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"Reconcile land system changes
with planetary health"

Regional scale biophysical assessment of potential for sustainable intensification

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Abstract

Smallholder farmers in sub-Saharan Africa (SSA) predominantly depend on rain-fed agriculture, rendering them highly susceptible to food insecurity. The region's agricultural systems are increasingly threatened by climate change, which disrupts traditional weather patterns and introduces unprecedented climatic conditions. This vulnerability is further exacerbated by rapid population growth, escalating the demand for food and placing additional pressure on natural resources. Consequently, enhancing agricultural productivity while conserving natural resources is imperative, particularly in developing countries where land degradation poses a significant threat to food production. Sustainable intensification (SI) offers a viable solution by increasing agricultural output while reducing environmental impacts and improving resource-use efficiency. However, the potential for SI in northern Ghana remains largely unexplored. This study aims to identify biophysical potentials and associated risks of selected SI practices in northern Ghana. To achieve this, we will perform a typology analysis to identify homogenous production units (PUs) with shared biophysical characteristics. The SIMPLACE model will be run first for a baseline simulation using 'business as usual' management options. Subsequently, a selected number of Integrated Soil Fertility Management (ISFM) options, including inorganic and organic fertiliser applications in sole cropping systems, variety types, and planting time will be evaluated within each PUs. Key sustainability indicators will be employed to assess the viability of each practice. These sustainability indicators include GHG emissions, risk of N leaching, changes in SOC, WUE, NUE and the risk of yield failure. Furthermore, large-ensemble climate datasets will facilitate a robust risk assessment, ensuring that climate variability is adequately considered. This approach aims to minimise climate risks while enhancing food security at the regional scale.

Keywords: Biophysical assessment, Integrated Soil Fertility Management (ISFM), Production Units (PU), Sustainable Intensification (SI)

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