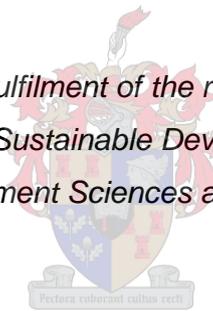


**“God has locked the sky”:
Exploring traditional farming systems in Tigray,
Ethiopia**

by

Nava Derakhshani

*Thesis presented in partial fulfilment of the requirements for the degree of
Master of Philosophy in Sustainable Development in the Faculty of
Economic and Management Sciences at Stellenbosch University*



Supervisor: Ms Eve Annecke

March 2015

Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: March 2015

Integrated abstract

The Tigray region in northern Ethiopia is a historic centre of agricultural production and home to many subsistence farmers that still use traditional farming systems and practise rain-fed agriculture. The region has been affected adversely by famines and periodic droughts for centuries and is vulnerable to climate change. Farmers are producing on small plots of often degraded land and through their own actions have depleted the natural resources they rely on, in particular soil, water and trees.

This study sought to explore the environmental degradation of Tigray through both a literature review of its agricultural socio-political history and a lived experience in the village of Abraha We Atsebaha among farmers of the region. It uses a variety of methodologies and methods, including a literature review, grounded theory, narrative inquiry and ethnography, to expand on the factors that have contributed to the current degradation, the implications for traditional farming and the potential for land regeneration.

The first journal article seeks to explore how Ethiopians have shaped their natural environment. In particular, it focuses on deforestation, soil degradation, the role of changing governance and land-ownership patterns, and the effects of climate change. The article demonstrates that traditional farming systems do not operate in isolation from their socio-political and environmental context.

The second journal article provides an in-depth narrative inquiry conducted in Abraha We Atsebaha over a three-month period in 2014. This village is known for its indigenous farming knowledge, commitment to regeneration and innovation in conservation practices. Interviews were conducted with selected farmers and local leaders and informal discussions were carried out with government extension representatives using the ethno-ecological cosmos-corpus-praxis guidelines to enable an integrated exploration of the nature of traditional farming, the causative factors of environmental deterioration and the resultant communal response. In addition to written interview notes, observations and field notes were recorded daily. Photographs are used to give a real sense of the community and their work. It emerged during this process that underlying belief systems were exceptionally important in a context of traditional conservation.

Both articles discuss the development work undertaken by government in the rural farming sector and the successes and challenges faced. They also show that elements of traditional farming, sustainability measures and environmental care were suspended in favour of short-term survival as a consequence of social, political and population stressors. This study provides learning points, gained from insights gleaned from the literature review and the lived experience, for improving development interventions in this region. This study did not explicitly explore the role of religion in conservation or the potential long-term effects of current government policies and initiatives. However, it contributes to the small pool of literature on the region focused on traditional farming systems by providing a comprehensive overview of the drivers of degradation (historical and current) and offers a unique, “soft” experiential narration of a village in northern Ethiopia that allows insight into farmer experiences, pressures and adaptation efforts.

Keywords: traditional agriculture, traditional farming systems, Tigray, climate change, peasant farming, agricultural politics, Ethiopian political regimes, agricultural narrative.

Geïntegreerde opsomming

Die Tigray-streek in die noorde van Ethiopië is 'n historiese sentrum van landbouproduksie en die tuiste van menige bestaansboer wat nog op tradisionele boerderystelsels en reënbesproeiing staatmaak. Die streek het eeue lank onder hongersnood en periodieke droogtes gebuk gegaan en is kwesbaar vir klimaatsverandering. Boere bewerk klein stukke, dikwels afgetakelde, grond en het deur hul eie optrede die natuurlike hulpbronne waarop hulle staatmaak – veral die grond, water en bome – uitgeput.

Hierdie studie was daarop toegespits om 'n beter begrip te vorm van die omgewingsaftakeling in Tigray. Vir hierdie doel is 'n literatuurstudie van die sosiopolitieke landbougeskiedenis van die gebied onderneem, en is die lewe in die dorp Abraha We Atsebaha tussen boere van die streek ervaar. Die navorsing het van 'n verskeidenheid metodologieë en metodes, waaronder 'n literatuuroorsig, gegronde teorie, narratiewe ondersoek en etnografie, gebruik gemaak om lig te werp op die faktore wat tot die huidige aftakeling bygedra het, die implikasies vir tradisionele boerdery, en die potensiaal vir grondvernuwing.

Die eerste tydskrifartikel verken hoe Ethiopiërs hul natuurlike omgewing gevorm het. Dit konsentreer veral op ontbossing, grondaftakeling, die rol van veranderende staatsbestuurs- en grondbesitpatrone, en die uitwerking van klimaatsverandering. Die artikel toon dat tradisionele boerderystelsels nie afsonderlik van hul sosiopolitieke en omgewingskonteks funksioneer nie.

Die tweede tydskrifartikel beskryf 'n narratiewe diepte-ondersoek wat oor 'n drie maande lange tydperk in 2014 in Abraha We Atsebaha onderneem is. Hierdie dorp is bekend vir sy inheemse landboukennis, toewyding aan vernuwing, en innoverende bewaringspraktyke. Onderhoude is met 'n uitgesoekte groep boere en plaaslike leiers gevoer, en voorligtingsbeamptes van die staat is by informele gesprekke betrek. Die etno-ekologiese *cosmos-corpus-praxis*-riglyne is gebruik om 'n geïntegreerde studie te onderneem van die aard van tradisionele boerdery, die oorsaaklike faktore van omgewingsaftakeling, en die gevolglike gemeenskapsreaksie. Benewens skriftelike aantekeninge gedurende die onderhoude, is waarnemings en veldnotas ook daaglik opgeteken. Foto's word

gebruik om die gemeenskap en hul werk getrou uit te beeld. Gedurende hierdie proses het aan die lig gekom dat onderliggende oortuigingstelsels besonder belangrik is in 'n tradisionele bewaringskonteks.

Albei artikels bespreek die ontwikkelingswerk wat die regering in die landelike boerderysektor onderneem, sowel as die suksesse en uitdagings daarvan. Dit toon ook dat elemente van tradisionele boerdery, volhoubaarheidsmaatreëls en omgewingsorg as gevolg van maatskaplike, politieke en bevolkingsfaktore laat vaar is ten gunste van korttermynoorlewing. Die insigte wat uit die literatuuroorsig sowel as die lewenservaring in die bestudeerde gemeenskap spruit, bied lesse vir die verbetering van ontwikkelingsintervensies in die streek. Die studie het nie uitdruklik die rol van godsdiens in bewaring of die potensiele langtermynuitwerking van huidige staatsbeleide en -inisiatiewe ondersoek nie. Tog dra dit by tot die klein hoeveelheid beskikbare literatuur oor tradisionele boerderystelsels in die streek deur 'n omvattende oorsig te bied van die (historiese en huidige) snellers van aftakeling, en vertel dit 'n unieke, 'sagte' ervaringsverhaal oor 'n dorp in die noorde van Ethiopië om sodoende insig in landbou-ervarings, -druk en -aanpassingspogings te bied.

Trefwoorde: tradisionele landbou, tradisionele boerderystelsels, Tigray, klimaatsverandering, kleinboerdery, landboupolitiek, Ethiopiese politieke bedelings, landbounarratief.

Acknowledgements

Thank you to the Sustainability Institute, to Eve and Mark, for your inspiration, your passion and your action. Thank you for creating the “home” I was looking for.

To my parents and brother, I am always grateful for your undying support, even when you don't understand what I am doing or why.

I am tremendously grateful to the TRECC Africa programme for enabling the life-changing opportunity that allowed me to step out of my comfort zone and into the magic that Ethiopia held for me.

To the Baha'i community of Ethiopia, Addis and especially of Mekelle, thank you for being my extended global family. Your love, warmth and hospitality have made all the difference. Thank you Lena, for being a friend and sister in a faraway place and Heruy, for our traditional art sessions and especially for introducing me to Ethiopian angels and magic scrolls. Fytsum for helping me with language, Bahere for sharing your home with me, Daniel, Robel the philosopher, Tesfai, Jonas, Dr Senai, Metkel, kullum! Thank you to Alem and Ahadu in Addis, for your family warmth and for AREQU guesthouse, and Daniel for your friendship.

To the diverse, weird and wonderful *farengi* community of Mekelle: Thank you Guesepe for showing me your work and for including me on FAO trips into the field to see your fruit-tree projects, and for thoughtful and animated conversation. To Katja, thank you for taking me in and for your tough love. Thank you both for encouraging and appreciating my photography. Thank you Ivo Strecker for your mentorship and encouragement, for your fascination and delight with the world and for introducing me to the concept of merchants of wonder. Haja, the novel is underway.

To professors and colleagues at Mekelle University – you are wonderful. Thank you for accommodating me and guiding me, for providing me with key literature and for your emotional support during difficult times. Amanuel, Atkilt, Girmay, thank you and to Dr Fetien and the Institute of Environment, Gender and Development Studies

team for helping me learn about Abraha we Atsebaha. Senait, thank you for our coffee and Tigrinya sessions; and thanks to Henoah, the small boss.

Fellow exchange students, Mantue, Stella, Sawaya, Urbans, Florent and Musa too. Thank you for showing me again how diverse our continent is, for sharing your stories and for football. And Sofie thank you for the sweet introduction to Mekelle.

To the entire community and place of Abraha We Atsebaha, I cannot express my love and gratitude for you all. Thank you for having me, and for sharing your world with me. Thank you for your experience and for mine with you. Thank you for the laughter, and for the invitation to play, for your wisdom and memory. Mama Tsegao, you are wonderful, thank you for your wisdom and playful spirit. For teaching me about coffee and how to make it, about household work and duties, for letting me join you in community rituals, and especially for our little jokes together. Doa Africa – warhi yelley. I love you. Sheshy haftey, Haftu, little Sheshy, Ma’azu and Daniel-ooo – You will always be in my heart. Ato Hailay for my name, Ma’aru, and for constantly encouraging me in my Tigrinya, Mama Lette Berhan, Tesfai Kiros, Amata Kiros, Muluberhan and your sweet family, little Tazier for your imni-gimni gifts, I still have them with me – Thank you. My brother Haile Mariam-ooo, for sharing your experience with me, and your time. For helping me navigate the village and its surrounds, for switching off your radio for me, and for our jokes and laughter. Thank you. My brother and close friend Yohanness-ooo. Thinking of you brings me so much happiness. Thank you for your friendship and love, for your daily encouragement – “please write!”, and especially, for your pure joy. I hope we will meet again.

Aba Hawie, you are amazing. Thank you for having me in your household and within your care. For taking me around your village and home to show me all the work. For your love of nature and your dedication to development. You have taught me so much, just by allowing me to be in your company. You are an inspiration. Nowelay!

To my brothers who work for development through the government extension: Alem, Tadese and Haile Selassie. Thank you for showing me your work, sharing your time, and for your individual commitment to making Ethiopia better.

And finally, to Da'aro Mai Ayni. For your grace, your majesty, your inspiration, your patience and your knowledge. Thank you for being my refuge and my haven, and my point of daily pilgrimage. May you live another few centuries and may there be many, many more of you once again. The peace you gave me will always be with me.

Thank you to my global sisterhood of love, understanding and support from faraway places. Thank you for holding me and loving me, and for your interest, support and fascination in my life and adventure. Mona, Shannon, Heidi, Vafa, Tabitha, Vanessa, Nyakwezi. I love you all. And Stef, for your mentorship, encouragement, care and professional meticulous editing, thank you.

Thank you to the Credit Providers Association staff for hosting me and for sharing your warm and friendly office space with me. The dedicated work space was instrumental in the last lap of writing this paper. And for my mother for making this and everything possible – you are wonderful.

Thank you to my masters supervisor, Eve, for your gentle, thoughtful and meticulous feedback and ardent support of my journey.

And finally, the entire Stellenbosch University administrative support, who is incredibly efficient and helpful! Faculty librarians, IT support, and at the Sustainability Institute, Beatrix and June – thank you.

Contents

Integrated abstract	1
Geïntegreerde opsomming.....	3
Acknowledgements	5
Contents.....	8
List of photographs.....	10
Glossary & acronyms	11
Introduction	12
1.1 Overview	12
1.2 Background and personal motivation	12
1.3 Research structure and methodologies.....	13
1.3.1 Initial framework of complexity theory.....	13
1.3.2 Research structure and methodological tools.....	14
1.4 Delimitations, limitations and contribution of the overall study	16
History, ecology and politics: Shapers of traditional farming systems in Tigray, Ethiopia	18
2.1 Introduction	18
2.2 Methodology and methods.....	18
2.3 Introducing Ethiopia and Tigray.....	19
2.3.1 An overview of Ethiopia’s agricultural sector	19
2.3.2 An overview of Tigray’s agricultural sector	21
2.4 Interlinked themes of causative factors	23
2.4.1 People and environment	23
2.4.2 People and climate	28
2.4.3 Land politics.....	31
2.5 The state of agriculture in Ethiopia today	39
2.5.1 Soil and water conservation.....	39
2.5.2 Fuel versus fertiliser	42
2.6 Conclusion	43
Abraha We Atsebaha: A delicate grassroots narrative inquiry.....	45
3.1 Introduction	45
3.2 Methodology and methods.....	45
3.1.1 Narrative inquiry	46

3.1.2	Photography	46
3.1.3	Ethnography and Toledo’s triad	47
3.1.4	Research guides and participants	48
3.2	Introducing Abraha We Atsebaha	50
3.3.	Emergent themes and the <i>kosmos-corpus-praxis</i> triad	52
3.3.1	History and memory	52
3.3.2	The story of trees.....	59
3.3.3	Cosmos: Belief systems and conservation	64
3.3.4	The importance of rain and seasonal rhythms.....	69
3.3.5	Corpus–praxis: Identifying and managing land.....	72
3.3.6	Shifting from abundance to necessity: “there is not enough”	75
3.3.7	Leadership and development	77
3.3.8	Adaptation strategies and stagnation	82
3.4	Conclusion	85
	Conclusion.....	87
4.1	Meeting the research objective	87
4.2	Emergent research outcomes	88
4.2.1	Findings on the importance of governance.....	88
4.2.2	Findings on the importance of security	88
4.2.3	Findings on current government initiatives	89
4.2.4	Findings on cultivation practices.....	89
4.2.5	Findings on climate change effects	90
4.2.6	Findings on the importance of belief systems.....	90
4.3	The contribution of the study and its limitations.....	91
4.4	Recommendations for further research.....	92
	References.....	93

List of photographs

Photograph 1: Two generations: modern/traditional: 1: Reflexive image 2: People behind the story.....	47
Photograph 2: Landscapes: 1: Surrounding mountain, Umba Korai 2: Kushet church, Munda	51
Photograph 3: Sifting Dagusha	54
Photograph 4: Women weeding in a field of young Teff.....	55
Photograph 5: Oxen and plough	58
Photograph 6: Assembling ploughing equipment	59
Photograph 7: Modern construction, hussar in storage, dung drying	61
Photograph 8: Wukro wood sales	63
Photograph 9: Grain-storing ritual with makeshift cross	66
Photograph 10: Morning prayers at Bayt Christi'an Abraha We Atsebaha	67
Photograph 11: Da'aro Dawit morning panorama	68
Photograph 12: Many hands	72
Photograph 13: Grazing: 1: Netsa, meadow 'free' of livestock 2: Mountain grazing .	76
Photograph 14: Watching over animals and children while boys go to school	78
Photograph 15: Aba Hawie: 1: Public motivation 2: Acknowledgement & awards ...	79
Photograph 16: After a community terrace build	81
Photograph 17: Striking water, community hand-dug well.....	81
Photograph 18: Cooking: 1: With fire-fed Mogogos 2: Stacking Injera	84
Photograph 19: Fresh food: 1: Market 2: Fruit.....	84

Glossary & acronyms

Awlie	Olea Africana / olive tree close to extinction in Ethiopia
Da'aro	Ficus sycomorus / sycamore fig tree
Dagusha	Pennisetum typhoides / finger millet
Extensification	(agricultural) increasing of area used for farming practices / utility
Golgol	Meadow usually specific for animal grazing
Hasser	Fodder, excess hay from harvest
Holocene	Geological epoch following the Pleistocene starting approximately 10–12 000 years ago up to present day
Injera	Staple food base made from differing varieties of fermented grain, steam-cooked into a savoury flat pancake bread
Kosmos	(German) word for cosmos – meaning the universe appreciated as an orderly whole
Kushet	Sub-village
Legho'a	Small, orange local variation of maize found in Tigray
Momona	Faidherbia Albida / a leguminous nitrogen-fixing acacia-like species that is indigenous to Africa
Tabia	Village
Transhumance	Movement of livestock across seasonal grazing lands
Teff	Eragrostis abyssinica / A grass grain cultivated in Ethiopia which is rich in nutrients used to make Injera
TPLF	Tigrayan People's Liberation Front
TRECC Africa	Transdisciplinary Training for Resource Efficiency and Climate Change Adaptation in Africa
Woreda	District

Introduction

1.1 Overview

Outsiders to Ethiopia consider the country as a place of concentrated poverty and famine and it is ranked by the United Nations as a least-developed country (UNCTAD, 2011). Yet Tigray, located in northern Ethiopia, is one of the world's historic agricultural centres and the homeland of an ancient civilisation (Redda, 1983; Nyssen, et al., 2007). The region holds a complex history of traditional farming practices still used throughout most of rural Ethiopia (Arndt, Robinson & Willenbockel, 2011). Why then has Ethiopia experienced such extensive and recurrent hunger? What role does climate change play in Ethiopia's ability to self-sustain? Is there value in its traditional knowledge that could provide the world with better ways to cope with vulnerability in the face of climate change? These queries led to the formulation of the research objective, which was to explore the complexities associated with traditional farming systems in Tigray, northern Ethiopia. This exploration was in the hope that the study would yield knowledge that could contribute to building resilient farming systems in the face of climatic change.

1.2 Background and personal motivation

I am part of an inter-African collaboration titled TRECC–Africa, which stands for Transdisciplinary Training for Resource Efficiency and Climate Change Adaptation in Africa. The programme provides bursaries to enable the “next generation” of African scholars and professionals to address the “real and interlocking challenges of climate change and resource depletion” for the continent's future (TRECC Africa, 2014). The initiative is hosted by the universities of Ghana, Nigeria, Mekelle, Dar es Salaam, Botswana and Stellenbosch. I spent eight months in Ethiopia as part of this programme and was steered towards studying the country's northern province of Tigray, home to Mekelle University. I spent time at the university, travelled the region and lived for eight months between both Mekelle and the nearby village of Abraha We Atsebaha.

My studies have been driven by my belief that our future sustainability lies in healthy soils and that the globalised systems of producing and consuming food have negatively affected the ecological resilience of food-producing systems (Von Braun, 2000; Hammer & Anslow, 2008).

In particular, soils have been degraded. More than 65% of Africa's soils are considered depleted (TRECC Africa, 2014) and farming systems are increasingly described as nutrient mining (Vanlauwe, Kihara, Chivenge, Pypers, Coe & Six, 2011). Ethiopia, and the Tigray region in particular, is deforested to such an extent that government and community initiatives have banned people from cutting down trees for firewood and have embarked on soil and water conservation interventions to try and replenish the degraded soils and water table. Initiatives include tree planting (afforestation) and protected area exclosures from human and animal use, to replenish the degraded soil and water table. These are done by the community under the support of the government every summer season (Kiremti). For this reason, the opportunity to undertake my study in this region was appealing. In addition, it would provide an opportunity to contribute to the limited literature on the region and its traditional farming systems.

1.3 Research structure and methodologies

This research is primarily qualitative in nature as the investigation looked for connections and narratives (Rosaline, 2008) to explain the phenomena of traditional farming systems in Tigray, Ethiopia. Descriptions and explanations were pursued (Rosaline, 2008) and words were used as a primary tool throughout the research process (Clandinin, 2007). Specific methodologies and tools are described in the following sections.

1.3.1 Initial framework of complexity theory

Exposure to complexity theory during studies undertaken at the Sustainability Institute in 2011 provided a conceptual framework with which to approach the study, while methodologies suitable to collecting data in the particular research space were used in the research process. Complexity theory was useful as an initial process as it emphasises the interconnections between elements in a given system and allowed for a mental mapping of the research space.

Traditional farming systems are embedded within a particular socio-political dynamic and consist of multiple components (including farmers, governments, non-governmental organisations, climate, land and eco-systems).

Cilliers (1998) notes that multiple elements interact dynamically with each other in complex systems. In addition, complexity theory notes that system history and memory shape system identity (Cilliers, 2005). This notion would be an important guiding concept for the study given its focus on historical farming systems. In addition, no system operates in isolation and the forces acting on it cannot be ignored when trying to understand its dynamics (Cilliers, 1998). These three elements – multiple actors, memory matters and external drivers – provided a path for the literature review and the subsequent grounded exploration of farming life in Abraha We Atsebaha.

1.3.2 Research structure and methodological tools

The research is presented as two journal articles. The first explores the determinants or drivers of environmental degradation in the region through a comprehensive literature review and the second expresses a delicate, narrative inquiry conducted through interviews, participant observation and reflection in the village of Abraha We Atsebaha in Tigray. The articles and the relevant methodology and tools are described below.

Journal article 1: History, ecology and politics: Shapers of traditional farming systems in Tigray, Ethiopia

Presented in chapter 2, this article, based on a comprehensive literature review, provides an overview of the complex and historical factors that have moulded Ethiopia's agricultural system. It also pays attention to modern development efforts. It examines the complex and interlinked drivers of environmental degradation in the region (political, economic and social) and the non-linear consequences for subsistence farming and smallholders. The emergent drivers are grouped into three broad thematic areas:

- People and environment: encompassing deforestation, expanding populations and intensified production, transhumance, topography, rain and soil erosion.
- People and climate: focusing on drought and rain-fed farming and climate change.
- Land politics: examining three periods of governance which have affected traditional farming systems and land-tenure arrangements.

In addition, it is noted that government has a large influence on rural development and agriculture in the country. For this reason, the article examines current government initiatives in this sector, including water and soil conservation programmes, as well as some of the unintended consequences of these interventions.

Grounded theory was used in an effort to conduct a research process free of pre-conditions and one that would allow theories to emerge “from the ground” (Bryant & Charmaz, 2007). For this reason the focus of the literature review developed organically, based on my field experience, and used both historical and current sources to unravel the factors that have led to severe soil degradation in the country. Three relevant governance periods were identified through this process, all of which have had a significant influence on traditional farming systems. My intermittent field experiences shaped my perception of the literature and further focused my attention to what farmers felt was relevant. As a result of this, I developed several “small” theories. Firstly, that there is a relationship between insecurity of land tenure and neglect of the environment and secondly, that history and memory cannot be underestimated as a determinant of future potential, limiting or opening up “space” to act.

Journal article 2: Abraha We Atsebaha: A delicate narrative grassroots inquiry

Presented in chapter 3, this article provides a grounded description of my lived experience in a specific village in Tigray – Abraha We Atsebaha. It attempts to demonstrate the lived reality of people who have witnessed dramatic change and undergone tremendous shocks in their lifetimes, and their capacity to carry on.

The research is based on Toledo’s cosmos-corporis-praxis triad (Toledo, 2002) and I have used indigenous knowledge literature to guide the narrative inquiry. During a three-month period of field research I conducted interviews with farmers and village inhabitants and had discussions with government representatives and academics in the village and at Mekelle University. This data combined with personal observations and field notes form the basis of the ethnographic account given of the villagers and their relationship to the land.

During this process, several themes emerged. These are the effect of “held” memory and life under three political regimes, trees and their loss, the role of belief systems, rain and seasonality, land-management systems, a shift from abundance to deficiency, leadership and development, and adaptation strategies.

While both papers are intended to stand alone and can be read independently, juxtaposed they create a dialogue of sorts between the larger socio-political context and the lived reality of subsistence farmers and smallholders in the region of Tigray, Ethiopia. This juxtaposition serves to illustrate the complexities that government and villagers face when faced with development and environmental issues.

The articles will be submitted to the peer-reviewed journal GAIA–Ecological Perspectives for Science and Society. The journal focuses on the analysis, causes and solutions for environmental issues (GAIA, 2014). It publishes a masters student’s article, which focuses on societal transformation linked to environmental sustainability, annually. I believe that the second journal article would be of interest to them. The article will be adapted to their requirements. In addition, I am considering submission to the Journal of Peasant Studies. This is a peer-reviewed journal that focuses on rural development and wants critical contributions related to change, social structures and institutions linked to rural life (JPS, 2014). This study falls within its stated criteria and, in addition, it is interested in the voices of those at grassroots level, which this study does.

1.4 Delimitations, limitations and contribution of the overall study

The study focus is limited to Ethiopia and in particular to the Tigray region with a further delimitation around the village of Abraha We Atsebaha. In addition, the boundary to the literature and topics explored during interviews was that of farming systems. Furthermore, while there is some literature references to small scale traditional water storage for irrigation systems, these have not been explored and the study focusses on traditional rain-fed agriculture.

This study does not concentrate on all current government projects and initiatives or how policy is likely to affect the sustainability of traditional farming systems. This is an area highlighted in chapter 4 as worthy of future research. In addition, it does not delve in-depth into the role of the church in rural Ethiopia, but merely notes its significance in terms of conservation.

Exploring these may be useful for future development considerations due to the powerful influence religion has in rural locations in the country. Furthermore, the relatively short three-month period spent in the field may have limited an even deeper understanding of the village context, which would have been enhanced by a prolonged period of immersion.

The value of this study lies in its contribution to the body of literature on this region and, in particular, its traditional farming systems, which is currently limited. In addition, it demonstrates the importance of stability (political, economic and ecological) for successful and sustainable traditional farming systems. Finally it has birthed a unique, “soft” experiential narration of a village in northern Ethiopia that allows insight into farmer experiences, their pressures and their adaptation methods.

History, ecology and politics: Shapers of traditional farming systems in Tigray, Ethiopia

2.1 Introduction

Ethiopia is particularly vulnerable to the effects of climate change. It has historically experienced droughts and famines on a cyclical basis and has been severely deforested in the last century. In addition, internal feudal and civil wars, as well as external wars against Italian invaders in the 1930s and neighbouring Somalia between the 1940s and late 2000s, have afflicted the country (Redda, 1983; Vestal, 1985; Kebede, 1988) with detrimental effects on traditional farming systems.

This article, through a comprehensive review of literature on the country and region, attempts to understand the complexities that have shaped and continue to shape traditional farming in Tigray in northern Ethiopia. It describes the methodology and methods used in the study before providing an overview of agriculture in Ethiopia and Tigray. The main body of the article focuses on three themes: people and environment, people and climate, and land politics. Several overlapping factors are described within these themes that contribute to the vulnerability of these systems in a time of climate change and several “small” grounded theories are expanded on throughout before concluding with the research findings.

2.2 Methodology and methods

The main methodology used for this research was grounded theory, which aspires to eliminate or minimise the effect that pre-conditions may have on the research process (Bryant & Charmaz, 2007; Stern, 2007). This enables theory to emerge, as opposed to using a pre-determined premise influenced by outdated, irrelevant or already-established theories (Bryant & Charmaz, 2007). My lived experience in Ethiopia, and particularly in the village of Abraha We Atsebaha, was supported by a review of relevant literature that enabled theories to emerge “from the ground” (Bryant & Charmaz, 2007).

This literature review was therefore developed organically and while current literature is used, period-specific literature provides for a better contextual understanding and has therefore been included. Significant dates for this study include the 1975 and 1984/85 famines, the Derg regime (1974–1990), and the most recent government transition in 1991.

The framework for the literature review was developed through my experience of living in Tigray and specifically in the village where I conducted my narrative inquiry. Through a process of “zigzagging” back and forth into the field (Miller & Salkind, 2002), over a period of three months, I developed “small” theories. The most significant theory, and one substantiated by the literature, is that there is a relationship between insecurity around land tenure and environmental neglect. This insecurity invariably has an effect on traditional farming systems. A further “small” theory is that social unrest, past and present, has affected traditional farming systems. My motivation for this research was to try and explore the factors contributing to Tigray’s environmental degradation.

Key words used in the search for literature included climate change, drought, deforestation, famine, land policy and tenure, with all terms linked to Tigray, north Ethiopia.

2.3 Introducing Ethiopia and Tigray

2.3.1 An overview of Ethiopia’s agricultural sector

The United Nations includes Ethiopia as a least-developed country (UNCTAD, 2011). Its economy is heavily reliant on its agricultural sector (Lemenih, Karlton & Olsson, 2005b; Gebrehiwot & Veen, 2013), which is characterised by low productivity (UNCTAD, 2011; Gelaw, Singh & Lal, 2014). Agriculture accounts for about 43% of Ethiopia’s gross domestic product (GDP) and 90% of its exports (Chanyalew, Adenew & Mellor, 2010). Primary export commodities are leather, coffee, sesame seeds, flowers and gold (CRGE, 2011).

Ethiopia's smallholders

About 11.7 million smallholder households contribute 96% of the overall agricultural contribution to GDP (Chanyalew et al., 2010) making rural farming the most important farming activity in the country and a dominant livelihood strategy (Munro, Deckers, Haile, Grove, Poesen & Nyssen, 2008; Hailu, 2009; CRGE, 2011) for more than 80% of the population (Segers, Dessenb, Hagbergd, Teklebirhane, Hailef & Deckersa, 2010; Gelaw et al., 2014).

Farming practices

Agriculture is predominantly subsistence in nature (Deckers, Haile, Grove, Poesen & Nyssen, 2008; Mengistu, 2011; Teka, Rompaey, Poesen, Welday & Deckers, 2012) and the sector is characterised by low productivity and low levels of technology use (Grepperud, 1996; Hailu, 2009; Arndt et al., 2011). Traditional farming systems combine animal husbandry with crop cultivation (Hailu, 2009; Teka, Van Rompaey & Poesen, 2013). Rural Ethiopians consider livestock a basic asset (Gebrehiwot & Veen, 2013). The combination of animal husbandry and crops has traditionally created a closed nutrient cycle with manure and crop residue used to fertilise and protect the land (Field Observations, 2014).

There has been little development of agricultural practices in the region and the practice of farming is regarded as archaic by some and ill-adapted to climatic variation (Vestal, 1985; Munro et al., 2008; Teka et al., 2012). For example, there has been little focus on extending irrigation systems despite the varying rainfall patterns over the last few hundred years (Kebbede, 1988; Kebbede & Jacob, 1988; Kiros, 1991) and farming remains predominantly rain-fed (Gebrehiwot & Van der Veen, 2013).

Traditional farming is characterised by family ownership (Vestal, 1985) and use of low-input systems (Gebrehiwot & Van der Veen, 2013; Taye, Poesen, Wesemael, Vanmaercke, Teka, Deckers, Goosse, Maetens, Nyssen, Hallet et al., 2013) and traditional farming implements (Arndt et al., 2011), which rely primarily on animal traction (Gebrehiwot & Van der Veen, 2013).

The main historical technological development in agricultural intensification has been the ox plough to reduce human labour (Headey, Dereje & Taffesse, 2014). In addition, the lack of food storage facilities can be traced to a history of heavy taxation and looting (Munro et al., 2008).

All of these factors place the region at risk of food insecurity in times of climatic stress. A “small” theory developed in this paper is that unfolding socio-political change over the past century has negatively affected farming practices and innovation.

The wane of traditional practices

As will be discussed later, traditional practices of maintaining soil fertility have been slowly eroded over the past century. These were:

- Leaving land fallow for alternate seasons (Omiti, Parton, Sinden & Ehui, 1999; Yirga & Hassan, 2010; Belay, Van Rompaey, Poesen, Van Bruyssel, Deckers & Amare, 2014).
- Applying manure and crop residues to the land (Yirga & Hassan, 2010; Belay et al., 2014).
- Burning the soil periodically (Omiti et al., 1999).

2.3.2 An overview of Tigray’s agricultural sector

Then and now

Tigray, located in Ethiopia’s northern highlands, is considered a historic centre of agricultural development (Bard, Coltorti, DiBlasi, Dramis & Fattovich, 2000; Lanckriet, Derudder, Naudts, Bauer, Deckers, Haile & Nyssen, 2014). It was the location of the great Aksumite (Axumite) Empire (Bard et al., 2000). The region’s endemic crops relay a long history of complex farming and genetic diversification (Bard et al., 2000). Great civilizations flourished here and residents developed cultivation methods that sustained productivity over centuries (Redda, 1983; Deckers & Poesen, 2007; Nyssen et al., 2007). This agrarian success is considered remarkable because it was achieved in a climate characterised by erratic droughts (Munro et al., 2008).

In 2014, Tigray is the third poorest region in the country and arable land is scarce (Teshome, de Graaff, Risema & Kassie, 2014). This region has a high population density: approximately 84 individuals per km². The population is estimated at roughly 4.5 million people (Gebrehiwot & van der Veen, 2013) which puts pressure on diminishing land resources (Deininger & Jin, 2006). Tigray's total land area is estimated to be approximately 54 000 km² (Gebrehiwot & van der Veen, 2013) with ownership varying between 0.5–1 hectare per household (Segers et al., 2010). Poverty is associated with small land size (Deininger & Jin, 2006; Segers et al., 2010).

State of the environment

Tigray is located in a delicate environmental climatic zone that has various dynamics which are difficult to manage (Kiros, 1991; Bard et al., 2000; Ebro, Shenkute, Haile, Sauerborn & Treydte, 2011). These include fluctuating rainfall patterns and periodic earthquakes, epidemics and pest invasions (Bard et al., 2000). It is one of the most environmentally damaged areas of Ethiopia (Woldemichael, Kidane, Bekele & Nemomissa, 2010).

The land is severely degraded, partly because of intensive production (Bard et al., 2000; Lemenih et al., 2005b; Gelaw et al., 2014), and there is a scarcity of water, primarily due to overgrazing and deforestation (Wolde-Georgis, Hadgu, Abreha & Habru, 2010; Hachooofwe, 2012; Negusse, Yazew & Tadesse, 2013).

Farming practices

Over 75% of the population is rural (Munro et al., 2008; Teka et al., 2012; Gebrehiwot & Veen, 2013) farming 65% of available land (Beyene, Gibbon & Haile, 2006). Most people engage in traditional rain-fed subsistence farming of annual crops (Araya, Cornelis, Nyssen, Govaerts, Begreegziabher, Oicha, Raes, Sayre, Haile & Deckers, 2011; Gebrehiwot & Veen, 2013; Belay et al., 2014) and animal husbandry (Mwendera, Mohamed Saleem & Dibabe, 1997; Segers et al., 2010).

The dominant agricultural problems confronting smallholders in the region are erosion and soil moisture availability (Nyssen et al., 2014). Only three of Tigray's 34 regions are food secure (Hachooofwe, 2012).

The rural Tigrayan lifestyle and agricultural practices have remained relatively unchanged for centuries (Vestal, 1985) displaying a lack of adaptive capacity and innovation. A variety of factors have influenced and shaped traditional farming systems in Tigray rendering them vulnerable to climate change. These factors have been grouped into three themes: people and environment, people and climate, and land politics. These themes are explored in depth in the following sections.

2.4 Interlinked themes of causative factors

2.4.1 People and environment

People have caused significant changes to their environment, which has affected their ability to survive and flourish. In terms of Ethiopian agriculture, the most significant of these has been deforestation. This has had numerous consequences, notably:

- Extensive soil erosion (Omiti et al., 1999; Mwendera et al., 1997; Nyssen, Poesen, Moeyersons, Deckers, Haile & Lang, 2004; Betemariam, 2011).
- Diminishing water tables (Nyssen et al., 2007).
- Loss of soil water retention capacity (Jagger & Pender, 2003; Muluneh, 2010).

These have had negative implications for sustained farming and have compromised food security. This and other factors are described in detail below.

Deforestation

Extensive deforestation has depleted ecological services (Deininger & Jin, 2006; Lamond, 2012; Lamptey, 2012; Hagdu, Meles & Michael, 2013; Negusse et al., 2013; Belay et al., 2014). In the early 1900s forests covered 40% of Ethiopia, but by the early 1990s total land forest cover had diminished to less than 3% of the country (Gebreegziabher, 1999). Only 2% of Ethiopia's forests remained in 2011 and most fertile soils have been washed away by erosion (Brighter Green, 2011).

Prior to the Axumite Empire period (Gebreegziabher, 1999), during the mid-Holocene (Betemariam, 2011) and prior to the Italian introduction of sawmills in the mid-1950s (Woldemichael et al., 2010), the region was densely forested and home to variety of indigenous species (Bard et al., 2000; Woldemichael et al., 2010; Betemariam, 2011).

It also had deep and rich soils which are still seen in conserved church land (Nyssen et al., 2007). Today, vegetation is scarce in Tigray (Woldemichael et al., 2010).

According to Nyssen et al. (2004), deforestation has been cyclical and linked to population growth cycles starting in the past two to three thousand years. However, prior to the Italian invasion of Ethiopia in 1935 a traditional protection system comprising forest custodians monitored forest use (Gebreegziabher, 1999).

The Italians introduced sawmills thus initiating forest exploitation (Gebreegziabher, 1999; Gessesse Dessie & Kleman, 2007; Woldemichael et al., 2010). Deforestation has been exacerbated by:

- Use of wood biomass for energy (Betemariam, 2011).
- Free grazing (Gebreegziabher, 1999; Betemariam, 2011).
- Unprecedented population growth (Gebreegziabher, 1999; Muluneh, 2010).
- Farming and commercial logging (Gessesse Dessie & Kleman, 2007).

An Expanding Population, Intensified Production and Soil Erosion

Ethiopia has the second largest population in Sub-Saharan Africa (Arndt et al., 2011) – roughly 87 million people (Freedom House, 2014). Rapid population growth rates have exceeded the supporting capacity of the land, which has been subdivided to meet demand and the result has been severe environmental degradation and soil erosion (Grepperud, 1996; Munro et al., 2008; Arndt et al., 2011; Taye et al., 2013).

Production was intensified as land limits were reached with more concentrated use of the same resources and human activities extended into new territory (Grepperud, 1996). Forests were increasingly cleared to create arable farming and grazing land (Gebreegziabher, 1999; Gessesse Dessie & Kleman, 2007; Muluneh, 2010; Betemariam, 2011; Ebro et al., 2011; Leminah, Kassa, Kassie, Abebaw & Teka, 2014) to feed a growing population under the Aksumite Empire (Bard et al., 2000; Munro et al., 2008). A new phase of disastrous soil erosion began around 700AD (Munro et al., 2008), which has caused accelerated erosion in the past three centuries (Bard et al., 2000).

It is speculated that forests regenerated intermittently due to past disturbances, such as war, which caused people to move out of the region temporarily (Munro et al., 2008). While research shows that the situation was already dire in the late 1900s (Nyssen et al., 2014). The early 1960s are considered the start of intensive deforestation due to population pressures (Belay et al., 2014; Gelaw et al., 2014) and intensified production (Grepperud, 1996).

This resulted in shortened fallow periods (Grepperud, 1996; Nyssen et al., 2007), farming and grazing on the same land area (Grepperud, 1996) and clearing forests for cultivation (Bard et al. 2000). This decreased the soil's organic matter (Gelaw et al., 2014) and changed soil composition (Mwendera et al., 1997; Lemenih et al., 2005b). The loss of organic matter in turn reduces the water-stable soil macro-aggregates (Ashagrie, Zech, Guggenberger & Mamo, 2007), which reduces the availability of water in the soil (Mwendera et al., 1997; Gessesse Dessie & Kleman, 2007). With less vegetative cover and reduced organic matter, the soil's ability to retain and absorb water is reduced accelerating water run-off and erosion (Taye et al., 2013). This means that despite the best of rains, land is less effective, less productive and more prone to drought (Kebbede, 1988; Kebbede & Jacob, 1988).

Transhumance

Transhumance is the practice of moving livestock in seasonal cycles across grazing lands (Oxford, 2014). Overgrazing is often cited as a reason for the extensive environmental degradation that has taken place in Ethiopia (Cutler, 1991; Kiros, 1991; Keller, 1992; Muluneh, 2010; Araya et al., 2011; Betemariam, 2011; Taye et al., 2013). As the practice of transhumance diminished due to the need to intensify production, farmers increasingly reared livestock on cropland between harvests; this practice removed organic matter from the soil and caused compaction (Grepperud, 1996).

Most households in the region keep livestock (Teka et al., 2012) rotating them between communal pastures and arable farmland between seasons (Mwendera et al., 1997; Teka et al., 2012). Grazing land is increasingly scarce (Betemariam, 2011) and agricultural lands have reached their limits (Cutler, 1991; Nyssen, Poesen, Moeyersons, Deckers, Haile & Lang, 2004, Haidey et al., 2014).

Population pressure on land is a significant factor in the degradation of Tigray's environment. This combined with the historic low adaptive and innovation capacity puts the region even more at risk of food insecurity, particularly during periods of climatic variability.

Topography and rain

The topography of Ethiopia's northern highlands consists of steep slopes formed by volcanic activity (Bard et al., 2000; Nyssen et al., 2004). These are conducive to water runoff and therefore subject to intensive erosion (Grepperud, 1996; Mwendera et al., 1997; Munro et al., 2008).

Population pressure on land availability forced farmers to progressively clear and plough these slopes for crop cultivation (Kebbede, 1988; Nyssen et al., 2007) further intensifying their erosion (Grepperud, 1996; Nyssen et al., 2004; Nyssen et al., 2007; Muluneh, 2010; Arndt et al., 2011).

Tigray experiences three defined seasons. Between June and September the monsoon "big rains" fall (Kebbede, 1988; Lanckriet, Frankl, Adgo, Termonia & Nyssen, 2014b) in intensive and localised storms (Lanckriet et al., 2014b), providing most of the annual rainfall (Ciampalini, Billi, Ferrari, Borselli & Follain, 2012; Gebrehiwot & Veen, 2013). A dry season follows from October until February (Lanckriet et al., 2014b) causing moisture stress that contributes to the erratic rainfall experienced in the region (Taye et al., 2013). The third season falls between March and May and is characterised by the "small rains" (Vestal, 1985; Kebbede, 1988; Lanckriet et al., 2014b). The monsoon rains are concentrated, intense and heavy and are often interpreted as floods due to their high erosive capacity (Kiros, 1991; Munro et al., 2008). Land clearing escalates the land's vulnerability to erosion as raindrops have more access to the earth (Mwendera et al., 1997) accelerating soil runoff and erosion (Grepperud, 1996).

The combination of steep slopes cleared for cultivation with intense rainfall interspersed with dry spells has resulted in the significant loss of top soils in the region reducing soil nutrition and land productivity.

Erosion

Deforestation exposes soils to erosive rains (Gebreegziabher, 1999; Nyssen et al., 2003) and the subsequent erosion leads to a loss of both soil and soil nutrients (Yirga & Hassan, 2010). This, in turn, has implications for the ability of land which has been eroded to remain productive (Omiti et al. 1999; Nyssen, Moeyersons, Poesen, Deckers & Mitiku Haile, 2003). A conservative estimate of soil loss is about 1 500 million metric tons a year (Betemariam, 2011). This is one of the world's highest rates of soil loss through erosion (Brighter Green, 2011). This loss of fertile soil is estimated to result in the loss of 1 million tons of grain a year (Betemariam, 2011).

Deforestation combined with intensive land-use practices and farming on steep slopes have compromised the region's water table (Nyssen et al., 2007) and has fed the flow of the Nile River, as water run-off from this region contributes 85% of the river's flow (Lanckrie et al., 2014b).

While erosion cannot be reversed, soil nutrient content can be re-established (Yirga & Hassan, 2010). Current government initiatives in this region include the introduction of soil and water conservation techniques (Haile, Herweg & Stillhardt, 2006) and synthetic fertilisers to enhance productivity (Nyssen et al., 2014). While fertiliser provides a short-term fix, it is likely that this intervention will have negative long-term consequences for soil fertility and biological activity (Swilling & Annecke, 2012).

Implications for traditional farming

Traditional farming practices in this region do not fully restore organic matter and result in a net loss of nutrients (Lemenih et al., 2005b; Yirga & Hassan, 2010; Belay & Bewket, 2013). Due to the factors discussed above, Tigray has experienced accelerated soil and water degradation (Herweg & Stillhardt, 2006) over the past decades (Gebreegziabher, 1999).

Productivity is restricted by reduced soil moisture (Gebreegziabher, 1999) and reduced soil fertility (Lemenih et al., 2005b; Yirga & Hassan, 2010; Araya et al., 2011).

Lowered production undermines food security (Teshome et al., 2014) at the household level and, as some lands are so depleted they are no longer agriculturally productive, which impacts national food security (Omiti et al., 1999).

Concluding on people and environment

Deforestation is a historic characteristic of the Ethiopian countryside, particularly in Tigray. By the early 20th century, the region was severely deforested and this trend has intensified since the early 1960s. In addition, traditional practices of conserving soil fertility (fallow periods, transhumance, etc.) have been increasingly compromised by intensifying population pressure on arable land. As soils were eroded and lost their nutrient and regenerative capacity and productivity decreased, which in the face of a growing population with limited capacity to innovate or adapt within traditional practices, has negative implications for food security.

2.4.2 People and climate

Low-income developing countries are disproportionately affected by the negative effects of climate change (Arndt et al., 2011). Ethiopia is often cited as a most extreme African example of climate change vulnerability (Conway & Schipper, 2011) particularly because of its substantial dependence on rain-fed agriculture (Mideksa, 2010; Gebrehiwot & Veen, 2013). Rain and temperature, both primary contributors to agricultural productivity, are both affected by climate change (Gebrehiwot & Van der Veen, 2013).

There have been considerable climatic variations in Ethiopia, above the already difficult and dynamic climate. The effects of these have been exacerbated by human activity (Bard et al., 2000; Lamptey, 2012), and often argued to have anthropic sources (Nyssen et al., 2004; Gessesse Dessie & Kleman, 2007; Arndt et al., 2011; Conway & Schipper, 2011). The country faced its driest decade in the past century with a succession of drought years between the 1970s and 1980s (Lanckriet et al., 2014a).

Understanding the origins and impacts of climate change, however, are difficult to ascertain as there is little information available on predictions on its course, timing and scale (Conway, 2000; Mideksa, 2010; Arndt et al., 2011).

And some argue that there is little evidence for lasting changes in rainfall (Lanckriet et al., 2014a; Lanckriet et al., 2014b). However, as indicated in the section on climate change below, the effects of variations accredited to climate change are already being felt in the Tigray region.

Drought and rain-fed farming

Farming in Ethiopia is primarily rain-fed (Conway & Schipper, 2011; Mengistu, 2011; Gebrehiwot & Van der Veen, 2013; Gebrehiwot & Veen, 2013). This makes agricultural productivity sensitive to rainfall fluctuations (Conway & Schipper, 2011; Mengistu, 2011; Gebrehiwot & Van der Veen, 2013; Gebrehiwot & Veen, 2013). The variation coefficient is 38% in the region, compared to the national coefficient of 8% (Gebrehiwot & Veen, 2013). This is due to the region's topography (Lanckriet et al., 2014b).

Recurrent and cyclic droughts have affected rain-fed food production in northern Ethiopia (Keller, 1992; Nyssen et al., 2007; Munro et al., 2008; Conway & Schipper, 2011; Teka et al., 2012) for millennia (Kiros, 1991; Munro et al., 2008) and have been increasing in intensity in the past seven decades (Mideksa, 2010). A 2006 World Bank report notes that Ethiopia has significant drought or flood events every three to five years (Teka et al., 2012). Tigray also experiences frequent localised droughts each year that result in crop failure (Gebrehiwot & van der Veen, 2013). More than 20% of the country's population was affected by drought in 2002 (about 14.2 million people) (Conway & Schipper, 2011).

Both droughts and floods have been increasing in intensity and frequency (Gebrehiwot & Veen, 2013; Gebrehiwot & Van der Veen, 2013). Fifteen climate-change disasters were recorded between 1998 and 2013 (Gebrehiwot & Veen, 2013). Tigray is one of the most vulnerable areas in terms of frequent droughts and floods, while having less access to institutional support or technology and infrastructure (Mengistu, 2011).

Climate change

While it is clear that rural Tigray has been subject to continuous climatic disequilibrium (Gebrehiwot & Veen, 2013), centuries of neglect, exploitation and deterioration have diminished the region's agricultural productive capacity and the land's ability to weather climatic abnormalities (Kebbede & Jacob, 1988). Slight increases in rainfall have resulted in severe flooding, which wash away precious top soils (Kebbede & Jacob, 1988).

There is consensus in the scientific community that global climate change has anthropogenic origins (Arndt et al., 2011; IPCC, 2014), and it is clear that Ethiopia is part of this global causal system (Arndt et al., 2011). Crutzen and Steffen (2003) note the accelerated human impact on climate beginning in the 1950s. According to the Intergovernmental Panel on Climate Change's 2013 *Fifth Assessment Report*, human interference with nature has caused at least 50% of the increase in mean global temperature (IPCC, 2014). Temperatures in the Indian Ocean basin have been steadily rising since the mid-20th century (IPCC, 2014). These reduce the precipitation falling on East Africa (Williams & Funk, 2011), and particularly the "small rains" of northern Ethiopia (Lanckriet et al., 2014b).

Human-induced climate change in Ethiopia may result in extreme droughts, flooding and temperature change (Gebrehiwot & Veen, 2013). This has daunting implications for the country's agricultural-dependent economy (Mideksa, 2010), as rain-fed subsistence agriculture has few mitigating buffers (Kebbede, 1988).

Government will need to carefully manage the country's still abundant water resources to adapt to climatic variations resulting from climate change (Arndt et al., 2011). Developing and extending irrigation systems would be an important development (Gebrehiwot & Van der Veen, 2013; Gelaw et al., 2014), as will introducing other relevant technologies and improving farming and conservation practices (Mideksa, 2010; Chanyalew et al., 2010).

Concluding on people and climate

Some of the factors that influence Ethiopia's climate are out of its control; however, the massive deforestation which has taken place in the country has contributed to the Anthropocene era shift.

The Anthropocene is defined by Paul Crutzen as a human induced geological epoch by increased gaseous emissions (Steffen et al., 2007). The sporadic rainfall, periodic droughts and highly erosive floods compromise the region's ability to produce food. Wise-water usage could mitigate the effects of climatic variations, as could environmentally sensitive farming methods with an emphasis on soil and water conservation.

2.4.3 Land politics

*Indeed the state of any country's environment
is a reflection of the kind of governance in place,
and without good governance there can be no peace.*

(Wangari Maathai, Nobel Peace Prize award speech, 2004, Oslo, Norway)

All of the factors discussed in the previous sections do not happen in isolation to the socio-political environment. Governance in Ethiopia has undergone significant shifts in the past century and with each shift land policy has changed dramatically affecting rural farmers in particular (Benin & Pender, 2001; Deininger & Jin, 2006; Segers et al., 2010).

This section focuses on three periods that have had significant consequences for the country's environmental and agricultural health. These periods are the feudal period (encompassing Emperor Haile Selassie's regime), the communist/Marxist/socialist military regime of the Derg (Government of the People's Democratic Republic of Ethiopia) and the free market-orientated regime of the Ethiopian People's Revolutionary Democratic Front led government (Deininger & Jin, 2006; Diao & Pratt, 2007; Teka et al., 2013). Phases of land degradation correlate with different land policies over these three successive periods (Lanckriet et al., 2014a).

Feudalism and the reign of Haile Selassie (pre-1975)

The span of the former Ethiopian empire of Abyssinia (17th to the 20th century) (Kebbede, 1988) was characterised by feudal warfare (Chinigò, 2014), which undermined agricultural stability as people were constantly moved or disrupted in their traditional practices (Kebbede, 1988). Lands were also often raided and looted during times of peace (Kebbede, 1988).

Furthermore, land was unequally distributed (Deininger & Jin, 2006; Segers, et al., 2010; Headey et al., 2014; Lanckriet et al., 2014a). Less than 1% of the population, comprising the royalty, clergymen, military elite and business owners, owned more than 70% of arable land (Kebbede, 1988; Segers et al., 2010). About 80% of the agrarian community were tenants who paid a large portion of their produce to landlords as rent (Kebbede & Jacob, 1988; Lanckriet et al., 2014a), along with grain surplus (Kebbede, 1988; Belete, Dillon & Anderson, 1991). Landlords were often absent (Deininger & Jin, 2006; Bezabih, Kohlin & Mannberg, 2011; Headey et al., 2014).

Prior to the 1940s, government only participated in agriculture through tax collection (Nyssen et al., 2004). Security of tenure on land was not guaranteed (Bezabih et al., 2011; Teka et al., 2013), nor were farmers certain they would be able to cultivate the same piece of land each season (Kebbede, 1988). Farmers could be evicted arbitrarily, suddenly and without compensation (Koehn, 1979; Cohen & Isaksson, 1988; Deininger & Jin, 2006; Bezabih et al., 2011).

The lack of centralised conservation policies (Lanckriet et al., 2014a) combined with high taxes and insecurity around land tenure has had multiple effects on peasantry and traditional farming systems (Belete et al., 1991; Nyssen et al., 2004). One of these was the stagnation in innovation in agricultural practices and the prolonged use of primitive farming techniques (Belete et al., 1991; Nyssen et al., 2004). Others are outlined briefly below.

A subsistence culture

With little incentive to produce more than what was needed, as grain surpluses were surrendered to landowners (Kebbede, 1988; Belete et al., 1991), a culture of subsistence production developed. It was impossible to put excess food aside for storage and farmers were not interested in labour that would not generate rewards (Kebbede, 1988). The “extreme exploitation of the peasantry allowed no margin of safety” causing high susceptibility to natural catastrophes such as drought (Kebbede, 1988:127). Furthermore, when yields increased, landlords would increase rents based on the argument of increased farm value (Koehn, 1979).

Harmful environmental farming methods

Poverty coupled with a survival mentality due to warfare and peasant exploitation, led to environmentally harmful farming practices (Nyssen et al., 2004).

Poor farmers were marginalised and forced to cultivate sloping terrain, which caused heavy erosion (Lanckriet et al., 2014a; Nyssen et al., 2014). They also extracted and sold environmental resources to supplement their subsistence lifestyle (Kebbede, 1988). Effectively, farmers exhausted the land to meet their own needs and the demands of their landlords (Lanckriet et al., 2014a). They reduced fallow periods, cleared steep hills and neglected to invest in the soil (Koehn, 1979; Kebbede, 1988). The result of this long-term lack of investment in soil (Deininger & Jin, 2006; Teka et al., 2013; Lanckriet et al., 2014a) was erosion and soil degradation (Kebbede, 1988; Teka et al., 2013).

This feudal governance system formed the basis for Haile Selassie's regime (Keller, 1992) and resulted in poverty and entrenched insecurity around land tenure. The need for short-term survival overrode the need for long-term preservation, environmental care and a thriving agricultural sector (Nyssen et al., 2004). Unequal access to land and insecurity around land tenure is believed to have been one of the most significant factors leading to the overthrow of his regime in 1974 (Deininger & Jin, 2006; Lanckriet et al., 2014a).

In addition, Haile Selassie suppressed information about the 1973-4 famine (Keller, 1992) during which an estimated 200 000 people died from starvation (Bush, 1985). And exports doubled in that year (Kebbede, 1988).

Civil war and the military Derg (1974–1991)

The militarised Derg took power in the period of chaos that followed the overthrow of Haile Selassie's regime (Vestal, 1985; Kebbede, 1988; Asfaw, 1990). The Derg party advocated for, among other calls to action, "land to the tiller" and "food to the hungry" (Redda, 1983). It ostensibly waged war against illiteracy, poverty, disease and hunger (Vestal, 1985; Müller, 2013) yet, in actuality, ruthlessly crushed any opposition to their rule and spent the country's resources on establishing the largest military force in "Black Africa" (Redda, 1983; Asfaw, 1990).

Several of the Derg's policies and initiatives influenced traditional farming systems in northern Ethiopia. These are briefly described below.

Land reform

The land-reform proclamation of 1975 was the most significant and radical move of the Derg regime (Cohen & Isaksson, 1988; Grepperud, 1996; Chinigò, 2014; Headey et al., 2014). The state nationalised and redistributed land (Vestal, 1985; Deininger & Jin, 2006; Segers et al., 2010; Chinigò, 2014) to farmers (Benin & Pender, 2001; Headey et al., 2014). This radically shifted the political model from feudalism to socialism (Vestal, 1985; Omiti et al., 1999) in efforts to equalise land ownership (Nyssen et al., 2014). The immediate result of this policy, in conjunction with government incentives for agriculture, was increased harvests; however, these did not last beyond two years (Koehn, 1979). And while the proclamation did give 5.6 million smallholders access to land (Belete et al., 1991), land reform was only partly applied in Tigray (Lanckriet et al., 2014a). This is discussed further under *Scorched earth policy* in this section.

State farms and cooperatives

The Derg endeavoured to organise farmers into state farms and cooperatives (Belete et al., 1991; Müller, 2013; Teka et al., 2013; Headey et al., 2014). Believing that smallholders were inefficient, and that state collectives would make better use of land and labour, government prioritised investment in state farms (Cohen & Isaksson, 1988). Yet state farms only constituted 5% of total farmed lands, and 4% to 10% of agrarian production (Vestal, 1985; Belete et al., 1991). The World Bank deemed these farms as highly inefficient (Vestal, 1985). In addition, government focused on industrial crop production for export (Coehn, 1988) and did not address local food security.

Farmers feared they would lose their land in this collectivisation process (Asfaw, 1990; Teka et al., 2013). Faced with limited land, the Derg pressured smallholders to join collectives and surrender their holdings (Cohen & Isaksson, 1988). Smallholder tenants were compelled to partake in the process (Teka et al., 2013) and were often forcibly removed from their allotments to join collectives (Bezabih et al., 2011).

Furthermore, land redistribution could occur every one to two years and therefore compromised security around land tenure, which had been intended to incentivise increased production (Benin & Pender, 2001).

In effect, the Derg entrenched the environmental damage done to the nation during the previous regime (Lanckriet et al., 2014a). Their policies were inappropriate (Belete et al., 1991) for traditional smallholders (Vestal, 1985). They did not recognise the essential role played by smallholders in food production (Vestal, 1985; Cohen & Isaksson, 1988; Belete et al., 1991) and led to agricultural stagnation – both in terms of productivity and innovation of practice (Belete et al., 1991). In effect, the government compromised food security in favour of foreign exchange (Koehn, 1979; Cohen & Isaksson, 1988).

Some argue that the Derg simply replaced the previous regime's exploitative nature in the guise of socialism (Asfaw, 1990) by continuing to extract food from the rural populace (Müller, 2013). Government set food prices (Teka et al., 2013) and farmers were obliged to sell their produce in markets below production costs (Redda, 1983).

This was possibly so that government could afford to feed its growing army (Asfaw, 1990; Müller, 2013). Productivity and innovation was thus further discentivised (Asfaw 1990, Müller, 2013).

Scorched-earth policy

The Derg's rule is referred to as the civil-war period (Redda, 1983; Grepperud, 1996; Gebreegziabher, 1999; Lanckriet et al., 2014a). The military government crushed all opposition killing thousands of Ethiopians in the struggle to maintain political power against internal opposition and external forces (Asfaw, 1990). One of these internal wars was between the Derg and the peasantry of the Tigray region (Kebbede, 1988), organised into the Tigray People's Liberation Front (Keller, 1992; Müller, 2013).

In retaliation to the armed Tigrayan rebellion, the Derg cut off provision to this region and introduced a "scorched earth policy" (Vestal, 1985; Keller, 1992). Villages and food stores were bombed by the air force (Müller, 2013), croplands were looted and burnt and people were harassed (Redda, 1983; Vestal, 1985; Keller, 1992). Additionally, food was used as a weapon by denying humanitarian aid to rebel-held areas in times of famine (Cutler, 1991; Keller, 1992).

These internal and external conflicts stagnated the economy and reversed conservation efforts (Lanckriet et al., 2014a).

A 1973 World Bank report recommended that peasants be relocated from the population-pressured, unproductive and ecologically degraded lands of the north (Cohen & Isaksson, 1988). As a result, government launched a massive resettlement programme in the midst of the 1984 famine (Keller, 1992) arguing that this would prevent food insecurity in the region (Kloos & Lindtjørn, 1994). Yet force and brutality was displayed during the relocation (Kebbede, 1988; Keller, 1992) – people were often moved at gunpoint (Kebb, 1988), and the ensuing high mortality rate (Cohen & Isaksson, 1988; Keller, 1992; Kloos & Lindtjørn, 1994) had conservative estimates of 50 000 deaths (Keller, 1992). This reinforced the suspicion that the Derg was following a hidden agenda to rid itself of its northern opposition, which included Tigray (Vestal, 1985; Kebbede, 1988).

In summary, the Derg did not develop agriculture where it was most needed and it gave minimal support to the smallholder sector (Lemma, 1985), the backbone of food production in the country (Lemenih, 2005a). It orientated agriculture towards the export market and even during the 1984/85 famine, exported vegetables to Europe (Kebbede, 1988; Kebbede & Jacob, 1988), along with spending about US\$200 million on its 10-year anniversary celebrations in the same period (Kebbede, 1988; Asfaw, 1990; Müller, 2013).

The ongoing civil wars further stagnated and, in some cases, reversed development efforts (Redda, 1983; Lemma, 1985; Asfaw, 1990; Keller, 1992), which were altogether driven by government's commitment to an ill-suited ideology, rather than to serve the grassroots needs of the people and enhance food security (Vestal, 1985; Cohen & Isaksson, 1988; Keller, 1992).

By the end of their reign in 1991, the Derg had contributed to further undermining already fragile ecosystem services, environmental wellbeing and traditional farming practices in northern Ethiopia (Lanckriet et al., 2014a).

A New Era: Ethiopian People's Revolutionary Democratic Front (1991– present)

The Tigray People's Liberation Front, founded in 1975 (Keller, 1992), defeated the Derg in 1991 (Segers et al., 2010; Headey et al., 2014) after 16 years of civil war. The Tigray People's Liberation Front is the Tigrayan branch of the current Ethiopian People's Revolutionary Front led government.

Its members had gained substantial knowledge around land reform (Segers et al., 2010) and had successfully instigated a large land-redistribution programme in their region during the rebellion (Lanckriet et al., 2014a). The new government, supported by the International Monetary Fund and the World Bank, initiated a structural adjustment programme aimed at liberalisation of the economy, participatory governance and development (Lanckriet et al., 2014a).

Changes in land policy

Given the previous disputes around land tenure security (Chinigò, 2014) land policy was a politically sensitive topic (Benin & Pender, 2001; Deininger & Jin, 2006; Segers et al., 2010). The discontinuous trajectory in the country's tenure system makes it a unique case in the context of Africa and security of tenure became uniquely significant in policy debates (Deininger & Jin, 2006).

Land is an agriculturally based economy's most valuable resource (Segers et al., 2010; Yirga & Hassan, 2010) and security of tenure is considered indispensable for continued and increased productivity and related land investment (Teka et al., 2013; Teshome et al., 2014).

Given that continuous land redistribution undermines security of tenure (Benin & Pender, 2001), it was argued that policy entrenching secure tenure for smallholders was necessary to incentivise investment in land, improve soil use, increase profitability and promote sustainable land use (Benin & Pender, 2001; Deininger & Jin, 2006; Yirga & Hassan, 2010).

Land remains national property and is allocated to farmers with usufruct rights (they may use and take advantage of the land, but may not destroy or waste its resources) (Bezabih et al., 2011; Teka et al., 2013; Headey et al., 2014; Teshome et al., 2014).

Although land transfers are part of a free-market economy ideology, government has not integrated this principle (Deininger & Jin, 2006; Teka et al., 2013), but instead, recognising the important contribution that smallholders make to the economy (Belete et al., 1991; Chinigò, 2014), has offered them freehold tenure (Omiti et al., 1999). These land rights are protected in the 1994 Constitution (Segers et al., 2010).

According to Deininger and Jin (2006), the optimal way to increase productivity is through a flexible system that combines security of tenure and the right to transfer land by rent or sales. This would allow the market to allocate appropriate resources to maximise production (Deininger & Jin, 2006). Their research suggests that further land distribution would be counterproductive and re-instil feelings of tenure insecurity. They therefore argue that a more flexible model would enable productive and/or well-equipped individuals to make best use of limited resources and encourage those not suited or equipped to farming to transfer to another economic sector (Deininger & Jin, 2006). For this reason, Deininger, Ali and Alemu (2013) promote land rental to enable flexibility as the economy diversifies beyond agriculture. However, government argues that national ownership protects peasant farmers by securing their access to land and that a free-market system could encourage the sale of land to rich elites (Bezabih et al., 2011).

Sustainable agriculture needs to be at the heart of sustainable development in an agriculturally dependent economy (Lemenih et al., 2005a; Belay & Bewket, 2013; Gebrehiwot & Veen, 2013). Healthy soil is the foundation of sustainable farming (Lemenih et al., 2005a; Ciampalini et al., 2012).

As limits to agricultural lands are met (Betemariam, 2011), the need for more intensive use of existing farming lands in a sustainable way becomes necessary to avoid the associated negative environmental side-effects of intensification (Haile et al., 2006). It also requires the diversification of the economy and migration of some out of the agricultural sector (Teka et al., 2013; Headey et al., 2014) to reduce dependency on the sector as a livelihood strategy and increase the country's ability to adapt to climate change (Mideksa, 2010).

Government has embarked on an agriculture development-led industrialisation plan (Arndt et al., 2011; Teka et al., 2013; Chinigò, 2014).

It is focused on commercialising the sector (Hailu, 2009). This involves introducing high-valued and yielding crops, diversifying production, using natural resources sustainably and building capacity in key individuals (Hailu, 2009).

2.5 The state of agriculture in Ethiopia today

Ethiopia's arable highlands land is saturated, limits to productivity and expansion have been met (Headey et al., 2014) and land can no longer support the country's naturally increasing rural population (Muluneh, 2010; Woldemichael et al., 2010; Betemariam, 2011). This population is primarily dependant on subsistence agriculture for food (Muluneh, 2010). Substantial varieties of plants and animals are extinct (Gebreegziabher, 1999) and it is estimated that natural forests were declining by 125 000 hectares per year; used for wood construction, fuel and commodity sales (Jagger, Pender & Gebremedhin, 2005).

Land is fragmented (Teka et al., 2013; Teshome et al., 2014) and remaining small forest patches (Belay et al., 2014) are disconnected, which has undermined their regeneration and resilience potential (Gessesse Dessie & Kleman, 2007), while also reducing habitat for other species (Asfaw, 1990; Tolera, Asfaw, Leminih & Karlun, 2008).

Subdivision of land to accommodate growing families means that new generations have substantially less land than previous ones (Headey et al., 2014). The pressure to maintain productivity on smaller plots has resulted in the decline of traditional practices (for example, using fallow periods) and compromised soil fertility (Omiti et al., 1999; Deininger & Jin, 2006; Belay et al., 2014).

2.5.1 Soil and Water Conservation

Soil and water conservation initiatives are an integral part of government's vision for an agricultural development-led industrialisation of the country (Taye et al., 2013; Lanckriet et al., 2014a; Nyssen et al., 2014). Civil war during the preceding government's reign had undermined existing conservation activities.

One of the most successful, was a food-for-work programme introduced in Tigray in 1978 (Belay et al., 2014) with the aim of rehabilitating lands and demonstrating the resultant increase in agricultural production (Munro et al., 2008, Belay et al., 2014).

These initiatives have to a certain degree continued successfully in Tigray (Betemariam, 2011) where smallholders commit 20 days of unpaid labour each year to various soil and water conservation initiatives (Jagger et al., 2005) during the dry season (Lanckriet et al., 2014a). It is administered under the Productive Safety Net Programme that aims to enable sustainable livelihoods (Lavers, 2013) and promote food security (Conway & Schipper, 2011). The programme focuses on asset (livestock) building and uses food (Lanckriet et al., 2014a) or cash to remunerate participants for their labour.

The Tigray People's Liberation Front had started soil and water conservation projects in the late-1970s (Lanckriet et al., 2014a). Current government programmes are intended to reduce soil erosion, enhance soil water infiltration and improve vegetation (Nyssen et al., 2014) and are typically low in capital and high in labour input (Yirga & Hassan, 2010).

They include the construction of traditional ditches, bunds (Yirga & Hassan, 2010; Lanckriet et al., 2014a), check dams (Lanckriet et al., 2014a) and terraces along site contours to improve water retention; the use of crop residue for mulching to improve soil nutrition; and reforestation to reduce soil loss and erosion (Hengsdijk, Meijerink & Mosugu, 2004).

In addition:

- Degraded grazing lands were banned from use to allow the natural vegetation to rehabilitate (Belay & Bewket, 2013; Belay et al., 2014).
- A strict community management system enforced the practice to “cut and carry” hay from fields to feed livestock instead of direct grazing, which had led to overgrazing (Nyssen et al., 2004; Yami, Mekuria & Hauser, 2013).
- Extension services were enhanced (Lavers, 2013; Chinigò, 2014; Heady et al., 2014).
- Training was given on improved seed and fertiliser use for intensifying production (Nyssen et al., 2004).
- Grass was planted in gullies and leguminous trees on slopes to regulate erosion and supply quality forage for cattle (Lavers, 2013; Lanckriet et al., 2014a; Heady, 2014; Belay et al., 2014).

- Indigenous trees were protected, even on individual plots (Teka et al., 2013).
- Slopes were excluded from cultivation (Munro et al., 2008).
- Irrigation was introduced (Lavers, 2013; Lanckriet et al., 2014a; Gelaw et al., 2014).

These initiatives have had some success. Terracing, in particular, has significantly reduced soil runoff, helped regulate floods and contributed to increasing deep soil moisture (Taye et al., 2013).

The introduced systems are low cost, easy to use and made from locally available resources; they also require farmer participation (Hailu, 2009). Nyssen et al. (2004) research indicates an increase in soil fertility and Muluneh's (2010) research indicates demonstrated improvements in vegetation cover through photographic images. There is now more vegetation in northern Ethiopia (Betemariam, 2011) and soil loss has significantly reduced (Araya et al., 2011).

However, there remains a great deal of work to be done (Betemariam, 2011) and government's efforts have been criticised in the past for their limited impact and short-term success (Beyene et al., 2006). Terracing and planting trees take away significant space from already-limited cultivation land and affect yields negatively (Hengsdijk et al., 2004). Furthermore, the development approach of government and non-governmental organisations has been characterised by centralised, top-down and standardised implementation (Aberra, 2004; Hailu, 2009).

There has been a lack of local participation (Betemariam, 2011, Teka et al., 2013) resulting in communities not integrating the programmes into their practices or adapting them to fit local conditions (Aberra, 2004). Successful sustainability initiatives require local participation and social, political and cultural factors must be considered in planning and implementation (Aberra, 2004; Beyene et al., 2006; Hailu, 2009).

If local knowledge is used as a starting point for collaboration between government and citizenry there is likely to be more acceptance and implementation of these initiatives (Aberra, 2004; Hachoofo, 2012).

Gelaw et al. (2014) recommend reverting cropland land to forest and grasslands to increase the organic matter and nitrogen-sequestering capacity of soil and agro-forestry. This has taken place to some extent in the northern highlands and progressive greening is observed (Nyssen et al., 2014) and the soil nutrient content is increasing (Belay et al., 2014).

The correlation between population growth and deforestation has changed as, despite an increasing population, policy has enabled modest greening and an end to deforestation (Teka et al., 2013; Belay, et al., 2014). Yet these emerging signs of success are not free of complexities. Household expenditure on food is increasing (Teka et al., 2013). Food aid has been essential in supporting rehabilitation efforts because farmers, due to the factors discussed above, are producing less (Belay et al., 2014). However, these rehabilitation efforts are essential to rebuilding ecosystem services for resilience to climate change and will eventually enhance farmers' ability to adapt (Gebrehiwot & van der Veen, 2013).

2.5.2 Fuel versus fertiliser

Only 0.2% of Tigray was covered in natural forest by 2003 because wood was used to meet most domestic energy needs and as an income-generating source through wood sales; this contributed a large portion of the average household's income (Betemariam, 2011). This low level of natural forest cover emphasises the critical need for conservation.

The constructed tree plantations of foreign species may ease energy and construction needs in the short-term; however, they have already caused significant damage to the region's biodiversity and watershed services (Gessesse Dessie & Kleman, 2007; Nyssen et al., 2007).

Close on 100% of wood demand in rural Ethiopia is for household fuel consumption (Jagger & Pender, 2003). Animal dung and crop residues have been increasingly used to compensate for wood loss (Kebbede, 1988; Jagger & Pender, 2003; Betemariam, 2011; Belay & Bewket, 2013). This has implications for soil nutrient content as dung and crop residues were traditionally used as organic fertilisers (Vestal, 1985; Jagger & Pender, 2003).

Their use for energy deprives soils of necessary organic nutrients (Kebbede, 1988; Jagger et al., 2005), reduces productivity (Belay et al., 2014) and causes soil depletion and erosion (Jagger & Pender, 2003). About 50–80% of animal manure and 70–90% of crop residue are used for fuel, livestock fodder and for construction purposes (Yirga & Hassan, 2010). The associated loss of soil fertility is estimated to have resulted in an approximate loss of 700 000 tons of grain in Tigray in 1991 (Jagger et al., 2005). In addition, the shortage of grazing land has put further pressures on forests for grazing (Betemariam, 2011).

2.6 Conclusion

Ethiopia is a predominantly rural society, which is largely dependent on agriculture as a livelihood strategy. This article focused on three main themes in an effort to explore the historic factors behind the region's severe environmental degradation and the linkages to traditional farming. Based on "small theories" from the field and expanded on through the literature review, these themes – people and environment, people and climate and land politics – illustrate the intertwined social, political and economic drivers of land degradation, as well as the historical trajectory that has led to the current state of degradation.

The expansion of the Aksumite Empire situated in Tigray, required increased agricultural production to feed its growing population and so forest lands were cleared for permanent cultivation. This trend has not abated and Ethiopia's forests have been progressively cleared to meet the demand for land from a growing population – for food production, timber for construction purposes and wood for sale as a commodity.

Deforestation and loss of vegetative cover has exposed lands to erosive rains resulting in surface water run-off, soil erosion, reduced soil organic matter content and declined levels of soil water-retention capacity. This has resulted in reduced soil fertility and declining agricultural production, in the face of a growing population.

Climate change, caused by factors not within the control of the Ethiopian government, will further exacerbate the vulnerability of the region's smallholders to food insecurity, as it affects rainfall patterns and temperature. Slight variations in climate lead to famines in this region, which is dependent on rain-fed agriculture.

The low levels of technological innovation and adaptation can be laid at the door of a historic under-investment in the country's smallholder sector and the insecurity around land tenure this group has faced. Forced into a short-term survival mode of existence for majority of the past 100 years, farmers have neglected to invest in their methods or the soil.

Conservation efforts, led by government and non-governmental organisations, focus on soil and water conservation, have had some beneficial effect. They are to a certain extent informed by traditional practices in their efforts to restore ecological services, but in the main have followed a centralised, top-down approach that has not been conducive to community participation. In addition, the introduction of synthetic fertilisers and alien tree lots, while having beneficial effects in the short term, is not a sustainable option for the region. The region remains dependent on food aid and suffers from chronic food insecurity. Will conservation efforts be enough and fast enough to restore the ecological base that this agriculture-dependent economy relies on? The sector does not operate in isolation from dynamic, global factors, such as climate, and local, shaping factors, such as governance.

Abraha We Atsebaha: A delicate grassroots narrative inquiry

3.1 Introduction

This article presents a lived experience in the Ethiopian village of Abraha We Atsebaha, located in the province of Tigray, Ethiopia in 2014. I began this study hoping to find that traditional farming systems, embedded in social systems in which history and memory is valued, provided keys to resilience in the face of the predicted effects of climate change on farming systems. Instead I learnt that surviving in a subsistence culture is complex and that development will rest on government-led initiatives and strong participatory leadership.

This paper seeks to reflect, as accurately as possible, the experience and narrative of the people in this village around their farming systems and uses Toledo's triad (Toledo, 2002) in an effort to unravel the complexities of traditional farming systems. Indigenous knowledge literature was used to guide the inquiry and focus on the following emergent themes: the effect of "held" memory, trees and their loss, the role of belief systems and leadership, rain and seasonality, land-management systems, a shift from abundance to deficiency and adaptation strategies, all within the context of the village's agricultural system.

3.2 Methodology and methods

The research methodological framework of narrative enquiry was selected as within this methodology stories are accepted as both methods of studying and the phenomena itself (Clandinin, 2007). This made it a particularly apt way in which to uncover the story of farming in Abraha We Atsebaha, explore the complexities of traditional farming systems and contemplate the challenge of sustainable food security in the village and greater region.

As Clandinin (2007:29) notes, "What fundamentally distinguishes the narrative turn ... is understanding that knowing other people and their interactions is always a relational process that ultimately involves caring for, curiosity, interest, passion and change."

Both my lived experience and the told stories of the people I engaged with formed the basis for this ethnographic, narrative inquiry.

3.1.1 Narrative inquiry

According to Clandinin (2007), narrative inquiry encompasses four distinct shifts from traditional positivistic research methodologies. These are an equal and respectful relationship between the researcher and researched, a shift from using numbers as data to words as data, valuing the specific as opposed to universally applicable generalisations and expressing an interest in and an embracing of other ways of knowing. Accordingly, “[Narrative enquirers] recognize the researched is not atemporal but exists in time and that time is itself a socially constructed concept” (Clandinin 2007:11). As an outsider to the village, I was able to retain a degree of objectivity or detachment. This became more apparent in the analysis process as openness to different ways of understanding was necessary in order to communicate the story in a coherent and honest way (Clandinin, 2006; Pink, 2007).

I immersed myself in the village over three months in 2014 and recorded my “fly on the wall” observations daily in field notes diaries (Rosaline, 2008; Strecker & LaTosky, 2013). In addition, I practised careful listening in the semi-structured interviews (Rosaline, 2008) and gathered visual representations of the study context by means of photography. Photography provides a unique aspect to the study.

3.1.2 Photography

I have used photographs to bring to life the ethnographic and narrative style of the inquiry – to show the real people behind the story that is presented (Becker, 2002:5). Photography is often critiqued as being subjective and selective (Schwartz, 1989; Becker, 2002; Pink, 2007; Mitchell, 2008) and images can be manipulated to tell a story that the photographer wants to relay (Becker, 2002). However, people trust what they see, and are able to interpret beyond the photographer’s intentions (Becker, 2002). As photographic meaning is contained within the images themselves (Schwartz, 1989), if they are presented without analysis, the reader is enabled to interpret them for themselves and in so doing is “not just the passive recipient of information and ideas”, but an active participant in the research analysis (Becker, 2002:4). Therefore the photographs used in this paper are simply presented, without additional explanation, open for the reader’s own analysis.

Permission was asked prior to taking photographs which were shown to participants. If participants did not approve of the image, it was deleted. Photographs were all taken during the immersion period in the village in 2014.



Photograph 1: 1: Reflexive image 2: People behind the story. Two generations: modern/traditional

As this study focuses on traditional knowledge and engages with traditional practitioners, indigenous knowledge literature was used to guide this inquiry within an ethnographical framework.

3.1.3 Ethnography and Toledo's triad

Different sciences are used to study traditional knowledge in relation to natural systems and farming. Etho-pedology speaks specifically to traditional ways of knowing soils (Barrera-Bassols, Zinck & Van Ranst, 2006). Ethno-ecology is broader and speaks to ways of knowing the environment and nature (WinklerPrins & Barrera-Bassols, 2005; Barrera-Bassols et al., 2006; Gerique, 2006). Ethno-biology is specific to biotic flora knowledge systems (Barrera-Bassols et al., 2006). Ethnography encompasses all of these and is an anthropological methodology of understanding people through immersion and lived experience in their environment (Pink, 2007). These are generally divided into three ways of knowing, identified by Toledo as the *kosmos-corpus-praxis* triad (Barrera-Bassols et al., 2006; Haile, Herweg et al., 2006).

These three ways of knowing, coined by Toledo (2002) as the *kosmos-corpus-praxis* triad were used to guide my narrative inquiry.

Kosmos (cosmos) represents the belief systems people hold about their environment and it includes perceptions and explanations on how people fit into the world (Berkes, Colding & Folke, 2000; Barrera-Bassols et al.; 2006; Haile et al., 2006).

This belief system affects behaviour and enables “appropriate environmental ethics” through qualitative management (Berkes et al., 2000:1259). *Corpus* represents the knowledge people have of their context; it includes identifying species, climatic factors and is essentially cognitive (Stepp, 2005; Haile et al., 2006). *Praxis* encompasses practices – how people manage their environment and use plants and animals (Berkes et al., 2000; Stepp, 2005; Barrera-Bassols et al., 2006; Haile et al., 2006). It is possible using this triad to gain an integrated understanding of how people comprehend, manage and live with nature (Toledo, 2002; Haile et al., 2006).

There are concerns around the rights and exploitation of traditional communities regarding research work (Mauro & Hardison, 2000; Davis & Wagner 2003; Smith, 2005; Popova, 2013; Williams & Hardison, 2013). Ethnography necessitates the researcher to be cognisant of her position and perceived identity in the field (Pink, 2007; Strecker & Latosky, 2013; Strecker & Verne, 2013). It was therefore critical throughout my time in Abraha We Atsebaha to be respectful of the people and the place, and to be aware of my otherness and outsider position. Furthermore, as far as possible, this paper tries to use the original translated word of research participants, so that they can be read both independently and in combination with the interpretation given to them. This is based on considerations learnt from other native communities who prefer their own words and terms of reference to be used, rather than those removed from their context (Rains, Archibald & Deyhel, 2000; Smith, 2012).

3.1.4 Research guides and participants

Because of my interest in traditional farming, I was guided by local supporting professors at Mekelle University, Ethiopia to study in this particular village because its inhabitants are making unparalleled efforts to regenerate their lands. The village is held up by academics as an example of successful adaptive management using indigenous knowledge based on the emergent innovations and community ownership of the process. Lecturers from Mekelle University facilitated and supported my entry into the village.

Key guides emerged from my immersion in the village. One was the village leader and administrator who has been given the name *Aba Hawie; Father of Fire*. He is a major driver of the development and took me with him on numerous outings to see local development work. His household hosted me. By sharing their compound, and allowing me to take part in their daily lives and occasional rituals, they enabled the deeper levels of learning and observations without which this research would not have been possible. Government extension officers assigned to Abraha we Atsebaha were helpful and eager to speak of their work. Through them, I was able to experience and witness the tremendous effort the community is making to develop and rehabilitate their land. They offered insight into government's work and its commitment to green grassroots development embodied in Ethiopia's Climate Resilient Green Economy plan (CRGE, 2011). Two translators who commuted from Mekelle were employed to assist in interviews.

I conducted open, semi-structured interviews with 38 male farmers (aged between 47 and 94 years) and used their priorities to guide the conversation. Farmers were selected by accessibility and elder farmers were prioritised and actively sought in an effort to access old or traditional knowledge linked to farming. In addition, I interviewed five village leaders, including a strong female leader, to understand the role they played in transformation and development in the village. In addition to these interviews, I engaged in discussions with various members of the community who I was able to access. My time began with my lived experiences, observations and participation with the women and elderly in the extended households I was affiliated to by my hosts, and their activities, both at home and in the farmlands. This experience, and informal conversations held with the random selection of individuals at the household level, together with guiding literature, was used to structure the interviews held with the 38 elderly farmers. I believe that the combined approach enabled a rich narrative that I hope to present here.

While interviews intended to cover topics related to Toledo's *kosmos-corporis-praxis* triad, farmers guided me to discuss their concerns and, through attentive deep listening, I learned to hear what they needed to say. Interviews started with general questions on farming, and what was needed to be a good farmer. These initial questions broadened into a conversation around the important aspects of farming and why they were important.

These include land, rain, oxen and tools. I also asked questions related to time periods defined by government regimes in an effort to understand traditional ways of farming, as well as the reason for the massive deforestation of the region. This brought my awareness to social and political change and the impacts of these. In particular by focusing on the *kosmos* aspect during interviews I was able to discover the prominence of Christian beliefs. In addition, my fascination with the relative abundance of old and large sycamore fig trees in the village led to me learn of some concealed belief systems. I pursued an active inquiry around these trees.

I recorded conversations by hand during interviews and kept them with my daily field notes and observations. From this data, I grouped the themes highlighted in the introduction and selected pertinent quotes for each. Quotes are taken from individual conversations, yet are grouped into themes that were developed through thematic analysis of interviews after my departure from the field.

As people feared retribution from government, I have not provided information about the source of the quotes to protect the individual identities and opinions. In 2008 and 2009 the government passed laws to limit the freedom of press and issued an Anti-Terrorism Proclamation (Freedom House, 2014) increasing the powers of security and law enforcement agencies, which has caused fear and uncertainty among citizens (Rahmato, 2014). There have since been news articles about government prosecuting those who speak negatively about it (Fortin, 2014) which legitimise these concerns.

Before expanding on what I learnt from conversations with villagers, my own observations and my lived experience, the following section provides a sense of place for Abraha We Atsebaha.

3.2 Introducing Abraha We Atsebaha

Abraha We Atsebaha is a small village in Tigray named after the twin monarchs, Abraha and Atsebaha, who introduced Christianity into the region and are elevated to sainthood in traditional mythology (Field note, 2014). They implemented and oversaw the construction of the first rock-hewn churches in the country.

The church of Abraha We Atsebaha is believed to be one of the oldest and it is said to have been constructed in 347AD (Asrat, 2002). The village is located in a beautiful valley that has rivers passing through it and is surrounded by rocky-red mountains, which are inhabited by baboons, among other small wildlife.

As noted, I was guided to choose this village by Mekelle University staff as it is used as shining example of “green development”, both regionally and nationally (Wolde-Georgis 2010; Wolde-Georgis et al., 2013). It provides an example of adaptive local ecological knowledge (Lamprey, 2012). It also represents a story of a community that has faced significant political and environmental changes, which have increased their vulnerability and negatively affected their resilience to external shocks.



Photograph 2: Landscapes: 1: Surrounding mountain, Uмба Korai 2: Kushet church, Munda

Abraha we Atsebaha is 15 kilometres from the nearest town and the district (*woreda*) capital of Wukro (Hailu, 2009). About 5 000 people live in the village in 915 households (Hailu, 2009). Just over 1 000 hectares (13.5%) of the total land area of 7 724 hectares is cultivated and 47% is protected for reforestation (Hailu, 2009). The remainder is hilly and difficult to cultivate (Hailu, 2009). Crop production is dependent on rain with only 10% of land under irrigation (Hailu, 2009). Rainfall is low and erratic with the main rains falling between July and August, amounting to 350–600 millimetres of water each year (Hailu, 2009). The community has been vulnerable to drought over the past decades (Hailu, 2009).

According to the village's 2008 extension office report, farmers from this village face challenges around lack of land, poor soil fertility and low levels of soil moisture, along with a shortage of oxen for ploughing (Hailu, 2009).

In the early 2000s the governing party, the Ethiopian People's Revolutionary Democratic Front, encouraged people to relocate from this region as they were food insecure and the land degraded and unproductive (Hachoofo, 2012; Lamptey, 2012). However, they chose to stay under strong leadership and apply traditional farming methods to regenerate their land and water (Hachoofo, 2012; Lamptey, 2012). They implemented aggressive watershed management and applied rehabilitation experiments (Lamond, 2012).

The village attracted both governmental and non-governmental support after their initial success (Wolde-Georgis, 2010; Hachoofo, 2012; Lamond, 2012). Their receptivity to this support enabled the village to reverse its status from being food insecure to being 80% food secure (Lamond, 2012; Hachoofo, 2012).

Out of the 915 households, 350 do not own cultivated land and 270 households do not have oxen for ploughing. The food-for-work programme introduced by international development agencies in 1978 (Munro et al., 2008; Belay et al., 2014) in which participants receive food or cash in exchange for their labour on development projects (Conway & Schipper 2011; Lavers, 2013) still plays a significant role in buffering hunger for most farmers in the village (Hailu, 2009).

Having set the study context and outlined the methodologies and methods used for this ethnographic, narrative inquiry, the following sections explore the emergent themes from my conversations, observations and lived experience in the village, guided by the *kosmos-corpus-praxis* triad. These further led to the development of "small theories" that were used to source literature in which to situate them (Bryant & Charmaz, 2007).

3.3. Emergent themes and the *kosmos-corpus-praxis* triad

3.3.1 History and memory

"Bi Zebene Inni Inni, Himbasha Kelo Imni"

Tedlock (2013) speaks of the significance of proverbs, cultural anecdotes, songs and language as access points in understanding culture and meaning in ethnographic research. The quote above is a Tigrinya proverb that seems to encapsulate the story of Abraha We Atsebaha in a single line: “In old times, the stones were bread”. It was explained to mean that previously there was plenty and there was as much bread to eat as there are stones scattered. Villagers often refer to the abundance of past times, as well as the biblical period of Adam and Eve in the garden of paradise, prior to their exile.

The older generation in the village have lived through three radically different governance regimes and have faced much suffering.

These regimes were the feudal system culminating in the reign of Haile Selassie (pre-1974), the military regime of the Derg (1974–1991) and the free market-orientated Ethiopian People’s Revolutionary Democratic Front (EPRDF) (1991–present) (Teka et al., 2013); the local division of this party is the Tigrayan People’s Liberation Front (TPLF).

People of the village have experienced different degrees of hunger, insecurity around land tenure and general safety, forced relocations, drought and poverty.

These experiences are depicted through their words in the following section, and were the basis of my “small theory”: insecurity was the cause for environmental degradation.



Photograph 3: Sifting Dagusha

Since long before, our fathers were farmers, and that is what they teach us. We don't participate in trade or other activities. Our ancestors were farmers, and still now, we are farmers.

I began by asking farmers how they came to be farmers. Without exception, everyone spoke of inheriting the lifestyle of farming, either from their parents, from their ancestors or from the time when the biblical figure Adam was expelled from the garden of paradise and “told to work before he could eat” (Interview notes, 2014). The way in which this community has farmed has not substantively changed in living memory. Men plough the land with oxen, plant and harvest crop, and women weed and tend to their households, as they have always done (Field notes, 2014; Interview notes, 2014).



Photograph 4: Women weeding in a field of young Teff

Life under Haile Selassie (1930–1974)

In the time of Haile Selassie, there was more forest and land was good, we could cultivate and harvest anything. Cows were giving more milk and there was grass. It was a rich time of honey and butter – of everything. If you spread grain, it was not lost, it gave fruit and you could harvest.

There is an old sycamore fig tree in the village called *Da'aro Tsa'ada Teff*, which means the white teff fig tree.

The name it is given stands as a symbol of the land's past fertility in which this sweeter variation of the local staple grain was cultivated. During Haile Selassie's reign there was plenty of food, the land was lush, the rivers perennial and the soil fertile (Interview notes, 2014). There were also fewer people and so less pressure on limited available arable land (Interview notes, 2014).

However, there was a tangible sadness in the voices of farmers when they spoke of the inequality of the past feudal system, expressing feelings of enslavement and unhappiness.

*In time of Haile Selassie, the poor depended on rich for work, like servants.
Now even though I am poor, I am free to work. Now it depends on your heart's
desire.*

Despite the abundance of good land and good harvests, farmers and the region's poor still suffered as food was not equitably distributed. The powerful often took advantage of their position and could kill or imprison people if they disagreed with them (Interview note, 2014). Land was owned by the *risty* (wealthy families) (Deininger & Jin, 2006; Bezabih et al., 2011; Headey et al., 2014) and everyone else "ate by working for food" (Interview note, 2014). Ownership of land benefited the *jazmat* (elite). Farmers exploited their lands, and farmed on marginal slopes, to meet their basic needs (Lanckriet et al., 2014a) forgoing thoughts of future development for present survival (Kebbede & Jacob, 1988; Yirga & Hassan, 2010).

Life under the Derg (1974 –1991)

*Then the Derg came into power and land was given to those who can plough
and we were happy with the distribution.*

*It was not illegal to have a gun at that time because gangsters could come
and demand our food – now it is just for us. If we had money, we would hide
it; now, it is peaceful.*

Haile Selassie was overthrown in 1974 and the military communist movement, which came to be known as the Derg (Government of the People's Democratic Republic of Ethiopia), seized power (Lanckriet, Derudder et al., 2014).

They had good intentions to give land and power to those who worked the land, encapsulated in their political slogan of "land to the tiller" (Redda, 1983:1579), to increase productivity and to eradicate hunger (Redda, 1983; Vestal, 1985; Cohen & Isaksson, 1988).

Yet the government was ruthless with any opposition to its rule (Redda, 1983; Vestal, 1985). The period is referred to the "Red Terror" (Tareke, 2008) because the military government would take by force what they wanted (Interview notes, 2014).

This type of suppressive governance thwarted development efforts and there were no forums for organising projects or discussing problems (Interview notes, 2014).

The Derg was still not good for Tigray, they had a slogan: 'To catch the fish, you have to dry the ocean' so they killed many people. Students were against the Derg, so they took children to fight for them. The resettlements were part of the drying of the ocean, not to make the livelihoods of people better.

The Derg also forcibly removed the people of Abraha We Atsebaha from their land (Interview notes, 2014). This was part of their resettlement scheme in the midst of the 1984/85 famine (Keller, 1992) where people were forcibly moved (Kebbede, 1988; Keller, 1992) in what the Derg claimed was an effort aimed at curbing food insecurity; however, people believed it to be an aggressive move to stamp out opposition in the north (Vestal, 1985; Kebbede, 1988). Many escaped and found their way back or hid to remain on their land, their birthplace, which had been blessed by the twin monarchs of Abraha and Atsebaha (Interview notes, 2014). This was a difficult topic to discuss as the memories of this era are still very painful.

Life under the Tigray People's Liberation Front (1975 –present)

The freedom fighters had a slogan: One hand for war, one hand for development.

"Now, no one is forcing us, we have democracy, there is no partiality and everyone is treated equally, we have peace.

For everything, the government is the one who protects.

The Derg was overthrown by the TPLF in 1991 (Segers et al., 2010; Headey et al., 2014). Many of the current leaders in Abraha We Atsebaha served as guerrilla fighters in their youth (Interview notes, 2014). The TPLF and its leader Meles Zenawi Asres were development-orientated and initiated educational and conservation activities while still fighting for their independence from the Derg.

Land was redistributed again with the Tigray People's Liberation Front to those who didn't have. The elder's land was reduced for the younger generation.

Now land is distributed for all. But everyone has very small land, so it is useless because we don't have more [enough] land.

The party, while rebelling against the Derg government, redistributed land in three rounds between 1978 and 1987 (Corbeels, Shiferaw & Haile, 2000) to increase access to those without land (Nyssen et al., 2004).

The EPRDF policy which entitles every individual over the age of 18 to access land contradicts land shortages (Benin & Pender, 2001), particularly as further redistribution has been prohibited (César & Ekbom, 2013). There is thus a strong drive to increase productivity. Having resisted the government's urge to relocate in the 1990s (Hachooofwe, 2012, Lamptey, 2012) combined with the painful memories of forced relocation under the Derg regime inspired community leaders to mobilise the community to invest in the village through conservation activities (Interview notes, 2014; Field notes, 2014).



Photograph 5: Oxen and plough

What is important now is the land.

We have democracy now, everyone is treated equally.

3.3.2 The story of trees

Everything is from trees; including tools which a farmer needs... it was all lost.

Ethiopia has been extensively deforested over the past century (Brighter Green, 2011; Hadgu et al., 2013; Shiferaw et al., 2013). Many farmers spoke of cutting trees as a daily cultural activity during the time of Haile Selassie. Villagers used trees wastefully and exported wood (several donkey-loads of wood a day) to nearby towns for sales. Wood provides for most domestic energy use (Betemariam, 2011; Jagger & Pender, 2003).



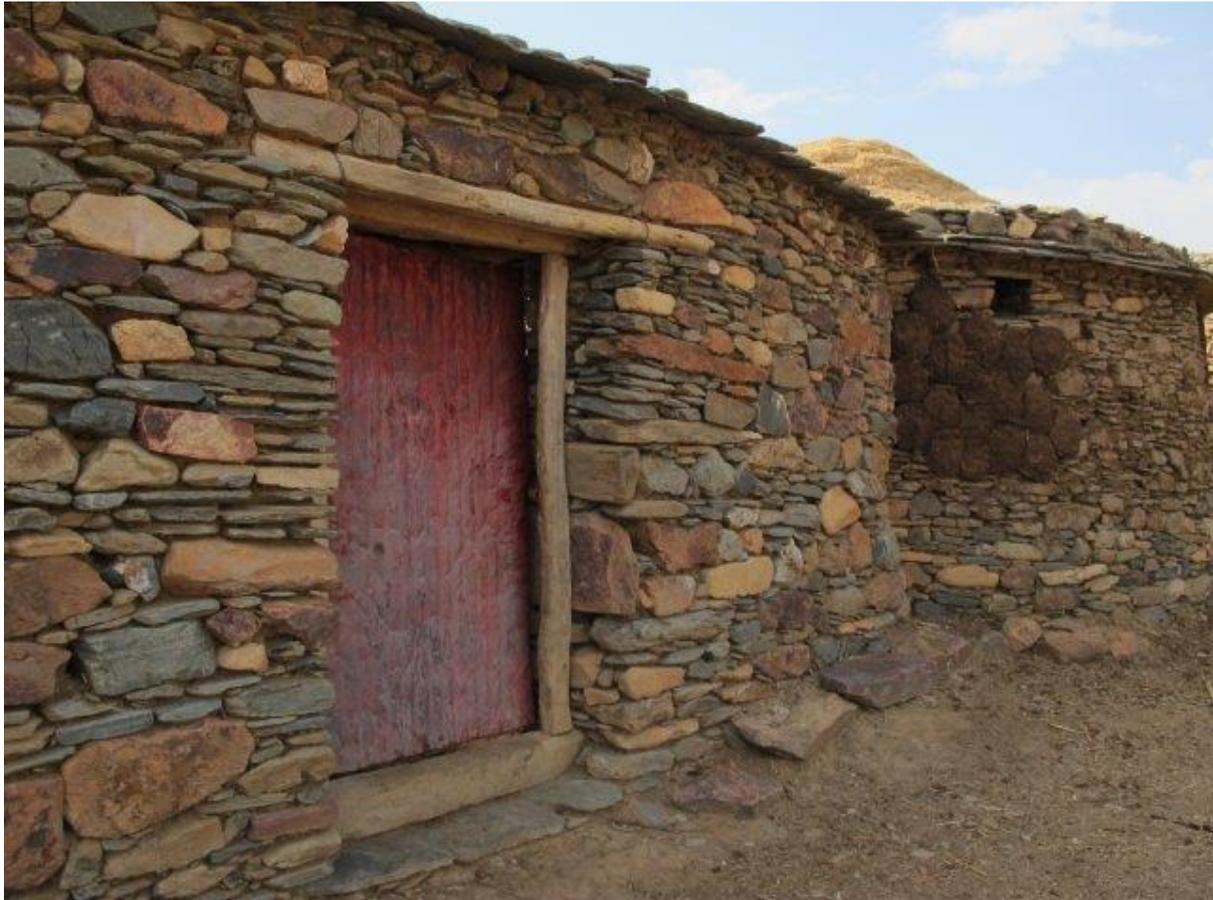
Photograph 6: Assembling ploughing equipment

When we were young, the canopies of the trees were so full, when you stood inside the river, you could not look up to see the sky; they reached over both sides... Now it is empty.

In the time of Haile Selassie! There were many trees. People cut and destroyed them. Before, when Mekelle and Wukro became towns, all the houses there were made from wood; one donkey load to sell was 5 Birr. Even here, we never used stones to build houses before, there was only wood. And when someone matured, we had to go to the mountains to help with bringing all the trees to build houses... It was all lost.

The elderly of Abraha We Atsebaha remember thick and lush forests, and are able to name the varieties of species that were around as well as their specific utilities. The tree's properties determined the function for which it was used (Hachooofwe, 2012).

Qualities include aspects such as hardness, agility, strength etc. Some trees were close to extinction because the cutting of trees was so fierce (Interview notes; 2014; Vreugdenhil, Vreugdenhil, Tamirat, Anteneh & Zelealem, 2012). In some cases, the roots of trees were used and so the trees were lost forever. Awlie (*Olea Africana*) was one of the most threatened species (Gebreegziher, 1999).



Photograph 7: Modern construction, hussar in storage, dung drying

I visited homes where the doors were made from thick hardwood and wood was used for structural elements. Pulping instruments for coffee and grain are made from strong hardwood, where the original tree grain and form is often still visible.

In the time of Haile Selassie, there were more palm trees on all mountains; they were covered with more trees. To get just three leaves for the animal, we would cut the whole branch. We were cutting five trees per day. It was our daily activity... Now it is forbidden, and it is good to be protected because it was empty and we were worried... because the past government was not wise enough.

Before, we cut trees to plant sorghum. Before we didn't understand its usefulness and to cultivate we needed to cut trees to have new land.

In addition to using wood from trees for construction purposes, firewood and household utilities, it was also used to make farming tools and used as food for livestock (Field notes, 2014).

Most people in the village are involved in farming – cultivating crops or rearing livestock – and so the need for making and repairing equipment is perpetual (Field observations, 2014). This is typical of the mixed farming system used in the majority of Ethiopia (Gebrehiwot & Veen, 2013; Teka et al., 2013). Animals were allowed to graze on the mountain slopes, which added to the loss of trees (Interview notes, 2014). As the population increased, more land was cleared for farming and farming was intensified (Grepperud, 1996; Lanckriet et al., 2014a). In addition, wood was sold to the neighbouring towns of Wukro and Mekelle for construction purposes (Interview notes, 2014).

We had no choice; we cut trees to sell in order to buy what we needed.

When we were younger there were more [trees], but many people were cutting trees... In the transition period, when there was war, many people cut trees because there was no one to protect them [the trees]. If an old man said 'don't cut', they would say, 'why do you care about this?' So people cut more at that time.

During the regime of Haile Selassie, opulence and hunger were equally evident. Poverty was accompanied by desperation and wood sales were used as a coping strategy to feed families from the income gained through deforesting activities. This kind of forest related economic activity remains a major part of rural income in Tigray (Betemariam, 2011).

Everyone (both rich and poor) was cutting trees. The governors were bad so everyone cut trees. The poor cut them and travelled to towns where they sold the wood.



Photograph 8: Wukro wood sales

In addition, the opulence of the wealthy was expressed as exorbitant spending, including constructing new houses and feasting (Interview notes, 2014). Gebreegziabher (1999) speaks of the Derg redistribution policy that required every new landowner to have a home constructed. Deforestation increased as many more homes were built in a short space of time to meet this policy.

People were cutting trees and taking them to Wukro [nearby town]. There are no trees to keep the soil. Soil is all eroded and there is only sand left.

Before, there was a tool specific for cutting the tree, and everyone had it - kojomo. Now government teaches us it is important to keep and protect the trees, we understand it is important not to cut, and no one has kojomo. It was lost with Haile Selassie.

There were so many trees, but at the same time, there were so many axes. Everyone, everywhere, cut trees... we didn't have heads.

Almost too late, people are becoming aware of the importance of trees and government has made afforestation one of its four major green development pillars (CRGE, 2011). There has been government training and education on preserving and planting trees (Lamptey, 2012; Interview notes, 2014; Field observations, 2014). In addition, guards are employed to protect mountain lands, recuperating river beds and areas of young groves/clusters of trees. There is also a government-run nursery in the village that nurtures and supplies a variety of tree seedlings to the community. Finally, permission is needed before a tree is cut, with the exception of eucalyptus trees (Interview notes, 2014).

If there are no guards, people can cut it (all) in one day.

We Habesha [Ethiopians], no one can compare with us in destructing... For development we are not active, but for destruction, no one can compete.

Community leaders are very optimistic that trees are close to replenished and that people are aware enough now not to cut their trees. Looking around, however, I mostly saw young shrubs and young trees in addition to the ancient sycamore fig trees that were preserved, and older *momonas* (legume acacia adopted by farmers for its soil-enhancing properties). Additionally, many farmers admitted that without the guards guarding the mountains and protected areas, they would continue cutting trees.

Even though the importance of trees is appreciated and the implications of losing them understood, people have unmet needs for wood. This typifies the competing social and environmental interests playing out in the village.

If there were no guards, yes, even now, I could take one tree – to use to cook for my house.

3.3.3 Cosmos: Belief systems and conservation

*Greenery is like the dress for the church...
it is like the church is naked without it.*

Social guidelines determine human behaviour towards the natural environment (Toledo, 2002). Two belief systems have protected the natural environment from complete degradation to some extent. Firstly, the Orthodox Tewahido churches of the region are viewed as extremely important and vegetation surrounding them is protected and administered by the church (Wassie & Teketay, 2006). Secondly, there is a belief system related to old trees that has been somewhat suppressed since the introduction of Christianity in the village with few people still willing to speak of it.

Bayt Christi'an (Church)

Christianity and the local churches of Abraha We Atsebaha are very influential in the village. There are 10 church holidays, each dedicated to a saint, in each month and on which work is prohibited. This is in addition to weekends where work is normally suspended (Field notes, 2014).

Development agents, in particular, find this frustrating and many argue that this practice stagnates the Ethiopian economy (Redda, 1983). In addition, there are two fasting periods each year (between 40 and 60 days each) in which people may not consume meat and animal products. This practice negatively affects the nutrition diversity of the community during these periods.

Churches have been central to conservation in Ethiopia. Despite the extensive deforestation in the region, vegetation around the churches has not been touched (Nyssen et al., 2004; Woldemichael et al., 2010). It is believed that angels and saints take refuge in this vegetation and those who remove them, by clearing the land, will be punished. These spaces have thus been biological storehouses and soil seedbanks of conservation (Wassie & Teketay, 2006).

Saints and angels live there (around the church), and the dead – the trees are their statues (hawelti). Everyone knows it is theirs – the saints and angels – it is their place.



Photograph 9: Grain-storing ritual with makeshift cross

The vegetation of the church is not planted by people, it is planted by God. If it is planted by the will of God, no one can cut it. Even it is dry and fallen, no one can take it to use for themselves.

Holy people and angels rest in the trees of the church, and use the shade to pray in. So no one can cut it. They bless the tree, and bless all places. The blessing of old people and saints are very important.

To cut tree at the church is like stealing from the government. You cannot sleep peacefully, because everyone cares for that. Even in the church, the angels care about the environment of the church. If you take from the church, the Mercy of the World (Jesus) will come in your dreams and ask you to take it back.

Trees are kept both as a courtesy for the pious and faithful who come to pray at the church, as well as for the angels who live among the trees.

People fear angering the angels who might curse them for destroying their environment, with bad consequences such as ill health, poverty or even death, or by sending locusts or hail (Interview notes, 2014).

Villagers appreciate the grace and beauty of the greenery that surrounds the churches, as well as that of the large sycamore fig trees. This in conjunction with the belief that angels play, sing and live in these trees, have safeguarded the survival of vegetation and trees. This belief system cannot be underemphasised in terms of the role it has played in conservation.



Photograph 10: Morning prayers at Bayt Christi'an Abraha We Atsebaha

Da'aro

During my stay in Abraha We Atsebaha, I learnt that large sycamore fig trees were significant to the community in that they had names. The Tigrinya name for sycamore fig is *da'aro*.

They were named either to mark a certain attribute of their place – such as *Da'aro Mai Ayne* (water source), to commemorate a historical event – such as *Da'aro Dawid* (the holy Ethiopian Orthodox Tewahido Christian book *Dawit* was studied and consulted under this tree), or because of their own attributes – such as *Da'aro Henchelchel*, because this is where the birds gather and sing.

The elderly spoke with respect for old trees and some spoke of the spirits who live in them or close to them. Many *da'aros* have been lost to the community through deforestation. Despite the elderly and village priests protesting their destruction, the stresses on people incentivised further deforestation.



Photograph 11: Da'aro Dawit morning panorama

Two schools of thought exist as to why some of the *da'aros* have survived. Some claim they were too large to be cut and therefore they were left alone in time to be saved during the TPLF's conservation period.

Some believe that the *da'aros* should be respected as they are useful. They create shelter from the rain and sun, give fruit and their leaves are good for livestock.

If there is powerful rain, children can take shelter under the da'aros with their cattle. It is like a house. We consider it like a human - it can die on its own, but we don't cut it. It also has fruit.

*Wai! [expression of emphasis] There were more trees cut, but not da'aro!
They create shade [for cattle and humans] so it is unthinkable to cut them!
Ttse tse! [expression of emphasis]*

The elders said we should protect da'aros. It had a special protection and girma [grace]; it is our indicator, our beauty. If we cut it, we lose our girma.

You can't cut old trees because it has its own Adbar [protective spirit]. Big trees are the shelter of spirits. In our parent's time, old people and old trees like da'aro were respected. And old men are more respected, and next to that, old da'aros we respected.

This combination of beliefs around the nature of the trees and their usefulness has meant that there are a relatively high number of da'aros in Abraha We Atsebaha, despite the varied stresses, primarily conflict, hunger and insecure governance, faced by the villagers over the past few decades.

3.3.4 The importance of rain and seasonal rhythms

Only rain and land condition has changed between then and now [between Haile Selassie's time and now].

Traditional farming in this region is primarily rain-fed, despite the introduction of irrigation schemes by government (Hailu, 2009).

Nowadays, farming is not good, the rain is not good.

In Asmara [small rains] it usually rains once, and if God allows, three times, but now there is no Asmara.

The main thing to be a good farmer is the water. If you prepare your land, if you put compost in the ground, the main thing is the rain.

If there is Asmara, we can plant in March, but these days, there is no Asmara. Before it was common, but now, as there is more sun, it is not common. Plants can germinate, but after that, if they are exposed to the sun and no rain, they can die and we will have no harvest.

According to the local farmers, rainfall patterns have changed over the past two decades.

There are two traditional rainy seasons in the region and these are linked to two cultivation seasons. The “small rains” of short rainy season (*Asmara*¹) falling between March to May (Kebbede, 1988; Lackriet et al., 2014b) the second, more intense “big rains” season occurs from July to August (*Kiremti*) providing the majority of annual rainfall (Gebrehiwot & van der Veen, 2013; Lackriet, Frankl, et al., 2014).

There has been less rain falling during these seasons over the past two decades and the shorter *Asmara* period is now reported to be negligent and sporadic by farmers (Interview notes, 2014). Farmers say that there has been no real *Asmara* for the last 20 years and that it occurs only haphazardly in smaller areas (*kushet*) of the extended village. They wait and hope for it expectantly.

As there was lowti [revolution] on the ground, there was lowti even in the sky, and the early rains have stopped coming. There is less rain generally, but the Asmara especially has been affected, and we have lost a whole yearly harvest for approximately 10 years.

There was lowti even in the sky. Those who have power were not working for the truth, they cheat, so God worried about this and he locked the sky.

I beg to Christ to get water [rain]. As you can see around here, there is a shortage of water. There was always rain in Asmara. A farmer can be wise and prepare as much as he can, but without water, everything is useless.

The rainfall season determines which crop is grown as each has different attributes, including their reliance on water. Some require large amounts of water and others are drought resistant. There are three main grains planted in the *Asmara* period. These are maize, finger millet and *legho'a* – a smaller, orange variation of maize. In addition, *teff tsidia*, a teff variation, was grown. *Legho'a* and *teff tsidia* are not commonly planted anymore as they do not produce enough surplus hay, which is needed for fodder. Teff, wheat and sorghum are the main crops planted in the *Kiremti* season.

¹ *Asmara* was the term farmers used for the “small rains” season of rainfall and related crops. The name of the actual rains is *Belg*.

If there is rain, we sow in February and harvest after three months, if not, we use Kiremti for teff or wheat. We didn't plough dagusha [finger millet] this year because there was no Asmara. Before, our parents used to plant seeds when it rained, but now we don't. It depends on the rain.

*Before, there was rain even before Kiremti, so we **cultivated different extra food** [emphasis added].*

*Before the time of the Derg, we were harvesting **twice a year** [emphasis added]. In that time, it was common to have rain, but after that it is not common.*

The loss of the *Asmara* rainfall has had serious consequences in that the second planting season and the resultant harvest have effectively been lost with implications for the village's food security. Despite deforestation having played a significant role in reshaping rainfall patterns, there are also broader contributory factors over which villages have no control.

These include the increase in temperature in the Indian Ocean basin over the past six decades (IPCC, 2014), which have directly affected Tigray's *Asmara* rainfall period (Lanckriet et al., 2014b). Furthermore, global human activity has contributed to 50% of the rise in average global temperature (IPCC, 2014).

One day in the village I took shelter from the intense, dry heat of the sun under a *momona* tree with an elderly farmer. We sat on red rocks and were both relieved for the rest and the shelter of the tree. He kept repeating that:

God has locked the sky, I don't know why. There is no longer any rain.

I suggested to him that the rains would return when there were more trees in the region. He noted that this is what the scientists and the young people were saying, but that despite planting trees there was still no rain.

If there is rain, we sow, regardless of the land... How can humans make rain? If God locks it, it is locked! I believe in the will of God. Why is there no rain now? We are expecting and eager for rain. Still, there are plants [even now], why don't they call the rain.

Efforts at afforestation and re-vegetation of the landscape have been underway in the Tigray region for decades. Yet I noticed that the density of trees is still not very high; Tigray's vegetation is predominantly shrub and bushland (Belay et al., 2014; Lankriet et al., 2014a). This particular conversation affected me deeply and I came to the full realisation that the efforts of these villagers to revitalise their lands will not be enough on their own. They operate within a global and closed climatic system in which they have little influence on the broader contributors to climate change.

This farmer, his village and wider community are affected by trends they do not even have knowledge of. Their noteworthy efforts, consuming a lot of their time, energy and resources, are minimised in the larger global arena.

For them, God has locked the sky.



Photograph 12: Many hands

3.3.5 Corpus–praxis: Identifying and managing land

Land is like a mother, if there is no land, there is no anything. Land is the source of everything. We need to take care of it.

Corpus, the second part of Toledo's triad, encompasses the cognitive observations and perceptions that communities have of their environment (Toledo, 2002).

There are layers to this element in Abraha We Atsebaha. Firstly, there are overlapping soil identification systems. Soil can be identified by type, similar to the Western paradigm: sand (*hootsa*), silt (*ba'akhel*) and clay (*walka*).

More specifically to Tigray, soil can be distinguished between thick (*roguid*), medium (*ma'akheley*) and thin (*rekik*) (Corbeels et al., 2000; Beyene et al., 2006; Haile et al., 2006).

Soil is measured by its productivity and it is understood that its nature cannot be changed. *Roguid* soil is the most productive and *rekik* soil the most fragile. *Roguid* soils are generally found in places where water collects and it is enriched by the minerals and nutrients flowing from the surrounding mountain watershed (Interview notes, 2014).

When government redistributed land, it ensured that everyone got one of the three types: *roguid*, *ma'akhley* and *rekik*. For example, the most fertile, *roguid* farm land in Abraha We Atsebaha is in an area named Ruba Belles, and this land is divided so that everyone has a plot there, however small. The size of the land is determined by a traditional measurement known as *tsimdi* (pair). A *tsimdi* is the smallest land measurement that a farmer can have as it is what a pair of oxen can plough in a single day. A *tsimdi* is about 0.25 hectares. This indicates the importance of oxen and the practice of ploughing in this region.

Soil types determine land praxis. Farmers practice several techniques to maintain or increase the productivity of the land – most of these practices are applied to medium and thin soils, as it is believed that the thick (*roguid*) soils will produce continually. The two primary traditional practices are keeping land fallow in three-year rotations and applying manure to the soil.

Land is like a woman, if she gives birth continually, it is not good for her, she needs rest. Land is like the woman, it needs rest.

Our land is in use since the time of our ancestors; it needs rest.

Land needs rest; it is ploughed for many years. It needs to be ploughed and left idle for a season and the next year we can plough and sow again. We plough and sow for two rainy seasons (Kiremti), and the third year, it is left idle. We plant in another place to make sure there is enough food; we rotate the lands turn by turn. If you plough every year, it becomes rekik [thin]. To put manure every year is not enough. It needs to be idle for a year.

However, as the population has increased and land has been further redistributed, the practice of leaving land fallow for a season has been undermined. Farmers are compelled to put the land under pressure to maintain and increase production.

The traditional practice of applying manure to the soil each year, including in fallow periods, to increase soil fertility has also been undermined because, for a variety of reasons, farmers are no longer able to support many animals.

We used to use manure before, because we had more cattle then. But now, we have less because we sold them, there is not enough food for them. Now we use manure for cooking. With the few cattle we have now, there is not enough manure.

Manure is preferable to fertiliser, but we can't get enough. Especially when it is prepared, it can stay in land for three years. Fertiliser is just once off. Baka [enough/finished], the next year it needs more.

Ploughing with oxen is a traditional method of preparing the land in Abraha We Atsebaha. Farmers use wooden and handmade ploughing instruments. Ploughing, however, requires good rainfall to soften the earth.

A farmer should plough on time, at least five times [each year]. The soil should be soft like flour.

If a woman has no husband, she can't produce children. In the same way land needs to be ploughed in order to get crops.

To maintain soil nutrition, crops are also systematically rotated each season to maintain productivity.

3.3.6 Shifting from abundance to necessity: “there is not enough”

The refrain that “there is not enough” is a recurrent one. It is mentioned in reference to the diminishing rainfall, diminished forests and diminishing grazing lands, which in turn diminished livestock and their manure. It is expressed most acutely when referring to animals, cattle in particular.

Cattle used to be fed in the grasslands, we would leave them there in the morning and we took them at night, by rotation through the year. If a son was lazy, he would always take them to one place. A good keeper rotates them; he takes cattle to the next place.

There are traditional grazing meadows in Abraha We Atsebaha. These places are kept free from farming as pasture lands. A traditional praxis system moderated rotational grazing patterns between pastures and the surrounding mountains over seasons. Animals would also graze on farmlands once the harvest was complete and they were fed straw from the harvest.

We had many cattle and we were rich.

Netsa (free) [the central meadow] was free, every animal would eat there... Before, everywhere was free for grazing, so every farmer could have 10 cows to milk.

*Cattle are not free to graze and cutting trees is forbidden for fuel, so **there is not enough** [emphasis added]. We can't have more [cattle] because where can they spend their day? What can you feed them? All the mountains are forbidden, the cattle can't go there, even in the golgol [meadow] and farmlands. As you can see, they spend their time under the tree. We can keep some sheep and some cattle, but no more.*

The system that regulated grazing patterns collapsed resulting in overgrazing, which contributed to the deforestation in the region and overburdened the meadows. This compromised the staple food base for animals. Grazing land is under serious shortage in Tigray (Betemariam, 2011), and animals grazing on farmland has caused strain on the fragile land by intensifying its use (Grepperud, 1996).

Free grazing is now forbidden by government and community incentive to allow grazing lands to recover. Animals are fed fodder from harvests and grass rationed by a “cut and carry” system from the meadow as an overgrazing-prevention measure.

*Before, there were many cattle and no problem of grazing. Now ... many people have sold because what can we feed them? **Now we worry to feed our children and our cattle** [emphasis added].*

Now times are good for those in power, and for those who can work the land, not for the old and the cattle.

Our parents were eating this more [Leghowa, which is a local variety of corn], but we cannot get cattle food from it, so people don't use it now.



Photograph 13: Grazing: 1: Netsa, meadow 'free' of livestock 2: Mountain grazing

Hasser (fodder) has increased in importance because it is the primary feed for cattle. This has implications for crop choice and soil fertility practices. Farmers choose crops based on their ability to produce fodder and straw, previously used for mulching and protecting the soil, is used to feed animals.

If someone has good oxen, he will be encouraged to plough the land, not only his, he can rent to others to plough too.

Manure from cattle was used before fertiliser. It is preferable, but we can't have enough.

Cattle are very important, however there is still *not enough* to support them, and many have sold their animals to meet their basic needs reducing the amount of manure that can be used on the soil. Grazing has been forbidden and government needs to give permission for cutting trees and guards protect tree lots, as well as the surrounding mountains. Trees were traditionally used as an energy source for fuel and the shift, as they diminished in numbers and are now protected, led to increased use of manure as a fuel source. This also has implications for soil fertility and soil building, as less manure is applied to the fields.

3.3.7 Leadership and development

We made this place to be known at country and international level.

Government has adopted a conservation-based, agricultural development-led industrialisation (Lanckriet et al., 2014a; Teshome et al., 2014). It is focused on increasing farming productivity and government is implementing intensive soil and water conservation projects in rural areas (Belay et al., 2014; Techome et al., 2014). These efforts are incentivised through the Food-For-Work programme where labour is remunerated for with food or cash (Conway & Schipper, 2011; Lavers, 2013) especially during dry seasons when people cannot farm (Lanckriet et al., 2014a).

I have identified several elements that have contributed to the village's reputation as a shining example for development; these are:

- Community support and a desire for education.
- Confident and skilful leadership.
- A strong sense of community.
- Government and external support through training initiatives and the Food for Work programme.

These elements are explored briefly below.

Education

There was Asmara, what was lacking was education.

Tigrayans feel they have been deprived of good education for historic reasons. The Derg (1974–1991) imprisoned and murdered many educated people; its leader Mengistu Hailemariam was eventually prosecuted, among other members of the party, for genocide at the International Court for Justice, Hague (Mengesha, 2008).

As the Tigray region had risen in armed rebellion against the Derg, it was punitive towards the region in many ways (Vestal, 1985; Kebede & Jacob, 1988). The TPLF eventually overthrew the Derg in 1971 (Segers et al., 2010; Headey et al., 2014). Today people are receptive to learning.

Before people were ignorant, now the minds of children are open. Now children are going to school, this is the difference, so they are better than us.

Many youth prefer urban life and once exposed to it by schooling there, do not want to return to the village where life is often difficult and labour-intensive. There is a fine tension between children being able to leave and possibly improve their lives and the loss of traditional knowledge that accompanies this shift.

For sure, if we [elders] stop ploughing, harvesting, all activities for sure, there will be no food. The young are distracted with other things and not doing this work.



Photograph 14: Watching over animals and children while boys go to school

Leadership, innovation and recognition

Aba Hawie, the appointed village administrator, started guarding a patch of forest in the village when he was 18 and today directs the implementation of new technologies and adjusts designs to make them more appropriate to the local context.

Rural people often have an advanced understanding of their environment and are therefore able to innovate for adaptation in the face of environmental changes (Berkes et al., 2000; Hachoofoe, 2012). Furthermore, traditional knowledge is increasingly recognised for its contribution to ecological knowledge (Mauro & Hardison, 2000) and climate change adaptation strategies (Williams & Hardison, 2013).

Aba Hawie is now a respected member of the community due to his accomplishments (invitations to international conferences, financial success through farming exports) and is incentivised to do even more.

He has been to the following international conferences:

- United Nations Development Programme award ceremony in Brazil where he was awarded an Equator Award in 2012
- Conference of the Parties 11 on climate change in Namibia in 2013
- Climate change conference in Germany.

He is quoted as saying that Abraha We Atsebaha will become the next Amazon forest to international guests (Field scout notes, 2014).



Photograph 15: Aba Hawie: 1: Public motivation 2: Acknowledgement & awards

Besides Aba Hawie, strong church leaders have loosened taboos around working on holy days (Hailu, 2009). A collective of key individuals, who participated in the freedom struggle, have been at the forefront of development initiatives by adapting them to the village context. Aba Hawie retains a prominent role as a community leader.

Government and community

Had we worked this hard before, we would have been kings. Even women come from home and work; there is no one who cannot work at this time.

The Tigray agricultural extension services is reputed to be one of the world's best (UNCTAD 2011; Lamptey, 2012). It is working to mitigate the effects of radical environmental degradation to its predominantly rural population.

I have observed community members expend a large amount of energy committing their labour to the development initiatives. Four projects are worth mentioning.

- Large terraces to create two farming plots for two youth in Kushet Munda.
- An irrigation channel from the main Suluh River to water-deprived central lands.
- Terracing to slow down the trajectory of rainwater and prevent erosion on the Uмба Korai (crippled) Mountain's edge.
- Multiple hand dug wells for farmland irrigation. The water table has risen considerably thanks to conservation work (Woldemicheal, 2010; Lamond, 2012).

There remains more work to be done. The community, however, is cognisant of the benefits of their work and the Food for Work programme further incentivises their efforts.

Now there is not enough time to play; there is only farming.



Photograph 16: After a community terrace build



Photograph 17: Striking water, community hand-dug well

3.3.8 Adaptation strategies and stagnation

Our land is already addicted to fertilizer.

Fertiliser – friend or foe?

One of the technologies government has introduced to increase productivity is synthetic fertiliser (Nyssen et al., 2004), which the farmers of Abraha We Atsebaha are mandated to buy. Government is using integrated soil fertility management to intensify agricultural production. This includes managing fertiliser use, supplying improved seed and combining fertiliser with organic inputs (Vanlauwe et al., 2011).

Research has shown that chemical fertilisers used in combination with organic inputs result in significant improvements in soil fertility (Dong, 2012; Bedada, 2014; Li, 2014) whereas used alone, while making nutrients immediately available to plants (Singh & Ghoshal, 2010), fertiliser does not improve soil fertility (Bedada, 2014).

Synthetic fertilisers, however, are not a sustainable solution. They are produced using non-renewable fossil fuels, making them susceptible to price increases on a volatile international commodity market (Moffitt, 2007). Their use also releases nitrous oxide (Gilbert, 2012), which poses a significant hazard to human and environmental health (Bhardwaj, 2014).

Soil or nutritional access from the soil is not built over time by use of fertilisers, and the massive nutrient flow into an ecosystem has consequences for both eutrophication as well as “dead zones”, gradually reducing soil organic matter and biological activity (Swilling & Annecke, 2012). Their use is therefore counterproductive to soil building, and restoration of an ecological support system for sustainable and highly productive agriculture.

Farmers had the following concerns regarding fertiliser:

- It is a short term measure good for single use to feed plants, whereas manure application can keep soil productive for up to three years.
- It is expensive. Some sell livestock to afford it and the government offers a credit scheme to purchase it.
- It requires water, making it is good for those with irrigation, but not for those practising rain-fed agriculture, particularly in years of drought.

The soil of Abraha We Atsebaha, however is predominantly sandy and poor in nutrient content (Haylu, 2009). Additionally, there is a lack of organic input in the village, as manure and crop residues are increasingly used as fuel and fodder. Therefore, synthetic fertiliser is a necessity to ensure productivity and food security, where soil moisture is good or irrigation is implemented. However, it places farmers at risk as they are dependent on an external input, the price of which is controlled by others (Swilling & Annecke, 2012).

Eucalyptus trees

Eucalyptus trees were introduced to Ethiopia as early as 1895 (Pohjonen & Pukkala, 1990). They are fast-growing trees and can be used to meet the demand for firewood, construction and wood sales (Jagger & Pender, 2003; Belay et al., 2014). However, they are alien and consume a lot of water (Jagger & Pender, 2003) negatively affecting the water table and increasing soil-water runoff (Belay et al., 2014). In addition, they prevent other growth around them, absorb ground water (Jagger & Pender, 2003) and reduce soil fertility and carbon content over time (Belay et al., 2014).

The community is aware of their high water use and alienation of other growth, yet they are valued for their use as fuel, for construction purposes and a source of income through sales.

Other Incentives

The community has mobilised and pooled its financial resources to electrify the village (60% is currently electrified) (Lamptey, 2012). Government trains people in how to construct fuel-efficient *mogogos* (round, large fire-fed stoves) and has introduced electric *mogogos*.



Photograph 18: Cooking: 1: With fire-fed Mogogos 2: Stacking Injera

Furthermore government has introduced fruit trees and cultivation of vegetables into the community, which traditionally has only grown grains and legumes. This has greatly enhanced nutritional diversity (Lamprey, 2012). The village is now able to export fruit and vegetables to nearby towns alleviating poverty and building financial stability increasing the community's resilience to crop failures, drought and famine (Wolde-Georgis, 2010; Lamprey, 2012; Wolde-Georgis et al., 2013).



Photograph 19: Fresh food: 1: Market 2: Fruit

3.4 Conclusion

I have made an effort to delicately relay the story of traditional farming and environment in Abraha We Atsebaha, Tigray, Ethiopia. It is hoped that by using the original, translated word accompanied by photographs embedded within my theoretical framework and dedicated recordings of observations and semi-structured interviews that I have been able to relay an authentic representation of what I have learnt through my immersion in this community.

The village has lived through radical socio-political change and this is held in a collective memory. Changes in governance, periods of social unrest and insecurity accompanied by environmental degradation exacerbated by population growth and poverty have resulted in degraded soils and negatively affected productivity. During this process, essential elements of traditional knowledge were suspended, and are under threat of loss.

Various initiatives have been implemented to regenerate the ecological services of Abraha We Atsebaha. These include the prohibition of tree cutting and restricted access to grazing lands. Wood shortage has resulted in households shifting to using manure to meet their fuel needs and crop residue to feed their cattle. This has resulted in further soil degradation as manure and crop residues were traditionally used to fertilise and protect the land through mulching. Electricity and fuel efficient mogogos are progressively introduced to manage fuel needs, yet the source of this energy needs to be critically assessed in terms of ecological sustainability and peace keeping.

Government introduction of synthetic fertilisers, which farmers are mandated to use, has long-term implications. Firstly, that unless these are used in combination with organic materials (which are in short supply in the village as they used for fuel and feed), they do not contribute to building up the soil. Secondly, that they lock financially insecure farmers into using an external input that requires irrigation and that is traded on a volatile international commodity market. Additionally, while eucalyptus trees provide for the short-term needs for fuel and construction, they are water-intensive trees in an arid region.

Belief systems have prevented complete ecological destruction. Removal of vegetation around church buildings is prohibited and these spaces have thus served as genetic storehouses for species that may have otherwise been lost. A traditional respect for the old sycamore fig trees of the region has allowed some of them to survive.

Climate variation manifested in the decline of a seasonal rainfall period has had major implications for food security, where the efforts of the village alone are minimised in the global context of climate change causalities.

I am hopeful this lived experience of a village, struggling for survival, after having weathered many shocks, can be met with compassion and care and will inspire international cooperation in efforts to mitigate climate change, particularly for those who are more vulnerable to its predicted consequences.

Conclusion

4.1 Meeting the research objective

The primary research objective of this master's project was to explore the complexities associated with traditional farming systems in Tigray, northern Ethiopia. An expected outcome was that this exploration would yield knowledge that could contribute to building resilient farming systems in the face of climatic change. The study was devised as two journal articles, the first exploring the determinants of traditional farming systems in the region and the second presenting a grounded description from my lived experience in Abraha We Atsebaha, a village in eastern Tigray, Ethiopia.

A detailed outline of the complex, historical factors that have moulded Ethiopia's traditional farming system was outlined in the first article, based on a comprehensive literature review that spanned historical, political and environmental arenas. It also focused on modern development areas in the region and in the village in particular. The research objectives for this first part of the study were to explore the reasons for the massive and counterintuitive deforestation that has taken place, which has resulted in soil degradation and erosion. Divided into three focus areas – people and environment, people and climate, and land politics, the study considered the role of three governance regimes that have had significant effect on the country's smallholders and their ability to maintain productivity levels on degrading soils. It also examined the effects of climate change in a region that is already characterised by climatic variation and that is experiencing an increase in the severity and frequency of drought and floods – all with negative implications for subsistence and smallholder farmers practising rain-fed agriculture.

In summary, a series of unstable political regimes, combined with rapid population growth and historic insecurity around land and personal safety have significantly contributed to environmental degradation of the area.

The second article describes the delicate narrative grassroots inquiry undertaken in the village of Abraha We Atsebaha, Tigray. It provides a grounded description of my lived experience in the village over an intermittent period of three months.

Using indigenous knowledge literature to guide the process of interviewing, observing and reflecting, the aspects of Toledo's kosmos-corpus-praxis triad were explored in relation to agricultural practices. This slow unfolding process allowed eight themes to emerge: the importance of history and memory, the story of trees, the value of belief systems for conservation, systems for managing and identifying land, the shift from abundance to necessity, the importance of rain, leadership and development initiatives underway.

Several broad outcomes that emerged from reviewing the literature, actively observing in the village and from field notes and interviews are outlined below; all of which indicate the complex interdependency of traditional farming systems related to their social, political and environmental context.

4.2 Emergent research outcomes

4.2.1 Findings on the importance of governance

Northern Ethiopia's history has been characterised by conflict, both internal and external, for the past four centuries. The effect on subsistence farmers and smallholders has been extreme as they lived at the whims of the landlord during the feudal era (pre-1974), were neglected and further dispossessed of land under the Derg regime (1947–1991) and are battling to survive the current state of environmental degradation – soil, water and tree loss. The extension services of Tigray have been exemplary through the regions political party, and by their commitment and community work, degradation is beginning to ebb and be countered.

4.2.2 Findings on the importance of security

Insecurity of tenure is linked to environmental degradation as long-term benefits do not necessarily accrue to those who work the land, which discentivises them from investing resources (time, energy, money) into the soil, which is the bedrock of sustainable farming. In addition, inappropriate policies under the Derg (1974–1991) neglected the needs of smallholders and subsistence farmers furthering the marginalisation of most rural food producers in places such as Abraha We Atsebaha.

Villagers also hold in their collective memory and resisted the forced relocations under the Derg and the suggested relocations by the current government, indicating the importance of security of place.

4.2.3 Findings on current government initiatives

The current government adopted a conservation-based, agricultural development-led industrialisation plan in 1991, which focuses to a large degree on soil and water conservation initiatives. These initiatives have been successful and evidence of vegetation regeneration can be documented. However, progressively excluding land from agricultural use, to allow it to regenerate, has reduced agricultural productivity in the region.

The Food for Work programme provides food aid to those who contribute their labour each year to conservation initiatives. The success of conservation and rehabilitation efforts has come to rely heavily on these food subsidies. The continual support by the Food for Work programme is not a sustainable solution, yet it is a necessary short-term initiative until the ecological support systems can recover.

Government has introduced synthetic fertilisers, which farmers are often mandated to use, and improved seed, to assist with productivity and coping with changing rainfall patterns. Both of these are external inputs however, and put farmers at risk as they are priced according to an international commodity market. Fertilizer requires secure water input causing farmers to increasingly rely on irrigation – in a country where most farmers practice rain-fed agriculture. Finally, they do not contribute to building the soil, which is the basis of sustainable farming. Additionally, introduced eucalyptus trees, while serving as a source of wood for fuel and construction, consume a lot of ground water in an arid environment.

4.2.4 Findings on cultivation practices

Farming methods, traditional and otherwise, have cumulatively depleted the region's resources, especially by erosive ploughing methods and exposed soils. As population pressures increased and farmlands decreased in size to accommodate the need, poorer farmers were forced to use marginal and sloped land. Using these types of "thin" and "fragile" soils resulted in extensive soil loss and, thus, erosion.

In addition, farmers needed to intensify production on smaller pieces of land making more concentrated use of the same resources. Traditional practices, which maintained soil fertility, were discarded. Examples include leaving land fallow for a season every three years and applying harvest residue and manure to soils. Furthermore, cultivating and grazing animals on the same piece of land was adopted as land resources became scarce. As the forests depleted through an intensified demand for farmland and firewood, construction materials and as a commodity to sell for cash, farmers turned to using manure and crop residues for fuel.

These were previously used for compost and mulch, helping to keep the soils fertile and moist. As natural resources declined, the ability of nature to support human and animal populations likewise reduced causing farmers to seek alternate measures to survive. This has included crop choices oriented to providing fodder for livestock as meadows and forest grazing lands were degraded.

4.2.5 Findings on climate change effects

By speaking to farmers in Abraha We Atsebaha, I learnt that rainfall patterns have changed and seasonal small rains have become haphazard and unreliable. While the region has a long history of sporadic drought and flooding, these have increased with time. Research by Williams and Funk (2011) indicates that the temperature increase over the Indian Ocean may be linked to reduced precipitation in East Africa, affecting these small rains in particular. As the climate changes, affecting the region's small rains, traditional farmers will need to increase conservation and regeneration efforts to maintain their livelihoods on the soil, while faced with periodic food insecurity. Furthermore, careful management of the country's water resources for irrigation is an adaptation method suitable for Ethiopia.

4.2.6 Findings on the importance of belief systems

By using Toledo's *kosmos-corporis-praxis* triad to explore various facets of agricultural life in the village, in-depth interviews, personal observations and field notes were used. Through this the central role that belief systems play in conservation in the region emerged. Two distinct systems were identified. Churches have been central to conservation efforts in that the vegetation and trees around them are not disturbed as it is believed that angels and saints take refuge in these places and those who disturb them will be punished.

Beyond this, there is an apparent appreciation of the grace and beauty of the natural surrounds. In effect, the area around churches has become a biological storehouse for species that might otherwise have been lost.

An older, and not often spoken about, belief system revolves around the large sycamore trees once commonly found in the region. These trees (*da'aros*) are named indicating their significance to the community – they are sometimes named after function (small home, sweet fruit, shit fruit [eyva] etc.), as landmarks or sometimes more poetically as the places where birds gather and sing, for example.

There is also recognition of their functionality in creating shelter, giving fruit and providing leaves for livestock. There is a relatively high number of *da'aros* in Abraha We Atsebaha despite the conflict and hunger the community has faced over the decades.

While both papers are intended to stand alone and can be read and used independently, they contribute to creating an internal dialogue between the large, overarching issues and the lived realities on the ground. Their juxtaposition in this study attempts to provide a sense of the complexities and potential conflict points faced by both government and farmers when attempting conservation work.

4.3 The contribution of the study and its limitations

It is increasingly clear from this study that traditional farming systems cannot be understood in isolation from their context within a broader socio-political-environmental landscape. I have attempted to provide a historical background juxtaposed with an up-close personalised account of the present. Yet, for a system to be understood, all of the factors affecting it at the present moment, in combination with those from the past, need to be considered (Cilliers, 1992) and this study does not encompass every contributing factor. Examples of factors not explored include the effect of land grabbing on food security in Ethiopia. In addition, while the importance of belief systems is highlighted as an aspect crucial to conservation, literature on the power of the church over rural lifestyles (as explained in the work of Redda (1983) or its role in conservation, for example, was not consulted. Finally, extremely little information was found on traditional irrigated agriculture, while irrigation was observed as a modern investment propelled by government initiative. Therefore a study aimed at understanding irrigation specifically may add value.

However, this study has demonstrated the importance of stability (political, economic and ecological) for successful and sustainable traditional farming systems. It has also highlighted the significance of security of tenure to this aim. Finally, it has birthed a unique, “soft” experiential narration of a village in northern Ethiopia that allows insight into farmer experiences, their pressures and their adaptation methods.

4.4 Recommendations for further research

Recommendations for future research include:

- Exploring the potential role that religion has/is/could play(ed/ing) in conservation and development initiatives in rural areas in Ethiopia.
- Analysing current government policies and the implications for sustained farming and food security in northern Ethiopia.
- Explorations on traditional irrigation systems and modern implementations; a possible comparison and considerations for maintaining a secure water table

References

- Aberra, Y. 2004. Problems of the solution: intervention into small-scale irrigation for drought proofing in the Mekele Plateau of northern Ethiopia. *Geographic Journal*, 170(3): 226-237.
- Araya, T., Cornelis, W.M., Nyssen, J., Govaerts, B., Begreegiabher, T. Oicha, T., Raes, D., Sayre, K.D., Haile, M. & Deckers, J. 2011. Effects of Conservation Agriculture on Runoff, Soil Loss and Crop Yield Under Rainfed Conditions in Tigray, Northern Ethiopia. *Soil Use and Management*, 27(3). 16 September 2014.
- Arndt, C., Robinson, S. & Willenbockel, D. 2011. Ethiopia's Growth Prospects in a Changing Climate: A Stochastic General Equilibrium Approach. *Global Environmental Change*, 21(2).
- Asfaw, K. 1990. Ethiopia's Unfulfilled Revolution. *Africa Today*, 37(1).
- Ashagrie, Y., Zech, W., Guggenberger, G. & Mamo, T. 2007. Soil Aggregation, and Total and Particulate Organic Matter Following Conversion of Native Forests to Continuous Cultivation in Ethiopia. *Soil and Tillage Research*, 94(1).
- Asrat, A. 2002. The rock-hewn churches of Tigray, Northern Ethiopia: A geological perspective. *Geoarchaeology*, 17(7), 649-663.
- Bard, K. A., Coltorti, M., DiBlasi, M.C., Dramis, F. & Fattovich, R. 2000. The Environmental History of Tigray (Northern Ethiopia) in the Middle and Late Holocene: A Preliminary Outline. *African Archaeological Review*, 17(2).
- Becker, H. S., 2002. Visual evidence: A Seventh Man, the specified generalization, and the work of the reader. *Visual Studies*, 17(1), 3-11.
- Bhardwaj D, Ansari M, Sahoo R, Tuteja N. 2014. Biofertilizers function as key player in sustainable agriculture by improving soil fertility, plant tolerance and crop productivity. *Microbial Cell Factories*, 13(1):1–22.
- Barrera-Bassols, N., Zinck, J.A. & Van Ranst, E. 2006. Symbolism, Knowledge and Management of Soil and Land Resources in Indigenous Communities: Ethnopedology at Global, Regional and Local Scales. (Report). *Catena*, 65(2).
- Bedada W, Karlun E, Lemenih M, Tolera M. 2014. Long-term addition of compost and NP fertilizer increases crop yield and improves soil quality in experiments on smallholder farms. *Agriculture, Ecosystems & Environment*, 195:193–201.
- Berkes, F., Colding, J. and Folke, C., 2000. Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications*, 10(5):1251–1262.

- Belay, K.T., Van Rompaey, A., Poesen, J., Van Bruyssel, S., Deckers, J. & Amare, K. 2014. Spatial Analysis of Land Cover Changes in Eastern Tigray (ETHIOPIA) from 1965 to 2007: Are there Signs of a Forest Transition? *Land Degradation and Development*.
- Belay, M. & Bewket, W. 2013. Farmers' Livelihood Assets and Adoption of Sustainable Land Management Practices in North-Western Highlands of Ethiopia. *International Journal of Environmental Studies*, 70(2).
- Belete, A., Dillon, J.L. & Anderson, F.M. 1991. Development of Agriculture in Ethiopia since the 1975 Land Reform. *Agricultural Economics*, 6(2).
- Benin, S. & Pender, J. 2001. Impacts of Land Redistribution on Land Management and Productivity in the Ethiopian Highlands. *Land Degradation & Development*, 12(6).
- Berkes, F., Colding, J. & Folke, C. 2000. Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications*, 10(5).
- Betemariam, E.A. 2011. Forest Diversity in Fragmented Landscapes of Northern Ethiopia and Implications for Conservation. *Ecology and Development Series*, (76).
- Beyene, A., Gibbon, D. & Haile, M. 2006. Heterogeneity in Land Resources and Diversity in Farming Practices in Tigray, Ethiopia. *Agricultural Systems*, 88(1):61–74.
- Bezabih, M., Kohlin, G. & Mannberg, A. 2011. Trust, Tenure Insecurity, and Land Certification in Rural Ethiopia. (Report). *The Journal of Socio-Economics*, 40(6).
- Brighter Green. 2011. *Climate, Food Security, & Growth Ethiopia's Complex Relationship with Livestock*. [Online] Available: (http://www.brightergreen.org/files/ethiopia_bg_pp_2011.pdf / <http://www.brightergreen.org/>. [11/5/2013])
- Bryant, A. & Charmaz, K. 2007. Chapter on Grounded theory and reflexivity in *The SAGE handbook of Grounded Theory*. SAGE Publications Ltd.
- César, E. and Ekbom, A., 2013. Ethiopia Environmental and Climate Change policy brief. 05-27. [Online]. Available: <http://sidaenvironmenthelpdesk.se/>. [10/19/2014].
- Chanyalew, D., Adenew, B. & Mellor, J. 2010. *Ethiopia's Agricultural Sector Policy and Investment Framework (PIF) 2010-2020*. Addis Ababa: Federal Democratic Republic of Ethiopia Ministry of Agriculture And Rural Development.
- Chinigò, D. 2014. The Politics of Land Registration in Ethiopia: Territorialising State Power in the Rural Milieu. *Review of African Political Economy*. [Online] Available: <http://dx.doi.org/10.1080/03056244.2014.92861>[16/9/2014].

- Ciampalini, R., Billi, P., Ferrari, G., Borselli, L. & Follain, S. 2012. Soil Erosion Induced by Land use Changes as Determined by Plough Marks and Field Evidence in the Aksum Area (Ethiopia). *Agriculture, Ecosystems and Environment*, 146(1).
- Cilliers, P. 1998. Complexity & Postmodernism, Understanding complex systems. Routledge: New York. (Chapter 7: Complexity and Postmodernism)
- Clandinin, D., Jean. 2007. Part I Situating narrative inquiry, in Clandinin, D., Jean(ed.). *Handbook of narrative inquiry: Mapping a methodology*. SAGE Publications, Inc.
- Cohen, J.M. & Isaksson, N. 1988. Food Production Strategy Debates in Revolutionary Ethiopia. *World Development*, 16(3).
- Corbeels, M., Shiferaw, A. & Haile, M. 2000. Farmers' Knowledge of Soil Fertility and Local Management Strategies in Tigray, Ethiopia. Paper presented at Managing Africa's Soils. February, 2000, Edinburgh, IIED-Drylands Programme, 10.
- Conway, D. 2000. Some Aspects of Climate Variability in the North East Ethiopian Highlands – Wollo and Tigray. *Sinet, Ethiopian Journal of Science*, 23(2).
- Conway, D. & Schipper, E.L.F. 2011. Adaptation to Climate Change in Africa: Challenges and Opportunities Identified from Ethiopia. *Global Environmental Change*, 21(1).
- CRGE. 2011. *Ethiopia's Climate-Resilient Green Economy Strategy*. [Online]. Available: http://www.uncsd2012.org/content/documents/287CRGE%20Ethiopia%20Green%20Economy_Brochure.pdf. [10/1/2014].
- Crutzen, P. J. 2006. Anthropocene man, in Ehlers, E. and Krafft, T. (eds.). *Earth system science in the anthropocene*. Vol. 467. Berlin Heidelberg: Springer.
- Crutzen, P. & Steffen, W., 2003. How Long Have We Been in the Anthropocene Era? *Climatic Change*, 61(3), pp. 251–257.
- Cutler, P. 1991. The Political Economy of Famine in Ethiopia and Sudan. *Ambio*, 20(5).
- Davis, A. & Wagner, J. 2003. Who Knows? On the Importance of Identifying “Experts” when Researching Local Ecological Knowledge. *Human Ecology*, 31(3).
- Deininger, K. & Jin, S. 2006. Tenure Security and Land-Related Investment: Evidence from Ethiopia. *European Economic Review*, 50(5).

Deininger, K., Ali, D.A. & Alemu, T. 2013. Productivity Effects of Land Rental Market Operation in Ethiopia: Evidence from a Matched Tenant-Landlord Sample. *Applied Economics*, 45(25).

Diao, X. & Pratt, A.N. 2007. Growth Options and Poverty Reduction in Ethiopia – an Economy-Wide Model Analysis. *Food Policy*, 32(2).

Dong, W., Zhang, X., Wang, H., Dai, X., Sun, X., Qiu, W., & Yang, F. 2012. Effect of different fertilizer application on the soil fertility of paddy soils in red soil region of southern China. *Plos one*, 7(9), e44504.

Ebro, A., Shenkute, B., Haile, G., Sauerborn, J. and Treydte, A.C. 2011. Land use / Land Cover Dynamics in the Rift Valley of Ethiopia: Implications on Food Security. Paper presented at Food Security Center, Universität Hohenheim. Paper presented at Food Security Center, Universität Hohenheim, 2011.

Freedom House (2014) Ethiopia. [Online] Available: <http://freedomhouse.org/country/ethiopia?gclid=CPXrsMSntMECFYzHtAodnl0A2A#.VEFfIPmUcTC> [10/15/2014].

Fortin, J. "Ethiopia: 9 Media Workers Arrested." New York Times 29 Apr. 2014: A5(L). Academic OneFile. Web. Accessed 14 Oct. 2014.

GAIA. 2014. *Aims & scope*. [Online]. Available: <http://www.oekom.de/zeitschriften/gaia/aims-scope.html> [10/5/2014].

Gebreegiabher, Z. 1999. DESSA'A PROTECTED AREA: An Assessment of Human Impact, Evolutionary Pattern and Options for Sustainable Management. Paper presented at Tigray Region Bureau of Agriculture and Natural Resources. Mekelle University, November, 1999.

Gebrehiwot, T. & Van der Veen, A. 2013. Climate Change Vulnerability in Ethiopia: Disaggregation of Tigray Region. *Journal of Eastern African Studies*, 7(4).

Gebrehiwot, T. & Veen, A. 2013. Farm Level Adaptation to Climate Change: The Case of Farmer's in the Ethiopian Highlands. *Environmental management*, 52(1).

Gelaw, A.M., Singh, B.R. & Lal, R. 2014. Soil Organic Carbon and Total Nitrogen Stocks Under Different Land Uses in a Semi-Arid Watershed in Tigray, Northern Ethiopia. *Agriculture, Ecosystems and Environment*, 188.

Gerique, A. 2006. *An introduction to ethnoecology and ethnobotany theory and methods, Integrative assessment and planning methods for sustainable agroforestry in humid and semiarid regions*. Unpublished thesis. Department of Geography, University of Giessen, Senckenbergstr.

Gessesse Dessie & Kleman, J. 2007. Pattern and Magnitude of Deforestation in the South Central Rift Valley Region of Ethiopia. *Mountain Research and Development*, 27(2).

Grepperud, S. 1996. Population Pressure and Land Degradation: The Case of Ethiopia. *Journal of Environmental Economics and Management*, 30(1).

Gilbert N. 2012. African agriculture: Dirt poor. *Nature*.483(7391):525–527.

Hachoofoewe, E.M. 2012. *Local ecological knowledge of trees on farms, constraints and opportunities for further integration in tigray region, northern ethiopia: A case study of smallholder farmers in abreha wa atsbeha and adi gudom*. Unpublished thesis. BSc Agroforestry (The Copperbelt University, 2008).

Hadgu, K., Meles and Michael, D., G. 2013. Indigenous Knowledge Practices for Climate Change Adaptation and Impact Mitigation: The Case of Smallholder Farmers in Tigray, Northern Ethiopia. ATPS Working Paper, No. 70.

Haile, M., Herweg, K. and Stillhardt, B. 2006. Sustainable Land Management – A New Approach to Soil and Water Conservation in Ethiopia. Mekelle, Ethiopia: Land Resources Management and Environmental Protection Department, Mekelle University; Bern, Switzerland: Centre for Development and Environment (CDE), University of Bern, and Swiss National Centre of Competence in Research (NCCR) North-South.

Hailu, B. 2009. *The impact of agricultural policies on smallholder innovation capacities: The case of household level irrigation development in two communities of kilte awlaelo woreda, tigray regional state, Ethiopia*. Unpublished thesis. Wageningen University:Department of Social Sciences.

Hammer, E. & Anslow, M. 2008. *10 Reasons Why Organic Can Feed The World*.

Headey, D., Dereje, M. & Taffesse, A.S. 2014. Land Constraints and Agricultural Intensification in Ethiopia: A Village-Level Analysis of High-Potential Areas. *Food Policy*, 48.

IPCC. 2014. *Intergovernmental panel on climate change fifth assessment report*. [Online]. Available: <http://www.ipcc.ch/report/ar5/index.shtml> [10/7/2014].

Jagger, P. & Pender, J. 2003. The Role of Trees for Sustainable Management of Less-Favored Lands: The Case of Eucalyptus in Ethiopia. *Forest Policy and Economics*, 5(1).

Jagger, P., Pender, J. & Gebremedhin, B. 2005. Trading Off Environmental Sustainability for Empowerment and Income: Woodlot Devolution in Northern Ethiopia. *World Development*, 33(9).

JPS. 2014. *Journal of peasant studies: ISS.nl*. [Online]. Available: http://www.iss.nl/publications/journal_of_peasant_studies/ [10/6/2014]

Kebede, G. 1988. Cycles of Famine in a Country of Plenty: The Case of Ethiopia. *GeoJournal*, 17(1).

- Kebede, G. & Jacob, M.J. 1988. Drought, Famine and the Political Economy of Environmental Degradation in Ethiopia. *Geography*, 73(1).
- Keller, E.J. 1992. Drought, War, and the Politics of Famine in Ethiopia and Eritrea. *The Journal of Modern African Studies*, 30(4).
- Kiros, F.G. 1991. Economic Consequences of Drought, Crop Failure and Famine in Ethiopia, 1973–1986. *Ambio*, 20(5).
- Kloos, H. & Lindtjørn, B. 1994. Malnutrition during Recent Famines in Ethiopia. *Northeast African Studies*, 1(1).
- Koehn, P. 1979. Ethiopia: Famine, Food Production, and Changes in the Legal Order. *African Studies Review*, 22(1).
- Lamond, G. 2012. Local knowledge training using the AKT5 software and methodology at Mekelle University, funded by the AfricaRISING project: *A report on a two week research study in the village of abreha we atsbeha in Tigray region, northern Ethiopia*. Unpublished thesis. ICRAF, Bangor University.
- Lampitey, E.A. 2012. Abreha Weatsbha Community Ethiopia: Equator Initiative Case Studies: *Local Sustainable Development Solutions for People, Nature, and Resilient Communities*. [Online] Available: http://www.equatorinitiative.org/index.php?option=com_winners&view=winner_detail&id=13&Itemid=683&lang=en [10/4/2014].
- Lanckriet, S., Derudder, B., Naudts, J., Bauer, H., Deckers, J., Haile, M. & Nyssen, J. 2014a. A Political Ecology Perspective of Land Degradation in the North Ethiopian Highlands. *Land Degradation and Development*. DOI: 10.1002/ldr.2278 [9.16.2014].
- Lanckriet, S., Frankl, A., Adgo, E., Termonia, P. & Nyssen, J. 2014b. Droughts Related to Quasi-Global Oscillations: A Diagnostic Teleconnection Analysis in North Ethiopia. *International Journal of Climatology*. DOI: 10.1002/joc.4074. [9/14/2014].
- Lavers, T. 2013. Food Security and Social Protection in Highland Ethiopia: Linking the Productive Safety Net to the Land Question. *Journal of Modern African Studies*, 51(3).
- Lemenih, M., Karlun, E. & Olsson, M. 2005a. Assessing Soil Chemical and Physical Property Responses to Deforestation and Subsequent Cultivation in Smallholders Farming System in Ethiopia. *Agriculture, Ecosystems & Environment*, 105(1–2).
- Lemenih, M., Karlun, E. & Olsson, M. 2005b. Soil Organic Matter Dynamics After Deforestation Along a Farm Field Chronosequence in Southern Highlands of Ethiopia. *Agriculture, Ecosystems & Environment*, 109(1–2).

Lemenih, M., Kassa, H., Kassie, G.T., Abebaw, D. & Teka, W. 2014. Resettlement and Woodland Management Problems and Options: A Case Study from North-Western Ethiopia. *Land Degradation and Development*, 25(4). pp 305-318. 2014.

Lemma, H. 1985. The Politics of Famine in Ethiopia. *Review of African Political Economy*, 12(33).

Li, C., Li, Y & Tang, L. (2013) The effects of long-term fertilization on the accumulation of organic carbon in the deep soil profile of an oasis farmland. *Plant & Soil*, 369(1/2):645–656.

Maathai, Wangari. 2014. Wangari Maathai – Nobel lecture. [Online]. Available: http://www.nobelprize.org/nobel_prizes/peace/laureates/2004/maathai-lecture-text.html [Accessed - 10/10/2014].

Mauro, F. & Hardison, P.D. 2000. Traditional Knowledge of Indigenous and Local Communities: International Debate and Policy Initiatives. *Ecological Applications*, 10(5).

Mengesha, M., W., 2008. *Delay of Justice in Ethiopia and the Genocide trial of Derg Officials*, (thesis) Central European University.

Mengistu, D.K. 2011. Farmers' Perception and Knowledge on Climate Change and their Coping Strategies to the Related Hazards: Case Study from Adiha, Central Tigray, Ethiopia. *Agricultural Sciences*, 2(2).

Mideksa, T.K. 2010. Economic and Distributional Impacts of Climate Change: The Case of Ethiopia. *Global Environmental Change*, 20(2).

Miller, D., C. & Salkind, N., J. 2002. Grounded theory research, in *Handbook of research design & social measurement, sixth edition*. SAGE Publications, Inc.

Mitchell, C., 2008. Getting the picture and changing the picture: visual methodologies and educational research in South Africa. *South African journal of education*, 28(3), 365-383.

Moffet, J. 2007. Sowing the Weeds of Success – Harvesting Underutilised Crops: *The response of a commercial farm to changing terms of trade, to Peak Oil and to Climate Change*. Paper presented at the 5th International Symposium New Crops and Uses: their role in a rapidly changing world. University of Southampton: 3 & 4 September 2007

Müller, T.R. 2013. 'The Ethiopian Famine' Revisited: Band Aid and the Antipolitics of Celebrity Humanitarian Action. *Disasters*, 37(1).

Muluneh, A. 2010. *Synthesis of research on land use and land cover dynamics in the ethiopian highlands*. Unpublished thesis. Reykjavik, Iceland: Hawassa University.

Munro, R.N., Deckers, J., Haile, M., Grove, A.T., Poesen, J. & Nyssen, J. 2008. Soil Landscapes, Land Cover Change and Erosion Features of the Central Plateau Region of Tigray, Ethiopia: Photo-Monitoring with an Interval of 30 years. *Catena*, 75(1).

Mwendera, E.J., Mohamed Saleem, M.A. & Dibabe, A. 1997. The Effect of Livestock Grazing on Surface Runoff and Soil Erosion from Sloping Pasture Lands in the Ethiopian Highlands. *Australian Journal of Experimental Agriculture*, 37.

Negusse, T., Yazew, E. & Tadesse, N. 2013. Quantification of the Impact of Integrated Soil and Water Conservation Measures on Groundwater Availability in Mendae Catchment, Abraha we-Atsebaha, Eastern Tigray, Ethiopia. *Momona Ethiopian Journal of Science (MEJS)*, 5(2).

Nyssen, J., Moeyersons, J., Poesen, J., Deckers, J. & Mitiku Haile. 2003. The Environmental Significance of the Remobilisation of Ancient Mass Movements in the Atbara–Tekeze Headwaters, Northern Ethiopia. *Geomorphology*, 49(3–4).

Nyssen, J., Poesen, J., Moeyersons, J., Deckers, J., Haile, M. & Lang, A. 2004. Human Impact on the Environment in the Ethiopian and Eritrean Highlands—a State of the Art. *Earth-Science Reviews*, 64(3–4).

Nyssen, J., Descheemaeker, K., Haregeweyn, N., Haile, M., Deckers, J. and Poesen, J. 2007. *Lessons Learnt from 10 Years Research on Soil Erosion and Soil and Water Conservation in Tigray*. Paper presented at Tigray Livelihood Papers, Mekelle: Zala-Daget Project, Mekelle University, K.U.Leuven, Relief Society of Tigray, Africamuseum and Tigrayn Bureau of Agriculture and Rural Development.

Nyssen, J., Frankl, A., Haile, M., Hurni, H., Descheemaeker, K., Crummey, D., Ritler, A., Portner, B., Nievergelt, B., Moeyersons, J., Munro, N., Deckers, J., Billi, P. & Posen, J. 2014. Environmental conditions and human drivers for change to north Ethiopian mountain landscapes over 145 years. *Science of the Total Environment*, 485–486(1).

Omiti, J.M., Parton, K.A., Sinden, J.A. & Ehui, S.K. 1999. Monitoring Changes in Land-use Practices Following Agrarian De-Collectivisation in Ethiopia. *Agriculture, Ecosystems & Environment*, 72(2).

Oxford. 2014. Oxford dictionaries. [Online]. Available: <http://www.oxforddictionaries.com/> [Accessed: 10/7/2014]

- Pink, S. 2007. Doing Visual Ethnography: 1 the Visual in Ethnography: Photography, Video, Cultures and Individuals. SAGE Research Methods, pp21–40.
- Pohjonen, V. & Pukkala, T., 1990. Eucalyptus globulus in Ethiopian forestry. *Forest Ecology and Management*, 36(1), Pgs. 19–31.
- Popova, U. 2013. Conservation, Traditional Knowledge, and Indigenous Peoples. *American Behavioral Scientist* 2014, 58(1).
- Rains, F., Archibald, J. and Deyhlele, D., 2000. Introduction: Through our eyes and in our own words. *International Journal of Qualitative Studies in Education*, 13(4):337–342.
- Rahmato, D., 2014. The perils of development from above: land deals in Ethiopia. *African Identities*, 12(1):26–44.
- Redda, A. 1983. The Famine in Northern Ethiopia. *Review of African Political Economy*, (27/28).
- Rosaline, B. 2008. Chapter 1: *The scope and contribution of qualitative research, Introducing qualitative research*. London, England: SAGE Publications, Ltd.
- Schwartz, D., 1989. Visual ethnography: Using photography in qualitative research. *Qualitative sociology*, 12(2), 119-154.
- Segers, K., Desseinb, J., Hagbergd, S., Teklebirhane, Y., Hailef, M. & Deckersa, J. 2010. Unravelling the Dynamics of Access to Farmland in Tigray, Ethiopia: The 'emerging Land Market' Revisited. *Land Use Policy*, 1019(27).
- Shiferaw, T., Lamond, G., Gebrekirstos, A., Meles, K., Aynekulu, E., Hachooofwe, E. M., & Sinclair, F. 2013. Recognizing local agro-ecological knowledge in sustainable intensification of tree-crop-livestock farming systems. World Agroforestry Centre, Nairobi, Kenya
- Singh, P. and Ghoshal, N., 2010. Variation in total biological productivity and soil microbial biomass in rainfed agroecosystems: Impact of application of herbicide and soil amendments. *Agriculture, Ecosystems & Environment*, 137(3–4), 241–250.
- Smith, L.T. 2005. Building a Research Agenda for Indigenous Epistemologies and Education. *Anthropology & Education Quarterly*, 36(1).
- Smith, L.T. 2012. *Decolonizing methodologies: Research and indigenous peoples*. London and New York: Zed Books.

Steffen, W., Crutzen, P.J. & McNeill, J.R. 2007. The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature? *Ambio*, 36(8).

Stepp, J.R. 2005. Advances in ethnobiological field methods, *Field methods*. Sage Publications. [Online]. Available: <http://fm.sagepub.com/content/17/3/211.short> [10/4/2014].

Stern, P. N. 2007. On solid ground: Essential properties for growing grounded theory, in Bryant, A. and Charmaz, K. (eds.). *The SAGE handbook of grounded theory*. SAGE Publications Ltd.

Strecker, I. & LaTosky, S. 2013. Introduction, in Strecker, I. and LaTosky, S. (eds.). *Writing in the field; festschrift for Stephen Tyler*. Deutsche Nationalbibliothek.

Strecker, I. & Verne, M. 2013. Introduction, in Strecker, I. and Verne, M. (eds.). *Astonishment and evocation; the spell of culture in art and anthropology*. New York–Oxford: Berghahn Books.

Swilling, M. & Anneck, E., 2012. Chapter Six. Soils, Land and Food Security. In: *Just Transitions: Explorations of Sustainability in an Unfair World*. First edition. Tokyo, New York, Paris: United Nations University Press, Pgs 137–176.

Tareke, G., 2008. The Red Terror in Ethiopia: A Historical Aberration. *Journal of Developing Societies*, 24(2):183–206.

Taye, G. Poesen, J. Wesemael, B.V. Vanmaercke, M. Teka, D. Deckers, J. Goosse, T. Maetens, W. Nyssen, J. Hallet, V. et al. 2013. Effects of Land use, Slope Gradient, and Soil and Water Conservation Structures on Runoff and Soil Loss in Semi-Arid Northern Ethiopia. *Physical Geography*, 34(3).

Tedlock, B. 2013. Ethnographic evocations and evocative ethnographers, in Strecker, I. and Verne, M. (eds.). *Astonishment and evocation; the spell of culture in art and anthropology*. New York–Oxford: Berghahn Books.

Teka, K., Rompaey, A., Poesen, J., Welday, Y. & Deckers, J. 2012. Impact of Climate Change on Small-Holder Farming: A Case of Eastern Tigray, Northern Ethiopia. *African Crop Science Journal*, 20.

Teka, K., Van Rompaey, A. & Poesen, J. 2013. Assessing the Role of Policies on Land use Change and Agricultural Development since 1960s in Northern Ethiopia. *Land Use Policy*, 30(1).

Teshome, A., de Graaff, J., Ritsema, C. & Kassie, M. 2014. Farmers' Perceptions about the Influence of Land Quality, Land Fragmentation and Tenure Systems on Sustainable Land Management in the North Western Ethiopian Highlands. *Land Degradation and Development*. DOI: 10.1002/ldr.2298 [16/9/2014].

TRECC Africa. 2014. *About us*. [Online]. Available: <http://www.treccafrica.com/pages/about-us.html> [10/3/2014]

Toledo, V.M. 2002. Ethnoecology: A conceptual framework for the study of indigenous knowledge of nature, in Stepp, J.R., Wyndham, F.S. and Zarger, R.K. (eds.). *Ethnobiology and biocultural diversity* Vol. 2014. Georgia, USA: International Society of Ethnobiology.

Tolera, M., Asfaw, Z., Leminih, M. & Karlun, E. 2008. Woody species diversity in a changing landscape in the south-central highlands of Ethiopia. *Agriculture, Ecosystems & Environment*, 128(1–2):52-58.

UNCTAD. 2011. *Sustainable Agriculture and Food Security in LDCs*. [Online]. Available: http://unctad.org/en/Docs/presspb20116_en.pdf. [9/16/2014].

Vanlauwe, B., Kihara, J., Chivenge, P., Pypers, P., Coe, R. & Six, J., 2011. Agronomic use efficiency of N fertilizer in maize-based systems in sub-Saharan Africa within the context of integrated soil fertility management. *Plant and Soil*, 339(1), pp. 35-50.

Vestal, T.M. 1985. Famine in Ethiopia: Crisis of Many Dimensions. *Africa Today*, 32(4).

Von Braun, J. 2000. The World Food Situation: New Driving Forces and Required Actions. IFPRI. 1-16

Vreugdenhil, D. Vreugdenhil, A. D., Tamirat Tilahun, Anteneh Shimelis, Zelealem Tefera, 2012. *Gap Analysis of the Protected Areas System of Ethiopia*, with technical contributions from Nagelkerke, L., Gedeon, K. Spawls, S., Yalden, D., Lakew Berhanu, and Siege, L. USA: World Institute for Conservation and Environment.

Wassie, A. & Teketay, D., 2006. *Soil seed banks in church forests of northern Ethiopia: Implications for the conservation of woody plants*. (Report). *Flora*, 201(1):32.

Williams, A. and Funk, C., 2011. A westward extension of the warm pool leads to a westward extension of the Walker circulation, drying eastern Africa. *Climate Dynamics*, 37(11), Pgs. 2417–2435.

Williams, T. & Hardison, P. 2013. Culture, Law, Risk and Governance: Contexts of Traditional Knowledge in Climate Change Adaptation. *Climatic Change*, 120(3).

WinklerPrins, A. & Barrera-Bassols, N. 2005. Introduction: Ethnoecology. *Capajournal of LMHII Jmerican Geography*, 4(1).

Wolde-Georgis, T. 2010. Climate Change Adaptation at the Local Level: A Case Study of the Abraha Wa Atsebaha Village in Tigray, Ethiopia. Paper emailed to me by author. Presented at Consortium for Capacity Building, University of Colorado, 12 January, 2010.

Wolde-Georgis, T., Hadgu, K.M., Abreha, A. & Habru, A. 2010. Climate Change Adaptation and Impact Mitigation: A Case Study of Abraha Wa Atsebaha Village in Tigray, Northern Ethiopia. *Journal of the Drylands*, 3(1).

Woldemichael, L., Kidane, Bekele, T. & Nemomissa, S. 2010. Vegetation Composition in Hugumbirda-Gratkhassu National Forest Priority Area, South Tigray. *College of Natural and Computational Sciences Mekelle University*, 2(2).

Yami, M., Mekuria, W. & Hauser, M. 2013. The Effectiveness of Village Bylaws in Sustainable Management of Community-Managed Enclosures in Northern Ethiopia. *Sustainability Science*, 8(1).

Yirga, C. & Hassan, R.M. 2010. Social Costs and Incentives for Optimal Control of Soil Nutrient Depletion in the Central Highlands of Ethiopia. *Agricultural Systems*, 103(3).