Aksum: Environmental Archaeology

Federica Sulas
Centre for Urban Network Evolutions, Aarhus University, Aarhus, Denmark
Anthropology and Archaeology, University of Pretoria, Pretoria, South Africa

Introduction

Rising above the Sudanese lowlands to the north and the Red Sea coastal plains to the east, the highlands of northern Ethiopia and Eritrea have long been recognized as a center of plant domestication and host of some of the earliest complex societies of sub-Saharan Africa. The intensification of contacts with southern Arabia in the first millennium BCE favored the development of complex societies and, later, the emergence of the Kingdom of Aksum (c. BCE 140–CE 800). Aksum is located on a gentle plain at the heart of the Tigray highlands (Fig. 1) which provided excellent ground for the new kingdom to thrive for almost a 1000 years by engaging in long-distance trade and commerce, developing literacy and coinage. The adoption of Christianity in the early fourth century CE furthered Aksum’s importance within and beyond northeast Africa. This historical significance has fostered intensive archaeological research in the region, but the history of its diverse environment has received little scholarly attention until recently. Today, Aksum (UNESCO World Heritage Site, 1981) is one of the most important archaeological sites of Africa and remains the leading religious center for the Ethiopian Orthodox Church. As environmental archaeology in Ethiopia and Eritrea grows, the historical contexts of landscape change are becoming increasingly prominent in current debates about land degradation and sustainable resource uses.

This essay presents an updated review of environmental archaeology at Aksum as appeared in the first edition of the Encyclopedia of Global Archaeology (2014). While the original framework offered then has not changed, the last couple of years have seen the publication of few important syntheses and studies that provide new stimuli to advance knowledge, and research, on human-environment interaction in the greater Aksum area in the coming years.

The essay first outlines the environmental aspects that have been explored by archaeological research at Aksum. The historical background traces the emergence of archaeological research through three main phases: the “discovery” (1900s–1940s), the “consolidation” (1970s–1980s), and the “diversification” since the early 1990s. A third section explores the emerging critique of environmental history models in the light of new research findings and changing perspectives. The review ends with a remark on the emphasis on the role of environmental archaeology and history to current debates on heritage management, land degradation, and sustainable

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Definition

Environmental archaeology in the northern highlands of Ethiopia has focused on three main topics: (1) the development of settlement and its impact on the landscape, (2) the availability and management of environmental resources such as land and water, and (3) the legacy of past land uses into present-day landscapes and societies. The emphasis on these topics is much the result of advances in archaeological methods and the sociopolitical transformations that have shaped modern Ethiopia and Eritrea. Intensive archaeological survey and reconnaissance records have elucidated the main patterns of settlement history in the Aksum plain. However, while the research focus on the development of the kingdom has produced well-defined settlement trajectories for
the first millennium CE, the records for the periods before the emergence of Aksum and following its decline are patchy, and there are important gaps. For example, excavations at rock-shelter sites have detailed later prehistoric occupation sequences (c. ninth/eight millennia BCE) in the hills surrounding the Aksum plain (Phillipson 2000), but the landscape that hosted these early groups is poorly understood. In fact, no solid environmental record is available from Aksum for this period, though regional and continental datasets of past climate are available. The regional record of significant climate amelioration at the beginning of the Holocene (c. 10,000 BCE) has been linked to the peopling of the area – though sporadic occurrences of Early Stone Age and Middle Stone Age material point to much earlier frequention. Substantial environmental records are available only for the Aksumite periods, broadly encompassing the rise of social complexity and the demise of the kingdom (c. 900 BCE–CE 800). Studies of plant and animal remains and geoarchaeological investigations have contributed to illuminating aspects of the subsistence base of the kingdom and its impact on the landscape. Archaeobotanical and zooarchaeological studies have concentrated on settlement sites and funerary contexts, and geoarchaeological data come mainly from landscape sequences and buried soils (or paleosols). Regional climatic records provide further sources of information, but the physical diversity of the northern Ethiopian-Eritrean highlands together with patchy archaeological records makes it difficult to build solid correlations (see below). The cultural and environmental history following the decline of the Aksumite kingdom (c. 800 CE onward) is poorly understood, but there is now indication that Aksum’s countryside was not abandoned (Fattovich 2008; Sernicola 2017). In addition, buried soil records, palaeobotanical data, and historical sources provide supporting evidence for prolonged settlement and arable land use throughout the second millennium CE.

Over the last decade or so, the implications of environmental reconstructions beyond archaeological research have begun to emerge. Geomorphological and land evaluation studies have often linked past land uses to present environmental degradation (e.g., Nyssen et al. 2004). The links between intensifying agriculture and the decline of the Aksumite kingdom feed into discussions about traditional land uses and their contribution to present environmental conditions. This remains a debated topic, which is unlikely to find consensus until a far more coherent and richer body of data is available. In fact, while Aksum is arguably the place where most archaeological research has taken place, environmental and land evaluation studies have targeted other areas of the Ethiopian-Eritrean highlands and beyond. Thus, correlations between local archaeological evidence and regional environmental proxies rely on questionable geographical, cultural, and temporal uniformities.

**Historical Background**

**Discovery (1900s–1940s)**

Archaeological investigation at Aksum begun in the early 1900s with the Deutsche Aksum-Expedition (hereinafter DAE) led by Enno Littmann. The German team comprehensively recorded ancient monuments at Aksum and other sites of Tigray and Eritrea. The detailed analysis of ancient architecture, inscriptions, and material culture was published in four volumes (Littmann et al. 1913) and laid the foundations of Aksumite archaeology. Although this team was not particularly concerned with environmental aspects, the expedition’s photographic archive includes several panoramic views of Aksum’s landscape in 1906 and, thus, before the occurrence of main reforestation programs, infrastructure building, and urban development, which later transformed significant parts of the Ethiopian highlands. This is a remarkable source of information that remains largely untapped. The DAE publication offered the first detailed description of the local archaeology, which Carlo Conti Rossini (1928) framed within a coherent historical context and linked to textual and oral sources. This includes, for example, reference to oral traditions linking the “fall” of Aksum to the destruction caused by the external invasions, droughts, and famines. However old
some of these local traditions may be, they are preserved in manuscript texts, often compiled in much later periods than those to which they refer. That said, these sources offer remarkable information on Aksum’s landscape, and some have long been referenced in support of archaeological interpretation (see Fattovich 2008).

In the 1930s and 1940s, systematic excavations at Aksum included the recording of landscape stratigraphy. In 1937, while in Aksum for the relocation of a stele to Rome, Ugo Monneret de Villard (1938) conducted a topographic study and investigated the stratigraphic sequence of the Aksum plain. He identified two main phases of sediment depositions next to the Cathedral Maryam Seyon (Fig. 2): the earliest phase would have preceded the rise of Aksum, and, in particular, it would have occurred before the erection of the monoliths at the Northern Stele Park; a second phase would have taken place after the decline of the kingdom. Shortly afterward, further sedimentary data were collected by Salvatore Puglisi (1941), who led the Missione Archeologica Italiana at Aksum and sought to expand research beyond the then known archaeological area by surveying other sectors of the plain. Puglisi excavated a main residential building and conducted test excavations to the west and northeast of the old town where he recorded a stratigraphic sequence of cultural layers interspersed by alluvial deposits (Fig. 2). In the 1950s and 1960s, the newly established Ethiopian Institute of Archaeology (Addis Ababa 1952) sponsored further systematic research by French scholars who excavated important monumental structures and sites. The results of these studies provided new evidence for outlining the early cultural sequence of Aksum and its surroundings (e.g., de Contenson 2005).

Consolidation (1970s–1980s)
The early 1970s saw the beginning of large-scale excavations and surveys at Aksum and its surroundings by British, Italian, and American archaeologists. The new research programs were designed to examine the environmental factors and cultural processes involved in the development of the Aksumite kingdom (e.g., Munro-Hay 1989; Ricci 1990; Michels 2005). However, these were cut short by widespread sociopolitical unrest that culminated in the demise of the Ethiopian monarchy in 1974 and the establishment of the Derg regime (1974-1991). The new political setting halted field research for nearly two decades, but this interruption provided time for elaborating and publishing the results of the research conducted in the early 1970s. In particular, two main works laid the foundations for subsequent modeling of the environmental and settlement history of Aksum. In 1972, Butzer (1981) had conducted preliminary geoarchaeological investigations in the Aksum plain, which included the application of soil micromorphology. The results were elaborated into an “archaeo-sedimentary” sequence that provided for the first time an integrated framework for linking cultural developments and environmental change. Although the chronological frame available in the 1970s was later revised, Butzer’s sequence remains the main reference point for any environmental reconstruction of the Aksum area. The analysis of several sections in the core archaeological area (Fig. 1) led Butzer to conclude that four aggradation phases had occurred at Aksum. The first aggradation phase (c. BCE 150-CE 150) was associated with a period of increased precipitation and the growth of Aksum as a regional political center. The second aggradation phase was linked to the erosion of degraded agricultural lands upslope due to heavier rains coupled with settlement and demographic increase. The last two phases of aggradation occurred several centuries after the decline of the Aksumite kingdom.

Shortly after Butzer’s work at Aksum, an American team led by Joseph W. Michels conducted a systematic survey of the region comprised between Aksum and Yeha (Fig. 1). During the 6 months of intense fieldwork, the survey documented over 250 ancient sites, and the resulting database not only included archaeological information but also a new classification of settlement types and records of modern land uses (Michels 2005). The results of this work (2005; an interim report was published in 1984) were fundamental in showing the intensity of ancient settlement over a diversified environment and the
links between landscape characteristics and land uses.

**Diversification (Since the Early 1990s)**

Following the establishment of the Federal Democratic Republic of Ethiopia in the early 1990s, the country regained enough political stability for resuming archaeological fieldwork. New research programs began investigating the development of farming and livestock holding, the settlement system and subsistence base of the Aksumite kingdom, and the short- and long-term impact of land use practices on the environment. In 1993, two large-scale archaeological projects started at Aksum: David W. Phillipson (2000) led the British Institute in Eastern Africa’s research in the plain, and the Italian-American expedition directed by Rodolfo Fattovich and Kathryn A. Bard resumed research on the adjacent hill of Beta Giyorgis (Fattovich et al. 2000). In addition to sharing a multidisciplinary approach, both projects combined large-scale excavations and systematic surveys for over a decade, and, thus, they ensured an unprecedented continuity of research. The British expedition excavated a number of sites to the north and west of the town. The excavations of rock-shelter sites clarified aspects of later prehistoric occupation, and research on later periods included the excavations at Aksumite sites and, significantly, the first rural settlement known as “D site” (domestic site). This low-status satellite farming settlement was located to the north of the old town (Figs. 1 and 2) and yielded evidence for two distinct occupations: an early farming-based settlement (c. 700–400 BCE) and, after a significant hiatus, a lower-status occupation in the sixth century CE. Botanical and faunal assemblages revealed a widening of the resource base from the early phase and included the first appearance of African cereals such as tef (Boardman 1999; Phillipson 2000). The records from “D site” and other sites nearby show that Near Eastern and African crops were grown from at least the mid-first millennium BCE and possibly earlier (Bard et al. 2000; D’Andrea 2008). Near Eastern plants (i.e., barley, emmer wheat, flax) were the most common groups and were most likely associated with dry farming. Since the mid-first millennium CE, there is evidence for an increase in food plants, cereals, pulses,
oil, and fiber plants (Boardman 1999). With the exception of few species (grape, sorghum, finger millet), there is a remarkable continuity between the later Aksumite times and today (Phillipson 2000: 420). A similar scenario is illustrated by the results of exploratory pollen analyses on archaeological sediments from Beta Giyorgis hill, which point to the presence of an open grassland vegetation cover with tree patches from the mid-first millennium BCE (DiBlasi in Bard et al. 2000). While further palynological studies have yet to be undertaken, research on plant resources and vegetation history has gradually diversified. Recent developments include ethnobotanical approaches to reconstruct crop processing and taphonomic processes (D’Andrea 2008) and analyses of phytoliths and charred wood, from buried soils and sediments to acquire information on the vegetation history (French et al. 2009; Sulas 2016). As for zooarchaeological studies, the faunal assemblages from settlement sites at Beta Giyorgis and Aksum show a predominance of domesticated mammals (cattle, sheep, and goat), suggesting that animals were kept for meat, by-products, and labor (Bard et al. 2000; Phillipson 2000). These first studies showed the potential of zooarchaeology for investigating environmental and resource use aspects of the Aksumite culture. However, no further research in this direction has been conducted, and, in the absence of taphonomic studies, the role and use of animal resources remain poorly understood. Recent detailed analyses of lithic assemblages, instead, have added significant depth to understanding of the early peopling and resource management history of the Aksum area and the wider region in general (Phillipson 2009, 2017). Comparative studies of lithics by L. Phillipson (2017), in particular, have elucidated how rural population from the later prehistoric period has adapted to changing cultural and economic circumstances before and during the Aksumite period.

The last few years have witnessed the rise of the first Ethiopian archaeologists working at Aksum (Hagos 2001, 2010; Wurku Derara 2015) and the opening of the first archaeology department in the country (2006) at the newly established Axum University. New research projects were set up to investigate the local landscape history by combining geoarchaeological, palaeobotanical, and remote sensing techniques (Schmid et al. 2008; French et al. 2009). At the same time, Fattovich (2008), Sernicola (2017), and Phillipson (2009, 2017) resumed systematic surveying to complete the archaeological map of the greater Aksum area as well as conducting high-resolution studies of material culture (Fig. 3). Other recent studies also include geopedological research on past soil erosion (Ciampalini et al. 2008). As detailed in the following section, these new developments provide the basis for rethinking a series of aspects concerning the theories and methodologies of environmental archaeology in the region.

Key Issues/Current Debates

Recent research advances call now for a reconsideration of a series of long-established ideas about Aksum’s past. First, new archaeological findings indicate the presence of agropastoralists in the Aksum area, and the northern Ethiopian highlands in general, since the mid-fourth millennium BCE at least (Phillipson 2017 and reference therein). It is also now apparent that a mosaic of cultures and subsistence strategies populated the region during the first millennium BCE (Phillipson 2012). This evidence calls for a rethinking of former cultural sequences emphasizing the importance of a single culture (viz., the pre-Aksumite culture) and farming. While these were part and parcel of Aksum’s development as a kingdom, other cultures and ways of life played important roles in the broader region that was later under the control of the Aksumite kingdom. Second, there are substantial temporal and spatial discrepancies between the archaeological and landscape data at regional and local scale. A wide range of regional data about past environment and climate come from lake deposits and landscape sequences in areas and regions (see, e.g., Nyssen et al. 2004) for which archaeological evidence is very limited, if not absent altogether. On the other side, the remarkably rich cultural record from Aksum has been associated with limited local landscape data.
until recently; these were almost exclusively based on Butzer’s “archaeo-sedimentary” sequence, linking the rise and demise of Aksumite cultures to increased rainfall, population growth, and intensified land use. Since the mid-1990s, the study of plant and animal remains and, more recently, geoarchaeological research have provided new local data that suggest a more complex scenario. Studies of plant macro- and microfossils (seeds, charred wood, pollen, and phytoliths) indicate the presence of a woody savannah vegetation cover at Aksum before, during, and after the kingdom was in place, and there is no evidence for the occurrence of woodland and, subsequent, land clearance. This is further illustrated in the sedimentary record from the hilltop of Beta Giyorgis, hilltops, and river valleys north of the town (Fig. 1), reflecting prolonged landscape stability.
associated with permanent settlement and land uses from the mid-fourth millennium BCE until about 1600 CE (French et al. 2009). On hilltops and uplands, thick buried soil horizons were associated with settlement and farming, while buried soil records from hillside deposits may have been linked to pastures. The botanical remains (phytoliths and charred wood) from the buried soils reflect a substantially stable woody savannah vegetation cover with tree patches nearby watercourses and settlements, of which palm trees were a significant component. However, the impact of the climatic fluctuations on the vegetation is still unclear, and the possibility of localized, intense, and climate-driven events, such as natural fires and the partial removal of vegetation by erratic rainfall, requires careful consideration. The buried landscape records have also prompted a revision of earlier models linking land productivity to irrigation at ancient Aksum. Yet, the buried soil record shows no evidence for irrigation, and the botanical indicators reflect the presence of crops and other plants that can grow under rain-fed farming (Boardman 1999; D’Andrea 2008; Sulas 2014).

Today, Ethiopia is undergoing major landscape transformations due to urban development and agricultural programs, and these changes are having a significant impact on the “traditional” lifestyles of the rural population. Modern Aksum is situated in a buffer position between international borders, a war-prone zone where rain/crop failure and political instability are actual rather than potential threats. A main theme of current research targets precisely the debate about present-day landscape conditions: Are the results of mismanagement since people permanently settled down, started farming, and ultimately transformed Aksum’s landscape? Or have both human and natural forces contributed to change? If so, what lesson can be learned from the past? These questions highlight the need for studies designed to understand the interrelated histories of land use and degradation not simply for writing Aksum’s history but also for negotiating current challenges to heritage preservation and management (Wurku Derara 2015). As outlined above, archaeological research has long focused on the development of settlement and the emergence of social complexity, and only a limited number of studies have addressed the potential effects of agriculture and other land uses on the landscape. These are now emerging themes for understanding but also assessing and conserving Aksum’s long-lasting environmental and cultural heritage.

International Perspectives

Since the early 1980s, the decline of the kingdom in the late first millennium CE has been linked to environmental degradation due to population pressure, arable land use intensification, and increased precipitation. This thesis has then been integrated with large-scale survey data on settlement patterns and applied for modeling a cultural history of Aksum, whereby human-induced factors inhibited landscape readjustments to climatic shifts. However, recent work has begun to question a number of assumptions based on earlier research. First, recent large-scale landscape investigations using a variety of archaeological science techniques are now regularly able to elucidate finer details from buried landscapes that indicate intrinsic linkages between human exploitation of landscapes, soil and vegetation change, and long-term climate change. The development of geoarchaeology has had a fundamental role in placing human activity in changing landscape settings by deciphering long-term trajectories of landscape change and by identifying the effects of human settlement on the sustainability of landscapes under human pressure. In Ethiopia, human activity as a factor of soil formation and development has rarely, if ever, been considered. Instead, an increasing number of studies, particularly pertinent to tropical environments, are showing how important the perception of local people is for addressing soil issues. In addition, recent archaeological survey has also indicated a greater time depth and gradual intensification of settlement development in the northern Aksum area over at least the last four millennia. As such, archaeology has moved beyond simple equations linking state formation, settlement expansion, agricultural
intensification, and consequent deforestation, erosion, and soil degradation. Rather than raising new questions, these considerations refocus perspectives and viewpoints for old issues: Was intensification of agriculture a result of decreased land productivity, environmental/climatic worsening, increased population/market demands, or a combination of all of these?

**Future Directions**

Throughout the twentieth century, the understanding of the relationship between the development of subsistence systems and environmental changes at Aksum was based on a combination of multi-scale and multidisciplinary data. The interpolation of environmental data, which informs our wider research question of human settlement, was drawn from regional scale and context-specific archaeological records. The Aksumite urban development has long been linked to the idea of an agricultural substratum dependent on irrigation and responsible for land clearance. However, it is now clear that woods were not a common feature of the local landscape either before or during the Aksumite period and that agriculture relied on rainfall. Even if some aspects of ancient resource management have been investigated, site-specific studies and informed research are still very few. Furthermore, important issues such as terracing and field systems have yet to be addressed, albeit clearly priorities within the context of a changing landscape. A greater amount of environmental and archaeological records are needed particularly now that relevant comparable datasets have recently been acquired from elsewhere in Tigray (e.g., Gebru et al. 2009). The retrieval of landscape information is needed to contextualize non-environmental factors affecting societal decision-making over time. A greater amount of archaeological and historical data on the typology/typologies and distribution of rural settlements is necessary to address urban development and, subsequently, the decline of the Aksumite kingdom. The trajectories of settlement and land use diversification need to be addressed within their environmental and ecological contexts. Indeed, the paucity of buried landscape records implies that any attempt at modeling synchronous histories of forest expansion/clearance or the impact of changing rainfall, to mention just two important topics, has to rely on assumptions of environmental and cultural uniformity across vast regions.

Perhaps, the most compelling task currently facing archaeology and cognate disciplines concerns the development of multiple “applied approaches.” In this respect, there are a number of opportunities and challenges for archaeological research at Aksum. The applied nature of archaeology has often been confined to the spheres of heritage creation and conservation, and tourism development. However, archaeology has much to offer to integrated, environmental research and can act as a bridge to link theories and methods from the humanities and earth sciences. Past societal responses to environmental stresses and opportunities were chosen from within a range of cultural and ecological constraints, and the understanding of these responses may well contribute to approaching and negotiating present and future environmental risks.

**Cross-References**

- Archaeobotany
- Archaeobotany of Early Agriculture: Macrobotany
- Archaeobotany of Early Agriculture: Microbotanical Analysis
- Butzer, Karl W
- Geoarchaeology
- Landscape Archaeology
- Oral Sources and Oral History
- Phytolith Studies in Archaeology
- Plant Domestication and Cultivation in Archaeology
- Soil Pollen Analyses in Environmental Archaeology
- Taphonomy: Definition
- Zooarchaeology
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References


Further Reading


