From Space to Place

2nd International Conference on Remote Sensing in Archaeology

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POSTER SESSIONS

Landscape Archaeology and GIS for the Eco-cultural Heritage Management of the Aksum Region, Ethiopia*

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1 Introduction and Research Design

This paper is based on a research project aimed at reconstructing the diachronic changes in the landscape in the area of Aksum (N Ethiopia, 14° 8' N; 38° 43' E, see Figure 1), the capital city of the Aksumite kingdom, from ca. 400 BC to AD 800 (Conti Rossini 1928; Fattovich 1997 b; Fattovich *et al.* 2000; Phillipson 1997, 1998).

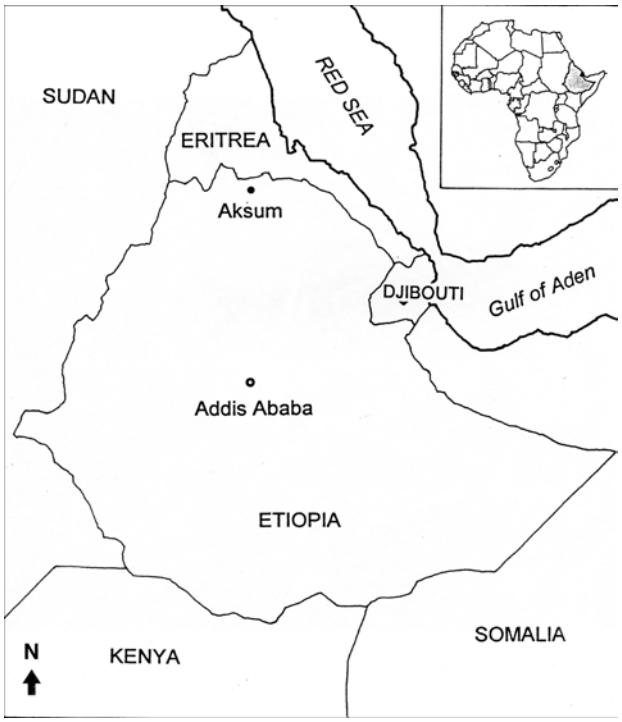


Figure 1

A complementary aim of the project is the understanding of the dynamics of human exploitation, manipulation, and management of this territory also related to environmental stress and to social pressures. As the whole N Ethiopian plateau this area is heavily affected by environmental deterioration and soil erosion (Butzer 1981, 1982; Machado *et al.* 1997; Nyssen *et al.* 2004). Two different sets of data have been integrated in this work. The first set is from excavation, archaeological survey, and geoarchaeological survey on the hill of Bieta Giyorgis and the valley N of it, by the UNO-BU Expedition and by the team of the Soil Science Department of the University of Florence (Bard and Fattovich nd.a, Bard et al. 2003, Ciampalini et al. 2006).[1] These data allowed to generate a very detailed diachronic model of the Man-Environmental relationship at a microregional scale. The second set of data resulted from the survey of the World Bank project "Ethiopian Cultural Heritage Project – Aksum Branch – Site Planning and Conservation Component" covering the whole Aksum region, and was finalized to the site inventory for the heritage management.[2] A predictive model of the archaeological impact on the territory of Aksum was elaborated on the base of the first set of data; subsequently a comparative analysis of the predictive model and the data from the World Bank survey gave interesting and encouraging results.

A systematic collection of archaeological, palaeoagricultural, and palaeoenvironmental data formed a multidisciplinary approach in which the landscape is considered a palimpsest of all past evidences of ecosystemic interaction significant for the reconstruction of many aspects of the Man-Environment relationships (Fattovich 2003). Hence special attention is given to the chronological and functional classification and distribution of the sites, as well to the study of the landscape infrastructures and exploitation marks (ancient fields, roads, terraces, facilities for water management, plough marks, quarries and sources of row materials). The recent pedological geomorphological and palaeoagricultural investigations in the area of Aksum highlighted new and encouraging results concerning the ancient and traditional cultivation techniques. The ancient system of terracing for the conservation/exploitation of the hill slopes was reconstructed, and was as well assessed the impact that modifications in the Man-

* Rossano Ciampalini studied the palaeoagricultural evidences; Andrea Manzo contributed with GIS analysis; Cinzia Perlingieri contributed with landscape interpretation; Luisa Sernicola contributed with GIS analysis. All authors contributed to the final remarks.

[1] The project is directed by Prof. Rodolfo Fattovich (University of Naples "l'Orientale"); preliminary reports of the Italo-American Expedition of University of Naples "l'Orientale" and Boston University are 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.

[2] The fieldwork was conducted by Prof. Rodolfo Fattovich and Ato Tekle Hagos (ARCCH, Addis Ababa).

Environment relationship had on the whole landscape through times.

2 The many dimensions of landscape

"Landscape is not something in and of itself but the creation or organization of land, a process" (Schwarzer, 2003: 84). In order to outline the diachronic changes in the landscape of the study area, different components of the landscape were distinguished (Ashmore and Knapp 2000; Cambi and Terranato 2001; Fattovich 2003): *Natural landscape*, consisting of all geological, geomorphological, vegetal and animal features that provide information about the spatial distribution of resources; *Economic landscape*, the configuration of artificial features reflecting the different patterns of land use and territory exploitation; *Social landscape*, the configuration of artificial features reflecting the hierarchical organization of the society; *Power landscape*, i.e. the manifestation of the power in the landscape; *Sacral landscape*, the combination of man-made features reflecting the religious and symbolic organization of the territory.

These components have a conceptual value of distinction among the many levels and dimensions at which human dynamics affect the territory, and help in understanding a discernible order of continuities/discontinuities in the landscape changes that, even if not sharply demarcated, can be measured on an empirical ground. As a secondary aim, this paper in fact asks not just what landscape "is" or "means" but what it "does", how it works as a cultural practice; beyond the landscape as a visual background, there is a landscape in the archaeological records that is a source of social identities.

3 Environmental Setting

The study area encompasses the modern town of Aksum, the hills of Bieta Giyorgis and May Qoho, the sloping plains N and S of them, and the hills which surround the area of Aksum and delimit the territory of the ancient capital city. The present agricultural landscape is characterised by scattered households and cultivated fields. Most of the slopes and plains are terraced, and few restricted spots are used for grazing. A massive reforestation affected large areas of the surrounding hills in the last decades. The geology of the region is known by studies at regional scale, Tigrean highlands are partly layers of Tertiary basalts due to volcanic activity forming a distinctive terraced topography with successions of flat surfaces and steep slopes characterized by gully erosion, creeping and sheet wash. Erosive processes have been very active since long time, and mainly associated to rifting and uplifting (Brancaccio *et al.* 1997). A more detailed geological study of Bieta Giyorgis was conducted in the framework of the UNO-BU Expedition (Johnson and Scott Harris nd.a).

The strong lithologic and topographical variation of the Aksum area is reflected in a mosaic of soils. Thin mantels of silt/clay loam reddish soils cover the hilltops; 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 (vertisoils) (Koch and Schmidt nd.a). The present soil distribution and the degradated vegetal cover result from ongoing natural erosive and anthropogenetic processes related to climatic changes. The methodological approach of this project highly contributed to the debate concerning the relationships linking these factors.

4 Palaeoagriculture and erosion dynamics[3]

The oldest evidence for cultivation (basically plough marks), has been assumed on the base of the chronology of the terraces associated with archaeological records, thus date back to the Proto or Early Aksumite times (Fattovich 1997, 2000). Agriculture on the footslopes (Butzer 1981) around the syenite plug of Aksum has been performed through a very old technique of terracing (Hurni 1985, Nyssen *et al.* 2004), in order to reduce the slope gradient and to improve the soil drainage. This technique seems to be very effective as the fragile balance between the terrace step and the escarpment is constantly maintained. The terrace system is managed as a whole, like in the Middle East: the upslope terraces are mainly used for grazing and water harvesting, the downslope are mostly exploited for cropping. The terrace sequence is consequently built in the same moment and the upper part of the terracing is not to be considered as an enlargement of agricultural areas under human dynamics.

The traditional plough still used in the region is the *maresha*, an "ard plough" that seems to have been introduced in Ethiopia between 1000 and 400 BC by Semitic tribes (Yemen), or even before by Cushitic speaking peoples from north-eastern Sudan (Gebregziabher et al. 2006). The impact of the plough against the stones is frequent, and the stones are consequently scratched: 1) on the top if rocks are at a lower depth than the tilling depth (8 –16 cm), or 2) on the sides if rocks are protruding (Figure 2). The occurrence of plough marks, thus, is a safe evidence for past cultivation on lands presently cultivated, degraded or strongly dissected.

[3] Thanks to Prof. G.A. Ferrari and Prof. P. Billi for the support in "Palaeoagriculture and erosion dynamics".

Figure 2 *Sequence of plough marks on a rock outcrop*

The highest plough marks on the side of the boulder face are actually the oldest. Pedo-geological features (different weathering rinds, patinas, varnishes) are used to reconstruct past ground surfaces. Ancient plough marks may be found at different height levels on big boulders or rock outcrops, thus providing valuable information on the thickness of soil loss. A systematic study of these ancient plough marks suggests that the total soil loss starting from Aksumite times ranges between 1.9 and 4.8 t ha^{-1} y^{-1} (Ciampalini et al. 2006).[4] These mean values are lower than the threshold erosion rate commonly accepted by international soil conservation agencies. The slope of the present terraces results to be lower than the original one, due to aggradation of soil material against the rock bund. In Fig. 3 the inference of old ground surface obtained by plough marks data processing is presented. The uninterrupted line is the present topographic surface; the dashed line connects the upper border of the plough marks belts on boulders of opposite sides of the terrace; the interrupted line is a reconstruction of the old ground surface, considering an average plough depth of 15 cm.

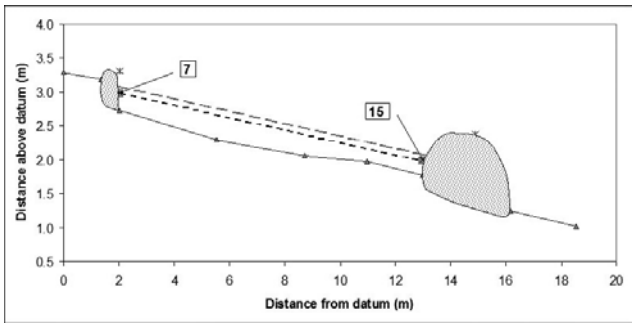


Figure 3 *Scheme of a terrace cross section*

The strike of plough marks on the boulders surface gives information about the ploughing technique. The plough marks orientation is restricted around a marked mode corresponding to the ploughing direction along the contour lines. Archaeological evidences and the study of the plough marks highlighted that the land conservation local practices, were very effective on the long time span. Pedological investigation confirmed this interpretation, since an argillic horizon was found in the terrace soil profiles: this diagnostic horizon is present only in soils developed on very stable geomorphic surfaces of old deposits. The presence of illuvial clay cutans in the Bt horizon demonstrates the stability of the deposits. The lack of skeleton in the soil is an evidence of the "guided aggradation" by farmer activity.

On the contrary, recent changes in the land use from agriculture to grazing, started during the Derg administration (1974-1987), produced an incredibly high soil loss, which strongly accelerated the environmental degradation.

The land degradation is the result of the progressive lack of maintenance of the stone bunds or the abandonment of the agricultural activities. The relationship between land degradation and anthropic pressure in the region of Aksum has to be re-considered under a new perspective. The necessity of high manpower to maintain effective environment conservation structures is a requirement for the preservation of the agricultural capacity (Tiffen 1994).

Preliminary results can be summarized as follows: 1) ancient agricultural exploitation of the upper part of the Bieta Giyorgis etchplain is not to be considered as an expansion of the cultivated valleys, but as the result of an integrated strategy of land use; 2) plough marks are sure evidence for ancient agriculture and help in determine the extension of cultivated areas, as well to evaluate the soil loss; 3) sediment facies and pedological features confirm the validity of the traditional terracing system for the stability and conservation of the land; 4) increasing human pressure is not a cause for degradation, on the contrary it is necessary for a sustainable land use and management; 5) impoverishment of agricultural land does not depend exclusively on degradation for overexploitation or on climatic conditions; 6) variability of soil capability, market fluctuations, wars, pestilences and other plagues or synergy of all, have to be considered as important elements affecting past environment.

5 Quantitative analysis and ancient settlement pattern

One of the first evidences emerged from this work is the occurrence of three main settlement areas: A) the capital city of Aksum, B) the Bieta Giyorgis hill and the plains N of it, and C) the broader surrounding rural area (Figure 4). It is demonstrated by the archaeological evidence that these areas have always been closely connected one to each other, and that the peopling in the capital city of Aksum and in the surrounding regions have always had very tight relationships. In this scenario it must be highlighted that Bieta Giyorgis always had a preminent role directly connected to the development of the capital city, as shown by the occurrence from the 400 B.C.

[4] t=tons, ha=hectares, y=years.

onwards, of strong administrative evidence, monumental buildings, imported goods, and proximity to the main land routes.

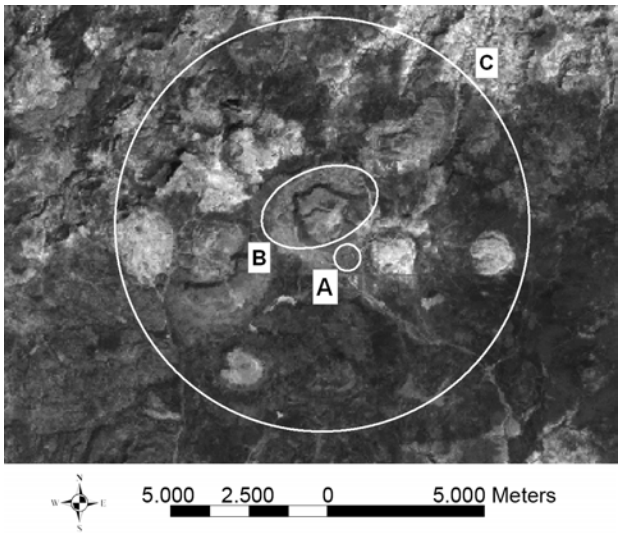
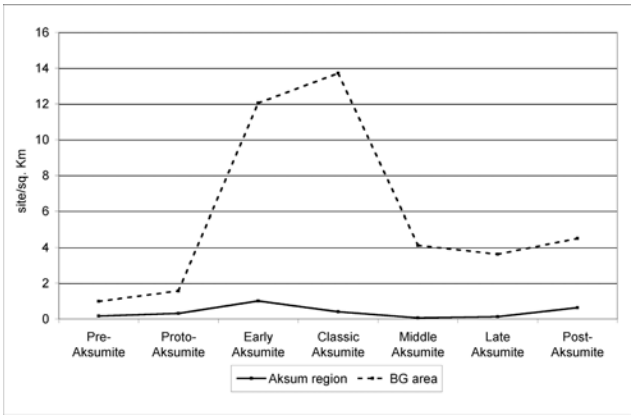


Figure 4

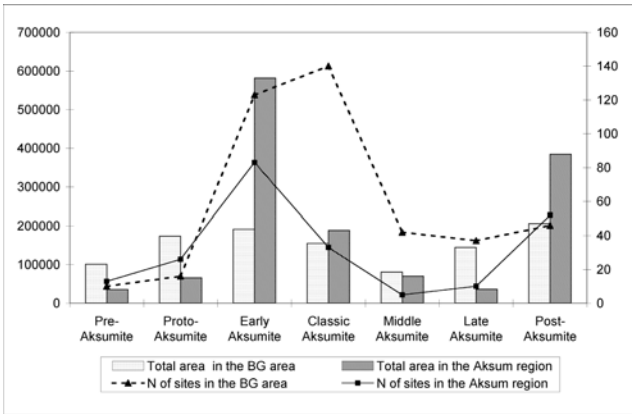
Quantitative analysis allowed the reconstruction of the settlement dynamics occurred in the area, and their relationship with the formation process of the political and economic capital of the Aksumite kingdom. One of the first results was learning that human settlements were not homogeneously distributed: a denser occupation characterises all phases at Aksum and Bieta Giyorgis, comparing to the occupation development in the rural area (as seen in Graph 1).

A constant increase in number and sites average dimensions characterized Bieta Giyorgis and the rural area from Pre-Aksumite (ca. 800 BC) to the end of Early Aksumite times (ca. AD 150) (Graph 1 and Graph 2).
This suggests that a progressive shift occurred from sparse small agglomerates, mainly concentrated around ceremonial sites on top of Bieta Giyorgis and in the SE and SW areas, towards a more intense occupation connected with the emergence at Bieta Giyorgis of elite groups and local polity.



Graph 1

Archaeological evidence for Aksum, though very scanty, seems to suggest that at this time the city was a center with no political and administrative predominance (Figure 5).



Graph 2

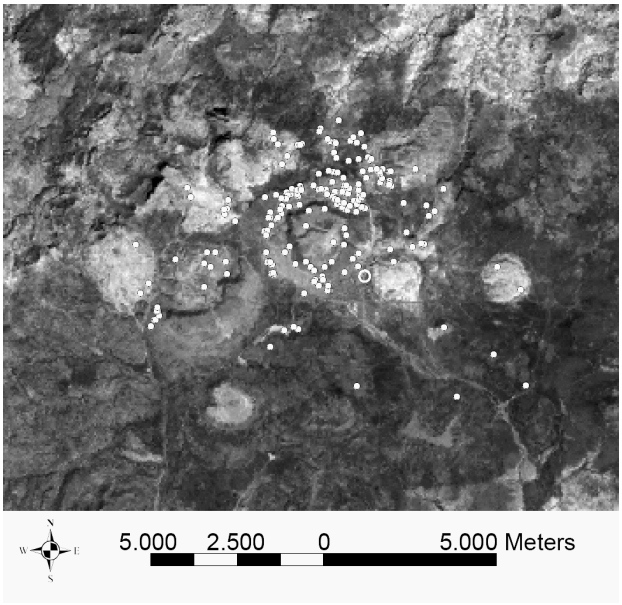


Figure 5

From AD 150, during the Classic Aksumite period, there is a clear differentiation in the occupation of all areas: number and size in the rural area dramatically decrease; at Bieta Giyorgis the total number of sites is continuously increasing but their size decreases (Graph 1 and Graph 2); at Aksum test excavations highlighted that the extension of the city considerably increased (as marked in Figure 6) (Fattovich, Bard, Petrassi & Pisano, 2000, pag. 79, fig. 20-21). The decrease in the number of sites in the rural area and the reduction of the average sites dimensions at Bieta Giyorgis maybe related to the expansion of the urban settlement of Aksum, and may be explained by the urban migration in the capital city rather than by a demographic decrease.

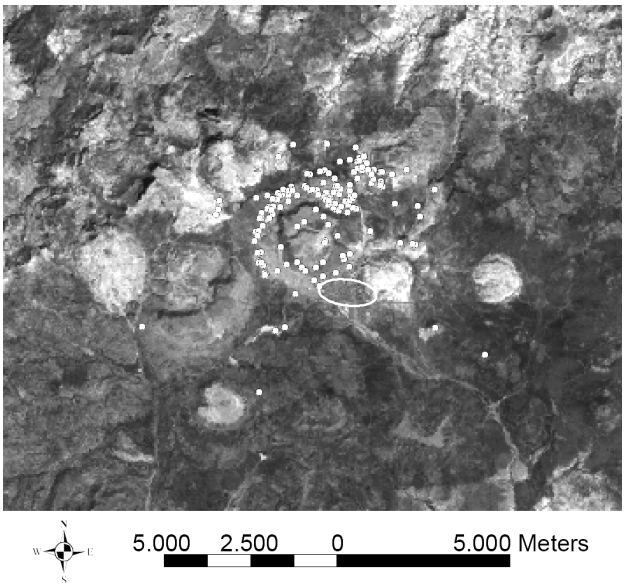


Figure 6

Later (from AD 350 onwards) a similar trend of decrease in the number of sites involved also Bieta Giyorgis. Few sites are recorded both at Bieta Giyorgis and in the rural area, though noteworthy increased in dimensions (Graph 2). This evidence seems to remark a change in the occupation model towards a flourishing of medium to large satellite villages around the expanding capital city (Figure 7). Possibly, this was a consequence of social changes strictly related to a different administrative organization at regional and interregional scale. The beginning of minting at Aksum (already started since AD 270), the erection of monumental buildings and high status funerary structures, as well military expeditions in South Arabia and Nile Valley, witness the rising of a new political scenario based on a centralized power with its political and administrative capital at Aksum.

A completely different trend was remarked from Late Aksumite to Post-Aksumite times: the number and extensions of the sites at Bieta Giyorgis and in the rural area increase despite the contraction of the urban area of Aksum (see Figure 8 and Graph 2) (Fattovich, Bard, Petrassi & Pisano, 2000, pag. 79, fig. 20-21). After its decline as a political and economic capital, Aksum remained an important ceremonial center, reduced in a small area around the cathedral. At the same time there is a reappearing of a considerable number of medium and large sites, possibly scattered households similar to present, in the surrounding areas characterised by the absence of administrative devices and of monumental buildings, and not strikingly proximal to the main land routes.

6 Predictions and verifications: present and future

The first step of this research allowed the elaboration of a predictive model of archaeological sites distribution based on a classification of soils and their fertility, and their relationship with archaeological sites. The major result showed that the archaeological sites are mainly associated with the more fertile and productive soils. This evidence was adopted as a training region to investigate the archaeological impact in non surveyed areas, and produced a map of the archaeological risk.

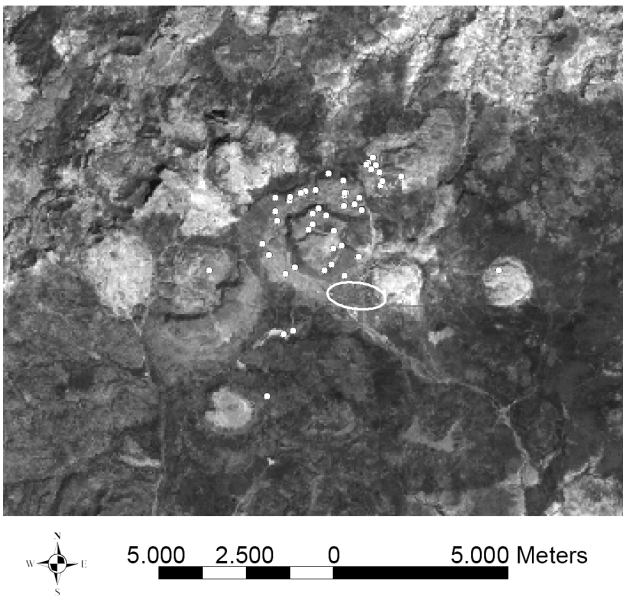


Figure 7

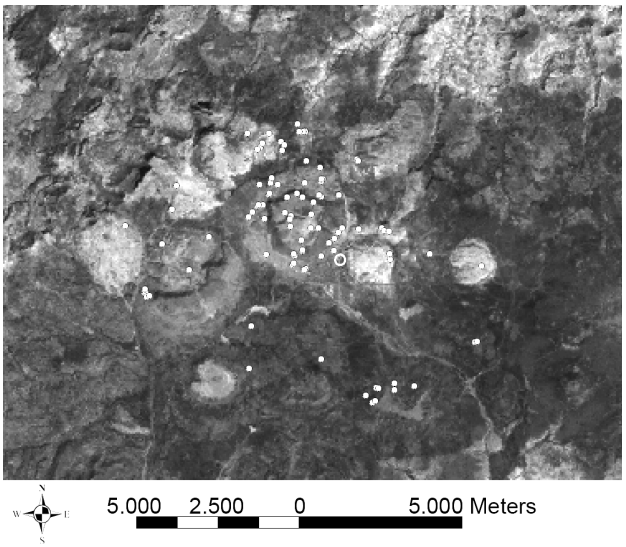


Figure 8

The survey carried out within the World Bank project demonstrated that the predictive model was reliable, as most of predicted area based on the training regions found a precise correspondence in the archaeological areas recorded later. This was an important verification of the validity of the predictive model based on the relationship between soils and sites, suggesting that the model may be extended to other regions of N Ethiopia with the same ecological conditions.

A further step of the project will be conducting further verifications to relate changes in the landscape to the erosional processes. This verification will validate, or not,

the correlation between processes of land degradation and de-population of agricultural areas. This may be reflected in the qualitative and quantitative changes of sites in the agricultural areas. Noteworthy, the explanation of the past degradation processes may give parameters for the decision makers and planners of future development (Glantz 1987; Wainwright and Mulligan 2004).

7 Landscape and human geography

Landscape is one of those words that possess many definitions: it can be a scenery of nature, an artistic or architectural design of cities, a patrimony over lands indicative of heritage, the study of the environment or an ecological system (Schwarzer 2003: 85). As landscape expands to vast arrays of forms, through space and time, how does it convey meaning? How cultural practices implant themselves within landscapes and shape the history of places? Natural and property boundaries, roads, commercial networks, patterns of habitation, public meeting places, ceremonial and administrative buildings, and other monuments, all together influence the landscape development over time, but which are the archaeological indicators for the many dimensions of landscape?

Changes in the Aksum landscape as emerged by the analysis above made possible small moves towards the comprehension of some landscape dynamics. Some aspects of human geography as argued by the study of the past are also supported by the strategies observed in the present autonomous household-based communities (similar to the last phase of development of the Aksumite and Post-Aksumite times). In general terms, the decrease in the intensity of the human settlement and the weakening of the social landscape might be related to the changes in the power/ideological landscape and can be archaeologically traced and examined. In turn, the changes in the distribution as well as the re-definition of the monumental/ceremonial buildings are related to the changes in the political and ideological Aksumite identity.

The dispersion and lack of cohesion of the rural agglomerates, differently in respect to the integration of the earlier phases, and the subsequent isolation of households, caused a termination of the integrative process. In periods in which the ideological/administrative presence in the territory is strong (mainly during Classic and Middle Aksumite times), the social landscape is strongly integrated because directly influenced, when not organized, by a centralizing power. The archaeological evidence (based mainly on the distribution of the administrative devices) from Bieta Giyorgis and from Aksum, demonstrates that Sacral and Power landscape are always equated: monumental/ceremonial buildings are at the same time buildings of power and administration. Also the imported materials, important markers for the circulation networks (Manzo 2005), seems to be associated mainly with ceremonial/administrative buildings or sites. The distribution of these buildings on the territory demonstrates the use of extended ritual spaces rhythmically placed among hamlets to ensure social harmony and possibly to deter movements toward ideological/political centralization, as well to assure land maintenance.

8 Cultural Landscape and Heritage Management

The approach adopted here gave the possibility to assess the heritage of the Aksum region not only in terms of single monuments and sites, but in a perspective of eco-cultural impact, according to the up-to-date outlines of UNESCO and ICOMOS (ICOMOS 2005: 42, 46-48, 96-97; UNESCO 1972: art. 1, 2006: 6).

The author's hope is to contribute in shaping the idea of a *cultural landscape* of the Aksum region as "… the total assemblage of visible things that human beings have done to alter the face of the earth …" (Lewis 1993: 115-16). A true and effective way to appreciate, manage and exploit a cultural landscape is considering the reception of landscape as important as its production, and to consider "…the current inhabitants as important in determining the temporal angles of meaning as the original constructors." (Shwarzer 2003: 90). One of the main roles of the archaeological research on the territory is emphasizing the discontinuities of the landscape form through time, and also rise discussions on the importance of inhabitants in making that form. In fact, an important component of the eco-cultural heritage consists of the traditional systems of land management and exploitation, and their development. It includes knowledge of the natural environment, with its cycles and critical moments, which are embedded in the social memory together with possible technological solutions to environmental stresses. Both the traditional systems of land management and exploitation, and the ideological perception of the landscape leave traces that can be detected through a landscape archaeology approach.

The archaeological impact assessment, through the complete site inventory of the region, contributes to the heritage management and planning and decision-making activities. In terms of environmental impact, the degradation and the loss of soil fertility analysed in paragraph 4, allowed us to assess the potential and actual erosion risk. The mapping of the erosion models and locations where rehabilitation is most urgently needed, can play an important role in supporting rehabilitation planning at both the farm and the regional levels. Moreover, the evaluation of the effectiveness of the traditional land management system in response to the environmental and social stresses, will contribute to the planning of a sustainable development for the studied areas (TKWB nd).

A geographic information system outlining the different aspects of the ancient landscape may represent a first step towards the implementation of a sustainable eco-cultural development based on a "presentness of memory" in which the past must not be kept in the past. In this perspective the enhancement of rural development does not collide with people's tradition and sense of identity. In the Tigrean region, where the religious and historical memory is predominant and where the claim for a cultural identity is very strong, past should be revived and lived rather than remembered. This living landscape, where past is kept in the present, is itself a monument that is at risk of invisibility and oblivion.

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