EGU24-17914, updated on 13 Jul 2024
https://doi.org/10.5194/egusphere-egu24-17914
EGU General Assembly 2024

Impact of climate change on coffee agrosystems and potential of adaptation measures

Raniero Della Peruta[1], Valentina Mereu[1], Donatella Spano[1,2,3], Serena Marras[1,2,3], and Antonio Trabucco[1,3]

[1]Euro-Mediterranean Center on Climate Change CMCC, Research Division Impacts on Agriculture, Forests, and Ecosystem Services IAFES, Sassari, 07100, Italy

[2]Department of Agricultural Sciences, University of Sassari, Sassari, 07100, Italy

[3]National Biodiversity Future Center (NBFC), Palazzo Steri, 90133 Palermo, PA, Italy

Coffee is one of the most economically important agri-food systems globally, and is the main source of income for many rural households in several developing countries. Ongoing climate change could cause problems for sustainable coffee production, with greater instability from year to year and lower average yields. To overcome these problems, possible adaptation measures and agronomic practices should be evaluated, such as intercropping with other tree species that can provide more shade for coffee plants and promote resilience and environmental sustainability. To study the effectiveness of such options, the use of process-based models can be very useful.

The DynACof model was developed specifically to simulate coffee agrosystems, including phenological development, physiological processes related to flower and fruit production, carbon allocation, the effect of water availability, light and temperature, and management. We validated the yields modeled by DynACof with productivity data available from some sites and areas included in previous evaluation studies in Mexico, Rwanda, Brazil, Ethiopia, and Costa Rica. We then developed and established a modeling framework in which the model can be applied spatially on a continental or pan-tropical scale, using extended climate projection ensemble and soil geodata.

Our modelling tool was then used to simulate potential yields in Latin America and Africa for both 1985-2014 and 2036-2065, using an ensemble of statistically downscaled and bias adjusted climate projections for two different shared socioeconomic pathways. Comparing the two periods, the model predicts a decrease in yields between 23 and 35 percent in Latin America and between 16 and 21 percent in Africa. The spatial representation of these changes indicates a likely future shift of suitable production areas to higher elevations, possibly impacting fragile mountain ecosystems. We simulated a specific management option, namely increased agroforestry shading, to evaluate its effectiveness in improving resilience to climate risks. The results suggest that increased tree shading could partially reverse the trend of declining yields due to climate change in some lowland areas. However, these preliminary results must be confirmed by further analyses. Impact analysis and adaptation modeling of coffee agrosystems, together with socioeconomic indicators, have the potential to delineate realistic integrated risk assessments and support effective adaptation

recommendations.