababa manually entering the data from the surveys into an Excel Spreadsheet while I waited for my ethics approval.

3.7.2 First Days in the Field

On October 5th I received notification that my project had been approved. Four days later I headed to Alaba Kulito with a barrel of food (containing noodles, soup, a case of chocolate bars and cereal) and a kettle in hand. I checked into my hotel mid-day on October 9, got settled and then enjoyed a quick tour of town on the back of Asrat's moped.

The following day Asrat took me to meet with the regional health officials to obtain permission to conduct my research. After approval was granted, a stack of letters addressed to the chairman of each *kebele* outlining my research was signed and stamped by a staff member at the regional health office. These letters were later presented to the chairman of each *kebele* prior to data collection in order to explain why we were there and to help avoid any problems from occurring. In the evening, Asrat helped me find a guide, translator and driver to assist with my research.

Over the next couple of days I accompanied Asrat to work to learn a little more about ORBIS's work. I was fortunate to have the opportunity to sit in on a health

extension worker (HEW) training session that he was speaking at. The Health Service Extension Program (HSEP) was launched in 2003 by the Ethiopian government. It aims to deliver preventive and basic curative health services at the community level. In particular, the program focuses on improving mothers and children's access to and utilization of health care services. Under the program each rural *kebele* is assigned two HEW's to deliver health care services. The HEW's are expected to spend 75% of their time in the field conducting outreach services and 25% of their time at a local health post (Admassie, Abebaw, & Woldemichael, 2009). The HEWs have to have completed grade 10 and are trained for approximately one year on basic health care services. Medicine and supplies for the health posts are provided by the Federal Ministry of Health, the Regional Health Bureaus and the *Woreda* Health Offices. In 2007, 57% of rural *kebeles* in the country had implemented the program (Admassie et al., 2009).

The lecture I attended was being offered at the hospital in Durame. The presentation focused on various eye issues including trachoma. Fifty six women from four regions were participating. The women were given statistics on blindness, shown diagrams of the eye, informed about various eye conditions / diseases and taught different methods to identify an eye problem. Sitting in on this session was a valuable opportunity for me to learn more about the eye, the Health Extension Worker program and the type of training the HEW's received.

3.7.3 Data Collection

On October 15th my driver arrived. The following day my translator, guide, driver and I headed to the first *gott* in my study area to begin collecting data. From Alaba Kulito it took close to an hour to get to the *gott*. The main road to Durame was fairly well maintained; however, the road from Durame to the *gott* was in rough shape. Nevertheless, eventually we made it to the *gott* and were able to survey 20 households on our first day. Over the next couple of days we seemed to develop a system and our surveying became far more efficient. In the end we were averaging one and a half to two full *gotts* a day. We worked six days a week (Monday to Saturday). We left Alaba Kulito around 7:30 am

each day and came back between 5pm and 6pm before the sun came down. In the beginning, my driver would stay with the vehicle to watch over it, while my translator, guide and I went to the households. However, once I started conducting interviews / focus groups (we completed the first one on day six) we decided it would be more time efficient if my translator stayed in the car with my laptop to start transcribing. In the end, we managed to survey all the *gotts* and conduct either an interview or focus group in each by mid-November. Once this was complete, we interviewed the health care workers, interviewed the teachers and spent a full day and night in one of the *gotts* so that I could more closely observe community life.

The main challenge we encountered in the field was the roads. On a couple of occasions we got stuck and had to get pushed out. Another challenge was the bees. Many of the households had beehives attached to their houses for honey. Although the bees generally stayed near their hives one day while collecting data we were warned that the bees were upset a few houses down and that we had to stop surveying. Fortunately, we listened and got into our car in time. As we drove away we saw that others were not as fortunate and were desperately swatting the air as they tried to escape the swarm of bees that was attacking them.

3.7.4 Life in Alaba Kulito

While in the field I lived in a hotel in Alaba Kulito, the administrative center of Alaba Special *Woreda*. My hotel room had a bed, table, bedside stand and a private bathroom with plumbing and shower. Although basic, the room was considered the nicest in town. I never saw any other females staying at the hotel other than the resident prostitutes who frequented the hotels bar at night for clients. In rural Ethiopia, women generally do not go into the bar unless they are prostitutes. Thus, in order to avoid any problems I stayed clear of the restaurant/bar after sundown. The bar was always the busiest on Thursdays, which was the market day in Alaba Kulito. My translator and contact from ORBIS Ethiopia also lived in town and my driver who was from Addis Ababa stayed at the same hotel as me. Next to no one in Alaba Kulito spoke English.

Thus, I heavily depended on my translator and contact from ORBIS Ethiopia to help me. Cell phone service in town was intermittent and internet service was extremely slow and unreliable.

In general, I did not leave the compound of my hotel without someone I knew. On the few occasions that I did it was to walk to Asrat's house or to buy bread. In Alaba Kulito I seemed to attract more attention than I did in other parts of Ethiopia, making it extremely difficult for me to go out on my own. This could have been because as far as I knew I was the only foreigner in town at the time. Any time I tried to venture out on my own the adults would stop what they were doing to stare and on occasion yell and a crowd of children would swarm me yelling "Abba". Unfortunately, I never found out exactly what this meant. Amongst the swarm of children there would always be a few who knew a couple of English phrases. Usually I would be asked "How are you?", "What is your name?", "Where do you come from?" before their English vocabulary ran out. Although endearing, the crowd of children could get so large it made it difficult to walk. On occasion I would sit just outside the gate of my hotels compound to observe life in Alaba in an attempt to learn more about the community. This seemed to be a safe approach since as soon as the attention I received started to get out of hand I could escape back into the compound where the people could not follow. Nonetheless, for the most part I spent my evenings in my hotel room planning for the next day's field work and entering data. On Sunday's (our day off) I would either go to Asrat's house to use the internet/visit or my driver would take me to Awassa, the closest city and the capital of the Southern Nations, Nationalities and Peoples Region.

3.7.5 The Communities Response to me

The majority of the communities I visited were welcoming and most people were happy to participate in my research project. Often we were given fruit or beans as we travelled from house to house and on occasion we were invited in for coffee and snacks. The hospitality we received was overwhelming particularly given the stark poverty of the people. The children were usually excited to see us and seemed to enjoy laughing at the

Ferenji or white person in their community. Nonetheless, because my guide and translator were with me they usually kept their distance with the exception of the brave few who would try to talk to me. In contrast, when I approached some households the babies and small children would cry or hide when they saw me. My translator told me it was because they had never seen a white person before and were afraid. In fact, one little girl was so busy staring at me that she actually fell into a 2m deep hole and hurt her wrist. I felt terrible watching her cry and left hoping that she had not broken it.

Amongst the children and the adults my digital camera was a hit. One family and one woman actually changed into their best clothing for pictures which I later sent to them. Further, when my husband came to visit he ended up taking photo finish pictures for a group of children's foot races for over an hour. Although taking photos can get tiring, my camera definitely helped bridge cultural divides and gave us all something to laugh about.

While visiting the households my translator was often asked if I was a missionary. In the past the region had a large number of protestant missionaries. Since I was a foreigner they seemed to assume I was somehow associated with the missionaries. Fortunately, from what I could tell the missionaries were well liked in the area and as a result of their positive experiences most people were receptive to me even though I was not a missionary. My translator explained that the missionaries brought roads and aid to the region that the people were grateful for. On occasion my translator was also asked what my religion was. When he replied that I was Catholic the people seemed content and happy to cooperate with me. I'm not sure if their attitude would have been different if given a different response. However, I do recall another foreigner telling me that based on his experience as long as you say you are something (i.e. Christian, Muslim or Jewish) the people were content, but if you say you have no religion they have a hard time comprehending this. He himself was non-religious, but told people he was Catholic. Similarly, after visiting a household of potters in my study area my translator mentioned to me that people have "a bad feeling towards potters". When I asked why he explained that people do not like them because they are pagans and they eat cattle that die of natural causes. Further, he elaborated that they keep to themselves and only marry other potters.

Although the majority of people were receptive, there were a few instances where our presence created controversy and/or was not welcome. In addition to associating foreigners with missionaries, the people also associate foreigners with aid and development. As a result some people became suspicious when I was only visiting a sample of households in each area or only interviewing one person. My translator explained to me that they thought that the households I visited were going to receive something for their participation that the others would not. Even after explaining that we were there only for research purposes, the houses chosen were a sample and no one would be receiving anything for participating, a couple of individuals still did not believe us. In these cases my translator and I decided it would be best to just pretend to survey the upset individual's household in order avoid any unnecessary problems and so we could carry on with our work. However, in one *gott* a group of women became quite upset when they realized we had finished collecting coordinates and had not been to everyone's households. They asked to see our permission letter, yet were still not satisfied once they saw it. I did not understand the conversation; however, I could tell that one woman in particular was very upset. Eventually my translator told me that we needed to leave without conducting our planned focus group. In the end, we drove to another part of the *gott* and conducted a quick interview before taking off. Later on my translator mentioned that part of their suspicion may have been due to the fact that my guide was wearing his *tagiyah* (a short rounded cap worn by Muslim men) that day and we were in a predominantly protestant area. Although Muslims and Christians generally get along in Ethiopia a few Christians suggested a distrust of Muslims while I was there. In contrast, I did not have any Muslims express similar views towards Christians to me. However, this could be because I come from a Christian background.

Another common misperception was that I was a doctor. I assume they thought that because I was doing research on trachoma I must have some medical knowledge. A few times I was asked to take a look at someone or asked for medication. Fortunately, people were understanding when my translator explained that I was a Geographer and could only offer some basic supplies from my first aid kit.

3.8 Conclusion

The above chapter explained the methods used in this thesis. A combination of qualitative and quantitative methods were employed to address the series of subquestions provided in chapter one. Mixed methods were used in order to gain insight into the complexity of the issue and capitalize on the strengths of both approaches. This chapter also attempted to provide a summary of my experiences in Ethiopia including some of the challenges I encountered and how my experiences may have impacted the results. As a foreign researcher I felt that it was particularly important to highlight the research participant's reaction towards my research team and I, since their feelings could have impacted the responses we received in the interviews and focus groups.

4. Results

4.1 Introduction

The following chapter provides a detailed description of the research results. The chapter begins by presenting the results of the quantitative analysis. This section includes the baseline maps and results of the cluster and multi-level analyses. Subsequently, the results of the qualitative analysis are provided. This section is sub-divided into four components: description of the sample population, interviews and focus groups with household heads, interviews with teachers and interviews with health care workers.

4.2 Quantitative Results

4.2.1 Multi-Level Modeling

4.2.1.1 Model #1

The first model used mixed effects logistic regression to look at which predictors most influence whether a child develops active trachoma. Out of the 13 predictors explored; age, facial cleanliness and household expenses (on a per person basis) were found to be significant risk factors ($p \leq 0.05$). Table 4 below summarizes the results of the analysis.

Table 4 - Results from Model #1: Exploring the Influence of the Predictor Variables on Whether or not a Child Develops Active Trachoma

	Estimate	Std. Error	p-value
Intercept	-0.49	0.32	0.12
Age	-0.11	0.02	< 0.01
Face	0.98	0.15	< 0.01
Expenses	-0.01	0.00	0.03

Children with an unclean face were found to have a higher probability of developing trachoma. More specifically, based on the adjusted odds ratio, children with unclean faces were more than twice as likely to develop active trachoma as children with a clean face. The probability of developing trachoma decreased as the amount of money spent per person in the household increased. For each unit (1 ETB) increase in per person monthly expenses, the odds of a child developing the condition decreased by a factor of 0.9. Similarly, as age increased, a child's likelihood of developing the condition decreased. Specifically, the adjusted odds ratio revealed that younger children were more likely to develop the condition by a factor of 0.8. No significant relationship was found between sex and the likelihood of developing trachoma. Figures 3 through 6 graphically illustrate each of these relationships.

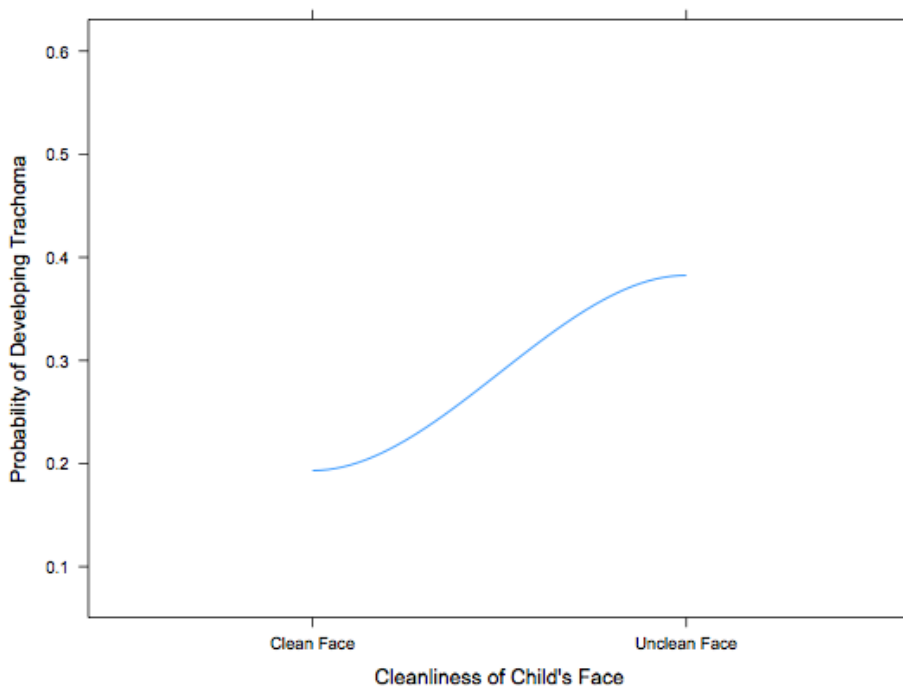


Figure 3 - The Relationship between Facial Cleanliness and a Child's Probability of Developing Active Trachoma

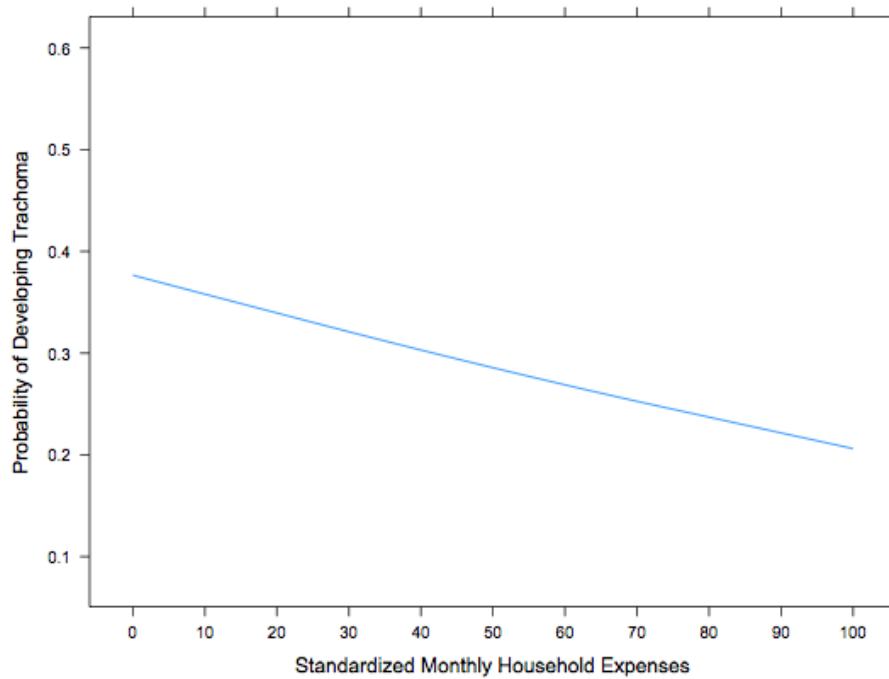


Figure 4 - The Relationship between Monthly Household Expenses and a Child's Probability of Developing Active Trachoma

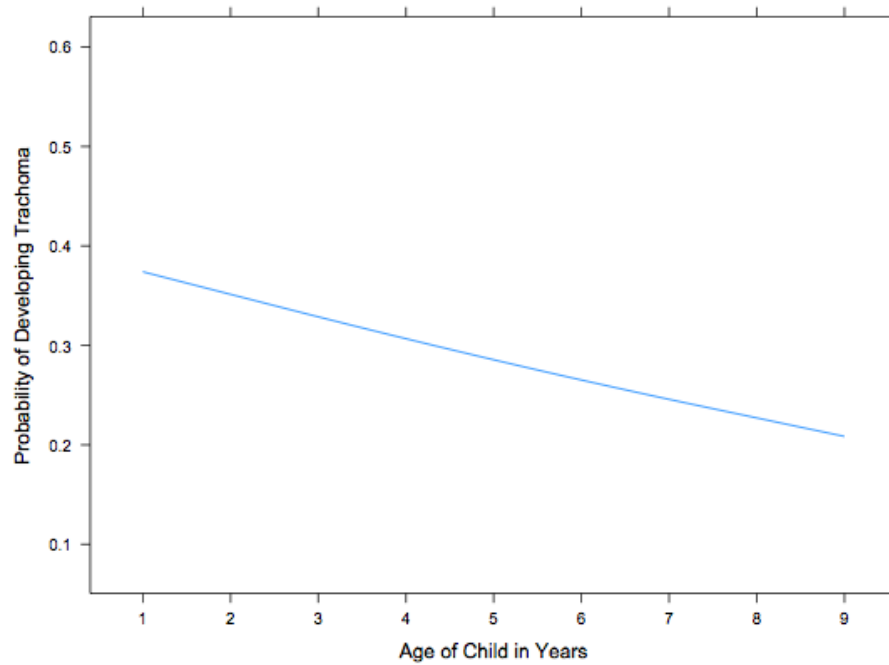


Figure 5 - The Relationship between Age and the Probability of Developing Active Trachoma

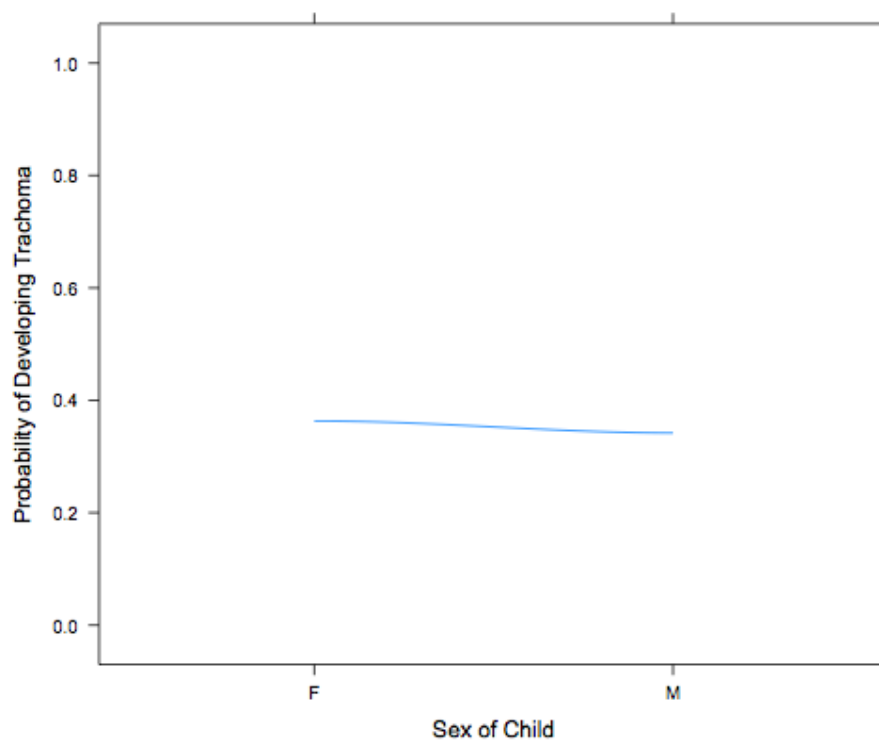


Figure 6 - The Relationship between Sex and a Child's Probability of Developing Trachoma

4.2.1.2 Model #2

A second model was used to investigate which predictors influenced trachoma severity in a child with active trachoma. Trachomatous inflammation – Intense (TI) is considered more severe than trachomatous inflammation – follicular (TF). Similar to model #1, age and facial cleanliness both showed a statistically significant relationship ($p \leq 0.05$). Further, the distance from the child's home to the closest latrine also had a strong positive influence. Table 5 below summarizes the results of the analysis.

Table 5 - Results from Model #2: Exploring the Influences of the Predictor Variables on Whether or Not a Child with Trachoma will Develop TF or TI

	Estimate	Std. Error	p-value
Intercept	-2.87	0.82	< 0.01
Age	-0.30	0.11	< 0.01
Face	4.94	0.83	< 0.01
Latrine Distance	0.01	< 0.01	0.06
Age by Face	0.88	0.14	< 0.01

Figure 7 shows the relationship between age and the probability that a child will develop TI, given that they have active trachoma. Initially, the slope is relatively flat suggesting that there is no real change with age. However, around the age of five the line starts to slope upwards. This suggests that if a child above preschool age does develop active trachoma (which was less common in model #1) they are slightly more likely to develop the more severe form.

A strong interaction between age and facial cleanliness was found in model #2. Model #1 showed that as age increased the risk of developing active trachoma decreased. Further, children with unclean faces were more likely to develop active trachoma. In model #2, older children with clean faces and active trachoma are less likely to have TI, the more severe form of the disease. However, as age increases, children with unclean faces and active trachoma are much more likely to develop TI (see Figure 8 below). Although this relationship makes sense in older children, surprisingly children under five with clean faces have a higher probability of developing TI than children under five with an unclean face.

An unexpected relationship was found between trachoma severity and the distance to the closest latrine. A child with trachoma was found to be more likely to develop TI the further they lived from a latrine. Figures 7 through 9 graphically illustrate each of the above relationships.

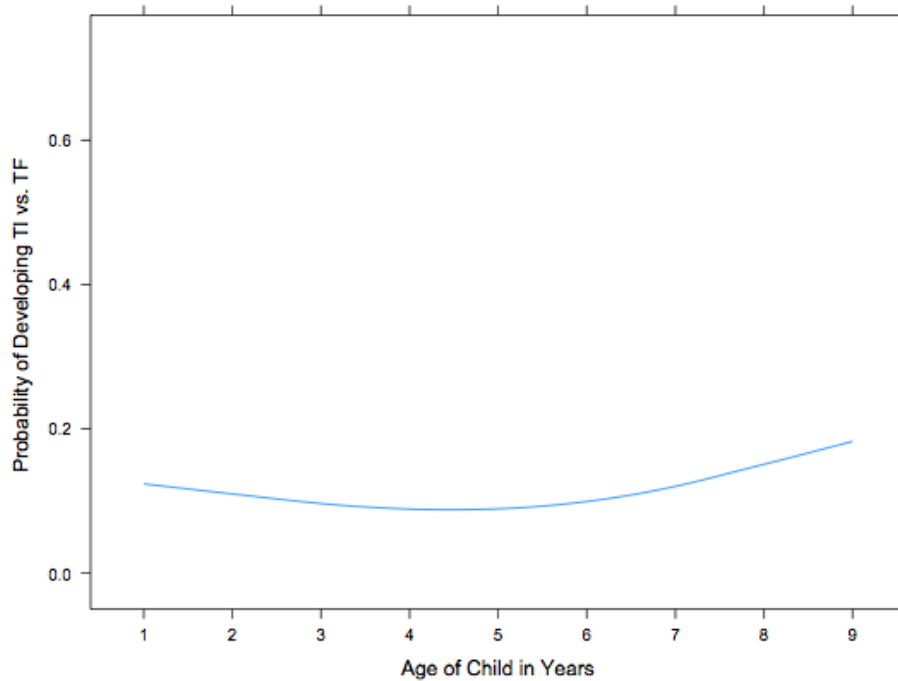


Figure 7 - The Relationship between Age and Trachoma Severity

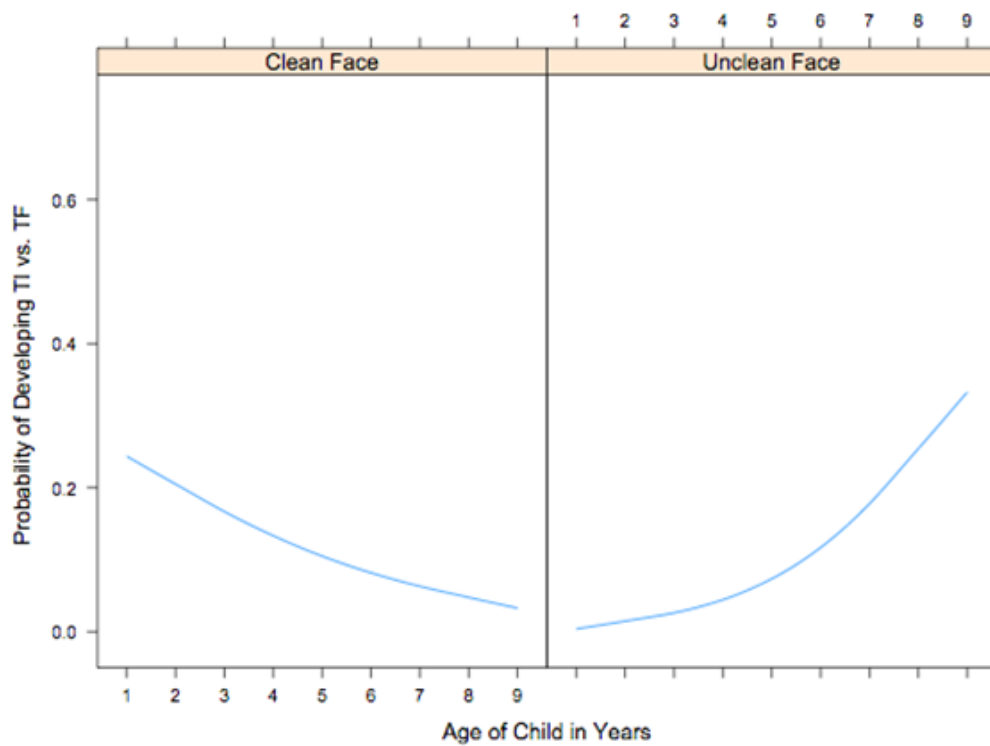


Figure 8 - The Interaction between Age of Child and Cleanliness of a Child's Face

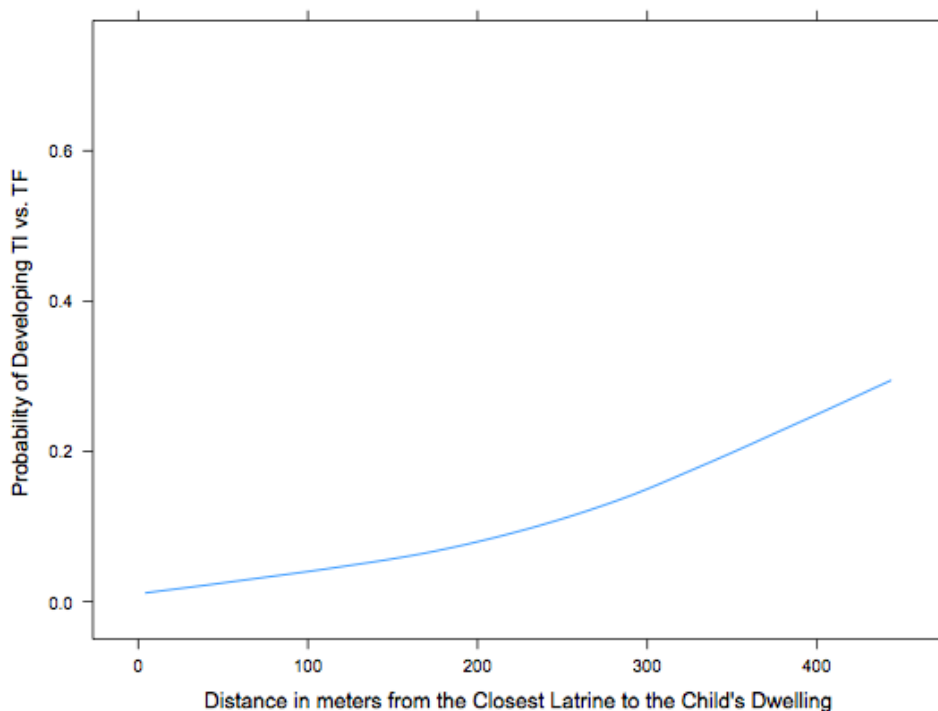


Figure 9 - The Relationship between Latrine Distance and Trachoma Severity

Using the results from model #1 the probability of children with clean and unclean faces developing active trachoma under different economic and social situations was estimated. Similarly, using the results from model #2 the probability of children with clean and unclean faces developing TI over TF under different economic, geographic and social situations was explored. The following two tables summarize the results.

Table 6- Probabilities of a Child Developing Trachoma Using the Results from Model #1

Age	Expenses (ETB)	Probability of developing trachoma – if Face is Clean	Probability of developing trachoma – if Face is Unclean
1 year	Low (10)	33%	57%
4 years	Medium (50)	20%	40%
8 years	High (90)	10%	23%

Table 7 - Probabilities of a Child Developing TI vs. TF Using the Results from Model #2

Age	Latrine Distance (metres)	Probability of developing TI vs. TF if face is Clean	Probability of developing TI vs. TF if face is Unclean
1 year	Mid (45)	6%	1%
4 years	Mid (45)	2%	1%
8 years	Mid(45)	1%	6%

4.2.2 Spatial Distribution of Trachoma Risk Factors

A series of maps showing the three most significant clusters with higher than expected number of children with unclean faces, number of people with low per capita monthly expenses (< 36 ETB/person) and number of households with low latrine ownership are provided below. Although multivariate analysis did not find a relationship between latrine ownership and trachoma, ORBIS Ethiopia's bivariate analysis did. Hence, the distribution of households with low latrine ownership was explored. Age was not investigated since it is not a modifiable risk factor and therefore is of less interest in this study. In the maps clusters four and seven are located outside the boundaries of Kedida Gamela *Woreda*. The *Woreda* polygons were created by digitizing a map that was not spatially referenced. Once digitized, the map was georeferenced in AutoCAD using a set of control points from topographic maps of the area. Since the georeferencing process uses a model to assign a geographic location to the map image there is some error. Consequently, two of the clusters are located outside the boundaries.

4.2.2.1 Unclean Faces

The cluster analysis identified 11 significant clusters (at the 0.05 level) with a higher than expected number of children with unclean faces. The three most significant clusters are mapped in Figure 10 below. The most significant cluster is centered on cluster 18, house 22 and has a radius of 6.33 km. It covers the central portion of the study area and includes parts of both Kedida Gamela and Damboya *Woredas*. Secondary Cluster #1 is centered on cluster 28, house 24. It has a radius of 4.23 km and is centered

over Kedida Gamela *Woreda*. Secondary Cluster #2 is centered on cluster 29, house 1. It is very small and only includes cluster 29 within its boundary. The remaining eight clusters were not mapped for the sake of simplicity and ease of interpretation. Table 8 summarizes the results for the top three clusters.

Table 8 - Statistics on the Clusters of Unclean Faces

	Most Likely Cluster	Secondary Cluster #1	Secondary Cluster #2
Expected Cases	497.18	221.86	48.33
Number of Cases	557	265	66
Observed / Expected	1.12	1.19	1.37
Relative Risk	1.23	1.25	1.39

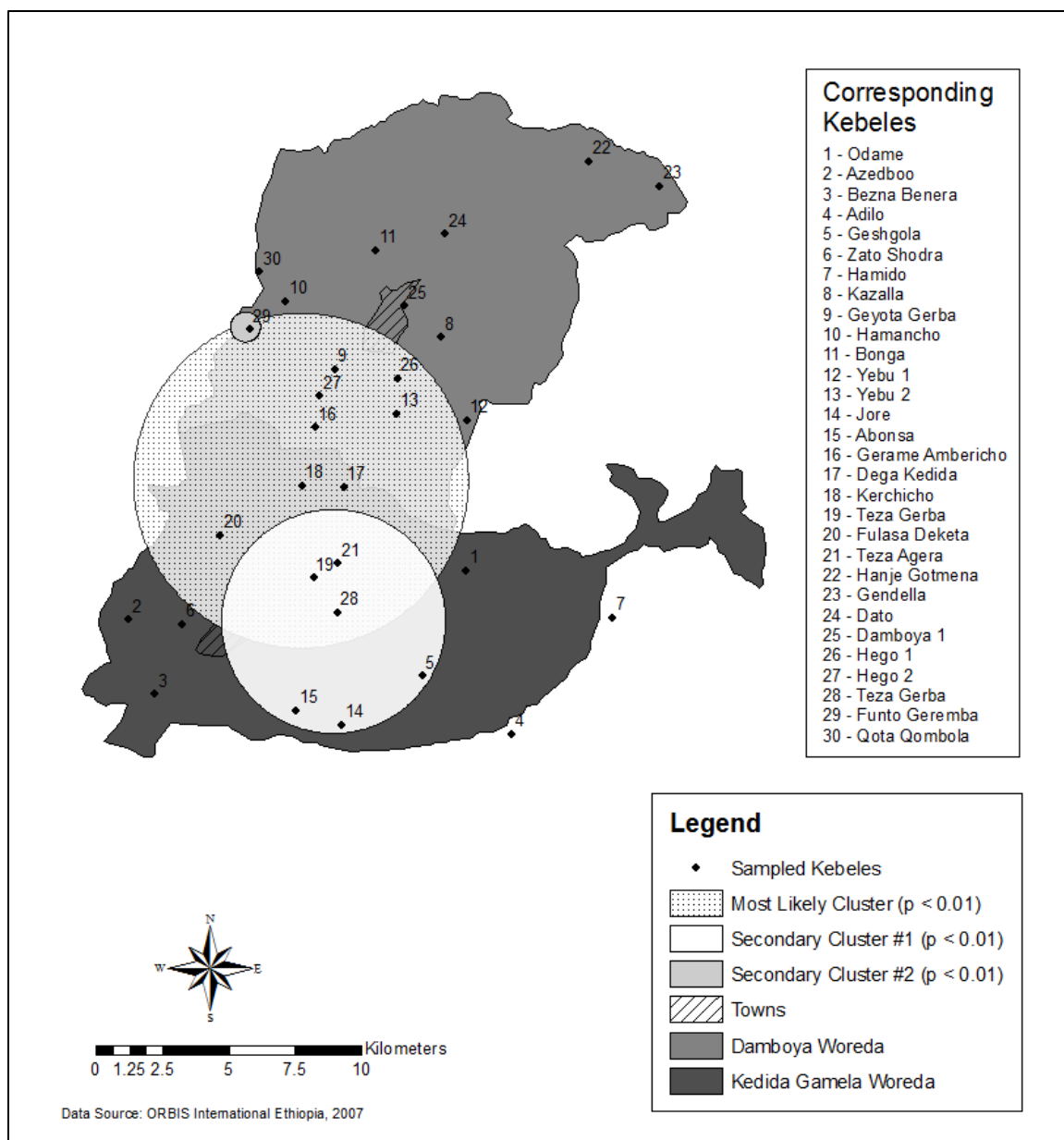


Figure 10 - Clusters of High Levels of Children with Unclean Faces

4.2.2.2 Low Per Capita Monthly Expenses (< 36 ETB/ person)

The cluster analysis identified 11 significant clusters (at the 0.05 level) with a higher than expected number of individuals with low per capita monthly expenses. The three most significant clusters are mapped in Figure 11 below. The most likely cluster is centered on cluster 27, house 1. It has a radius of 2.51 km. Secondary cluster #1 is

centered on cluster 29, house 1 and has a radius of 5.32 km. Finally, secondary cluster #2 is centered on cluster 19, house 10. It has a radius of 1.25 km. The following table summarizes the results.

Table 9 - Statistics on the Clusters of Low per Capita Expenses (<36 ETB/person)

	Most Likely Cluster	Secondary Cluster #1	Secondary Cluster #2
Expected Cases	37.44	71.93	26.60
Number of Cases	72	118	53
Observed / Expected	1.92	1.64	1.99
Relative Risk	2.15	1.94	2.16

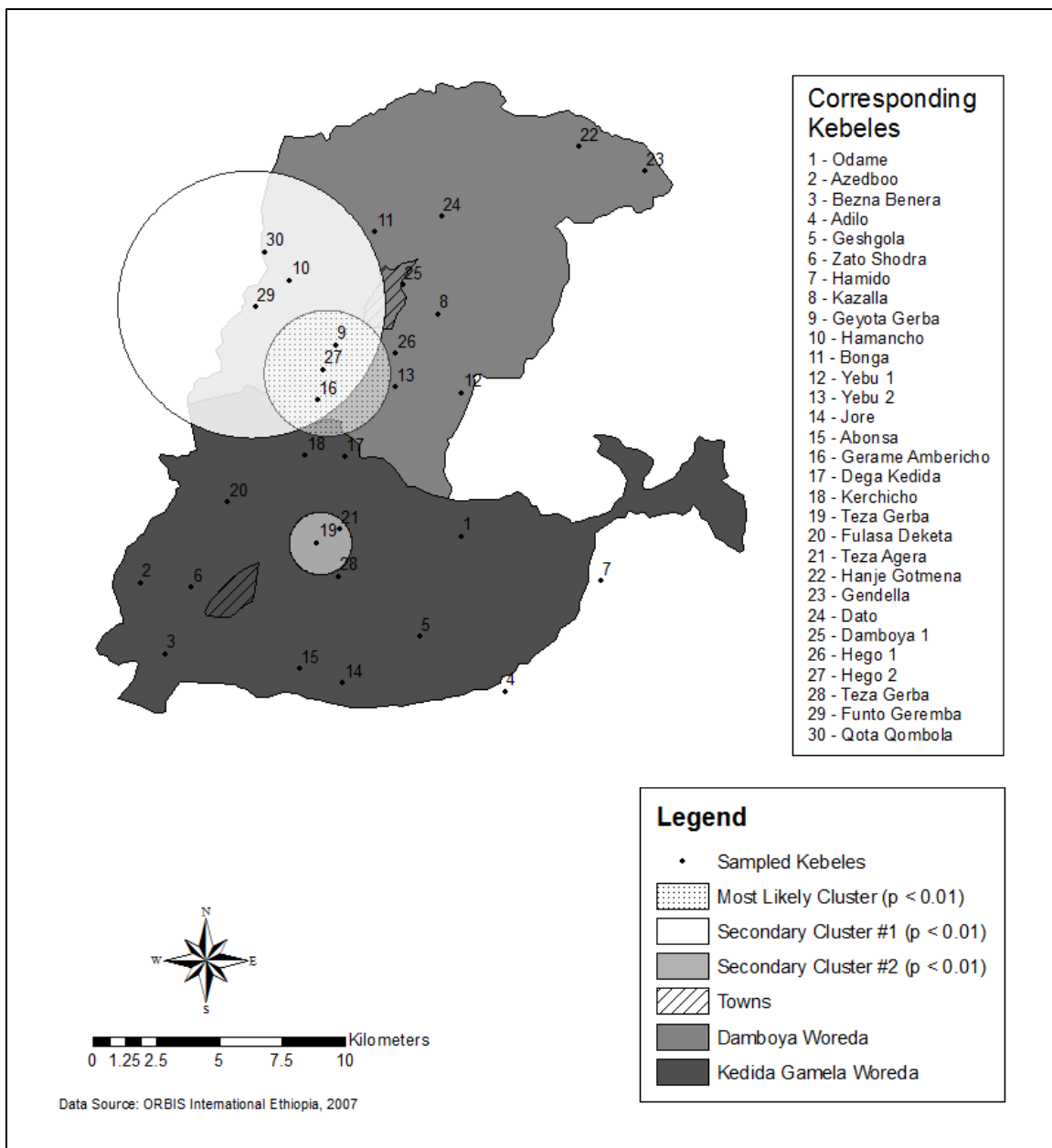


Figure 11 - Clusters with High Levels of Individuals with Low per Capita Monthly Expenses

4.2.2.3 Low Latrine Ownership

The cluster analysis identified five significant clusters (at the 0.05 level) with a higher than expected number of households with lower than expected latrine ownership. The three most significant clusters are mapped in Figure 12 below. The most likely cluster is centered on cluster 12, house 3. It has a radius of 2.43 km. Secondary cluster #1

is centered on cluster 24, house 11 and has a radius of 0.22 km. Secondary cluster #2 is centered on cluster 22, house 16 and has a radius of 0.34 km. Both of the secondary clusters are very small and reveal that clusters 22 and 24 had a significantly higher than expected number of households without a latrine. Table 10 summarizes the results.

Table 10 - Statistics on the Clusters of Low Latrine Ownership

	Most Likely Cluster	Secondary Cluster #1	Secondary Cluster #2
Expected Cases	12.70	3.53	6.70
Number of Cases	28	10	16
Observed / Expected	2.20	2.83	2.39
Relative Risk	2.35	2.91	2.48

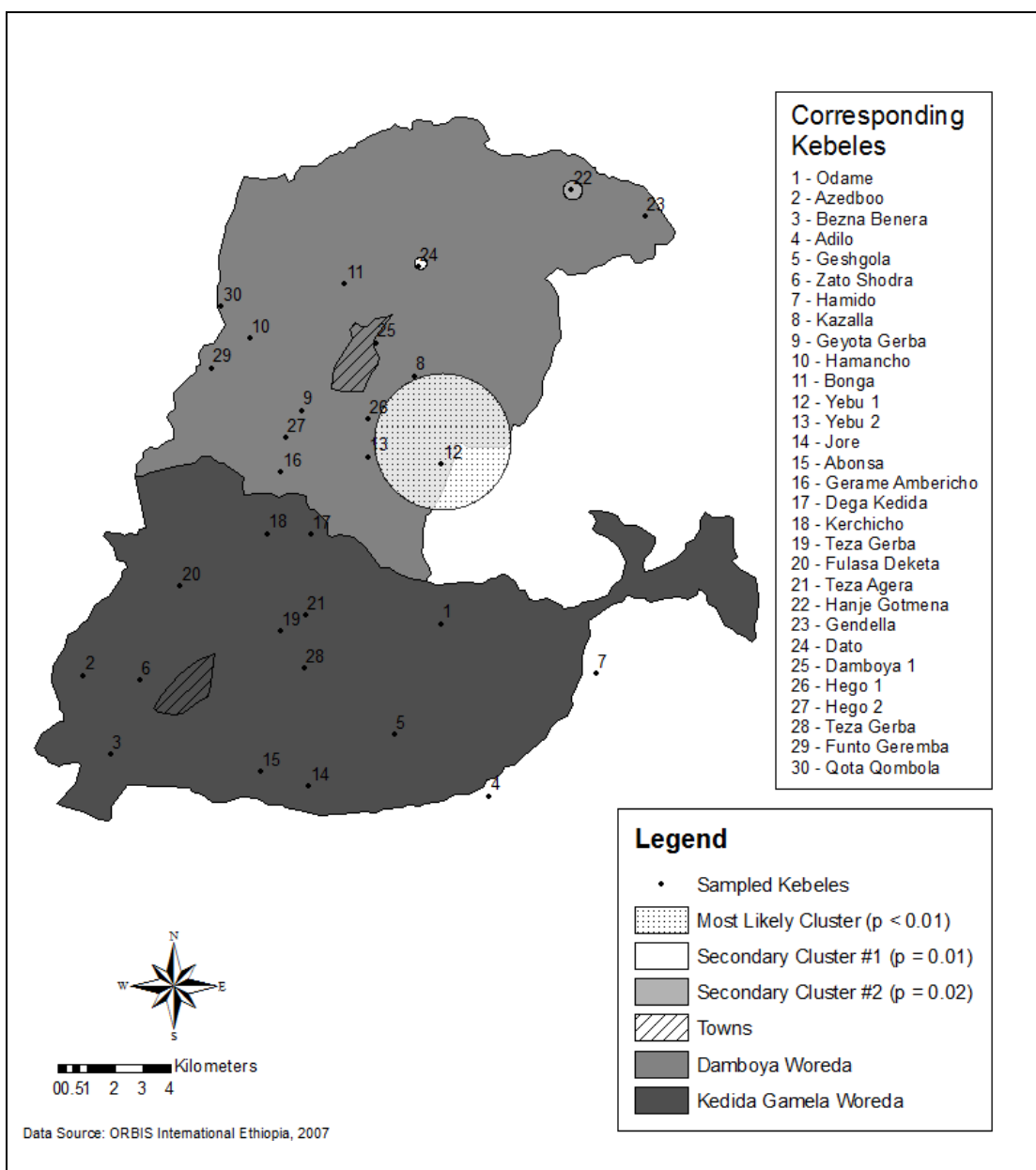


Figure 12 - Clusters of High Levels of Households without a Latrine

4.2.3 Spatial Clustering of Active Trachoma

The Kulldorff spatial scan statistic identified 10 significant clusters in the study area. The two most significant clusters ($p < 0.05$); one with high levels of active trachoma (the most likely cluster) and the other with low levels of active trachoma (a secondary

cluster), are mapped in Figures 13 and 14. Thus, the null hypothesis that trachoma cases are geographically randomly distributed throughout the study area can be rejected.

The most likely cluster of high levels of active trachoma is centered on cluster 11, house 22 in Damboya *Woreda*. It has a radius of 8.69 km and covers the northern portion of the study area. The most likely cluster of low levels of active trachoma is centered on cluster 14, house 6 in Kedida Gamela *Woreda*. It also has a large radius (11.03 km) and covers the southern portion of the study area. The following two tables summarize the results.

Table 11 - Statistics on the Most Likely Cluster of High Levels of Active Trachoma

	Children Aged 1 to 6 (Data Set #1)	Children Aged 7 to 9 (Data Set #2)
Population	387	344
Expected Cases	161.21	92.40
Number of Cases	214	113
Observed / Expected	1.33	1.22
Relative Risk	1.79	1.51

Table 12 - Statistics on the Most Likely Cluster of Low Levels of Active Trachoma

	Children Aged 1 to 6 (Data Set #1)	Children Aged 7 to 9 (Data Set #2)
Population	450	362
Expected Cases	187.46	97.24
Number of Cases	138	80
Observed / Expected	0.74	0.82
Relative Risk	0.58	0.71

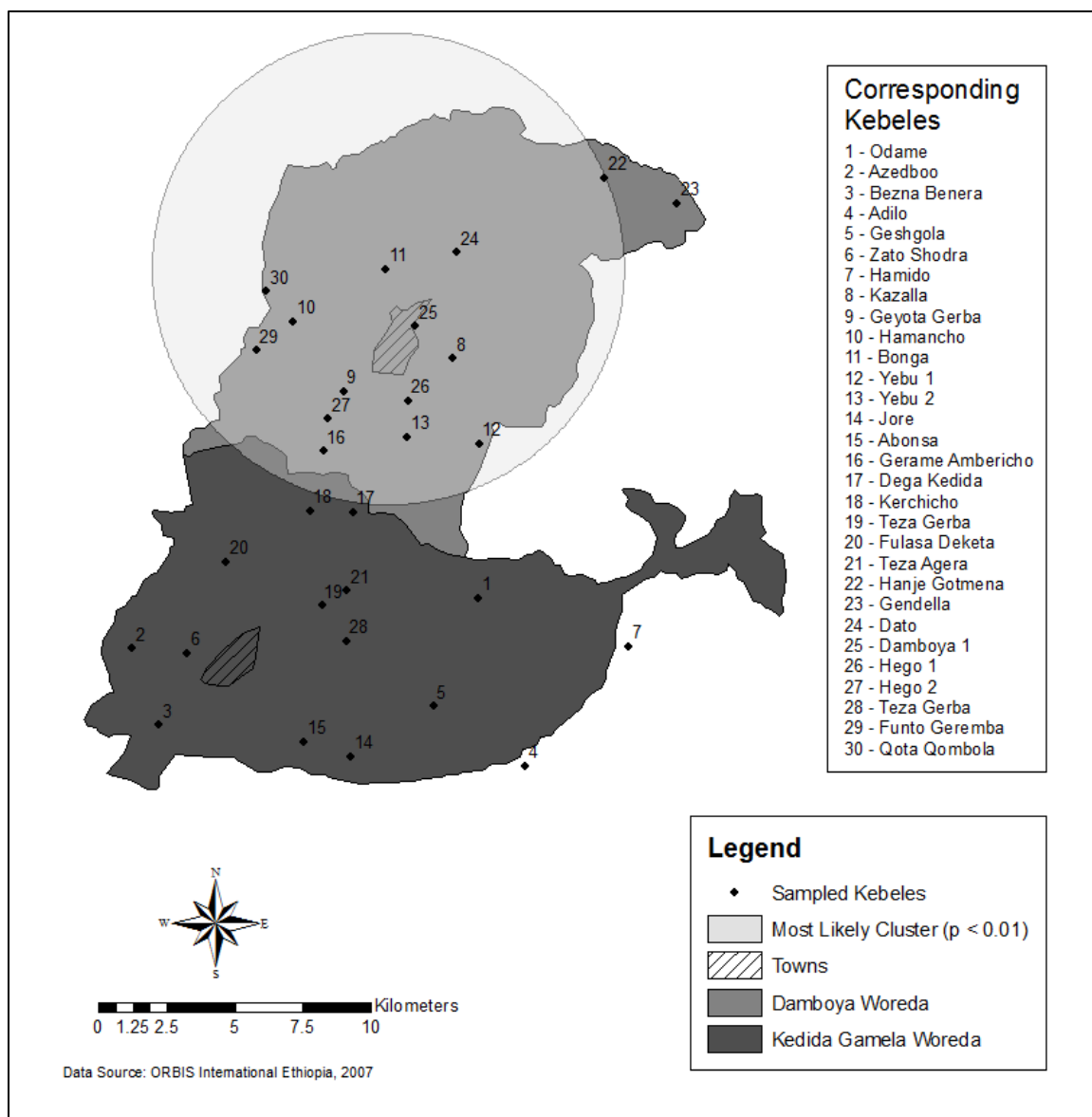


Figure 13 – Most Likely Cluster of High Levels of Active Trachoma in Children Aged 1 to 9

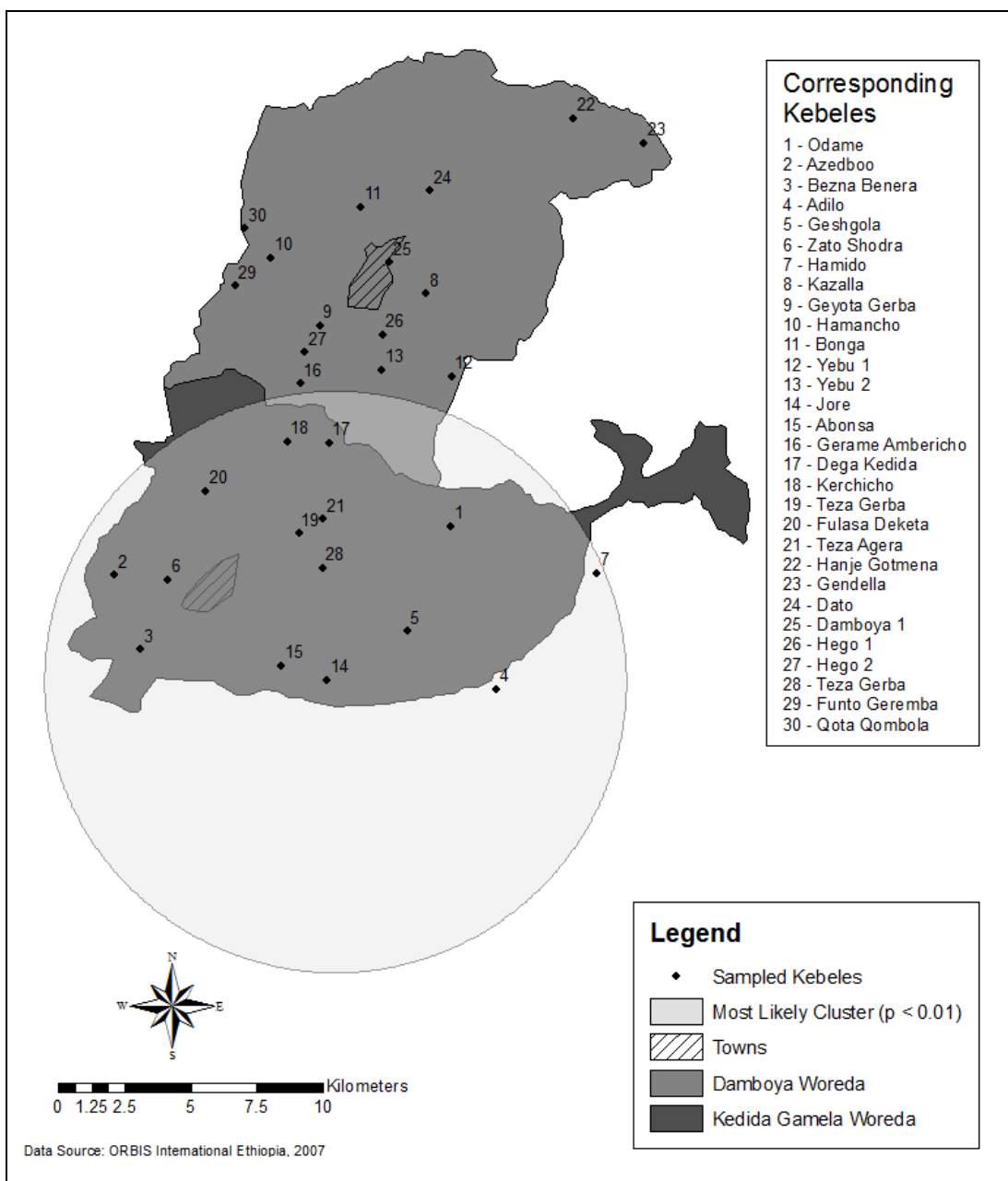


Figure 14 – Most Likely Cluster of Low Levels of Active Trachoma in Children Aged 1 to 9

Out of the remaining eight significant clusters, five had high levels of active trachoma and three had low levels of active trachoma. These secondary clusters are mapped along with the most significant high and low clusters in Figures 15 and 16 below. All except one of the clusters of high levels of active trachoma are centered in Damboya *Woreda*; and all of the clusters of low levels of active trachoma are centered in Kedida Gamela *Woreda*.

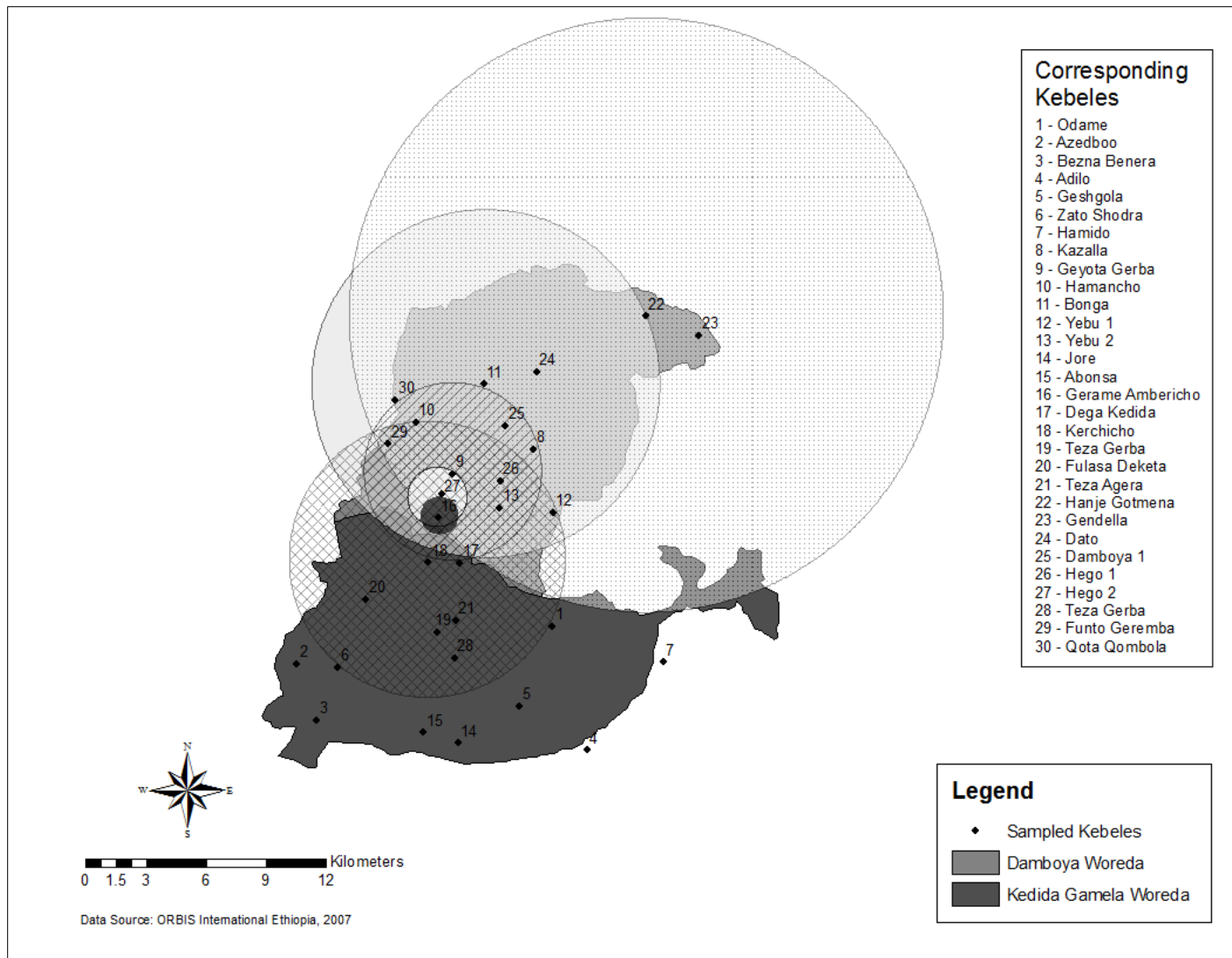


Figure 15- Spatial Clustering of High Levels of Active Trachoma in Children Aged 1 to 9

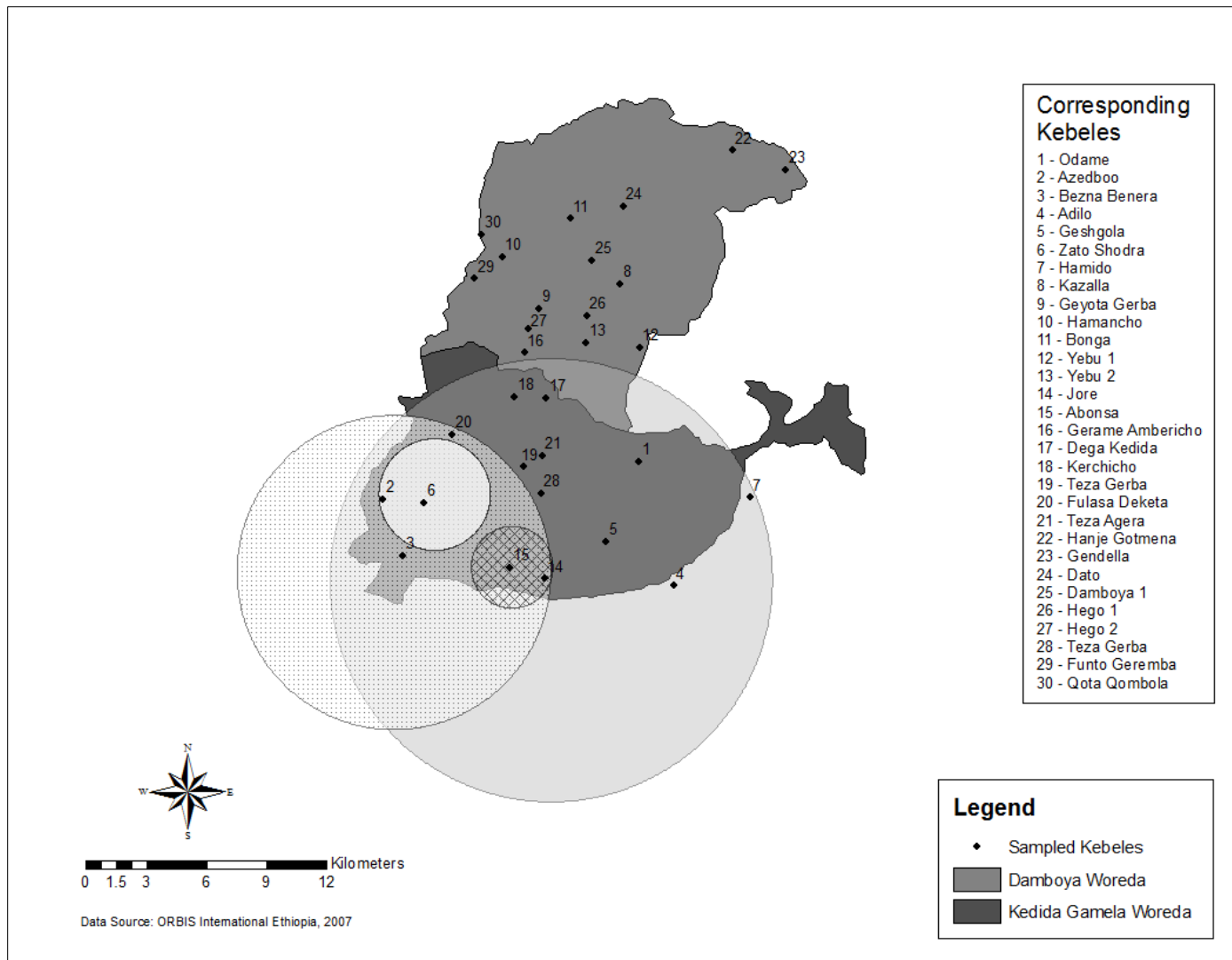


Figure 16 - Spatial Clustering of Low Levels of Active Trachoma in Children Aged 1 to 9

4.3 Qualitative Results

4.3.1 Description of the Sample Population

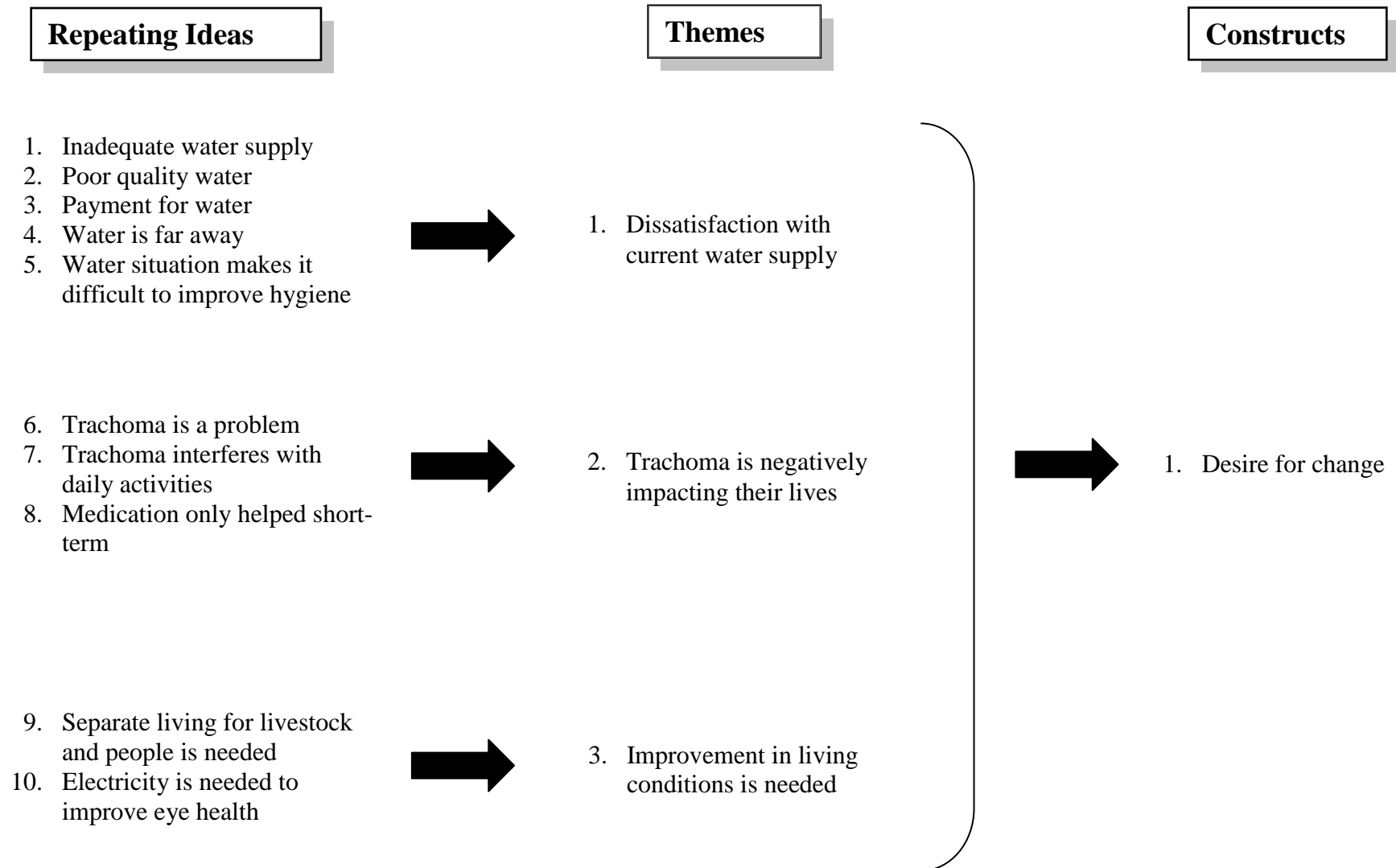
In total 20 household heads were interviewed. Out of these 20 individuals, six (30%) were female and 14 (70%) were male. Seven of the informants had no education and only one of the informants had completed high school. Thirteen of the informants were farmers, three were housewives, one was a carpenter, one made local carpets and two were students²⁵. All except one of the households had a cow or an ox, 11 of the households had both a cow and an ox, one also had a donkey and four had two or more cows in addition to an ox. Wealth in Ethiopia is generally based on a combination of livestock and land holdings. Those families that own an ox or more than two cattle are considered relatively wealthier (SNNPR Livelihood Profiles Regional Overview, 2006).

The interview fact sheet was not used during the focus groups. However, the sex of the focus group participants was noted in my field notebook for all except one of the focus groups. Out of these nine focus groups, seven (14%) of the participants were female and 43 (86%) were male.

4.3.2 Interviews and Focus Groups of Household Heads

The interviews / focus groups with household heads were conducted to gain a more in-depth understanding of the lifestyles, practices, beliefs and behaviours that contribute to trachoma risk in the study area. The informants were also asked about how/if trachoma was impacting their lives and what they saw as the solution to the problem (see Appendix 8 - Interview Questions for Household Heads, for a complete list of interview questions). In total, 20 interviews and 10 focus groups were held. The results of the coding process are summarized in Figure 17. Eleven themes and five constructs were identified based on the 46 repeating ideas found in the data set.

²⁵ One of the women reported she was a housewife and a student so the total does not add up to twenty.



Repeating Ideas

11. Trachoma is spread by insects (flies and mosquitoes)
12. Flies, mosquitoes, living with livestock, dust, the local light, lack of cleanliness, smoke, improper latrine use and animal waste cause trachoma
13. In order to minimize the number of flies the people are cleaning, washing, using chemicals, burning, using a mosquito net and using a tree or plant that bugs do not like
14. Education on sanitation, hygiene and nutrition is needed
15. Most people do not know the importance of hygiene
16. Lack of education
17. Some children have learned about trachoma in school, but others have not
18. Some people have learned about trachoma from voluntary health workers, ORBIS Ethiopia, clinics, hospitals, schools and the local NGO
19. Heard of trachoma but do not know its cause or how it transmits

Themes

4. Awareness of trachoma

5. More education is needed

Constructs

2. Lack of in-depth knowledge / education



Repeating Ideas

Themes

Constructs

- 20. Lack of money prevents people from living separate from animals
- 21. Lack of money to buy water
- 22. Lack of money makes it difficult to improve hygiene
- 23. Economic problems prevent people from going to the clinic
- 24. Job opportunities are needed
- 25. Children are taken to the hospital / clinic for eye problems if they have

- 26. Food is first
- 27. Lack of variety of food is impacting their health

- 28. Belief that hygiene is ok
- 29. Latrines are used
- 30. Most people believe their latrine is adequate

- 31. Improper use of latrine
- 32. Lack of cleanliness
- 33. Hands are washed once or twice a day without soap
- 34. Clothes are washed around twice a month
- 35. Blankets are rarely washed



6. Lack of money makes change difficult

7. Lack of food is of greater concern

8. Perception that current hygiene / sanitation is ok

9. Hygiene / sanitation is poor



3. Overwhelming poverty

4. Conflicting views of hygiene

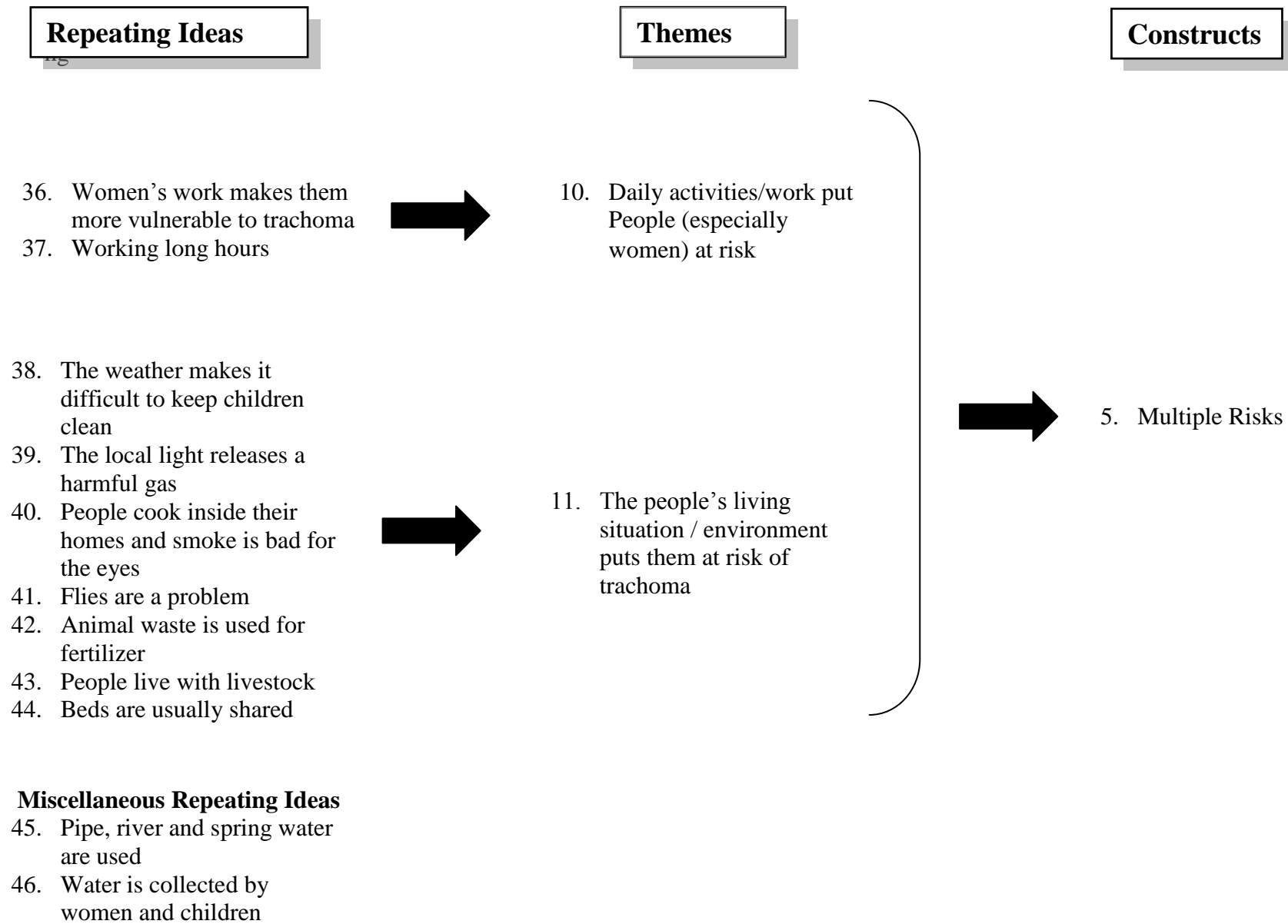


Figure 17 - Coding Process

4.3.2.1 Construct #1: Desire for Change

Throughout the interviews and the focus groups it was apparent that the people wanted change. In particular, they expressed dissatisfaction with their water supply and general living conditions. Further, when asked about trachoma most said that it was negatively impacting their lives.

Theme #1: Dissatisfaction with Current Water Supply

Water was discussed in all of the focus groups and interviews. Many individuals commented that their water supply was limited, unclean, far away and in some cases had a fee. As a result, several felt it would be difficult to improve their hygiene unless there were improvements to the supply and quality of the water.

The majority of people reported that they were getting their drinking water from a pipe and their wash water from a river or water hole. However, some individuals were using river water for all purposes, either because there was no piped water or because there was a fee for piped water. Most individuals reported that their water was collected twice a day by the women and/or children of the household. Fourteen out of the 19 informants²⁶ felt that their water supply was not adequate. During the dry season the water supply was reported to be more of an issue. For example, one informant stated “At summer time there is no problem, starting from the end of November it becomes dry.” Others also expressed that the problem was particularly extreme from November to June when the rivers and in some cases the wells dry up. Long line-ups at the water pumps were also a common concern. One individual stated “Sometimes we have to wait four hours.”

The focus group participants in Abonsa felt their water situation was particularly dire. One individual explained, “It’s a serious problem in this area, the lack of water. This is different from the others. It’s a serious problem.” The group elaborated that their pipe had been broken for two years and that they were forced to get their water from the river.

²⁶ I had a conflicting response for one of the informants so this individual was left out.

However, the river only flows during the rainy season from June to August. As a result, during the dry season most people are forced to travel long distances to access water from another river. The only exception was wealthier individuals who were reported to be buying their water from private homes in Durame during the dry season.

Payment for piped water was also reported to be a problem. For example, one interviewee stated “Around 10L is almost 40 cents, but you know for poor people it is difficult to get that money every day.” In other areas the cost for water was different; one *gott* said they paid 50 cents for 50 L and another said they paid 15 cents for 25L. When I asked what the payment was used for I was told it either went to the Non-Governmental Organization that created the well or was used to pay a guard.



Figure 18 - The Water Line-up in Adilo

Theme #2: Trachoma is Negatively Impacting Their Lives

When the focus group participants were asked if trachoma was a problem in their community all 10 groups said it was. One of the focus group participants in Zato Shodra elaborated “It isn’t a serious problem, but there is a problem. Often we are going to the hospital and spending more money to cure it.” In Abonsa one individual explained

“Especially children are a victim in this area of trachoma.” The participants from all 10 focus groups also felt that trachoma interfered with their daily activities. Eight of the groups elaborated on how it interfered with their daily lives. The majority said that trachoma interfered with their ability to work for long periods of time because it caused tears, pain, discomfort and/or sight problems. One individual explained, “I am a victim of trachoma and cannot wake up early because of my trachoma. My eyes water in the morning time so it is difficult to wake up at the morning time.” Another individual commented “Someone who is a victim of trachoma cannot work for a long time and someone who is a victim of trachoma cannot read for a long time.” Other problems included the inability to harvest or plough land after noon and sensitivity to smoke. When asked how they thought trachoma could be eliminated many individuals said (amongst other things) that long-term access to medication was needed since the medication they received so far only helped in the short-term. Another theme was the desire for free medication.

Theme #3: Improvement in Living Conditions is Needed

The need for separate living space for livestock and people came up in six of the focus groups. In general, participants felt that current living conditions (livestock and people in the same house) made it difficult to improve hygiene and prevent/reduce the risk of trachoma. One participant explained “Someone who is living in a hut and someone who is living in a villa there is a difference. You know when you go to this home (referring to the hut) everything is there you know. The peoples are living there, the cows are living there, the donkeys... all livestock are living there and they are you know living in their urine and waste product. They are sleeping there. So the waste product and urine mix and there is an acid that comes out and it is harmful to our health you know.”

In three of the focus groups the participants felt that electricity was needed to improve their eye health. One informant explained, “Most students study with the help of the local light (a dim kerosene lamp). The light is harmful for eyes, so it is better to use alternative technology like electricity.” When I asked my translator to clarify how the light was harmful he said that it releases a dangerous gas that is harmful for the eyes.

4.3.2.2 Construct #2: Lack of In-depth Knowledge / Education

In general, most of the informants had some knowledge of trachoma. However, their understanding often seemed to be incomplete or in some cases inaccurate. Further, many of the participants expressed that more education would be beneficial. Thus, the second construct is based on two themes; awareness of trachoma and the need for more education.

Theme #4: Awareness of Trachoma

In the interviews and focus groups the participants were asked if they knew of trachoma, its cause and modes of transmission. Most of the participants were aware of trachoma and were able to identify at least one risk factor. The most commonly reported cause was lack of cleanliness (15 times). Other cleanliness related causes included the removal of waste products (seven times), touching your eyes with unclean hands (three times), improper use of latrines (nine times) and living with livestock (four times). One individual elaborated “When someone removes waste products and collects it for a long time, after three or four days it brings a bad smell that is harmful to the eyes and health.”

Dust or dirt was also commonly reported (15 times) as a cause and/or source of trachoma. One individual explained “There is something like smoke or steam coming out of the soil, especially when ploughing the land there is a smoke substance, it is not a smoke, but it seems just like a smoke. It goes into eyes. This is a problem.” Smoke itself was also mentioned 11 times. Other responses included a heavy workload (twice), sharing ointment, clothing and pillow cases (twice) and the local light (a kerosene lamp) (twice).

Flies (12 times) were the most commonly given explanation for how trachoma is spread. In the words of one of the informants: “The first cause is through flies, from the one who is infected with trachoma to the one who is healthy person through the flies...from one person to another one.” Although many of the informants knew flies

were transmitting trachoma, some had the misperception that mosquitoes were also transmitting the condition. This response was given in three of the focus groups and one of the interviews.

Most people reported that they took some measures to try to minimize the number of flies. Methods included: chemicals, burning (e.g. dirt, leaves of the olive trees, wood, dried ox/cow dung), using a mosquito net, cleaning the surroundings, washing and placing the leaves of a tree or plant in their house that the flies do not like.

Theme #5: More Education is Needed

Seventeen of the interview participants were asked where they learned about trachoma. Responses included the voluntary health workers, ORBIS Ethiopia, at a clinic or hospital and in school. Although most individuals were aware of trachoma, the participants in one of the focus groups and six of the interviews did not know its cause or how it transmits. This shows that there is still a need for more education. Further, 13 of the interview participants were asked if they thought their children had learned about trachoma in school. Seven said yes and six said no; again illustrating that there is room for improvement. “Lack of education” was also stated in eight out of the ten focus groups in response to various questions. When asked why so many of the children had dirty faces, lack of education was the second most common response. In particular, two individuals stated that due to lack of education many parents do not force their children to wash their faces. One stated, “Most of the women or the mother or wife they don’t care about their children. They don’t care because they don’t have that education to care.” The other commented “Most of the wives and men are not forcing their children to wash their faces due to lack of education.”

Participants from five of the focus groups also mentioned that more education was needed to improve the hygiene of children in their community. Some individuals stated that there was a difference in behaviour between educated and uneducated people. One informant explained it as follows: “There is a lack of education, those who are educated now they are trying to keep their children clean, they are washing once or something like that, but those who are not they don’t have education, they are leaving as

it is so that's the problem you know. There is a difference between educated and uneducated." Others stated "Most people they don't have awareness of keeping clean" or "Some people they don't know the importance of hygiene."

4.3.2.3 Construct #3: Overwhelming Poverty

The third construct was labelled overwhelming poverty. This construct is based on two themes; lack of money makes change difficult and lack of food is a greater concern.

Theme #6: Lack of Money Makes Change Difficult

Lack of money/economics was mentioned at some point in all 10 of the focus groups. In total it was mentioned 20 times. The participants explained that without money it is difficult to build a new house with separate living spaces for livestock and people, buy water, clean your latrine/surroundings, buy chemicals, eat properly, buy soap and/or go to the hospital. One participant stated "Because of lack of money, even living is difficult for most people." In general, due to their economic situation, most people felt that it was difficult to make changes that would reduce their risk of trachoma. One individual explained, "If someone has money he can just clean his latrine, he can just clean his surroundings and even buy different chemicals to remove those flies and dirt substances from around here. But for those living below the poverty line it is difficult I think to reduce the risk of trachoma."

Lack of money was also mentioned in the interviews when the participants were asked if there was anything that would prevent them from taking their child to a clinic/hospital when sick. Thirteen out of the 20 participants asked this question said that this decision depends on money. If they have the money they take them to the clinic and if they do not have the money they do not. When asked if there was anything else they wanted to mention, participants from two of the focus groups also commented that job opportunities were needed.

Theme #7: Lack of Food is of Greater Concern

Diet and lack of a variety of food was mentioned in seven of the focus groups. The participants in Gerame Ambericho spoke the most about diet and the lack of variety of food. The topic came up six times in their responses to four different questions. Three times the participants mentioned that they needed cows. The group felt that if you do not have a cow your life is in danger. They explained that people with cows can make cheese and butter which helps create a more balanced diet and makes you less prone to disease. They also explained that they felt eating was more important than washing and that they only worry about getting food. One individual also mentioned that he thought “the tablets given by ORBIS were like acid because we do not eat a variety of food.”

In the other six focus groups lack of a variety of food was seen to cause poor hygiene and make people more vulnerable to trachoma. Several individuals suggested that greater variety was needed to improve children’s hygiene and reduce the prevalence of trachoma. In total, lack of variety of food was mentioned 19 times. Poor diet was also the most common explanation for why so many children had unclean faces. When I asked my translator to explain this response he said that in the eyes of the informants “food is first” and “eating is better than washing.” He elaborated that they do not worry about cleaning their hands and faces; they only worry about getting food.

4.3.2.4 Construct #4: Conflicting Views of Hygiene

In the interviews and focus groups there seemed to be conflicting views of hygiene. Many of the participants expressed that they felt their hygiene was ok, while at the same time providing responses that would suggest their hygiene is poor.

Theme #8: Perception that Current Hygiene/Sanitation is “Ok”

Participants in five of the focus groups were asked if they thought that the hygiene in the area was good. Out of the five, two groups said it was good, two said it was medium and only one group said it was bad. Further, 16 out of the 18 interview participants with a latrine reported that their latrine was adequate. When asked if they use their latrines all 18 with latrines said yes.

Theme #9: Hygiene/Sanitation is Poor

Improper use of latrines was mentioned 10 times in the focus groups and interviews. Improper use of latrines was most commonly reported to be a cause of trachoma. Similarly, proper use of the latrine was given as a way to minimize flies and trachoma. One individual stated “There is a problem of latrine. Some people... it is not that many... but some people they are going outside of the latrine. If someone uses the latrine it reduces the risk of transmission.” A couple of individuals also commented that more and more people are now using latrines so this is becoming less of a concern. In addition, lack of cleanliness or washing was also reported several times to be a cause of trachoma and reason for transmission. Many felt that through improved cleanliness trachoma could be reduced. In the interviews all the participants stated that they washed their hands once or twice a day without soap, their clothes twice/month (13/20) with soap and their blankets rarely (all of the individuals reported less than four times a year and 10 reported two or fewer times/year). One individual commented “Neither men nor women are keeping clean, because of their work load women do not have time to keep clean”.

4.3.2.5 Construct #5: Multiple Risks

The final construct focuses on the multiple risk factors identified in the interview process. In particular, factors that put women at greater risk are highlighted.

Theme #10: Daily Activities/Work put People (Especially Women) at Risk

All of the interview participants were asked why they thought trichiasis was three times more common in women than in men. Responses included heavy work load (15 times), cleanliness (nine times), diet (once), male priority (once), crowding (once), cooking (16 times), the local light (five times) and waste product removal (eight times). One individual stated: “Mostly women are working for a long time, mostly they remove waste products and sometimes they are collecting waste products at home and then after three or four days it brings a bad smell that is harmful for eyes as well as for health.” The focus group participants stated that women worked between 16 and 18 hours a day and men work eight to 10 hours a day.

One individual commented that trichiasis was more common in women because they were given less priority than men when they had health problems. He stated “Most of the time women are not going to the hospital or clinic because of money. Men go fast if they have money or they borrow from someone. Everything is under the control of men. For women it is difficult to find money. However, if it is serious her husband will give her money. Usually not at the moment...even the women will wait.”

Theme #11: The People’s Living Situation/Environment puts them at Risk of Trachoma

Nineteen out of the twenty interview participants reported they were sharing beds in their household. Most were sharing with one or two other people. However, only six out of the sixteen households asked reported they were sharing clothes and blankets.

All of the informants indicated that during the day their livestock was brought outside to graze in the yard surrounding their house and at night time it was taken into their home. One informant had separate living areas for cattle and people. The remaining households shared their house with the cattle. Sixteen of the informants were also asked why they store their livestock in their homes.²⁷ In response, 13 reported it was because of hyenas, eight reported fear of theft, eight reported because it is the culture and one said “to give food.” Nineteen of the informants were also asked what they do with the animals

²⁷ This question was added to my research questions after completing the first few interviews. Consequently, some of the informants were not asked it.

waste.²⁸ All 19 responded that they were removing the waste out of their homes, bringing it to their farm and using it as fertilizer. Nine of the respondents also stated that prior to being used as fertilizer the waste was stored in a small hole outside.

Fifteen informants felt that eye seeking flies were a problem in their area and five felt that they were not. Out of the five that felt that flies were not a problem, four lived in Kedida Gamela *Woreda*. One of the informants elaborated “Most of the people in this area have at least some educational background; they know flies are just like enemy.”

Nineteen out of the 20 interview participants reported they were cooking inside their home. One said they were cooking in a separate building where the livestock is kept. Several participants also reported that their kerosene lamps release a gas that is harmful to their eyes. Finally, three times weather was mentioned as a reason for why the children’s faces were unclean. These informants felt that even if you wash, due to the dust your face will become dirty again shortly after. Although smoke, gas and dust do not cause trachoma, it is possible that these environmental factors may aggravate the condition in infected individuals.

4.3.3 Interviews with Teachers

In total five teachers were interviewed. Four were male and one was female. On the day of the interviews, all five teachers were participating in a training session on eye health where ORBIS was teaching. At the training session the teachers were learning how to measure the visual acuity of their students (so they could refer students to the health centres) and how to start school eye care clubs. At these clubs the children would be given health education on trachoma including face washing and environmental sanitation.

Two of the teachers taught in Damboya *Woreda* and three taught in Kedida Gamela *Woreda*. All of the teachers were teaching elementary students (grades one to six). Two (from Kedida Gamela) were also teaching grades seven and eight. The teachers reported having around 75 students in their class. All of the teachers said that school starts around 8:30 am and goes until 12:45pm with a 15 minute break. The teachers from Damboya *Woreda* reported a lack of resources such as teachers, text books, chalk and

²⁸ The response to this question is missing in the transcript of one of the interviews

teaching guides. However, in Kedida Gamela lack of resources was said to be a minor problem.

Four out of the five schools represented had a latrine; however, water was not available at any of the schools. Since there was no water most children were not washing their hands while at school. The only exception was those children that brought water with them in a plastic water bottle. One of the teachers commented, “Those who are coming from a small town bring water in Highland plastic. Those who are from rural areas don’t bring water because the water isn’t clean.” When asked whether or not they felt the hygiene education was sufficient at their school, the teachers all said no. One teacher from Damboya stated “No, now the education is not given as a major topic level but it is given as a sub topic level.” Similarly, a teacher from Kedida Gamela commented “It must be included as a major topic level.”

Sanitation and hygiene education is incorporated at the schools. The teachers in Damboya said they were teaching their students to wash their bodies, faces and clothes regularly and also encouraging the children to use the latrine. The teachers from Damboya also mentioned that they were trained three years ago to teach sanitation and hygiene. Since then there has been some improvement. In Damboya, health education and sanitation was said to be incorporated in science for grades one to six. When asked if trachoma was included in the curriculum the teacher’s from Damboya responded, “Yes, but it is included in grade seven and eight biology.” One of the teachers from Kedida Gamela stated that there was a diagram on trachoma in grade three environmental sciences. Another mentioned that although there is no text book, the teachers have included information on trachoma from the training ORBIS has given them.

Trachoma was reported to affect student participation at school; however, it was said to be uncommon. One of the teachers commented, “Sometimes I find students who have a problem of sight. I give them permission to sit at the front seat.” All five schools reported that there were health clubs at their schools. The teachers from Damboya stated that the participation was low because it is after school and the children need to help their families. In contrast, in Kedida Gamela *Woreda* participation was said to be high since there is drama and jokes at the club.

4.3.4 Interviews with Health Care Workers

In total five health care professionals were interviewed, including three nurses and two health extension workers (HEW's). The three nurses were male and the two health extension workers were female. The primary goal of these interviews was to gather more background information and gain the insight of a few professionals working in the field. The interviews with the nurses were conducted primarily in English whereas the interviews with the health extension workers were conducted in Kembattegna.

All of the health care professionals reported that malaria and diarrheal disease were the primary health concerns of the area. Nonetheless, trachoma and other eye conditions were also an issue. Two out of the three nurses were asked at what stage people with trachoma usually come to the hospital to receive medication attention. Both reported that they come when they start to feel pain in the earliest stage (TF).

The health care professionals were also asked what they believed was the biggest challenge in preventing or limiting the spread of trachoma. One of the nurses stated "The first one is lack of awareness or lack of education, most of the peoples they don't have better understanding." Another nurse felt that the main problem was the shortage of water, but lack of understanding was a corresponding problem. In his opinion even if there was more water the people would not use it properly. Thus, he felt that creating awareness prior to improving the water supply was crucial. He commented "How can we wash their brain. It's really difficult as you are asking. If excess water is here maybe there's no change in the community. Most of, 50 or 75 percent of the community may be changed, but 25% of the community maybe it's difficult to change once the awareness." Both of the HEW's thought that water was the main challenge in preventing trachoma. One of the HEW's elaborated that the water supply was not adequate since the people had to travel for more than an hour to get water. Nonetheless, she still thought that it was possible to maintain proper hygiene with the current water supply.

At the end of each interview the participants were asked if there was anything else they wanted to add from their experience as health care workers. One of the nurses commented that "There is a breakdown in practice. Although educated, people's behaviour does not change." When I asked why he said, "Skepticism, suspicious of health care workers recommendations. This suspiciousness is different from the people in rural

areas. It is unique to the town.” When I asked why they were suspicious the worker responded “Perhaps because most people are educated, but I don’t know.” He also explained that if he prescribes medication, people do not follow the recommendations and they will go somewhere else for a second opinion when diagnosed with a condition.

One of the health extension workers felt that the community’s response to her teaching was good and that the people are practicing what they are taught. As a result of her work she said that most people now had their own latrine. This statement is consistent with that of one of the nurses who said that the HEW’s educational campaigns on latrine use had resulted in improvements. In contrast, the other HEW reported that the people do not accept their teachings right away. “When we go again and again they accept and practice it. There is a difference between old and young. Old people they don’t accept at the moment; however, young people accept at the moment.”

The HEW’s teach the people about trachoma as part of one of their 17 health packages. The focus of their work is prevention. Consequently, there is a government limitation on the amount of medication available at the health post level. When asked what stops people from going to the doctor, one of the HEW’s said lack of awareness, procrastination based on the assumption that tomorrow it may feel better, lack of medicine and choosing to go to a traditional healer instead.

Two out of the three nurses were asked if they thought there was a shortage of resources at their clinic/hospital. One reported no shortage (from Damboya) and the other reported a shortage of manpower (from Kedida Gamela). The nurse who felt there was a shortage of manpower explained that a lot of medical professionals upgrade their skills through a scholarship the government offers and then move to the city or find work with an NGO to receive a better salary. He also explained that due to the limited budget they could not hire more nurses and there was a shortage of supplies. As a result, sometimes they can do nothing to treat people. However, ORBIS had donated tetracycline eye ointment for three years so that people with trachoma could be treated for free while supplies last.

At the time of the interviews ORBIS Ethiopia had started eye clubs in over 80% of the 220 schools in the zone. The children in these clubs usually met once/week to learn about various eye issues, sanitation and eye health. Participation was reported to be

alright by one of the nurses; however he felt it could still be higher. ORBIS also provides the medical supplies and trichiasis sets to the hospitals in the zone so that trichiasis surgery is available free of charge. In the past, trichiasis surgery cost 10 ETB for one eye and 17 ETB for two eyes. The surgery is performed by integrated eye-care workers who have been trained by ORBIS.

4.3.5 Participant Observation

4.3.5.1 Water

The main water sources were pumps, tap water, rivers, lakes, ponds, wells and continuously flowing pipes. Some of the pumps and taps had been created by international organizations such as World Vision, the European Union and Christian Aid. Some of the pumps / taps were fenced and only open during certain hours of the day, whereas others were accessible all the time. Those communities that relied on surface water such as rivers, lakes and ponds often shared their water source with cattle. At one of the rivers I observed people collecting water downstream of where the cattle were drinking and wading. Figures 19 through 23 illustrate the diversity in the communities' water sources. In Abonsa, the community pump was not working. Consequently, they were digging until they reached the water table in a dried river bed. Cattle were grazing nearby and dung was observed close to the hole.



Figure 19 - Water Tap



Figure 20 - Water Pump



Figure 21 - Pipe Water



Figure 22 - Water Well



Figure 23 - Abonsa Water Hole

4.3.5.2 Sanitation

Often the younger children had unclean faces and runny noses; however, in general the older children's faces were clean. Most children had clothing; however, it was typically ripped and dirty. In total, 63.6% of households in the study area had a latrine (Wondimu, 2007). Although this is fairly high, several of the latrines were poorly constructed. For example, some of the latrines I observed had insufficient depth, were located on a slope and/or had an insufficient (or no) cover. In general, latrine quality varied throughout the study area. Although some of the households had cement pads, the vast majority of latrines were created by placing logs across a hole that had been dug. In total, I saw two latrines that had a bottle of water nearby to wash your hands afterwards. These latrines were in Geshgola and Adilo. Figures 24 through 26 show some of the latrines I visited.

I frequently observed cattle dung outside around the households. On occasion I also saw dung inside a house. Cattle and donkeys move in and out of the house like people. Often grass is brought into the house to feed them.

In total, I only observed isolated human faeces on the ground at three households in the study area, suggesting most people were using their latrine. On occasion I saw people washing their clothes, faces and bodies. Prior to eating at a restaurant the people typically wash their hands.



Figure 24 - Lid / Cover Latrine

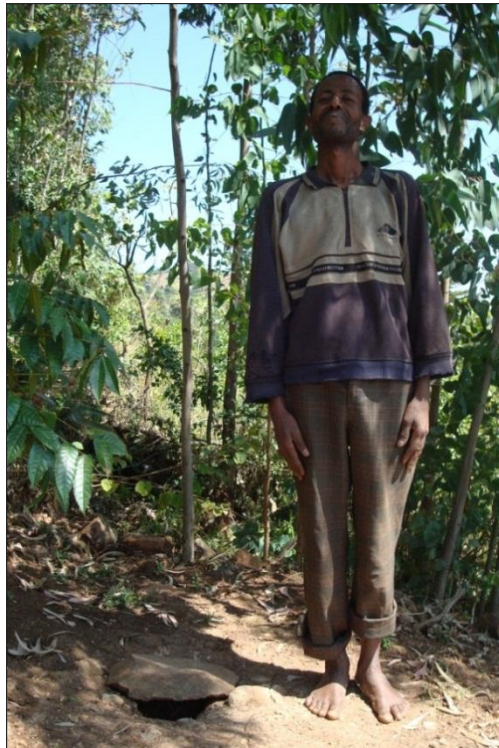


Figure 25 - Lid Latrine



Figure 26 - Conventional Dry Latrines with no Cover / Lid

4.3.5.3 Households & Community Life

Most people lived in a round tukul that was constructed using local materials such as eucalyptus, straw and mud. The radius of a tukul typically ranges from 9 to 20 feet. Eucalyptus poles are used to build the frame and a centre pole is set so that the roof will have an angle of at least 50 degrees. The roof is made using straw. A pottery jar is added at the top to help prevent water from coming in along the centre pole. Wealthier families

had houses that were square in design with tin roofs and separate rooms. Some also had gated or fenced compounds with gardens and covered latrines. This style of house was more common in the town of Damboya, but it was also observed in some of the *kebeles* such as Jore, Zato Shodra and Dega Kedida. I was told that some of the wealthier households had children overseas who sent them money. Although uncommon, a few of the households had permanent structures around their latrines and/or electricity. Two of the households in Damboya had household water taps. Some communities' water sources were relatively accessible, whereas others were far away (in some cases uphill) or had a fee. In general, the study area was dry and dusty. Men primarily work on the farm and women do household chores such as cooking, cleaning and collecting water. During the 24 hours I spent in one of the *kebeles* I also observed a group of women preparing kocho; a local bread made using fermented enset or false-banana (see Figure 31 below). Some households had malaria nets.



Figure 27 - Brick / Tin Roof House



Figure 28 - Traditional Tukul

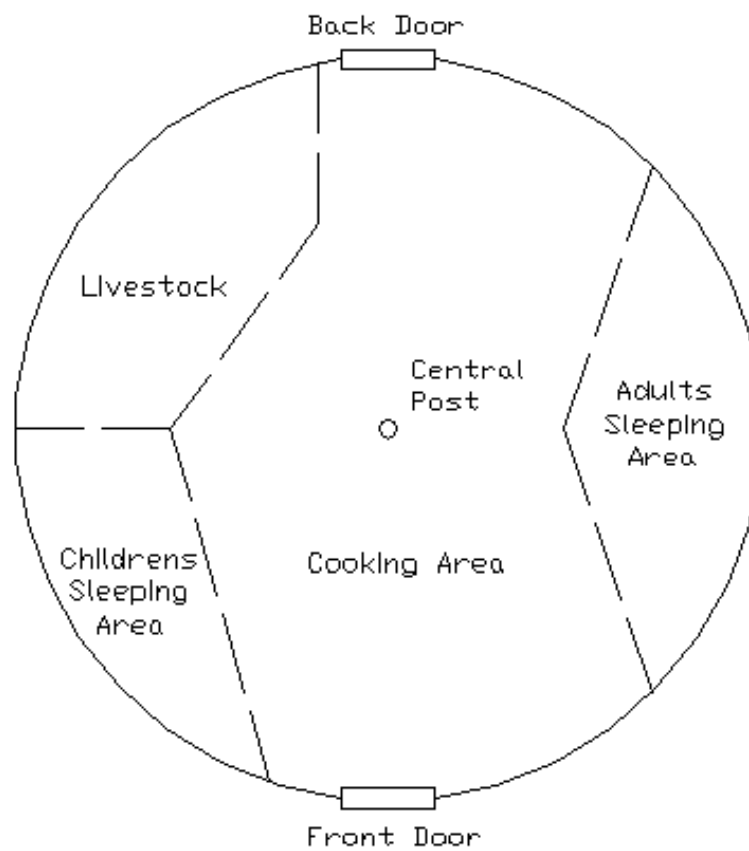


Figure 29 – Sketch of the Inside of a Tukul

(Note: the layout is not exactly the same in all households)



Figure 30 - Women Washing



Figure 31 - Women Preparing Kocho

4.4 Conclusion

Chapter four provided a summary of the research results. Ten significant clusters of high or low trachoma prevalence were identified and two of these clusters were mapped. Further, the results of two multi-level models were presented. The first model found that age, facial cleanliness and household expenses are significant risk factors for active trachoma. The second model examined found that age, facial cleanliness and household distance from the closest latrine have a relationship with trachoma severity. Qualitative analysis of the interviews and focus groups of household heads identified five constructs. These constructs included a desire for change, a lack of in-depth knowledge/education, overwhelming poverty, conflicting views of hygiene and exposure to multiple risk factors. A summary of the results from the interviews with teachers and health care workers was also provided. The chapter ended with a description of my observations on water, sanitation, the households and community life.

5. Discussion

5.1 Introduction

In this study quantitative and qualitative methods were employed to determine which environmental, social, economic and behavioural factors influence the distribution of trachoma in the Kembata zone of Southern Ethiopia. In order to accomplish this, four secondary questions were investigated;

1. What environmental, social, economic and behavioural factors influence a child's risk of developing active trachoma?
2. How are these risk factors distributed / clustered in the study area?
3. Is there evidence of spatial clustering of active trachoma cases?
4. What factors are encouraging or impeding facial cleanliness (F) and environmental improvement (E) efforts to reduce the spread of trachoma?

The following chapter begins with a discussion of the findings and how these results compare with past research. Next, a summary of the limitations of the methods is provided. This section is followed by the final conclusions and recommendations. This project was completed in order to identify some of the context specific risk factors for trachoma with the hope that the results will be used to improve local delivery of the facial cleanliness (F) and environmental improvement (E) components of the WHO's SAFE strategy.

5.2 Findings

5.2.1 Statistically Significant Risk Factors

Multivariate analysis (mixed effects logistic regression) found that age, facial cleanliness and household expenses (on a per person basis) all had a significant influence (p -value < 0.05) on whether a child develops active trachoma. These findings are consistent with ORBIS Ethiopia's bivariate analysis of the data, which also found these

three variables to have a significant association with active trachoma. The second generalized linear mixed model found that age and facial cleanliness influenced the severity of trachoma a child developed if they had active trachoma. Further, increased distance from a latrine had a strong positive relationship with trachoma severity ($p = 0.06$)

5.2.1.1 Age and Sex

As age increases the likelihood of a child developing trachoma decreases. This finding is consistent with that of past studies and reaffirms that young children are the main reservoir of infection (Burton, 2003). Trachoma severity was also found to be associated with age. More specifically, the results of the second multivariate analysis found that if a child above preschool age has trachoma they are slightly more likely to have TI, the more severe form. Ngondi et al., (2007) also found a relationship between age and severity of active trachoma signs. It is possible that older children have had more infections during their life time, leading to greater scarring of the conjunctiva. However, it is unclear how many infections and/or the duration of episodes needed for more advanced forms of trachoma to develop (Montgomery, 2006).

No association between active trachoma and gender was found, contrary to past studies in which females were more likely to have trachoma (Abdou et al., 2007; Courtright & West, 2004; Wang et al., 2010). However, other studies have also found the prevalence to be similar in boys and girls (Cruz et al., 2008; Mpyet, Goyol, & Ogoshi, 2010).

5.2.1.2 Facial Cleanliness

Children with unclean faces were found to be twice as likely to have active trachoma as children with clean faces. Several other epidemiological studies have also found that children with an unclean face are at higher risk (Abdou et al., 2007; Bogale & Bejiga, 2002; Ngondi et al., 2007; Regassa & Teshome, 2004; West et al., 1995).

As age increased, children with clean faces and active trachoma were less likely to have TI, the more severe form. However, children with unclean faces and active trachoma showed an increase in TI with age. Although this relationship makes sense in older children (i.e., older age and an unclean face put a child at greater risk), it is surprising that the probability of developing TI in children under five with clean faces is higher than in children under five with unclean faces. This finding is counterintuitive and hence should be the subject of further research.

In Sudan, unclean faces were also found to be associated with increased relative odds of having a more severe active trachoma sign (Ngondi et al., 2007). This finding reaffirms the necessity for trachoma control programs to emphasize the importance of face washing in their efforts to reduce trachoma incidence. On an unclean face, discharge from the eyes and nose attracts eye-seeking flies, the most likely insect vector of trachoma (Emerson, Frost, Bailey, & Mabey, 2006). The World Health Organization has set three ultimate intervention goals (UIGs) for the elimination of blinding trachoma. One of these goals is that hygiene promotion and environmental improvement should be conducted until, at any given time, 80% of the children have clean faces. At the time of ORBIS Ethiopia's baseline trachoma survey only 26.4% of the children surveyed had clean faces (Wondimu, 2007). Thus, continued education and support for cleanliness is warranted.

Past studies have found that modest health education programmes do not produce a significant decrease of active trachoma nor an increase in facial cleanliness (Abdou et al., 2010; Edwards et al., 2006). However, more intensive participatory hygiene intervention programmes involving neighbourhood meetings, school plays, seminars with traditional healers, individual meetings with villagers and meetings with other village groups have produced a modest increase in facial cleanliness in Tanzania (West et al., 1995). However, despite this improvement, no reduction in the overall prevalence of active trachoma was observed (West et al., 1995). Hence, a more substantial health intervention may be needed in Kembata. Ultimately, more research is needed to determine ideal program timing, length and activities.

5.2.1.3 Household Expenses

The probability of developing active trachoma was found to decrease as the amount of money spent per person in the household increased. It is probable that those households that spend more money per person have higher household incomes. Households with higher per person incomes would be more likely have higher education, better quality latrines, greater access to water and/or greater access to health care. These factors may be minimizing their risk of trachoma.

This finding supports previous evidence of a relationship between trachoma and economic status. For example, in the Meiktila, Magwe, Myingyan and Yamethin districts of Burma, 34.4% of people from higher income²⁹ households were found to be free of trachoma, whereas only 23.5% of people from lower income households were free of the condition (Ko & Gyaw, 1968). Similarly, in the Upper Rio Negro Basin in Brazil, strong associations were found between trachoma and low income (Cruz et al., 2008). Other indicators of low economic status such as a thatch-roofed house and the absence of electricity have also shown a relationship with the condition (Ngondi et al, 2008).

5.2.2 Potentially Important Risk Factors

5.2.2.1 Latrine Access

An unexpected relationship was found between distance to the closest latrine and the level of the condition a child develops, given they have trachoma. A child with trachoma was found to be more likely to develop TI the further they live from a latrine. A possible explanation for this relationship is that the further the latrine is from the household the less likely the members are to use it; leading to open defecation, more isolated³⁰ human faeces and greater fly densities. Greater fly densities may lead to more frequent fly to eye contact, and increased number of infections and a more severe form of

²⁹ The term income is used here because the studies in Burma and Brazil both used household income, rather than monthly per person household expenses as a measure of socio-economic status.

³⁰ In this study, isolated human faeces refers to open faeces on the ground that are not in a latrine.

active disease. Compared with sporadically infected children, persistently infected children are more likely to have severe disease (Bobo et al., 1997). Further, individuals with TI have been found to have higher infectious loads (Bobo et al., 1997; Burton et al., 2003; Solomon et al., 2003). An individual's first infection with *C.trachomatis* typically heals without permanent sequelae. However, in Tanzania West et al., (2005) did not find a relationship between infection load and the presence of flies or presence of a latrine.

The distances to the closest latrine ranged from 4.32m to 456.37m with an average of 48.1m. One of the problems associated with this variable is that it is a measurement of the closest latrine and not necessarily the latrine that is used. Consequently, the measurement used for households without a latrine was the distance to the closest neighbour's latrine. Given that lack of latrine facilities was not associated with increased risk of trachoma or severity of the disease, it is difficult to conclude why there would be a relationship between severity and distance to the closest latrine. Thus, this relationship should also be the subject of further inquiry.

5.2.3 Non-significant Risk Factors

The remaining 10 predictor variables (sex, education of household head, household density, ability to correctly identify trachoma, source of water, time needed to collect water, household latrine, livestock, compound cleanliness, daily water and distance to water source) were not significant in either of the multivariate models. However, ORBIS Ethiopia's bivariate analysis of the data did find a significant association between latrine use and active trachoma ($P < 0.001$). This finding is consistent with past studies that have found latrine access to be associated with lower risk of trachoma (Cumberland et al., 2005; Emerson et al., 2004).

No association between water sources, time needed to collect water, daily water and distance to water source was found. All of the villages have average water availabilities below 9L/person. This is less than half of the World Health Organization recommended minimum daily water requirement of 20 litres per person (UNHCR, 2010). The relationship between water and trachoma has been studied extensively in several different settings, yet the results are often conflicting. Some studies have found that

individuals living further from a water source are at increased risk of trachoma (Schemann et al., 2002; West et al., 1989); while others have not (Kuper et al., 2003; West, Munoz, Turner, Mmbaga, & Taylor, 1991). The basis of these studies is the belief that easier access to water should result in a larger supply leading to improved hygiene and less infection. However, correlation analysis of the data on distance to the closest water source and on the amount of water collected/person/day from this study revealed a small but significant positive correlation (Pearson Correlation Coefficient = 0.21, $P < 0.01$). In other words, as distance to the closest water source increased the amount of water collected / person / day also increased. Although this relationship seems counter intuitive, it may be an indication that the relationship between water supply and access to water may not be as straightforward as sometimes assumed. A second correlation analysis of the distance to the closest water source and the total amount of water collected per household did not find a significant relationship.

On average, families with trachoma have been found to use less water per person per day than families without trachoma (Bailey et al., 1991; Luna et al., 1992; Pruss & Mariotti, 2000). Nevertheless, in this study the amount of water available per person per day also did not have a significant relationship with active trachoma. The above findings suggest that more in-depth analysis of the relationship between water supply and access to water may be needed. It is possible that behaviour, education and/or culture may be playing a more significant role than access and supply in the Kembata zone.

The percent of people living with livestock was high throughout the study area. The only exception is in Damboya town where less than 40% of people live with livestock. This is in stark contrast to the other clusters where the percent of people living with livestock exceeds 70% in all cases. Past studies have found that children living in households with livestock were more likely to have trachoma (Abdou et al., 2007). Nevertheless, in this study no relationship was found.

5.2.4 Spatial Distribution of Active Trachoma Risk Factors

The multivariate analysis identified which variables were significant; however, it did not tell us anything about the distribution of these risk factors. Consequently, the

Kulldorff spatial scan statistic was used to analyze the distribution of some of the identified trachoma risk factors in order to determine hotspots or areas of increased risk. Visual representation makes pattern identification and interpretation easier. Once patterns are identified, they can be used to improve understanding and help in planning intervention activities.

5.2.4.1 Statistically Significant Risk Factors

Facial cleanliness is a considerable issue throughout the study area. In 25 out of the 30 *gotts* sampled, more than 60% of children had an unclean face. Unclean faces were found to be clustered in some parts of the study area (see Figure 10). In particular, the central portion of the study area was found to have a higher than expected number of children with unclean faces. *Gotts* 19, 21, 28 and 29 (found in Teza Gerba³¹, Teza Agera and Funto Geremba *kebeles*) were included in more than one significant cluster with a higher than expected quantity of children with unclean faces. This is not surprising given that the percent of children with unclean faces exceeded 80% in all four of these clusters and exceeded 90% in three out of these four clusters (clusters 21, 28 and 29).

Low per capita monthly expenses is common throughout the study area. However, some areas in particular were found to have a higher portion of people with low per capita monthly expenses. Three of these areas were highlighted in Figure 11. The large cluster in the South western portion Damboya *Woreda* suggests that in general incomes may be lower here since the people are spending less on a monthly basis. This is not surprising given that *gotts* 9, 16 and 27 all have average per capita monthly expenses below 30 ETB. In general, the Northern portion of Damboya (particularly surrounding the town of Damboya) had higher per capita monthly expenses. This may be related to access to markets in town. However, not all of the *gotts* around Damboya have higher per capita expenses, nor are the areas of higher per capita expenses limited to the *gotts* around Damboya.

³¹ Two *gotts* were sampled in Teza Gerba

The distribution of latrines was also not even in the study area. Figure 12 highlighted three clusters of areas with lower than expected latrine coverage. All three of these clusters are located in Kedida Gamela *Woreda*. In general, the Northeastern portion of the study area has lower latrine coverage. The cluster analysis also highlighted the fact that *gotts* 12, 24 and 22 have particularly low coverage. In two out of these three *gotts* less than 30% of households had latrines.

Although latrine distance was found to be related to trachoma severity, this variable was not mapped since the nature of the relationship is not clear. The vast majority of people in the study area lived within 50m of a latrine. In fact, only seven of the *gotts* had average distances exceeding 50m. In four out of these seven *gotts* more than 50% of the households did not have a latrine and in two of these four more than 70% did not have a latrine. This likely accounts for the significantly larger average distances in these *gotts*. Age was also not mapped since it is not a modifiable risk factor and therefore is not of significant interest in this study.

5.2.5 Spatial Clustering of Active Trachoma

In this study, the Kulldorff spatial scan statistic was employed to investigate whether or not there was a pattern of clustering in the study area. In total, 10 significant clusters were found using the settings specified in the methods chapter. Thus, the null hypothesis (trachoma cases are geographically randomly distributed) was rejected. The Kulldorff spatial scan statistic identified six clusters of higher than expected levels of trachoma. Five out of these six clusters are centered in Damboya *Woreda*, including the most significant cluster (illustrated in Figure 13) which contains the majority of the *gotts* in the northern portion of the region. This cluster highlights the relatively high prevalence of trachoma in Damboya. In contrast, four clusters with lower than expected levels of trachoma were identified in Kedida Gamela *Woreda*. The most significant of these clusters covers the majority of the southern portion of the study area (illustrated in figure 14).

The results of the cluster analysis suggest that there is some clustering at the *Woreda* level. This clustering may be due to differences in the underlying distribution of

risk factors (note: age was corrected for). Alternatively, the clusters may be an indication that there is spatial auto-correlation in the data-set. In other words, *gotts* that are closer together have more similar disease prevalence than *gotts* that are further apart due to transmission. This finding contradicts that of Hagi et al., (2010) who found a lack of spatial correlation between individuals living in neighbouring Gambian villages. The difference in outcome between these two studies may be related to differences in travel patterns and social interactions between the two countries. A recent study in Gurage, Ethiopia, on travel and trachoma found that 78% of the surveyed households had at least one traveller, the majority of which were women travelling to the market or to school (Shah et al., 2010). One third of these individuals travelled more than once a month (Shah et al., 2010). Assuming travel patterns are similar in Kembata, this may explain part of the difference. In order to complete a true comparison, more research on the travel patterns of villagers in The Gambia would be needed. A study in Tanzania did not find an association between infection and either visitors or travel (West et al., 2005).

In Tanzania, Polack et al., (2005b) found evidence of spatial clustering at the village level, implying inter-familial transmission was taking place. However, no evidence of spatial clustering was found at the village level in The Gambia, suggesting transmission between households is less common there (Bailey, Osmond, Mabey, Whittle, & Ward, 1989). Despite evidence of clustering between *gotts*, no significant clusters were found within *gotts* in this study. This may be due to the small sample size surveyed. Past studies have also found clustering at the household level (Hagi et al., 2010; Polack et al., 2005b). In this study, evidence of clustering within households was not investigated.

The identification of clusters can highlight hot spots that help determine the appropriate level to target control interventions. Once identified the cause of a cluster can be investigated to aid health care professionals and decision makers in effectively targeting the disease. In the study area, Damboya *Woreda* was found to have higher levels of trachoma. In addition to the large primary cluster, several secondary clusters were found in the south west portion of the *Woreda* and in some cases the northern portion of Kedida Gamela *Woreda*. These clusters included several high prevalence *gotts* such as Geyota Gerba, Hego and Gerame Ambericho.

5.2.6 Challenges in implementing F and E

Only one out of the five constructs identified in the interviews and focus groups could be considered to be encouraging efforts to reduce the spread of trachoma. This construct is a desire for change. In particular, the people desired improvements in their water supply and living conditions, which in most cases were viewed to be inadequate. However, this readiness seemed to be accompanied by a lack of in-depth understanding of trachoma and conflicting views of hygiene. Thus, it is questionable whether or not improvements to the water supply would lead to corresponding improvements in hygiene. A couple of the health care professionals felt that greater understanding of the value of hygiene was needed in order for improvements to the water supply to have an impact. Their sentiment is consistent with past research that has found significant decreases in disease will only be observed if improved resources are coupled with appropriate education on their use (West et al., 1989).

According to the interviewed teachers, students in Kedida Gamela and Damboya *Woredas* are currently being educated on hygiene and trachoma at school. However, none of the schools represented had water on site. As a result, unless they brought their own water to school the children were unable to apply the messages they learned. An evaluation of a school-based trachoma curriculum in Tanzania identified the same problem. This study concluded that “the disparity between health education messages and environmental capacities for implementing these messages (no wells at the schools and minimal latrine facilities at the schools and homes) limited usefulness of the curriculum” (Lewallen et al., 2008, p. 1068). Thus, in order to improve the hygienic behaviour of school aged children it may be necessary to find a way to provide on-site water.

The participants also seemed to feel trapped or restricted in their ability to effect change due to lack of money and/or the precedence of other concerns such as lack of food. This construct highlights the challenge of addressing issues such as hygiene in areas where extreme poverty dictates greater concern for more pressing issues. Ideally, these more basic needs should be concurrently addressed in order to improve the odds of producing positive changes in hygienic behaviour. Further, multiple trachoma risk factors

(i.e., living with livestock, poor hygiene, crowded living, and lack of access to water) were identified, making it difficult to know where to focus intervention efforts. In the interviews and focus groups the participants seemed to be the most concerned about access to water. However, as mentioned previously, past research has indicated that improvements in supply do not automatically result in improvements in hygiene. Ultimately, creative solutions that take into consideration the communities' current level of resources and understanding are needed. Based on the results of the multivariate analysis these efforts should begin by focusing on improving facial cleanliness, latrine access and household income.³²

5.3 Limitations

5.3.1 Quantitative Methods

The results of this study should be interpreted with the following limitations in mind. First, the geographical coordinates were collected with a standard handheld GPS unit and were not differentially corrected. According to the user manual, waypoints taken with a Garmin 60 GPS should be within <15m of the true location. Generally, these estimates are considered conservative. Nonetheless, this potential error should be noted. In particular, this is of concern in the measure of distance to the closest latrine since the distances being investigated were small (ranging from 4.3m to 456.4m). In order to improve GPS accuracy a small antenna was used. Another potential problem is straight line distances can be unreliable since they do not take topography into consideration. Further, since some individuals were not home and therefore could not give permission to survey their household, geographical data for some households was missing.

Second, the activities of the study individuals were reduced to a single point (the household). This simplistic view of an individual's life ignores the complexity of real life activities and interactions that influence disease risk. Further, it should be noted that the

³² In this study, monthly per person expenses was used as an indication of wealth. Households that were spending less on a per person basis were viewed as having lower income than households that were spending more. Given that lower expenses were found to be a risk factor for trachoma, it is likely that improvements in income will result in improvements in trachoma prevalence.

sample size is not adequate to make any inference on *Woreda* or *kebele* level prevalence (Wondimu, 2007).

Next, the proportion of individuals with clinical signs of active disease may not correspond with the proportion of individuals with infection. Past studies have found Chlamydial infection in individuals without signs of clinical disease and an absence of Chlamydial infection in individuals with active disease (Burton et al., 2003; Wright & Taylor, 2005).

One of the main limitations with generalized linear mixed model's (GLMM's) is the challenge of evaluating the integrals in order to make any inference about the data. The accuracy of GLMM's, especially when using laplace approximation, can be affected by the size of the clusters and the variance of the random effects (Krause, personal communication, July 6, 2010). Although laplacian approximation is known to produce biased estimates, this bias is generally a bigger issue in the estimate of the variance components rather than in the estimates of the fixed effects. Since the fixed effects are the primary interest of this study, laplacian approximation is the most reliable. Additionally, it is possible that some crucial variable was left out. Omission of a key covariate can cause bias in the estimation of the influence of those variables that were included. Further, only children aged one to nine were included in the analysis. The inclusion of older children, teenagers and adults may have produced significantly different results.

Finally, despite ORBIS Ethiopia's efforts to minimize human error (i.e. through enumerator training and a one-day orientation and refreshing course for the ophthalmic nurses involved), it is still possible that some survey responses were inaccurately recorded and the disease status of some individuals was inaccurately assessed. Further, self-reported data can be unreliable.

5.3.2 Qualitative Methods

The main limitation of the qualitative methods is the lack of representation of women. Culturally, Ethiopian women tend to be shy and hesitant to speak up, particularly in rural areas. Consequently, it was difficult to get them to participate. On a few occasions, when I asked if I could speak with a woman I was told by a male or in one

case by the woman herself that she would not know the answers. When I was able to find a woman willing to participate in a focus group they tended to speak less. These women may have felt intimidated by the presence of men (i.e. the other participants and/or my translator). Thus, in some cases their views were lost in the group view. In order to encourage their participation, on occasion I would ask my translator to specifically ask them what they thought. This helped in getting some of the women to share.

In general, the women seemed more comfortable in the interviews. Two women in particular were very forthcoming with their responses and actively engaged. Both of these women were students and I was able to speak with them in private without spectators. A second issue was one of privacy. While conducting the interviews and focus groups we often had a small crowd of onlookers. Given the amount of attention I drew and the fact that most of the interviews and focus groups were conducted outdoors, this was difficult to control. The majority of onlookers were women and children, likely because many of the men were out working on the farm. Nonetheless, the participants (both male and female) may have felt restricted in what they were able to say in front of these individuals. The reliability of the qualitative results must be interpreted in light of these limitations. Despite these challenges the responses received were remarkably similar across the focus groups and interviews (including those conducted in private/with women). Further, I noted that the onlookers often nodded their heads in agreement with what was being said.

The goal of the qualitative analysis was to gain insight into the peoples lived experience and how their environment/circumstance influenced their actions. Consequently, another limitation is that the results are contextual and cannot be applied to other areas. Further, the themes and constructs identified represent only one way to organize, interpret and draw conclusions from the data.

Since I do not speak kembattegna, a translator was used. Fortunately, I was able to find a male university student who grew up in the region and was familiar with the culture to assist me. It is possible that some of his biases may have come through in the translation. However, it is difficult to identify or quantify what these biases may have been. Further, as a foreign researcher I also bring my own biases and lens through which I interpreted the data. For example, given that I grew up in Canada my understanding of

hygiene and sanitation is drastically different from that of the participants. Other researchers (in particular local researchers) may have interpreted the data in another way or through a different lens. In order to track my thought process, a detailed diagram of the coding process was created and included in the results chapter.

5.4 Recommendations and Conclusion

This study has looked at the role / interaction of various social and environmental factors in determining trachoma risk in order to gain a better understanding of the distribution of the disease in the Kembata Zone. A combination of quantitative and qualitative techniques were employed to accomplish this objective. Statistical analysis found that unclean faces, low per capita monthly expenses (an indicator of low income) and young age were significant risk factors for active disease. Further, household distance from a latrine, age and facial cleanliness were found to influence trachoma severity. Based on the qualitative data lack of access to water, lack of a variety of food and lack of money seemed to be of greatest concern to the community.

In many ways the results of the qualitative and quantitative analysis converge. For example, lack of access to water is a concern for the community and an unclean face is a risk factor for trachoma. If the water supply is improved the result could be twofold if active trachoma decreased and the quality of life of the residents improved. Further, active trachoma was found to be related to low income. Likewise, the people were very concerned about their poverty. Again the results converge, suggesting that there is a clear need for increased economic opportunities. The people were also concerned about the lack of variety of food. This concern was less directly related to the results of the quantitative analysis. Given that many people expressed their concern for food took precedence to cleanliness, it may be necessary to concurrently address the issue of food in order to produce lasting change.

Past studies have found that improving water supply does not always produce improvements in hygiene (West et al., 1989). Consequently, it is important that efforts to improve the supply in Kembata are coupled with health education programs to improve

hygienic behaviour. Similarly, hygiene education should be supported by appropriate access to water. The current disparity between hygiene education and supply in the schools may be limiting overall effectiveness. In order to improve the effectiveness of eye care clubs and teacher training on trachoma, it is recommended that the feasibility of providing access to on-site water be investigated.

Despite a desire for change, overwhelming poverty, multiple risk factors and a lack of in-depth knowledge seems to have left the people feeling powerless. Consequently, external interventions from government and non-governmental organizations will likely continue to be needed. As suggested by Molyneux, Hotez and Fenwick (2005) (Molyneux, Hotez, & Fenwick, 2005) it may be more cost effective for trachoma interventions to be offered as part of a package for the control and elimination of neglected tropical diseases. Fly reduction, improved sanitation, access to clean water and hygiene/ health education could have a positive impact on other diseases such as Malaria and Typhoid fever, which are also common in the area.

Trachoma is an entirely preventable and treatable disease. As such, blinding trachoma can and should be eliminated. The results of this study support continued efforts to implement the facial cleanliness and environmental improvement components of the WHO's SAFE strategy for combating trachoma. However, it is important that such initiatives take into consideration the communities' current level of resources, priorities and understanding as well as the local culture and social norms. It is hoped that the results of this study will contribute to greater understanding of trachoma risk factors and aid trachoma control programs in targeting their efforts.

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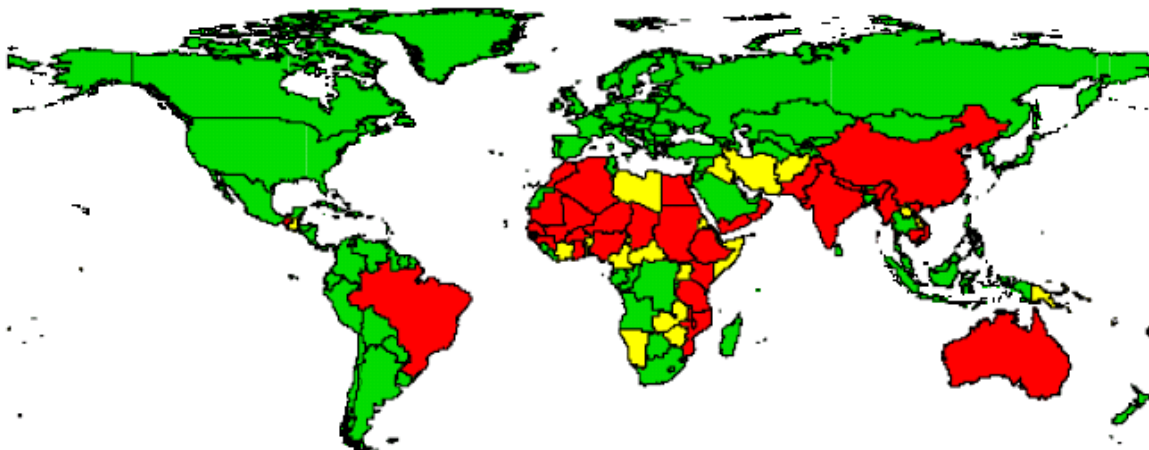
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Appendices

Appendix 1: The Global Distribution of Active Trachoma



Country trachoma status:
■ No active trachoma
■ Data confirmed endemic active trachoma
■ No data identified, believed endemic active trachoma



Note. From Polack et al., 2005a Reprinted with permission.

Appendix 2 - Clinical Assessment Form

Cluster No _____ Name of enumerator _____ Name of examiner _____																
	Name of participant	age	sex	Eye examination findings												
				TO	1-9 year old children						>14 years old adults					
								Eye discharge		Nasal discharge		TS	TT		CO	
					TF	TI	TF/ TI	Yes	No	Yes	No		Rt	Lt	Rt	Lt
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
Supervisor _____ Date: _____																

Appendix 3 - Household KAP Questionnaire

Annex 3A: Questionnaire for Household KAP Survey

Serial(<i>do not fill in field</i>)				
Woreda				
Kebele				
Cluster No				
House No				
Identity number				
Name of the interviewer				
Demographics				
Q1	Sex of respondent	Male	1	
		Female	0	
Q2	Age of respondent (in years)	<i>Write in years</i>		
Q3	What's the highest level of schooling you have completed?	None	0	
		Non-formal education	1	
		Religious school only	2	
	<i>If 'None' ask:</i>	Some primary	3	
		All primary	4	
	'have you attended Koranic/religious school or NFE?'	Some secondary	5	
		All secondary	6	
		More	7	
Q4	What is your main occupation?	Farming	1	
		Petty trade (business)	2	
	<i>Circle only one (select the one he or she spends most time doing)</i>	Cattle rearing	3	
		Formal employment (receives monthly salary)	4	
		Priest/Imam	5	
		Other (write in)	88	
Q5	What religion do you follow?	Islam	1	
		Christian	2	
		Other	88	
Q6	What is your ethnicity?	Gamo	1	
		Oromo	2	
		Amhara	3	
		Other	88	
Q7	How many people (including children) usually sleep in this compound?	<i>Write in number</i>		

Knowledge of trachoma				
Q8	Do you know what this condition is called? <i>Show them the picture of trichiasis.</i> <i>If answer is not trichiasis, tell them "trichiasis"</i>	Trichiasis	1	
		Trachoma	2	
		Inappropriate response	3	
		No answer/don't know	88	
Q9	What infection or disease causes trichiasis?	Trachoma	1	
		Inappropriate response	2	
		No answer/don't know	8	
Q10	Have you ever been informed about trachoma?	Yes	1	
		No	2	
Q11	If the answer for No 11 is Yes, What is the source of information? <i>Circle all that apply</i>	Health personnel	1	
		Non health personnel	2	
		Radio	3	
		TV	4	
		Movies	5	
		Poster	6	
		Billboard	7	
		No answer/don't know	88	
		Other(<i>write in</i>)	99	
Q12	What are the symptoms of trachoma? <i>Circle all that apply</i> <i>After each response ask 'Anything else?'</i>	No symptoms	1	
		Painful eyes	2	
		Itching and/or burning	3	
		Sunlight is painful	4	
		Ocular discharge	5	
		Foreign body sensation	6	
		Eyelashes touch eye	7	
		Red eyes	8	
		No answer/ Don't know	88	
		Other(<i>write in</i>)	99	
Q13	How is trachoma spread from person to person? <i>Circle all that apply</i> <i>After each response ask 'Anything else'</i>	By flies	1	
		By sharing towels or wash cloths	2	
		By sharing a bed or a pillow	3	
		By sharing eye make-up	4	
		By close contact	5	
		By touching your eyes	6	
		Inappropriate response	7	
		No answer/don't know	88	
		Other (<i>write in</i>)	99	

Q14	How can trachoma be treated? <i>Circle all that apply</i> <i>After each response ask 'Anything else'</i>	Antibiotics (TTC or Zitromax)	1	
		Medicine	2	
		Inappropriate response	3	
		No answer/Don't know	88	
		Other (write in)	99	
Q15	How can you avoid getting trachoma? <i>Circle all that apply</i> <i>After each response ask 'Anything else?'</i>	Take medicine	1	
		Go to the clinic	2	
		Wash face	3	
		Use own towel/face cloth	4	
		Use latrine	5	
		Use own pillow	6	
		Stop flies	7	
		Keep the compound clean	8	
		Clean up faeces	9	
		Inappropriate response	10	
		No answer/Don't know	88	
		Other (write in)	99	
Q16	In the end, what can happen if you have trachoma? <i>Circle all that apply</i> <i>After each response ask 'Anything else'</i>	No consequence	1	
		Blindness	2	
		Reduced vision	3	
		Pain	4	
		The lashes touch the eye	5	
		Sensitivity to light	6	
		No answer/don't know	88	
		Other (write in)	99	
Environment				
Q17	What are you or people in your community doing with regards to preventing trachoma /Accept more than one response/ Ask what else to get more answers	Advise people who have trichiasis to undergo surgery	1	
		Advise people with trachoma to get treatment	2	
		Wash your own and your children's faces	3	
		Clean your environment	4	
		Inappropriate response	5	
		No answer / I don't know	88	
		Other	99	

Q18	What do you or people in your community plan on doing with regards to preventing trachoma /Accept more than one response/ Ask what else to get more answers	Advise people who have trichiasis to undergo surgery	1	
		Advise people with trachoma to get treatment	2	
		Wash your own and your children's faces	3	
		Clean your environment	4	
		Inappropriate response	5	
		No answer / I don't know	88	
		Other	99	
Q19	Where do you normally go to collect water	River	1	
		Non-protected spring	2	
		Protected spring	3	
		Water point	4	
		Pipeline at home	5	
		Well	6	
		Pond	7	
		Hand pump	8	
Other	99			
Q20	Can you go, collect water and come back in the time it takes to brew coffee? (not make and drink coffee, just brew it)	Yes	1	
		No	0	
Q21	On average, how many liters of water do you collect every day?	<i>Write in number</i>		
Q22	Do you have a latrine in the compound	Yes	1	
		No	0	
Q23	What type of slab does the latrine have	Cement slab with vent	1	
		Cement slab without vent pipe	2	
		Local type	3	
Q24	Who Supplied the slab	Orbis International	1	
		My self	2	
		Other	3	
Q25	Are there (fresh) faces in the pit latrine?	Yes	1	
		No	0	
Q26	What type of cover does it have?	No cover	0	
		Flat stone	1	
		Wood	2	
		Iron Sheet	3	
		Tin can or other container	4	
		Other	88	

Q27	On average how frequently are the faces of the children washed?		0	
		Never washed		
		Occasionally	1	
		Daily	2	
		Twice daily	3	
		More than twice daily	4	
	I don't have kids	5		
Q28	Do your livestock (sheep, cows, goats, horses or donkeys) sleep in the same room as any member of your family	Yes	1	
		No	0	
Q29	Is there evidence of solid waste or garbage within 20 meters of the house (This does not include animal droppings)	Yes	1	
		No	0	
		No	0	
Q30	What is the estimated monthly expense?	<i>Write in number</i>		

Appendix 4 - Questionnaire for KAP survey of Trichiasis Cases

Serial <i>(do not fill in field)</i>				
Cluster No				
House No				
Date of this interview DD/MM/YYYY				
Demographics				
Q1	Sex of respondent	Male	1	
		Female	0	
Q2	Age of respondent (in years)	<i>Write in years</i>		
Q3	What's the highest level of schooling you have completed?	None	0	
		Non formal education	1	
		Religious school only	2	
	<i>If 'None' ask:</i>	Some primary	3	
		All primary	4	
	'have you attended Koranic/religious school or NFE?'	Some secondary	5	
		All secondary	6	
		More	7	
Q4	What is your main occupation?	Farming	1	
		Petty trade (business)	2	
	<i>Circle only one (select the one he or she spends most time doing)</i>	Do not work / retired	3	
		Formal employment (receives monthly salary)	4	
		Priest/Imam	5	
		Other (write in)	88	
Q5	What religion do you follow?	Islam	1	
		Christian	2	
		Other	88	
Q6	What is your ethnicity?	Kembata	1	
		Amhara	2	
		Hadya	3	
		Other	88	
Knowledge of trichiasis				
Q7	Does your eye problem affect your ability to do your normal work	Yes	1	
		No	0	
Q8	Are you doing something to relieve the problem with your eyelashes?	Nothing	0	
		Epilation/plucking	1	
		Stick lashes to eyelid	2	
	<i>After each response ask:</i>	Burn lashes	3	
		Go to traditional healer	4	
	'Anything else'	Other traditional or local practice	5	
		Intend to go for surgery	6	
	<i>Circle all that apply</i>	Have been for surgery	7	
		Other(write in)	88	

Q9	Do you know that it is possible to get surgery for your condition?	Yes	1
		No	0
Q10	Have you had surgery for your condition?	Yes	1
		No	0
Q11	Yes for Q 10, is it a recurrence?	Yes	1
		No	0
Q12	In the end, what can happen if you do not have surgery for your condition? <i>Circle all that apply</i> <i>After each response ask 'Anything else'</i>	No consequence	1
		Blindness	2
		Reduced vision	3
		Pain	4
		The lashes touch the eye	5
		Sensitivity to light	6
		No answer/don't know	88
Other <i>(write in)</i>	99		
Q13	Why haven't you gone for surgery? <i>Circle all that apply</i> <i>After each response ask 'Anything else?'</i>	No reason / don't know	1
		Trichiasis is not a problem for me	2
		Fear of complications / afraid I would go blind	3
		Fear of the surgery	4
		Did not know it was available	5
		Waiting for the summer season	6
		Lack of transport	7
		Nobody to accompany me	8
		Nobody to do my duties while I get better	9
		Cost	10
		Its God's will that I have this condition	11
		Seen a negative outcome of surgery	12
Other <i>(write in)</i>	99		
Q14	If surgery were free, would you be willing to go	Yes	1
		No	0
Q15	Where would be most convenient for you to have trichiasis surgery	Home	1
		Village	2
		Clinic	3
		Hospital	4
		Don't want surgery	5

Appendix 6 - Participant Consent Information Letter (Parents)

Social and Environmental Risk Factors for Trachoma: A Mixed Methods Approach in the Kembata Zone of Southern Ethiopia

This letter is an invitation to consider participating in a study entitled “Social and Environmental Risk Factors for Trachoma: A Mixed Methods Approach in the Kembata Zone of Southern Ethiopia.” This research project is being conducted as part of my Master’s degree in the Department of Geography at the University of Victoria under the supervision of Professor Stephen Lonergan with the assistance of the staff at ORBIS Ethiopia. You may contact my supervisor in Canada by e-mail at lonergan@uvic.ca or if you prefer to speak to someone in Ethiopia about this project or require assistance contacting my supervisor in Canada please contact Asrat Gebre, field coordinator for ORBIS Ethiopia at 0911876744. Please read this form carefully and feel free to ask any questions you may have before agreeing to take part in this study.

The focus of this study is trachoma, an infectious eye disease and the world’s leading cause of preventable blindness. The purpose of this research project is to conduct a spatial analysis of trachoma cases in order to identify disease clusters and help clarify factors that influence risk of infection. This study also seeks to understand the community’s perception of trachoma. Specifically, how individual perceptions influence behaviour and consequent risk of infection. Research of this type is important because it may aid decision makers in formulating locally appropriate disease intervention strategies that focus on primary prevention as opposed to treatment of the disease.

You are being asked to participate in this study because children typically have the highest rates of infection and are believed to be the main source of trachoma infection for other people. As a parent, you likely have significant influence over the behaviours and beliefs of your child / children. Consequently, I would appreciate the opportunity to speak to you about your experience with trachoma and your knowledge of this condition.

If you agree to voluntarily participate in this research, your participation will involve attending one interview session that will require approximately an hour of your time. During the interview you will be asked a series of questions related to hygiene and sanitation in your home and community. In order to ensure an accurate recording of your responses you will be asked permission to be tape recorded.

There are some potential risks to you by participating in this research. These risks include the possibility that you may feel uncomfortable with some of the questions I ask you or stressed by the interview process. However, you are free to not answer any questions you do not wish to answer, take a break or withdraw from the interview at any point without any consequences.

The potential benefits of your participation in this research include improved understanding of local disease characteristics and more effective interventions that strive to lower

trachoma prevalence. Further, to date there is very little published literature using mapping software (GIS) to study and/or map the distribution of trachoma. Consequently, this research project may add to the current limited database of literature on trachoma research of this kind.

Your participation in this research must be completely voluntary. If you do decide to participate, you may withdraw at any time without any consequences or any explanation. If you do withdraw from the study your data will only be used if you give permission to do so. Otherwise the data will not be used.

In order to protect your anonymity pseudonyms will be used in all final reports, presentations and publications that result from this research. Further, all data resulting from this interview will be stored either in a locked cabinet or as a password protected computer file when not in use.

It is anticipated that the results of this study will be shared with others through a thesis and dissertation, a published article, class presentations, a report for ORBIS Ethiopia and academic conferences. It is possible that excerpts from your interview may be included as anonymous quotations in final projects related to this research. A copy of the final report will be stored by ORBIS staff in Alaba town. This report will be available to the public upon request. All audio recordings will be destroyed once the study is complete.

In addition to being able to contact the researcher, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Associate Vice-President, Research at the University of Victoria 00-1-250-472-4545.

Sincerely,

Candace Vinke
MA Candidate

Appendix 7 - Consent Form

I have read the information presented in the information letter about the study entitled “Social and Environmental Risk Factors for Trachoma: A Mixed Methods Approach in the Kembata Zone of Southern Ethiopia” being conducted by Candace Vinke of the Department of Geography at the University of Victoria. I have been given the opportunity to ask any questions I had related to this study and received satisfactory answers to my questions.

I am aware that I have the option of allowing my interview to be tape recorded to ensure an accurate recording of my responses. I am aware that excerpts from the interview may be included in the thesis and/or publications to come from this research, with the understanding that the quotations will be anonymous. I am aware that ORBIS may retain a copy of the transcribed interviews from this research with names and identifying information removed for possible future use. I was informed that I may withdraw my consent at any time without penalty by advising the researcher.

This project has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Victoria and the local Regional Health Bureau. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact the Associate Vice-President, Research at the University of Victoria at 011-250-472-4545.

I agree to have my interview tape recorded.

YES NO Initial: _____

I agree to allow the data collected for this project to be used for future research.

YES NO Initial: _____

Your signature below indicates that you understand the above conditions of participation and that you agree of your own free will to participate in this study.

Name of Participant

Signature

Date

If you decide that you would like to withdraw from this study at a later date please contact Asrat Gebre of ORBIS Ethiopia at 0911876744.

Although I have chosen to withdraw from this study, I agree to allow the information I have given thus far to be used for this research. Initial: _____

Appendix 8 - Interview Questions for Household Heads

1. Can you describe to me how and where your livestock is stored both during the day and at night?
2. When an animal defecates on your property what is typically done with the faeces?
3. Do you feel that eye-seeking flies are a problem in your household and community? Please elaborate.
4. If applicable, how do you think you could lower the number of flies in and around your house?
5. Can you describe to me any measures you and your family take to minimize your contact with flies?
6. Where do you get your water for drinking, cooking, washing, cleaning and bathing? (pipe water supply, hand pumped well, spring, pond, well or river?)
7. Who is responsible for collecting water in your family? (Donkey?)
8. Typically, how often and how much water is collected?
9. What portion of the water you fetch would you say goes towards face washing, bathing and laundry? How is the rest of the water used?
10. Do you feel that the water supply in your community is adequate? Please explain your answer.
11. If the water supply in your community was improved so that you were able to use more water on a daily basis, what would you use this extra water for?
12. Trichiasis, a potentially blinding condition is three times more common in females than in males in this area. Why do you think this is the case?
13. Where do you and your family typically go to the washroom?
14. If applicable, do you feel that your latrine adequately fulfills the needs of your family? Please explain your answer.
15. If applicable, is there anything that discourages you or your family members from using the latrine?
16. Do any of your family members share a bed when they sleep at night?
17. Do you and your family members share clothing, blankets, pillows, etc.? and how often do you wash these items?
18. How often do your children wash their faces? Hands? (soap?)
19. Can you tell me how your children's clothing is washed (i.e. with or without soap) and how often it is washed?
20. Can you tell where food is cooked for your family? (inside or outside)
21. Have you ever heard of trachoma? And if so can you describe to me your understanding of what trachoma is and how it is transmitted?
22. If applicable, where or how did you first learn about trachoma?
23. Have your children ever mentioned to you that they have learned about trachoma in school?
24. If you or any of your family members were to experience problems with their eyes, can you tell me what you would do?
25. Is there anything that would prevent you from going to see a doctor or nurse?
26. Is there anything else you would like to share related to the health of your family and your experience as a parent?

Appendix 9 - Interview Fact Sheet

Kebele: _____

Gott: _____

Cluster & Household (if applicable): _____

Date: _____

Profession: _____

Age: _____

Education: _____

Number of Children: _____

Age and sex of Children: _____

Education of Children: _____

Livestock (type and quantity): _____

Latrine Style (pit alone, pit with shelter, concrete slab, tube): _____

Appendix 10 - Interview Questions (Teachers)

1. What grade(s) do you teach?
2. On average, how many children are in a classroom?
3. Can you describe to me how hygiene and sanitation is incorporated into the everyday activities of your students while at school?
4. How frequently would you say that your students wash their hands while at school?
5. Where do the students typically go to the washroom while at school?
6. Do you feel that the children at your school are well educated when it comes to the issues of health, hygiene and sanitation? Please elaborate
7. Can you describe to me how health education is currently incorporated into the curriculum at your school?
8. Can you describe to me what students are typically taught about trachoma?
9. How would you describe the level of understanding of your student's parents when it comes to issues of health, hygiene and sanitation?
10. Have any of your students ever complained about having any of the following symptoms of trachoma; eye redness, watering eyes, swollen eyelids, sensitivity to bright lights, eye pain, corneal scarring or small red lumps on the eyelids
11. If one of your students was experiencing problems with their eyes, can you tell me what you would do?
12. How do you think health education at your school could be improved (if at all)?
13. As a teacher is there any resources you lack that you feel would help you to improve your students understanding of health issues?
14. How do you think the education system in your community could be better used to help improve the health of your students?
15. Is there anything else you would like to share from your experience as a teacher?

Appendix 11 - Interview Questions (Health Care Professionals)

1. What are the major health issues of this area?
2. On average, at what stage of trachoma infection do individuals typically seek medical attention (i.e. trachomatous inflammation follicular, trachomatous inflammation intense, trachomatous scarring, trichiasis, corneal opacity)?
3. What factors (if any) do you believe are hampering efforts to prevent / limit the spread of trachoma in this area?
4. How often would you say that you treat individuals with trachoma?
5. How often (if at all) are mass antibiotic treatments administered in this area?
6. Can you describe in detail how mass antibiotic treatments are administered? Please include details on who (if not everyone) receives antibiotics.
7. As a health care professional is there any resources you lack that you feel would help you to better treat patients with trachoma and/or lower the number of trachoma infections?
8. What do you perceive to be some of the barriers individuals with trachoma face when it comes to seeking medical attention?
9. Do you feel that the water supply in the area is sufficient for community members to maintain the level of hygiene needed to avoid serious trachoma infection?
10. Do you feel that the latrines in the area are sufficient to meet the community's needs?
11. How do you think the education system in your community could be better used to help reduce the number of trachoma infections amongst children in the area?
12. Is there anything else you would like to share from your experience as a health care professional?

Appendix 12 - Focus Group Guide (Household Heads)

Introduction

Good afternoon. My name is Candace and this is my research assistant_____. Thank you for volunteering your time to participate in this discussion. Before beginning the discussion I would like to ask you all to take some time to read over the participant consent information letter and to fill out the corresponding consent form given to you if you have not already done so. If anyone has questions feel free to ask either _____ or myself. I will collect the forms once everyone is done. If you decide that you no longer would like to participate in this discussion after reading the information letter please let me know. There is no consequence whatsoever for withdrawing from this discussion at any point.

Discuss Procedure / Purpose

Once all participants have filled out a consent form I will briefly describe the discussion procedure. Participants will be told the following;

During the discussion I will be asking a series of questions that are of interest to my research. Please feel free to respond to any of my questions or to other members in the group without waiting to be called upon. However, I would appreciate it if only one person spoke at a time. I would also like to assure you that there is no right or wrong answer to each of the questions and you are free to disagree or agree with each other. However, out of respect for the other participants I would like to ask you to please keep the information discussed in today's session confidential. It is your opinions and thoughts that are of interest to me. Consequently, I will not be sharing any of my own thoughts. Throughout the discussion _____ will be taking notes. The discussion will also be tape recorded so that I do not miss anything that was said. Does anyone have any questions before we begin?

Participant Introduction

Participants will be asked to introduce themselves to the group.

Questions

1. Is trachoma a problem in your community?
Probes: Does trachoma frequently interfere with daily activities?
2. What do you think causes trachoma?
Probes: How do you think trachoma is transmitted?
How can you prevent or minimize your risk of getting trachoma?
3. What would you suggest be done to improve the hygiene of the children in your community?
Probes: How can the hygiene of children in your community be improved?

4. What would you suggest should be done to solve or reduce health issues such as trachoma in your community?
Probes: What needs to be done to reduce the risk of trachoma infection?
 (Education? Water? Latrines? Health Care?)
5. What are the barriers to eliminating blinding trachoma in your community?
Probes: What prevents the problem of trachoma from being solved now?
6. What role do you think organizations such as ORBIS should play in dealing with health issues such as trachoma?
Probes: How can OBRIS help eliminate trachoma in your community?
7. Is there any other information you feel would be useful for my research or that you would like me know?

Closure

Thank you once again for participating in this afternoon's discussion. I appreciate the time each of you has taken out of your day to discuss this topic. Your comments and thoughts on the subject have been very useful. If you have any further questions or concerns you would like addressed before you leave please come and see _____ or myself.