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"Resilience of agricultural systems against crises"

Global Impact of Climate Change on Coffee Suitability

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Abstract

The fact that climate change will have an adverse impact on agriculture is evident. Various studies show that the exposure of coffee systems to climatic changes will result in decreased suitability, yield, inferior quality and increased pest and disease pressure. This is commonly related to in increases in temperature and changes precipitation patterns. To date, no global study on the impact of climate change on coffee suitability exists.

To assess the impact of climate change on coffee suitability globally we first quantified changes in predicted climate patterns by 2030 and 2050 using 18 Global Circulation Models (GCM). Then, we modeled the potential current world coffee distribution using the Maxent crop prediction programme training it on over 5200 unique coffee evidence locations worldwide. This model is widely acknowledged to yield the most accurate results. Finally, we projected the future global coffee distribution to using the GCM' to identify the level of exposure of coffee suitability under progressive climate change. As climate input data we used 19 bioclimatic variables from Worldclim (current climate) and 18 GCMs (future) under emission scenario A2 and on 2.5 arc-minutes (approximately 5 kilometers) scale.

The specific results show that suitability in the Mesoamerican coffee regions tend to be lower in areas between 400 – 800 m. a.s.l. While South American coffee regions show increasing suitability of 40 % in areas close to the equator with an average altitude between 1600 – 2000 m. a.s.l., the areas north and south of the equator show a decrease of suitability up to 60 %. In some African coffee regions (Ethiopia, Kenya and Madagascar) coffee-suitability gains up to 40 %. While in some South East Asia coffee regions (Vietnam) coffee-suitability loses close to 60 %.

Thus, our model reveals drastic losses of coffee area in low regions at high latitudes. However, our model implicitly assumes unchanged cultivation practices. We therefore conclude that coffee research must focus on developing new means that address the coming changes. Our results are expected to serve as an analysis tool for future projects related to socioeconomic, vulnerability and political analysis of the adaptation of coffee production.

Keywords: Climate change, *Coffea arabica*, modelling

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