



Soil erosion in the archaeological area of Aksum, Ethiopia: a multi-site, spatio-temporal analysis

Rossano Ciampalini (1,2), Luisa Sernicola (3), Paolo Billi (4), Giovanni Ferrari (5), Lorenzo Borselli (6), and Stéphane Follain (7)

(1) INRA, UMR – LISAH, Laboratoire d'étude des Interactions Sol - Agrosystème - Hydrosystème, INRA – IRD, SupAgro Montpellier, Bat. 24 - 2 place Viala - 34060 MONTPELLIER, France, (2) INRA, US InfoSol - Centre de recherche d'Orléans, ORLEANS, France, (3) University of Naples 'L'Orientale', Naples, Italy, (4) Dipartimento di Scienze della Terra, Università di Ferrara, Ferrara, Italy, (5) Università di Firenze, Di.P.S.A., Piazzale Cascine, 18 – 50144, Firenze, Italy, (6) Instituto de Geología / Fac. De Ingeniería, Universidad Autónoma de San Luis Potosí (UASLP), Av. Dr. Manuel Nava, 5 – 78240, San Luis Potosí, S.L.P., Mexico, (7) Montpellier SupAgro, UMR – LISAH, Laboratoire d'étude des Interactions Sol - Agrosystème - Hydrosystème, INRA – IRD, SupAgro Montpellier, Bat. 24 - 2 place Viala - 34060 MONTPELLIER, France

The aim of this research is to synthesize previous works on soil erosion evaluation in response to soil conservation strategies practiced in the area of Aksum (Tigray, northern Ethiopia) throughout the last three millennia. This location presents favourable conditions for the implementation of a long-term approach for assessing soil conservation techniques that have been used for centuries (i.e. since the Aksumite kingdom, 2400 y BP to 1200 y BP). These techniques have been maintained until present and parts of the terraced systems of the area are still in use.

The study is based on an archaeologically based reconstruction of the ancient settlement pattern of the whole area which provided significant information on the changes occurred in land occupation, exploitation and management throughout the Aksumite civilization. In such context, the rate of soil erosion was evaluated on the basis of the analyses of the presently exposed, deep scratches (plough marks) left on the rocks in the soil by the maresha, the ard-plough pulled by oxen used in agricultural practices of the area; further considerations have been done by the means of associated patinas, varnishes and weathering rinds on the boulders exposed by soil loss.

Analyses for the assessment of soil erosion have been focused on three terraced areas where evidence of occupation and ploughing could be traced back since at least the beginning of the Aksumite kingdom, and where the plough marks are still well preserved. The plough marks method indicates average rates of soil erosion of 3.1, 2.8 and 1.2 $\text{t ha}^{-1} \text{y}^{-1}$, respectively.

Recent changes in land-management in one of the sites, shifting from soil conservation conditions under traditional agriculture (long-term observations) to accelerated erosion after abandonment (short-term observations) occurred during the land use reorganisation in the 70s, produced a high soil erosion of about 62.6 $\text{t ha}^{-1} \text{y}^{-1}$.

These data lead up to a new survey phase able to provide a detailed framework of the human pressure and the resulting soil erosion in the Aksum area through the last two millennia.