THE SPATIAL CONFIGURATION OF AGRICULTURAL PRACTICES AND THE ROLE OF RESILIENCE IN FARMING AT KHUTWANENG, BOKONI

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DECLARATION

I declare that this Theses* is my own, unaided work. It is being submitted for the Degree of Master of Science at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

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Abstract

Despite the expansive size of the Bokoni complex, our knowledge with regards to many aspects of its occupancy is limited. Due to the agriculturally centred nature of the Bokoni, it is important to understand this facet of Bokoni life from as many perspectives as possible. This project aims to take us one step closer to achieving a deeper understanding of the agricultural practices of the Bokoni people. Through my fieldwork and the processing of collected data on land management practices of this society have been explored. Additionally Khutwaneng and the Bokoni complex in general, provide an interesting case study in the role of resilience in agricultural communities. Their agricultural success is inseparably linked to the adaptive strategies employed throughout their occupancy. This allowed for the consideration of the recursive relationship between resilience and sustainability, furthering our understanding of the Bokoni complex.

For my father

The inimitable, Jonathan Howard Henshall.

1952-2007

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Chapter1: Introduction

Farming historically played a key role in the development and success of societies on the African continent. Both abandoned sites, and current living communities that continue many of the systems developed hundreds of years ago, provide invaluable sources of insight into the evolution of farming on the continent.

Sites such as Engaruka, Nyanga and Konso, among many others, inform on the resilient nature of subsistence farmers, as well as some of the challenges they had to overcome to ensure their survival and/or prosperity. These sites are also examples of the importance of acknowledging local specialization, thereby moving away from assumptions based on generalised ideas regarding subsistence farming in Africa. The archaeology of farming in sub-Saharan Africa, however, remains understudied. There is a clear need for further, more focused research into many aspects of farming in Africa (Hunter & Ntiri 1978; Sutton 1984, 1989).

Furthermore, the spatial configuration of pre-colonial and traditional farming in general in southern Africa is not well understood. Very few in-depth archaeological and anthropological studies have focused on farming. In South Africa, these systems also no longer exist in an unchanged form, since several centuries of colonialism, as well as Apartheid policies, fundamentally disrupted, or at best altered, traditional agricultural systems in South Africa. Whilst some missionaries and ethnographers recorded information on farming systems during the colonial and Apartheid periods, the details have not been the subject of much in depth research.

Further research in this field is necessary in order for us to develop a better understanding of the different approaches to farming adopted and determining the results of these choices. Farming systems that led to success in producing not only higher yields, but resulting in the conservation of healthy, fertile soils and invasive species management without the use of pesticides and other modern day intervention may help us to create solutions for sustainable farming in the future. It also helps us to understand and appreciate how integral flexibility and innovative thinking was to these societies be it historical or current day.

Two particularly adaptive areas that will be discussed in this project, in addition to Bokoni, are Willowvale and Marakwet. Both provide different perspectives on life within agricultural communities. The challenges faced and solutions provided may help us gain insight into the variety of factors that shape a society ranging from environmental to political, as well as how effective problem solving impacts the sustainability of subsistence farming.

The farming strategies and resilience of Willowvale (Eastern Cape) farmers under the onslaught of Apartheid betterment planning, which were recorded through detailed ethnographic study is a seminal case study on resilience. By overcoming a multitude of social challenges introduced through Colonialism and the implantation of the Apartheid system, the farmers of Willowvale showed how flexibility in the farming strategies can aid in their success (Heron 1990; McAllister 1989).

Further afield, but equally relevant is the research on the Marakwet (Kenya) farmers. Their economy and social structure is focused on agriculture and agricultural infrastructure. The people of Marakwet have displayed ingenuity in the face of catastrophic environmental stressors, and introduced of a variety of farming strategies (Davies 2008; 2009).

I will use the research conducted in Willowvale and Marakwet to better understand farming at Khutwaneng, focussing on agricultural practices, the use of space, and adaptions that ensured the continuity of the farming systems.

Khutwaneng, a predominately urban site, forms part of the wider Bokoni complex (see Fig. 1.1). It is situated in the Badfontein valley south of the town of Mashishing, amongst rolling hills and fertile valleys. Khutwaneng, a second and third phase Bokoni site, marks the last stage in the farming history of a great agricultural community that forever changed the landscape of the Mpumalanga escarpment.

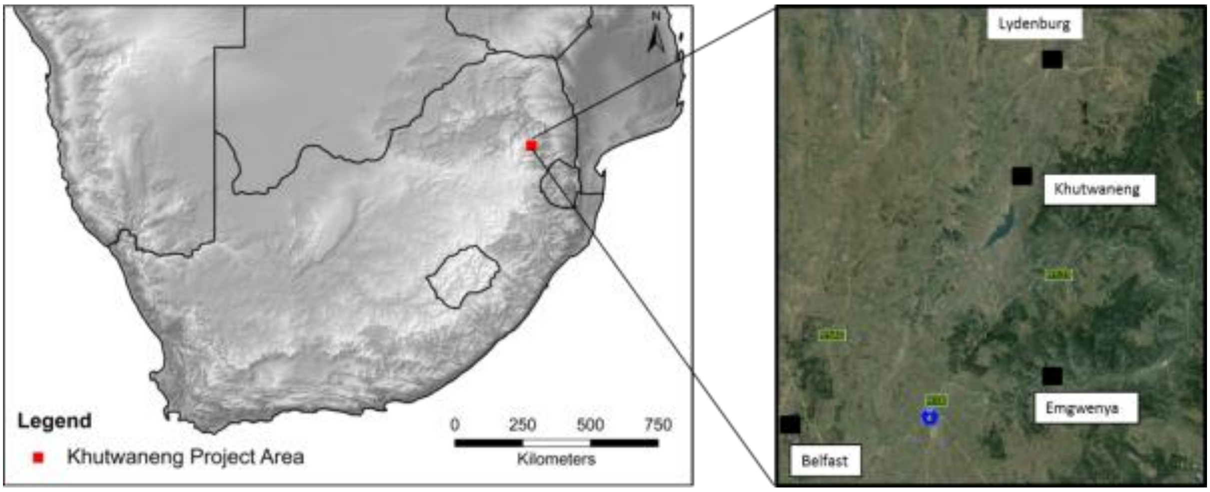

Figure 1.1: Map indicating the location of Khutwaneng project area (Google Earth & ArcGIS)

Farming formed a fundamental component of the economy and ideology of Bokoni society (Delius & Schoeman 2008). Understanding how this pre-colonial farming system worked, however, is not easy. There are no direct historical or ethnographic sources on farming in Bokoni, because Bokoni, as an independent socio-political system, ceased to exist after a century of conflict forced its people to disperse, and join larger neighbouring polities (Delius *et al.* 2012). As a result we are limited in what we can ascertain from non-archaeological sources about the day to day lives of the people of Bokoni.

Including the introduction this project contains seven chapters:

Chapter 2 reviews existing literature relevant to this project. This includes a general overview of agriculture in Africa, a general review of South African agriculture from a historical view point, and a discussion of the broader factors of land management and farming strategies. The focus will then shift to a basic background of Bokoni and how Khutwaneng is located within this complex's occupation sequence, a background to the history and agricultural practices in Marakwet, a background to the history and agricultural practices in Willowvale. Resilience, the theoretical framework this project draws on, will also be discussed here.

Chapter 3 will outline the methods and techniques used in both the course of field work in which data was collected, as well as the way in which this data was then processed.

In Chapter 4 I present the data collected during my field work, after it had been processed in order to create this data set. The data presented includes in-depth site descriptions for each of the mapped homesteads. I also indicate the location of the boundaries of different areas of each homestead.

Chapter 5 will present average yields for each of the mapped homesteads, variability in results when accounting for the application of specific farming strategies, a demonstration of the impact of shifting climates on average yields (plant species specific), the surface areas covered and lastly a comparison of yields for the three regions discussed.

Chapter 6 serves as the discussion of the above mentioned data. This chapter will look at a comparison between the sites as well as the role resilience has played in the three regions successes and failures. .

Chapter 7 is a summary of the main conclusions of this project; I will also outline constraints of the project and make suggestions for research going forward.

Chapter 2: Literature review

This Chapter examines existing literature in order to form a foundation on which an understanding of the data set created in the course of this project can be built. This literature review looks at agriculture in broad and specific terms in order to attempt a holistic understanding of this complex topic and some of its subsidiaries.

Agriculture in global archaeology

Agriculture as a concept has no single point of origin, it was practised at various times and places independently. Moulded by the landscape, climate and political factors (among others) agriculture has taken many forms over thousands of years. This has included approaches to farming suited to drier areas, e.g. shifting dryland cultivation, terrace agriculture and irrigation farming, as well as farming methods that manage waterlogged areas, e.g. paddy farming and raised field agriculture such as that practiced in the Bolivian Amazon (e.g. Mazoyer & Roudart 2006; Sutton 1984; Whitney *et al.* 2014).

Landscape and climate, often dictating the largest variances in the styles of agriculture practised, as well as the farming strategies implemented, also play a role in the length of occupation at a site. Harsher winters, land availability when compared to population density, amongst other factors, resulted in a trend towards extended occupancy of sites in Europe. In Africa's vast, mineral rich environment this comparatively has often not been the case, with settlements often strategically shifting. This difference in locational fluidity is suggested to have led many European researchers to view African subsistence farming as both primitive and wasteful, in terms of the way land and the environment are utilised (Hunter & Ntiri 1978; Sutton 1984, 1989).

An overview of agriculture in Africa

Historically agriculture within the African context was often generalised as 'shifting' in nature. Often described as 'slash and burn' or 'swiden' agriculture, the initial understanding of early subsistence farming in Africa led to unfavourable conclusions (Hall 1987; Hunter & Ntiri 1978; Sutton 1984, 1989; Vansina 1996). The early model of African farming was that inhabitants of an area would utilise the soils until they had been depleted, after which they would simply expand (sometimes by burning existing bush – hence the ‘slash and burn’ terminology) or migrate. To many early researchers this seemed primitive, destructive and abusive towards the environment, as well of a waste of the physical efforts required to build the required agricultural features (Hall 1987; Hunter & Ntiri 1978; Vansina 1996). Later research has seemingly altered this view for many (but not all) researchers, who have gained valuable insight by studying archaeological and present day sites throughout Africa (Hunter & Ntiri 1978; Shaw 1972; Stahl 1999; Sutton 1984, 1989).

This research has brought several key aspects of subsistence agriculture in Africa to light; firstly the adaptive nature of African farmers, and secondly the complexity of these sites. Many of the sites had initially been interpreted by simply applying generalised ideology of African agriculture and ignoring the role of localised specialisation and the occurrence of agricultural intensification. This is particularly prevalent at sites practicing terracing and /or irrigation. The implication that the sites were abandoned has also been re-examined, sites were often allowed to lie fallow and then reused seasonally or at a later time (Hunter & Ntiri 1978; Niemeijer 1996; Sutton 1984, 1989; Westerberg *et al.* 2010).

While generalisations, such as the function of terracing as a means to prevent soil erosion, and that irrigation allows for the transport of water to areas that cannot depend on annual rainfall, are valid, the focused study of localised specialisation gives us greater insight into the strategies and techniques used by individual communities (Keller *et al.* 1975; Lane 2009; Sutton 1984, 1989). Types of variation include the type of irrigation used, how extensively this is adopted within the site and how these furrows or channels were constructed. Much of this would be influenced by the climate at the time of production. Irrigation in Africa, for example, often provided an invaluable solution to the erratic rainfall and periods of widespread drought experienced in many parts of Africa (Adams & Anderson 1988). Terracing on the other hand can vary in function, method of construction and density, among other factors. Aspects such as gradient, soil type, cultivar being harvested and yield desires/requirements could all be influencing variables to consider. Examples of this can be seen throughout Africa at sites such as Engaruka and Nyanga (Hunter & Ntiri 1978; Niemeijer 1996; Sutton 1984, 1989; Westerberg *et al.* 2010).

Engaruka is an abandoned stone walled site in Northern Tanzania that exhibits terracing and stone cairns covering approximately 2000 hectares of land (Laulumaa 2006; Sassoon 1967; Stump 2010). The terracing in this site varies in height, width and function. While the bulk of this terracing is agricultural in function, several sections of large levelled terrace are argued to have served other purposes. The shape of the terracing at this site is influenced by the contours of the hills they were constructed on (Sassoon 1967).

Engaruka also contains well preserved gravity fed irrigation furrows. One example of localised specialisation at this site is the presence of small neatly packed rocks lining the irrigation furrows (Westerberg *et al.* 2010). This is not present at all African sites; Sutton suggests the reason for this is practical- the hills of Engaruka have high rock content (particularly at surface). These rocks would need to be disposed of in order to clear the ground for agricultural production. The use of the rocks as a lining for furrows allows a simple solution to this issue, with the added benefit that it allows for superior preservation of these furrows compared to sites where no stone lining is present (Sutton 1984;1989; Adams & Anderson 1988). Irrigation at this site fed water between terracing, as well as to small fields on the lower flatter ground (Sutton 1984; Westerberg *et al.* 2010).

The extensive nature of the constructed furrows have been compared to sites in the vicinity, such as the Chagga located on the southern slopes of Mount Kilimanjaro (visible from Engaruka when the weather permits) and to sites further north, such as Konso in Ethiopia. Both of these sites have been successfully maintained and inhabited for hundreds of years producing a variety of cultivars to sustain the people and often surplus for trade (Davies 2008b; Stahl 1964; Sutton 1984).

The Chagga also use irrigation furrows. The motivation behind their adoption, however, differs from those constructed at Engaruka. The location of the Engaruka fields and terraces receives unreliable rainfall. This reached a peak between 1550 and 1670 CE when annual rainfall decreased resulting in severely dry periods and increased aridity (Agrawala *et al.* 2003). The furrows allowed farmers to retrieve water for their crops from a more reliable source – a stream fed by water from the Ngorongoro crater highlands - which would have greatly increased their chances of success and survival (Agrawala *et al.* 2003; Spear 1997; Westerberg *et al.* 2010). The slopes of Mount Kilimanjaro, on the other hand, are located within a superior climate for agricultural production. The area receives higher and more consistent annual rainfall - more than what is required for successful agricultural production. The soils also contain a high nutrient content as a result of weathered basalt from volcanic activity in the past. The surrounding forest and vegetation is evidence of the optimal variables for plant growth (Fisher 2012). Despite these conditions, the Chagga people adopted irrigation. The motivation for this was to allow for extended planting seasons, as well as to allow them to introduce a variety of cultivars that would have been difficult to maintain otherwise. This includes extensive production of bananas (Fisher 2012; Grove 1993; Spear 1997; Stahl 1964; Sutton 1984, 1989).

The Konso people also do not display a dependence on irrigation at the same level as Engaruka. The Konso people have introduced irrigation to act as a failsafe in the event that the area undergoes climatic changes resulting in drought. This once again shows planning, flexibility and adaptation to the sometimes erratic climate experienced in some parts of Africa (Hallpike 1970). Due to the dependence on these crops for community sustenance, as well as their economic success, these types of strategies have allowed these communities to survive through trying times that they may not have otherwise (Hallpike 1970; Sutton 1984, 1989; Watson 2006).

Nyanga, a sprawling terraced site in Eastern Zimbabwe covers approximately 22000 hectares of land. The hills display narrow terracing covering most available land. Nyanga is not formally irrigated; the rainfall in the area is high enough to support agricultural production (Chirikure & Rehren 2004; Soper 2002, 2006; Stump 2010). While terracing covers a large area it is not necessarily indicative of annual yield because it is possible that not all of the terracing was utilised in a single season. Instead people might have used fallowing, or crop rotation. The presence of narrow drainage channels indicate that water logging would have been a bigger issue than insufficient water for growth (Sutton 1984, 1989). There is a notable presence of some irrigation furrows at Nyanga; these however are considered to have been designated as a backup rather than as a dependant means of supplying water to crops. In the event of drought water from streams could have been used to irrigate crops if needs be. The uneven layout and construction of the terraces would have made full irrigation improbable and less effective than at sites such as Engaruka (Chrikure & Rehren 2004; Soper 2002, 2006; Sutton 1984, 1989).

Börjesen, amongst others (Börjesen 2004; Börjesen & Annaler 2007; Börjesen *et al.* 2008; Håkansson *et al.* 2008) has shifted the way in which we look at intensive agriculture. Challenging past research (Beek 1995; Boesrup 1965; Gourou 1966), Börjesen suggested that agricultural intensification was a propulsive factor its own, rather than necessarily being a consequence of population pressure or siege as previously suggested (Beek 1995, 2002; Gourou 1966; Widgren 2010). Research carried out in North-central Tanzania, specifically on the Iraqw society, amongst others, has supported the antithesis of previously established ideas regarding intensification. Börjesen suggests that agricultural intensification may be the cause, rather than then the result of population growth (Börjesen 2004; Börjesen & Annaler 2007; Börjesen *et al.* 2008). Recent research has supported this idea of agriculture stimulating population expansion linking optimal geographic, climatic and environmental factors with socio-political cohesion and stability that is associated with sites such as Iraqw (Börjesen 2004; Börjesen & Annaler 2007; Börjesen *et al.* 2008; Håkansson *et al.* 2008; Tagseth 2008).

Climate and its link to changes in agricultural practices has been a long studied concept (Hall 1976; Smith *et al*. 2007; Stahl 2004). Hall (1976) suggested that the balance between agricultural production and animal husbandry when studied in conjunction with rainfall patterns displayed a flexibility and resilience in farming communities. These societies essentially shifting focus in order to attempt to compensate for poor rainfall. His work (pre-dating Börjesen's) suggests agricultural intensification as a driver for population increase (Hall 1976).

Overall, as evidenced by the discussion of the sites above, African farming can be characterised as flexible, adaptive and resilient. These farmers were not static, rather they utilised the land and often implement strategies to make the most of erratic climate, unstable or thin soils, and/or poor soil nutrition. When looked at in terms of local specialisation it is clear that the history of farming in Africa is anything but primitive (e.g. Hunter & Ntiri 1978; Niemeijer 1996; Sutton 1984, 1989; Westerberg *et al.* 2010).

The history of agriculture in Southern Africa

In addition to grappling with the Bokoni sequence, using archaeological and historical sources, it is important to develop a thorough understanding of the agricultural practices of the Bokoni farmers. Through comparative analysis with other agriculturally based communities we can gain insight into what types of agricultural techniques were used traditionally in South Africa. Bundy (1988), for example outlines the key role women and families played in what he terms 'peasant farming' in the Cape and Natal between the mid-1800s and the early 1900s. His work also gives us insight into the impact colonialism, and the associated changes in political structures, had on African farming communities.

Bundy (1988) depicts how imperative the production of crops were to the economy in Herschel, and how farmers continued to adapt their farming practices in order to maximize the profitability of crop farming. In the 1800s, for example, farmers diversified their production by introducing produce such as beans, oats and potatoes. Previously they had focused their cultivation on the staple crops of maize and sorghum. The major challenge that these farmers faced was the limitation the colonial regime placed on them, in terms of access to arable land, and the manner in which this land was assigned. These allocation systems were deeply flawed and had negative impacts on the progression of these farming communities in some cases leading to their downfall (Bundy 1988).

Reading Morrell (1986) shifts our gaze northwards. Morrell's (1986) study of local farmers in Middelburg, highlights the importance of developing skills required for successful farming, as well as an understanding the benefits of diversification. The Middleburg farmers increased their likelihood of successful harvests, and added variety to their diet through, for example, combining gardens that produced a variety of vegetables, with field agriculture that focused on staple crops such as maize.

Beinart's (1982) research in the Eastern Cape on Mpondo farmers is also enlightening. This study explored the deficits and achievements of the Mpondo people's agricultural record, as well as what external factors would have affected this society. The goal in this community exceeded agricultural production for the sustenance of the household, they also aimed to produce sufficient surplus for trade Similar to Bokoni, agricultural responsibilities were delegated to the female members of the household. This division of work had far reaching consequences, because it meant that the land a man could farm, and thus was allocated, became dependant on the number of wives his household had. The more wives a man had the larger the land he would be given to work, and the more food his household could produce (Beinart 1982).

Quin's (1959) provides a comprehensive description of the foods grown and consumed by Pedi speakers. The food types Quinn noted that the Pedi relied on for sustenance was harvested crops, wild plants and fruits, meat from domesticates and edible insects. The crops that formed the basis of the Pedi diet included three main groups Gramineae (maize, millet, sorghum and sugar cane), Leguminosae (cow-peas, Bambarra nuts and mung beans) and Cucurbitaceae (pumpkins, gourds and melons). These crops formed the staple diet and contributed to Pedi economy (Quinn 1959).

The necessity of land management

Land management strategies have often been vital to the success of agricultural communities who often rely on their produce for trade, as well as sustenance for their populous (Bartlett 1980; Darnhofer *et al.* 2012). One of the key aspects, any land management strategies focus on are maintaining the fertility of the soil they farm in. The soil fertility of an area is dependent on its physical and chemical structures. The physical structures that should be considered when studying soil fertility include; water-holding capacity, erosivity, porosity and aggregate stability. Chemically the key concerns with regard to fertility are pH, nutrient pools, base saturation, organic matter content and elemental composition. When these factors are all at ideal levels they allow for the successful transfer of the required minerals to vegetation thus encouraging optimum growth (Robertson *et al.* 2015).

There are 14 essential elements/ plant nutrients that are required for plant growth, 2 of these (Oxygen and Carbon) come from the air, the remaining 12 are provided by the soil. These can be separated into 3 categories; base or macro elements, secondary elements and micro or trace elements. Soil is created through the decomposition of rock and/or organic matter (Troeh & Thompson 2005; Widgren 2006). The elemental composition of the soil will be dependent on the type of parent rock and added organic matter. For soil to be fertile from a molecular composition perspective (in that it contains sufficient nutrients to allow plant growth) it has to contain a base elements nitrogen, phosphorus and potassium. The remaining composition of the soil is dependent on the type of rock has decomposed from. Secondary elements necessary for plant nutrition are sulphur, calcium and magnesium. The trace elements needed are zinc, manganese, boron, copper, iron, chlorine, molybdenum and nickel (Barker & Pilbeam 2007; Marschner 2011).

Nitrogen is the most critical element to have present in soils. It is responsible for strong plant growth and makes up a key component of chlorophyll cells responsible for photosynthesis and the green pigment in leaves. Nitrogen deficient soils most commonly produce plants displaying stunted growth and chlorosis (yellowing of the leaves) (Lal 2006). Phosphorus promotes root growth, helping roots grow deeper into soils, plays a vital role in plant membrane formation, as well as energy transfer and aids in the ripening of fruit and formation of blossoms. Potassium acts as the defender of the plant, it fights off disease, aids plants n withstanding extreme temperatures and aids in the formation of blossoms and ripening of fruits (Ratta & Lal 1998; Tan 2006).

During the growth process plants leech these nutrients from the soils through cation exchange, the process by which nutrients are absorbed by the plant through an exchange of cations with soil nutrients; this is particularly problematic in the case of cereal crops (Atwell *et al.* 1999; Marschner 2011). If the soils are not managed they run the risk of nutrient depletion, leaving them infertile and unusable (Barker & Pilbeam 2007). If certain types of organic matter (containing the correct elements) are added to the soils, mineralisation will take place allowing nutrients to be returned to the soils for further agricultural function (Foth & Ellis 1997; Paul *et al.* 2015).

The physical characteristics of the soil can also be managed in order to create an improved environment for plant growth. Factors such as porosity, water holding capacity and erosivity can be altered through human intervention. Porosity, the space in between the grains the soil consists of, can be improved through the process of tilling the soil (see Fig. 2.1). When compact soils, such as clays, are agitated the grain-to-grain packing is altered allowing for improved permeability, i.e. fluids will be able move with increased ease between the grains (Boggs 1987). The ability of fluids to move easily through the soils is important because it allows for proper water drainage; this prevents waterlogging of soils that would otherwise result in root rot (Kramer & Boyer 1995).

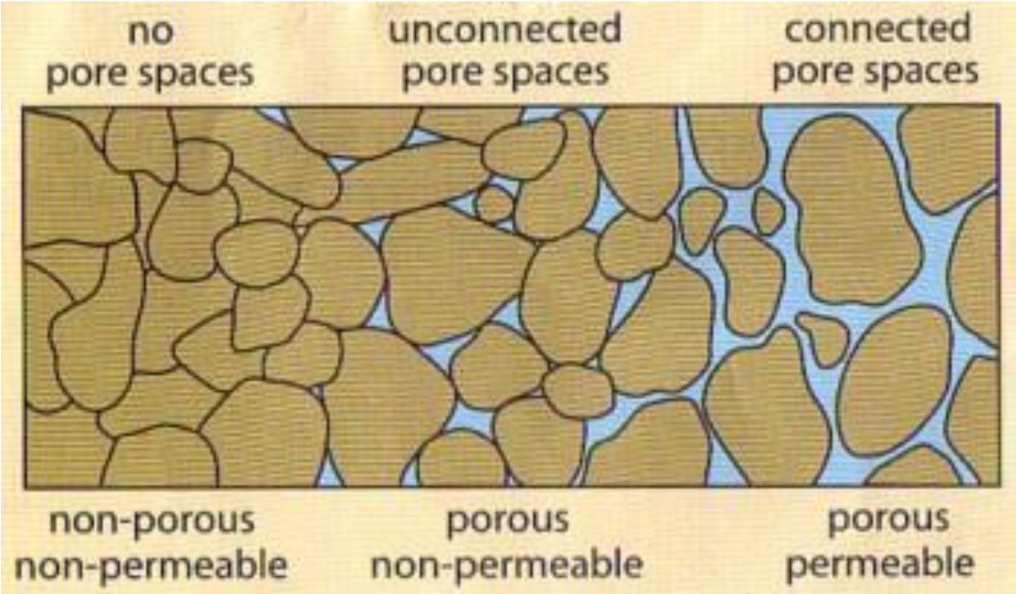

Figure 2.1: Diagram depicting porosity (www.asu.edu/courses/gph111/Hydrology/PorousPermeable)

Water holding capacity can be improved in soils with poor drainage through the introduction of various sized rocks strategically placed in the soils in order to encourage drainage during heavy rainfall. Soil erosion is another manageable factor. Soils that display easy topsoil wash can be supported through the planting of specific plants with shallow root systems that encourage soil stability, as well as by building supporting walls (terraces) where land gradient may be an issue (Kramer & Boyer 1995; Morgan 2009; Troeh & Thompson 2005). Marker & Evers (1976) suggested that Bokoni soils on hillsides are prone to erosion and that terraces also helped to prevent erosion.

These techniques combined with farming strategies, discussed later, can allow farmers the opportunity to adapt their environment and achieve positive outcomes. Due to uncontrollable environmental factors, such as extreme changes in climate, the ability to be adaptable and to adapt one's environment is vital to the success of farming communities (Bartlett 1980; Darnhofer *et al.* 2012).

Environmental change in Bokoni

A number of studies have been carried out with regards to environmental changes in and around the Bokoni region. Those with the most applicable data are Sjöström (2013), Hattingh's (2014), Aub (2014) and Woodborne *et al.* (2015). By combining and comparing the data they have collected, we are able to begin to reconstruct the climatic conditions of the area during its occupation.

Sjöström's (2013) Masters research attempted to reconstruct the climate of the Mashishing area over the last 1700 years. This reconstruction was carried out based on δ13C shifts coupled with result from phytolith analysis of a core from the Lydenburg Fen in the town of Mashishing (previously Lydenburg). She concluded that the area experienced a changing environment, with a substantially drier episode between AD 1300-1350, after which conditions started to tend towards a more mesic environment with rainfall and temperatures similar to present day figures after AD1400.

Hattingh's (2014) also used phytolith analysis, although Hattingh covered a variety of plant species found in the soils at two Bokoni occupation sites, Komati Gorge and Buffleskloof, which had experienced occupation at different phases of the Bokoni cycle. Her analysis led to the conclusion that the rainfall levels and temperature were lower than at present during the phase 1 occupation the Komati Gorge village, and that the phase 3 occupation at Buffelskloof experienced higher temperatures than at present. The rainfall levels were relatively high during the occupation, but were lower than current levels in the area.

Aub's (2014) data supports the results established through Hattingh's (2014) Masters. Aub's results were gathered through Carbon isotope analysis of tree rings from a *Prunus Africana* collected from Buffelskoof. His results led to the conclusion that during the occupation period the area experienced a cooler and drier climate. He suggests that the difference between Hattingh and Sjöström's (2013) results may have been due to the potential presence of a microclimate in the Lydenburg fen where Sjöström's research was conducted.

Aub's data correlates with the eastern pattern identified in the research conducted by Woodborne *et al.* (2015). This data was collected through Carbon isotope analysis of tree rings from four baobab trees. The record created from this analysis suggests fluctuating rainfall after AD1075, with the three driest spells (c. AD 1635, c. AD 1695 and c. AD1805) all occurring during the period that Bokoni was occupied (Woodborne et al. 2015). The AD1805 dry spell is preceded by a substantial wet spell. The suggested

Khutwaneng occupation dates (see Delius et al. 2012) include the two most recent of these three dates.

Farming strategies

It is possible that traditional farming methods, such as intercropping, crop rotation and allowing fields to lie fallow, could have been adopted at Bokoni. These methods are also used in Marakwet (Davies 2008; 2009) and Willowvale (Andrews 1992; McAllister 1989).

Intercropping is a key component of adaptive agriculture. This process has proven highly beneficial to farming communities around the world. Intercropping occurs when multiple types of plants are cultivated together (Mead & Riley 1981). Crops such as maize, sorghum and millet can leach large quantities of nitrogen from the soil – maize more than the others. Repeated seasons of cultivating these cereal crops can lead to large areas of once arable land becoming unfertile (Devi *et al.* 2014; Pearce & Edmonson 1984). One of the benefits of intercropping cereal crops with vegetables, such as peas, beans or cowpeas (commonly found in Willowvale, Marakwet and Mpumalanga) is that they have the ability to fix atmospheric nitrogen. This has the effect of restoring a percentage of the nitrogen lost to the soils (e.g. Devi *et al.* 2014).

Through intercropping legumes with cereal crops the dry mass harvested increases, as well as the availability of protein as a staple to the diet. Increasing protein and vitamin intake allows for the avoidance of diseases such as Kwashiorkor. It is also an effect form of weed and pest management (Fard *et al.* 2014; Liebman & Dyck 1993).

An added benefit of practising intercropping is that different plant species have different root depths. This effectively allows the different species to utilise nutrients and soil moisture at different depths. This leads to a decrease in competition of individual plants for resources necessary for successful production, as well as preventing nutrient (particularly nitrogen) depletion in the soil. This in turn allows for the maintenance of soil fertility over a longer period. This in effect then aids in reducing the soil fertility reliance on external inputs, such as fertiliser, overall resulting in a greater self-sustainability level for agricultural production (Mohammed 2012).

In addition to the 'fertilizing' effect that these plant types may have, there are a number of other positive effects. One of the most important of these is that in times of unpredictable climatic changes, such as drought or early onset of frost, there is a greatly reduced likelihood of starvation, since multiple sources of nourishment help to ensure that if one crop type fails others might still provide sufficient produce to sustain the population (Devi *et al.* 2014; Guttaman-Bond 2010).

When practicing intercropping multiple factors must be taken into consideration in order to reach the maximum yield possible for both/ all of the plant species produced. These include the relative maturation dates of the species, plant density, spatial arrangement and the architecture of each plant (Silva *et al.* 2009). A good example of why these factors are important can be seen in the research carried out in Nepal by Prasad and Brook (2004).

Their results highlighted the importance of considering plant density, arrangement and maturation when co-planting. They focussed on the decreasing yield of soybeans when these are intercropped with maize, suggesting that the soybeans' poor photosynethic adaptability was not compatible with the shade effect of the maize leaves (which grow higher than the soybean plants). When the plants were more generously spaced, the yields increased dramatically as the shading no longer had an effect (Prasad & Brook 2004).

Other research has shown that other positive outcomes of intercropping include reduction in weed damage in cereal crops and earlier flowering (Fard *et al.* 2014). Crops such as maize have a weak competition rate with weeds, and have been found to be prone to weed damage. By introducing plants such as beans or cowpeas weed damage is significantly reduced, as they fend of the advances off weeds (Liebamn & Dyck 1993).

There are multiple types of intercropping throughout the world. These include mixed, relay, strip and row intercropping (terminology referring the way the crops would be laid out when planting begins). The method utilised could be influenced by multiple factors. One of the most influential of these would be space. The size of the land being used for agricultural purposes, as well as the gradient of the land would change the method utilised in order to optimise crop production.

The experiments carried out by Mohammed (2012) that aimed to test the impact of intercropping on monocultures in terms of yield in Western Darfur state, give insight into the benefits of intercropping. This was assessed using Land Equivalent Ratios (LER's) and comparing dry matter yields. LER's are a means of comparing yields between mono-cropped and intercropped fields. This is achieved by measuring the yield in a constant size of land and what equivalent size of land (of the same production potential e.g. soil nutrient levels, rainfall etc.) would be necessary for the comparative crop yields to be equal (Mead & Willey 1980). In this case, for example, the yield obtained when harvesting an area (of a set size) of a single monoculture would then be compared to the yield when harvesting the same area where intercropping of at least two species had been carried out. An LER of 1 implies that the area required to achieve the same yield is the same. In this case, however, it The LER was measured at 1.2 – in favour of the intercropped yields (Mohammed 2012).

This means that 20% greater land area would be required in order for the monoculture to produce the same yield as the intercropped yield. The results also showed that the land that had been intercropped had higher post-harvest nitrogen levels, as well as a higher dry yield recovery. Dry yield is calculated by weighing fresh matter, allowing it to air dry for 15 days in order to achieve a constant weight and is then reweighed (Mohammed 2012).

A large amount of research on the benefits of intercropping has been carried out in areas ranging from tropical to arid climates. Overall the experimental results show greater yields and prolonged soil fertility. When the necessary factors are considered, for the land that is being utilised, correctly the results of implementing intercropping are considered superior to the production of monocultures in most situations (Fard *et al.* 2014; Liebamn & Dyck 1993; Willey 1990).

Other farming strategies that are useful to consider are crop rotation and the practice of leaving fields to lie fallow over specific periods of time. Crop rotation is the practice of growing different crops on the same land in alternating seasons (Liebman & Dyck 1993). Benefits of this strategy include weed and pest control, increased fertility in soils and improved soil structure. As different plants require different types and amounts of nutrients to grow, alternating species of plant allows for soils to restore nutrients absorbed from the previous crop (Bullock 1992; Havlin *et al.* 1990).

Crop rotation allows for similar benefits to the soils as intercropping. Planting different species in alternating seasons aids in managing nutrient leaching that would result in soils becoming infertile and therefor unable to yield agricultural produce (El-Nazer & McCarl 1986). Planting species that have a higher weed tolerance, or are able to strongly compete with weeds that occur naturally, decreases the rate of reproduction e.g. by reducing the weed population by 20% through competition will reduce the number of weeds reproduced the following season. Over time this strategy could systematically eradicate weeds present in day to day farming. This allows for crops, such as maize, who are poor weed competitors and whose yield is impaired by weed presence, to increase their yields each planting season (Gonzalez-Diaz *et al.* 2012).

Weed management, particularly in communities where there is no option to utilise herbicides or chemicals, is extremely important. Weeds can drastically impact yield production, soil nutrient content and water availability. Both crop rotation and intercropping have been proved through a number of case studies and experiments to effectively decrease weed seed density. In some situations species of weed have been completely annihilated through the implementation of these strategies (Liebamn & Dyck 1993). In many communities weeding parties are utilised in order to reduce the impact of weeds. In Marakwet and Willowvale weeding was carried out by the women in the community (Andrews 1992; Moore 1996). This probably was also the case in Bokoni.

Water use is also a factor that can be substantially impacted through both intercropping and crop rotation. Not all plants require equal amounts of water in order to ensure optimal yield production. By mixing plants with different water requirements, or rotating such crops, farmers are able to take advantage of the water resources available to them. There, however, is no 'insurance' against unpredictable extreme changes in weather. A single crop could be completely destroyed due to drought, unseasonable frost and other natural elements beyond the farmer's control. This can have catastrophic consequences for those mainly dependant on their agricultural produce in order to sustain themselves and their families (Liebaman & Dyck 1993).

The second technique, fallowing, allows soils to recover from nutrient leaching (Carswell 2002). Leaving fields to lie fallow for a season can be beneficial as, it not only aids in restoring the nitrogen content of soils, it also improves water storage and usually results in higher yields in future seasons. These breaks in farming allow the soils to recover keeping them fertile for future farming (French 1978). The land requirements in order to effectively practise fallowing can be a limiting factor. It is ideally carried out in areas with multiple arable field type agricultural areas, which allows for one field to produce and the other to recover each season. The nutrient recuperation rate is slow, unlike what can be seen through intercropping nitrogen fixing plants (cowpeas, beans etc.) with nitrogen leaching plants (cereal crops) (Nie *et al.* 1997). There are two types of land fallowing, natural fallowing and improved fallowing.

Natural fallowing, the most commonly practiced form, is simply allowing the plot of land to recover through non-use or as a grazing area. The time period that the land will lie fallow can range between a season to decades of non-use. Improved fallowing entails planting nitrogen fixing plants, such as, legumes in order to increase the speed at which soil fertility is regained. The benefits of fallowing include weed management, a reduction in pests that are harmful to crops, increased soil moisture and a retention of increased organic content in the soils (Amadalo *et al.* 2003; Brenchley & Warrington 1936; Gleave 1996; Sjögren *et al.* 2010).

An experiment carried out by Bünemann *et al.* (2004) in central Kisa, Kenya showed that fallowing can be very beneficial to long term agricultural production. Both improved and natural fallowing was practiced between March 1997 and August 2002 on a plot of land that had a record for the production of maize with the use of mineral fertilizers. The results indicated that both processes increased soil nutrient and reduced organic material loss from the soils (Bünemann *et al.* 2004*).*

Resilience and sustainability

Examples of resilience can be found worldwide in both historical and modern day societies. The concept of 'resilience', around which resilience theory is based, focuses on the adaptive techniques adopted by societies to overcome a multitude of challenges they may encounter. The ability to adapt to challenges/ problems can often dictate the survival or success of a society. These challenges can include, but are not limited to, economic, environmental or political factors/stressors (Folke 2006; Redman & Kinzig 2005). The concept of resilience appears to be strongly correlated with the idea of sustainability, particularly in the agricultural sector.

The concept of social resilience, as explored by Keck and Sakdapolrak (2013), can be reduced to three key elements; coping capacity, adaptive capacity and transformative capacity. According to this 'definition' resilience can be determined not only by people's ability to withstand attacks on the social framework underpinning their society, but their response to this. In essence it is not purely about survival alone. The success of a group's ability to withstand events that may lead to the necessity of adaptive behaviours is often linked to precautionary planning combined with impulsive strategy implementation (situation dependant). The events that follow the overcoming of a challenge, i.e. the coping and adaptive phases, are equally important. The ability for a group to learn and display an ability or to further adapt in order to improve the chance of positive outcomes for future challenges is potentially the key to resilience (Keck & Sakdapolrak 2013).

Keck and Sakdapolrak (2013), however, emphasise that due to the fact that the concept of resilience is rooted in ecology, researchers need to be cautious that they do not ignore the systems that led to the society/group in question to the situation that would require resilient behaviour to occur. Neither should the role of agency be ignored. If these are ignored, the result would be the depoliticization of the context, and reduction of the social dynamics to a state of over simplified determinism.

Research on resilience in agriculture has focussed on benefits of crop diversification; highlighting another adaptable strategy (Lin 2011). Crop diversity has a multitude of benefits that aid in a community's resilience to climatic and environmental challenges that extend beyond structural (irrigation and terracing for example) strategies. Crop diversification, and by extension the move away from mono-culture production, allows farmers to overcome or reduce negative factors, such as pests, disease and nutrient leaching. It also allows for an increased likelihood of long term sustainability due to the maintenance of soil health and structure, while providing a 'buffer' of sorts against shifting climates (Lin 2011).

Next, I discuss a few archaeological farming resilience case studies. Resilience strategies can be structural, as can be seen in the raised field systems in the Bolivian Amazon (Whitney *et al.* 2013). Although faced with infertile soils, due to poor soil porosity and low nitrogen content, farmers adopted raised field strategies, as far back as AD 310. This form of farming entails the creation of a platform constructed using soil from canals.

These soils, unlike those they were built on, contained a higher nutrient content and showed sufficient drainage for successful maize production. The Bolivian farmers also intercropped maize with sweet potatoes (Whitney *et al.* 2013).

The stonewalled and terraced site of Engaruka is a good example of pre-colonial suitability and resilience in an agricultural community within Africa. From Westerberg and his team's perspective (2010) Engaruka showed signs of long term sustainability, overcoming a number of obstacles due to their adaptive nature. The occupants of the site survived extreme climate shifts, particularly between 1500 CE and 1670CE, during which temperatures rose and periods of extended reduction in rainfall occurred. The irrigation systems at the site allowed for their continued production during this time, allowing them to sustain their community (Westerberg *et al.* 2010).

Another shift, this time political and economic, occurred between 1550CE and 1750CE when large sections of their trade networks collapsed. Engaruka relied on long distance trade with the coast, as well as local trade. When long distance trade collapsed, adaptive economic systems allowed for their continued survival as a valuable local food resource. Their economic basis also appears to have been flexible in nature. They expanded into pastoralism, when the climate allowed for the sustainable keeping of large herds, and the shifted back to a more agriculturally based economy when pastoralism was not viable. All of this facilitated the long term occupancy of the area. The site was only abandoned when climate shifts resulted in a severe and prolonged drought, leading to the disappearance of the water sources feeding irrigation systems. Once the irrigation systems collapsed the situation resulted in a singular solution – abandonment of the site (Sutton 1984; Westerberg *et al.* 2010).

Politics of an area can have far reaching impacts on adaptations made to ensure the survival of a community. Sutton (1984) suggests that farming sites in what is now South Sudan were selected due to their defensive positioning. Threats of danger and an unstable political environment thus may have been the driving forces behind the occupancy of hill sites. This resulted in the adoption of terracing. The positions chosen would have allowed the community to defend themselves against raiding parties (Sutton 1984). This theory is supported by the fact that rural communities in present day South Sudan have maintained sites on hillsides and terrace agriculture (Fig 2.2) in their still politically unstable environment.

Figure 2.2: Photograph of present day hillside settlement in South Sudan (Photograph: Timothy Marais)

Smith's (2005) PhD additionally provides insight into the sustainability of agriculturally based communities. She examines the successes and failures of agropastoralists in the face of climate change, specific to the Shashe-Limpopo River Basin. In her research she accounts for the strategies adopted by farmers in order to overcome infrequent extreme dips in precipitation. Some of the strategies credited for the sustainability of farming in these societies included intercropping, plating based on rainfall expectancy, flexibility in time of planting and crop size. Other factors farmers considered were the types of crops grown. These were selected according to features, such as nutritional value, hardiness in terms of pest and drought resistance. Smith (2005) highlights the importance of the use of these techniques in order to overcome harsh climatic conditions necessary to achieve sustainability.

Recently Moore (2015) argued for the application of the knowledge gained through the study of indigenous farmers (historically) in the form of the adoption of Agro-ecology, in order to solve issues surrounding sustainability in present and future contexts. Moore suggests that looking at strategies adopted to improve fertility, soil structure and filtration, amongst other factors, could assist researchers in the necessary shift in our approach to sustainability. The goal here is to change the understanding and definition of sustainable agriculture in order to recognise the importance of local knowledge and people prosperity, rather than imposed values (Moore 2015).

Bokoni

Figure 2.3: Aerial photograph of a section of the Bokoni complex (photograph: Graeme Williams)

The Bokoni complex comprises stone-walled settlements located in the Mpumalanga and Limpopo provinces of South Africa (Fig. 2.3). The complex extends from Carolina in the South to Orighstad in the North (Fig. 2.4). The most basic components of the sites - homesteads - are composed of homesteads built in a circular shape connected by stone walling and roads. Another notable feature of these sites is the presence of agricultural terraces dispersed amongst the homesteads (Delius *et al.* 2012). One of these complexes was thought to have had 40 000 inhabitants during the 18th Century making it an extensive society at this time (Beinart 2010: 219; Evers 1975). Although Bokoni has a substantial archaeological signature, large gaps in our knowledge of this society remain (Beinart 2010). The site within the Bokoni complex that this project is focused on is Khutwaneng. Khutwaneng is located in the Badfontein valley, between Mashishing and the Kwena dam, and stretches approximately 4 kilometres in length.

Research to date

The work of Prinsloo carried out in the 1930s, studying the grammar and phonology of SeKoni is a valuable resource in understanding the archaeology of this region. After growing up learning SeKoni and interacting with SeKoni-speaking farm-workers, he returned to the region for his Masters research. His research was primarily linguistic, but he also recorded a basic oral history. This is the only known oral history from within Bokoni (Delius *et al.* 2012; Delius and Schoeman 2008). The information contained in Prinsloo's (1936) dissertation is limited, and as a result, oral accounts from neighbouring polities and kingdoms such as the Ndzundza and Pedi Kingdom have been used to supplement our understanding of Bokoni history (Delius *et al.* 2012; Schoeman 1997).

The research undertaken by Evers and Marker in the 1970's played a role in the early identification and classification of some of the Bokoni sites, particularly in the Mashishing region (Evers 1975; Marker & Evers 1976). With the assistance of aerial photographs, Marker and Evers (1976) identified and studied sites in the Lydenburg Valley. These sites were assigned to either Early or Late Iron Age communities. They only identified 5 Early Iron age sites, estimating the population to be approximately 6000 people.

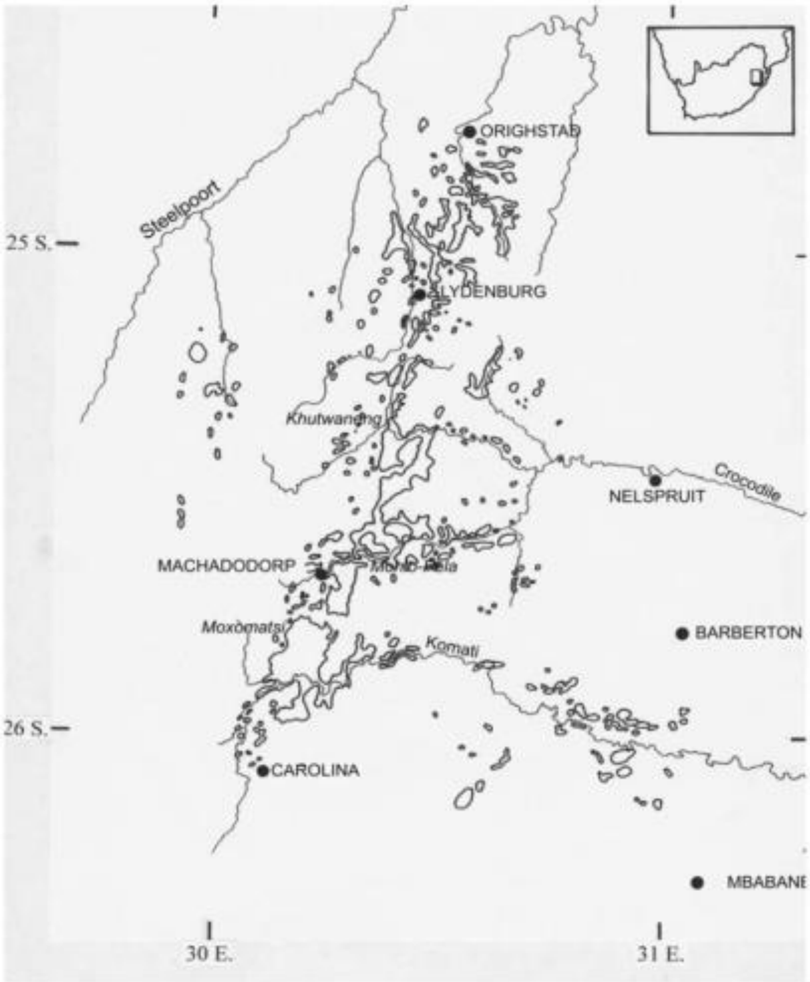

Figure2.4: Map of Mpumalanga indicating expanse of site (Delius *et al*. 2012:400)

The Late Iron Age (now known as Late Farming Community [LFC] sites) sites are much larger, greater in number and display a vastly increased complexity. They identified 58 LFC sites, estimating a population of between 19000 and 57000. Marker and Evers (1976) identify the key features of the sites namely the cattle tracks (now more commonly referred to roads), homesteads and terracing. They speculate that, although there is open land past the edge of the terracing it is unlikely that it was cultivated as the roads stop. The terracing is protected by the presence of roads; presumably if the lower land had been cultivated the occupants would have seen fit to protect this area as well (Marker & Evers 1976). The function and importance of the terracing is also explored, including their influence on the settlement layout and their role as an adaptive farming strategy. It is put forward that the terraces prevented soil erosion- an issue that would have been otherwise problematic due to a combination of soil type, gradient and rainfall (Evers 1975; Marker & Evers 1976).

The spatial configuration of the central Badfontein village (Khutwaneng), a second and third phase Bokoni site (Schoeman & Delius 2011), was explored in David Collett's MSc Thesis (1979), and a subsequent publication (Collett 1982). In his research four 'complex' sites, two 'simple' sites and two terraced areas were mapped and excavated throughout the site. Through mapping and a series of excavations on these stone-walled sites, Collett found that complex and simple ruins served different purposes, and that the site configuration was shaped by a range of factors. These include potential forms of politics, kinship and economy that may have been prevalent in those responsible for the sites. 'Complex' sites for example were associated with huts, whereas 'simple' sites were not (Collett 1979, 1982).

Collet's research was carried out during the early stages of research into South African farming communities. At this time ceramics played a key role in the identification of groups. Through his excavation of the 'complex' sites 3574 pot sherds were recovered (a combination of both decorated and undecorated pieces). Collet studied the sherds and came to two main conclusions; firstly that the ceramics, and by proxy the homesteads, belonged to a single group of people and secondly that these people were most likely Pedi (Collett 1979, 1982).

He assigned the ceramics to the Marateng industry (See Fig 2.5, 2.6.and 2.7) – part of the Pedi sequence (Collett 1979, 1982). He came to this conclusion due to the distinct similarities between the ceramics known to be associated with historic Pedi speakers, and the decorated sherds found in the excavations. Collett felt that these similarities were additionally mirrored in the site patterns- the Pedi sites also kept live stock in the centre of their homesteads. He did note, however, that there was a possible presence of cattle out posts or enclosures not associated with a homestead.

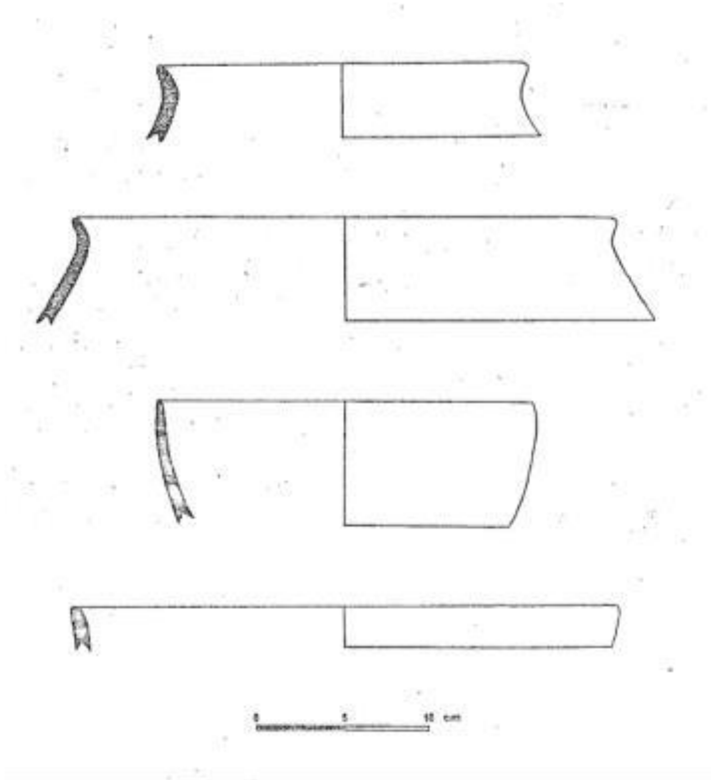

Figure 2.5: Drawing of undecorated pottery found at Khutwaneng (Collett 1979:45)

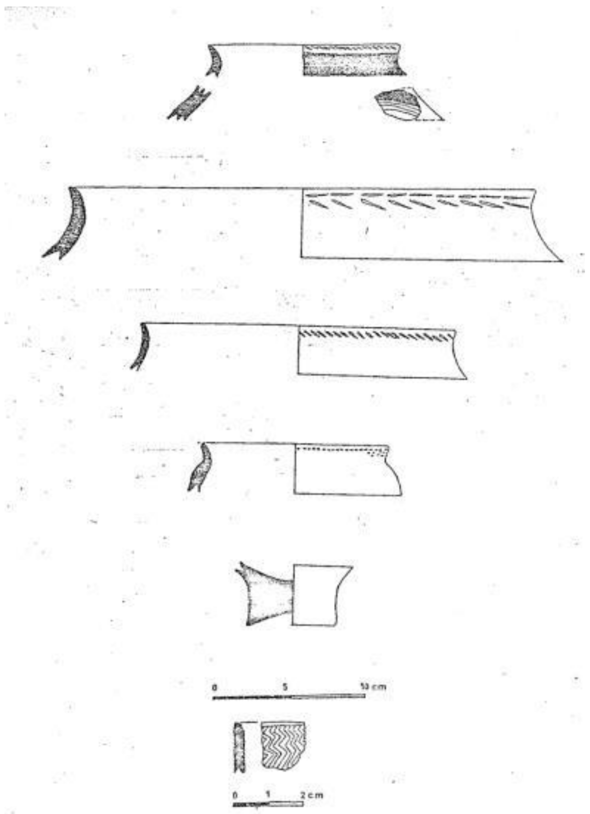

Figure 2.6: Drawing of type 1 decorated pottery found at Khutwaneng (Collett 1979: 44)

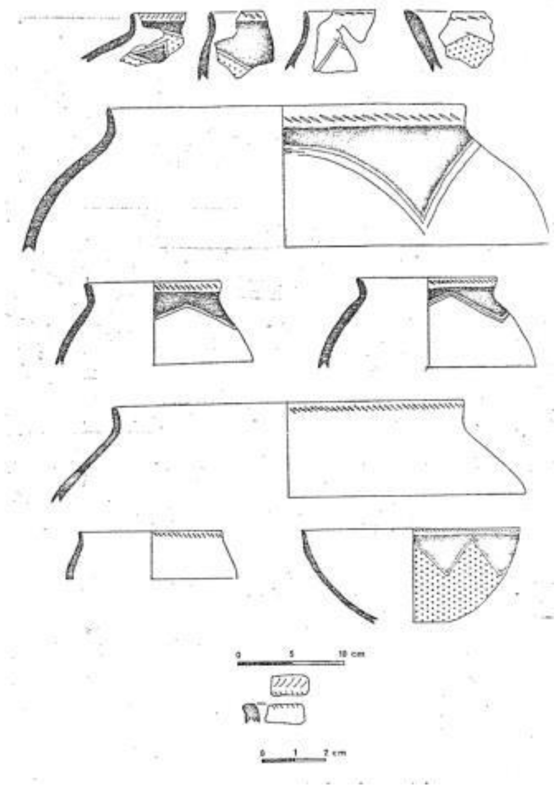

Figure 2.7: Drawing of type 2 decorated pottery found at Khutwaneng (Collett 1979: 29)

In addition to this, Collett (1979, 1982) concluded that climate and economics played a role in the layout of the site. The preference seen for west facing slopes can be explained due to the fact that east slopes experience a greater drop in temperature in winter resulting in an increased occurrence of frost. He also ascribes economic factors as an influence, in that the roads were clearly built with great effort and care. It would be easier to build a homestead close to the existing tracks then to build a new extensive section to a different location.

The spatial configuration of Bokoni villages and homesteads also informs on social aspects of Bokoni society. Building terraces into the hillside was labour intensive and required far more effort than farming the flat land available (Delius *et al.* 2012). The importance of the crops on these terraces is evident through the construction of roads and paths, which were built in order to balance cattle management with agriculture. Clearly, maintaining, planting, harvesting and processing terrace crops played an important role in the success and survival of the people of Bokoni. The form of agriculture practiced on the terraces probably facilitated the production of a stable food supply. It is also possible that a surplus was produced (Delius & Schoeman 2008; Delius *et al.* 2012; Maggs 2008; Schoeman & Delius 2011).

The configuration of the terraces also inform on the internal social dynamics within Bokoni society. One of the unique features Bokoni boasts is evidence of distinct breaks in the stone walling. The occurrence of stone walling built vertically at 90° to the horizontal walling is similar to that seen in sites in Zimbabwe, for example Nyanga. Soper (2002) proposes that the boundaries in the terracing allocated to each homestead at Nyanga served to section off the horizontal (to the hill) terrace walling (cf. Soper 2002). This may allow us insight into why this type of walling is present at Bokoni sites.

The ongoing research carried out on Bokoni by Peter Delius, Tim Maggs, Alex Schoeman and their teams has started to fill some of the gaps in our knowledge about Bokoni. They have suggested that the occupation of the Bokoni complex was not simultaneous, instead it is theorised to have occurred in four phases (Delius & Schoeman 2008; Delius *et al.* 2012; Schoeman & Delius 2011). The first phase of occupation is the least clear because there is little in the way of oral historical evidence and many of the stonewalled sites have been re-used making it difficult to reconstruct exactly what the initial occupation would have been like (Coetzee & Schoeman 2011). It, however, has been suggested that phase 1 sites cluster in southern Bokoni (Delius *et al.* 2012). Two possible phase 1 sites, Komati Gorge village and Doornkop, have been the subject of substantial archaeological attention over the last few years (Schoeman pers. comm. 2015).

The second phase of Bokoni occupation makes use of open air sites in a time when defence from conflict was not yet of the utmost importance. Instead the focus is on the intensification of agricultural production, optimization of land usage and cattle management. Space is used in a very structured manner, as can be seen in the stonewall structures still standing today (Delius *et al.* 2012; Delius *et al.* 2014; Schoeman & Delius 2011). This phase allows for successful yields, and potentially trading of agricultural surplus and other (Coetzee & Schoeman 2011; Delius *et al.* 2014). Moxomatsi and Khutwaneng are named as two of these phase 2 sites (see Delius *et al.* 2012; Prinsloo 1936).

Unfortunately the people of Bokoni were unable to sustain this period of success. Due to the nature of their open air sites, i.e. a notable lack of defensive walling, or structures that could offer protection from attack, when confronted with attack the options they had were limited to flee or face their attackers. The attacks resulted in the third phase of occupation – refuge in the kloofs and dispersion. Initially many took refuge in the kloofs in the surrounding areas[1], this allowed for an increased ability for defence against attackers due to their position. The location of the refuge sites allowed not only for increased invisibility, warning of impending danger, but also made attack less likely due to the difficulty in breaching their position. This was unsustainable for a long period of time, however, and eventually led to either dispersion to neighbouring polities or capture in the process of attack. The kloofs in the hills around the Badfontein valley, in which Khutwaneng is located, were used as refugia during this period. It has also been suggested that people continued to use the site in the centre of the valley when there was a lull in the violence (Delius *et al.* 2012; Delius & Schoeman 2008).

The final phase of occupation was characterised by the scattering of Bokoni people throughout Mpumalanga. The few who remained in the area moved back to open air sites. These re-occupations were much smaller, and some include square walled structures. This final phase led to the end of the Bokoni as a single clear political group. Many did not return and chose to stay in the societies into which they had been absorbed. Those that did return were unable to recreate the agricultural successes they had once maintained (Delius & Schoeman 2008).

Marakwet

Marakwet is a present day village located in the Kerio Valley on the steep western escarpment of the Rift Valley, Kenya (Davies *et al.* 2014; Fischer 2012) (see Figs 2.8 and 2.9). Marakwet consist of three geologically varied areas; the highlands made up of the Cherangani Hills, the Kerio Valley and the Western Escarpment. These areas vary substantially in factors such as gradient to average annual rainfall. The highlands receive 1100-1500mm of rainfall annually compared to the 600-700mm of annual rainfall experienced by the Western Escarpment and Kerio Valley areas (Moore 1986).

[1] An example being Buffelskloof where the *Prunus* sp. tree was sampled by Aub (2014).

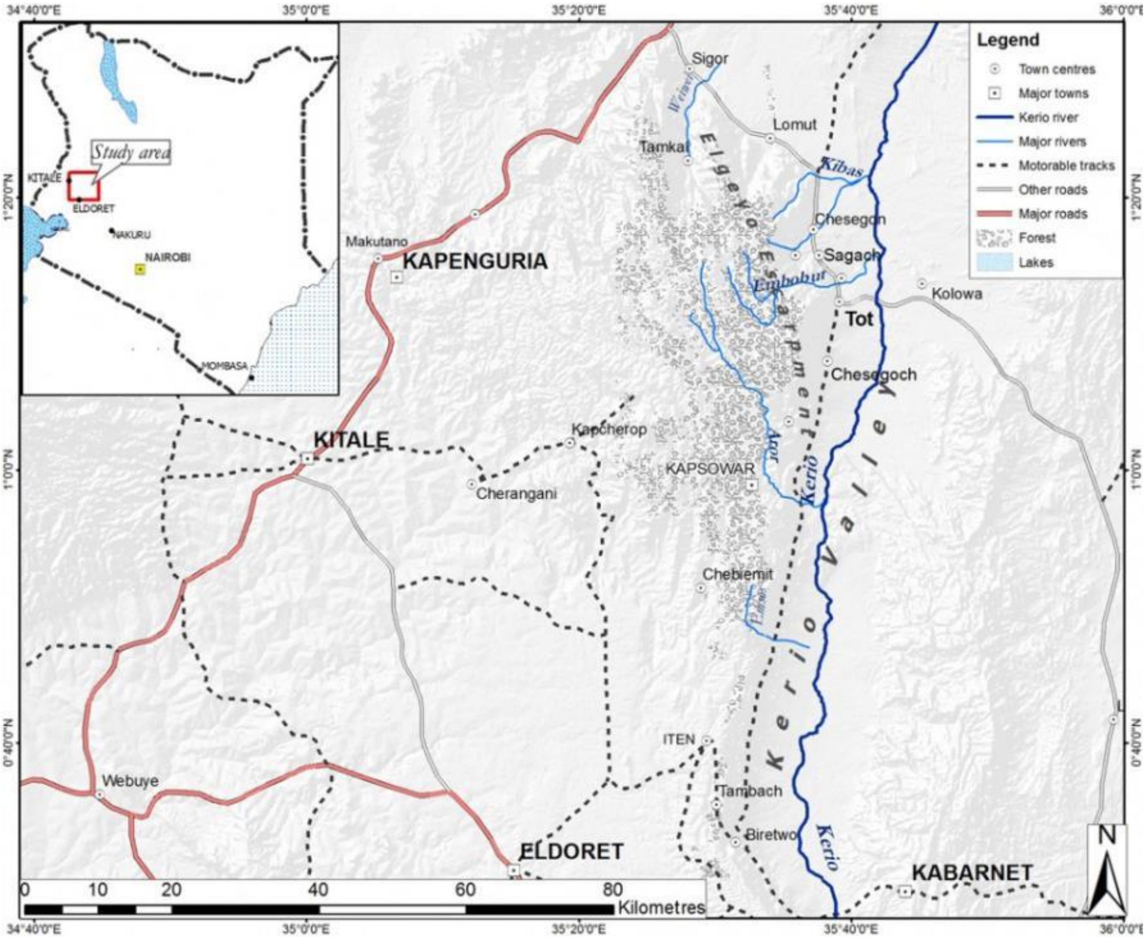

Figure 2.8: Map showing Kerio Valley in context (http://marakwetheritage.com/landscape-and-maps)

Marakwet has a population of ±81 400 people covering 1,595km² of land. The Marakwet people are made up of five sections; Almo, Cherangani, Kiptani, Endo and Marakweta. These sections became a unified group during the process of colonialism in the area (Moore 1986).

The area has become well known for its hill furrow irrigation, terrace agriculture and adaptive agricultural style. It has been proposed that these furrows could be 400-500 years old, based on linguistic studies – however there are no archaeological dates to support this widely accepted theory (Davies 2008b; Fischer 2012).

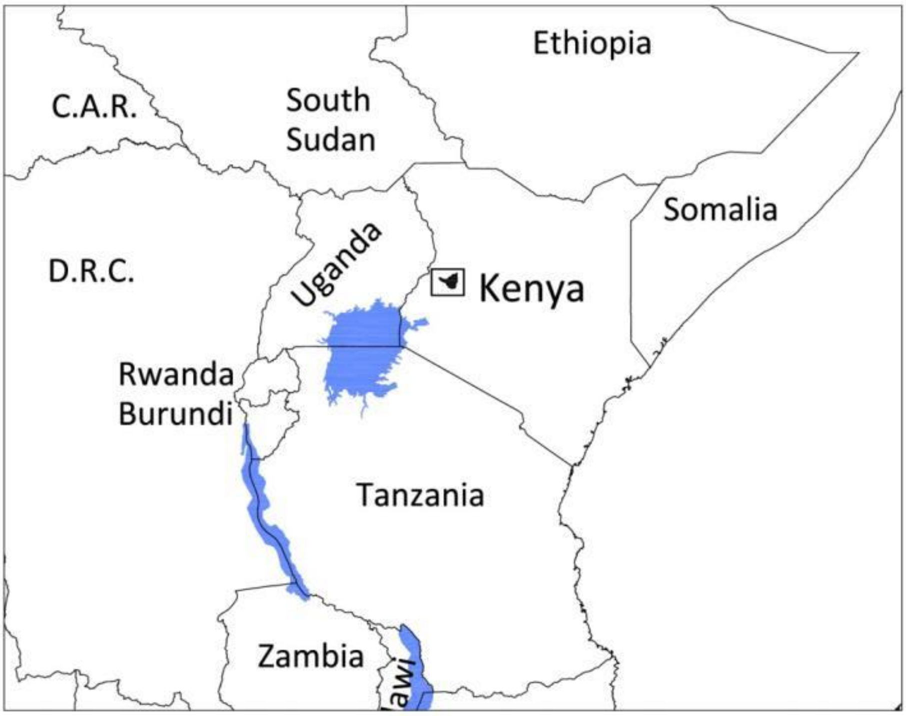

Figure 2.9: Map indicating location of Marakwet (Drawn by Lynda Whitfield)

The agricultural techniques applied by farmers in Marakwet have much in common with those in Bokoni. The clearest of these similarities is the use of terracing in their land management practices. The people of Marakwet have successfully utilised terrace agriculture, which has been particularly effective in dryer areas. The advantages of practicing terrace agriculture can be seen through the continued successful annual yields in Marakwet. This is due in part to one of the major benefits of terracing, particularly on land with a steep slope; it aids in the maintenance of soil structure (Davies 2008).

Vegetation growth is a common cause for unstable soils leading to detrimental levels of soil erosion. This is a common issue encountered when cereal crops are grown on a large scale because both the processes of planting and harvesting, as well as root growth compromise the structure of the soil. Once this structure has been compromised, it can lead to excessive levels of soil erosion during rainfall. Soil erosion becomes problematic when the amount of soil washed away is greater than the amount of soil that would be recouped between planting seasons (Stocking 1996; Stocking & Murnaghan 2001). Building terraces addresses this issue in two major ways; firstly the levelling of the planting area reduces the gradient and increases the force of water required to wash substantial quantities of soils away. Secondly, the soil that is caught up in the downslope wash is caught by the terraces forcing the soils to resettle (Davies 2008).

Figure 2.10: Terracing at Marakwet (http://marakwetheritage.com/agriculture/)

Davies (2008) reported on some of the agricultural techniques adopted by people in Marakwet and Pokot (a neighbouring community). The terraces found at Marakwet (see Fig. 2.9) are most commonly constructed using one of three techniques. The first, and most common of these methods, is referred to as trash- terracing. The second method, stone-terracing, is similar to the first, only differing in that stones are utilised in the construction of a retaining strip rather than vegetation. The last method is usually adopted when terraces are constructed on steep slopes; this process is called fenced-terracing (Davies 2008; Davies 2012).

The cereal crop produce grown in this region also mirror much of what has been found by Collett (1979) and Hattingh (2014) to have grown in the terraces in Bokoni. This includes sorghum and millet. Maggs (2008) also suggested that maize was grown in the area, although no direct evidence has yet been found to support his claim. The land management practices carried out in Marakwet include inter-cropping and fallowing. Some plots of land used for large crops are left to lie fallow for anything between one and ten years. This allows the soil to recuperate and restore the nutrients the crops had depleted. Inter-cropping has also been successfully practised here, pigeon peas, cassava, ground nuts and sweet potato are added in order to aid in stabilising soils and keeping them fertile for longer periods (Davies 2008). The average annual yield figures for maize range between 1000-2000 kg/ha, finger millet yields range between 450-900kg/ha and sorghum yields between 550-1700 kg/ha. These cereal crops are also augmented by the fruit and vegetables grown that are grown in conjunction to the cereal crops (Davies 2009).

Moore (1996) illustrates the growth of a 'house-hold compound'. It begins as a small structure when a man departs from his family home, once the man marries and his family grows his 'house-hold compound' will as well. This often includes the addition of housing for multiple wives, children and aged/widowed parents and structures for livestock (Davies 2010; Moore 1996).

The agricultural land in Marakwet is distributed on a kinship system, much like that suspected in Bokoni. Agricultural land is divided into well distinguished blocks. These blocks are maintained and worked by kin-groups occupying the land associated with these blocks (Davies 2009, 2012; Moore 1996; Widgren 2006). Kin ownership patterns interact with household patterns that are informed by gendered labour. Moore (1986) details how the organisation of space informs on gender relations. Women, in these communities, have a multitude of tasks they are responsible for carrying out. There is also a necessity for these women to stay in close proximity to their home bases in order to care for the young. This impact the way space is used, for example terraces would need to be close to the homestead to allow women to work them effectively whilst still maintaining their other duties (Moore 1986).

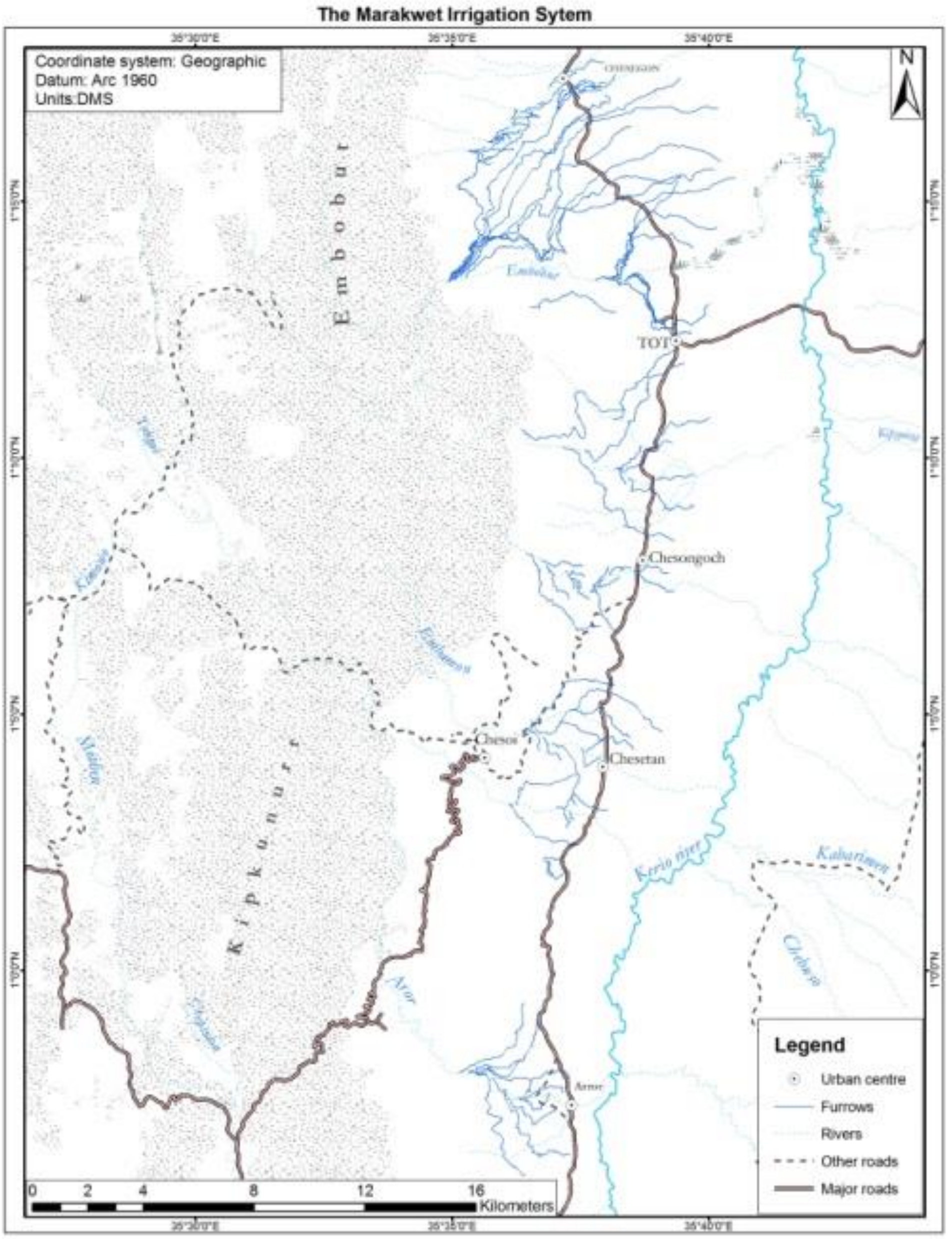

Figure 2.11: Map depicting Marakwet's irrigation system (http://marakwetheritage.com/agriculture/)

One aspect of farming in Marakwet that differs greatly from Willowvale and Bokoni is the use of irrigation (e.g. Fig. 2.11). The Marakwet farmers use irrigation furrows that allow the transport of water for over 40 kilometres. Rainfall in this area is highly seasonal; this results in very dry months in the year. The rainfall in this area is also very unpredictable. In order to circumvent this problem the men of the area constructed irrigation furrows leading from rivers or streamlets (Davies *et al.* 2014; Watson *et al.*

1998). The villages comprising Marakwet are located at substantial distances from a reliable water source, making the incorporation of irrigation furrows into their adaptive survival strategies vital to their success as a community (Adams 1996; Davies *et al.* 2014).

The irrigation furrows used by people of Marakwet are wider than many of the others in the region There are two distinct types of irrigation furrows found in this region as classified by Davies (2008, Davies *et al.* 2014). These are hill furrows (Fig. 2.12) and valley furrows. The type of furrow used is geographically dictated because they tend to make optimal use of the physical features the landscape offers. Hill furrows utilise streams that rely on season rainfall to create a significant water level. A catchment area is built by creating a barrier causing a damming effect. This allows the water levels to increase causing sufficient overflow. This overflow is then channelled by the furrows, using gravity, to direct the water to the areas in need (Adams 1996; Adams *et al.* 1997).

Figure 2.12: Marakwet irrigation furrow (http://marakwetheritage.com/agriculture/)

The distance between the water source and the villages often results in secondary braches being developed off the main furrows- this is uncommon in the other irrigation systems in the region. The people in Pokot, for example, make use of secondary water sources near to their villages as a means of augmenting their water resources (Davies 2008, Davies *et al.* 2014; Watson *et al.* 1998).

The water collected through the irrigation system is distributed systematically; firstly each village receives a portion, following this the water is further divided between the clans/groups that occupy the villages. Once this has been allocated it is shared to individual clan members (Adams 1996; Davies 2008b; Watson *et al.* 1998).

Since 2011, the Marakwet Community Heritage Mapping project has focused on understanding settlement patterns, agricultural practices and lineage distributions. Through the use of GPS mapping, photography and surveys the team, led by Henrietta Moore and Matthew Davies, have created a strong data base on settlement patterns and farming this community (Davies *et al.* 2014).

Willowvale

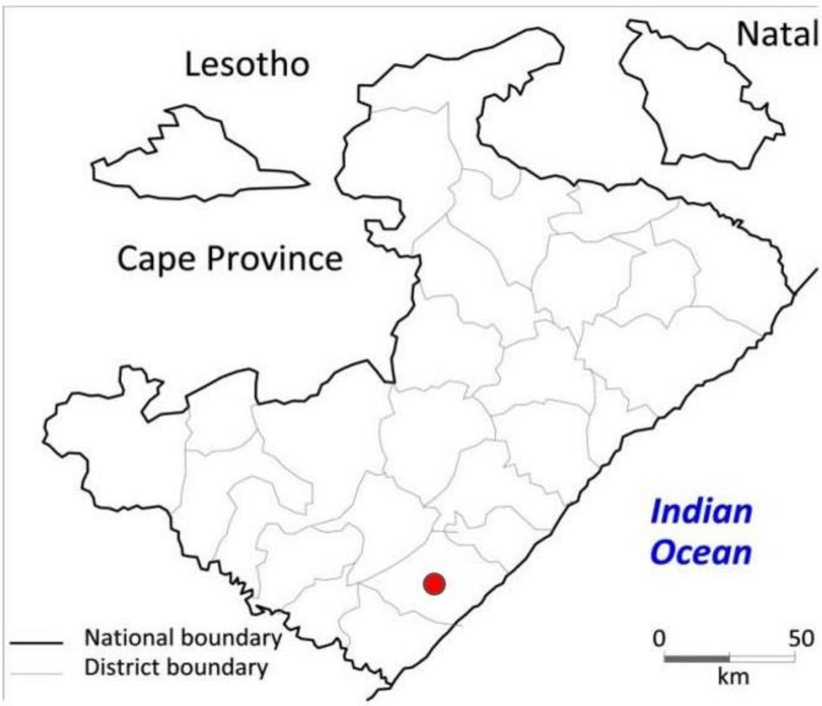

Figure 2.13: Location of Gatyana (indicated by red dot) redrawn from Andrews (1992).

Figure 2.14: Location of districts that constituted Gatyana (Willowvale) (redrawn from Andrews 1992).

The work of Patrick McAllister (1989) and his students on farming in the face of implementation of betterment planning in South Africa (focusing on Willowvale) provides a unique data set on the yields and spatial configuration of a farming-centred community in South Africa.

The Willowvale district, later renamed Gatyana, was one of the two districts 'established' by F.N Stratfield in 1979. These districts were established to strip area chiefs of power, while still attempting to preserve the local economy of the inhabitants (Andrews 1992). Each of the two Main districts were then further divided n to smaller sub-wards. The focus of much of the research carried out is on Shixini and Nompha sub-wards (see Figs 2.13 & 2.14) (Heron 1990).

The population inhabiting the area that would come to be known as Willowvale/Gatyana, was an amalgamation of peoples that had been absorbed by the Xhosa polity during a series of conflicts with neighbouring groups. Once independent groups including the Khoi, Thembu and San people were incorporated, and rather than enslaved, were given equal rights and opportunity to gain wealth within the predominantly Xhosa society (Andrews 1992).

This area underwent periods of change in land management practise and socio-economic structure, the most notable occurring between the 18th and 19th century. This period was significant due both the speed of the changes, as well as the degree to which these changes occurred. This is most commonly attributed to the beginning of colonial contact and the impact that this contact had on the Xhosa people inhabiting this area as well as other Nguni speaking inhabitants (Andrews 1992; Heron 1990). This dramatic transformation began with a change in the dynamic of trading and the importance of surplus. Trade of goods such as tobacco and dagga had taken place between Xhosa-speakers and inland farming societies before the arrival of Europeans in South Africa. This shifted however when other goods offered by the Europeans including beads, iron pots and blankets started to flood the older trade networks (Andrews 1992; Herron 1990).

In the colonial era this desire to trade led to the increased willingness of wealthier individuals to trade cattle that previously would have been used to aid those in the community, who otherwise had insufficient livestock to plough their land. This change in the socio-economic structure of the inhabitants of Willowvale led to a marked widening of the wealth gap. The knock on effect this had was notable because without oxen to plough, yields decreased - meaning homesteads could barely cover the needs of the household. This meant that the wealthier members of society used trade with Europeans to bring substantial improvements to their lives, increasing their wealth in the process, while the situation for those on the other end of the scale became increasingly desperate (Andrews 1992).

In Willowvale two agricultural production methods were used; field and garden agriculture. Field agriculture focused largely on growing starch crops, while gardens were used for a wide variety of crops. Fields were harder to maintain, located farther away from the home base and when cultivated continuously struggled with soil infertility. Gardens, on the other hand, allowed for a far greater diversity in the crops cultivated. This allowed for a greater ability to adapt to changes in climate, ensuring starvation would be avoided (McAllister 1989).

Gardens were the domain of women, while both men and women farmed the fields. The fields were located between 15-30 minutes walking distance from the homesteads and lacked fencing. Use of fields for communal agricultural production decreased in the twentieth century, for many reasons, including that fields were harder to obtain, and after the introduction of the migrant-labour system, men were no longer around to help clear fields. The decreasing labour pool also resulted in a decrease in crop variability, because the smaller labour force meant that fields were shared. Consequently, field production in the 20th century became dominated by maize crop production (McAllister 1989). Furthermore, women felt that the fields were located too far from the homestead to easily maintain. The distance, and associated travel time, made it difficult for them to fulfil their other domestic and agricultural responsibilities. In addition, soil fertility was a constant concern, because these fields were located in less fertile areas, and were difficult to fertilize artificially (McAllister 1989).

In contrast, practicing farming in the gardens allowed for an increase in diversity in the types of crops cultivated, as well as the ability to cultivate crops specific to the needs of each individual homestead. Crop variability is also strategic, because it reduces the chances of crop failure due to temperature or rainfall fluctuations. Gardens were fertilized using manure from livestock in order to increase yield as well as sustaining soil nutrition (Andrews 1992).

In order to circumvent labour constraints to some degree, work parties were organised. These could be held for both agricultural and non-agricultural tasks including brick making, collecting of thatching materials, building necessary structures, thatching, weeding, ploughing and planting. These parties could be either gender specific, or mixed dependant on the task. Two types of work parties were described by Herron (1990) during his research on the people of Willowvale, namely an 'Isicelo' and an 'Indwanda'.

An Isicelo was a work party organised by a member of the household by going to houses in their neighbourhood and extending an invitation to specific individuals. The participants were usually limited to those living in close proximity of the hosting household. The groups were usually small. Beer would be brewed in order to serve the participants, with the exception of parties consisting of young unmarried women who would be served tea, along with bread and samp. In some cases payment exceeded libation and included small stock such as a pigs (Herron 1990).

The second type of work party, an Indwanda, occurred on a significantly larger scale. For these occasions, approximately sixty litres of beer would be brewed. The invitation would be general and extended to the entire section the household is located with. This invitation would be extended by an external individual, i.e. someone who does not live in the household hosting the party, at a formal event such as beer drinking (Herron 1990).

Yield figures for these areas were difficult to obtain because surveys carried out by both McAllister and Herron resulted in a varied range of results. McAllister concluded that between 1975 and 1976 the maize yield ranged between 6.16 bags (554.4kg per household) to 7.02 bags (631.8 kg per household) from the average field and 5 bags (450kg per household) and 12 bags (1080kg per household) from garden harvesting (McAllister 1989). Fifteen years alter Herron (1990) found that much of this variance was the result of the tendency of the inhabitants of to increase production only when the amount of food required increased. He found a higher correlation between the number of consumers and increased yield figures than number of workers and yield. Maize production in particular increased when consumer units per household increased.

The use of a range of farming strategies in Willowvale, and their adaptability when faced with hardship, allows us insight into how important adaptive farming strategies are in order to ensure a community's successful survival.

Summary

The research to date on Bokoni still leaves us with many unanswered questions. It appears that the study of pre-colonial farming in southern Africa in general has aspects that require further study in order to deepen our understanding of this subject. This is particularly apparent when discussing the archaeology of traditional farming in sub-Saharan Africa. Knowledge on how these systems worked and what they may have looked like prior to colonial influence is still an under researched field. In Bokoni specifically large gaps exist due to the lack of ethnographic sources available, his includes questions relating to farming including traditional methods used, exactly what was farmed when and a multitude of social issues. Studies such as this one aim too begin to answer these questions and fill the gaps. While there is evidence on a global scale of the application of concepts such as resilience and the impact of land management strategies on pre-colonial farming communities, there appears to be a lack of research highlighting these issues in the southern African context. Understanding the concepts in a broader sense, through case studies and experimental archaeological research we can begin to apply these ideas.

In the following chapter I provide a description of the methods and techniques used in the duration of this project.

Chapter 3: Methodology

This chapter outlines the techniques and methods applied during the course of this project. This includes all fieldwork as well as data collection and processing. The research for this dissertation gathered data using three methods. The first was based on traditional archaeological field methods, i.e. mapping, shovel testing and analysis of recovered material of the central valley site at Khutwaneng.

The second focussed on the calculation of possible yields in Bokoni under three different environmental regimes as well as three different farming strategies.

The first calculations modelled the impact of environmental change. The environmental regimes considered with regards to the yield calculations carried out were taken from the rainfall record in Woodborne (Woodborne *et al.* 2015) and Aub (2014) that provided maximum and minimum rainfall figures and an approximation of the temperatures experienced. Through phytolith analysis and tree ring isotope analysis a reasonable record has been created upon which the figures and their exploration are based (Aub 2014; Hattingh 2014; Woodborne et al. 2015). The sequence data were then compared to calculations using the average rainfall experienced in the area. These figures were then compared and discussed based on the calculated requirements for the sustainability of the homestead.

The second set of calculations focussed on the potential impact of different farming strategies on yield in Bokoni. The farming strategies used are mono-cropping, intercropping and crop rotation. Mono-cropping is the process by which a single species such as a cereal (like sorghum or millet) is grown. Inter-cropping is the process of mixing legumes or other nitrogen fixing species amongst cereal crops (Devi *et al.* 2014; Mohammed 2012). Crop rotation is applied by planting different species annually or seasonally to prevent nutrient depletion in the soil. Each strategy has a range of yield impact deduced through a multitude of studies and experiments (Gonzalez-Diaz *et al.* 2012). The yield figures were altered accordingly to produce an idea of how yield would vary following the application of each strategy.

The third was the comparative analysis of approaches to farming and yields in Bokoni, Willowvale and Marakwet. This was attained through a comparison of available yield figures for each area, as well us a comparison of the farming techniques we know have been implemented and the impact these have had on agricultural production in Marakwet and Willowvale.

Survey

Khutwaneng (in its entirety) falls across a number of farms outside of Mashishing. The scope of my mapping and foot survey was limited to only one of these farm (albeit the farm containing the greatest portion of the village). The limited scope was due to some farmers being unwilling to allow us onto their properties. The whole village, however, was studied using Google Earth, aerial photography and ArcGIS in order to confirm conformity with the section of the site accessed.

A Google Earth survey of the accessible section of Khutwaneng village was also conducted. The village is approximately 4km long (see Fig 3.1), and comprises numerous homesteads. In order to map and sample a representative sample of the homesteads selection criteria included, size, location, state of preservation and visibility. I selected large, medium and small homesteads (ranging in size from 163m^2 to 1703m^2), located in both the central and peripheral zones. Central zones are categorized as the area around the main central road that runs through the village (refer to appendix 1) the peripheral zones are the areas closer to the outskirts of the village where the homestead distribution is comparatively less dense (refer to appendix 1 and Fig 3.1). In these areas the sizes of the homesteads varied from very large and complex to small and simple. Homesteads were selected at intervals throughout the entire 4km stretch of the village that we had been granted access to. Large and small homesteads were selected in each section of the village in as close proximity to each other as possible. The interval between the homesteads (I.e. 1 and 2, 3 and 4 etc.) averaged at 90m. The greatest distance occurred between homesteads 9 and 10 due the poor state of preservation and the level of disruption that has occurred at the top of the farm boundary. The intervals between the homestead pairs averaged at 200m. Where possible, homesteads offering better perseveration were chosen.

Once these homesteads were selected, a foot survey was carried out to confirm suitability. One of the challenges I faced when mapping was the state of preservation of the homesteads, as well as the extent of the vegetation overgrowth in the area. The site has not undergone seasonal burning for a long period of time, resulting in the grass growing in excess of 2m high in some areas.

I have done my upmost to ensure an accurate representation of the homesteads has been recorded, but it is possible, particularly in the case of terracing, that some features have been over looked. In sections densely covered in vegetation a terrace line can easily be missed (as I suspect is the case with homestead 10).

Figure 3.1: Aerial photograph of a section of Khutwaneng (ArcGIS)

Mapping

Ten homesteads in the Khutwaneng village site located outside of Mashishing were mapped and shovel tested (see Fig. 4.1). The homesteads selected are spread throughout the settlements (see Fig. 4.2) Key features that were identified as common throughout the site are inner and outer homestead walling, terraces, roads and stone lines,. Inner stone walling is defined as walling that form the inner enclosures in the homestead, this structure type was found at all ten mapped homesteads. Outer stone walling is defined as the walling surrounding the inner enclosure, not all homesteads had the same amount of stone walling present – some had no outer walling present at all, some had sections of outer walling and others had complete outer walling present. Terracing is defined as stone walls or lines created in order to demarcate agricultural areas and serve as a means to prevent soil erosion and manage water retention for crops. Terracing was present at all mapped sites. Roads appear throughout the site and join up to the main road that runs through the site. These are well built and are often in a more complete state than the homestead walling. Roads lead from the road into individual homesteads and were present at every homestead mapped with the exception of homestead 4. Stone lines are identified as single lines one stone high used to demarcate specific use areas.

A Differential Global Positioning System (DGPS) was used to compose maps of the individual homesteads, as well as the landscape they are situated in. DGPS mapping uses stationary stations that use fixed points in combination with satellite information to capture points within a specific location (Barcelò & Pallarès 1998; McNamara 2008). Points were taken at the base of the stone walling in fluctuating intervals; this was dependant on the shape of the structure being mapped. A curve in the wall would require points being captured at shorter intervals in order to produce an accurate shape file during the data processing. A long straight wall does not require the same density of data points, thus allowing for wider intervals.

Once these points were taken they were processed using Trimble Business Centre. This software allows one to convert all mapped points into a format we can begin to manipulate. Each point has a GPS coordinate allowing the data to pulled into Google Earth or ArcGIS and locate the site automatically. Once an image has been created the files are exported and transferred into ArcGIS for processing. The mapped images were turned into shape files (for example Fig. 4.5) and overlaid onto aerial imagery of the area. The aerial imagery has a resolution of approximately 2m allowing for smaller features to be visible. An image with a resolution of approximately 2m means that each pixel, when the image is zoomed in on, covers a distance of approximately 2m. The smaller the distance of each pixel is, the greater the zoom quality of the image (Campbell & Wynne 2011). By overlaying the mapped files onto the aerial photographs we are not only able to check the accuracy of the mapped figures, but also locate the mapped homesteads in the context of the village.

In addition to the use of the DGPS mapped images an overview map was created using Arc GIS, Google Earth and aerial photographs. Satellite imagery taken over different years of each section from Google Earth was geo-referenced and layered in ArcGIS over the base layer (the aerial photograph). By looking at different years different features become more and less visible. This allowed for the creation of a map of Khutwaneng, unbounded by farm access, with roads, homesteads and terraced areas identified where ever possible. However, due to the state of preservation it is likely that the number of homesteads is still underrepresented.

Following this, area calculations were carried out using Arc toolbox and the shape files that had been created. This allowed for yield calculations to be determined in order to discern the annual yield for comparison with those of Marakwet and Willowvale. Scales for the shape files were made using Google Earth.

Shovel testing

In addition to mapping these sites, shovel testing was carried out. This was done with Ms Lauren Solomon, who used the soil collected from these pits for her MSc research. The testing was done under SAHRA permit number 5277. Shovel testing was used to establish what the mapped areas were used for, since Collett's (1979) excavations showed that some areas that might appear to be terraces were residential areas. Shovel testing also helped me to gather stratigraphic data, as well as test the soil for remains of material culture (Shott 1989). Shovel testing provided insight into spatial use, soil contrasts in different sections of the homesteads and provided a better understanding of the spatial layout of the homesteads. This was achieved through the artefacts recovered during sieving. The soil comparison also provided an interesting contrast- terrace soils were consistently darker and had higher organic content that the soils within the homesteads.

Shovel testing is a process in which a series of 50cmx50cm or 1mx1m holes are dug – no more than a meter deep (Fig 3.2). The suggested distance these pits can be dug from one another ranges from 1m to 10m (Kintigh 1988; Krakker *et al.* 1983). In this case the intervals were chosen in order to determine what the spaces were used for. The location of each test pit was selected in order to try and determine space function whilst disrupting the site as little as possible. The pits were placed in spaces that would not pose any threat to the integrity of the stone wall structures. Depth was decided based on Collet's (1979) excavations, he dug down in 5cm spits and stopped at level 3 (11cm-14cm) because this level was found to be sterile. The soil for each pit was sieved and artefacts were bagged in brown bags and labelled with the site name, homestead number, test pit number, contents and date. All the brown bags from each test pit were then placed into a clear plastic bag and labelled.

Figure 3.2: Photograph of a test Pit dug at homestead 6 (Photograph: Tiffany Henshall)

Yield calculations

The yield calculations for Khutwaneng were worked out for maize, finger and pearl millet and sorghum. The formulae used to calculate average yield was:

Total production Σ Crop Surface area x μ yield

Both maximum and minimum figures were calculated. The crops – sorghum, finger millet, pearl millet and maize _ were chosen based Collett's (1979) discovery of sorghum seeds at Khutwaneng, the millet and sorghum phytoliths identified by Tanya Hattingh (2014) from other sites in the region, as well as on Maggs' (2008) assertion that maize might have been present in the area.

The data used in the calculations is from the International Food Policy Research Institute (Fermont & Benson 2011) in addition to the Food and Agriculture Organization of the United Nations (Deb *et al.* 2004; Deosthale *et al.* 2012). These sources were selected due to their reliability, relevance and the established reputation of the organization responsible for their production. Once these figures were calculated they were compared to those of Marakwet and Willowvale in order to help infer the potential forms of land management the inhabitants of Khutwaneng may have adopted. The yield figures for Marakwet were obtained through the research carried out by Matt Davies (2008). The yield figures used for Willowvale were based on those presented by McAllister (1989) and Herron (1990).

Figures for crop rotation and intercropping were also calculated in order to ascertain the impact these strategies may have on yield. The figures for intercropping were produced based on experiments carried (Mohammed 2012). The crop rotation figures were calculated using the same formulae for average yields simply taking cowpeas into account as a crop.

Comparative analysis, ethnographic and historical data

Library research focused on ethnographies, agricultural practices in South Africa, as well as the history of Willowvale and Marakwet. This data was utilised in the formation of an analogical comparison, as can be seen in the discussion. During this process I analysed the text, made records of relevant aspects of these papers and dissertations, and cautiously compared as well as contrasted farming in these societies. When using ethnographies as a source of information it is imperative to take into consideration the limitations of this type of source. In order to prevent generalisations, blanket explanations, or make incorrect assumptions it is important to consider the relevance, validity and credibility of the ethnographic study being used (Orme 1974). These sources were approached in a critical manner, referred to as 'reading against the grain' or critical literacy (Bartholomae & Petrosky 1993). This involves critically analysing text in a way that looks beyond the surface of the text (Kramer-Dahl 1995).

The use of ethnographic and historical data by archaeologists is an ongoing challenge that has been extensively debated (see e.g. Binford 1967; Orme 1974; Ucko 1969). I follow Orme (1974) and argue that historical and ethnographic data can be valuable in the development of interpretations of archaeological data. There are no ethnographic accounts about life in Bokoni, and the available historical data on Bokoni does not reflect on their agricultural system. Consequently, my interpretation of farming in Bokoni draws on generalised interpretations of farming in southern African archaeology (Beinart 1982; Bundy 1988; Morell 1986; Quinn 1959; Sutton 1984; 1985) I also took into consideration ethnographic accounts from neighbouring polities. These included the Ndzundza and Pedi polities. It should be noted that this type of research needs to be carried out with caution and awareness regarding the limitations of ethnographic data (Orme 1974).

Willowvale and Marakwet, on the other hand, are living communities, and both have been the subject of the anthropological gaze for a substantial period of time (Andrews 1992; Davies 2008; 2012; Herron 1990; McAllister 1989; Moore 1986). My understanding of approaches to farming and yields is based on engagement with ethnographic and ethno-archaeological sources, which allowed a better understanding of the social life and land management practices adopted in Willowvale and Marakwet.

I use comparative analysis to develop an understanding of approaches to African farming systems, and yields. Comparative analysis was commonly used in anthropology in the twentieth century, but became less popular due to some researchers feeling that there was too high a risk of misinterpretation, bias and generalization occurring (Orme 1974; Smith 1955). Some researchers such as Smith (1955) failed to see a connection between behaviour and material culture. Due to her view that there was no relationship evident, she felt that analogical reasoning was rendered pointless (Orme 1974; Smith 1955)

More recently, however, researchers built on Binford's (1967) call to apply stricter criteria when using ethnographic parallels or analogical reasoning. The move towards applying critical thinking and a move towards greater objectivity has made strides in reducing the tendency to apply generalizations and focus on the data that is of genuine value rather than a broad overview of a subject (Jordan & Yeomans 1995; Orme 1974; Ravn 2011; Trigger 1982).

The work of Stahl (1993) and Wylie (1985; 1988) on the use of analogy within an archaeological context has also pushed for a move towards critical thinking. Stahl (1993) highlights two main areas that need to be assessed when determining the relevance and reliability of an analogy, source and subject- side issues. Source-side issues concern how we select sources and establish their relevance as a basis for analogy. The main criticism of analogy that has no direct historic link is that there is a risk of simply projecting existing ethnography onto the past. In order to avoid this Stahl (1993) suggests critically analysing sources for bias, understanding the standpoint of the author, determining the intended audience of the source and examining the relevance of the time frames considered. Adopting multiple resources may also assist in overcoming criticisms of analogical reasoning (Wylie 1985, 1988). Stahl (1993) stresses that many subject side concerns can be addressed by avoiding the use of analogy as an illustrative device and use it rather as a means to create a comparative model. This can be accomplished by the acknowledgment of both positive and negative points of comparison, highlighting both similarities and differences in the past (Stahl 1993).

In this dissertation comparative analysis was used to examine the ethnographic data from the two sites and the archaeological data from a third, that have no direct historic relationship with one another, in order to start to grapple with agricultural yields at sites where people use traditional farming methods. This was carried out focusing on specific aspects such as agricultural practices in the chosen regions, the placement of homesteads and gardens and the importance of adaptive farming.

Delimitations of this project were limited to homestead choices during the foot survey as preference was given to homesteads displaying higher levels of preservation and the selection of variables accounted for in the formation of the data set.

Summary

The methods and techniques discussed above are all widely adopted and time tested processes. These methods allowed for the creation of the data set below. During the collection and processing of this research, the aim has been to attempt to achieve objective results in order to produce data that maintains the ideology of scientific research. In the following chapter I will present the first set of data collated during this project. This is a detailed site description and a presentation of material culture found.

Chapter 4: Data

Site description

Chapter 4 provides a detailed description of the mapped sites and all material culture recovered during my field work. This data was the result of the foot survey, DGPS mapping, test pitting and analysis of Google Earth and Aerial imagery. The data is there for filed based.

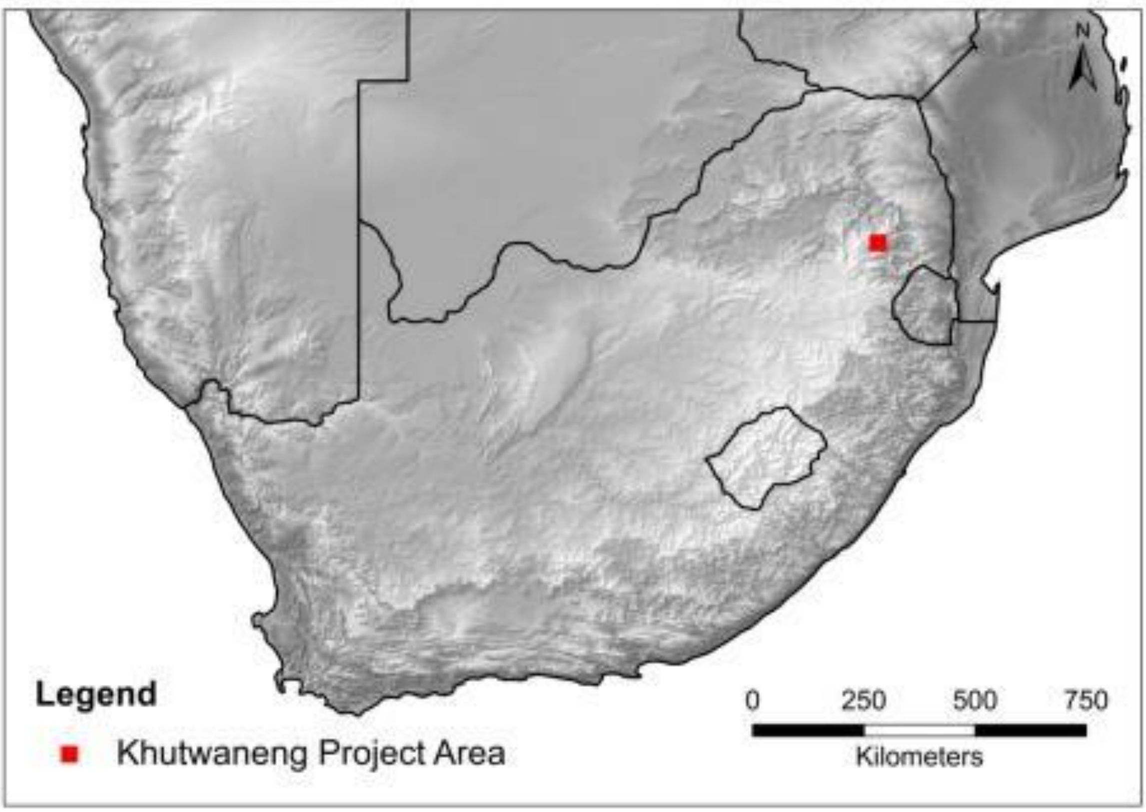

Figure 4.1: Location of Khutwaneng with in South Africa (ArcGIS)

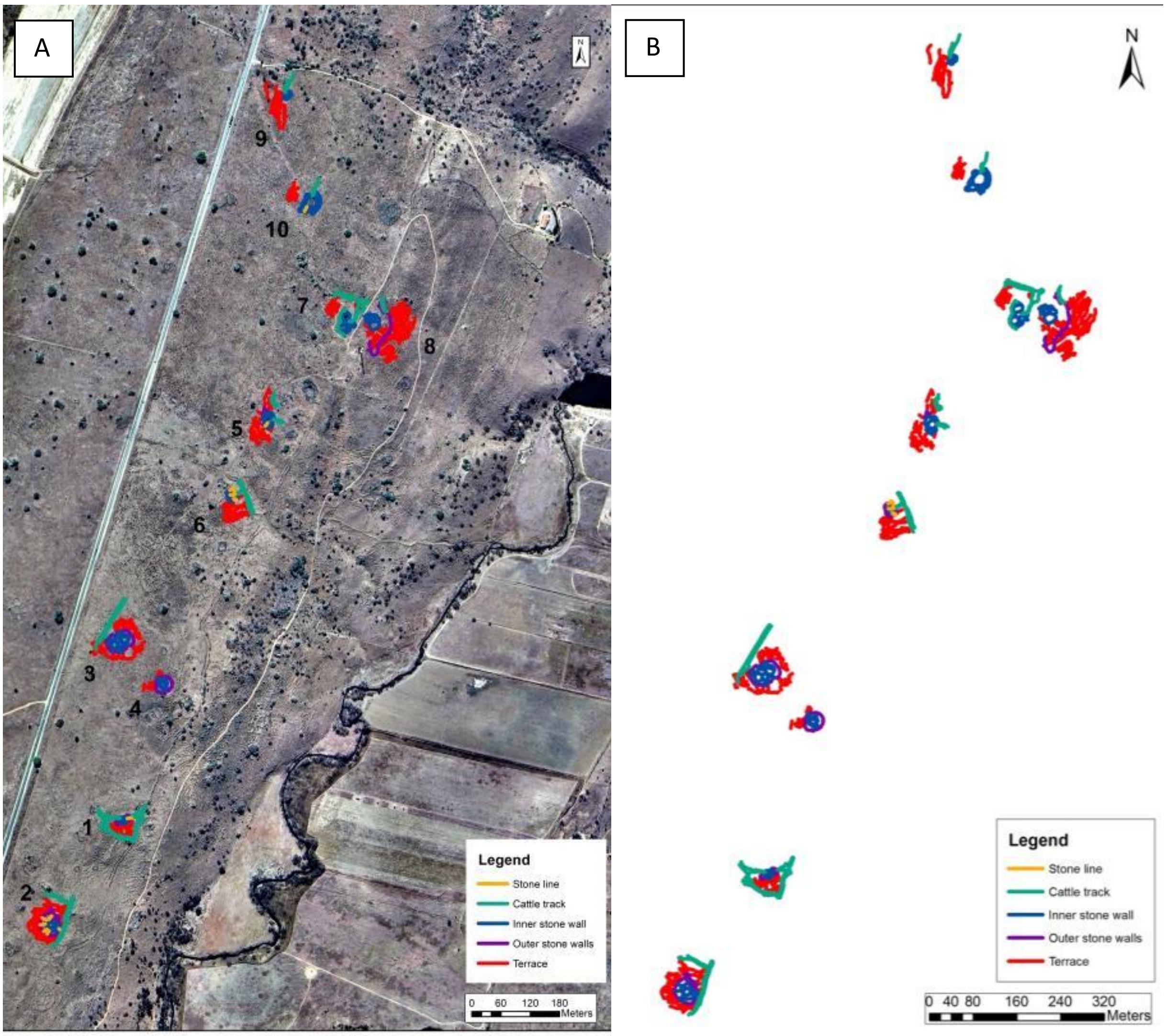

Figure 4.2: Aerial photograph of site distribution with mapped site overlay (A) and site layout DGPS mapped image (B)

The village of Khutwaneng is located in the centre of the Badfontein valley, about 21km south of Mashishing and approximately 3km from the Kwena dam. It is now dissected by the R36 provincial road and several farm boundaries. The bulk of the village falls on the farm surveyed for this project (Figs 4.1 & 4.2). The site is near to the tributaries of the Crocodile River, the most likely water source evidenced by the presence of roads leading to the water source.

The village layout is clustered around the central road (the road that runs through the village) with peripheral clusters on the surrounding valley slopes. The homesteads vary in shape, size and state of preservation. The varied state of preservation makes it difficult to determine an exact number of homesteads. The road system mostly branches off the centre road into tributary roads connecting individual homesteads to the roads and one another. The cattle tracks lead to open valley floors (see appendix A) that show no sign of homestead remains. The valley floors are flat and open. Some of these have been used as present day commercial farming sites.

Homestead 1

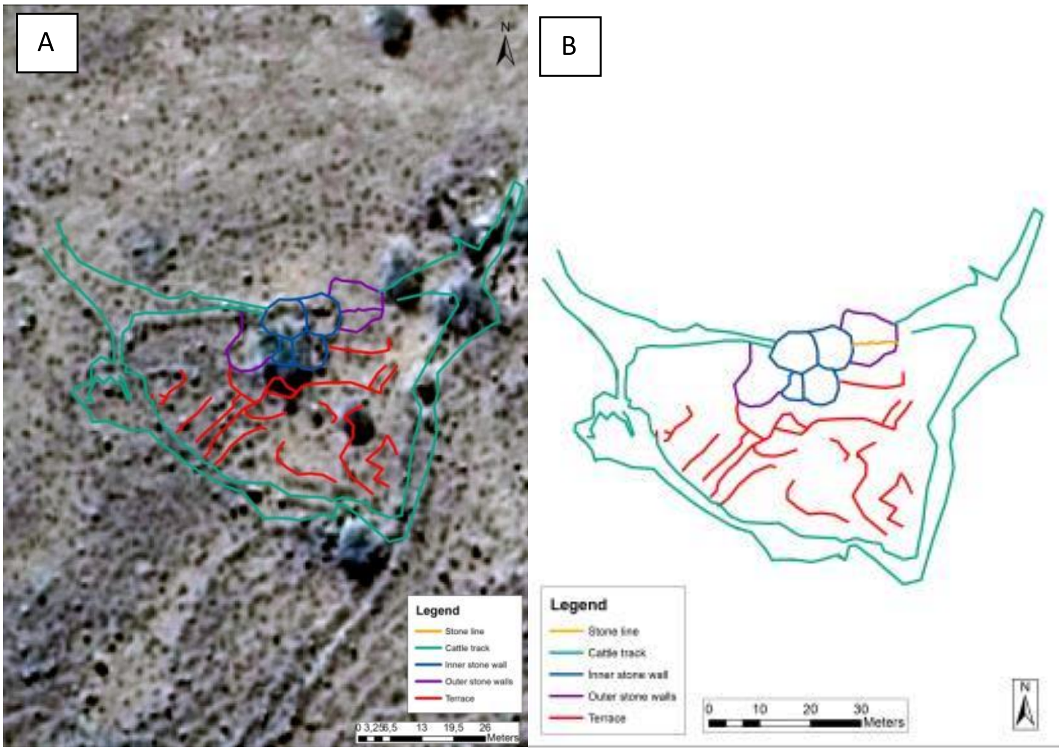

Figure 4.3: Aerial Photograph of homestead 1 with mapped site overlay(A) and homestead 1 DGPS mapped image (B)

Homestead 1 is one of the smaller homesteads at Khutwaneng, where the stone walling is still in a reasonable state of preservation, i.e. there are still large portions of stone walling that are intact and are structurally stable. It is located on the Southern end of Khutwaneng. Homestead 1 comprises a solid soil and rock filled platform, 2.5m wide, surrounded by stone walling this is surrounded by 3 inner enclosures. These enclosures vary from 6.5m to 8m in diameter; each shares a common wall with at least one of the other enclosures. The eastern and western sides of the inner enclosure clusters are enclosed within outer boundary walls.

There is almost no outer wall present. This could be due to numerous factors, such as lack of building material, the length of occupation or the owner could have been in the process of expanding the inner enclosures before completing the outer walling. The Inner walls were well built and have been well preserved in that they are still intact and structurally stable; they average at 1m in height and 70cm in width. There are areas that have experienced minor collapse, but the overall structure of the enclosures is still clear and soundly formed. The remaining/visible outer walls are poorly preserved; they average at 20cm high and have an average width of 30cm.

The open area in-between the outer walling and inner enclosures is divided by a stone line creating area demarcations. Only one of these lines is visible, there may have been more at a stage before degradation of the site took place. These lines extend from the base of the outer wall up to the exterior of the inner enclosures. They comprise of a single or double line of stones, one row high and form a straight, easy to follow line. There is a strong possibility that there were more of these lines that have been disturbed and there for are no longer clear enough to map.

The terracing associated with this homestead is located just to the south of the outer walls (Fig 4.3). It extends approximately 30m from the lowest point of the homestead downwards and 50m across at its widest point. The terracing continues up the eastern and western sides of the homesteads. Some of this terracing extends from the base of the road up until the outer walling of the homestead. The state of preservation of the terraces ranges from 50cm in height to 10cm high. There is a substantial amount of collapse visible in the terracing.

This homestead is located on the southern end of the village where the gradient of the slope is more moderate, the change in elevation over a distance 51.5m was only 3.5m resulting in a slope with a 3.9° gradient. This may explain the difference in terrace walling height. The smaller the elevation change (the ground is flatter at the bottom/southern point of the homestead) the lower the terracing. As the gradient of the slope increases the terrace walling becomes higher. The change in height, however, may also be the result of poor preservation in some sections.

All available land in this homestead appears to have been allocated to serve a function with the exception of the top west corner of the homestead below the road. This area was unterraced and was strewn with small rocks. It appears that all usable land was terraced- the only areas that terracing does not occur in this homestead is occupied either by roads, the actual home stead or large boulders/ boulder clusters.

Homestead 1 is surrounded by walling on three sides. These tracks extend from the main road that runs through Khutwaneng. The branches attach on two sides to openings/entrances of an inner enclosure on the western side, and the other wall on the eastern side of the homestead. The road surrounds the terracing effectively walling it off from potential trample by cattle moving from their enclosures to the grazing areas.

<u>Test pits: Homestead 1</u>

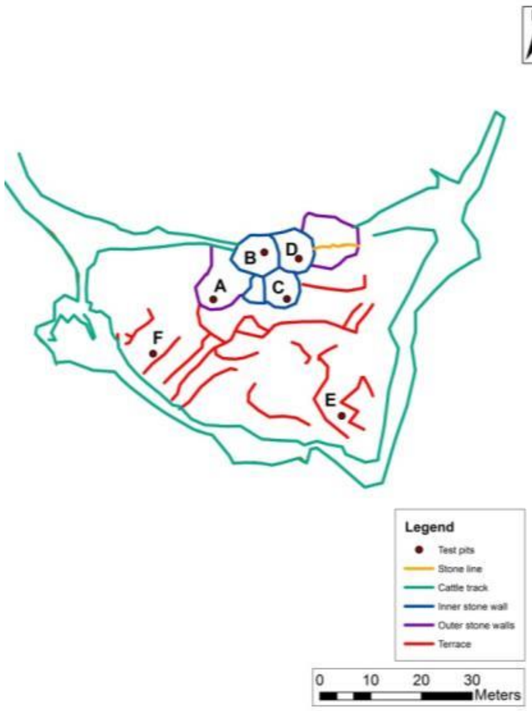

Figure 4.4: Homestead 1 DGPS mapped image indicating the location of test pits.

Six test pits were dug at homestead 1. These were each 50cmx50cm and went down to a depth of 15cm from surface..

Test pit 1 was located in inner enclosure A (Fig. 4.4 A). No material culture was recovered during the sieving of the extracted soil from this test pit. Test pit 2 was located in inner enclosure B (Fig. 4.4 B). This enclosure contained a grindstone located

25cm from the test pit (See Fig 4.5). This pit hit a rocky layer at 7cm that could have been a floor layer. No material culture was recovered from test pit 2. Test pit 3 was located in inner enclosure C (Fig. 4.4 C). No material culture was recovered from the soil sieved from test pit 3; however there was a notable increase in organic content in the soils composition. Test pit 4 was situated in inner enclosure D (Fig. 4.4 D). No material culture was recovered from the soil sieved from test pit 4. The rock content of the soil extracted from the test pit was approximately 5%, slightly higher than the previous test pits. Test pit 5 was placed on the lower section of terracing (Fig. 4.4 E) This test pit contained five pieces of thick, undecorated and potentially weathered body shards of pottery, as well as one decorated body shard. Test pit 6 was placed in the upper section of the terracing associated with homestead 1 (Fig. 4.4 F). This test pit contained three pieces of thick, undecorated and potentially rolled body shards of pottery. Rolled pot shards are shards that have been weathered and the edges rounded/smoothed (rather than jagged), in case during the process of being rolled in the soil over time.

Figure 4.5: Photograph of the grind stone found in enclosure B of homestead 1 (Photograph: Tiffany Henshall)

Homestead 2

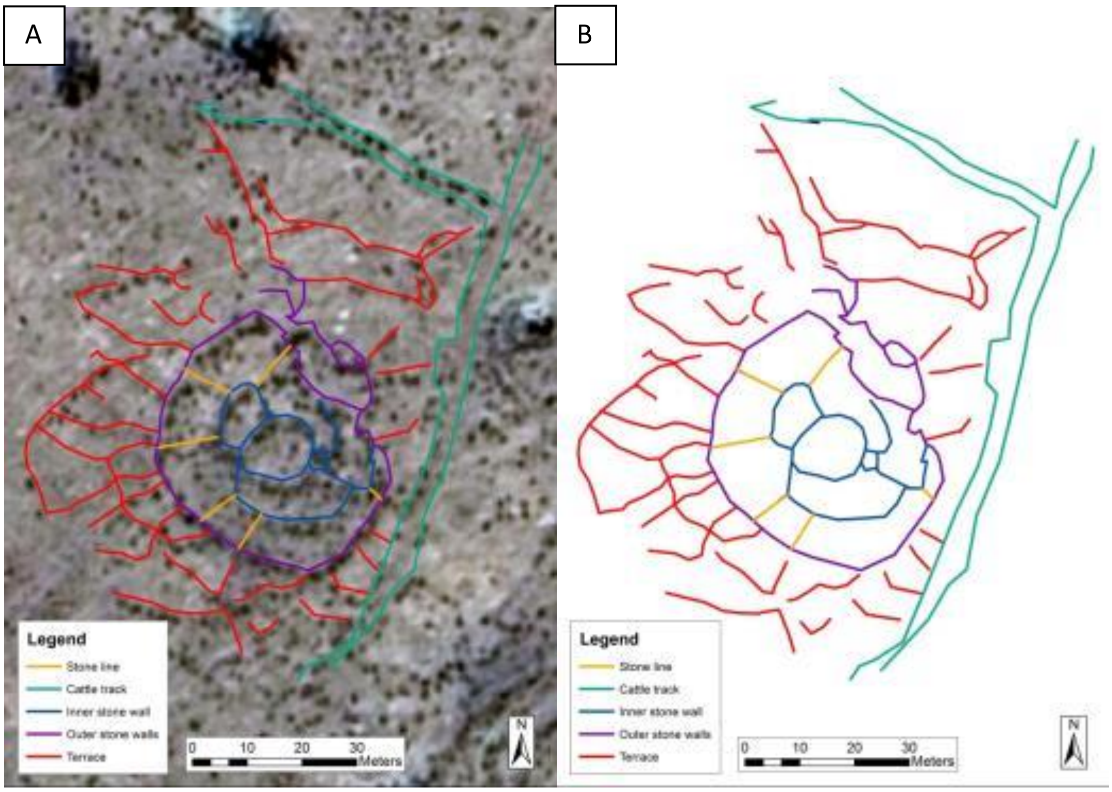

Figure 4.6: Aerial Photograph of homestead 2 with mapped site overlay(A) and homestead 2 DGPS mapped image (B)

Homestead 2 would be classified as medium to large in terms of surface area occupied (see table 5.1 for surface areas). This homestead contains a full outer wall in varying states of preservation; the walls vary between 60cm and 120cm high and 15cm to 1m wide. It is one of the homesteads that displayed a complete outer wall- although this walling was in varied states of preservation. This wall was most likely complete and near level at one stage as the areas in which there is a large height variation, in some cases up to a 60cm difference, piles of fallen rock can be found at the base. Reoccupation after the collapse of the wall is unlikely as the fallen rock would most likely have been redistributed due to limited availability of building materials. The outer walls are constructed using a double line of rocks of various sizing (there is no infill between these two lines however).

The inner enclosure is composed of 4 larger enclosures and one very small enclosure. The walls of the inner enclosures are well preserved and range between 45cm and 76cm in height. They are constructed using the same technique as was utilised for the outer walls. The inner walls are in a better state of preservation than the outer walls and show little evidence of collapse of material removal. The height variation in the walls is also far less evident in the inner enclosures as the walls vary in height by 11cm at most (as opposed to the 60cm range visible in the outer walls), making the overall appearance more uniform than the outer walls. The inner walls have maintained a fairly standard width averaging 40cm with a 5cm margin on either side.

Between the inner enclosure walls and the outer walls there are visible divisions. These are only rock high averaging 10cm in height. These stone lines are most likely domestic use area demarcations. There are 7 distinctly marked off sections of flat open land between the outer wall and the inner enclosures. The improved level of preservation of these lines may be the result of the existence of the outer wall, making disruption less likely. Seven of these divisions were identified, but due to heavily over grown plant life visibility is poor in the open space between the inner and outer stone structures meaning more demarcations may exist.

The terracing at this site covers a substantial surface area both above and below the homestead (Fig 4.6). The terrace walling ranges from 10-20cm and often comprises of a single line of rocks. The land that the terracing is located on has a gentle gradient of 2.9°, which may explain the low walling. This may have served as a division, rather than a means to control rain water dispersion and absorption and the management of soil erosion.

The section of road in the vicinity of homestead 2 runs along the main road that runs through Khutwaneng and then branches off along the border of the Northern most terracing associated with this homestead. The connection to the outer wall of homestead 2 is no longer visible, had it once existed. The road is approximately 1m in height and the sections that were visible (Fig. 4.5) are well preserved with little evidence of collapse. The walls of the main road are high and well preserved though most of the village.

Test Pits: Homestead 2

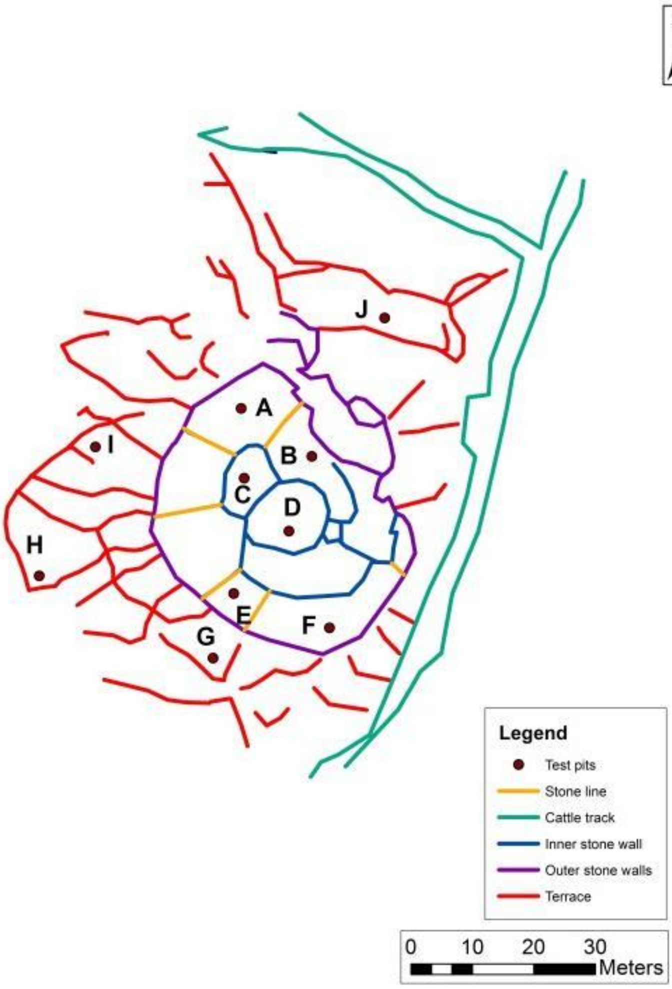

Figure 4.7: Homestead 2 DGPS mapped image indicating location of test pits

Ten test pits were dug at homestead 2. Dimensions for all test pits were standardised at 50cmx50cm with a depth of 15cm.

One piece of rolled, thick walled pottery was discovered on the surface of this test pit. Test pits 1 and 2, marked as A and B on the map respectively (Fig. 4.7 A, B), were situated in the open area between the outer wall and inner enclosures on the northern side of the homestead.

These pits were placed in two sections separated by a domestic area demarcation (stone line). No material was recovered from either test pit 1 or 2. Test pit 3 was located in inner enclosure C (Fig. 4.7 C). One piece of pottery was recovered from test pit 3. It was an undecorated, thick walled body shard. Test pit 4 was dug in inner enclosure D (Fig. 4.7 D). No material culture or significant soil changes were discovered in this test pit. Test pit 5 and 6 marked as E and F on the map respectively (Fig. 4.7 E, F), were situated in the open area between the outer wall and inner enclosures on the southern side of the homestead. One piece of rolled, thick walled pottery was recovered from test pit 5. No material culture was found in the extracted soil from test pit 6. Test pit 7 was located on the terracing situated directly below the southern outer wall of homestead 2 (Fig. 4.7 G). No material culture was discovered in this test pit.

Test pit 8 was dug on the lowest line of terracing associated with homestead 2 (Fig. 4.7 H). No material culture was recovered from this test pit. Test pit 9 was situated on the terracing to the west of homestead 2's outer wall (Fig. 4.7 I). No material culture was recovered from the extracted soil. Test pit 10 was dug on the terracing located to the north of homestead 2's outer wall (Fig. 4.7 J). No material culture was discovered in this test pit; however a higher organic content was noted.

The test pits recovered very little material culture from this homestead. The most notable changes between the test pits were the changes in soil colour and organic content. Soil on the terraces was darker, moister and had a higher organic content. A large number of insects were also discovered in the terrace soils.

Homestead 3

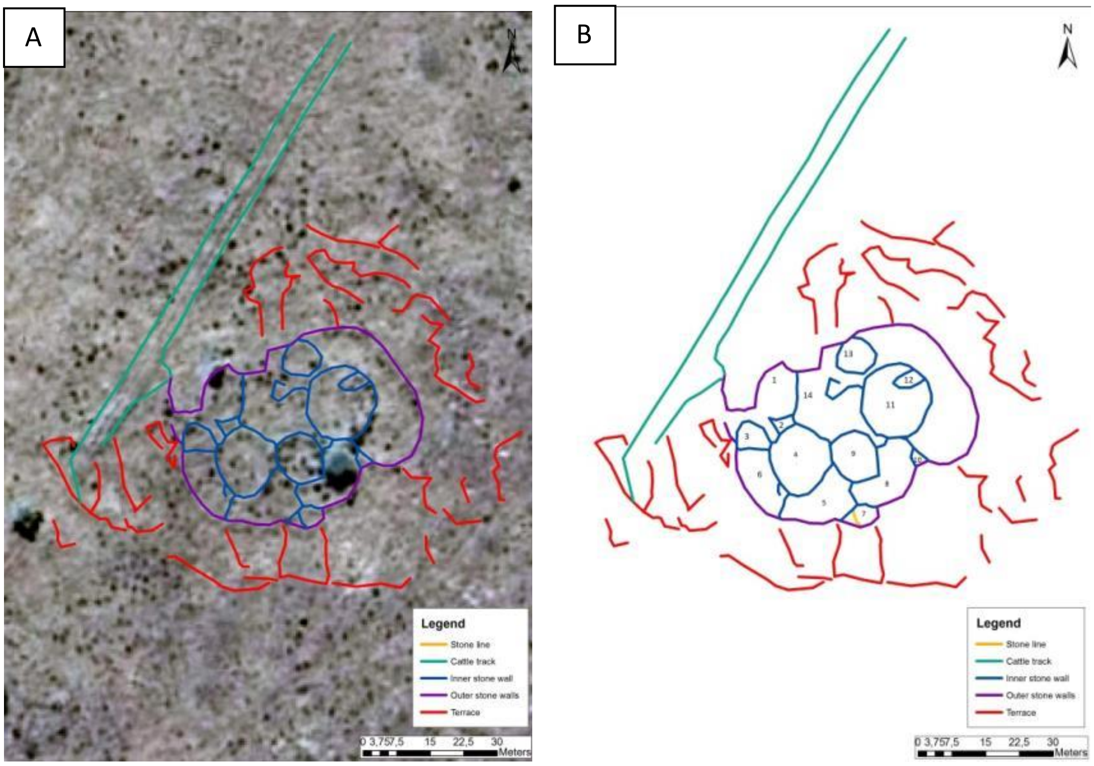

Figure 4.8: Aerial Photograph of homestead 3 with mapped site overlay (A) and homestead 3 DGPS mapped image (B)

Homestead 3 is one of the larger homesteads still visible at Khutwaneng (see table 5.1 for surface areas). This homestead is well developed with walling that, at some stage of this homesteads occupation, was complete. The homestead covers a huge surface area, but contains little open space in between inner enclosures and the outer walling. It consists of outer walls that span approximately 50m from east to west and 35m from north to south. The outer walls of homestead 3 vary in height, width and state of preservation. At their highest the outer walls reach 50cm and 30cm wide, these walls, however, are not common and can be seen patchily across the outside of the homestead. The outer walls average at 20cm in height and show evidence of extensive collapse across the site. There is evidence of faunal damage to a portion of the outer walling, including evidence of animal burrows. This has definitely contributed to the state of preservation of this site. Although the outer walls are considered to be in a fairly poor state of preservation, much of the pre-existing building material can still be seen in crumbled heaps at the base of the remaining walls. The outer walling shows signs of being complete at one stage, but have undergone collapse in some sections. The building material used for these sections can be seen piled in front of the broken sections of walling with the smaller infill rocks spilling from the centre. The piles do not appear to have been intentionally placed there, as one would have expected had the walling still been in the construction process.

The inner enclosures of this site are in better condition. These walls average at 1m in height and 75cm in width. The inner enclosures span most of the land enclosed by the outer walls. They all differ in size, shape and level of completion. The inner enclosures are maze like, almost all of them shared walls with other enclosures forming connections to each other. Most of these enclosures have clearly marked entrances due to a gap that has been neatly constructed. Some of these gaps have an accompanying boulder next to it that fits inside to close the enclosure off.

There are 14 enclosures in total, some of which are very large. All of the enclosures, with the exception of enclosure 13, are connected to one another by stone walling, many of them sharing multiple walls with other enclosures. Inner enclosures 1, 3, 6, 7, 8, 10 and 13 (see Fig 4.8) are built onto or, in part, using the outer wall. Enclosure 7 contains a low partition forming 2 separate areas. Enclosures 2, 10 and 12 are very small - averaging 3.5m in length. Many of these enclosures have entrances that are still clearly visible. This is particularly clear in enclosures 14 and 1. Enclosure 12 is enclosed within enclosure 11- one of the largest inner enclosures at this site. Many of the enclosures contain a substantial amount of vegetation – 8, for example is occupied by a very large tree that forms a canopy over it and the neighbouring enclosure. There is evidence of animal damage to a portion of the walling in enclosure H.

The terracing at this site covers a large surface area. The terraces are wide and spaced between 10m and 5m apart depending on the slope of the ground. The steeper areas - with a gradient of 3.05° - seem to tend toward the narrower spacing of terracing. The width of the space between terraces results in fewer terraces, however, a substantial surface area is still allocated to production. The terracing associated with this homestead has been built surrounding almost the entire homestead- bounded only by a road that runs across the top of the homestead (Fig 4.8). The terrace walling is also in varying stages of decay. In some areas the terraces are constituted by only a single, broken line of stones, in others they are 20cm high.

The road in this homestead is connected to the second main road in Khutwaneng and branches directly off the walling of the homestead. It forms a boundary wall for the terracing, as is seen in many other homesteads. The road it connects to is also extensive and spans almost the entire length of the Khutwaneng site. It has multiple smaller braches that would have allowed cattle to be led in to the appropriate homestead. Many of the homesteads are also connected to one another through smaller branches of these roads, which allows for ease of movement for both humans and animals through the village without putting terraces – and thus crops - at risk of damage.

<u>Test Pits: Homestead 3</u>

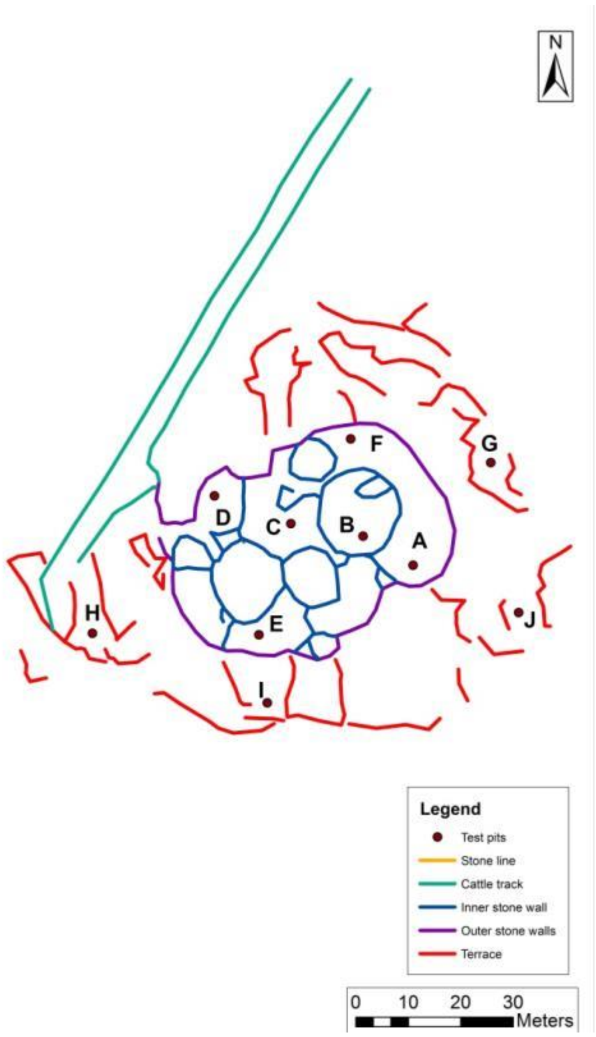

Figure 4.9: Homestead 3 DGPS mapped image indicating location of test pits

Ten test pits were dug at homestead 3. Dimensions for all test pits were standardised at 50cmx50cm with a depth of 15cm.

Test pit 1 was dug in inner enclosure A (Fig. 4.9 A), the enclosure containing a large tree. The soil in this test pit yielded six undecorated ceramic body shards. Test pit 2 was placed in inner enclosure B (Fig. 4.9 B), the enclosure adjacent to enclosure A. Four pieces of undecorated pottery and two pieces of decorated pottery, all body shards, were recovered from this test pit during sieving. Test pit 3 was located in inner enclosure C (Fig. 4.9 C) No material culture or significant soil change was discovered in this test pit. Test pit 4 was placed in inner enclosure D (Fig. 4.9 D). One piece of pottery was recovered from this test pit; it was an undecorated, thick walled body shard. Test pit 5, located between the inner and outer wall on the south eastern end of the homestead (Fig. 4.9 E), contained one thick walled (12mm thick), undecorated pot shard. Test pit 6 was dug between the inner and outer wall in the large open space (Fig. 4.9 F). This test pit contained nine thick walled undecorated body shards. There was no significant soil change noted in this test pit. Test pit 7 was placed on the terracing to the east of the homestead (Fig. 4.9 G). Two pieces of undecorated pot shards were recovered from this test pit, both body shards. Test pit 8 was also placed on the western terracing (Fig. 4.9 H). Five pieces of undecorated thick walled body shards were recovered from this test pit. The soil in this test pit had a higher organic content than that seen inside the homestead. Test pit 9 was placed on the southern terracing (Fig. 4.9 I). This test pit contained four undecorated body shards of pottery and one decorated pot shard. The soil once again had a higher organic content, approximately 60%, than test pits 1 to 6. The last test pit dug at homestead 3, test pit 10 contained two undecorated body shards, and was dug on the eastern terracing (Fig. 4.9 J).

Shovel testing carried out on these terraces once again produced a total of 14 pot shards, but no residential remains. The continued presence of these thick, rolled pot shards on terracing at different homesteads make the likely hood of accidental placement in the terraces extremely unlikely. The fact that they are below surface, some as low as 15cm also tends toward the idea of intention placement. This would be harder to justify if the ceramics had all been found at surface- this could be dismissed as surface wash from rainfall.

Homestead 4

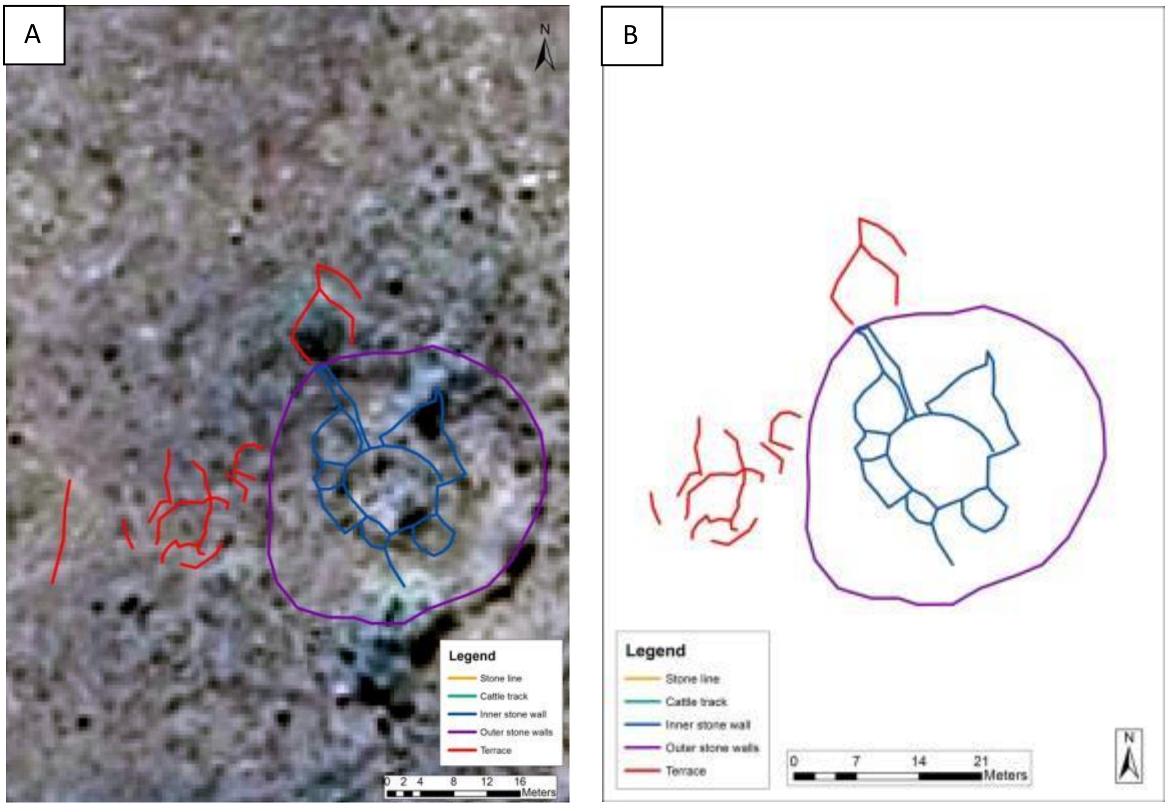

Figure 4.10: Aerial Photograph of homestead 4 with mapped site overlay(A) and homestead 4 DGPS mapped image (B)

Homestead 4 is one of the most peculiar of the ten mapped homesteads. It contains a number of features that none of the other mapped homesteads possessed. The first of these was the manner in which portions of the homestead had been constructed. The homestead was built on one of the few outcrops in the village that contained very large boulders. These boulders are both high and wide making moving them around the site improbable. The homestead was built using the boulders to create a section of the outer walling. The homestead and its terracing have clearly been built around the feature – this is made clear through the gaps in terracing caused by large boulders.

Homestead 4 is a smaller homestead (see table 5.1 for surface areas). The outcrop it had been built into/on contains very large boulders making the boundary walls of this homestead up to 1.5m high, and almost as wide in some areas. This homestead has well preserved outer walling. Where there is decay, there is still remaining evidence of rock fall at the base indicating that the outer wall had been completed. The walls are constructed with larger rocks and boulders in two lines filled with smaller rocks and debris in-between (Fig. 4.11).

Figure 4.11: Photograph illustrating the method of construction used for building walls(Photograph Tiffany Henshall)

The interior of the homestead is extremely overgrown. This creates poor visibility when mapping the inner stone walling. Grass is in excess of 2m high and is dense. The inner walls that were visible were well preserved and formed a flower like pattern. There is one central, slightly larger inner enclosure surrounded by 6 smaller enclosures. There is also a path leading from the central enclosure out of the homestead. The inner walls vary from 50cm to 1m in height, and average at 35cm in width, there is little evidence of collapse on these structures.

Another unusual feature of this homestead is that the gradient of the slope inside the outer walling is steeper than the slope used for the terracing. This once again makes it seem that the design of this homestead was largely influenced by the natural formation it has been built on. The terracing at this site is sparse (Fig 4.10). This may be as a result of the density of flora in this area. Much of the terracing is very poorly preserved, making an accurate representation of the number and extent of terraces very difficult. The upper terracing, located directly beneath the outer walling, forms a petal like pattern.

The terraces run perpendicular to the downward sloping hill. The slope at this site is slightly steeper than homesteads 1 to 3, with a gradient of 5.5°. It then flattens out substantially at the base of the terrace lines. The terraces are mostly widely spaced, with wide gaps, often due to large rocks forming obstacles, in between them. There was no evidence of longer continuous lines as were seen at some of the other homesteads.

Approximately 2m from the homestead is a square stone structure. This structure is constructed differently to the stone walling seen through most of Khutwaneng. The walls comprise small, very tightly packed stones. The walls are about 1.5m high and 80cm wide. They are well preserved and show little evidence of collapse. When compared to the stone walled sites surrounding them they appear very different in layout, shape and construction. This immediately stood out as both its shape and style of construction were in stark contrast to most other homesteads in the areas. This structure was probably built at a later stage, or was the result of exposure to other forms of construction by other groups in the area.

On the lower southern side of the homestead is another 'structure' in the form of the presence of a large tree encircled by large boulders intentionally placed in an upright position. One of these boulders had peck marks on its top end surrounded by a very polished section. This area may have been used for ritual purposes, or it acted as a meeting space of some sort. Whatever its purpose, the occupants found it significant enough to move the large boulders, a task that must have been challenging. This feature is surrounded by terracing associated with the homestead, just over 1 meter from the outer wall of the homestead surrounded by terraces on the slope.

Test Pits: Homestead 4

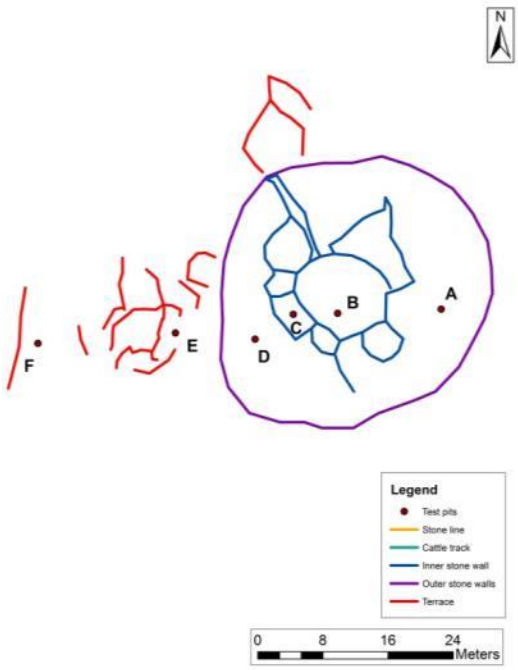

Figure 4.12: Homestead 4 DGPS mapped image indicating location of test pits

Six test pits were dug at homestead 4. Dimensions for all test pits were standardised at 50cmx50cm with a depth of 15cm.

Test pit 1 was placed between the inner and outer wall (Fig. 4.12 A), no material culture was recovered from this test pit. Test pit 2 was dug inside the larger inner enclosure B (Fig. 4.12 B). Three pieces of pottery were recovered from this test pit; they were undecorated, thick walled body shards. The soil in this test pit was darker than the soil in other areas and had a high organic content. Test pit 3 was placed inside the smaller inner enclosure C (Fig. 4.12 C). Seven pot shards were recovered from this test pit; these were thick walled shards (thickness between 12mm and 14mm). Test pit 4 was dug between the north western wall and inner enclosure, (marked Fig. 4.12 D). No material culture was recovered from this test pit. Test pit 5 was positioned on the second layer of terracing on the western side of the homestead, (Fig. 4.12 E). No material culture was recovered from test pit 5. Test pit 6 was situated on the second last line of terracing associated with this homestead, (Fig. 4.12 F). Four pot shards were recovered during the processing of the soil removed from this test pit. Three out the four shards were thick walled pottery (between 11mm and 13mm) and the other was a thin walled shard (6mm thick).

The vegetation growing in and around this homestead was dense. This became particularly problematic in the terraced areas. The preservation of the terracing associated with this homestead was poor to start with, and in combination with dense vegetation resulted in poor visibility. As a result the agricultural area calculated and mapped for this homestead may be an inaccurate representation of the original structures.

Homestead 5

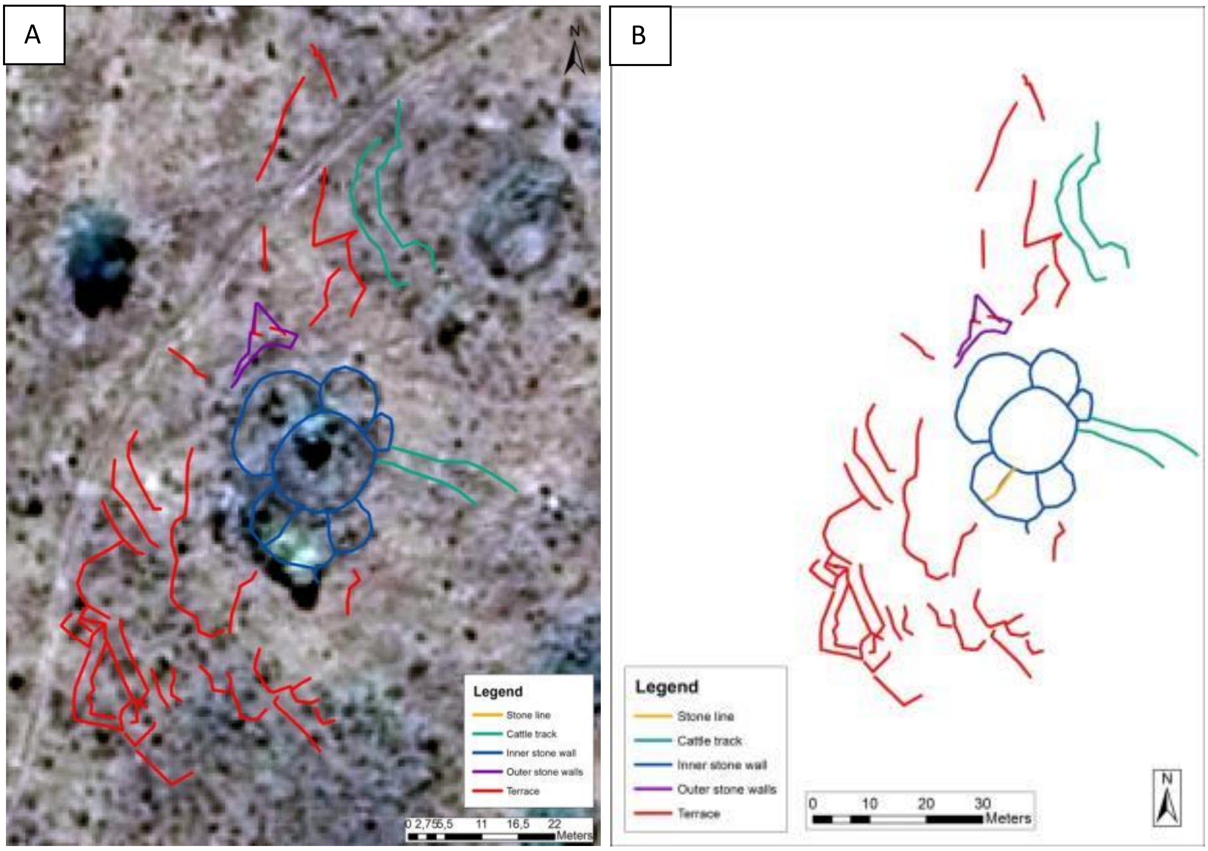

Figure 4.13: Aerial Photograph of homestead 5 with mapped site overlay (A) and homestead 5 DGPS mapped image (B)

Homestead 5 is a medium sized homestead (see table 5.1 for surface areas). It has almost no outer wall - it is very likely that no outer wall had been built as there is no evidence of collapse and no visible sizable rocks dispersed in the area surrounding the homestead. There is one small section of potential outer wall on the western side of the homestead connected to part of the terracing. Other than this missing feature, there is little remarkable about the structure of this site. The walls of the inner enclosure are high and wide, showing little evidence of damage to their structure. The inner enclosures mirror the flower like pattern seen at many of the homesteads found at Komati Gorge.

The inner walling of this homestead is very well preserved. The walls are up to 1.5m in height and are about 2.2m wide. They are constructed in a manner similar to those seen in homestead 4, two parallel lines of large rocks and boulders with smaller rocks, potsherds and debris filling the space between. This type of walling appears to withstand weathering and natural forces well because there is less evidence of collapse at sites where this technique had been used. The inner walls follow a flower like pattern with one larger centre enclosure surrounded by 6 smaller enclosures (Fig 4.13). Inner enclosure D has been split levelled. The separation has been made using a line of stone, and creating a platform type effect by raising one side of the enclosure, building one side up by 15cm. There are multiple entrances built into the inner stone waling allowing ease of access to all of the enclosures. Shared Walling (in-between) the enclosures is up to 30cm thicker than the walls that do not have connecting walls or structures.

The terracing is small and sparse near the top of the homestead, but increases in length and quantity as the slope increases (Fig 4.13). The lower terraces are very long and extend to lengths of up to 45m. The terrace walls vary in size from very low (only a single line 10cm high) to 30cm high. As the gradient of the slope increases,[2] the width of the terracing decreases. This would allow for the optimization of the land for agricultural practices. Terracing at this homestead makes use of all available space and is fairly inconsistent in size and shape. The builders appear to have built the walls to follow the natural flow of the land, rather than to achieve any type of uniformity. The same can be said for the spaces between the terraces. Once again pottery was found in the tests pits dug on the terraces of this homestead.

[2] The gradient is fairly gentle at 2°.

A road connects to the South eastern corner of the homestead. This divisional road leads to the main road and eventually towards the grazing areas. A second road appears on the north western side of the homestead. This section is poorly preserved and shows visible collapse.

In addition to the roads, a pathway distinguishable from the roads due the size of the entrance into the homestead and the width of the path, is visible leading from homestead 5 to a secondary smaller homestead about one quarter the size of homestead 5. The path is far narrower than the divisional road leading to the main road. The width makes the intended purpose of this path more likely for human traffic than to control the movement of livestock. The homestead that the path leads to, appears to be in the process of construction since there are large portions of walling missing but no evidence of rubble from collapse. The pathway connecting the two homesteads shows evidence of degradation due to animal activities. There is evidence of porcupine rubbings along the walling and burrows under certain sections.

Test Pits: Homestead 5

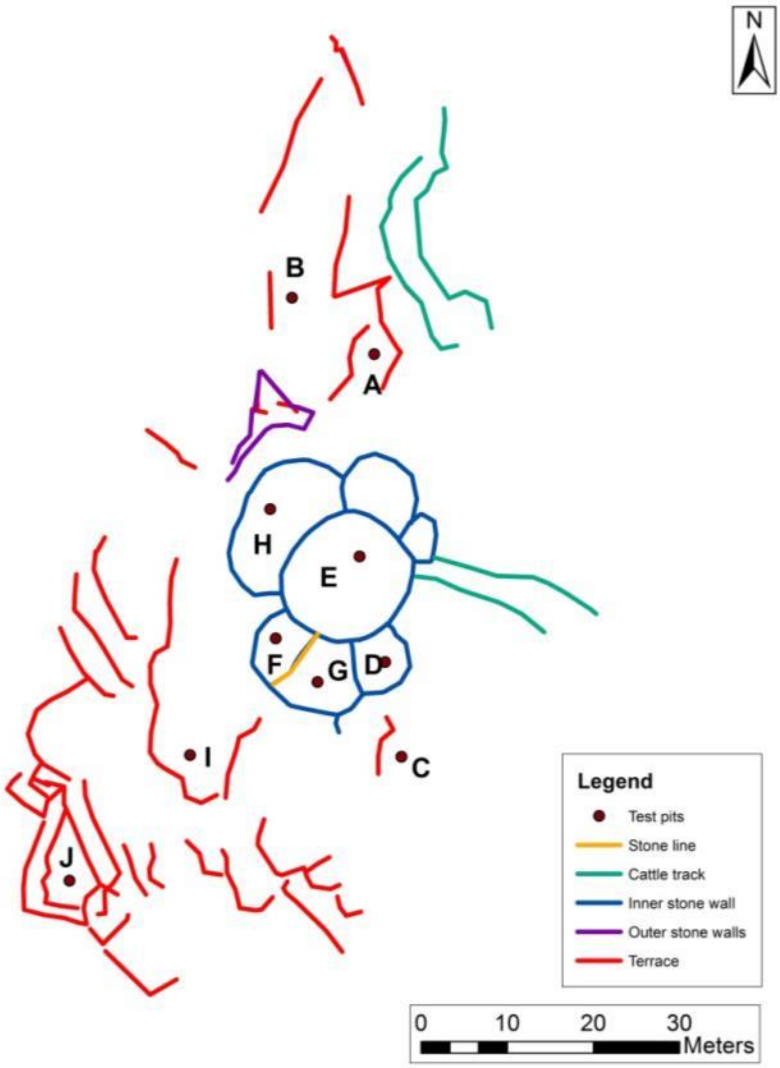

Figure 4.14: Homestead 5 DGPS mapped image indicating test pits

Ten test pits were dug at homestead 5. Dimensions for all test pits were standardised at 50cmx50cm with a depth of 15cm.

Test pit 1 was dug into the downslope, right terracing (Fig. 4.14 A). The soil had almost no rock content unlike the other test pits. No material culture was recovered from test pit 1. Test pit 2 was placed on the terracing above test pit 1 (Fig. 4.14 B). One undecorated body shard was recovered from this test pit, no soil changes were noted.

Test pit 3 was dug into the terracing on the southern end of the homestead. It was placed in the top section of this terracing, near the homestead wall (Fig. 4.14 C). No material culture was recovered from this test pit; a change in the soil composition, however, was noted. The soil from this test pit displayed greater rock content.

Test pit 4 was situated in enclosure 1, the large central enclosure (Fig. 4.14 E). One undecorated body shard was retrieved during the digging of this test pit. Test pit 5 and test pit 6 were located in inner enclosure D (see Fig. 4.14 D); this enclosure was built on two levels, separated by a stone-line. No material culture was recovered from either test pit. Test pit 7 was placed in inner enclosure F (Fig. 4.14 F). Three undecorated body shards were recovered from this test pit. No significant soil changes were noted. Test pit 8 was dug in inner enclosure G (Fig. 4.14 G) two undecorated, thick walled (12mm thick) body shards were recovered during the sieving of this test pit. Test pit 9 was dug into the lower terracing on the southern side of the homestead (Fig. 4.14 H). One undecorated body shard was recovered from this test pit. A 30% higher organic content was noted in the soil recovered from this test pit. Test pit 10 was situated on the lowest level of terracing beneath test pit 9 (Fig. 4.14 I). No material culture was recovered from this test pit. Four undecorated body shards were found in the outer stone walls of homestead 5. During the survey a large number of pot shards were found in a stone pile. The thirteen shards could be pieced together to create a large portion of a single vessel. Two decorated rim shards and one decorated body shard were also recovered in a surface collection done at this homestead.

Homestead 6

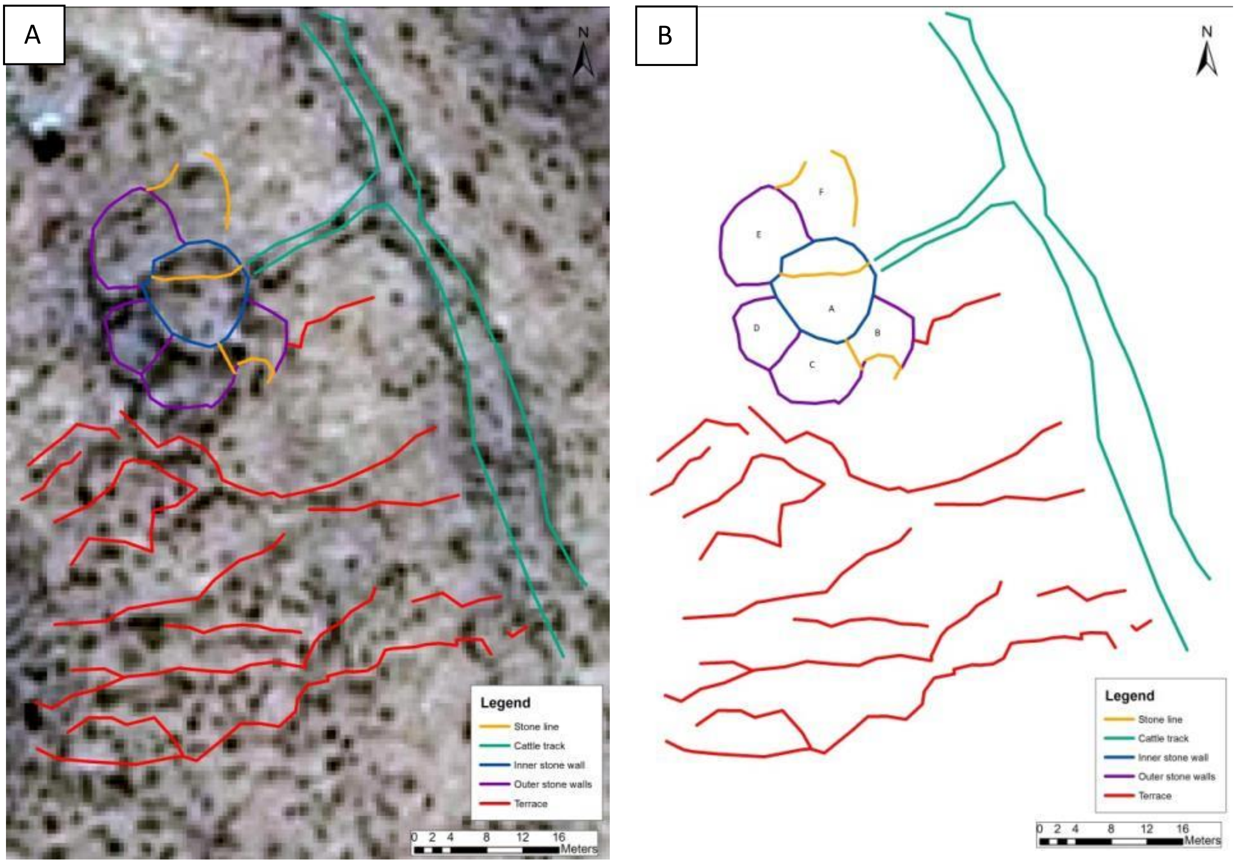

Figure 4.15: Aerial Photograph of homestead 6 with mapped site overlay(A) and homestead 6 DGPS mapped image (B)

Homestead 6 is a smaller homestead. The walls in this homestead vary in levels of preservation from very good to complete collapse. Homestead 6 was built on one of the steeper slopes in the area. There are no visible outer walls either due to poor preservation or non-existence; there, however, is no rock fall that would suggest that it collapsed.

There are six inner enclosures at this homestead (Fig 4.15). One larger central enclosure surrounded by five smaller enclosures forming a petal-like pattern. The large central enclosure is separated into two sections divided by a stone line on two different levels. The higher section (the smaller of the two) A, appears to be a raised platform of sorts. The platform is 45cm higher than its lower level. The motivation behind this is unknown but it is likely that the area was separated for different tasks. Although a test pit was dug in each half of the enclosure the results offered little in the way of indication with regards to the function of the space. There were no notable soil changes between the two sides and only one pot shard was recovered from the lower level. The presence of the shard may indicate that at least half of the area was used for domestic purposes.

This homestead may shed some light on the construction processes. Both the northern section and part of the southern sections of the inner enclosures appear to be in the process of construction. The southern section is near completion, with only a small section demarcated with medium sized rocks. Enclosure B (Fig. 14.15 B) has two well preserved walls averaging 70cm in height and two walls that consist of large boulders lined up in the shape of the wall. It appears to be in the process of being constructed. Enclosures C, D and E all have well-constructed, well preserved walls. These walls range between 60cm and 70cm in height and 45cm in width. Inner enclosure F has only one fully constructed wall, this wall is shared with enclosure A. The remaining 3 walls are made up of a single line of medium sized boulders as if being laid out in preparation for constructing the walls.

The entire northern most inner enclosure appears to be under construction. The shape of the enclosure is laid out in tightly packed medium sized rocks, averaging 70cm in height. If this section is compared to the completed walling it would appear that this would be part of the early stages of construction. A bored stone, probably used to as a hoe weight, was also found left in the middle of the terracing (Fig 4.16). The unfinished state the homestead was left in could imply that the occupants abandoned their home in a hurry.

The road connected to this homestead is very well preserved. It connects to the north eastern side of the homestead, extending 17m until it reaches the main road. This section of the road is located about 60 meters above the cross roads (the four way intersection in Khutwaneng's central road). This section of the road displays one of the best levels of preservation at the site, with walls reaching 1.5m in height and 1 meter wide. This section can be seen very clearly on satellite and Google imagery (see appendix 1).

Figure 4.16: Photograph of bored stone found discarded on terracing (Photograph: Tiffany Henshall)

The terracing at this homestead extends approximately 50 meters from the southernmost homestead wall. The terraces also vary in levels of preservation or stages of construction; some of the terracing is still seemingly fully intact and appears structurally sound while others are missing sections. The higher terraces, on the steeper section of the land beneath the homestead, vary between 15cm and 30cm in height and are easy to follow. The gradient of the slope is 3.5°. The lower terraces, heading southwards, are usually only a single stone row high and can be dispersed in sections. There is some terracing present attached to the outer wall of inner enclosure B. This small section covers approximately 71m² between the homestead, divisional road and the main road.

Test Pits: Homestead 6

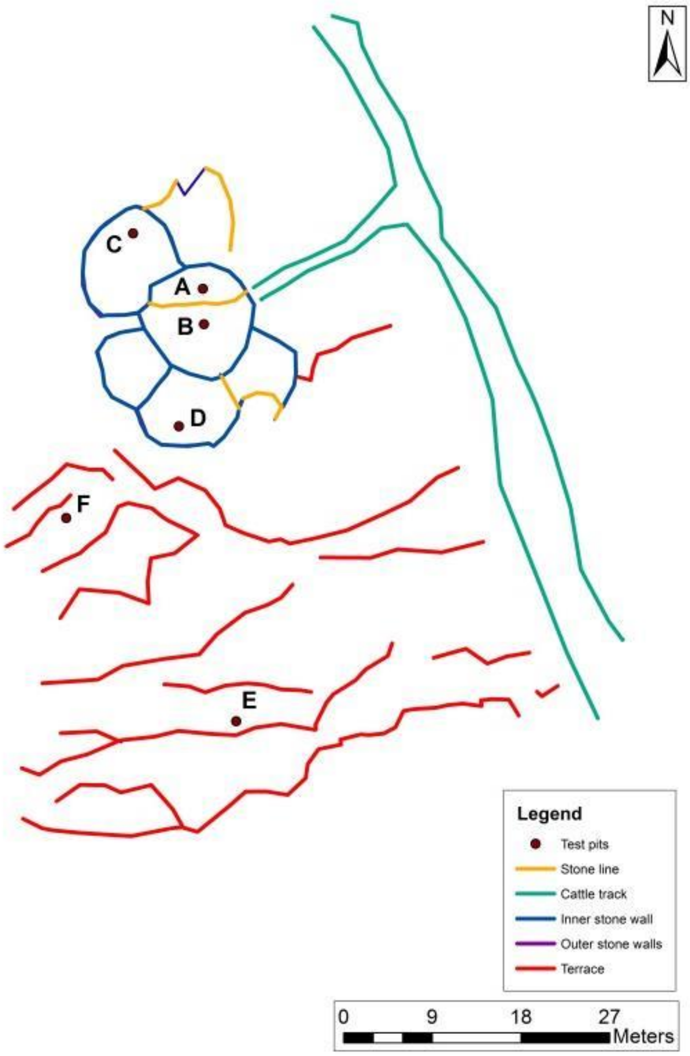

Figure 4.17: Homestead 6 DGPS mapped image indicating location of test pits

Six test pits were dug at homestead 6, one of the smaller homesteads at Khutwaneng (see table 5.1 for surface areas). Dimensions for all test pits were standardised at 50cmx50cm with a depth of 15cm.

Test pit 1 and test pit 2 (marked A and B respectively, Fig. 4.17) were placed in the large central inner enclosure. This enclosure is on 2 levels separated by a stone line. Test pit one was dug in the southern section of this enclosure. One undecorated body shard was recovered during the digging of this test pit. Test pit 2 was situated in the northern section of this enclosure, on the raised platform. No material culture was recovered from this test pit and no soil changes were noted. Test pit 3 was placed in inner enclosure C, on the northern side of the homestead (Fig. 4.17). One undecorated body shard was recovered from this test pit. Test pit 4 was dug in inner enclosure D on the southern side of the homestead (Fig. 4.17). One ceramic shard was recovered from this test pit, an undecorated thick walled (13mm) body shard. No soil change was noted. Test pit 5 was placed in the centre of the terracing to the south west of the homestead (Fig. 4.17 E). One undecorated body shard was discovered in this test pit. In addition to this it was noted that there was significantly higher organic content in the soil on the terraces. Test pit 6 was placed on the northern most terraces (Fig. 4.17 F). No material was recovered from this test pit. A bored stone was recovered on the terracing during a surface collection (Fig. 4.17).

Homestead 7

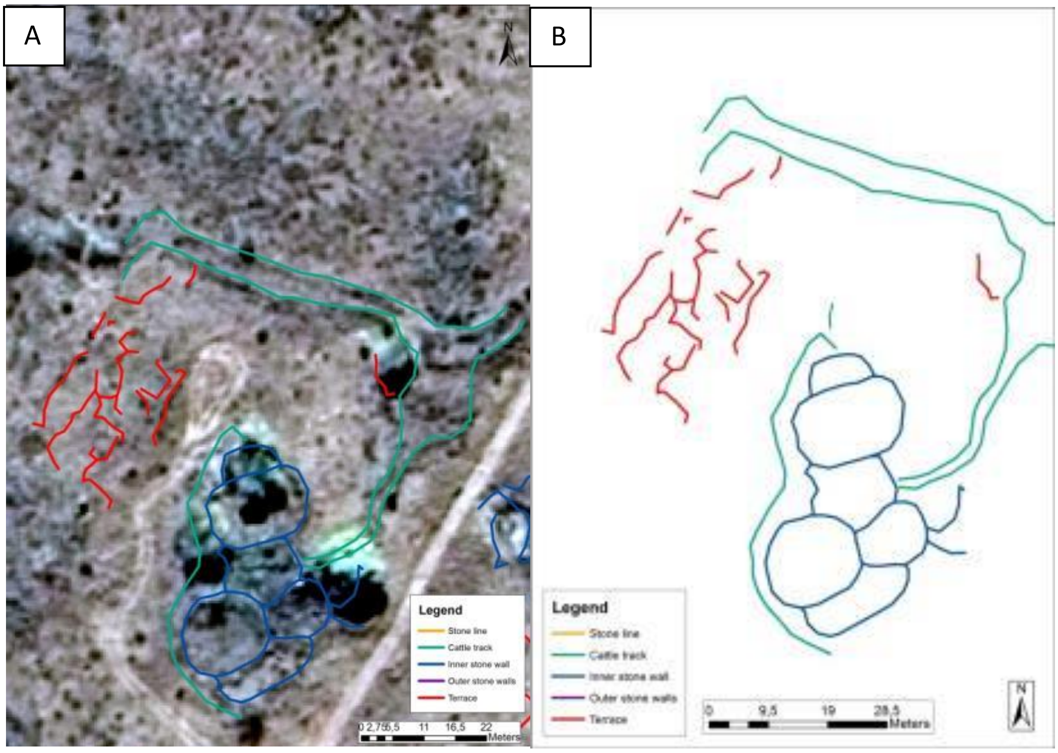

Figure 4.18: Aerial Photograph of homestead 7 with mapped site overlay(A) and homestead 7 DGPS mapped image (B)

Homestead 7 is a medium sized homestead with very well preserved inner walls, there are still large portions of stone walling that are intact and are structurally stable (see table 5.1 for surface areas). There is no visible outer wall to speak of at this homestead. There is no evidence that an outer wall had ever been in place at this site as there is no collapse or stray rocks that would have been sizable enough to be utilised as building material.

There are 6 large enclosures at this site, ranging in diameter between 5m to 18m (Fig 4.18). All of the enclosures share at least 2 walls with another enclosure. Shared sections of walling are thicker than the areas with no connecting walls. The layout of the enclosures differs from the more common flower pattern seen at many of these sites. There is no clear centre enclosure, since the enclosures have not been built focusing around a single larger stone walled structure. In this case 3 of the enclosures are large and none are central. There are two walls on the eastern side of the inner stone walling that branch off, the first extends for approximately 11m curving northwards then stops. The second extends for about 7m in an easterly direction before it ends.

The walls that make up the enclosures are well preserved; they show little evidence of collapse and average at 1.5m high and 2m in width. The methods of construction at this site change in different sections. The outer walls of the enclosures are constructed using the 'two rows of bigger rocks, with a filled centre' technique while the inner walls of the enclosure vary between a single or double line of large rocks and boulders (Fig. 4.19). The few areas of inner tone walling that show evidence of collapse are constructed using the latter technique.

Figure 4.19: Photograph of inner wall of homestead 7 (Photograph: Tiffany Henshall)

In recent years Vodacom constructed a cellphone signal tower in the middle of Khutwaneng. During the process of the construction of this tower several homesteads were damage. In the case of homestead 7, a large section of the road and terracing were removed to make way for an access road. The differences can be seen on Google Earth time lapsed satellite imagery that show homestead 7 and 8 before and after the construction of the tower (see Figs 4.20 and 4.21).

Figure 4.20: Satellite image of homesteads 7and 8 before the construction of the Vodacom tower

Figure 4.21: Google Earth image of homesteads 7 and 8 after the construction of the Vodacom tower and its access roads

There are 2 roads present at this homestead (Fig 4.18). The first runs the entire length of the western side of the stone walled enclosures, connecting to an entrance on the northern end of the enclosures. The southern end of this road begins to curve toward the main road through Khutwaneng. Unfortunately a large section of this road was destroyed during the construction of the Vodacom tower and access road located between the bottom of homestead's 7 and 8. The second road extends from enclosure A (on the eastern side of the enclosures) northwards, curving and splitting. One branch heads west towards the terracing associated with this homestead, the other continues north connecting to the main road. The walling of the road is well preserved and show very little evidence of collapse in this section.

Due to the construction a large part of the terracing appears to have been removed. The result is that the agricultural area may not accurately reflect the original structures. The terracing associated with this homestead is located to the north west of the enclosures. They have been built of the steepest slope available to the inhabitants of this homestead. The gradient is 6.04°, which may be the cause of the substantial width of the terracing. The terraces are up to 6m wide and irregularly spaced. They vary in length and shape as they follow the flow of the incline. The middle areas are built into box like shape. The terrace walls vary in height from very small at 10cm up to 30cm.

Test Pits: Homestead 7

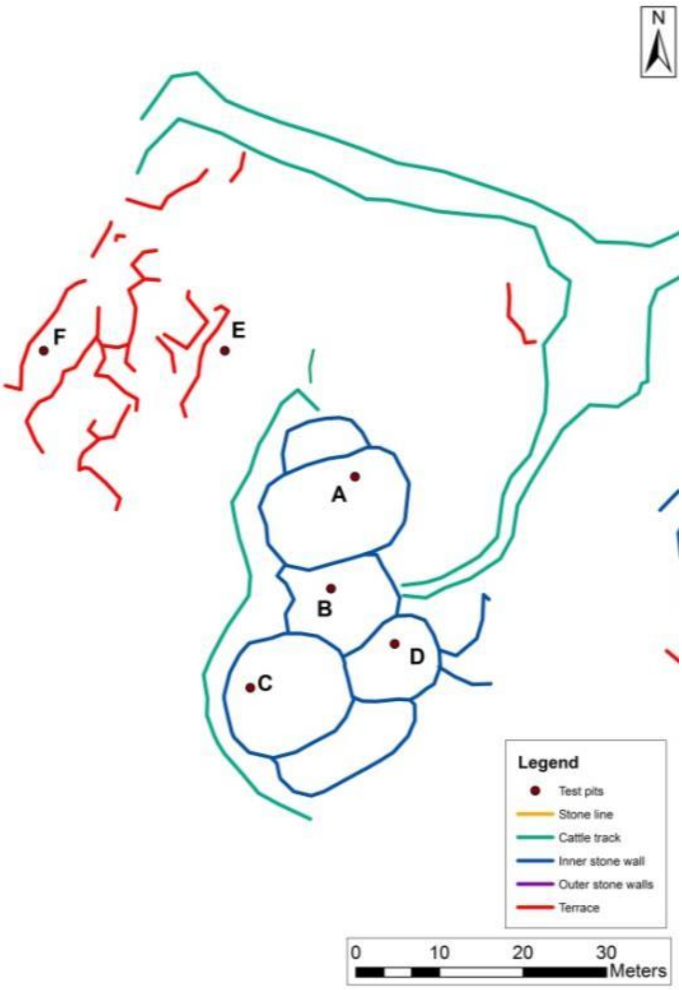

Figure 4.22: Homestead 7 DGPS mapped image

Six test pits were dug at homestead 7, one of the sites partially disturbed during the construction of the Vodacom tower. Dimensions for all test pits were standardised at 50cmx50cm with a depth of 15cm.

Test pit 1 was dug in inner enclosure A, the largest of the inner enclosures at this homestead (Fig. 4.22). The soil in this test pit was rocky (rock content was at least 5%

higher than most other test pits). No material culture was recovered from this test pit. Test pit 2 was placed in inner enclosure B (Fig. 4.22 B) adjacent to inner enclosure A. One undecorated ceramic body shard was recovered from this test pit. In addition, approximately 7cm down there was a flat stone layer 5-6.3 cm thick across the test pit. Test pit 3 was situated in inner enclosure C (Fig. 4.22 C) the enclosure adjacent to inner enclosure B. One undecorated body shard was recovered from this test pit. The soil in this test pit was much finer grained than that seen in other test pits. Test pit 4 was placed in the inner enclosure on the southern side of the homestead. One undecorated body shard was found in this test pit. Test pit 5 was placed on the upper terracing (Fig. 4.22). No material was recovered from this test pit. No soil change was noted. Test pit 6 was placed on the bottom layer of terracing (Fig. 4.22). The soil from this test pit had a higher rock and organic content than previous test pits. Two undecorated body shards and one decorated rim shard were recovered from this test pit.

Homestead 8

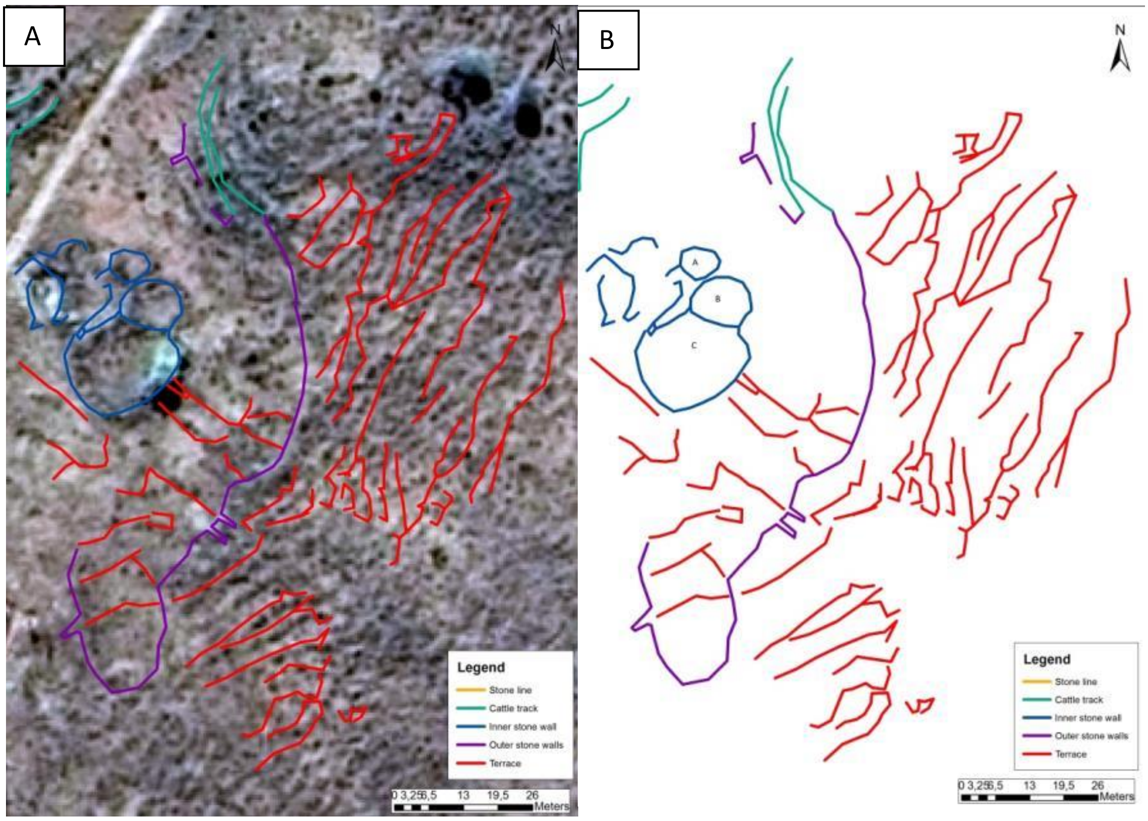

Figure 4.23: Aerial Photograph of homestead 8 with mapped site overlay (A) and homestead 8 DGPS mapped image (B)

The main reason homestead 8 was selected for mapping was the extensive terracing associated with this homestead (Fig 23). The Homestead itself is in varying states of preservation, whole sections of the enclosures have collapsed or are missing. The outer wall is only visible on the length of the eastern side of the homestead. Due to the proximity of the Vodacom signal tower, and its access road to this site, the missing outer walls could have been a result of damage during the tower's construction. The other possibilities are that either the wall had not been completed or that it was robbed. There is no evidence of collapse, as there are no sizable rocks in the vicinity of where the wall could have been constructed or its surrounds. The remaining sections of outer wall are only 50cm-70cm high.

The inner stone walling at this site consists of what appears to be 5 enclosures (Fig 23). Enclosures A, B and C are in a good state of preservation compared to the other enclosures. The walls vary between 1.5m and 2.1m wide, and 76cm to 1.76cm high. The walls are wide, and although there is evidence of some collapse inside the enclosure, there are no missing sections. The other 2 enclosures do not have complete walling; sections have collapsed or are missing entirely. These walls have, once again, been constructed using the double walling technique as mentioned above. There were large potsherds in the middle filling amongst the smaller rocks. A path is visible leading from the outside of the enclosures through to the inner structures. This path passes between enclosure B and C out into the gap between the complete and incomplete sections of the enclosures. The path may have once connected to the road. The road is no longer visible as it was destroyed in the construction of the towers access road.

The terracing is extensive at this site as it is built on the top of the edge of the hill. The terracing starts beneath the homestead on the flatter land. Near the top of the terracing are 2 stone piles. These are circular in pattern and are 50cm high. These fall inside paths that have been left in between the terrace lines. The upper terraces on the flatter land are wide and tend towards an irregular distribution.

The bulk of the terracing, however, is found on the steep slope directly below the eastern outer wall, it has a gradient of 6.5°. The terracing is located on the steepest gradient of all of the mapped sites, with an elevation gain of 7.6m over 66m. This terracing covers approximately three quarters of the length of the slope and about 130m across. These terraces narrow as the slope becomes steeper (the width of the terracing is directly proportional to the steepness of the slope). The terrace walls are an average of 15cm in height, and are mostly intact. Many of these walls extend the entire width without any significant gaps in the walling. They appear to run at a slight angle in some areas, rather than straight across, still maintaining a parallel line to the terracing above and beneath it. The lowest line was initially thought to be terracing, but during test pitting it was revealed to be a well-structured path way due to the presence of saprolite (decomposed usually porous rock that becomes sterile clay) near the surface.

Test Pits: Homestead 8

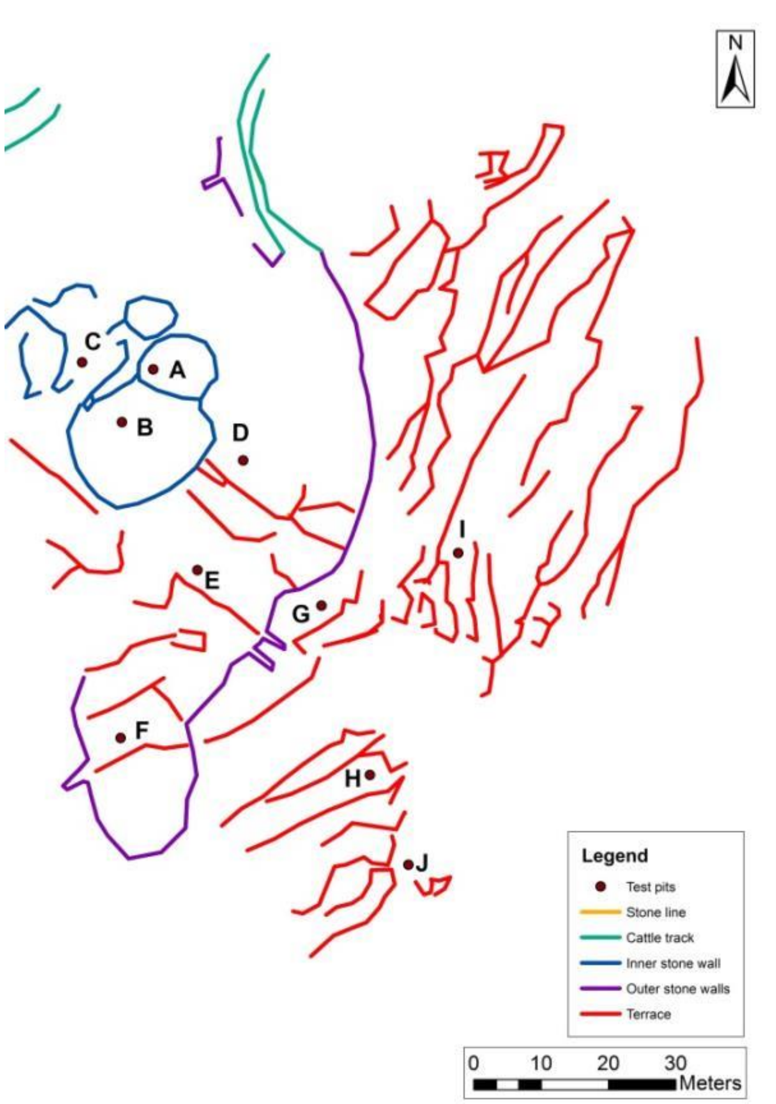

Figure 4.24: Homestead 8 DGPS mapped image

Ten test pits were dug at homestead 8; this site is associated with the most extensive terracing of the mapped homesteads. Dimensions for all test pits were standardised at 50cmx50cm with a depth of 15cm.

Test pit 1 was situated in inner enclosure A (Fig. 4.24 A). No material culture was recovered from this test pit. Test pit 2 was placed in inner enclosure B (Fig. 4.24 B). One thick walled, undecorated pot shard was recovered from this test pit. Test pit 3 was dug inside of inner enclosure C. Two thick walled pot shards were discovered inside this test pit. No change in soil content was noted. Test pit 4 was placed in inner enclosure D, the bottom enclosure of this homestead (Fig. 4.24 D). One thick undecorated pot shard was recovered in this test pit. The soil had a higher rock content than test pits 1, 2 and 3. Test pit 5 was placed in the terraced area between the homestead walls and the remaining outer wall located on to the south-eastern side of the homestead (Fig. 4.24 E). No material culture was found in this test pit. Test pit 6 was placed on the terracing just above what may have been the outer wall on the southern side of the homestead (Fig. 4.24 F). Three pieces of ceramic were discovered during the process of creating test pit 6. These consisted of one undecorated body shard, one decorated rim piece and a decorated body shard. Test pit 7 was located on the top layer of the terracing created on the steep slope south of the homestead (Fig. 4.24 G).One undecorated pot shard was recovered from this test pit. Test pit 8 was positioned on the upper middle layer of the terracing on the slope (Fig. 4.24 H). Two thick walled undecorated pot shards were found in this test pit. The soil had a notably higher organic content and was much darker brown than the soil in the homestead. Test pit 9 was situated on the lower middle terracing on the southern slope beneath homestead 8 (Fig. 4.24 I).

Two undecorated body shards were recovered from this test pit. Similarly to test pit 8, the soil had high organic content and was darker in colour. Test pit 10 was dug on the lowest layer of terracing (Fig. 4.24 J). 5 cm down saprolite was discovered. This implies that this was most likely not used for farming. No material culture was discovered in this test pit. Two large, thick walled shards were found on top of two stone piles, marked as SP1 and SP2 respectively (Fig. 4.24 SP1, SP2).

Homestead 9

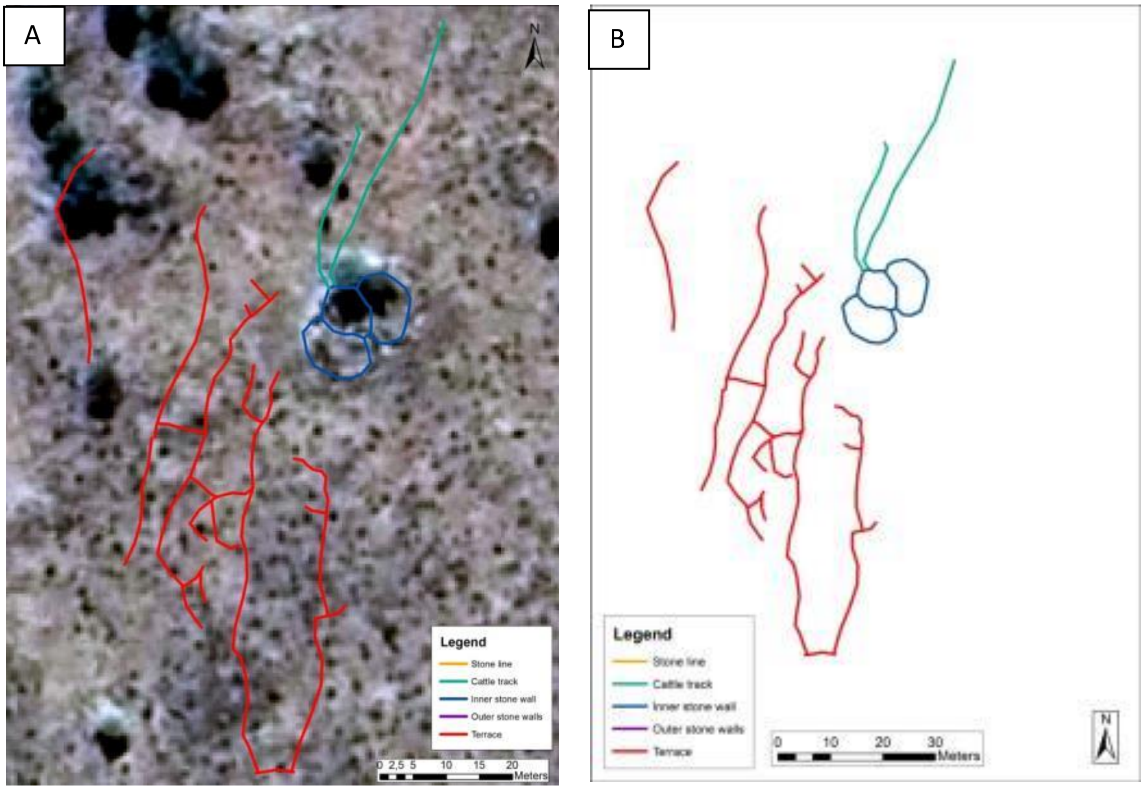

Figure 4.25: Aerial Photograph of homestead 9 with mapped site overlay (A) and homestead 9 DGPS mapped image (B)

Located on the northern end of Khutwaneng, homestead 9 is one of the least developed homesteads. It has no evidence of a pre-existing outer wall or collapse of any kind. It consists of 3 enclosures built in succession (Fig 25). The middle enclosure is circular in shape; its walls are average 1m in width and 1.5m in height. The walls of the two outer enclosures are also 1.5m high, but average 70cm in width, they are kidney shaped structures. There is a clearly defined entrance to the middle enclosure's northern side. This entrance leads to the road connected to the homestead on either side of the entrance.

The divisional road connects with the road. This section of the road peters out as it is located at the top of the farm and near the end of the Khutwaneng settlement. The preservation at this site is good. There is little evidence of collapse, most of the walls are complete and there is almost no evident rock fall.

Although the homestead is small and simple, the associated terracing exceeded expectations in the size of its surface area. The terracing at homestead 9 is built in three sections; there is upper, middle and lower terracing which are separated by gaps of unterraced land. These unterraced areas are between 10 and 15 meters wide. The terracing is longer than that seen at other homesteads; the slope the terracing was built on has a mild gradient of 2.1°. Most of the terrace walls are low, between 5cm and 10cm, but sufficiently intact that a full line is easy to follow. The walls range from 8-20cm in height, and on average have a thickness of approximately 15cm.

Seventeen meters away from the homestead, a second homestead had been outlined by single row of small rocks (about 10cm high). This seemed to be a form of planning as basic inner enclosures and part of an outer wall had been laid out (similar to architectural plans for a house).

Test Pits: Homestead 9

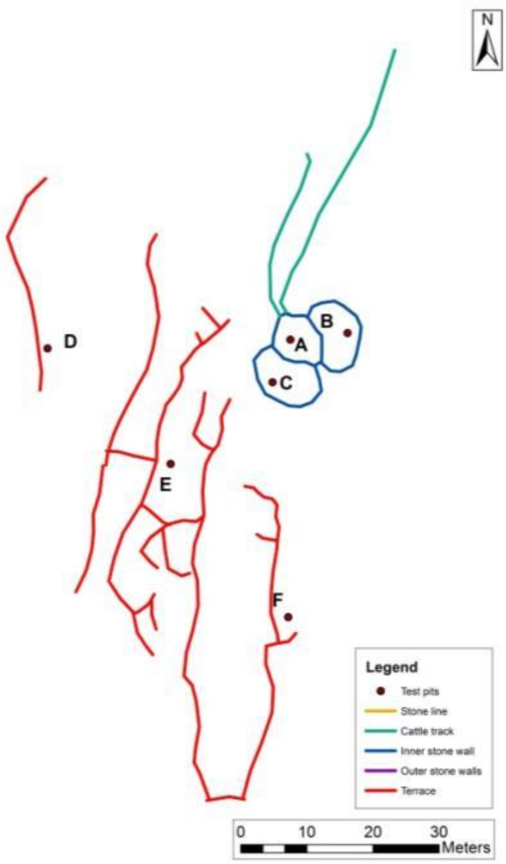

Figure 4.26: Homestead 9 DGPS mapped image indicating location of test pits

Six test pits were dug at homestead 5, one of the smallest sites at Khutwaneng. Dimensions for all test pits were standardised at 50cmx50cm with a depth of 15cm.

Test pit 1 was placed in the central inner enclosure A, the largest of the three found in this homestead (Fig. 4.26 A). No material culture was recovered from this test pit. The soil had a very low rock content compared to other test pits; there was also a very strong sulphuric odour to the soil not witnessed at the other test pits. Test pit 2 was positioned inside of the inner enclosure B, sharing a wall with inner enclosure A (Fig. 4.26). Two pot shards were recovered from this test pit one decorated body shard and one undecorated body shard. Test pit 3 was placed in the last inner enclosure, C that shares a common wall with centre enclosure A. No material culture was found in this test pit. The soil in this enclosure had a higher rock content than the other enclosures. Test pit 4 was dug on the lowest level of terracing (Fig. 4.26 D). Three undecorated body shards were discovered in this test pit, one of which was thick walled. The soil had a higher organic content than those dug inside the homestead. Test pit 5 was placed on the middle layer of terracing associated with this homestead (Fig. 4.26 E). Two undecorated thick walled pot shards were found in this test pit. Test pit 6 was dug on the upper level of terracing (Fig. 4.26 F). No material culture was found in this test pit. The soil sieved in this test pit had a reddish-brown hue and a high organic content.

Homestead 10

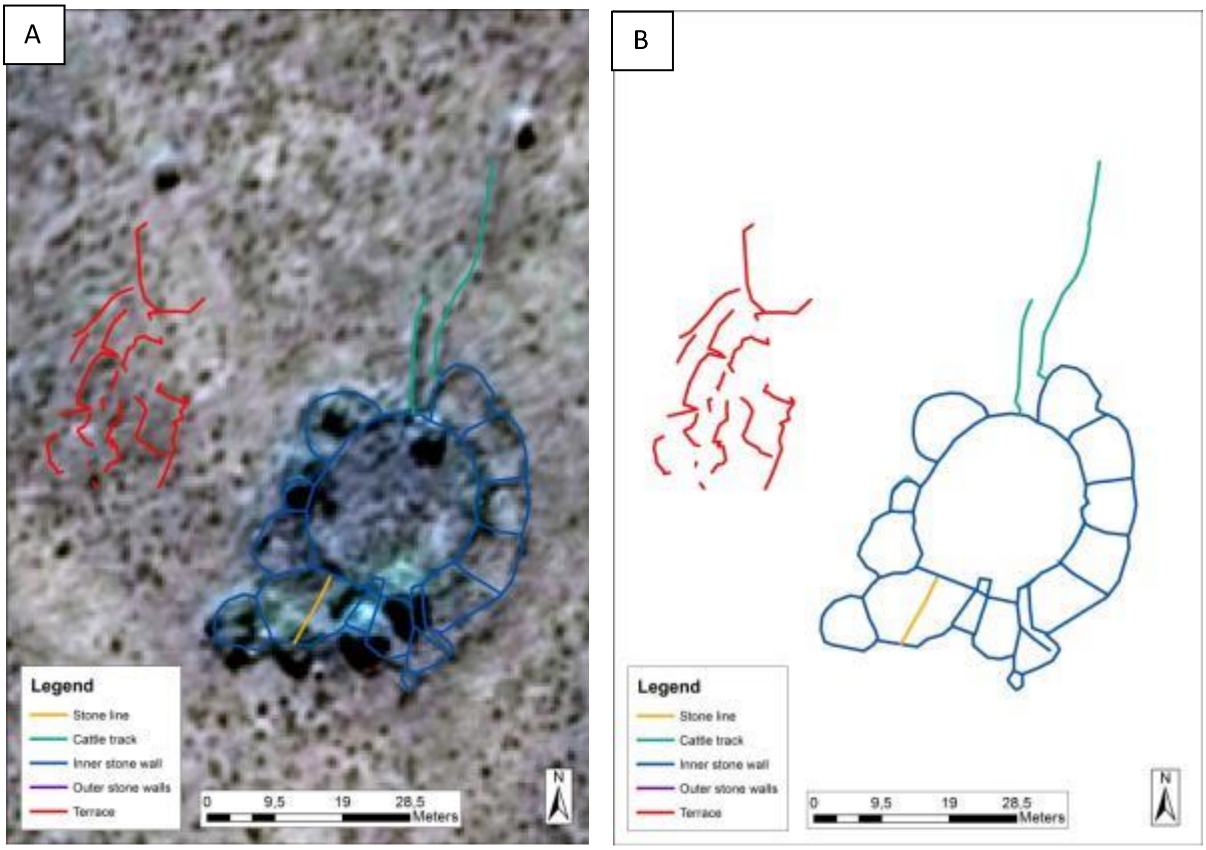

Figure 4.27: Aerial Photograph of homestead 10 with mapped site overlay(A) and homestead 10 DGPS mapped image (B)

Homestead 10 was excavated and researched by David Collett in 1979 (Collett 1979). The preservation at this site once again varies from very good to substantially collapsed. The vegetation present at homestead 10 was an issue because the dense nature of the flora made it difficult to accurately map small or poorly preserved features. There are no outer walls visible at this site nor were any noted by Collett (Collett 1979).

There appear to be thirteen inner enclosures surrounding one larger inner enclosure (Fig 4.27). These enclosures vary in size from 4.6m in diameter (the smallest enclosure) to 24m in diameter (the central enclosure). The walls of these enclosures average at 60cm in width, and are up to 1.5m in height. The walls were constructed using two rows of larger rocks filled with smaller rocks, pottery –some of which was decorated, and a broken grindstone (Fig. 28). There is a raised section that forms a platform about 1m in width between the enclosures (Fig. 4.27). There is some collapse, but this may be a result of the trees growing inside some of the enclosures.

The road is extremely well preserved. The walls are 2m high on average and a meter wide. The road walls run parallel to one another. Pieces of pottery were also found in the walls of the road. The road connects to the homesteads northern most walls. The track is 1.6m wide at its entrance to the homestead.

The mapping of the terracing at this site was somewhat impeded by the dense vegetation. If terrace walls were poorly preserved, or only a single row of small stones high they would have been impossible to find in the conditions present. The terraces mapped start about 16m to the west of the homestead wall. They varied in height from 10cm-25cm and covered an area of approximately 670m². The terracing was placed in the area with the steepest slope in the area surrounding this homestead, with a gradient of 2.2°.

Figure 4.68: Photograph of a broken grindstone used as stonewall infill (Photograph: Tiffany Henshall)

Collett's (1979) was fortunate to have carried out his field work shortly after the area had been burned. Once the area is burned it would be much easier to see smaller, poorly preserved structures, most notably terracing (see Fig. 4.29).

Figure 4.29: Aerial photograph of Homestead 10 when vegetation is sparse (Swanepoel *et al.* 2007)

Unfortunately this was not the case when the DGPS mapping of this site was under taken. At the time the vegetation was a hindrance as enclosures were filled with long grass and thorn trees. The terraced area was covered in grass just under 2m high making visibility almost non-existent. The terracing mapped may not be an accurate reflection of the quantity of terraces originally in place. Test pits were not dug because Collett carried out an excavation of this site during his research.

<u>Test Pits: Homestead 10</u>

No tests pits were dug at this site as a full excavation had been carried out during David Collett's research in 1979, as discussed previously. Thirteen undecorated pot shards, two of which were thick walled, were found on/in the stone walling of this homestead. One decorated rim and a decorated rim and body shard were also discovered in the stone walling.

Collett's (1979) excavation of this homestead yielded the following finds: 1605 pot shards, 2 ring bases, 6 pieces of bone- 4 pieces identified as Bos Taurus (cow) and 2 identified as Ovicaprids (sheep), 2 iron rings, 6 pieces of metal and 2 pieces of worked soap stone.

Finds

140 pot shards were found in the test pits dug in homestead 1 to 9 (see table 1). One hundred and twenty nine of these were undecorated shards (Fig. 4.30), 11 were decorated (Fig. 4.31). Pot shards ranged in size, thickness and condition (as discussed above in the individual test pit break downs). One bored stone was also recovered (Fig. 4.32).

Figure 4.30: Photograph of undecorated pot shards recovered during test pitting at Khutwaneng

Figure 4.31: Photograph of decorated pot shards recovered during test pitting at Khutwaneng

Figure4.32: Photograph of bored stone recovered during test pitting at Khutwaneng

Table 4.1 Ceramics recovered in test pits in homesteads 1 to10 at Khutwaneng

HS No	Location	Classification	Description	QTY
1	Test pits	Body	Undecorated	9
1	Test pits	Body	Decorated body shard	1
2	Test pits	Body	Undecorated	2
2	Surface	Body	Undecorated	1
3	Test pits	Body	Undecorated	34
3	Test pits	Body	Decorated body shard	3
4	Test pits	Body	Undecorated	14
5	Test pits	Body	Undecorated	8
5	Surface	Body	Undecorated	19
5	Surface	Rim	Decorated	1
5	Surface	Rim & body	Decorated	1
6	Test pits	Body	Undecorated	4
7	Test pits	Body	Undecorated	6
7	Test pits	Rim	Decorated	1
8	Test pits	Body	Undecorated	10
8	Test pits	Rim	Decorated	1
8	Test pits	Body	Decorated	1
8	Surface	Body	Undecorated	2
9	Test pit 2	Body	Undecorated	9
10	Stonewall	Rim	Decorated	1
10	Stonewall	Rim & body	Decorated	1
10	Stonewall	Body	Undecorated	11
Total				**140**

Summary of mapping and shovel testing outcomes

There is no evidence of very large amounts of open land in Khutwaneng. Most of the available space has either been utilised for living, i.e. the construction of homesteads, has been terraced or has been used to create pathways and roads protecting the integrity of the terraced areas from trampling.

The shovel tests revealed stratigraphy similar to that identified by Collett (1979, 1982). This comprises a loose shallow surface layer, which overlies approximately 10 to 15 cm of archaeological deposit. This deposit rests on sterile clay or saprolite. In addition, I found a consistent pattern in which the terrace soils contained a higher amount of organic material than the homestead soils.

Dissimilar to Collett's (1979) results at what is referred to as homestead 10 in this dissertation; the shovel tests did not identify any structures in the terraced areas. This suggests that the daga structure that Collett uncovered on the terrace (between Homestead 10 and the adjacent homestead) was an anomaly. Consequently, terrace space was treated as agricultural space in my yield calculations.

The type of ceramics I recovered from the site was similar to those recovered by Collett (1979, 1982). These form part of the Marateng tradition, which is present at all Bokoni sites. The similarity in the ceramics found at all the homesteads, in combination with the fairly consistent stratigraphy and clear evidence of a functioning and connecting road system throughout the site suggest that the homesteads, with a few exceptions such as the square-walled structure, were largely contemporaneous.

Ceramics were found dispersed over the site. This data, combined with the higher level of organic material in the terraces, supports the idea that household refuse was placed on terraces in order to fertilize the soil.

Summary

The data in this chapter serves to contextualise the homesteads and Khutwaneng in addition to providing an understanding of the spatial and structural layout of the remaining stone structures in the village. In the following chapter surface areas for each homestead and a variety of yield calculations are discussed. This includes estimated figures for sorghum, maize, pearl and finger millet under different conditions.

Chapter 5: Yields

Yield and surfaces areas were calculated in order to create an estimated data base. During the creation of this data base several variables were accounted for, these include the impact of climate change and the impact of the utilization of different farming strategies. This data base was then compared to existing yield figures from Willowvale and Marakwet.

Surface Area

At each homestead five surface areas were calculated; the total agricultural area- all associated terracing, inner stone walling/enclosures, outer walling (where outer walling was present) and finally a total surface area were calculate (Table 5.1). The margins for each of these areas were calculated using aerial photographs, satellite imagery and Arc GIS toolbox. The surface areas in table 5.1 were utilised in the calculation of average yields. The margins were confirmed via a foot survey of each site. Refer to Appendix A for images of each homestead illustrating surface areas calculated for Agricultural area, unusable area, outer stone walling and inner stone walling.

Table 5.1 Surface areas of mapped homesteads (m^2)

Homestead	Total area	Terrace walls	Total agricultural area	Outer walling	Inner walling
1	2165,56	42,95	1542,317	339,82	174,07
2	5335,57	106,642	3890,621333	1436,99	348,99
3	5820,85	91,86	4116,1	1702,73	557,2
4	1405,23	21,25	501,07	891,78	225,53
5	3067,76	66,33	2406,73	-	510,5
6	2197,89	62,164	1785,746	365,14	98,97
7	3110,21	31,69	927,39	-	716,73
8	7854,39	212,05	6162,85	-	491,38
9	2933	67,99	2685,71	-	162,91
10	2185,05	28,01	993,88	-	1167,62

Table 5.2 Approximate percentages of surface areas

Homestead	Terrace walls	Total agricultural area	Outer walling	Inner walling
1	2	73	16	8
2	2	67	25	6
3	1	64	26	9
4	1	31	54	14
5	2	81	-	17
6	3	77	16	4
7	2	55	-	43
8	3	90	-	7
9	2	92	-	6
10	1	45	-	53

Agricultural yield calculations

Four data sets were calculated for the purpose of this project; the first set are the average yields in the event of mono-cropping, the second set calculated reflected the impact on yield when inter-cropping is implemented, the third set reflects the impacts of crop rotation on average yield, and the last set of data represents the effects of rainfall on average yield.

Average yields are calculations carried out in order to determine crop specific yields per square meter of agricultural land in the event of mono-cropping. The crop species used in these calculations were sorghum (*S. bicolor)*, pearl millet (*P. glaucum)* and finger millet (*E. coracana)* as these were the crops cultivated by the people of Bokoni (Hattingh 2014). Additionally, maize (*Z. mays)* was included due to the possibility that it may have been grown - although this remains unproven at this time (Maggs 2008). Due to the lack of records regarding average yields, data was gathered from the International Food Policy Research Institute (Fermont & Benson 2011), as well as the Food and Agriculture Organization of the United Nations (Deb *et al.* 2004; Deosthale *et al.* 2012; du Plessis 2008).

Two sets of figures were calculated for each homestead, a maximum potential yield and a minimum potential yield (Table 5.3). This gives us a range for average yields produced by the inhabitants of Khutwaneng. Through research carried out during her masters, Tanya Hattingh (2014) collected useful data concerning rainfall and climate in the area. Hattingh’s data showed that the average rainfall that would have been expected averaged 770mm per annum, and that the region had a moderate climate. Soils in the area have also been tested and have proven to be ideal for agricultural production (Sjöström 2013; Solomon 2012). The presence of dolerite in the area allows for nutrient-rich agricultural land that is likely to have produced thriving crops (Solomon 2012). The requirements for the successful production of sorghum and millet crops are a mere 250mm per annum (Christiansen 2008; Hamaamba 1989). This combined with these species ability to thrive in harsh conditions increase the likelihood that the average yield tended towards the maximum figure calculated.

The average crop yield was calculated using the following formula:

Total production Σ Crop Surface area x µ yield

Crop surface area was calculated by using the area calculation tool in the Arc GIS toolbox on aerial photographs. The margins were confirmed through a foot survey of each site.

Table 5.3: Yield calculation results for sorghum, millet and maize at the ten sites mapped in kg

Homestead	Sorghum	Pearl millet	Finger millet	Maize
1-Min	110,74	77,12	103,18	188,26
1-Max	550,79	385,58	255,25	709,47
2-Min	279,35	194,53	260,28	474,89
2-Max	1389,42	972,66	643,90	1789,69
3-Min	295,54	205,81	275,37	502,41
3-Max	1469,94	1029,03	681,21	1893,41
4-Min	35,98	25,05	33,52	61,16
4-Max	178,94	125,27	82,93	230,49
5-Min	172,80	120,34	161,01	293,77
5-Max	859,49	601,68	398,31	1107,10
6-Min	128,22	89,29	119,47	217,97
6-Max	637,73	446,44	295,54	821,44
7-Min	66,59	46,37	62,04	113,20
7-Max	331,19	231,85	153,48	426,60
8-Min	442,49	308,14	412,29	752,24
8-Max	2200,88	1540,71	1019,95	2834,91
9-Min	192,83	134,29	179,67	327,82
9-Max	959,12	671,43	444,49	1235,43
10-Min	71,36	49,69	66,49	121,31
10-Max	354,93	248,47	164,49	457,18

Table 5.4. Table of number of people sustainable according to yield

Homestead	100kg p/a	65kg p/a	Average
1-Min	1	2	
1-Max	6	8	4
2-Min	3	4	
2-Max	14	20	5
3-Min	3	4	
3-Max	15	22	11
4-Min	0	1	
4-Max	2	3	1
5-Min	2	3	
5-Max	9	13	6
6-Min	1	2	
6-Max	6	9	5
7-Min	1	1	
7-Max	3	5	2
8-Min	4	7	
8-Max	22	32	16
9-Min	2	3	
9-Max	10	14	7
10-Min	1	1	
10-Max	4	5	3

Yield Calculations and surface areas

The yield figures for the ten mapped homesteads displayed a significant difference in range depending on the average consumption requirements for human survival. Studies undertaken by the International Crops Research Institute for the Semi-arid Tropics, suggest that this figure varies between 65kg and 100kg per annum per adult member of the household (Deb *et al.* 2004; Deosthale *et al.* 2012). Using this range the figures varied significantly (see Table 5.4).

It should be noted that figures for homesteads 4, 7 and 10 should be treated with suspicion due to inability to accurately account for the agricultural areas for these homesteads. We can conclude from this data that, at the very least, the people of Khutwaneng would have been able to feed their inhabitants.

Intercropping

The figures calculated were produced in order to represent the potential impact intercropping can have on yield. The method used was based on land equivalent ratios (LER). When intercropping cereal crops and legumes (such as cow-peas or beans) an average LER is 1.2 according to a number of experiments carried out by Mohammed (2012). An LER of 1.2 implies that 20% greater land area would be required in order for the monoculture to produce the same yield as the intercropped yield. The results from his experiments also showed that the land that had been intercropped had higher post-harvest nitrogen levels, as well as a higher dry yield recovery. Dry yield is calculated by weighing fresh matter, allowing it to air dry for 15 days in order to achieve a constant weight and is then reweighed (Mohammed 2012). Figures based on this LER were calculated for sorghum, pearl and finger millet, as well as maize, all intercropped with legumous plants, such as cowpeas or beans.

The figures below represent one possibility. Other studies have shown variability in yield increase. It is impossible to provide exact figures due the fact that there is no record of yield at Khutwaneng during its occupation. As a result the figures below are estimates that allow us to understand potential changes associated with different strategy application.

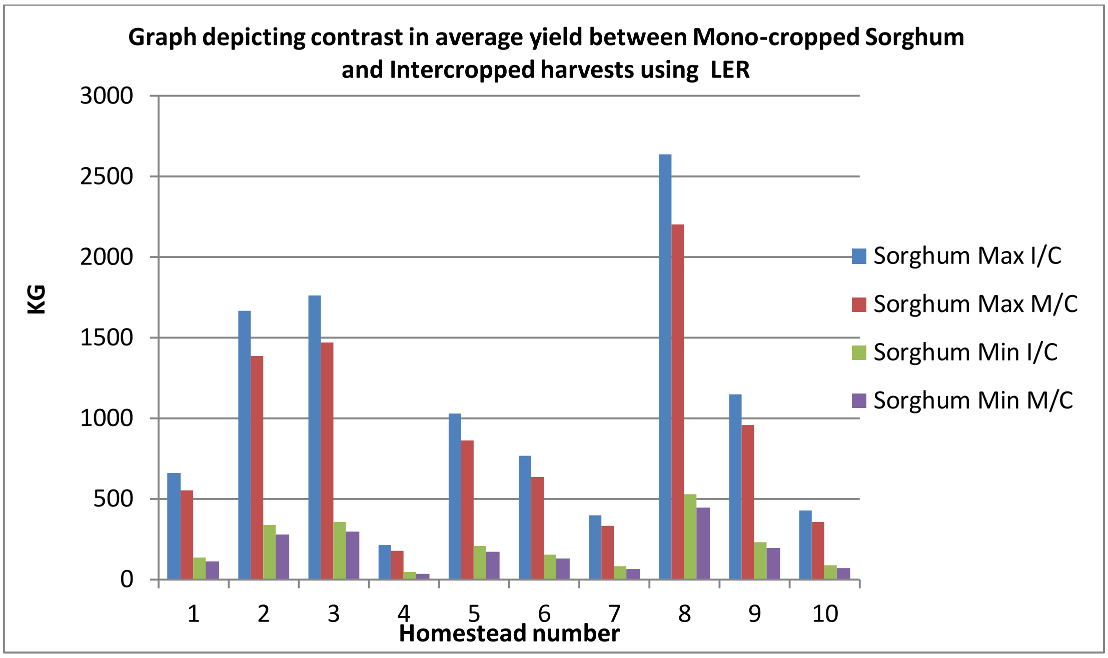

Figure 5.1: Graph depicting contrast in average yield between Mono-cropped Sorghum and Intercropped harvests using LER

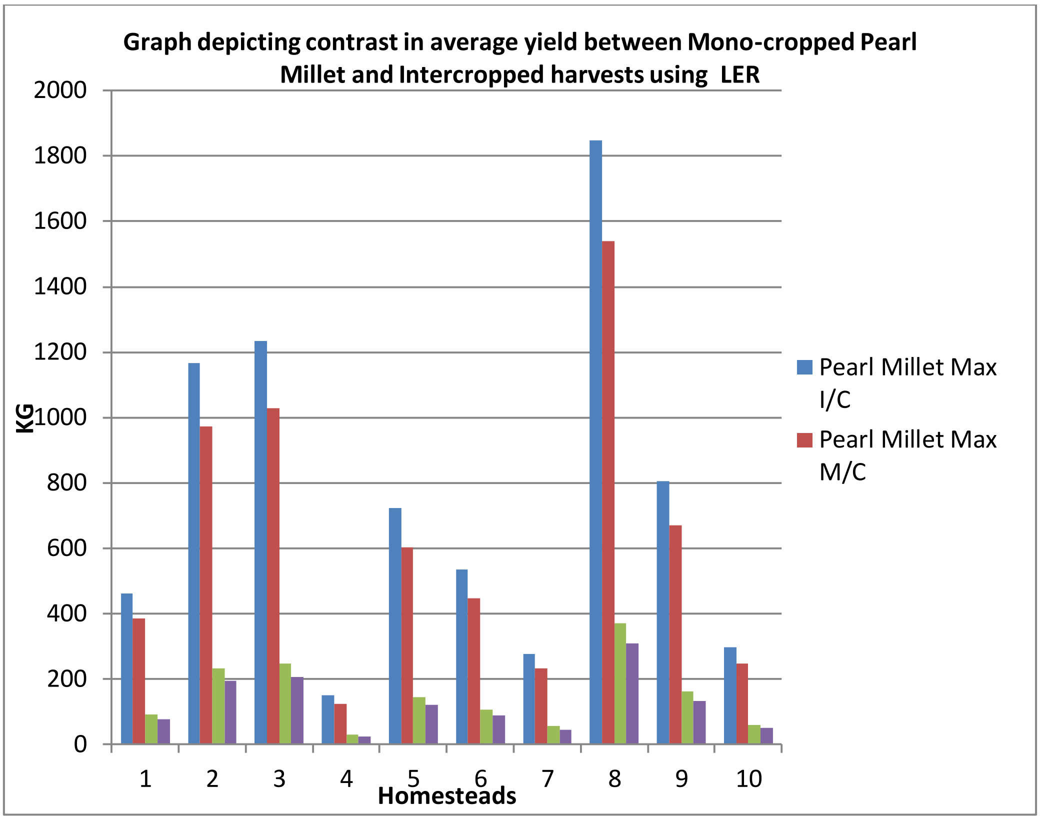

Figure 5.2: Graph depicting contrast in average yield between Mono-cropped Pearl Millet and Intercropped harvests using LER

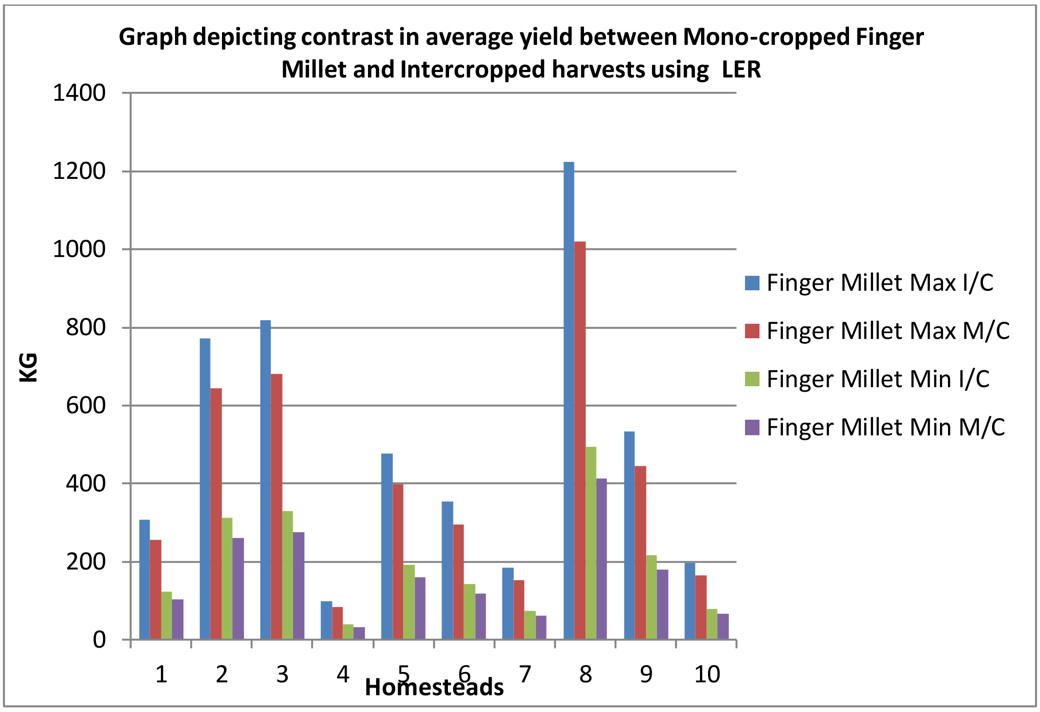

Figure 5.3: Graph depicting contrast in average yield between Mono-cropped Finger Millet and Intercropped harvests using LER

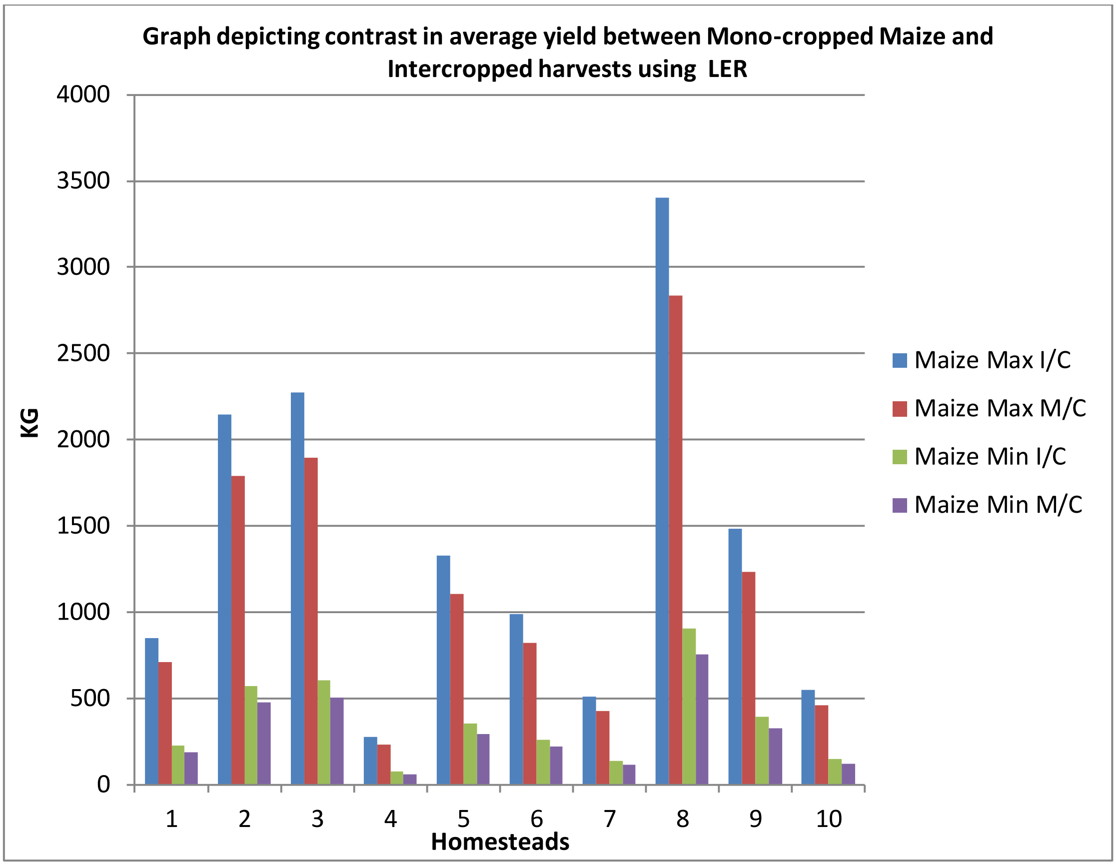

Figure 5.4: Graph depicting contrast in average yield between Mono-cropped Maize and Intercropped harvests using LER

Crop rotation

In the calculation below cow-peas (*V.unguiculata)* were used to calculate an average yield (Table 5.5). Due to the lack of records regarding average yields, data was gathered from the Food and Agriculture Organization of the United Nations (Gómez 2004). Although the yield figures are lower than those of cereal crops the benefits of crop rotation are numerous and improve cereal crop yields due to their restorative effect on soils (Ayisi *et al.* 2000).

Table 5.5 Yield calculation results for Cowpeas at the ten sites mapped in kg

Homestead	Maximum	Minimum
1	293,04	73,18
2	739,22	184,61
3	782,06	195,31
4	95,20	23,78
5	457,28	114,20
6	339,29	84,73
7	176,20	44,00
8	1170,94	292,43
9	510,28	127,44
10	188,84	47,16

Rainfall

Rainfall has already been factored in as a variable during the calculation of the minimum and maximum average yields per annum. Depending on the species, plants would be differently affected by changes in rainfall. Sorghum requires a minimum of 250mm p/a in order to grow, optimal rainfall conditions lie between 400mm-750mm p/a. Finger millet can grow with a minimum rainfall of 300m but optimal rainfall is between 500mm and 1000mm p/a. Maize requires a minimum rainfall of 300mm, with a ideal annual rainfall of 500mm-800mm. The hardiest of the cereal crops in this study, with regards to rainfall and temperature extremes, is pearl millet. It can grow in as little as 125mm p/a (although these yields would be lower than the minimum range. The ideal annual rainfall for Pearl millet production is approximately 500mm (Burton & Powell 1968; Deb *et al.* 2004; Deosthale *et al.* 2012; du Plessis 2003; Gangaiah 2008).

Woodborne and his team's research (Woodborne *et al.* 2015), correlated by carbon isotope and phytolith analysis (Aub 2014; Hattingh 2014), provide us with a rainfall record that gives us an approximate rainfall range over the last 100 years (Fig. 5.5). This graph, compared to the Zimbabwean record, gives a range of approximately 420mm to 680mm. If the annual rainfall was at the lower end of this range the yield of the crop would tend towards the minimum average yields. At approximately 500mm per annum yield figures would be expected to tend towards the maximum figures. According to research on maize production in South Africa (Blignaut *et al.* 2009) rainfall variability shows a strong correlation with crop production. On average a 1% drop in annual rainfall resulted in 1.16% decrease in average annual yield.

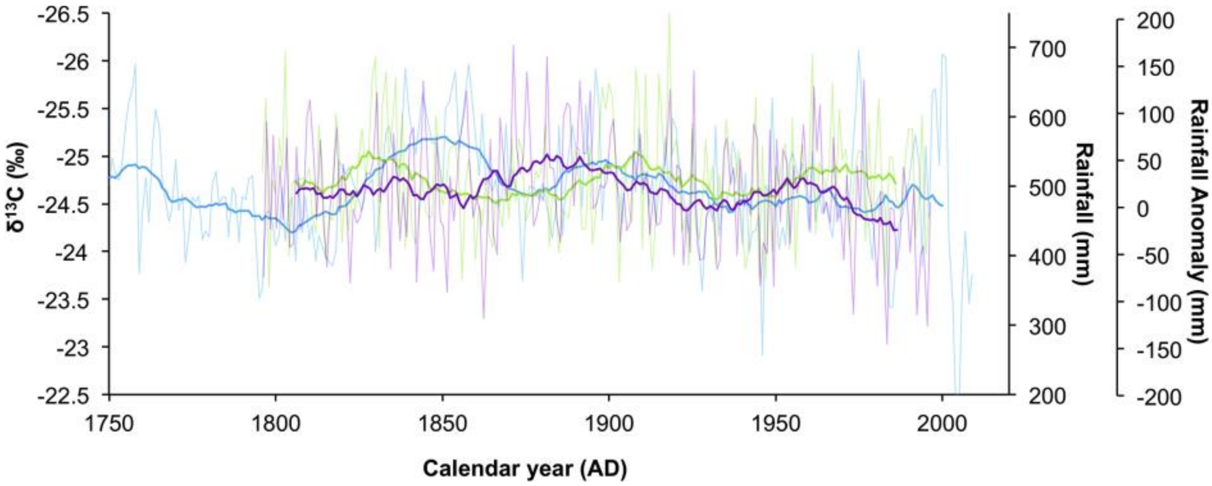

Figure 5.5: Regional rainfall proxy comparisons for southern Africa. Comparison between the 13C baobab record (blue) and a rainfall record from Zimbabwe (green), and the precipitation reconstruction of Neukom et al. (2013) (purple). (Woodborne *et al.* 2015: Fig. 4)

Other factors that can affect yield such as temperature and soils would have been less likely to result in outlying yield results as the temperatures in this region do not reach extremes to the point of resulting in gross losses.

Comparative yields

The yields figures for Marakwet were obtained from Davies research in the area (2008; 2009). The figures for annual average yield for Maize range between 1000-2000 kg/ha, Finger Millet 450-900kg/ha and Sorghum 550-1700 kg/ha- these cereal crops are also augmented by the fruit and vegetables grown that are grown in conjunction to the cereal crops (Davies 2009). They produce sufficient to sustain themselves, as well as sell surplus as cash crops.

The agricultural land in Marakwet is distributed on a kinship system, much like that suspected in Bokoni. Agricultural land is divided into well distinguished blocks. These blocks are maintained and worked by kin-groups occupying the land associated with these blocks (Davies 2009; Davies 2012; Moore 1996; Widgren 2006). Similarly in Bokoni the land utilised in agricultural production can be associated with a single homestead (family unit) (Delius *et al.* 2014).

As discussed in Chapter 2, yield figures for Willowvale were difficult to obtain. McAllister concluded that between 1975 and 1976 the maize yield ranged between 6.16 bags (554.4kg per household) to 7.02 bags (631.8 kg per household) from the average field, and 5 bags (450kg per household) and 12 bags (1080kg per household) from garden harvesting (McAllister 1989).

Crop diversity was possibly one of the foremost benefits of the utilization of gardens at Willowvale. The ability to diversify plant species allowed for increased protection from the negative effects of rainfall and temperature changes. These changes can result in crop failure, however not all plant species have the same water and temperature requirements for successful growth. By planting a variety of species, farmers have assurance that at least a portion of their plants will produce. Gardens additionally allow for the cultivation of plants specific to individual household requirements. Field production in the 20th century was usually dominated by maize crop production resulting in limited variability because harvesting and maintenance required a larger labour force which often resulted in shared fields (McAllister 1989).

This differs in some ways to what we see at Marakwet and what we suspect occurred at Bokoni sites. The intention of the gardens is centred on fulfilling the needs of each individual homestead. According to Herron's (1990) research there was no dependency on surplus as cash crops. The produce harvested and planted was done so with the family associated with that garden in mind. Sustainability of individual households is the function of these gardens. This could also account for the variation in figures as over time, as occupancy of a household increases or decreases the amount of produce required changes- this impacts what is planted on a seasonal basis.

Summary

The data presented above provides us with a possible indication of the annual production that could have occurred at Khutwaneng. In the process of creating this data set as many variables as possible were considered, this included farming strategies and climate variability. These figures were compared to those know from Marakwet and Willowvale. The following chapter serves as a discussion of the data presented in chapter 4 and 5 as well as building off the foundation created through the literature review.

Chapter 6: Discussion

In this chapter the results from my field work and the data set created thereafter are combined with information collected during the formation of my literature review in order to shed light on Khutwaneng, the potential application of farming strategies and the role resilience plays in farming communities. Khutwaneng, and Bokoni in general, are compared to Willowvale and Marakwet. Placing the data within an archaeological context allows for a deeper and substantiated understanding of land management a Khutwaneng to be developed. Questions asked were shaped by the literature, methodology. Aims were informed by the broader narrative, some of which are reflected in the literature review. In this section key aspects of this will be reflected upon. The studies discussed in the literature review also served to locate this research in terms of the study of Bokoni and research in agriculture in general.

Khutwaneng as an archaeological site

The settlement layout and design of Khutwaneng reflects two distinct phases of occupation. Earlier phase homesteads have round enclosures and outer walling, while those belonging to a later reoccupation display a move towards squarer, blockier shaped structures. There are a small number of homesteads that are completely square in structure, these are built with much smaller rocks and there is a clear focus on creating a uniform, densely packed wall (this does not occur in any of the mapped homesteads). This pattern supports the oral traditions and historical evidence that suggest that Khutwaneng was abandoned during the conflict that wracked the area, and then sporadically reused (see Delius *et al.* 2012). The period of reuse that resulted in the square walling might be the source of the nineteenth century glass beads recovered from the Badfontein valley (see Evers 1974)

In terms of ceramic style, the finds accumulated through shovel testing, foot survey and Collett's (1979, 1982) excavations are consistent with pottery found at other Bokoni sites. The uniformity of the finds throughout Khutwaneng also implies that occupation of the homesteads occurred at the same time. Very few diagnostic shards were found in the test pits. The diagnostic ceramics found, however, are similar to that found in the Collett (1979, 1982) excavations.

The ceramics found at Khutwaneng, and other Bokoni sites, were designated as Marateng style by Collett (1979, 1982). This pottery style has been found widely distributed throughout Mpumalanga, and is historically also associated with the Pedi-speaking people. For this reason - based on the similarity between the ceramic styles found in Bokoni and historic sePedi speaking areas - some researchers initially attributed the Bokoni sites to the Pedi. This was later disputed, falling into the argument surrounding the assumption of identity based on 'pots' (Delius & Schoeman 2010; Schoeman 1997).

The Khutwaneng pottery can be divided into two main categories: decorated and undecorated. Decoration might mark functional difference between cooking and serving vessels. Most of the pot shards found at Bokoni sites are associated with pots made for everyday use and are associated with tasks such as cooking, the carrying of water and storage of various goods. These pots are usually undecorated and indelicately finished, lacking the care and attention of pots made for special occasions or rituals purposes (Collett 1982; Delius *et al.* 2014).

Overview of Khutwaneng within the Bokoni complex

When comparing Khutwaneng, a phase two and three site, to earlier sites within the Bokoni complex, such as Komati Gorge, there is evidence of some obvious differences and similarities.

The most notable similarities include the same level of thought about the protection of agricultural land at both these sites, and the existence of the same basic settlement features such as cattle tracks, inner enclosures, outer walling, pathways, and stone line demarcations as well as terracing. A range in homestead size continues, showing clear differences between smaller, less established homesteads, in terms of number of inner enclosures compared to those that are well established, and would have been occupied by a larger family.

There, however, also are distinct differences. One of the key features of Khutwaneng is the lack of large unintentionally placed rocks and boulders. At other Bokoni sites, such as Komati Gorge, there are often rocky outcrops, or large boulders strewn throughout the landscape that could have served as building materials. At Khutwaneng this is not the case; with the exception of a hand full of small outcrops that contain very large boulders that would be extremely difficult to move the rocky areas contain smaller stones and rocks that are scattered and disorganised. These 'rocky areas' areas of unused space were mostly found in small corners in the homesteads, and through shovel testing produced rocky soils with low organic content. Clearly, there was a lot more pressure to use all available space at Khutwaneng.

Figure 6.1: Photograph of numerous potshards mixed with stone as infill for wall construction (photograph: Tiffany Henshall)

The limited availability of large and medium sized boulders could have resulted in both the reduced presence of outer walling and the introduction of new approaches to construction. Priority was given to the construction of enclosures for keeping livestock, as well as domestic areas and terrace walling. The outer walling would have been the last section constructed as it serves the least vital function of the three structures.

These priority walls were built using infill, which creates a structurally sound wall that is thick enough to serve as a strong boundary whilst reducing the number of larger rocks required. The infill of these walls was created using an assortment of small stones as well as broken pottery (see Figs 6.1 and 6.2) and well-worn grindstones that had been broken in half (whether or not this was ritualistic behaviour, or simply a convenient means of recycling broken tools is uncertain). Although this technique is not unique to Khutwaneng it does display an ability to optimise the building materials available.

This approach differs in some aspects from what has been found at earlier sites. Building material was not scarce at these sites, such as Komati Gorge, possibly resulting in more standardised homesteads. There most of the homesteads have inner lobes that are surrounded by outer walling forming domestic boundaries within the homestead, these walls have cattle tracks connected to them allowing for livestock to be safely led from the enclosures to open grazing land away from the homesteads and agricultural areas. The terracing is built surrounding the outer walls, the width changing depending on the steepness of the slope they are situated upon.

Figure 6.2: Photograph of a large pot shard mixed with infill in a stone wall (Photograph: Tiffany Henshall)

To understand these differences the time of occupation of these sites needs to be considered, as it aids in the understanding of possible choices that the people of Bokoni made. During the occupation of the Komati River Valley sites the people of Bokoni had led a relatively peaceful existence – the lack of defensive walling combined with the vulnerability of the choice of their locations provides evidence of this (Delius *et al.* 2012; also see Faerch 2012; Solomon 2012; Henshall 2013).

Komati Gorge homesteads show evidence for the continual reoccupation and reuse of space belonging to older homesteads – at least six Harris Matrix layers (Faerch 2012). In some cases this is demonstrated by the reconstruction of sections of walling, at other homesteads there are two homesteads present in very close proximity (in peri-urban locations this is unusual). In these situations there is often evidence of robbing of construction material (stone) from the older homestead. This implies long term occupation of this village. Continual growth is not visible at Khutwaneng, and there the use and reuse falls into two distinct phases as discussed above.

In the earlier occupation phases the space available was vast, and homesteads formed part of two main residential locations; the more densely populated 'urban' (village) homesteads, and the sparser peri-urban homesteads located on the outskirts rather than part of the central village. Urban homesteads were built in closer proximity to one another and, although size variation was still present, the space allocated to each homestead for terracing was limited (although seemingly relative to the size of their associated homestead). Peri-urban homesteads displayed greater distance between neighbours, allowing the land available for terracing to be greater. At these sites there is also evidence of large open spaces of land, possibly for cattle grazing (see Henshall 2013).

Khutwaneng, on the other hand, no longer has distinct Urban and Peri-urban sites. Most people appear live in the village on the hill, or in smaller villages on the surrounding slopes. The surrounding slopes are no longer configured as scattered peri-urban space, but more closely resemble the urban areas of Komati Gorge. There also is very little unutilised space visible in Khutwaneng village. Land not used to build homesteads (inner enclosures, outer walling and sometimes spaces demarcated with single level stone lines) was either turned into part of the system of complex road and connected paths that joined homesteads to the central road, or agricultural terracing. Terracing appears on almost all open land at this site, regardless of gradient. The only space in the valley that is not built up is the valleys. Rivers and streams run through these and many of the roads leading from the hills lead to these areas (Fig 6.3).

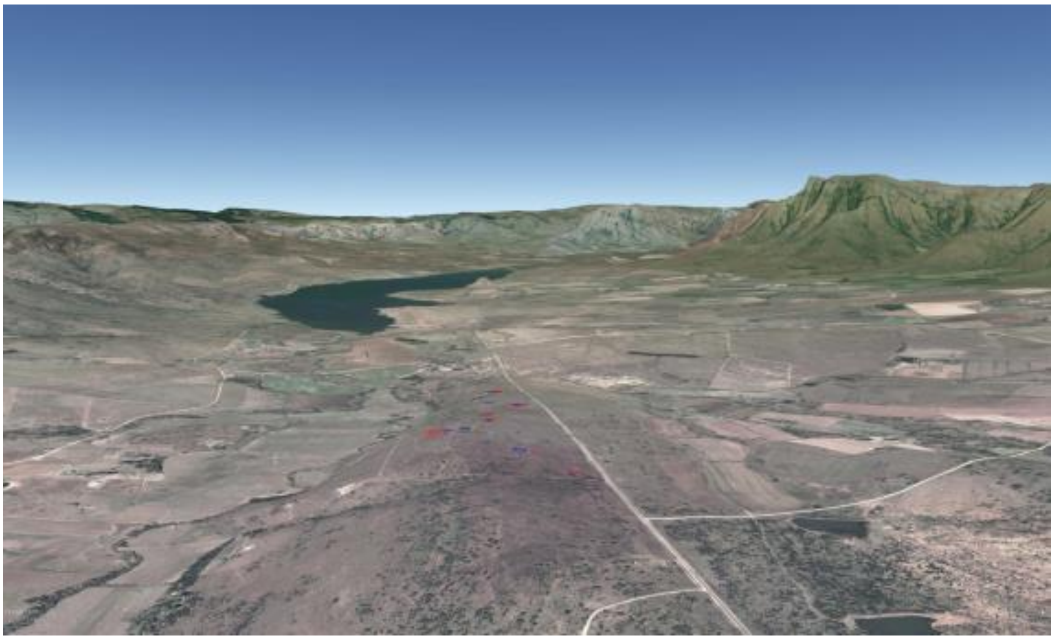

Figure 6.3: Google Earth image of surface topography view from Khutwaneng indicating mapped homesteads

The reduction in slope gradient through sections of the site, when compared to that of Komati Gorge, highlights the multi functionality of terrace walling, and may also serve as a possible explanation for the variance in terrace wall height seen at this site. The terracing at this site appears to serve as much as a demarcation of agricultural land, as it does as a soil erosion prevention strategy. In flatter sections where the risk of soil wash is lower, terraces are often shorter and have either preserved poorly, or are constructed as more of a marker than a as a means to improve the structure of the soils.

The layout of the site as a whole also shows some variance from other earlier Bokoni sites (such as Komati Gorge). Unlike the rather haphazard roads at Komati Gorge, Khutwaneng homesteads are built along a central road (see Fig. 6.4) that is well constructed, and easy to follow through both foot survey and by looking at aerial or satellite imagery of the site. The road provides ease of access and movement through the village, and through divisional roads that branch off to each individual homestead. This would have organised human and animal traffic through the site, thereby offering protection to crops, and protection to livestock that could be injured on low to medium terrace walls if moving at pace through the area. The road system is evidence of pre-planned, complex town organization

Figure 6.4: Google Earth image of central road through Khutwaneng

The surface areas calculated for each homestead further highlights the differences between Komati Gorge sites and Khutwaneng. At Komati Gorge a fairly reliable pattern emerged, in which there was a high correlation between number of inner enclosures (which have been linked to the number of wives per homestead [see Delius et al. 2014]), and the size of the surface area covered by terracing. The number of enclosures showed a relationship of direct proportionality with the size of terracing, with an increase in the one reflected in an increase in the other (see Henshall 2013).

While this is true for some of the results at Khutwaneng, many homesteads did not follow this pattern. Homesteads such as homestead 9 have a very small inner walling surface area, but the agricultural surface area was 16 times larger than the surface area of the enclosures. What was consistent was that most of land attributed to the homestead comprised agricultural land, this relationship ranged between 70% and 91% of land.

Willowvale and Khutwaneng

Both Bokoni and Willowvale are excellent examples of the recursive nature that is understood to exist between space and gender. Gendered labour division is a key feature present amongst the people of Willowvale and Khutwaneng. In both of these cases the gendered division of labour informs the spatial layout of their sites. Routine agricultural production is, for the most part, the responsibility of the female members of the homestead and plays an important role as to the location of agricultural space near the homes.

At Willowvale large agricultural gardens were attached to the homestead. Fields were located further away and required travel from the homestead. This form of farming was not favoured by women in Willowvale, but continued in parallel with garden agriculture in order to meet yield needs. At Khutwaneng the agricultural terraces were built around the homestead in close proximity to the living and domestic areas. In both of these cases the ability to carry out agricultural responsibilities, and fulfil the other duties female occupants were tasked with, resulted in an emphasis on a form of agricultural location that allowed for convenience and practicality in terms of day to day function.

The yield figures for Khutwaneng terrace gardens are lower than that from Willowvale as a whole. The average range for Khutwaneng (calculated excluding anomalous results that were misrepresentations due to farm boundaries etc. across the cereal species- using max and min figures) was between 353,88kg and 880,56kg per household per annum (depending on crop grown). The figures for Willowvale, from Herron (1990) and McAllister (1982), range between 450kg-1080kg per household per annum.

In addition to the similarity in spatial choices, it is likely that both communities practiced intercropping. Through studying the historical example at Willowvale we can understand the motivations behind an agriculturally based society's decision to apply this strategy to their production. In the case of the occupants of Willowvale intercropping was practised for several reasons.

Firstly, it allowed variation in the family's diet, providing a range of nutrients that a starch only based diet negatively impacts. Children who are raised eating only starch often develop health issues such as Kwashiorkor. By introducing a variety of vegetables this is avoided. Secondly, by mixing crop types there is a greater chance that there will be at least one successful crop if there are uncontrollable environmental factors. Not all plant species are effected equally by climatic changes, mixing species therefore reduces the chance of complete crop failure occurring. Thirdly, the process of intercropping allowed the soils they were farming in a greater chance at longevity and eliminated the need for leaving the land to lie fallow for long periods of time. Due to the nature of garden agriculture, the fallowing of agricultural soils would have been an impractical strategy.

The use of labour parties by Willowvale residents could also help in our understanding of how some agricultural communities carry out tasks that require a larger work force than what a homestead may have available. In the case of Khutwaneng we see small homesteads with terraced land that exceeds what would have been expected, compared to homesteads at Komati Gorge. It is possible that work parties could have acted as an aid to some of these homesteads to ensure agricultural success for the community as a whole.

Another important point of commonality is the ownership of cattle. This is important as substantial numbers were owned at both locations meaning that fertilization due to manure run off would have most likely occurred, even if this was unintentional. The availability of such a useful source of fertilizer also increases the chances that soils would have been enriched through unintentional or intentional fertilization. This differs from Marakwet where people do not keep large herds of cattle.

Marakwet and Khutwaneng

Much like Willowvale and Bokoni, the people of Marakwet have a gendered labour division. Women are responsible for day to day agricultural tasks including weeding, harvesting, sowing and digging. In addition to this, they process the harvested goods, for example grinding of flour. Men do not partake in 'female tasks' and rely heavily on the women of their household to provide not only the basis for the families subsistence, but also for the successful running of their household. At first look one would get impression that Marakwet is a society in which men hold all the power (Moore 1986).

In the case of Marakwet, Moore (1986) discovered that women hold a large amount of power over men. The agricultural produce that women harvest belongs to them. They maintain the rights to the distribution of this produce and no one is permitted entrance to a woman's granary without express permission. Women also maintain the right to withhold their labour in the event that their husband mistreats the women of his household. It is clear that the males of this community are not only abundantly aware of power distribution within the household, but will also great to great lengths to avoid the risk of women refusing to partake in their household and agricultural tasks. This may grant insight into one possible outcome of gendered labour division, and could be a model to consider for Bokoni.

The use of terrace agriculture also mirrors the practices of the Bokoni. People in Marakwet adopted terracing in order to make use of fertile soils situated on steep gradients. While people in Marakwet still practice field agriculture, the produce harvested from their terraces increases yield. They adjusted their farming techniques in order to make use of the maximum amount of land that could be farmed. As suggested previously, the terraces act as a means to control water flow, prevent soil erosion and support the structure of the soil. Other techniques such as intercropping, fertilization and weed management are implemented in order to ensure maximum yields.

Marakwet also provide insights into resilience. The ability of people in Marakwet to adapt to their environment has ensured their continued success as an agricultural community. The clearest example of this can be seen in their use of irrigation. Water shortage was a serious threaten to the existence of the communities in Marakwet rainfall in certain areas can be unreliable and insufficient for large scale agricultural production. By developing irrigation systems the farmers in Marakwet greatly increased their probability of success as an agricultural community and overcame a serious obstacle. This once again proves the importance of a community's ability to adapt.

The yield figures for Marakwet are good. Davies suggests figures of a minimum of 550kg/ha at Marakwet. There are many possible reasons for this; people in Marakwet have the advantage of science allowing for the improvement of farming strategies (such as improved fertilization techniques) and the changes in plant species. Plant species have become more resistant to pest and invasion resulting in a reduction in crop loss. They also plant a wider variety of plant species, combined with their use of irrigation, allow for year round production. There is also the question of motivation, the people of Marakwet have developed a predominantly agriculturally based economy relying on surplus produce as a trade/sales good (Davies 2008; 2009; 2012).

The yield in Khutwaneng was substantially lower, with the average Khutwaneng yield being a maximum of 360kg/ha of sorghum. The labour invested in the Bokoni terracing suggests that the Bokoni farmers were no less motivated, and other land use options, such as the use of wild plants in addition to cultivated crops should be considered. Possible land management choices are discussed below.

Land Management practices in Khutwaneng

When averages are considered it appears that most homestead terraces produced enough food to sustain themselves, but not enough to create a reliable surplus. This differs greatly from the results recorded at Komati Gorge where average figures allowed for yields that far exceeded the family's requirements. This data combined with information about the climate, soils and crops, as well as insights gained from Willowvale and Marakwet, aids us in suggestions about land management practices implemented at Khutwaneng.

I start with climate. We know that the area experienced substantial climatic fluctuations, but with the exclusion of extreme drought years (see Aub 2014; Woodborne *et al* 2015), most of the Bokoni occupation received rainfall suitable for successful production of sorghum and millet, which are the starches for which we have direct evidence (see Collett 1979, 1982; Hattingh 2014). Schoeman *et al.* (in prep) suggest that site selection and terracing might even have mediated the impact of the extreme climatic fluctuation. The cultivation of maize, for which there is no direct evidence at present, would have been more challenging.

We also know that the soils at Khutwaneng hill are suitable for the production of cereals, legumes and a variety of vegetables as a result of soil analysis carried out by Lauren Solomon (in prep). Thus, the environment posed very little potential limitations other than nutrient depletion due to over farming, soil erosion due to the slope of the land, weed management and porosity of the clay soils. A number of these limitations were overcome through the use of terracing. As discussed in the literature review, agricultural terraces would have aided in management of soils, by both improving the soils structure, and forming a boundary to catch soil that would otherwise have washed downhill.

In addition, my mapping of Khutwaneng showed that terraces also provide useful boundaries for agricultural areas, in that they demarcate and separate land used for agricultural purposes from that used for domestic purposes. Dividing walls also aid in demarcating areas of ownership or responsibility, either to certain individuals or specific homesteads. Terracing also ensures that water is distribute more evenly in that the walling allows water to be held for sufficient periods to be properly absorbed by the soils.

While the absorption of water can be a positive side effect of terrace agriculture, it can also cause issues with soil porosity. This is especially true for soils with tight grain-to grain packing, like the clay soils at Khutwaneng. The solution to this would be to turn the soil on a regular basis to aerate, thereby creating space between soil grains for drainage. This will prevent soils becoming water logged causing plants to experience root rot. This is very likely to have been practised at Khutwaneng as terrace soils contained rock and organic matter mixed together.

Soil nutrition is a harder problem to solve; it is unlikely that long term fallowing would have occurred on the terraces, because this would require the luxury of expendable agricultural land that probably was not available at Khutwaneng. It is far more likely that an approach similar to that used by the Willowvale women (see McAllister 1989) was used: a combination of intercropping and fertilization. Intercropping of legumes would have resulted in the plants fixing nitrogen from the air into the soils. These plants also have very different root systems to cereal crops in terms of depth and nutrition requirements. The depth of the root system allows these plants to draw nutrients from sections of the soil unaffected by cereal cops. Leguminous plats also proved stability to soil structure, aiding in the prevention of erosion.

At this stage we do not have data supporting this, but my shovel tests did find data that points to forms of fertilization, through the distribution of organic household waste on the terraces. Multiple non-domestic spaces contained rolled potshards, which most likely were distributed through the disposal of household waste on the terracing. The organic content of the soil was also significantly higher on the terraces than in the pits dug in domestic areas. In addition to this probable fertilization, the nutrients from livestock faeces and daily human living would have leached onto the terracing proving a form of accidental fertilization (see Solomon in prep).

In addition to managing the terrace soils in order to improve the yields, it is also likely that Khutwaneng village farmers, who lived in a context where space was at a premium, would have farmed additional fields elsewhere, similar to the Willowvale and Marakwet farmers. There are two options at Khutwaneng. Firstly, there is a large expanse of terracing on the eastern slope of the village. There are no homesteads directly associated with this terracing, and these terraces might have been cultivated collectively.

In addition, there is substantial farming space in the well-watered open valleys that surround the hill. It is possible that terrace garden agriculture was supplemented with field farming. These fields, similar to those in Willowvale and Marakwet, were probably located in the open valleys along the streams and rivers. Similar to Willowvale the yield from these fields would have been lower, since it is unlikely that these fields were intentionally enriched, and in addition the soil valley chemistry in Bokoni is not ideal for high yield cultivation (see Delius & Schoeman 2008). I suggest that it is possible that the people of Khutwaneng had their own terraces, as well as forms of communal farming, in order to compensate or the lack of open land.

Resilience

It has been established that resilience and sustainability are deeply intertwined concepts. All three of the sites discussed fulfil the requirements set out by Keck and Sakdapolrak (2013); cope, adapt and transform. In the case of Bokoni, research to date has presented a society that adapted farming strategies and their social infrastructure due to environmental and political challenges they had faced.

Willowvale affords us insight into the relationship between modern politics and resilience. When faced with numerous obstacles resulting from colonial influence and the attempted implementation of betterment planning, the social framework of Willowvale inhabitants shifted. Economic pressures, including taxation forced men to leave rural homesteads to seek work in mines or as labourers, resulted in an overhaul to household and societal dynamics. The responsibility fell on women to maintain their household and provide sufficient produce to sustain their families. The transformation in agricultural practices in order to achieve this, demonstrates how flexible this society was. Once again the adoption of farming strategies such as intercropping, crop diversification and weed management amongst others provided this farming community with improved potential for positive outcomes in their collective future.

Marakwet similarly provides evidence that resilience is important to long term sustainability. There the community has survived hundreds of years overcoming climatic, economic and political issues. Arguably the biggest of the transformations that occurred in the history of Marakwet was the construction of the irrigation system, still in use today. The employment of irrigation not only allowed farmers to prevail in spite of poor and erratic annual rainfall, but also provided them with the ability to expand their production seasons. Irrigation combined with the implementation of strategies such as inter-cropping, crop rotation , fertilization and the use of terracing (there by expanding the agricultural land available to them) and crop diversification has allowed the people of Marakwet to flourish and maintain their existence as an agricultural community in today's competitive climate.

When viewed both as a complex whole, or in site specific segments, Bokoni is filled with evidence of resilient behaviour on multiple levels. Their success and survival as an agricultural community is inseparably linked to the strategies they had implemented. Preliminary phytolith analysis shows that at the very least sorghum, millet and legumous plats (such as cowpeas) were grown (Hattingh 2014). Even though there is no direct evidence yet, it is very likely that intercropping or crop rotation were adopted, both strategies result in increased yield, extended soil fertility, reduce disease, pest and weeds, improved diet and increased protection in the event of erratic rainfall decline. These strategies show an ability to learn from the challenges they face and adapt in order to improve the chance of positive outcomes in the future.

The implementation of physical structures in order to maximize the quantity of land available for agricultural produce through terracing furthermore displays the adaptable nature of the people of Bokoni. Due to the gradient of some areas the production of crops, particularly cereal crops would have led to damaging soil erosion. The root systems would have destabilised the structure of the soil and caused the now loosened soil to wash downslope during rainfall. The terracing also prevents the washing of top soil in areas on gentler slopes – top soil is vital for successful yield results. Introducing the terracing as a result of the topography of the land available for farming is an adaptive technique that led that successful agricultural production.

In the most fundamental way, the people of Bokoni displayed resilience by changing their living situations drastically in order to survive social conflict that threatened their existence. Had the people of Bokoni not retreated to the Kloof refuge sites there is a strong possibility that their existence as a society would have ended at that point in history. Their return to open air sites once again illustrates resilience to social factors in that they underwent trying circumstances and still succeeded in reforming in some semblance of their society to continue their agricultural way of life.

All three of the sites discussed, along with a plethora of others on a global scale, present the fact that resilience and sustainability are interwoven concepts. Research into the successes and failures of these sites may have future application. Presently we exist in an increasingly challenging, demanding climate. Globally, farmers are facing issues with climate change, reduced availability to natural resources and increased demand for produce due to ever increasing populations (Moore 2015). The historic land management practices implemented in order to overcome challenges like shifting climate, could open discourse in this field that may produce positive results

Summary

Bokoni in general shows adaptability in many aspects. This is evidenced by the stone walled structures left today, spatial layout and examination of evidence from soil and phytolith analysis. Khutwaneng in particular displays flexibility in the changes seen in spatial use and layout, differing from other Bokoni sites. Marakwet and Willowvale provide interesting comparisons to Bokoni. Some aspects, such as the role of gendered labour divisions on power relations, provide a thought-provoking area for potential future studies. This study differs from others carried out in this area due to the combination of data and analogy to attempt to understand the use of space, agricultural practices and the role of resilience in farming at Khutwaneng, Bokoni. The following chapter is a summary of the project, presenting the achievements made through this research. Constraints and recommendations for future research are also put forward.

Chapter 7: Conclusion

This chapter serves as a summary of the key points of the discussion. It also provides a space in which the constraints of this project can be discussed as well as recommendations for future research in this field.

Summary of achievements

Khutwaneng, and the Bokoni complex as a whole, poses substantial interpretive challenges; this project focussed on one aspect of this society: urban farming strategies. This dissertation is the first in South Africa to explore urban pre-colonial farming yields.

Comparison of the archaeology of Khutwaneng with Komati Gorge, an earlier Bokoni village, showed that localised intensification of the use of village space occurred, while there was consistency in the overall approach to farming in villages. In spite of the more intensive use of space, there was less land on which to farm in the village of Khutwaneng, and consequently a smaller amount of food was produced per household on the homestead terraces.

I suggested that some attempts were made to increase yield, and that in addition to terracing these probably included intercropping and fertilising the field with household rubbish. This is supported by occurrence of pot shards and more organic soils in the terrace test pits consistently through the village.

This level of production was sufficient to sustain households under normal circumstances. The overall culture of farming in Bokoni and need to hedge for less favourable times, however, suggests that farmers would have cultivated additional land in other areas. These could include the parts of the hills that are too steep for residential purposes, and land in the valleys. The combination of garden and field agriculture is common throughout sub-Saharan Africa, and also took place in Willowvale and Marakwet.

The comparisons between Willowvale and Khutwaneng allow us to understand the cognitive factors that could come in to play when assessing how best to utilise land. There is also an interesting similarity in the role of gender in agricultural activities and how this informs on spatial layout. Similarly, comparison with Marakwet allowed me to reflect on the role of gender.

Lastly, through the comparison with farming at Willowvale and Marakwet, as well as the changes in the use of space in the Bokoni complex itself, it is clear that resilience played an important role in the success or failure of a community. All of the areas studied displayed forms of adaptation that allowed them to overcome challenges that otherwise could have led to their extinction.

Constraints

This dissertation contains pioneering work, but this is also a constraint. I adopted and adapted methodologies from agricultural sciences, which are more suited to extant communities and fields in which the constraints on farming are better known.

Mapping of the sites also was challenging. The first of these stemmed from the density of the vegetation. The ideal time to map would be shortly after burning, when vegetation is low, and thus small or poorly preserved structures are visible. Secondly, the limited access to Khutwaneng in its entirety posed limitations. Fortunately, the bulk of the village was on the farm access had been granted to. Thirdly, the construction of the Vodacom tower and its access road caused substantial damage to undocumented sites. This is unfortunate as we can now only speculate as to what structures were originally in place.

When participating in research on a society with almost no ethnographic record, there are always challenges and the risk of incorrect assumption. For example, I was forced to calculate figures using generalised figures rather than exact productions. This still provides us with a comparative base for discussion but it must be understood that the figures produced are estimates and not exact representations

Recommendations for future research

A large site mapping project for the whole of Bokoni would help to generate comparative yield data for the whole region. This will allow comparisons between different phases of occupation, as well as exploration of differences and similarities between places of power, such as Khutwaneng, and smaller villages on the outskirts.

Lastly, I suggest that there is a need for further archaeological research into African farming strategies, and this data should be used to reflect on the concept of agricultural resilience. The inclusion of archaeological data in the discourse on sustainable farming would deepen these debates, and present data on approaches that have been shown to be sustainable over centuries instead of the decades that normally are the subjects of these discussions.

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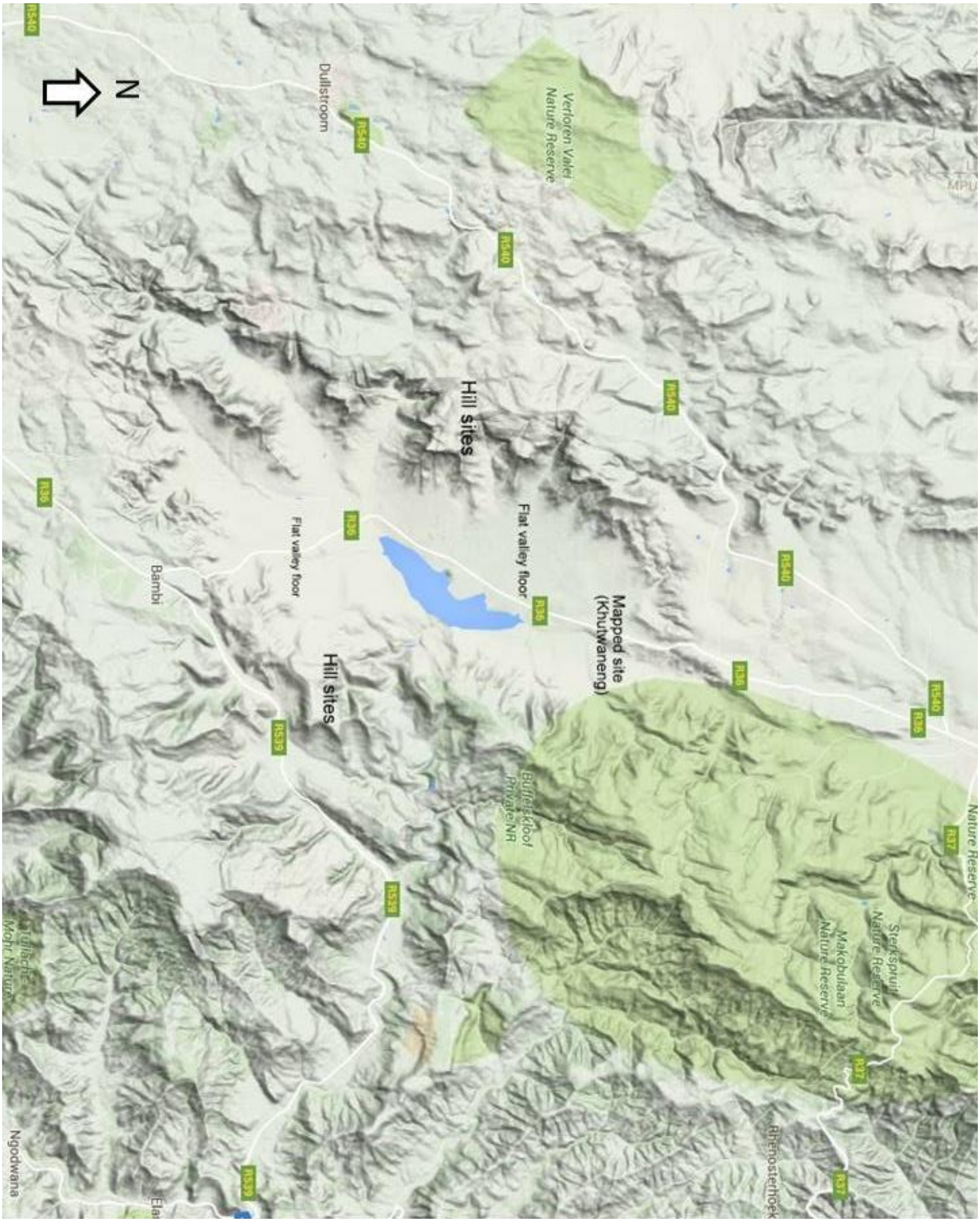
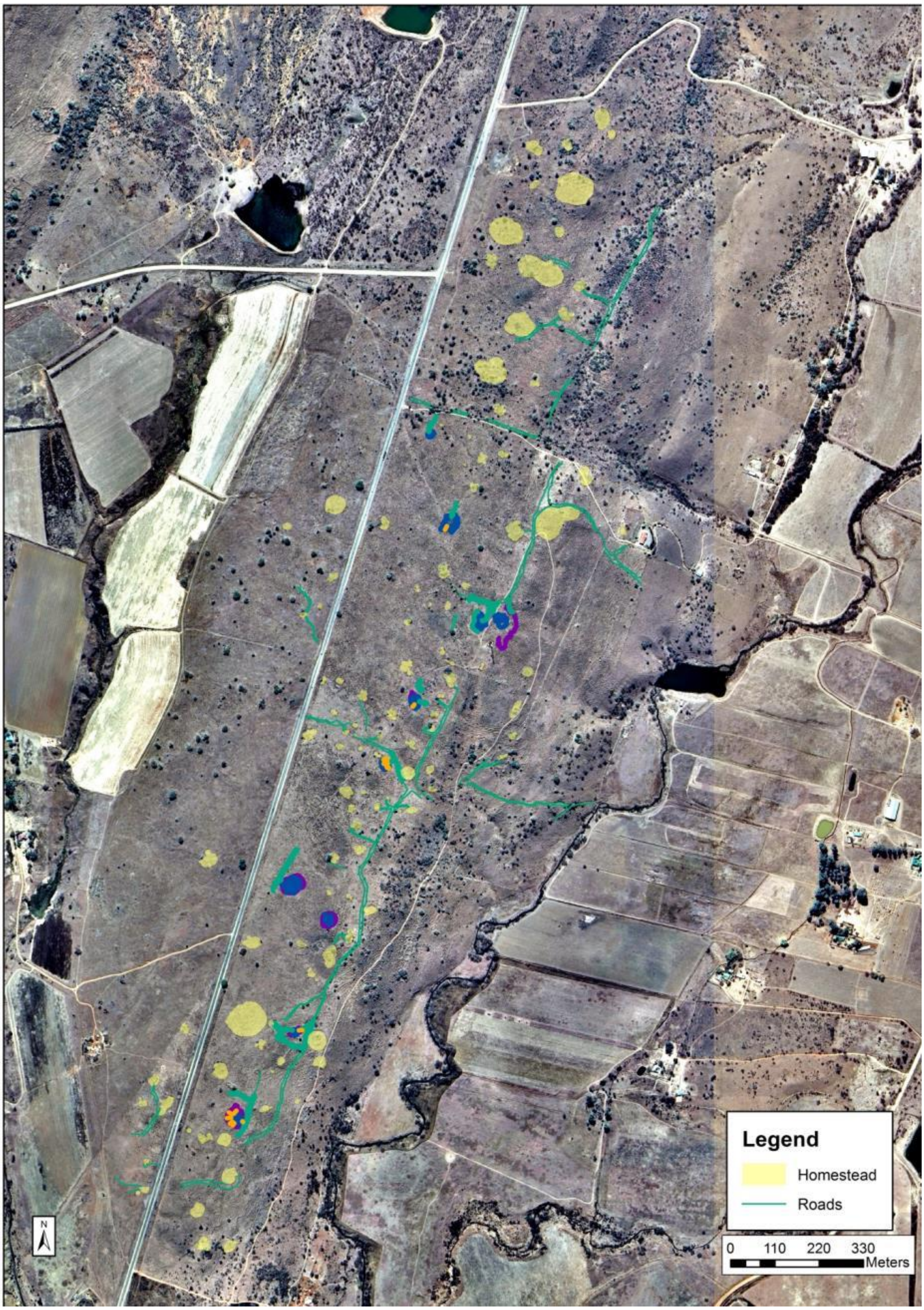
Appendix A: Map depicting mapped sit in context



Appendix B: Mapped Aerial image illustrating visible road and homesteads



Appendix C: Diagrams showing areas demarcated for surface area calculation

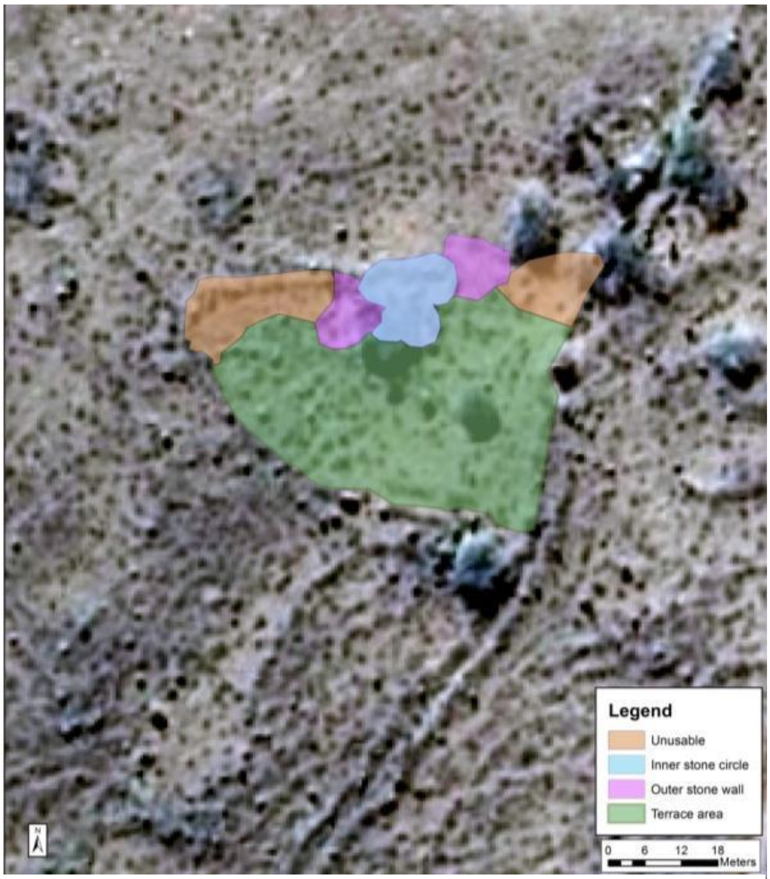


Figure 1: Homestead 1

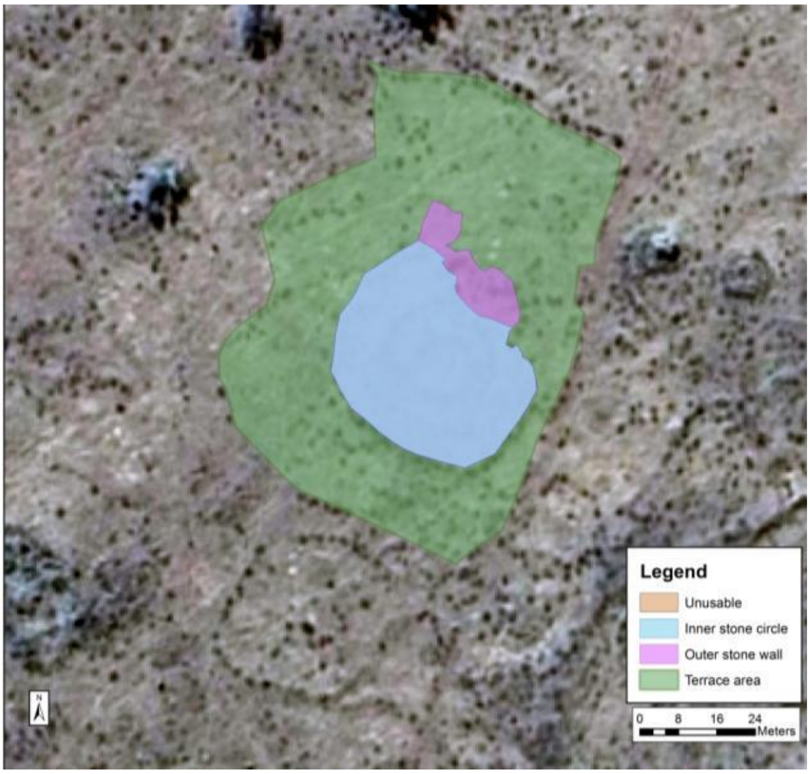


Figure 2: Homestead 2

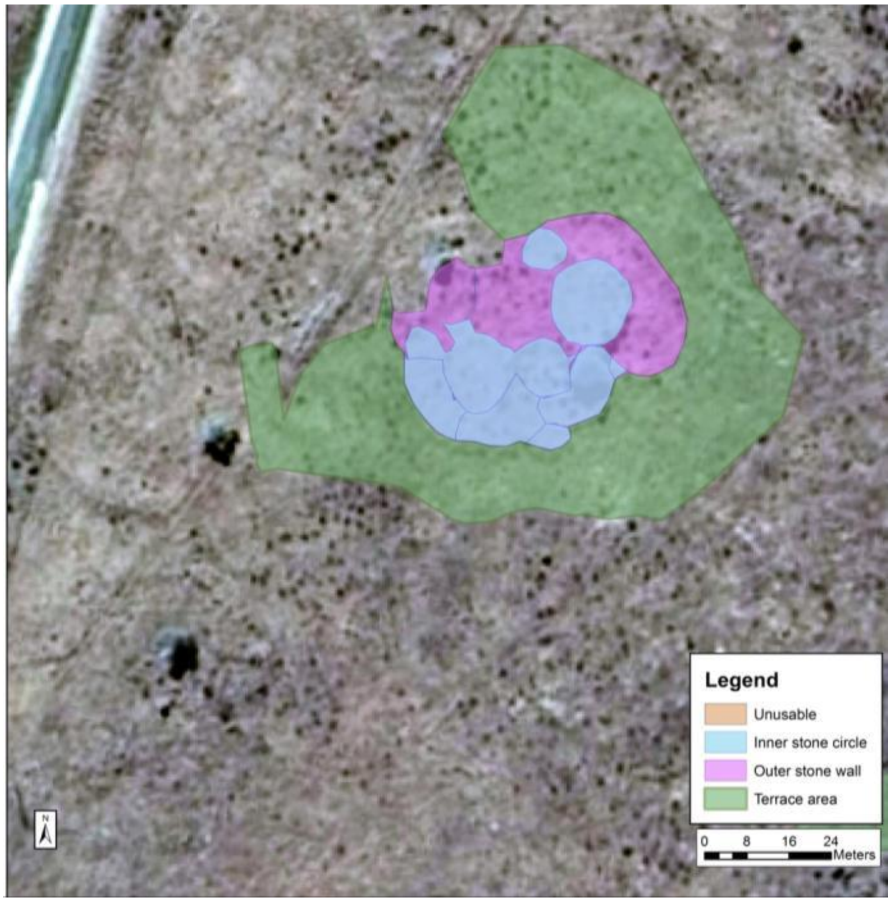


Figure 3: Homestead 3

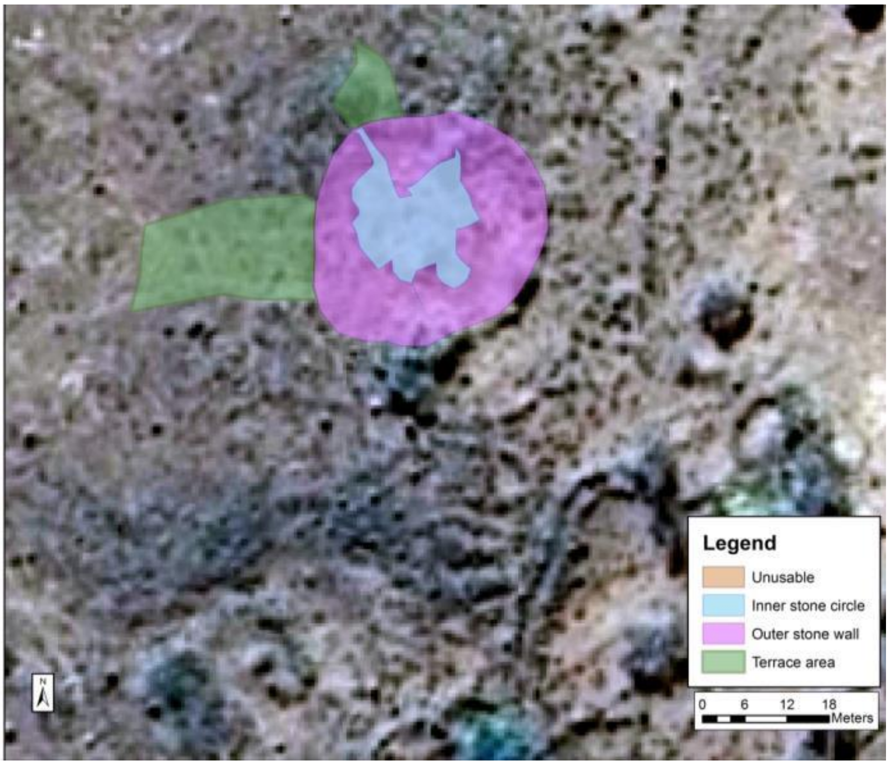


Figure 4: Homestead 4

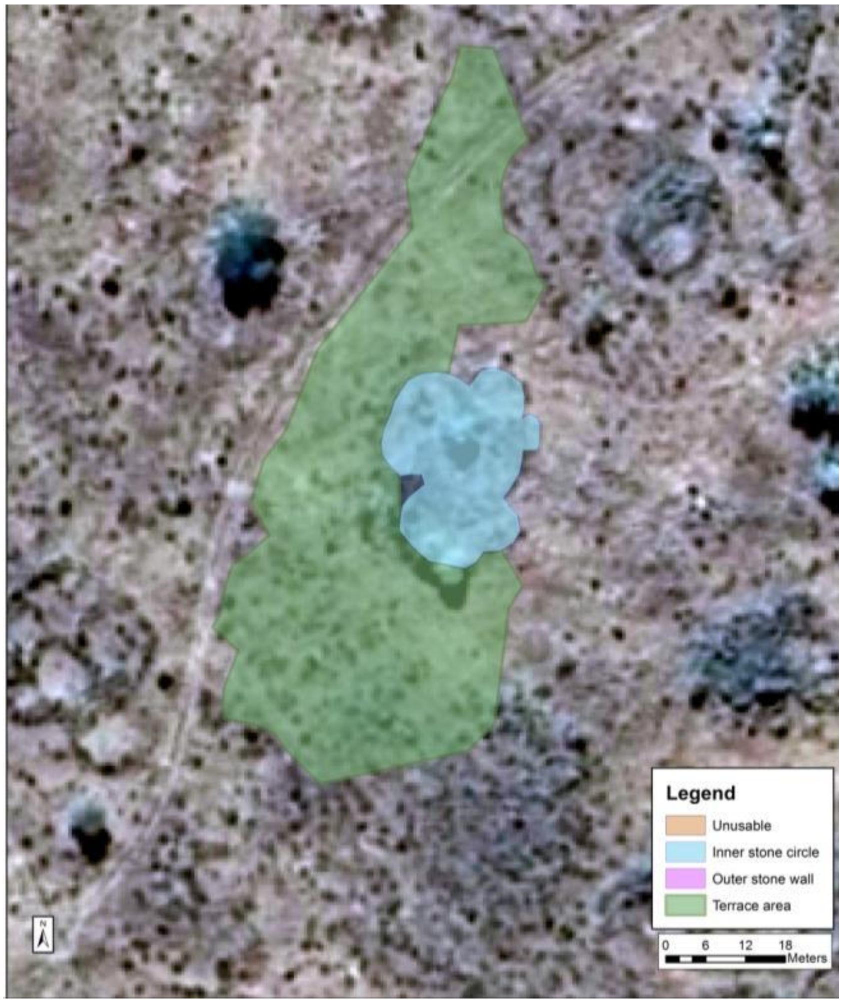


Figure 5: Homestead 5

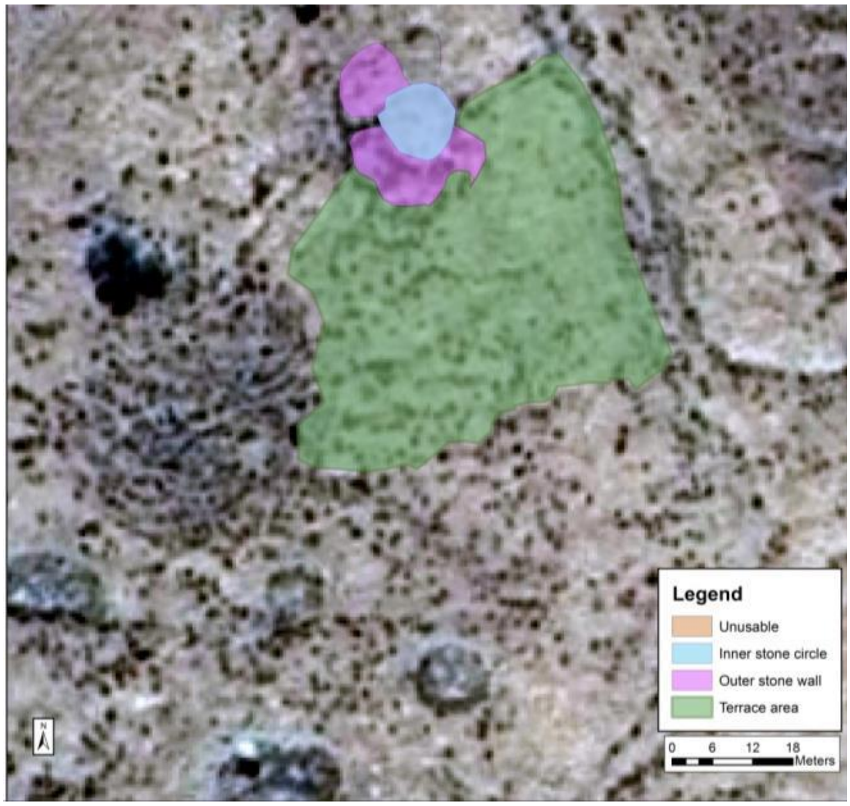


Figure 6: Homestead 6

Figure 7: Homestead 7

Figure 8: Homestead 8

Figure 9: Homestead 9

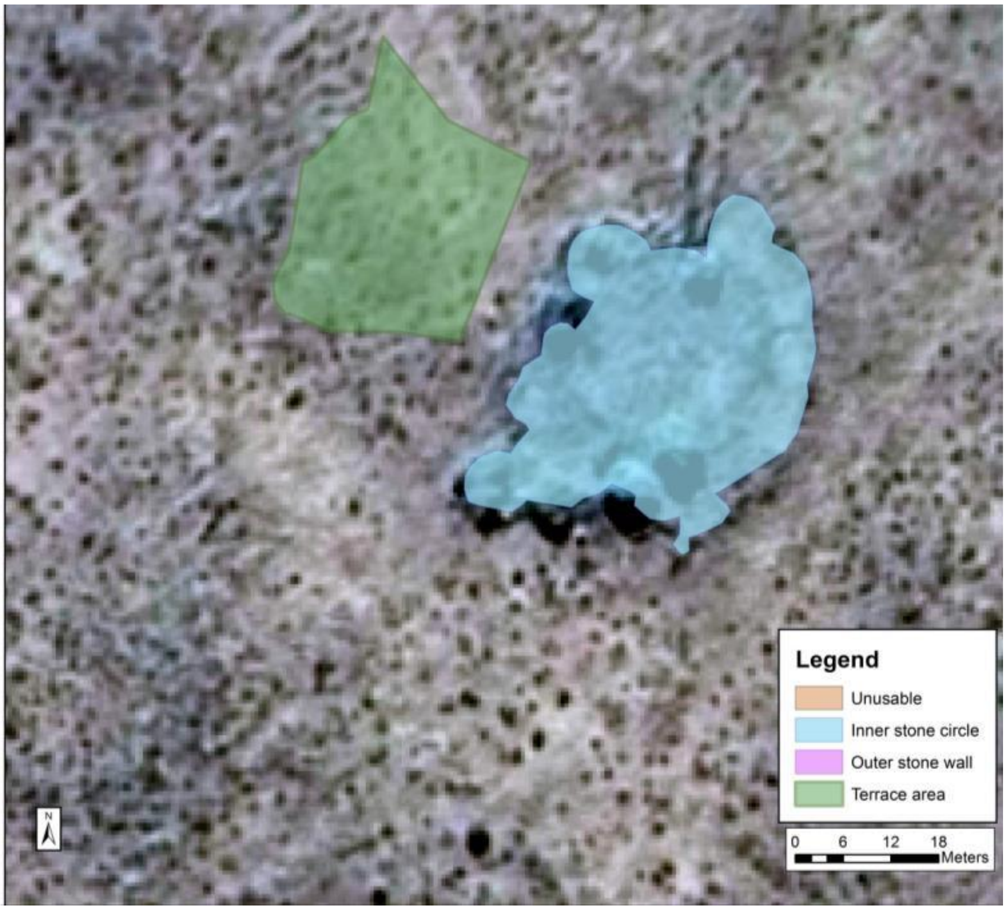


Figure 10: Homestead 10