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Agwise: A modular framework for agronomic recommendations using big data analytics and advanced modelling to support smallholder farmers in ssa

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Abstract

Smallholder farmers face numerous challenges, including poor fertiliser use and limited access to extension services. In response innovative approaches using big data analytics, process based, and empirical modelling offer tailored agronomic solutions related to fertiliser use, sowing dates or crop variety selection. AgWise, a modular (data curation, data sourcing, potential yield and response function) decision support tool developed under the OneCGIAR Excellence in Agronomy initiative, leverages geo-referenced and time stamped fertiliser yield response data, phenology, agronomic and geo-spatial datasets. The Potential yield module integrates spatialized crop models like DSSAT and *Oryza* with geospatial weather (CHIRPS, AgERA5) and soil (iSDA, ISRIC) data sets. The response function utilises machine models (ML) such as random forest and gradient boosting alongside QUEFTS crop modelling, to estimate soil nutrient supply and determine the nutrient inputs required to achieve specific target yield. AgWise has been successfully applied in Ethiopia, Nigeria, Kenya, Rwanda, Ghana and Southern Africa, for crops such as wheat, sorghum, teff, soybean, maize and potato. In Ethiopia, ML derived site-specific fertiliser recommendations have resulted in at least 30 % wheat yield increases. In Rwanda, the QUEFTS approach has been utilised to determine site specific fertiliser recommendation to achieve 10, 20 and 30 % potato yield increases. Spatialised DSSAT crop modelling has identified optimal planting dates and variety tailored to seasonal conditions. Specifically, for Chinyanja Triangle, Southern Africa, early sowing increases maize and soybean yields, with long season varieties showing higher productivity during La Niña and Neutral phases compared to the El Niño. The effectiveness of AgWise can be enhanced by integrating seasonal weather forecasts, accounting for climate change and incorporating soil health aspects ensuring more robust and adaptive agronomic recommendations.

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