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## Integration of CERES-maize modelling and remote sensing for crop condition and yield assessment in three agroecological zones in Kenya

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### Abstract

Crop modelling and remote sensing (RS) integration are crucial for understanding crop conditions (CC) and agricultural production. In the present study, the DSSAT-CERES-Maize model was integrated with Sentinel<sup>-2</sup> and moderate resolution imaging spectroradiometer (MODIS) RS data to analyse maize CC conditions and simulated yield in three agroecological zones (AEZ) in two counties of Kenya (Trans Nzoia and Uasin Gishu), with about 5425 km<sup>2</sup>. AEZ I, II, and III correspond to humid, subhumid, and semihumid regions with high, moderate, and low moisture indexes, respectively. Sentinel<sup>-2</sup> data was used to derive crop type extent maps, whereas MODIS data were used to map crop conditions via the enhanced vegetation index (EVI), normalised difference vegetation index (NDVI), and evaporative stress index (ESI).

The study showed that the RS CC exhibited high positive correlations with the simulated maize yield, especially at the peak season phenological stage. In particular, the ESI index demonstrated strong agreement with yield ( $r=0.94$ ). Also, NDVI and EVI showed satisfactory performance, with correlations of  $r=0.89$  and  $r=0.85$ , respectively. The response of the crop conditions at the AEZ level showed that AEZ I depict a strong relationship with the CC indicators compared to AEZ II and III. The analysis of the growing season influence showed that crop conditions and yield are strongly related between May and August (the vegetative-reproductive period in the study area). The study concludes that crop modelling approaches are important in exemplifying the relationships between crop conditions and maize production, especially in data-scarce landscapes. Integrating the assessment tools is important in monitoring agricultural landscapes, optimising agronomic management, and prior management of crop stressors to minimise/prevent yield losses.

**Keywords:** Ceres-maize, crop condition, DSSAT, remote sensing