



Land-nutrient-water nexus to enhance food security and mitigate greenhouse gas emission in small holder farming in sub-Saharan Africa

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Smallholder farms represent 80% of all farms in sub-Saharan Africa (SSA) and contribute up to 90% of the agricultural production in some SSA countries. However, they mainly suffer from lacking of food security. To enhance food security they commonly practice expanding agricultural lands, intensification and expanding irrigation in SSA. Expanding agricultural lands implies deforestation, and greenhouse gas (GHG) produced in the process is the most dominant sources of GHG emissions in SSA. There is only little room for further expansion of agricultural lands since fertile and uncultivated lands are only little left in SSA. Therefore it may be inevitable that conversion of natural lands to agricultural lands will occur further more. Intensification by continuous cropping with shortening fallowing periods and increasing nitrogen (N) fertilizer application have been carried out across SSA. These practices can increase GHG emissions since intensive cropping increases decomposition of organic matters with emitting carbon dioxide (CO₂) and N fertilizer is source of nitrous oxide (N₂O). There is a great potential for expanding irrigation in SSA. While irrigation can increase soil carbon sequestration there is a concern that expanding irrigation can result in increasing GHG emission. Irrigation increases soil moisture enhancing soil microbial activities and causes rewetting effect in dry soil- these are well known sources of GHG emissions. Therefore urgent efforts are required to identify measures enhancing both food security and GHG mitigation in smallholder farms in SSA. To achieve it, land, nutrient, and water components should be considered comprehensively. For land, instead of expanding agricultural lands at the expense of deforestation, agroforestry can be practiced in degraded land and it can increase agricultural yield and GHG mitigation. For nutrient, improved soil management with combined conventional- conservation agriculture (CCCA) practices can contribute to increasing yields without increasing GHG emissions. For water, appropriate irrigation technique and water management may have great potentials to enhance yield and GHG mitigation. Therefore, for any integrated and sustainable land management based solution, it is necessary to consider land- nutrient- water nexus (LNWN) since each of them alone cannot properly manage the complexity of food security and GHG mitigation. The concept of yield-scaled GHG emission can be used as a means to account both food security and GHG mitigation comprehensively. Considering difference in the current status and appropriate schemes for land, nutrient and water by areas, it is required to identify optimized LNWN scheme through assessing its potentials, limitations and trade-off for target areas.