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with planetary health"

Ecosystem services and living income: Assessing their contribution to cocoa farmers' livelihoods in Côte d'Ivoire

Bonna Antoinette Tokou[1], Claudia Coral[2], Stefan Sieber[3], Katharina Löhr[4], Constant Yves Adou Yao[5]

[1]*Leibniz Centre for Agric. Landscape Res. (ZALF), Sustainable Land Use in Developing Countries (SusLAND), Germany*
[2]*Humboldt Universität zu Berlin, Department of Agricultural Economics, Agrifood Chain Management,*
[3]*Leibniz Centre for Agric. Landscape Res. (ZALF), Sustainable Land Use in Developing Countries (SusLAND), Germany*
[4]*Leibniz Centre for Agric. Landscape Res. (ZALF), Sustainable Land Use in Developing Countries (SusLAND), Germany*
[5]*Félix Houphouët-Boigny University, Switzer Centre of Scientific Research (CSRS), Côte d'Ivoire*

Abstract

Agroforestry systems are considered one of the most effective nature-based solutions to global problems such as climate change and biodiversity loss, through the ecosystem services provided and their contribution to the farming households' Living Income (LI). Indeed, LI is a concept and poverty benchmark incorporating several well-being dimensions to guarantee decent living conditions for farming households, aligning with the European Union's regulation objectives. LI is widely applied to agrifood commodities but lacks explicit consideration of the contribution of Ecosystem Services (ESS) to smallholder farmers' well-being. Ecosystem services, including provisioning, regulating, cultural, and supporting functions, are essential for sustaining the livelihoods of low-income farmers, such as the secondary products, to meet their household needs and generate additional household income. To assess the potential of selected ESS for enhancing the LI of cocoa farmers, we evaluate ESS based on a survey of 151 cocoa agroforestry farmers and semi-structured interviews, followed by 78 cocoa agroforestry system (CAFS) inventories. Data on producer and CAFS characteristics, as well as management practices, were collected for this purpose in five localities of Côte d'Ivoire. In addition, during the inventory, the producer provided additional information, such as associated species and their various perceived ESS, as well as cocoa yields. This information was used to determine the impact of ESS on cocoa yield and to evaluate the potential capacity of trees for carbon sequestration. To this end, descriptive and statistical analyses are conducted following the carbon sequestration calculations using the allometric model. The analysis reveals a balanced relationship between the tree species associated with CAFS. While some species demonstrate a high capacity for carbon storage, others play an essential role in improving cocoa yield, directly influencing farmers' income. Our findings suggest that greater tree diversity enhances the stability of CAFS productivity and boosts resilience to climate fluctuations by providing shade and preserving soil moisture, while also improving soil fertility and cocoa yields. In conclusion,

Contact Address: Bonna Antoinette Tokou, Leibniz Centre for Agric. Landscape Res. (ZALF), Sustainable Land Use in Developing Countries (SusLAND), Eberswalder stra e 86, 15374 Müncheberg, Germany, e-mail: tokou.ant@gmail.com

the study emphasises the critical role ESS plays in CAFS and their potential to improve cocoa farmers' living income, highlighting the need for further integration of these services into agricultural policies and practices.

Keywords: Agroforestry, Carbon Sequestration, Cocoa, ecosystem Services, Living Income