

**The Political Ecology of Gold Mining and Health Outcomes
in the Upper Denkyira District, Ghana**

M.A. Thesis Proposal

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Table of Contents

<u>Abstract</u>	<u>1</u>
<u>Introduction</u>	<u>2</u>
<u>Background</u>	<u>5</u>
<u>Study Design</u>	<u>10</u>
<u>Conclusion</u>	<u>15</u>
<u>References</u>	<u>17</u>
<u>Appendices</u>	<u>20</u>

Abstract

Over the past decade, the global price of gold increased 550%. In Ghana, West Africa, as in many developing countries, this is only one of many factors influencing the development and diffusion of artisanal small-scale gold mining (ASM) or *galamsey*. Traditional land-use practices, neoliberal policies of “structural adjustment programs”, increased foreign investment and labor supply, lax environmental regulations, barriers of bureaucracy, and marginalization have combined with other forces in driving spatial distribution of ASM in Ghana. This industry poses serious environmental and human health risks. The proposed study will investigate the complex political and economic relationships influencing ASM in Ghana and associated impacts on human health.

Political ecology, increasingly utilized in examinations of human-environment interactions, will be employed as a theoretical framework for this study. Combining *political economy* and *ecological analysis*, this approach will address shifts in emerging infectious disease and other health impacts due to disturbed environments. Questions surrounding landscape degradation, marginalization, environmental conflict, and social movements will be incorporated into the political ecology framework to address the effect of larger political and economic forces influencing spatial distribution of ASM and its impact on health outcomes.

Introduction

The coupled dynamic of human disease and environment remains a central focus of research in health and medical geography. Human dimensions of environmental change, whether through development for agriculture, mining, housing tracts, or other means can result in drastic changes in health outcomes (Meade 1976; Meade and Emch 2010; Connor et al. 2004; Daszak 2001). Recent jumps in global gold prices, along with lax regulations for environmental protection, have resulted in increased local and foreign investment in mining infrastructure in Ghana, West Africa.

Landscape degradation, disruption of traditional farming practices, pollution, social upheaval, and increased immigration and internal migration resulting from growth in small-scale gold mining (*galamsey*) play a critical role in emerging health disparities in Ghana. These include rates of chemical poisonings, hunger, HIV/AIDS, and vectored/environmentally sourced diseases such as malaria and Buruli ulcer, among others (Ogola et al. 2002; Jasso-Pineda et al. 2006; Peplow and Augustine 2007). New approaches are needed to better understand shifts in disease patterns resulting from anthropogenic changes to the environment due to gold extraction.

This study will employ a political ecology framework in evaluating the health disparities in miner populations and local communities in the Central and Western regions of Ghana. The following questions will be addressed in evaluating this problem.

1. *How do conflicting interests of government (Lands Commission, Minerals Commission) and traditional power structures impact small-scale gold mining?*
2. *What is the effect of increased small-scale gold mining production on the physical and cultural environments in the Central and Western regions of Ghana?*
3. *What infectious diseases (malaria, HIV, Buruli ulcer) and other health outcomes are affected by landscape disturbance, migration patterns, and changes in local economies associated with small-scale gold mining in the communities of these regions?*

The proposed study will evaluate these nested questions with the goal of potentially identifying new strategies for mitigating adverse health outcomes created by small-scale gold

mining in Ghana. In order to provide context for these processes and questions, it is important to review the literature of political ecology of human-environment interactions related to health impacts, as well as issues specific to artisanal gold mining in Ghana.

Background

Human health is inextricably linked to environmental health. A central theme of health and medical geography research is the investigation of the complex coupled dynamic that exists between humans and their environment. There is a growing recognition of the complexity and interrelatedness of the many physical and social systems that impact the concentration and diffusion of disease and the importance of new approaches in addressing this phenomenon (Allotey et al. 2010). Human dimensions of environmental change, whether through development for agriculture, mining, or housing tracts, can result in drastic changes in health outcomes (Meade 1976; Meade and Emch 2010; Connor et al. 2004; Daszak 2001). This may occur through creation of new “space” for emerging or reemerging infectious diseases, changes to habitat for vectors and reservoirs of disease, or altered dynamics of environmentally sourced diseases (Connor et al. 2004; Jones et al. 2008; Derraik and Slaney 2007; Mayer 2000; Pimentel et al. 2007; Vasconcelos et al. 2001). New approaches are needed to investigate and better understand changes in disease patterns as a result of anthropogenic impacts on the environment.

Gold Mining in Ghana

The geography of resource extraction in Ghana (Figure 1), particularly the gold industry, has long been influenced by political and economic power structures. The impact of this industry in recent decades, exacerbated in the past several years due to increases in global gold prices, is widespread and well documented (Hilson 2002; Hilson and Potter 2005; Nyame and Blocher 2009). Hilson and Potter (2003) investigate the impact of the “Structural Adjustment Programs” on the gold mining industry in Ghana. These neoliberal policies served mainly to perpetuate poverty and negatively impact the livelihoods of small-scale miners while increasing the hegemony of larger national and international mining corporations. The true consequences of this industry’s practices, from a public health perspective, have yet to be fully realized. However, several studies have illustrated the serious health outcomes resulting from both large

and small-scale mining operations, impacting not only the miners and the surrounding communities, but also distant downstream populations.

Environmental and social changes due to mining practices can affect the prevalence and diffusion of diseases such as HIV/AIDS and other sexually transmitted diseases (STDs),

Tuberculosis (TB), and malaria. Barbieri et al. (2005) illustrate how Brazilian *garimpo* sites (small-scale alluvial gold mining) influence malaria incidence levels among miners and change patterns of malaria endemicity in the Amazon. Gold miners in southern Africa experience TB rates three times higher than any country in the world and are spreading HIV due to increased work-related migration (Basu et al. 2009). In Ghana, landscape degradation, disruption of traditional farming practices, pollution, social upheaval, and internal migration resulting from growth in the legal and illegal *galamsey* mining can have a critical role in

the rates of toxic poisonings, hunger, HIV/AIDS, vectored/environmentally sourced diseases such as malaria and Buruli ulcer, etc. (Duker et al. 2006, Kibadi et al. 2008, Ogola et al. 2002; Jasso-Pineda et al. 2006; Peplow and Augustine 2007, Campbell 1997).

Theoretical Frameworks of Human Health

Many theoretical frameworks have been employed in evaluating the critical link between human health and the environment. An ecosystem approach to disease focuses on the “understanding of interrelationships among factors that produce ill health and ecosystem disruption” (Spiegel and Veiga 2005). This framework uses a hierarchy of human health, from those directly involved in the mining activities to the general population, as its underlying structure and incorporates the social, cultural, economic, and environmental factors which

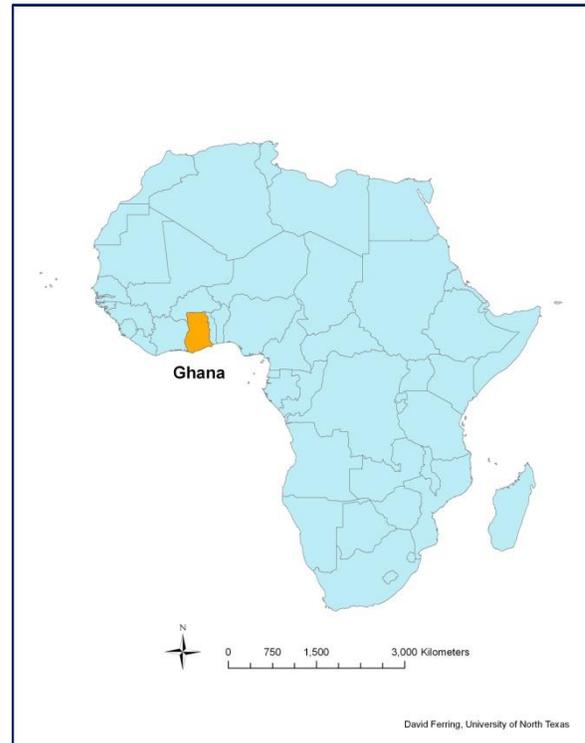


Figure 1

influence health outcomes at each level (Mergler 2003). Disparities in health outcomes have also been investigated from the environmental justice perspective, evaluating environmental hazard exposure differentials and resulting disease burdens in certain populations (Pearce et al. 2010).

Albrecht et al. (1998) argue for an approach to investigations of health disparities that identifies and explores non-linear relationships and provides “multi-level explanations” for the observed phenomena. The authors propose a “trans-disciplinary” approach to research, which incorporates the dynamic systems (social, environmental, political, economic, etc.) that interact at varying scales. This method seeks to incorporate not only a few inter-connected fields, but provides a framework allowing for collaboration across many disciplines, resulting in a more holistic perspective and novel solutions (Albrecht et al. 1998). This is an important concept in the application of political ecology to health issues – a seamless integration of various fields into a multi-faceted understanding of the socio-cultural environment and relationship to human health.

Political ecology combines two main perspectives: *political economy*, encompassing the political and economic power structures and associated activities, and *ecological analysis*, evaluating “bio-environmental” relationships from a variety of frameworks (Greenberg and Park 1994). Political ecology developed out of the cultural ecology sub-field of human geography (Zimmerer and Bassett 2003), with important contributions from other disciplines, and has continued to cross-pollinate with new themes and ideas, illustrating an example of the close relationships geography shares with other fields, including sociology, anthropology, etc. (Sutton and Anderson 2010).

The influence of political and economic forces on health disparities has long been acknowledged and researched. Farmer (2003) powerfully provides examples of what he terms “structural violence” and the public health outcomes resulting from these multi-scalar forces. Although the impact of cultural-environment interactions on health has been acknowledged since the time of Hippocrates, the work of John Snow during the cholera outbreak of 1854 in London began a new era in the investigation of this complex relationship (Meade and Emch 2010). Jacques May, known as the “father” of medical geography in the US, identified not only

the critical relationship between the physical environment and human health, but recognized that culture plays an equally important role in this dynamic (May 1960).

Turschen (1977) was one of the first to call for a political ecology approach to the study of disease and health. Her landmark paper reviewed approaches to health and medical ecology, which “by dismissing political and economic factors as irrelevant... suffers from a failure to consider the relation of people to their environment in all its complexity.” Many geographers have called for an examination of the geographical aspects of health outcomes and disease burdens from a political ecology perspective (Mayer 1996, 2000; King 2010). Mayer (1996) makes a forceful argument for a reexamination of medical geography and associated epidemiological fields, highlighting the applicability of the political ecology perspective. Current areas of research in medical geography, including HIV/AIDS and emerging and re-emerging diseases, would benefit, Mayer argues, from the deeper understanding resulting from the synthesis of disease ecology and political ecology in the health and medical geography context.

Kalipeni and Oppong (1998) apply the political ecology methodological approach in their survey of the refugee crisis in Africa. Highlighting the valuable analytical elements of their definition of political ecology: context and scale, historical depth, and structural relationships, the authors evaluate the varying health impacts of forced migration, displacement, and war. These effects include increased rates of HIV/AIDS, disruption of health delivery systems and livelihoods, and new cases of diseases stemming from poor sanitation, overcrowding, and hunger. *Context and scale* in the political ecology framework refers to the need to examine human-environment relationships in broader socio-political contexts and at local, regional, and global scales. *Historical depth* addresses the important temporal component of change in the human-environment dynamic, at times requiring examinations of long periods of time for critical analysis. The *structural relationships* incorporated into the political ecology framework acknowledge the effect of larger political and economic forces superseding expressions of individual agency. By examining this issue from multiple spatial and temporal scales, as well as incorporating the influence of political and other power structures, a more integrated understanding is gained concerning the health impacts of pan-African refugee issues.

The political ecology approach to investigating the impact of multi-scalar political and economic interactions can powerfully reframe the health of a community or population. Richmond et al. (2004) illustrate the potential importance of national and regional government policies influencing local connections to the environment and economies of natural resources (political economy of aquaculture) and health outcomes. The political ecology framework is reshaped to illustrate the critical relationships of autonomy, access to environmental resources, health and well-being, and economic choices and opportunities (Richmond et al. 2004).

Hanchette (2007) utilizes both sophisticated spatial analysis tools (measures of spatial autocorrelation) and a political ecology approach to investigate disparities of lead poisoning in North Carolina children. Hanchette (2007) employs the “tiered” framework of risk factors provided by the political ecology approach – proximate, intermediate, and ultimate: individual biomedical conditions (e.g. immune system, metabolism), behavior and interaction with immediate social and physical environment, and macro-level social, cultural, and economic processes, respectively. The results of this approach provide a novel context to accompany a spatial analysis of health phenomena, illustrating how different facets of the history of the tobacco industry in eastern North Carolina can result in present day health disparities related to lead poisoning in children.

Cutchin (2006) and Watts (2004) both provide examples of the advantages and insights gained through applying a political ecology framework to the petrochemical industries of Texas and Nigeria, respectively. The formidable political and economic power wielded by oil companies, when examined from a social epidemiology/health geography perspective, provides insights into the health burdens (stress, pollution-related illness, etc.) of communities adjacent to the industry’s activities. Disparities in health outcomes along racial and socio-economic lines are shown to exist in many different contexts, with important consequences (Cutchin 2006). These studies provide examples of the usefulness of this approach in examining the health impacts of gold extraction in Ghana – creating connections between resource extraction and the myriad health effects experienced by communities who may lack the political agency to combat these forces.

Many frameworks and varying perspectives on human-environment interactions have been employed in previous research evaluating the effects of this relationship: socio-political, ecological, among others. Political ecology has emerged as a research framework with a broad, inter-disciplinary approach to engage these issues in a way which provides due consideration to the overall dynamics of these systems. Relatively few studies of the geography of health have employed political ecology as a theoretical framework (Mayer 1996, King 2010). The investigation of health impacts from environmental degradation due to gold mining has identified important links to rates of infectious disease such as Buruli ulcer (Duker et al. 2006, Kibadi et al. 2008), malaria (Barbieri et al. 2005), and HIV (Gilgen et al. 2001), among others. The complex and often competing influence of political and economic forces on the diffusion of gold mining in Ghana, both legal and illegal, can impact health of both proximate and distant populations. The political ecology framework provides a means of identifying connections between socio-political forces at varying temporal and spatial scales to disparities in health outcomes. The following section illustrates how this approach will be applied in a case study designed to address the proposed research questions.

Case Study

This case study employs a political ecology framework to investigate health disparities in miner populations and local communities in the Central and Western regions of Ghana due to landscape disturbance from artisanal and small-scale gold mining (ASM). The proposed study will utilize this theoretical perspective and the data collection and analytical methods described in this section to investigate the three research questions presented in the introduction.

How do conflicting interests of government (Lands Commission, Minerals Commission) and traditional power structures impact small-scale gold mining? Points of contact/conflict between traditional and state political power structures influencing spatial distribution of ASM will be examined and analyzed. The role of conflicting political power structures will be examined, both through preliminary archival research in the development of these structures and interviews with current stakeholders within these institutions in Ghana. This research will provide important context to understanding how deregulation through “structural adjustment programs,” beginning in the 1980s led to current practices of gold mining in Ghana. It is

important to understand these differing forms of political power to evaluate how they have impacted the development of this industry.

What is the effect of increased small-scale gold mining production on the physical and cultural environments in the Central and Western regions of Ghana? In addition, impacts on the physical and socio-cultural environments from this resource extraction industry will be mapped. The proposed study will provide an illustration of the scale and direction of where ASM sites have developed in the study area. Ground truth data sampling will provide information concerning which land-use/land-cover types have been replaced by mining operations. In addition, surveys and interviews will provide “qualifying” data to understand the impacts of these changes. This question is critical due to the fact that many of these mining operations are illegal and are not remediated once mining is completed. Therefore officials from the Minerals Commission may not fully comprehend the extent of environmental and social disruption caused by these sites.

What infectious diseases (malaria, HIV, Buruli ulcer) and other health outcomes are affected by the landscape disturbance, migration patterns, changes in local economies associated with small-scale gold mining in the communities of these regions? The spatial environmental and social effects of the gold mining industry will be combined with health outcome data (*malaria, HIV, Buruli ulcer*) to reveal possible relationships to diffusion and prevalence of these diseases and ASM (landscape disturbance and marginalization of affected communities). This question will provide information to health officials, local non-governmental organizations, and affected communities concerning the deleterious impacts of this unregulated industry. These variables will be combined conceptually in a structural equation model for evaluation.

This study will evaluate these nested issues with the goal of potentially identifying new strategies for mitigating adverse health outcomes created by small-scale gold mining in Ghana. A mixed methods approach will be employed in investigating the political ecology of ASM in Ghana. Mining operations and three communities along the Offin River in the Upper Denkyira district of central Ghana will be used as a case study. Partnerships with Ghanaian collaborators at multiple institutions formed during a past research project investigating the impact

environmental (ASM) and behavioral factors influencing prevalence of Buruli ulcer, an infectious disease in Ghana (NSF CNH Award #0909447) are critical to the success of this proposed work.

A GIS of physical and ecological variables as well as classified high-resolution Quickbird imagery will be created to identify areas of land-use/land-cover change in the case study area. Disease prevalence data at varying scales for infectious diseases including malaria, Buruli ulcer and HIV/AIDS will be incorporated into the GIS as well. These data will be combined with ground truth qualitative data gained through participatory research in communities involved in and proximate to ASM. These data will be collected through activities such as concept, community, and historical land-use mapping and incorporated into an open-source format for ease of access to research participants and other interested parties in Ghana.

In addition to these data, structured and semi-structured interviews will be conducted with influentials and stakeholders at various points of contact with ASM as well as health officials, doctors, and traditional healers. Formal surveys and unstructured interviews in both ephemeral and permanent settlements in the study area will be conducted. These qualitative methodologies will provide ground-truth data and context for understanding both land-use/land-cover changes and perceptions of and responses to political and economic drivers of ASM and health outcomes. Presentations and activities in primary and secondary level schools will engage children in thinking about impacts on livelihoods, diseases, and the environment resulting from ASM, as well as provide additional insight into local attitudes towards these activities. IRB approval will be obtained for research involving human subjects, utilizing knowledge gained through CITI and NIH training courses on responsible conduct of research.

Case Study Area

The study area for this proposed research consists of communities located along the Offin River in the Upper Denkyira District in the Central Region of Ghana (Figure 2). Communities involved in this research will include three small villages: Subin, Pokukrom, and Nkotumso, surrounding the regional capitals of Dunkwa-on-Offin and Diaso.

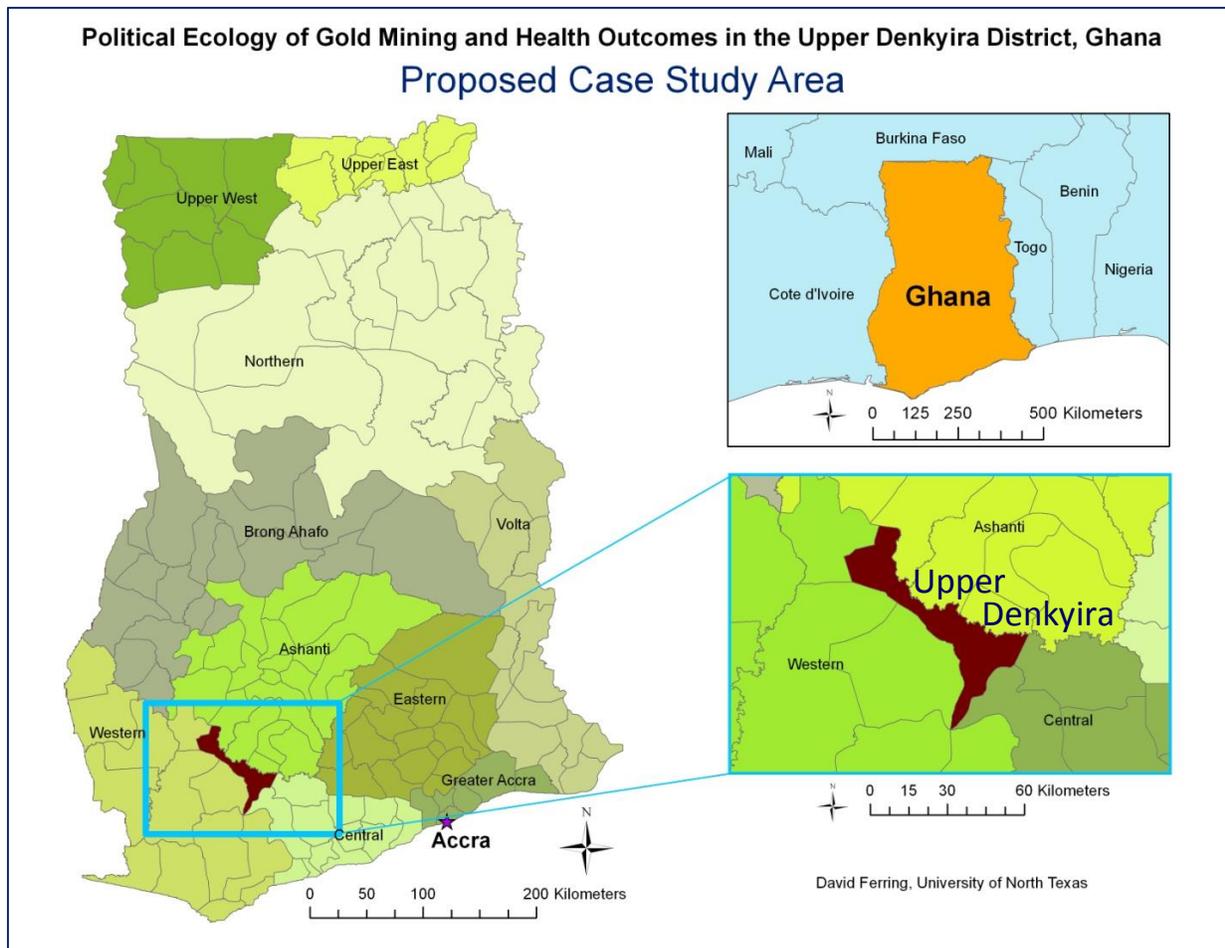


Figure 2: Upper Denkyira District of Central Region in Ghana

Data Sources

Archival - Prior to the field season in Ghana, archival data will be collected and organized to develop an understanding of the development of current political and economic structures in Ghana. National and regional disease outcome data and census data on population and household characteristics will be collected through data requests and contacts at the Ghana Statistical Service. Additional disease outcome data, at national, regional, and district levels will be provided by the Ministry of Health. Preliminary spatial data will be collected into layers of a GIS, to be combined with ground truth data collected during May and June of 2012. These data will include previously acquired satellite imagery as well as other spatial databases of physical and social variables.

Data Collection in Ghana – Quantitative: Mining concession maps will be acquired from Minerals Commission office in Accra and Tarkwa. Additional spatial data on mining activities

and local land-use patterns will be provided by the University of Mines and Technology in Tarkwa. GPS points will be taken, to be combined with data from previous studies, to map the extent of mining operations and what land-uses/land-covers have been replaced by these activities. *Qualitative:* Data will be collected through surveys, semi-structured interviews, participant observation, and participatory mapping in three communities along the Offin River in the Upper Denkyira District. Interviews with mining officials, government representatives, and academics in major urban areas (national and regional capitals) will also be conducted.

Timeline & Budget

The overall timeline for completion of this thesis can be found in Appendix A. Field data collection will take place over six weeks (mid-May to end of June) during the summer 2012. One week of archival data collection/interviews, meetings with representatives of Minerals and Lands Commissions and researchers at the University of Ghana and the Noguchi Memorial Institute for Medical Research, will take place in Accra. This will be followed by one week in Tarkwa at the University of Mines and Technology (UMAT) for consultation with members of the faculty and graduate students. Additional interviews will take place with representatives at the Minerals Commission office in Tarkwa, as well as meetings with regional mining companies (e.g. Asante Gold Corporation, Gold Field Ghana Limited) and tours of area small-scale mining sites, organized by Dr. Richard Amankwah at UMAT.

Following this time in Accra and Tarkwa, fieldwork will continue in cooperation with Emmanuel Effah, an engineering graduate student and past collaborator, well-versed in both qualitative data collection methodologies, school activities, local languages and considerations of cultural sensitivity. Data will be collected through concept, community, and historical land-use mapping in three communities in close proximity to ASM operations along the Offin River. Structured and semi-structured interviews as well as formal surveys will be administered in these villages to various community members and officials. Activities, presentations, and data collection will be conducted in area primary and secondary level schools.

In order to fund this research (see Appendix B for fieldwork budget), an application for a UNT Graduate Student International Award (\$1000) will be submitted to the Toulouse Graduate School. Other exterior sources of funding will be explored in support of this research.

Analysis

Analyses of this data will take place from June to August following field data collection in Ghana. GIS software will be utilized to identify areas of land-use/land-cover change – with particular interest in the conversion of agricultural and forested lands to alluvial ASM in the study area. All ground truth data resulting from field activities (quantitative and qualitative) will be incorporated into this GIS. Spatial clustering of disease and ASM operations will be analyzed and regression analysis and structural equation modeling used to predict areas of health disparities related to environmental degradation from ASM. These GIS analyses will be “qualified” by the data collected through participatory community mapping activities, interviews, and surveys. These qualitative data will be coded and categorized to identify important themes and perceptions of ASM and the environmental and socio-ecological impacts of this industry.

Results anticipated from these analyses include the following: 1) Multi-scalar political and economic pressures result in differential spatial distribution of ASM. 2) Developing economies of ASM lead to increased exposure to environmental and socioeconomic risks leading to disparate health outcomes in these (im)migrant and neighboring populations.

Conclusion

This collaborative research provides a novel approach to interrogating factors driving the nature, scale, and impacts of artisanal and small-scale gold mining in Ghana on health outcomes. Whereas past studies of these issues have investigated impacts on environmental health and land-use/land-cover or social systems and human health, this research will result in an integrated understanding of these processes, through qualitative and quantitative analyses at varying scales.

This research necessarily depends upon the engagement of affected communities, those proximate to ASM operations and the miners themselves. Results of this study will provide these populations with information critical to understanding the impacts of ASM and possible means of mitigating potential environmental and human health impacts. Social and environmental justice campaigns, policy-making addressing land tenure, livelihoods, and

remediation of mined areas, and public health interventions may benefit from the knowledge gained through this work.

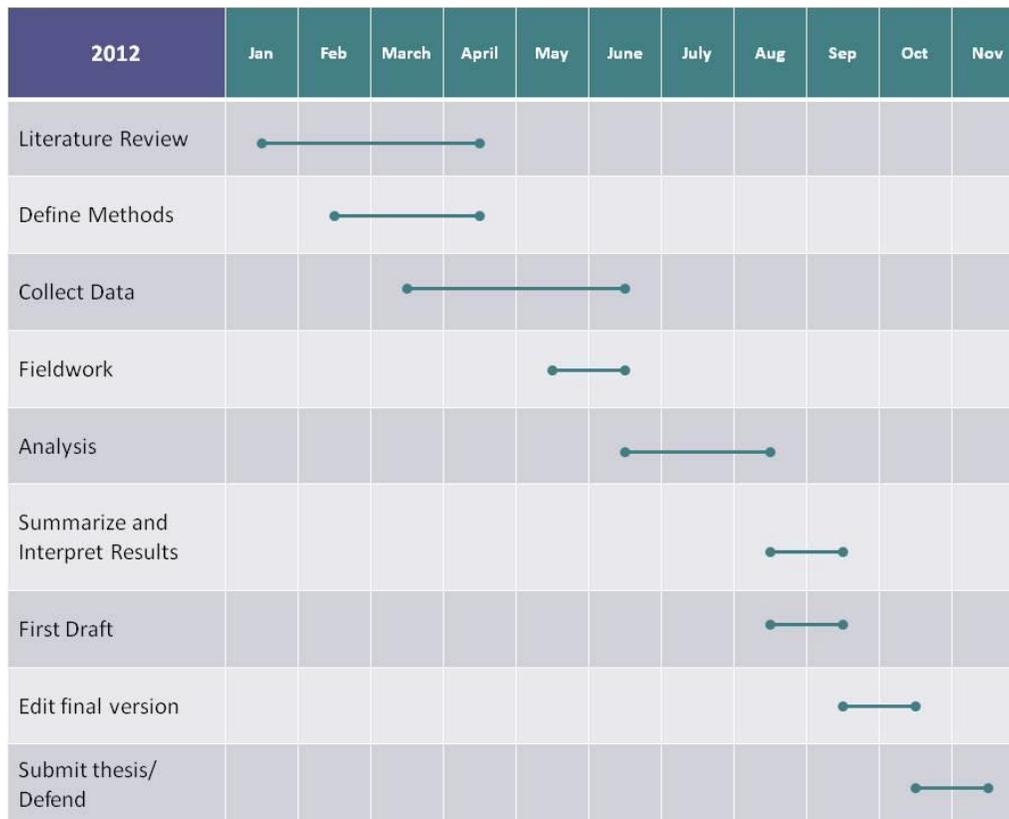
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Appendix A: Thesis Timeline



Appendix B: Budget (Fieldwork, Summer 2012)

Item	Amount	US Dollar Amount*
Airfare	\$2500 (paid by NSF CNH Award #0909447)	\$0
Visa	\$60	\$60
Per Diem: Research Collaborator (Graduate Student from University of Mines and Technology, Tarkwa)	50 cedis/day x 20 days	\$660
Per Diem: US Graduate Student	50 cedis/day x 35 days	\$1166
Transportation		
Accra/Tarkwa	15 cedis	\$10
Tarkwa/Dunkwa (return)	10 cedis x 2	\$13
Dunkwa area	25 cedis/day x 10 days	\$375
Dunkwa/Subin (return)	20 cedis x 2	\$26
Subin area	50 cedis/day x 10	\$330
Handshakes (gifts)	10 cedis/day x 20	\$133
Supplies	100 cedis	\$66
Total		\$2839

*US Dollar amount based upon current exchange rate of 1.5 Ghanaian cedis to 1 US dollar.