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Editorial: Sustainable intensification of smallholder farming systems in Sub-Saharan Africa and South Asia

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Editorial on the Research Topic
Sustainable intensification of smallholder farming systems in Sub-Saharan Africa and South Asia

Agricultural production in sub-Saharan Africa (SSA) and South Asia (SA) is mainly rainfall-dependent and dominated by smallholder farming systems. These smallholder farming systems with landholdings <5 ha produce about 80% of the food consumed in these regions (Chauvin et al., 2012; Jayne et al., 2014). Despite the contribution of the smallholder farmers to food production in these regions especially in SSA, productivity from their farms is low due to several factors such as low and declining soil fertility, limited use of external inputs, unfavorable policy, market and institutional arrangements, pests, and diseases, as well as the effects of climate change. The low productivity of agriculture among smallholder farmers exacerbates poverty levels since it is the main source of livelihood for more than 50% of the workforce in these regions (Odusola, 2021).

The world human population is projected to reach 9.7 billion persons by 2050, about half of the population will live in SSA and SA necessitating the production of more food to feed the growing population (Brandt et al., 2017; United Nations Department of Economic and Social Affairs Population Division, 2017). Increasing food production per capita in these regions through the conversion of marginal and grazing lands to productive arable lands is becoming limited and unsustainable due to the increasing demand for land for agricultural and non-agricultural uses (World Bank, 2007; Vanlauwe et al., 2017). Despite the success of agricultural intensification such as the Green Revolution type, it had some environmental limitations, and addressing these limitations evolved a sustainable intensification strategy (Pingali, 2012). Sustainable Intensification (SI) is the production of more food per unit area of land in an economically sound manner while reducing negative environmental, social, and human impacts (Pretty et al., 2011; Pingali, 2012; Smith et al., 2017). Promoting SI among smallholder farmers is critical for both regions to achieve the

sustainable development goals (SDGs) set by the United Nations, particularly SDG1 (no poverty), SDG2 (zero hunger), SDG5 (gender equity), SDG 13 (climate action), and SDG 15 (life on land).

In this Research Topic, we present original research (14) and review (1) articles on recent scientific advances in SI of smallholder farms in SSA and SA. The articles examined SI of smallholder farms from different areas including productivity, natural resource management, mechanization, socio-cultural, and scaling up of SI innovations. The article by Akanmu et al. reviewed the role of agroecology techniques in the SI of smallholder farming systems. They reported that agroecology practices such as mixed cropping, agro-forestry, and crop-livestock systems among smallholder farms strategically ensure food security and sustainability. Another study by Goswami et al. discussed how the linkages in resource flow and its efficient use at the farm level affect the sustainability of farming systems. They reported that properties of resource interaction networks, the nature of resource interactions, and the type of farms affect the sustainability of farms.

According to Smith et al. (2017), the measure of sustainability in agricultural technology heavily relies on the productivity of the technology itself, particularly in terms of yield, which is considered the main outcome of sustainable intensification practices and the most commonly used indicator in SI literature. Three articles in this Research Topic studied productivity as the key area for SI of smallholder framing systems. Das et al. reported that low level of technical efficiencies is a limiting factor for agricultural production, highlighting the need to improve it for SI of smallholder farmers. Sasu et al. studied the use of alternative quality feed sources to increase the productivity and SI of smallholder livestock production. Bahta et al. reported the need to consider drivers such as infrastructure, access to information and inputs to help harness the potential of increasing productivity and SI of smallholder farms.

Low and declining soil fertility on smallholder farmers is the main cause of declining per capital food production in these regions particularly SSA (Sanchez et al., 1997). Three articles in this Research Topic examined soil fertility management as an entry point for SI of smallholder farming systems. Awoonor et al. studied soil suitability indexing using climate and soil physico-chemical properties for SI of smallholder farms. They reported that soils are heterogeneous and decisions on SI management of soils should involve prevailing local conditions. The study by Adjei et al. reported that continuous cropping on the same land over a long time leads to poor soil quality and unsustainable productivity. They recommended the use of integrated soil fertility management for soil quality improvement and sustainability of smallholder farmers under continuous cropping. Nakei et al. studied the importance of biological fertilizers to complement integrated organic and inorganic fertilizer use for SI of smallholder legume production.

Mechanization of agriculture helps to enhance productivity and reduce the unit cost of production (Pingali, 2007). Two articles in this Research Topic focused on mechanization as an entry point for SI of smallholder farms. The findings by Gershon et al. showed that a collective business model for mechanizing maize shelling enhanced mutual understanding, and respect for individual farmer differences, fostered better relationships, and reduced conflicts among smallholder farmers for SI of maize production. The article by Birhanu et al. also demonstrated the role of solar-based irrigation systems for efficient water management to improve productivity and the natural resources of smallholder farms. The solar-based irrigation systems provided a sustainable water supply for domestic water use, livestock, and vegetable production. The affordability of the panels by many smallholder farmers makes the system an emerging climate-smart technology for the SI of smallholder farms.

Understanding farmers' know-how in terms of agricultural production is a key in the SI of farming systems (Pretty et al., 2011). Two articles in this Research Topic assessed the role of farmers' thinking in the SI of their production. The study by Kalu et al. reported that farmers' age, sex, and years of experience in farming have a significant influence on farmers' choices in production and hence the need to consider farmers' desired attributes of production in SI of smallholder farms. Ngoya et al. reported that farmers' indigenous knowledge of addressing current agricultural production challenges has some gaps. Hence, a need for research and farmer learning for SI of smallholder farms.

Scaling and adoption SI innovations has been challenging in most cases and learning from past experiences helps to improve the success of scaling and adoption of agricultural innovations (Van Loon et al., 2020). Three articles in this Research Topic provide insights on scaling and adoption of SI innovations among smallholder farmers. Muthoni et al. reported the use of extrapolation suitability index for scaling SI innovation to increase adoption of innovation among smallholder farmers. The extrapolation suitability index uses geospatial framework to identify potential suitable sites for extrapolation of innovation based on factors (biophysical, socio-economic etc.) that limit productivity of the innovation. Another study tested a combination of participatory tools for scaling SI innovations (Mekonnen et al.). They reported that matching innovations to community needs, systems integration of innovations, stepwise approaches to enhance the adoption of innovations, building successful partnerships etc. as key factors to consider for facilitating wider scaling of SI innovations. Tufa et al. also examined why previous efforts and investments to scale conservation agriculture (CA) practices in southern Africa have not led to widespread adoption. They identified gaps in the order of awareness and adoption > training and adoption > demonstration and adoption rates of CA practices. They concluded that training and demonstrations are better conduits to enhance adoption than mere awareness creation.

Finally, the 15 contributions published in this Research Topic provide insights into the role and need for SI of smallholder farming systems in addressing the food demand needs of the growing populations in Africa and South Asia.

Author contributions

NAR: Writing – original draft, Writing – review & editing. BHK: Writing – review & editing. FMT: Writing – review & editing. BK: Writing – review & editing. FMA: Writing – review & editing. TA: Writing – review & editing. CM: Writing – review & editing. FK: Writing – review & editing.

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Conflict of interest

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References

Brandt, M., Rasmussen, K., Peñuelas, J., Tian, F., Schurgers, G., Verger, A., et al. (2017). Human population growth offsets climate-driven increase in woody vegetation in sub-Saharan Africa. *Nat. Ecol. E* 1:0081. doi: 10.1038/s41559-017-0081

Chauvin, N. D., Mulangu, F., and Porto, G. (2012). *Food Production and Consumption Trends in Sub-Saharan Africa: Prospects for the Transformation of the Agricultural Sector*. New York, NY: UNDP Regional Bureau for Africa.

Jayne, T. S., Chamberlin, J., and Headey, D. D. (2014). Land pressures, the evolution of farming systems, and development strategies in Africa: a synthesis. *Food Policy* 48, 1–17. doi: 10.1016/j.foodpol.2014.05.014

Odusola, A. (2021). *Agriculture as the Fulcrum of Inclusive Development in Africa. Africa's Agricultural Renaissance: From Paradox to Powerhouse*. Cham: Palgrave Macmillan.

Pingali, P. (2007). Agricultural mechanization: adoption patterns and economic impact. *Handb. Agric. Econ.* 3, 2779–2805. doi: 10.1016/S1574-0072(06)03054-4

Pingali, P. L. (2012). Green revolution: Impacts, limits, and the path ahead. *PNAS* 109, 12302–12308. doi: 10.1073/pnas.0912953109

Pretty, J., Toulmin, C., and Williams, S. (2011). Sustainable intensification in African agriculture. *Int. J. Agri. Sust*. 9, 5–24. doi: 10.3763/ijas.2010.0583

Sanchez, P. A., Shepherd, K. D., Soule, M. J., Place, F. M., Buresh, R. J., Izac, A. M. N., et al. (1997). *Soil Fertility Replenishment in Africa: An Investment in Natural Resource Capital. Replenishing Soil Fertility in Africa 51*. Madison, WI: SSSA.

Smith, A., Snapp, S., Chikowo, R., Thorne, P., and Bekunda, M. (2017). Measuring sustainable intensification in smallholder agroecosystems: a review. *Glob. Food Secur.* 12, 127–138. doi: 10.1016/j.gfs.2016.11.002

United Nations Department of Economic and Social Affairs Population Division (2017). *World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248*. New York, NY: United Nations.

Van Loon, J., Woltering, L., Krupnik, T. J., Baudron, F., Boa, M., Govaerts, B., et al. (2020). Scaling agricultural mechanization services in smallholder farming systems: case studies from sub-Saharan Africa, South Asia, and Latin America. *Agric. Sys.* 180:102792. doi: 10.1016/j.agsy.2020.102792

Vanlauwe, B., Barrios, E., Robinson, T., Van Asten, P., Zingore, S., Gérard, B., et al. (2017). *System Productivity and Natural Resource Integrity in Smallholder Farming. Sustainable Intensification in Smallholder Agriculture*. Routledge. doi: 10.4324/9781315618791-11

World Bank (2007). *World Development Report 2008: Agriculture for Development*. London: The World Bank.