Synthesis of field experiments for the assessment of yield response to different management options in diverse agro-ecological zones in Kenya using the CERES-Maize model

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Introduction

- Maize (Zea mays L.) despite being a priority crop for food insecurity alleviation in Sub-Saharan Africa still records low production.
- Assessing its performance under various agronomic managements, in different climatic conditions is critical for developing site-specific recommendations.
- This study synthesizes on-site and documented field experiments to examine yield responses to fertilization, irrigation management, and sowing dates across four agro-ecological zones in Kenya.

Materials and Methods

Study area

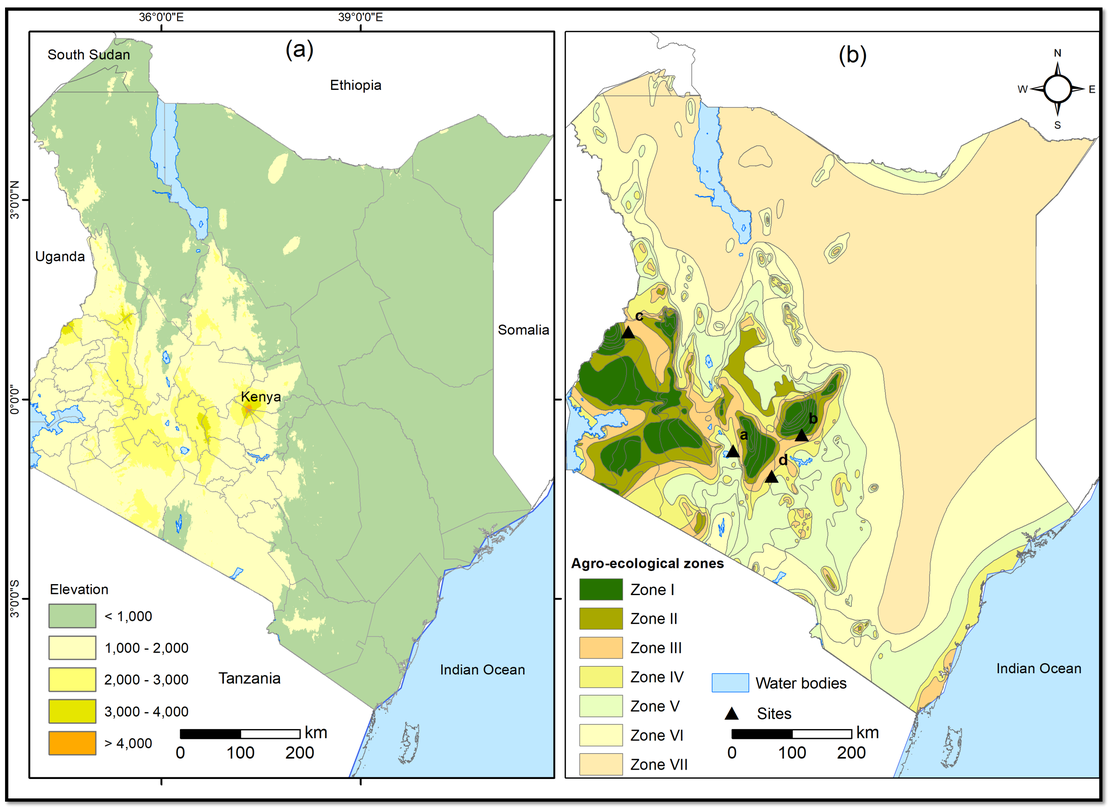

Figure 1a. Kenya map showing elevation variation, 1b. Agro-ecological zones and study sites a - Naivasha, b - Embu, c - Endebess, d - Juja

Approach

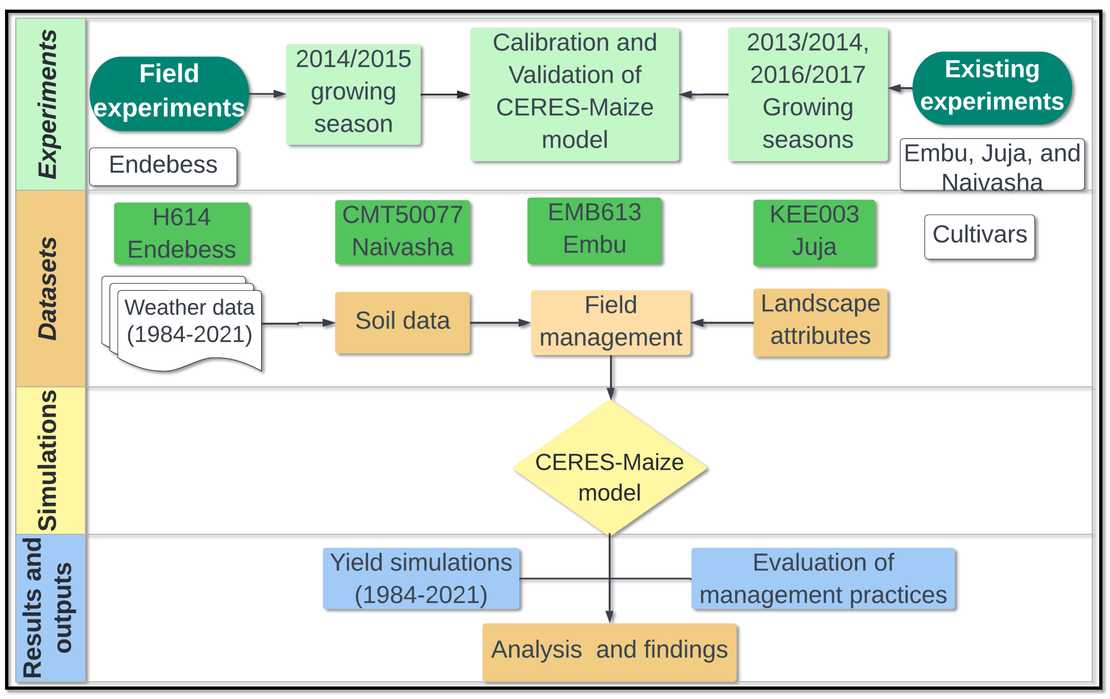

Figure 2. Study workflow.

Note: Weather data was retrieved from the National Aeronautics and Space Administration Prediction of Worldwide Energy Resources (NASA POWER):
Soil data was obtained from the Global High-Resolution Soil Profile Database for Crop Modeling Applications, Harvard University.

Objectives

1. To assess long term (1984-2021) yield responses to various management strategies across key maize growing agro-ecological zones in Kenya.
2. To determine suitable practices for each agro-ecological zone using calibrated and validated experiments and the CERES-Maize model.

Results

- The results showed high mean yield of maize in relatively humid regions of Endebess (5835 +/- 796 kg/ha) and Embu (4389 +/- 496 kg/ha).
- The yield was low and not significantly different in the medium potential zone of Juja (3105 +/- 602 kg/ha) and the semi-arid zone of Naivasha (2899 +/- 311 kg/ha).
- Supplementary irrigation improved yield by 27% and 36% in Naivasha and Juja, respectively, whereas yield increase was minimal in Endebess and Embu (+5% and +4%, respectively).

1

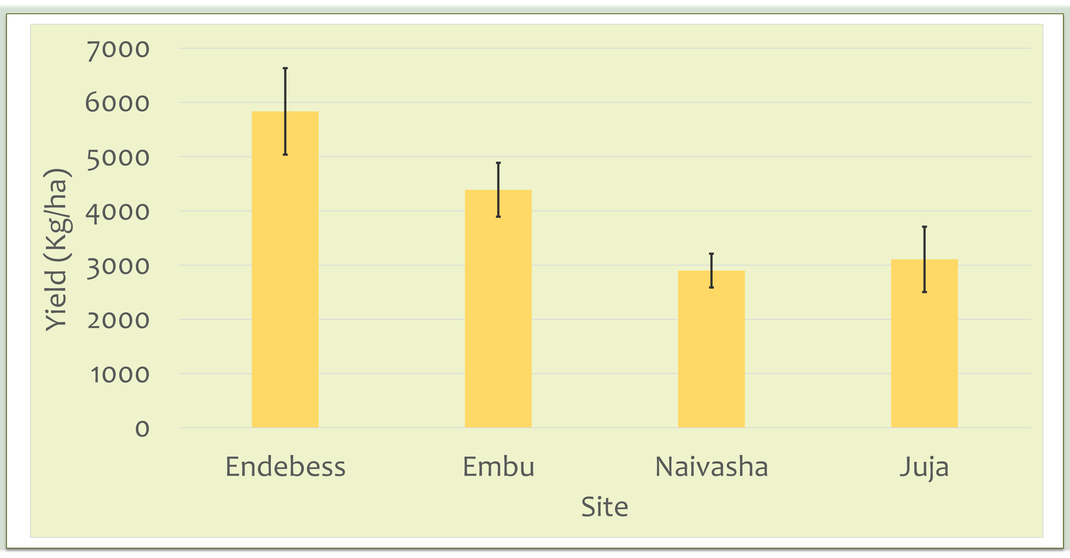

Figure 3. Long term (1984-2021) maize yield average and variation for different sites under the recommendation nitrogen fertilization (75 kg N/ha).

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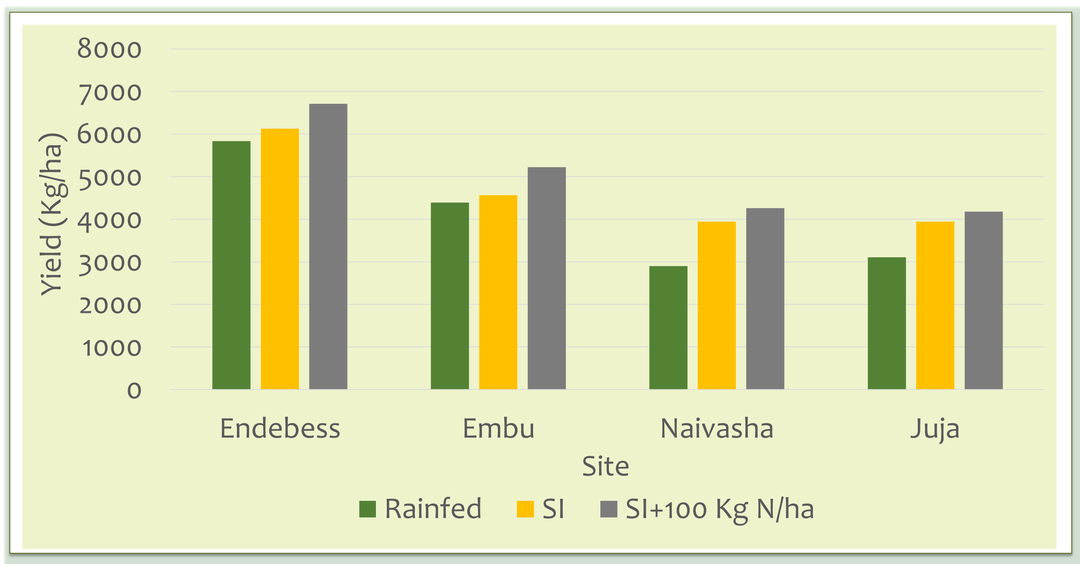

Figure 4. Effect of supplementary irrigation at 80 mm, 40 days after sowing and nitrogen fertilization (100 kg N/ha). SI means Supplementary Irrigation.

Conclusions

- Based on these findings, we conclude that nitrogen is more limiting in the upper midland and humid zones of Embu and Endebess, while moisture stress is high in the lower midland zones of Naivasha and Juja.
- Supplementary irrigation can increase yields by 36% and 27% in Naivasha and Juja respectively. A fertilization rate of 100 Kg N/ha can increase yields by 15% and 19% in Endebess and Embu, respectively.

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