Mesoclimate Regulation Induced by Landscape Restoration and Water Harvesting in Agroecosystems of the Horn of Africa

Giulio Castelli (1), Fabio Castelli (2), and Elena Bresci (1)

(1) University of Florence, Department of Agricultural, Food and Forestry Systems (GESAAF), Firenze, Italy (giulio.castelli@unifi.it), (2) University of Florence, Department of Civil and Environmental (DICEA), Firenze, Italy

When changes are made in a landscape, changes are made to its local climate. In arid and semi-arid agroecosystems of the world, measures such as Landscape Restoration and Water Harvesting (LRWH) have been implemented to combat land degradation, retain soil moisture and increase agricultural yields. The present research aims to analyse to what extent storing soil moisture with adequate LRWH practices can reduce temperatures in the months after the rainy season, as a feedback induced by Soil Moisture-Temperature Coupling (SMTC), in a semi-arid agroecological zone such as northern Ethiopian highlands. Since soil moisture deficit can enhance heatwaves in various regions of the world, it is hypothesized that the conservation of soil water can regulate temperatures during the dry and hot periods after the rainy season. The analysis has been carried for the catchment of Enabered in Tigray Region, Ethiopia, where rainfall occur from June to September. Here, LRWH implementation ended in 2008. A remote sensing analysis has been carried out to assess (1) to what extent LRWH measures can enhance soil moisture conservation at agroecosystem scale; (2) to what extent LRWH implementation can mitigate hot temperatures in the dry season at agroecosystem scale; and (3) if SMTC effects were evident. Results showed that the capacity of the catchment to maintain soil moisture accumulated in the rainy season increased, and reduced temperatures. Increase of soil moisture was significant for September ($P < 0.01$), while temperature decreases were evident in October ($P < 0.01$) and November ($P < 0.05$), with decreases of Land Surface Temperatures (LST) up to 1.74 °C. A simple, parsimonious linear regression model demonstrated that the effect of SMTC feedbacks is evident at catchment scale and that LRWH implementation provided a climate regulation effect in the watershed. The present work can reinforce the call for the adoption of land restoration, water harvesting and green water management to increase the resilience of agroecosystems located in arid and semi-arid areas, that represent a key element to achieve global food security.