Report of the Research Project

“The archaeological area of Aksum (Ethiopia): Remote Sensing and GIS for a Reconstruction of the Ancient Landscape and the Archaeological Heritage Management”

Grant Regione Campania L.R. 5, 2002

Naples 3/10/2005
Introduction and Research Design

As specified in the purpose, the research project was aimed at reconstructing the diachronic changes in the landscape in the area of Aksum (14° 8’ N; 38° 43’ E), the capital city of the Aksumite kingdom in N Ethiopia (ca. 400 BC-AD 800)\(^1\), and at understanding the dynamics of human exploitation, manipulation, and management of the territory also related to environmental stress and to social pressures as the whole N Ethiopian plateau is affected by environmental deterioration and soil erosion\(^2\). Moreover, the project also wanted to contribute to the archaeological heritage management in the area providing predictive models of site distribution and maps and data bases of the recorded evidence.

The adopted approach was a multidisciplinary one aimed at investigating the Man-Environmental relationships in ancient times, and data useful for paleoenvironmental modeling (bothanical and zoological remains, soils samples, etc.) were systematically collected. A Landscape Archaeology approach was adopted because the present landscape can be considered as a stratified palimpsest of all past evidences of ecosystemic interaction that can be studied to reconstruct the different aspects of the Man-Environment relationships\(^3\). For this reason a special attention was given not only to the distribution and chronological and functional classification of archaeological sites but also to the study of the off-site man-made features (ancient fields, roads, terraces, facilities for water management, etc.) and of their environmental settings.

The procedures used were archaeological survey and excavations conducted in Ethiopia from May 12\(^{th}\) to June 16\(^{th}\) 2005\(^4\), and laboratory quantitative, GIS and remote sensing analysis of the available data performed before and after fieldwork in the Laboratory of Archaeology of the Department for African and Arabic Studies of the University of Naples “l’Orientale”\(^5\). In the laboratory phase the data collected from 1993 to 2003 by the Joint Archaeological Expedition of the University of Naples “l’Orientale” and Boston University were also used to generate hypothesis to be checked before fieldwork and to complement the data collected in the field in the interpretative

---


\(^2\) For the relevance of these factors in the history of the area see K.A. Bard (ed.), K.A. Bard et al.2000.


\(^4\) The fieldwork took place under the direction of Prof. Rodolfo Fattovich. Members of the expedition were: Prof. Rodolfo Fattovich (“l’Orientale”, Naples, Italy), director; Prof. Yaqob Beyene(“l’Orientale”, Naples, Italy), ethnohistorian; Dr. Andrea Manzo (“l’Orientale”, Naples, Italy), archaeologist; Dr. Cinzia Perlingieri (“l’Orientale”, Naples, Italy), ceramic analyst; Dr. Laurel Phillipson (British Institute in Eastern Africa, UK), lithic analyst; Ms. Bethlehem Dejene (Columbia University, USA), historian; Mr. Brook Abdu (Boston University, USA), archaeologist; Ms. Luisa Sernicola (“l’Orientale”, Naples, Italy), archaeologist; Ms. Fedrica Sulas (Cambridge University, UK), geoarchaeologist. The Expedition collaborated with the geological expedition of the University of Florence, directed by Prof. Mario Sagri, and Prof. Giovanni Ferrari.

\(^5\) The laboratory analysis were conducted in collaboration with Dr. Magly Koch of the Center for Remote Sensing of Boston University (Boston, USA), and with the Laboratory of Geoarchaeology of the Cambridge University (Cambridge, UK).
phase. Actually the area selected for fieldwork, encompassing the eastern, northern, and western slopes of the Bieta Giyorgis, was purposely selected to be integrated with the data collected on the top of the hill by the Italian-American Joint Expedition (Fig. 1), and also the recording procedures were homogeneous with the ones of the Italian-American Joint Expedition.6

Fig. 1. The study area.

Environmental and Paleoenvironmental Setting (A. Manzo and F. Sulas)

The study area consists of the lands located NE of the modern town of Aksum (Fig. 1), where gently sloping plains N of the Bieta Giyorgis hill are ringed by the uplands of Ma Qono and Kube hill and to the west by the plain between Bieta Giyorgis and Gobedra. The present agricultural landscape is characterised by scattered households and cultivated fields. Most of the slopes and

6 Preliminary reports were published in the Rassegna di Studi Etiopici, and Nyame Akuma since 1993, see also K.A. Bard et al. 2003, the final report of the project, K. A. Bard and Rodolfo Fattovich (ed) nd.a.
plains are terraced, and few restricted spots are used for grazing. Forest lands are found only on the eastern slope of Ma Qono and along the slopes of Bieta Gioyrgis.

Local drainage system includes tree main seasonal streams: Gudgwad Agazen, May Hibay/Gwoda and May Leto. Gudgwad Agazen drains from the hilltop of Bieta Giyorgis hill along the north-eastern slope toward Ma Qono’s uplands where it confluences into the May Hibay/Gwoda. May Hibay/Gwoda river drains along northern foot slopes of Bieta Giyorgis running eastwards, while May Leto drains from the upper slope of Kube reaching the confluence with May Hibay/Gwoda at foot slope.

The geology of this area and in general of the Aksum region is known by studies at regional scale.\textsuperscript{7} Large parts of the Tigrean highlands are covered by thick layers of Tertiary basalts due to volcanic activity in remote times. These layers form a distinctive terraced topography with a succession of flat surfaces and steep slopes. Residual hills and ridges are common, while major river valleys and foot slopes are ringed by quaternary sediments. Erosive processes have been very active since long time, and mainly associated to rifting and uplifting.\textsuperscript{8} Gully erosion, creeping and sheet wash are widespread. A more detailed geological study of the Bieta Giyorgis was conducted in the framework of the UNO-BU Expedition\textsuperscript{9}: the hill is underlain by a large mass of phaneritic igneous rock cropping out on the central uplands and flanks of the hill, its core is a syenitic intrusive, of middle to late Tertiary age, which cuts across older sedimentary and metamorphic rocks and is covered by a discontinuous mantle of late Tertiary siltstone, sandstone and conglomerate, late Cenozoic colluvium, and Holocene deposits of human origin.

The strong lithologic and topographical variation of the Aksum area is reflected in a mosaic of soils. Thin mantels of silt loam or clay loam reddish soils cover the hilltops, while step hillsides and piedmonts being more prone to hill wash and soil erosion are left with stony sandy loam. Valley and flat plains are covered by dark grey silt clays (vertisols).\textsuperscript{10} The soil map at a scale of 1:25,000 which was used in this research project was prepared by remote sensing and ground data collection in the framework of the UNO-BU 1993-2003 project\textsuperscript{11} (Fig. 2).

\textsuperscript{7} Tadesse et al. 1999; Brancaccio et al. 1997; Dramis et al. 2003.
\textsuperscript{8} Brancaccio et al. 1997.
\textsuperscript{9} Johnson, and Scott Harris nd.a.
\textsuperscript{10} Butzer 1981.
\textsuperscript{11} Koch, and Schmid nd.a.
Fig. 2: Soil map of the study area. Keys: (1) white/light pink = highly reflective soils of mostly pyroclastic origin (trachyte), (2) cyan and magenta = agricultural fields with the more fertile and productive soils, (3) blue = rock outcrops and colluvium.

The present soil distribution and the degraded vegetal cover are the expression of ongoing natural erosive and of anthropogenetic processes both related to climatic changes. The relationships liking these factors are debated.

The regional climatic dynamics are mainly linked to the changes of the ITC position and of the position of the subtropical anticyclone whose effects on the precipitations and temperatures were defined by the study of changes in the lake levels in the Rift Valley, and in the fluvial deposits along the Nile. Other possible sources on climatic changes such as pollen analysis and soil formation studies might have been more affected for the Holocene by anthropic impact.

---

13 But also an anthropic impact, although usually not considered, cannot be excluded, see Nyssen 2003.
14 Bryson and Bryson 2000, p. 79.
15 See e.g. Gasse and Descortieux 1979.
16 Williams et al. 2000.
17 For the palinological studies see e.g. Bonnefille, and Hamilton 1986, for the soil formation see Nyssen 2003.
The reconstructed climatic trend seem to suggest that in the studied period, from mid-1st millennium BC to the end of the 1st millennium AD, a climatic situation similar to the present one was already established.

Mathematic models of the monthly latitude of the jetstream and of the latitude of the subtropical anticyclones were elaborated as well to reconstruct the trend of precipitations and evaporation. These models suggest an almost constant decrease of rainfall from 500 BC to AD 250, followed by an increase with a peak around AD 500 with a later decrease up to the end of the 1st millennium AD. More or less the same trend was also suggested for the evaporation.

Dealing with vegetal cover of the studied area, a reconstruction of vegetal cover on Bieta Giyorgis hill was conducted by means of pollen analysis. This model pointed out that the general vegetation pattern on Bieta Giyorgis from the mid-1st millennium BC was very similar to the pattern of today: a predominance of grasses and shrubs with only small clusters of trees near structures, in gorges along seasonal stream beds, and on rocky slopes and that the distribution of grassland and wooded grassland in the region was influenced by soil and topographic conditions, with trees growing in areas of well-drained soils and grassland across the plains of vertisols. Possibly this pattern was the results of earlier processes related to the anthropic presence in the area.

Most likely, also the soil formation and the related soil degradation processes in the Aksum area for the studied phases were the results of both climatic and anthropic actions. Apparently, pedogenetic processes took place in the second half of the 1st millennium BC and ended in the first centuries AD. Interestingly, a parallel phase of soil formation was also noticed in central Ethiopia. An other phase of soil formation was noticed in western Tigray at the end of the 1st millennium AD.

Local studies of the erosive phases and of their possible link to human activities were conducted in the Aksum area. These studies showed that intensive erosive processes took place from AD 100 to AD 350 and again from AD 650 to AD 800. Both were related to periods of heavy rains and to increasing of human exploitation and to overintensive land use possibly combined with widespread field and settlement abandonment respectively.

---

18 See Bryson and Bryson 2000.
19 DiBlasi nd.a.
20 Machado et al. 1998.
21 Sagri et al. 1999.
Geoarchaeology (F. Sulas)

The objective of the geoarchaeological study in the selected area was to contribute to investigation of ancient uses and landscape processes throughout the combined study of geomorphologic and archaeological record.

The missions in the field were:

1. To find out and record stratigraphic profiles along the streams and gullies possibly related to archaeological materials to get insights into erosional and aggradative processes that affected the area and their chronology;

2. To study the pedogenesis in the area in order to get insights into the ancient distribution of soils, and possibly to record and study ancient palaeosols;

3. To contribute to the study of the distribution of mineral resources and raw materials in the area.

The relationship between the local geomorphology and archaeology is still poorly known, but preliminary studies have been conducted in the past. Qualitative field observations were made on the kinds and distribution of rocks and soils and the relationship of these soils to ancient land uses. Micromorphological study of soil thin sections was undertaken by Butzer in the mid 1970s, who was then able to produce a model for the local stratigraphy and the relationship between environmental and anthropogenic processes involved in the shaping of Aksum’s landscape during the past two millennia. Recent investigations of Bieta Giyorgis hilltop have included geomorphological and pedological field observation along with physical and chemical analyses of surface soil samples. Archaeological research has so far concentrates on hilltop and western and southern foot slopes of Bieta Giyorgis hills, while the plains and hills east of Aksum have just been randomly surveyed. Large-scale archaeological survey of the area begun this year, and the geoarchaeological fieldwork proceeded alongside.

It is commonly accepted that the Aksumite agricultural system involved irrigation and terracing. Nevertheless, archaeological evidence for irrigation and terracing at Aksum is very poor. It has been argued that if irrigation was practiced by ancient Aksumites, furrows and tributary works might be expected on piedmonts, although perhaps unnecessary for higher terraced lands and hilltops, where dam infrastructures might prove to be more efficient. The only archaeological evidence for irrigation and terracing at Aksum is very poor. It has been argued that if irrigation was practiced by ancient Aksumites, furrows and tributary works might be expected on piedmonts, although perhaps unnecessary for higher terraced lands and hilltops, where dam infrastructures might prove to be more efficient.
evidence comes from Bieta Giyorgis hilltop, where a dam system has been recently investigated along the upper course of Gudgwad Agazen.31

In this framework, the survey of streambeds and terraced lands was conducted with the aim to detect natural exposures of stratigraphic sequences for soil sampling. In addition, the archaeological survey focused on site recording and sampling along with the investigations of field systems and terrace patterning.

Soil samples have also been collected from a section through May Lahlaha at the southern foot slopes of Bieta Giyorgis (ML05/6), which was investigated by Butzer.32 Results from micromorphological study will be integrated with Butzer’s data in the attempt to evaluate potential chances and preservation processes within the thirty-year span.33

Fieldwork
The survey concentrated along the course of three streams: Gudgwad Agazen, May Hibay/Gwoda, and May Leto. It also included the eastern slopes of Ma Qono and the plains of May Kirah and Gumala, which were investigated jointly with the major large-scale archaeological survey. Possible traces of ancient plough-marks on surface boulders and stones were recorded when found associated with archaeological sites. No suitable exposed profiles have been encountered within the May Kirah/Gumala area. A single site (Malhad 05/1) preserving traces of a possible ancient terrace was recorded, and it will be discussed at the end of this section. Archaeological sites and target geomorphologic features were recorded, georefered and sampled. Recording procedures included a description of each target area and an assessment of the site’s visibility within the landscape based on visual observations, and georeferring. These areas were selected in order to collect data for addressing the relationship between landscape dynamics and site formation processes within the project’s study area. Therefore, the natural exposures examined and sampled are located nearby archaeological sites.

31 See Bard and Fattovich nd.a.
33 The analysis are still in progress at the Charles McBurney Laboratory for Geoarchaeology, University of Cambridge (UK), and final results will be available by November 2005. A set of 22 soil samples were collected from exposed profiles and 3 soil samples were taken from excavated archaeological deposit at the site of Mesta Worki (MW I). Geochemical analysis of soil samples will include pH determinations, particle size distribution, loss of ignition, electrical conductivity, Redox determinations, and nutrient content. Soil thin sections for micromorphological analysis will be prepared according to Murphy 1986.
**Gudgwad Agazen**

The upper course of Gudgwad Agazen was surveyed in 2002 by the UNO-BU Joint Archaeological Expedition, and thus fieldwork concentrates on the mid to lower course. Local landscape is formed by terraced lands currently used for grazing and the slopes are characterised by colluvial boulders. Vegetation cover includes bushes and shrubs. Three main target areas were recorded and sampled. Along the eastern slope of Ma Qeno, geologists from the University of Florence recorded an exposed profile of a possible palaesol. A tongue of reddish clayey loam (MQ05/38), preliminarily defined as vertisol, emerged from the surrounding surface, which is covered by a yellowish clay loam. The profile measures 15 m in length with height ranging between 0, 90 m and 0, 50 m. A small trench (1 x 1 m) was opened to investigate the stratigraphic sequence and collect samples from beneath the surface. The profile appears very homogenous throughout, and three horizons have been identified on the field. Topsoil is formed by a dark brown humic loam with silt clay texture. It overlays a brown clay horizon distinguished by a decreased overall porosity and a more compact structure. The lower part of the profile is formed by a light brownish horizon very hard displaying deep rooting. The overall texture is consistent throughout the three horizons, and changes in microstructure are most likely due to bio-turbation.

Along the mid course of Gudgwad Agazen, a suitable section was recorded and sampled on the western side to the streambed (GA05/1). The profile, 2 m high, was composed by two distinct horizons overlaying the streambed. The upper horizon is a reddish clay loam with frequent coarse material and characterised by crumb structure with frequent rooting. It overlies a dark brown silt loamy horizon with occasional coarse material and channels, and characterised by a blocky structure.

In the area of Enda Giyorgis, along the mid slope of Ma Qeno, two archaeological sites (EG 05/2 and EG05/2a) and a clay mine (EG05/2b) were recorded and sampled. The clay mine is located on the terraced slope along the western side of the Gudgwad Agazen. In the same area, rocks very rich in iron were recorded. This area might have been a possible ancient iron source. Interestingly, this area is also traditionally related to metalworking, as suggested by oral traditions collected there. West of these features, a possible source of gray chert was recorded as well.

A semi-circular stone feature lies nearby the site of Enda Giyorgis and scattered archaeological evidence was recorded and sampled. A modern stone reservoir is located on the opposite side of the stream, where archaeological evidence was also recorded and sampled. According to local informants, the semi-circular feature was used for religious celebration until few years ago, when the new church of Enda Giyorgis was built few tens of meters upslope.

---

May Hibay/Gwoda and May Leto

May Hibay/Gwoda stream was surveyed from the confluence with the Gudgwād Agazen eastward up to the area of Gabra Manfas Qedus. Two profiles have been recorded and sampled within the area, while no archaeological evidence has been encountered.

At the confluence between Gudgwad Agazen and May Hibay/Gwoda, the western section of the Gudgwad Agazen has been sampled (MH 05/3). The profile is composed by light brown sandy loam, and a dark silt clayey loam with crumb structure. The latter might be a truncated soil and is seen as defined spots throughout, slightly increasing towards the bottom. Similar soil type is hardly found in the area, and local informants report that it rarely occurs in very small qualities. Its distinctive colour and structure might be the result of mineralization due to water percolation.

May Hibay/Gwoda is considered a holy stream by local people and a source of holy water is located on the streambed in the area known as Gabra Manfas Qedus. It was possible to survey only the area between the confluence with the Gudgwad Agazen and the holy source at Gabra Manfas Qedus, which lies on inaccessible land. A profile along the southern side of May Hibay/Gwoda nearby the holy source has been recorded and sampled (MH 05/4). The whole profile is c. 3 m high and three horizons have been identified on the field. The upper horizon is characterised by a brown/reddish sandy clay loam with a weakly developed crumb structure and rooting. It includes occasion gravels that increase towards the bottom. A thin layer of lighter sandy loam separated it from the lower horizon. The latter seems very similar to the upper one in terms of both texture and structure and it laid on a stratum of fluvial deposits.

The clay mine of May Asbahat (MA 05/7) was revisited and sampled. It is located on a terrace currently cultivated along the eastern slope of Ma Qono.

May Leto stream was surveyed from uphill towards the confluence with the May Hibay/Gwoda. Very few profiles have been observed and just one was fully recorded and sampled (ML 05/5) along the lower course. The profile on the southern side of the streambed was c. 2, 40 m high and included at least three horizons. The upper horizon is a dark brown sandy loam with gravels and characterised by a crumb structure. It overlies a thin layer of light sandy clay loam mixed with debris, namely traces of potsherds. The lower stratum is composed by fluvial deposits.

Malhad 05/1

Along the eastern foot slope of Ma Qeno, a portion of a possible ancient terrace has been recorded. The area, known as Malhad, is currently used for cereal cultivation and the land is covered by a brown clayey loam, locally known as bakahel. The terrace comprises two stone walls (Terrace 1 and Terrace 2). Terrace 1 is ca. 7 m long with an EW orientation and is made of small to
medium size stones. The terrace wall includes at least two stone rows with only the upper one visible, whereas larger blocks partially buried might represent a former stone row. The interstices between the stones were filled by a reddish clay soil, which might be alluvial in nature and thus resulted from downward movement of the slope soil cover. A larger block (0, 63 x 0, 38 m) displays lines associated to a dark patina on the lower part of the exposed surface. The patina is likely to reflect the former surface level. The block is partially buried and appears to have been in situ for some time. Similar kind of dark patina associated with lines was observed on some blocks forming Terrace 2. The latter is part of a main terrace running along the Mā Qeno foot slope. Terrace 2 runs perpendicularly to Terrace 1 with an ES orientation and is formed by a single row of stones partially buried.

Other Sectors
In the area of Zala, S of Gumala, a possible source of syenite and one of banded chert were identified. Clay quarries were recorded at May Agam, NE of Bieta Giyorgis. A source of yellow chert was identified in the Asba sector, NW of Biea Giyorgis.

Overview
Main results of the geoarchaeological survey were:
1. The identification of pedogenetic features formed through centuries long processes in some strata of natural profiles on the northern slope of Bieta Giyorgis along the eastern bank of the Guadguad Agazien stream, in the Ma Qono area. These features were also associated with possible ancient terraces. Together with the typology of the terraces, and possible associated ancient structures, these features will allow the researchers to recognize more easily ancient manmade off-site features for the management of the territory and the associated palaeosols;
2. The identification of ancient land management structures to be related with archaeological sites (Fig. 3, see also Appendix 1, Table 1);
Fig. 3. The ancient off-sites structures in the study area.

Only terraces were identified and they seem to cluster in the Enda Giyorgis-Ma Qono sector and in the May Khera area. The geoarchaeological survey of streambed has not detect any evidence for irrigation infrastructure within the slopes and plains NE of Aksum.

3. The identification of sources of raw materials such as iron, syenite, clay, chert, and chalcedony (Fig. 4, Appendix 1, Table 2). Moreover, the rocks used as building materials were identified and their possible origin pointed out. They resulted to be mainly syenites resulting from volcanic activity and emerging in outcrop in various parts of the studied area, and metamorphosed sandstone (Adigrat series), which forms the base of the geological sequence in the area and which is exposed in the valleys and on some hill tops as a result of intensive erosional processes.
Finally, dealing with the investigation of erosion and deposition processes, although erosive processes are very active in the area, the investigation of the drainage systems has provided suitable profiles for soil sampling. The integration of field observations along with the results of micromorphological and geochemical analyses of soil samples will allow the reconstruction of the local stratigraphy.

Archaeological Survey (by L. Phillipson, L. Sernicola)

During the 2005 field season a systematic survey was conducted on the northern side of Bieta Giyorgis hill, in the areas of Ma Qono, Asba, Enda Giyorgis and Gumala. The investigated area, covering a surface of 8.6 sq Km, encompasses the north-eastern and north-western slopes and foot-hill of Bieta Giyorgis and the adjacent plains up to May Hibay river and Kubie hill. The main
goal of the surveying activity was to reconstruct the man-environment interaction dynamics in ancient times and the processes of human adaptation, manipulation and management of the territory through the study of the settlement-pattern, its changes, and its relationships with the off-site features, other traces of anthropic activity (e.g. plough marks), and the natural features of the territory (topography, soil types and paleosoils, raw materials). A systematic collection of the place-names was also carried out to obtain from the study of toponomastyc and ethno-history information for the reconstruction of ancient landscape.

The survey was conducted using IKONOS satellite images to visualize and navigate the study area and GPS receivers for mapping sites and features.

For each site, as done on the Bieta Giyorgis hill by the UNO-BU Expedition\textsuperscript{35}, were collected the following data:

- size;
- soil type\textsuperscript{36};
- topography;
- vegetation cover;
- current land use;
- surface description;
- archaeological materials associated.

GIS software (ArcGIS 9.5) was employed to catalogue sites and information, provide data display and carry out spatial analysis.

On the whole 144 sites were recorded (Fig. 5).\textsuperscript{37}

\footnotesize{\textsuperscript{35} Fattovich \textit{et al.} 1999, pp. 45-50; Fattovich and Bard 2002, pp. 32-33.  
\textsuperscript{36} The description of the soil is based on the traditional classification used by local farmers. 
\textsuperscript{37} The sites are listed in Appendix 2.}
Two sites (May Kerah 05/43\textsuperscript{38} and Asba/Masta Worki\textsuperscript{39}), already indicated by scholars, were also georeferred to position them on the map; a surface collection was also conducted in order to date them more precisely.

The following paragraphers summarise general descriptions of the studied sectors, the recorded sites, and the chronology and function of the archaeological sites\textsuperscript{40} which was based on the analysis of the diagnostic artefacts.

\textsuperscript{38} Conti Rossini, 1910, p.5; Anfray 1973, p. 20 n.16; Godet 1977, p.41; Michels 1994, pp. 61-80; Wendowski and Ziegert 2003, fig.1.

\textsuperscript{39} Anfray 1965, p. 4, pl. IB; Godet 1977, p. 42.

\textsuperscript{40} The archaeological sites have been classified in: settlements, cemeteries, ritual places, workshops, inscriptions and rock shelters basing on artefacts collected and the structures visible on the surface. All the sites without any clear cultal or funerary evidences have been classed as settlements.
Ma Qono sector is situated along the NE footslopes of Bieta Giyorgis hill and is bounded at E and W respectively by Mai Kerah and Gudguad Agazien rivers, at S by Bieta Giyorgis upsslopes, and at N by Mai Goda and Mai Agam rivers. The area is naturally divided into three large cultivated terraces with few scattered farmhouses alternate with areas of the midslopes of the hill recently reforested with eucaliptoeus. Actually, part of the area is used in a regional project of bee-keeping.

The whole area was systematically surveyed: two large sites (Mai Kerah 05/43 and Ma Qono 05/62) with remains of a monumental structure were recorded on the eastern and the western edges of the hill and 52 smaller sites, mostly consisting of circular stone mounds with traces of collapsed walls. On the whole, 54 sites were recorded.

Enda Giyorgis and Asba

Enda Giyorgis sector is located on the NE edge of Bieta Giyorgis hill, between the Gudguad Agazien river and the Asba plain respectively at E and W. The area is characterized by the occurrence of gently sloping small terraces between the slopes of the hill up to the May Hibai river. 13 sites were listed in the area. They were mostly small settlements with low quantity of potsherds and lithics scattered on the surface and no traces of stone structures. These sites are often located on top of boulders outcrop.

The Asba sector, W of Enda Giyorgis, encompasses the north-western footslopes of Bieta Giyorgis hill and the cultivated plain between Enda Giyorgis at E, May Hibai at N, the Dungur area at S, and the plain of Gobedra at W. The survey mainly focused on the cultivated plain, as the slopes were already investigated in 2000 and 2002 by the UNO-BU Expedition. 41 33 small sites were located on top of boulders outcrop and one large site (Enda Chendoga LP/19), with high quantity of potsherds, lithics and fragments of bricks situated on the western edge of the surveyed area, along the footslopes of Bieta Giyorgis. On the whole 47 sites were recorded in the areas of Enda Giyorgis and Asba.

Gumala

This sector is located between May Filfil and May Zedfi rivers at W, Zala plain at E, Kubie hill at N, May Goda and May Agam rivers at S. A large, monumental site with traces of walls (May Zedfi 05/70) was recorded on the western edge of the May Zedfi stream; a fragmentary Greek inscription was found on a broken stele in a farmer’s house along Kubie footslopes ( site Gumala 05/30). 39 smaller sites were also individuated at Zala, a cultivated plain between Kubie hill and the

May Agam, and on a high terrace besides it. The old church of Maryam Leto situated on the south-eastern slopes of Kubie was also recorded because of the presence of possible ancient monograms engraved on stone blocks used in the basement of the church, and a ritual site (Geza Merechan 05/32) with a megalithic carved stone slab similar to the one recorded at Masta Worki Gumala and at Mesta Worki Absa was recorded at Zala.

*Archaeological Excavations (R. Fattovich, A. Manzo, C. Perlingieri, and L. Phillipson)*

Archaeological excavations were conducted at some selected sites recorded in the survey. The sites were selected to cover as much as possible the different typologies distinguished on the basis of the surface remains and systematic collections, or to test the presumable importance suggested by their location.

*Gumala Enda Taklawene I - II*

The choice to excavate Gumala Enda Taklawene I (469991E/1565738N) and Gumala Enda Taklawene II (469992E/1565713N), two contiguous sites 20 m one from the other, is due to the need to understand the function of quite a lot of small sites identified just on the basis of well-defined clusters of archaeological materials on the surface and lacking any trace of collapsed architectural structures. Actually, the only structure brought to light in these excavation units consisted of a granary storage pit in Gumala Enda Taklewene I. The two sites are located on a terrace of the northern bank of the May Filfil. On the surface some emerging boulders suggested a limited thickness of the deposit.

The excavation of these two sites provided evidence of a typology of sites which might have had an important part in the ancient Aksumite agricultural landscape and exploitation. Actually these two sites may be interpreted as possible small rural farmhouse with light structures, perhaps used seasonally. These small Aksumite farmsteads characterized by the presence of sherds and lithics together with little or no stone building rubble are located mainly at the bottom of hill slopes, immediately above flat ploughlands, usually where there is a change in soil color from the red of the metamorphosed altered rocks of the slopes of the hills to the black vertisols. These farmhouses might have been temporary functional sites related to contiguous sites with permanent stone structures which usually are located less than 150 m far. These other sites characterized by stone structures might have been wealthier private residences or sometimes public buildings with remains.

---

42 For a detailed description of the excavations see Appendix 3.
43 The sites were excavated under the direction of L. Phillipson.
of monumental structures, little ceramics and lithic tools on the surface, or concentrated hamlets or residential compounds characterized by remains of stone structures and by larger surface concentrations of ceramics and lithics.

Examples of this recurrent pattern do not occur in all the study area but just in the area of Asba, NW of Bieta Giyorgis, and in the area of Gumala.

**Mahraf**

Mahraf I (153614 N/470170 E)\(^\text{44}\) is situated on a low, elongated ridge East of the Bieta Giyorgis hill, ca. 600 m West of the so-called “Tombs of Kaleb and Gebra Masqal” (Fig. 6).

\(^\text{44}\) The name of the place means “resting place”. The site was excavated under the direction of R. Fattovich, A. Manzo and C. Perlingieri.

The site is partially disturbed by a small house partially rebuilt in recent times. In that part of the site, massive architectural remains were brought to light by modern activities. The most striking
feature of the site was the presence of dressed syenite blocks, and remains of a monumental stairway were visible in a pit excavated by the farmers. This structure was selected for excavation because of its location on an high crest between two traditional ways from Aksum to Hamasien and Akele Guzai, and not far from an inscription by king Ezana (4th century AD) which was erected where the two ways crossed. This location suggested that the monumental structure at Mahraf might have had a prominent place as a land marker and a strong symbolic value in the Aksumite ideological landscape of the area.

The excavation uncovered the remains of a large monumental stone structure different from all the other structures so far excavated by the UNO/BU Archaeological Expedition on top of Bieta Giyorgis (Fig. 7).

![Map of Mahraf](image)

It is not possible to specify if the structure excavated at Mahraf was an isolated building, and not part of a larger complex, as the archaeological site extends immediately to the N and W of the excavated area. The building was characterized by a East-West oriented external wall consisting of large dressed stone blocks and with projecting and recessed parts delimiting a rubble platform on top of which remains of a monumental entrance were brought to light. A stairway with monolithic steps gave access to the structure on the southern side.

All these elements suggest that the building partially excavated at Mahraf was a monumental structure. The pattern of the pillars and badly preserved walls on top of the platform and the human bones under the stone slabs paving the area outside the structure seem to suggest that
it was a church. In this case the main axis of the building was E-W, with the entrance facing W and the “Tombs of Kaleb and Gebra Masqal”, and the apsis to the E.

Nevertheless, the excavation showed that this was only a later phase of reuse of the structure. The stair and the platform linked to it might have been built (or rebuilt ?) when the latest monumental structure, possibly a church as previously suggested, was built, but the platform and the stepped wall seems to be earlier and might be related to the Classic Aksumite materials mainly collected in and under the collapse outside the structure. It is not possible to better specify the typology of the earliest structure, nevertheless no doubt it was a monumental one.

The fact that this structure was located on a crest points to the fact that the structure was also a land marker, a focal point in the ancient landscape of the area. The structure deserved to be seen mainly by people approaching or leaving Aksum through the two traditional tracks East and West of Mahraf and leading respectively to Akele Guzai and Hamasien and to the valley of Mareb, which might have represented a natural way to the Eritrean-Sudanese lowlands and the Sudanese Eastern Desert. Thus, this location might also explain the presence of the imported materials from this region. Most likely, both the Eritrean-Sudanese lowlands and the Sudanese Eastern Desert regions were mentioned in Aksumite 3rd and 4th century AD royal inscriptions45, and, worthy to note, a copy of one of these inscriptions was placed five hundreds meters S of Mahraf, on the track to Aksum.

The excavation of Mahraf showed that this site was characterized by an official or elite monumental building whose location made it an important land marker on the tracks leaving Aksum to present Eritrea and Sudan (Fig. 8).

Excavations at Enda Giyorgis (1564815 N/468343 E) concentrated on the remains of a multi-room stone structure located at the northern edge of an uncultivated terrace NW and nearby the modern church of Enda Giyorgis in the village of Ma Qono, NNE of Bieta Giyorgis hill. The site is situated on a plain terrace dominating the valleys and the streams of Guadguad Agazien at N and the May Filfil at NW (Fig. 9). The area still today is considered a very central zone used as a "meeting point" by all people from the village of Ma Qono and its vicinities. Our major objectives were: 1) to get an understanding of the layout and function of the structural unit at the site; 2) to obtain a better comprehension of the local territorial settings in the different phases of the Aksumite culture 3) to verify the social and administrative role of the monumental buildings in the area in relation to the organization of the land-use activities. To achieve these objectives, an extensive excavation was carried out in order to expose completely the layout of the structure.

---

46 The site is located in the sacred land surrounding the present church. The site was excavated under the direction of C. Perlingieri.
The excavation uncovered a cross-planned structural complex that had multiple phases of construction and structural modification at least from Classic Aksumite through Middle Aksumite times (Fig. 10).
The structure apparently isolated, is located at the north end crest of the small plan of Enda Giyorgis and dominates a system of N-NW facing sloping terrain that shows clearly defined ancient cultivating terraces, today completely eroded. The structure and the terraces seem to form an integrated settlement complex, clear and well visible despite the deterioration and downslope erosion.

At least in its earlier phases this building was characterized by monumental characteristics. Moreover, its plan might give insights into its function as only another possible cruciform Aksumite building is known and was identified as a church. 47

Moreover, also the present name of the site "Enda Giyorgis" or "Bieta Giyorgis" and the presence of the modern church called Bieta Giyorgis in the same area, ca. 50 m. to the SE of the archaeological site are of great importance, in terms of historical continuity, supporting the strong sacral character of the whole area.

Mesta Worki Gumala

Mesta Worki Gumala\(^{48}\) I (1565581 N/469812 E) is situated on a low, elongated ridge that is an extension of one of the terraces downslope of the village of Gumala, on the eastern slope of the Kobe hill. These terraces are presently cultivated, but the ridge where the site is located is not (Fig. 11).

The top of the ridge was characterized by massive architectural remains still visible on the surface. The most striking feature was the presence of a carved rectangular stone slab (1.53 m x 3.14 m x 0.29 m) with a low (ca. 0.07-0.10 m) edge (Fig. 12).

---

\(^{48}\) The site was already recorded by Tekle Hagos 2001, particularly pp. 38-39, 2003, particularly p. 67. The meaning of the place name is “the inventory of gold” or the “place for showing (or washing) gold”. The site was excavated under the direction of A. Manzo and L. Sernicola.
The excavation uncovered the remains of a large stone structure (Structure A) different from all the other structures so far excavated by the UNO/BU Archaeological Expedition on top of Bieta Giyorgis (Fig. 13).

The structure at Mesta Worki Gumala appears to have been an isolated building, and not part of a larger complex. Nevertheless most likely it was a part of a larger system of sites scattered all the W slopes of the hill were it is located. The structure was built on an earlier building with a similar N-W/S-E orientation (Structure B), partially overlapping an even earlier structure with a
completely different N/S orientation (Structure C). The preserved remains of Structure A were completely excavated, while only a part of the remains of the earlier structures were. Unfortunately, the S-W and N-E parts of Structure A were washed down from the ridge on top of which the structure is located and, thus, could not be investigated.

The symmetrical plan of the Structure A, as well as its monumental characteristics (large spaces and doors, external stepped wall on the eastern side, ramp leading to the big monolithic stone slab on top a stone platform in the western part of the structure) suggest that the structure was related to elite activities. The fact that the monumental features concentrate in the external part of the structure and the fact the it is visible from other sites located on similar crests along the terraces sloping to the Mai Leto points to the fact that the structure was also a land marker, a focal point in the ancient landscape of the area. The big stone slab on the stone platform in the western part of the structure seems to have been the focus of the activities performed in the Structure A, which deserved to be seen by people and might have had an ideological meaning.

Among the already investigated Aksumite structures, some interesting similarities not in the general organization of the structure but in its components can be noted with the monumental building investigated at Ouchatei Golo by H. de Contenson.49 Actually, both structures are characterized by a stone platform on top of which large monolithic stone slabs were located, and characterized by rounded built basins with a monolithic rounded slab at the bottom. In both cases the platform is flanked by an elongated room with basins and internal stairs giving access to the platform, and by a stair or ramp giving access to the platform directly from the exterior of the building. Finally, both buildings were characterized by a dominant topographic location which made them important ideological land markers, emphasizing the activities and possibly the ceremonies taking place on the stone platforms. Moreover, both structures dated back to Middle Aksumite times.

Ouachatei Golo was interpreted as a sacred building linked to archaic pre-Christian religious practices adopted and still performed in the Christian Aksum. Even if this remain unproved, it should be noted that also Mesta Worki Gumala was still used at least up to the early 5th century AD, as suggested by the coins and the associated pottery. In any case both structures seem to have represented focal points in the ideological and power landscape of their surroundings. Other sites recorded in the survey and characterized by the presence on the surface of big stone slabs such as the site named Mesta Worki located on the western side of Bieta Giyorgis50 (467033E; 1562962N) might have had similar characteristics and function.

49 See de Contenson, 1961, pp. 3-7.
50 This site was already recorded by Anfray 1965, particularly p. 5, Pl. I, fig. B.
Dealing with the earlier phases, as far as we know, Structure B might have been an outline not very different from Structure A. Actually, several of the walls of Structure A were built on top of the ones of Structure B. Thus this structure might have had a similar function to Structure A. It dated to Classic to Middle Aksumite times. Finally, Structure C, characterized by a completely different outline and orientation, can be dated to Early to Classic Aksumite times.

**Archaeological Materials (A. Manzo, L. Phillipson, and C. Perlingieri)**

Following the research design, archaeological finds were considered as meaningful elements for the reconstruction of the ancient landscape which can be studied and described at different levels (artifact/ecofact - feature - assemblage - site - landscape).

**The Pottery**

All the pottery from surveyed sites and excavation sites of the last field season was sorted and classified using the pottery typology elaborated on the basis of the Bieta Giyorgis ceramics corpus. The pottery was used as a marker to define the chronology of the surveyed and excavated sites (see Appendix 2). It also gave interesting insights into the use of some sites. The survey sites and the site at Mesta Worki Gumala yielded the majority of sherds.

**Enda Giyorgis**

The upper levels of occupation gave a possible late Classic Aksumite (late 3rd-mid 4th century AD?) assemblage. Classic Aksumite decorated vessels are found in association with cross motives on small bowls. The lower levels have a similar assemblage in which the Classic Aksumite decoration is more common and the cross motive disappear.

**Mesta Worki Gumala**

A very rich pottery assemblage came from all levels of this site. The upper strata gave an early Middle Aksumite or late Classic Aksumite (late 3rd century-4th century AD?) assemblage characterized by typical funerary/ceremonial wares. The lowest levels gave an early Classic Aksumite (2nd-3rd century AD?) assemblage and possibly a late Early Aksumite (early 2nd century AD?) scarce evidence.

---

51 For a detailed description of the archaeological finds see Appendix 4.
52 See, e.g., Doran, and Hodson 1975.
53 See Perlingieri 1999. The pottery was studied by C. Perlingeri.
Mahraf

The pottery assemblage from this site is an homogeneous Classic Aksumite assemblage (AD 150-350). The levels corresponding to the latest phases of use of the structure are disturbed.

The imported materials

Also imported materials were studied to give chronological elements to date assemblages from excavated and surveyed sites and their distribution was studied to better understand the function of the excavated and surveyed sites, as it was suggested that the concentration of imported materials was a feature of sites or structures related to elite or state activities54.

Concentrations of fragments of amphorae suggesting that these sites were in some way related to elite or state activities from Mesta Worki Gumala as well as from Enda Chendoga LP19 and Enda Giyorgis.

At Maharaf several fragments of glass and of Eastern Desert Ware pottery from Eastern Sudan were identified as well. The discovery of these ceramic sherds at Maharaf not only suggest that this structure was related to elite activities, but that these activities were in some way especially linked to the Sudanese Eastern Desert or the Eritrean-Sudanese lowlands, where EDW was recently recorded55, which is interesting if the location of the site is considered (see above).

The Coins

On the whole eleven coins have been discovered at excavated and survey sites.56 They gave further chronological data on the assemblages where they were discovered. Moreover, even if we assume that in Aksum there was not a real monetary economy, but coins were used as a mean of royal redistribution or awards57, the presence of coins in these assemblages might suggest that they were related to elite or state activities. Concentration of coins were remarked at Enda Giyorgis, Mesta Worki Gumala, GA 05/2, and Thala, suggesting that these sites were characterized by structures related to elite or state activities.

The Administrative Devices

A great amount of pottery discs interpreted as tokens have been found at Mesta Worki Gumala, Enda Giyorgis and at the surveyed sites in the May Kerah, Ma Qono, and Gumala, i.e., in

54 See Manzo 2005, particularly pp. 63-64. The imported materials were studied by A. Manzo.
55 Manzo 2004, pp. 75-83, particularly pp. 77-80.
56 Coins were studied by A. Manzo.
57 See Pedroni 1997 particularly pp. 76-77.
general, in the area North-East of Bieta Giyorgis. At the site of Mesta Worki Gumala a clay jar sealing was also identified.

All these elements suggest that administrative activities were taking place at these sites, which might have been related to elite or state activities.

*The Ancient Landscape in the Aksum area: a Tentative Model (A. Manzo, L. Sernicola)*

The data collected in the 2005 season allowed us to reconstruct the ancient landscapes that characterized the area through centuries.

The surveyed and the excavated sites give important insights into the typology of the structures which characterized the ancient landscapes of the study area, with special reference to the symbolic and power landscape (Mesta Worki Gumala, Mahraf, Enda Giyorgis), and to the ancient agricultural landscape (Gumala Enda Taklawene I and II). In turn, the data collected in the survey formed the backbone for all the territorial and landscape archaeology elaborations.

All these data were integrated with the data collected in the past years on the top of Bieta Giyorgis hill allowing us for the first time to reconstruct the development of the ancient capital city of Aksum in its regional setting as well as the Man-Environmental relationships with special reference to the possible impact on the environment of the dense human settlement which seems to have characterized the study area in the first centuries AD.

The data were studied also using a quantitative approach. In such a way, the density of the human occupation of the area in each chronological phase was pointed out through the calculation of the total area of the sites. The average dimensions of the sites and the maximum and minimum dimensions of the sites for each phase were calculated as well as (Fig. 14).

---

58 The administrative devices were studied by C. Perlingieri and A. Manzo.
Fig. 14. Graph showing average dimensions of the sites and the maximum and minimum dimensions of the sites for each phase.

Also the changes in the dimension of Ona Nagast, a major site located on top of Bieta Giyorgis was reconstructed by means of surface collections and data collected in the excavation units investigated there by the UNO/BU Joint Archaeological Expedition (Fig. 15).

Fig. 15. Graph showing the change in the dimensions of Ona Nagast.
To study the changes in the occurrence of sites with light structures and sites with stone structures, as well as to get an indication of the intensity of use of the sites in each phase, a graph showing the percentage of sites with traces of stone structures and the average density of materials on the surface (Fig. 16).

![Graph showing the percentage of sites with traces of stone structures and the average density of materials on the surface.](image)

Fig. 16. Graph showing the percentage of sites with traces of stone structures and the average density of materials on the surface.

Finally, a graph showing the changes in the distribution of the sites in the different topographic areas (hill top, slopes and base of the hill) was elaborated to point out if the sites were homogenously distributed through the surveyed area or if specific topographic locations were preferred in the different chronological phases\(^{59}\) (Fig. 17).

\(^{59}\) The graph was elaborated calculating a theoretical presence of sites in each topographic location on the basis of the percentage of different topographic features in the surveyed area and comparing this theoretical value with the real number of the sites recorded in the different topographic locations in the survey. See
In order to outline the changes in the landscape of the study area, different components of the landscape were distinguished:\(^60\):

1. **Natural landscape**, consisting of all geological, geomorphologic, vegetal and animal features that provide people with information about the spatial distribution of resources and possibly symbols related to their cultural identity and social or personal history;

2. **Economic landscape**, i.e., the configuration of man-made features reflecting the different patterns of land use and territory exploitation;

3. **Social landscape**, i.e., the configuration of man-made features reflecting the hierarchical organization of the society;

4. **Power landscape**, i.e. the manifestation of the power in the landscape;

5. **Sacral landscape**, i.e., the configuration of man-made features reflecting the religious and symbolic organization of the territory.

The relationships between the related components were pointed out by means of thematic maps elaborated for each phase.\(^61\)

---

\(^60\) See Fattovich 2003.

\(^61\) The maps were elaborated by means of ArcGIS 9.5 software.
Pre-Aksumite (ca. 800-400 BC)

Dealing with the natural landscape, it seems that starting for the whole studied period general conditions similar to the present ones were already established. The reconstructed climatic trend seem to suggest that in the studied period, from mid-1st millennium BC to the end of the 1st millennium AD, a climatic situation similar to the present one was already established. An almost constant decrease of rainfall might have taken place from 500 BC. Also the vegetal cover of the studied area reconstructed by means of pollen analysis was very similar to the pattern of today with a predominance of grasses across the plains of vertisoils and shrubs and only small clusters of trees near structures, in gorges along seasonal stream beds, and on rocky slopes. Possibly this pattern was the results of earlier processes related to the anthropic presence in the area.

In Pre-Aksumite times the settlements are homogenously distributed trough the topographic areas, they seem to concentrate along the southern and eastern of Bieta Giyorgis and at the base of the hill on the western and northern sides (Fig. 17). In this phase the number and the size of the settlements point to a scattered and not very dense settlement pattern (Fig. 14, 18).

---

[Fig. 18. Pre-Aksumite settlement sites.]

---

62 See above the paragraph on "Environmental and Paleoenvironmental Setting".
The sites are not related with the off-site features which may be later. On the contrary, the settlements sites on the top of the hill as well as the ones on the western side seem to cluster around primary agricultural soils (orange in the map), while the sites on the northern and western sides of the hill are located in less productive areas (Fig. 19).

Fig. 19. Pre-Aksumite settlement sites related to off-site structures (marked with \( \_\_\_ \)), soil types ((1) white/light pink = highly reflective soils of mostly pyroclastic origin (trachyte), (2) cyan and magenta = agricultural fields with the more fertile and productive soils, (3) blue = rock outcrops and colluvium) and site structures (green dot=perishable, red dot=stone built).

This is coherent with the low percentage of sites with stone structures but with high average density of materials on the surface (Fig. 16) pointing to light settlement structures continuously occupied or frequently occupied and most likely intended for agricultural exploitation.

Dealing with raw materials, the only clear association between Pre-Aksumite sites and raw material is at Ahaawahay, on the NE edge of Bieta Giyorgis, where a possible Pre-Aksumite inscription is located in a syenite quarry. On the north-western side of the hill, the two Pre-Aksumite sites at Asba are no more than 1000 m from sources of yellow and gray chert, iron and clay, nevertheless Pre-Aksumite exploitation of these resources remains speculative (Fig. 20).
Noteworthy, the location of the Pre-Aksumite site excavated by a British Expedition in the D area, immediately E of the study area\(^{63}\), follow the same rules of the Pre-Aksumite sites of the surveyed area that is close to sources of raw materials and a primary agricultural land. All the Pre-Aksumite settlement sites are located less than 200 m from the traditional tracks located in the surveyed area (Fig. 20).

\(^{63}\) See Phillipson (ed.) 2000.
Finally, dealing with sacral/power landscape (Fig. 21), an offering place and a possible religious structure were located on the edge and one possibly in the middle of Bieta Giyorgis hill respectively and an inscription was located on the eastern edge of the hill.

Fig. 21. Pre-Aksumite settlement sites related to sacral/power landscape components ($\&$ = inscriptions; $\triangleright$ = ceremonial sites).

This may suggest that the edge of the hill was considered as a kind of border and the sacral building in the middle may have been the central point of the sacral/power landscape. Noteworthy, the inscription at Ahawahyay is not far from the traditional track linking the top of the hill with the Gaza Agumay and the Domestic Area of the British expedition, where a Pre-Aksumite site was recorded\textsuperscript{64}.

\textsuperscript{64} See previous note.
Proto-Aksumite (ca. 400-40 BC)

In this phase the number of the sites seems to be more or less the same of the previous phase, but should be remarked an increase of the size pointing to a more intensive use of the area. This is confirmed by the increase of the total dimensions of the recorded settlement sites (Fig. 14). In this phase also new areas are settled: the earliest sites in the Gumala area dated to theProto-Aksumite.

Apparently, this did not affect too much the environment: at that time the pedogenetic processes were still active in Tigray, most likely as results climatic factors as well as a low concentration human presence.

In Proto-Aksumite times the settlements are scattered more or less in the same area of the previous phase (Fig. 22), and also in this phase they are homogenously present in all the topographic locations (Fig. 17). Many of the sites cluster around the site of Ona Nagast which is expanding in this phase (Fig. 15).

Fig. 22. Proto-Aksumite settlement sites.
More than 30 percent of Proto-Aksumite sites are characterized by the presence of stone built structures (Fig. 16). Perhaps they are related to elite or more permanent residences. On the contrary, the decrease of the average density of materials on the surface of the sites may be explained by the fact that the archaeological strata are sealed by rubble from collapsed structure (Fig. 16). Except for few terraces on the Ona Nagast area, there are not clear links between the Proto-Aksumite sites and off-site features (Fig. 23).

Fig. 23. Proto-Aksumite settlement sites related to off-site structures (marked with ••••), soil types ((1) white/light pink = highly reflective soils of mostly pyroclastic origin (trachyte), (2) cyan and magenta = agricultural fields with the more fertile and productive soils, (3) blue = rock outcrops and colluvium) and site structures (green dot=perishable, red dot=stone built).

All the sites are located not far from areas with good agricultural soils except for Enda Giyorgis 05/39, whose function may be related to the presence of raw-materials in the area (Fig. 24).
The traditional tracks seems to be related to the rise of a large settlement at Ona Nagast, but this might be due to fact that a settlement is still present in that location. The syenite quarries on the Ona Nagast and Ahawhyay sites are clearly related to Proto-Aksumite sites (Fig. 24).

Dealing with the sacral and power landscape, all the sites with the sacral structure of the previous phase were reoccupied in Proto-Aksumite times (Fig. 25) but with different structures: e.g. the building at Ona Enda Aboy Zeuge was covered by a funerary platform related to elite graves which had also a meaning related to the representation of the power.
Also the monumental palatial and possibly sacred buildings at Ona Nagast may have represented an ideological focus of the power landscape of this phase. Some of the sites with sacral meaning such as the offering place at Gobo Enda Nebri, continued to be located on the northern edge of the hill.

*Early Aksumite (ca. 40 BC-AD 150)*

Dealing with natural landscape, some changes took place\(^{65}\). Intensive erosive processes characterized the Aksum area from AD 100. This was explained suggesting increasing of human exploitation of the area combined with widespread enlargement of field areas, related to periods of heavy rains, which are not confirmed by the paleoclimatological models for this phase.

\(^{65}\) See paragrapher on "Environmental and Paleoenvironmental Setting".
In Early Aksumite times the total dimensions of the sites is increasing and the number of settlement sites as well (Figg. 13, 25).

Fig. 26. Early Aksumite settlement sites.

In this phase the dimensions of Ona Nagast are more than three times the once of the Proto-Aksumite phase (Fig. 14). In this phase the base of the hill was preferred for the settlement sites, on the contrary the sites on the slopes and on the hill top are less than expected (Fig. 16).

In Early Aksumite times the sites with stone structures are more than 25 % and, consequently, 75% of the sites were characterized by light structures (Fig. 15). The small light sites seem to cluster on the north-western corner of the hill, in the Asba area, on the contrary, several medium and small sites with stone built structures arose on the north-eastern corner of the hill and in the Gumala area (Fig. 27). The sites in the last two sectors seem to be related to off-site structures. In the Gumala area, Chendug and on the top of Bieta Giyorgis the Early Aksumite sites seem to be related with good agricultural lands. This is not true on the northern side of the hill. Thus, the ancient terraces recorded there and apparently related to the sites with stone built
structures northeast of the hill may have been intended mainly for the protection of sites from land sliding than for agricultural purpose. This might be explained by a tentative to protect these permanent sites with stone built structures against erosion in a phase characterized by heavy erosive processes. Nevertheless, in the same area several patinated plough marks on boulders or outcrops were recorded and this might suggest that soil suitable for agricultural exploitation was present there but, perhaps, despite the terraces, it was completely eroded. On the north-western side, many small settlement sites with light structures related to poor agricultural soils may have been seasonal camps possibly reoccupied year after year for the pastoral exploitation of the area.

Fig. 27. Early Aksumite settlement sites related to off-site structures (marked with rr.), soil types ((1) white/light pink = highly reflective soils of mostly pyroclastic origin (trachyte), (2) cyan and magenta = agricultural fields with the more fertile and productive soils, (3) blue = rock outcrops and colluvium) and site structures (green dot=perishable, red dot=stone built).

All the sources of raw materials may be directly related to Early Aksumite sites which usually are very close to them (Fig. 28).
Fig. 28. Early Aksumite settlement sites related to the sources of raw materials and the traditional tracks.

In the north-eastern sector and also on the top of the hill, many sites are directly related to the network of traditional tracks. On the north-eastern side the presence of middle/small sites with stone structures may be explained not only by agricultural exploitation of the area but also the presence and exploitation of sources of raw materials in the area and this may be confirmed by the facts that many of these sites are also related with tracks.

Dealing with the sacral and power landscape, the focus on Bieta Giyorgis hill remains at Ona Nagast and Ona Enda Aboy Zeuge (Fig. 29). Three rock inscriptions on the south-western slope of Bieta Giyorgis, not far from Ona Nagast, confirm that the edge of the hill was felt as a boundary of an area controlled by a lineage, which is confirmed by the presence of two cemeteries with stelae possibly related to different elite lineages at Da’ro, south-east of the hill, and at Asba, north-east of the hill. In this phase also Aksum downtown increased its political and sacral
importance and this may explain the need to mark boundaries between Bieta Giyorgis and Addi Kiltè/Dungwur area.

Fig. 29. Early Aksumite settlement sites related to sacral/power landscape components (E = inscriptions; I = cerimonial sites; ¨ = monumental cemeteries).

Classic Aksumite (ca. AD 150-350)

The process of erosion started in the previous phase continued. Most likely it was favoured by an increase in rains suggested around AD 250 by the paleoclimatological models.

Dealing with the topographic distribution of sites, in Classic Aksumite times there were no changes comparing to the previous phase (Figg. 16, 29).

---

66 For the increasing number of sites related to the power and sacral landscape in Aksum downtown starting in Early Aksumite times see Fattovich et al. 2000.

67 See paragraph on "Environmental and Paleoenvironmental Setting".
The number of sites increased in this phase but the dimensions, the average size and the total dimension decreased dramatically. On the contrary it is likely that the dimensions of major sites such as Ona Nagast (Fig. 15) and most likely Aksum\(^68\) increased in this phase. Even if an impact on human presence of the erosional processes previously stressed cannot be excluded, the decrease of intensity of occupation of the studied area might be just apparent and explained by the fact that a part of the population moved from it to these major sites, which might be related to changes in the social organization.

Dealing with the relationships between sites and soil types (Fig. 31), a new large site closely related to good agricultural land was recorded at Mahraf. In the meantime, the sites close to good agricultural lands in the Gumala area, Chendug and on the top of Bieta Giyorgis continued to be occupied as well as, on the northern side of the hill, the small settlement sites with light structures

\(^68\) See again Fattovich et. al. 2000.
related to poor agricultural soils interpreted as seasonal camps possibly reoccupied year after year for the pastoral exploitation of the area. Like in the previous phase, the off-site structures are close to Classic Aksumite sites in the area at north-east of Bieta Giyorgis. Given the associated plough marks and despite the poor soils presently characterizing the area, also in this phase the ancient terraces might be related to an ancient agricultural exploitation.

All the sources of raw materials may be exploited in this phase as they are very close to settlement sites (Fig. 32). Like in the previous phase, most of the sites with stone structures in the area northwest of Bieta Giyorgis which are close to the sources of raw materials are closely related to the traditional tracks and this may also be explained by the exploitation and the exchange of the raw materials present in the area.
The power/sacral landscape did not change between Early and Classic Aksumite phases, except from the appearance of the sites of the type “Mesta Worki” west of Bieta Giyorgis and in the area of Gumala (Fig. 33). These sites may have had ceremonial as well as administrative purposes and are located along a main track and in eminent topographic positions. Also the monumental structure at Mahraf may have been as an important landmark located on an eminent topographic position dominating the traditional tracks to the Hamasien, Akkele Guzay and to the Eritrean-Sudanese lowlands via Mareb. The isolation of the site of Mahraf in the recorded settlement pattern may be explained by the fact that it was a part of the suburbs of Aksum and that an area with few or no sites surrounded the capital city: the vast majority of the recorded sites are north of Bieta Giyorgis and just a few were recorded on the southern side of the hill.
Middle Aksumite (ca. AD 350-550)

In Middle Aksumite times the decreasing of the total dimensions and of the maximum dimensions of the sites already started in Classic Aksumite times continued (Fig. 14). Also the dimensions of Ona Nagast decreased in this phase and the settled area was reduced to ¼ of the Classic Aksumite one (Fig. 15). The number of sites decreased as well (Fig. 34). In this phase the number of the sites on top of Bieta Giyorgis augmented and they are more than what we could expect (Fig. 16). Thus, the decreasing of the total number is mainly related to the decrease in the number of the sites at the base of the hill. Apparently, many Classic Aksumite sites were abandoned and fewer other new ones arose.
Fig. 34. Middle Aksumite settlement sites.

The change is evident mainly in the Asba area, northwest of the hill, where most of the small Classic Aksumite sites with light structures disappeared (Fig. 35). On the top of Bita Giyorgis the decreasing size of Ona Nagast might be related to the increasing number of small settlements often linked to off-site structures and to a more disperse settlement system.
Fig. 35. Middle Aksumite settlement sites related to off-site structures (marked with \textit{rr}), soil types ((1) white/light pink = highly reflective soils of mostly pyroclastic origin (trachyte), (2) cyan and magenta = agricultural fields with the more fertile and productive soils, (3) blue = rock outcrops and colluvium) and site structures (green dot=perishable, red dot=stone built).

The only area where some of the sites were characterized by a certain continuity in occupation are the larger sites on the north-eastern side of Bieta Giyorgis related to off-site features. As previously stressed, these sites may have been related not just to agricultural exploitation of this area but also to the exploitation and exchange of raw materials which is confirmed also for this phase by the proximity of Middle Aksumite sites to the sources of raw materials, and by the presence of archaeological sites along the traditional tracks (Fig. 36).
The decrease of number and dimensions of the sites in surveyed area may be related to environmental factors: as previously stressed, the area was characterized by severe erosive processes in the previous phases also favoured by an increase of seasonal rains which reached their maximum around AD 500. An explanation related to the increasing dimension of the capital city where a part of the people previously living in the countryside might have moved is also possible, nevertheless this seems unlikely in the case of the abandonment of the sites with light structure in the Asba area, which might have been used as seasonal camps also to people living in Aksum.

Dealing with the changes on top of Bieta Giyorgis, they may be explained by the change of the rank of Bieta Giyorgis from an area under the control of an aristocratic lineage to an agricultural area in the suburbs of the capital city.

---

69 See the paragraph on "Environmental and Paleoenvironmental Setting".
70 Fattovich 1997.
As a matter of fact, in this phase all sites related to power/sacral landscape disappear on top of the hill except from the two churches BGS and BGI\(^71\) which are on the edge of the plateau facing Aksum downtown and the Dungwur area (Fig. 37).

![Fig. 37. Middle Aksumite settlement sites related to sacral/power landscape components (\(\mathbb{E}\) = inscriptions; \(I\) = ceremonial sites; \(\mathbb{C}\) = monumental cemeteries).]

Thus, also these two churches may be considered a part of the Aksum power/sacral landscape than of the power/sacral landscape of Bieta Giyorgis. Other sites related to the power/sacral landscape arose in the Gumala area where a church with a cemetery was funded and at Enda Giyorgis where a cruciform church was founded. These churches may have been used and sustained by the people living in the surrounding settlements. In this phase also the “mesta worki” sites were still used. The detail of the archaeological chronology, for the moment it is impossible to

\(^{71}\) See Ricci and Fattovich 1988.
say if this structure was used in the same moment of the churches or just in the first part of the phase.

**Late Aksumite (AD 550-800)**

From the point of view of the topographic distribution of the sites there is a continuity between Middle and late Aksumite (Figg. 16, 37). From the point of view of the total dimensions a small increase can be remarked (Fig. 14). In this phase the dimension of large settlements at Ona Nagast are almost the same than Middle Aksumite times (Fig. 15).

![Late Aksumite settlement sites](image)

Fig. 38. Late Aksumite settlement sites.

A general decrease of the sites with stone structures can be remarked (Figg. 15, 38). For example, in this phase, on top of Bieta Giyorgis, Ona Nagast is the only site with stone structures. Also the areas with more fertile soils were settled less densely. On the contrary several of the sites in the area northeast of Bieta Giyorgis were still settled. As they were close to several off-site, this might suggest that also these features were still in use.
The sites in the area northeast of Bieta Giyorgis were also close to a concentration of sources of raw materials: their exploitation might explain the continuity in occupation of the area also in this phase (Fig. 40). Nevertheless, communication seems to have been less important as in this phase just a few of the settlements may be related to the network of traditional tracks.
Fig. 40. Late Aksumite settlement sites related to the sources of raw materials and the traditional tracks.

These changes might be related to a new agricultural system arising from the need to fit with a deteriorated environment and with increasing aridity suggested after AD 500 by paleoclimatological models. ⁷² Nevertheless, a link with a general decline of the kingdom of Aksum remarked in this phase cannot be excluded. ⁷³ In any case, the result consisted of the abandonment of the sites with stone built structures mainly on the top of the hill. A further severe erosive phase started in AD 650 and continued up to the end of the phase. Interestingly, the geological strata which formed during this phase are very rich in architectural debris probably originated from the abandonment and collapse of stone built structures and infrastructures.

In Late Aksumite times, the power/sacral landscape is characterized by the presence of the two churches on the southern edge of Bieta Giyorgis and possibly by a church in Gumala and one in the Enda Giyorgis area, perhaps under the present church (Fig. 41).

---

⁷² See the paragraph on "Environmental and Paleoenvironmental Setting".
Fig. 41. Late Aksumite settlement sites related to sacral/power landscape components (E = inscriptions; I = ceremonial sites; ‘ = monumental cemeteries).

*Post-Aksumite (ca. AD 800 – 1400)*

The Post-Aksumite settlement sites seem to cluster in the southeastern sector of the studied area. Most likely, these sites were related to the town of Aksum (Fig. 42). In this phase like in the previous one, there were no specific rules for the topographic location of the sites (Fig. 17).
Fig. 42. Post-Aksumite settlement sites.

Despite the fact that the total dimensions of the sites are increasing (Fig. 14), the general decrease of the sites with stone structures can be remarked (Figg. 15, 42). The agricultural settlement in this phase seems to have consisted of sites with light structures often associated with rich agricultural soils, like on top of Bieta Giyorgis and in the Geza Agumai area, northeast of Aksum (Fig. 43).
Fig. 43. Post-Aksumite settlement sites related to off-site structures (marked with \( \mathbf{rr} \)), soil types (1) white/light pink = highly reflective soils of mostly pyroclastic origin (trachyte), (2) cyan and magenta = agricultural fields with the more fertile and productive soils, (3) blue = rock outcrops and colluvium) and site structures (green dot=perishable, red dot=stone built).

When the Post-Aksumite sites are not related to rich agricultural soils, like in the area NE of Bieta Giyorgis, they might be related to sources of raw materials and even tracks (Fig. 44). Sometimes these structures are not far from earlier terraces and off-site structures which might have been used also in this phase (Fig. 43)
In Post-Aksumite times, the power and sacral landscape is just represented by the two churches BGS and BGI on top of Bieta Giyorgis hill (Fig. 45), but we cannot exclude that there was an other church in Gumala and one in the Enda Giyorgis area, perhaps under the present church.

Fig. 44. Post- Aksumite settlement sites related to the sources of raw materials and the traditional tracks.
Interestingly, a phase of soil formation was noticed in western Tigray at the end of the 1st millennium AD and was interpreted as related to the decrease of settlements at the end of the Aksumite kingdom.\textsuperscript{74} The data collected in the study area seem to fit with this general framework.

\textit{Final remarks}

Despite the fact that at the beginning of the studied period the natural landscape of the area was already affected by the human activities such as deforestation, probably related to agricultural exploitation, an increasing human presence in the area was remarked from 500 BC to AD 150.

This increase seems to have been ecologically sustainable until the 2nd century or, most likely, the 4th century AD. At that time a progressive drop in the intensity of the human settlement in the area took place. This decrease is contemporary or immediately following a severe erosive process affecting the area, which might have been the cause of it and might be explained by the

\textsuperscript{74} Brancaccio \textit{et al.} 1997.
overexploitation of the area. Nevertheless, the apparent decrease in the intensity of the human settlement in the area might also be related to the changes in the power/ideological landscape characterized by the rise and increase in dimensions of Aksum, the capital city, where people might have concentrated from the countryside. This suggestion might be confirmed only by further detailed studies on the urban development of Aksum aimed at reconstructing the settled area in the different phases.

In any case, the decrease of human dispersed presence in the area taking place from mid-4th century AD is also related to a deep change in the distribution of settlements and their typology, with an increase of sites with light structures and the abandonment of sites with stone built structures and, in general, of sites previously settled.

Apparently, this decrease in the intensity of the human settlement in the study area with the abandonment of settlements and most likely off-site features favored a further severe erosive process around AD 550. Actually, the soil strata produced by this process in the valleys Bieta Giyorgis are very rich in architectural debris.

After this episode, the Post-Aksumite landscape was characterized by sites with light structures, and had is main power/sacral focus on Aksum and its cathedral. Although the Post-Aksumite landscape is characterized by a strong continuity with the Late Aksumite one, an increase in the total dimensions of the settled area can be remarked. This might represent the start of a new phase of increasing human presence in the area which might result in a further environmental deterioration.

**Landscape Archaeology and Cultural Heritage Management in the Aksum area (A. Manzo)**

The study of the relationships among the components of landscape also contributed to the archaeological heritage management of the whole Aksum region.

First of all, it allowed us to implement thematic maps relating natural landscape to the anthropic landscape (Figg. 22-38). This offer for the first time in the Aksum area material useful to define the cultural heritage in terms of eco-cultural heritage and cultural landscape, according to the up-to-date outlines of UNESCO and ICCROM.

Moreover, the research project provided predictive models of site distribution and maps and data bases of the recorded evidence.

Actually, it was used the same classification technique adopted in soil classification75 studies to figure out the relationships between the archaeological sites recorded in the study area and in the

---

75 See Koch and Schmid n.d.a.
past by the Italian-American Expedition on top of Bieta Giyorgis (Fig. 46), and the soil types (Fig. 47).

Fig. 46. Map showing all the archaeological sites recorded in the study area and the sites recorded in the past by the Italian-American Expedition.
The result showed that the archaeological sites are mainly associated with the soils represented as yellow-orange in color in the map of soils corresponding to agricultural fields with the more fertile and productive soils in the study area. This result was then used to point out in which areas outside the surveyed ones the presence of archaeological sites is more predictable (Fig. 48).
Fig. 48. Areas where the presence of the archaeological sites is predictable on the basis of the associated soils, plotted on the soil map with the recorded archaeological sites.

The final output consisted of a map of the archaeological risk, showing in which areas around Aksum the presence of archaeological sites is more predictable to be donated to the local authorities and to be used for heritage management and in all planning and decision-making activities (Fig. 49).
Fig. 49. Map of the archaeological risk. Areas around Aksum where the presence of the archaeological sites is predictable.

**Landscape Archaeology: a Step towards Virtuality (C. Perlingieri)**

The GIS Database of the excavation and survey carried out during the 2005 Field Season, contains a lot of multilevelled information about the territorial setting of the area, and will serve at different ways. At the moment different thematic maps can be provided, based on different sets of information (sites location, names, dimensions, relation to other geographic features such as rivers, water springs and basins, ancient paths, vegetation, other resources, etc.). The data collected provide great flexibility, allowing thematic maps to be quickly produced.

However, with the data stored in the GIS, further analysis and modelling would be possible, and the bidimensional data could be transformed into a virtual landscape. Models of ancient structures and palaces can be successfully produced as digital versions of the traditional building.
reconstruction and integrated into the virtual landscape as well. Archaeological data and previous ethnographic overview provide a complete set of information to build up a complete three-dimensional model of the ancient landscape. An attempt of virtual reconstruction has been already made based on part of a palace excavated at Ona Nagast on Bieta Giyorgis. Having the possibility of including this model in a wider virtual reconstruction would give a further important contribution to the interpretation of the archaeological landscape in the Aksum area.

Figs. 50-51. Above: View of the exterior of the 3D Model of a palace excavated at Ona Nagast, and a sample of a texture for the floor; Below: View of an interior with reconstructed pottery shapes.
Moreover, the virtual reconstruction could be made available for different uses. First of all, it can be disseminated on the internet as a series of pictures which represent the steps leading to a final product, or through simulation of a flight over, in order to show the area from different angles, different heights and different directions. Also a model can be presented as a SVG project (Scalable Vector Graphics). Through SVG, two-dimensional graphics of the GIS mapping could be described as vector shapes, text, and embedded raster graphics. A virtual model could be also presented as a tourists facility at the entrance of the archaeological park of Aksum, and in the Museum.
REFERENCES

Anfray F.

Anwar A. Magid, R.H. Pierce, and K. Krzywinski

Anzani A.
1926. Numismatica aksumita, Milano 1926.

Ashmore W., and A. B. Knapp (eds.)

Bard, K.A. (ed.)

Bard K.A., M. Coltorti, M.C. DiBlasi, F. Dramis, and R. Fattovich


Bard K. A., and Fattovich R.

Bard K. A., and R. Fattovich (ed.)

Barnard H.

Bernand E., A.J. Drewes, and R. Schneider

Bos J.E.M.F. with contributions by C.C. Helms

Brancaccio L. G. Calderoni, M. Coltorti, and F. Dramis

Bryson R.A. and R.U. Bryson

Butzer K.A.

Buxton D., and Matthews D.

Cambi F., and N. Terranato

Carboni S.

Conti Rossini C.
1928. Storia d’Etiopia, Bergamo.

de Contenson H.

Dieleman J.

Doran J.E., and F.R. Hodson

Dramis F., M. Umer, G. Calderoni and Mitiku Haile

Fattovich R.

Fattovich R., and K.A. Bard

Fattovich R., K.A. Bard, L. Petrassi, and V. Pisano

Fattovich R., Yaqob Beyene, A.C.D’Andrea, M.C.DiBlasi, and A.Manzo

Finneran N.

Francis P.

Gasse F., and C. Descortieux

Godet E.

Grose D.F.

Hahn W.

Hanffmann G.M.A.

Hayes J.W.

Isings C.
1957. Roman Glass from Dated Finds, Groningen/Djakarta.

Johnson G. H., and M. Scott Harris

Koch M., and T. Schmid

Kobishchanov Y.M.

Litthmann E., S. Kreneker and Th. Von Lüpke

Machado M., A. Perez-Gonzales, and G. Benito

Manzo A.

Michels J.W.

Morrison H. M.

Munro-Hay S.H.

Munro-Hay S. C., and B. Juel-Jensen

Murphy C.P.

Nyssen J., J. Poessen, J. Moeyrsons, J. Deckers, Mitiku Haile, and A. Lang
Nyssen J., J. Poessen, J. Moeyrsons, J. Deckers, and Mitiku Haile
nd.a. “Soil Erosion and Soil Conservation in a Tropical Mountain Catchment under Threat of
Anthropogenetic Desertification: a case study from Northern Ethiopia”, Ambio, in preparation.

Olivier A.

Pedroni L.
Numismatica, 28-29, pp. 7-147.

Perlingieri C.
1999. La ceramica aksumita da Bieta Giyorgis, Aksum (Tigray, Etiopia). Tipologia ed implicazioni
storico-culturali e socio-economiche, Ph.D. Dissertation, Università "l'Orientale", Naples

Phillipson D.W.

Phillipson D.W. (ed.)

Ricci L. and R. Fattovich
117-169.
pp. 123-197.

Riley J.A.

Sadr K., A. Castiglioni, and A. Castiglioni
203-229.

Sagri M., A. Balemwald, M. Benvenuti, P. Billi, S. Carnicelli, N. Dainelli, S. Di Grazia, G. Ferrari,
C. Iasio, K. Seifu, and D. Ventra
1999. “Geo-morphological evolution of the Lake Region (Ethiopia) and Climatic Change”,

Scatozza Höricht L.A.

Spaer M.
Studies, 34, pp. 44-62.

Sternini M.

Strouhal E.

Sulas F.

Tekle Hagos

Wendowski M. and H. Ziegert

Whitcomb D.S.

Williams M., D. Adamson, B. Cock, and B. McEvedy