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Editorial: Mixed farming technologies for increased resilience, mitigation and adaptation to a changing climate for smallholder farmers in Southern Africa

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Editorial on the Research Topic
Mixed farming technologies for increased resilience, mitigation and adaptation to a changing climate for smallholder farmers in Southern Africa

Smallholder farmers account for up to 70% of the farmers in most Southern African countries, and their productivity is therefore critical to national food security. However, most of the farming techniques still being practiced by smallholder farmers involve unimproved mixed farming methods, where yields are low. This Research Topic focuses on research that improves the efficiency of these traditional mixed farming techniques whilst incorporating newer technologies within an integrated climate-smart framework. This is critical in driving the resilience and adaptation of these vulnerable smallholder farmers.

One of the main mixed farming technologies presented by this topic is the intercropping of legumes and cereals and their effects on the land equivalent ratio. Nkhata et al. evaluate two newly released common bean varieties available in Malawi and their performance in an intercropped maize system. The results of this research indicate that the common bean varieties did not significantly influence the yield of maize, with no significant difference when maize was grown alone. However, their results also reveal a significant difference in the land equivalent ratio (LER) between the two varieties, NUA45 and SER83, with the SER83 having the highest LER. Notably, this study reports a 159% yield advantage for NUA45 grown in association with maize and 177% for SER83 grown in association with maize. Similarly, in a 3-year study, Parwada and Chinyama evaluated the LER of intercropping cowpeas (a legume) with sorghum under different

cattle manure amendment rates. The sorghum and cowpeas were planted as sole crops and as intercrops and fertilized using manure applied at a rate of 100% (17.7 t/h); 75%, 50%, and 0%. Intercropping with the application of more than 75% manure was observed to result in a 75% increase in the sorghum yield whilst increasing the harvest index by 125% relative to where there was no manure. It was also noted in this study that the application rate of 75% manure in the intercrop enhanced sorghum grain yield and increased the biomass production of the cowpeas, but it did not increase the cowpea grain yield. These research manuscripts indicate the agronomic importance of intercropping as it results in higher land equivalent ratios as well as increased yields for legumes, though not for cereal crops.

Other research papers on the subject of mixed farming technologies focus on the issues of climate change, the various scientific aspects of intercropping, and the social aspects of farming, such as gender issues. Crop diversification has been considered a proxy indicator of climate risk mitigation strategies, and Awiti et al. evaluate the effects of diversification under a changing climate on variable production cost structures among smallholder farmers. Using both the Allen and Morishima elasticities, this study indicates that the variable costs (land, capital, labor, fertilizer, and seeds) substitute each other in crop production. It shows that although crop diversification has potential climate change mitigation effects, the total cost of production is positively influenced by the substituted variable cost. This study demonstrates that the benefits of crop diversification should seriously consider the trade-offs created by variable costs.

With climate change becoming a major factor affecting crop productivity, there is a call for climate-smart cropping systems. However, few studies have evaluated the gender differences that surround the issue of access and use of climate-smart agriculture (CSA). Using a bean cropping system in Malawi, Nchanji et al. acknowledge that more women than men and young people tend to plant earlier and use fertilizer and better seed varieties as climate mitigation strategies. Men are shown to prefer the adoption of physical activities like irrigation, whilst young people prefer technologically advanced systems like pesticides and conservation agriculture. This study recommends the implementation of policies that promote gender-responsive CSA systems, rather than recommending climate-smart agriculture systems without understanding the gender roles in their adoption.

Also focusing on climate change, Ajibade et al. discuss a climate-smart technology called vermicomposting and its potential in organic agriculture. This study evaluates the effects of different vermicomposts (cow- and pig-manure-based) used as a soil amendment and observes better growth in pig-manure-based vermicompost relative to the inorganic P source alone. Furthermore, the vermicompost is shown not to result in elevated levels of potentially toxic metals, indicating its potential as an effective soil amendment in organic soil fertility management. This technology can therefore be effective in reducing the use of industrially produced and environment-polluting chemical fertilizers. Moreover, the use of carbon-based fertilizers can also sequester soil carbon, thus mitigating climate change.

The last study by Sokombela et al. focuses on healthy food production by evaluating the various agronomic performances of *Moringa oleifera* under different nitrogen and phosphorus levels. This is critical in the domestic growth of Moringa, which is mainly found and harvested for medicinal purposes in the wild. In this study, it is concluded that a combination of 100 kg N per ha and 80 kg P per ha is recommended for the highest agronomic performance of Moringa.

We hope that these articles will provide the reader with an insight into the various farming technologies for increased resilience and adaptation to and mitigation of a changing climate for adoption by smallholder farmers in Southern Africa.

Author contributions

HM: manuscript drafting and final write-up. AN and NG: manuscript review and final write-up. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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