

# Yield and Biomass Gap Analysis of Maize in Ethiopia - A Case Study of Oromia Region -



Amit Kumar Srivastava; Cho Miltin Mboh; Thomas Gaiser; Girma Abera Tola; Frank Ewert

## Introduction

Yields and biomass of crops must increase substantially over the coming decades to keep pace with food demand driven by increasing population and income growth. Agricultural productivity growth in Sub-Saharan Africa over the past four decades averaged only 2.4% compared with 4% in the rest of the developing world. Ultimately global food production capacity will be limited by the amount of land and water resources available and suitable for crop production. Therefore future increases in production will mainly depend on closing the yield gaps (Figure 1) or increasing the genetic potential of crops. Crop responses to changing temperature and incident radiation are visible in the potential yield, but even more in the simulated amount of potential aboveground biomass per crop. We carried out this study in **Oromia region** (Figure 2) which is one of the nine ethnically based regional states of Ethiopia covers a total land surface area of 284,538 km<sup>2</sup> and is one of the major maize production areas.

## Materials and methods

Within the SIMPLACE modelling framework, a combination of the LINTUL5 crop model with a detailed soil water balance model (SLIM) was used to simulate the maize yield at regional scale. Weather data for use as model input was derived from the Africa Rainfall Climatology Version 2 (ARC2), ERA-interim and GEWEX databases. Soil parameters were extracted from the soil property maps of Africa (ISRIC soil database). The simulations were run at 38 x 38 km grid cells across the target region. Maize yield was calculated for each simulation grid for the period of 12 years (2000-2011) and aggregated to the district level to compare with the simulated actual yield. Yield gap was calculated as the difference between average simulated potential (water-limited condition) and observed average farmer yields in Mg ha<sup>-1</sup>. The biomass and yield gap was estimated for maize (*Zea mays* L.) in three sites namely Jimma, Bako and Yayu in the Oromia region of Ethiopia.

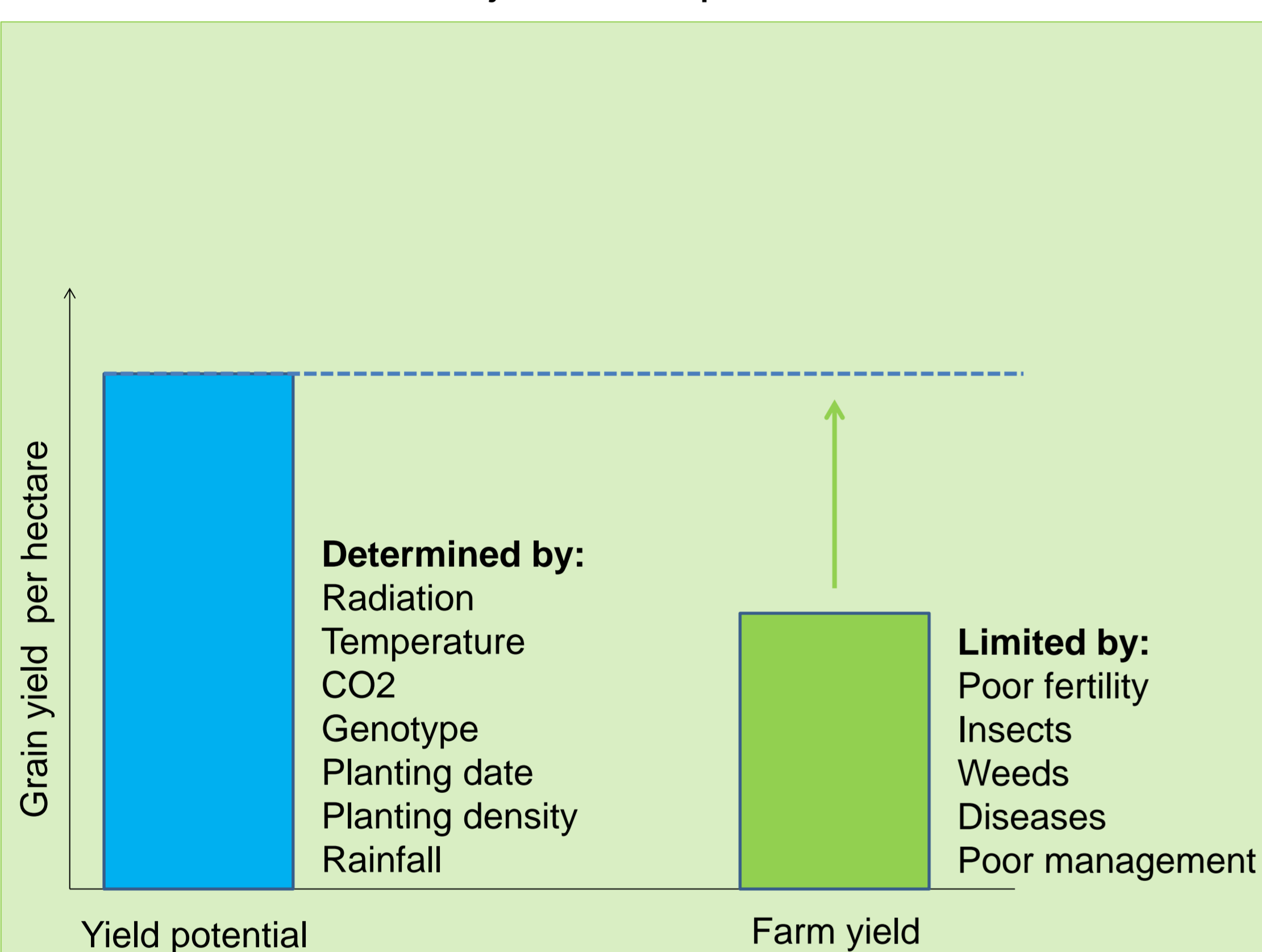


Figure 1: Conceptual diagram for yield gap.

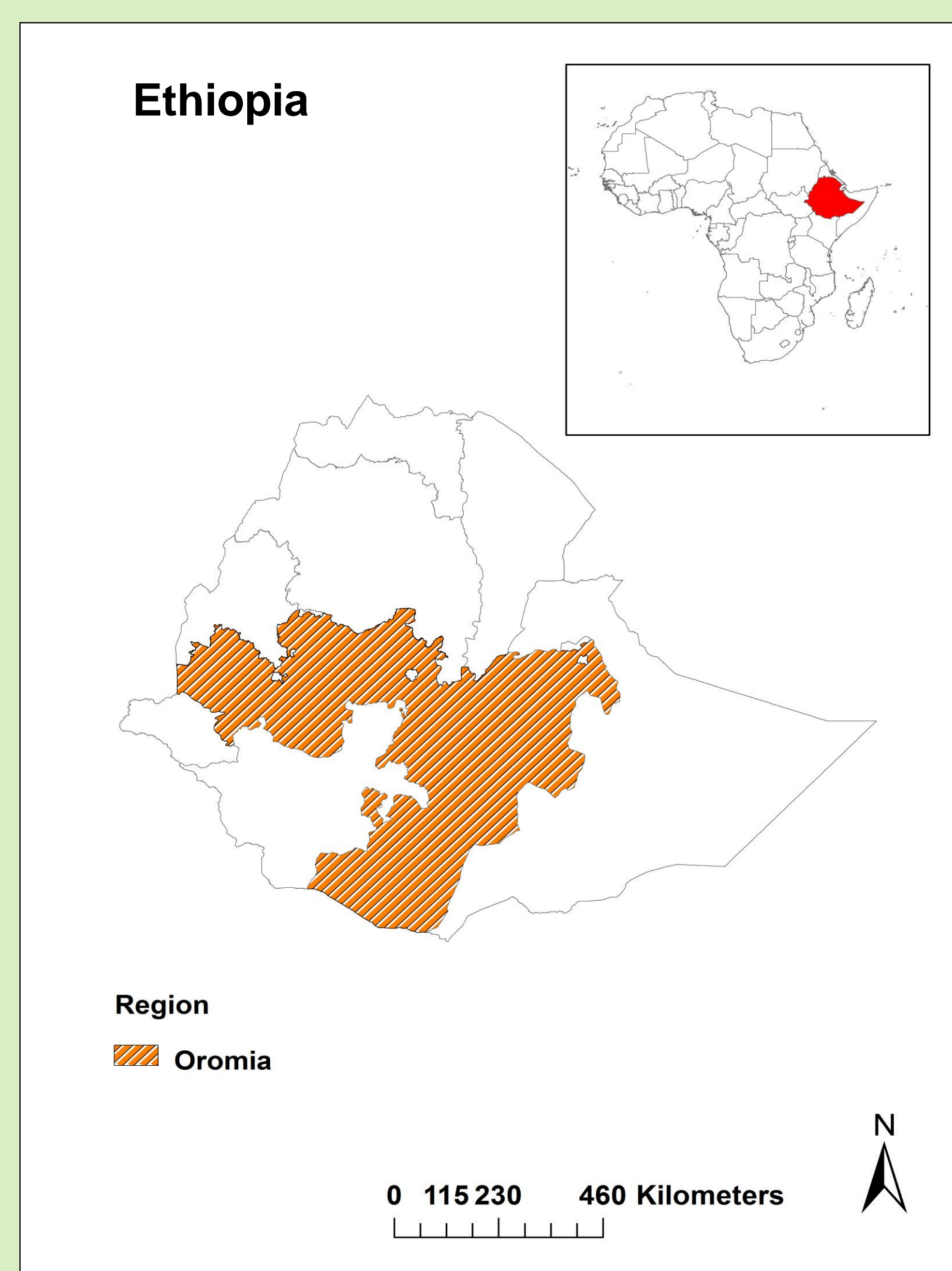


Figure 2: Map of Oromia region in Ethiopia.

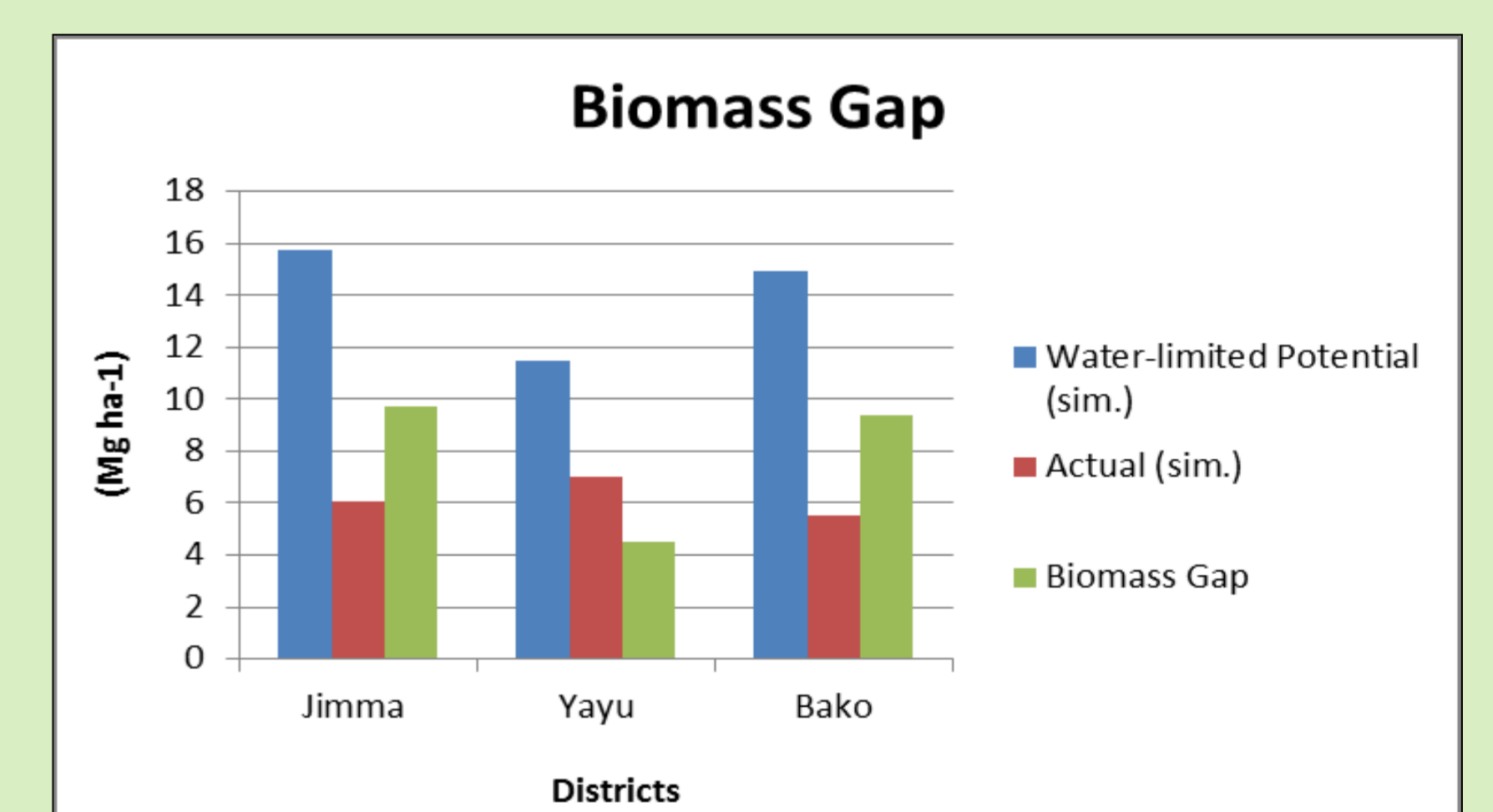
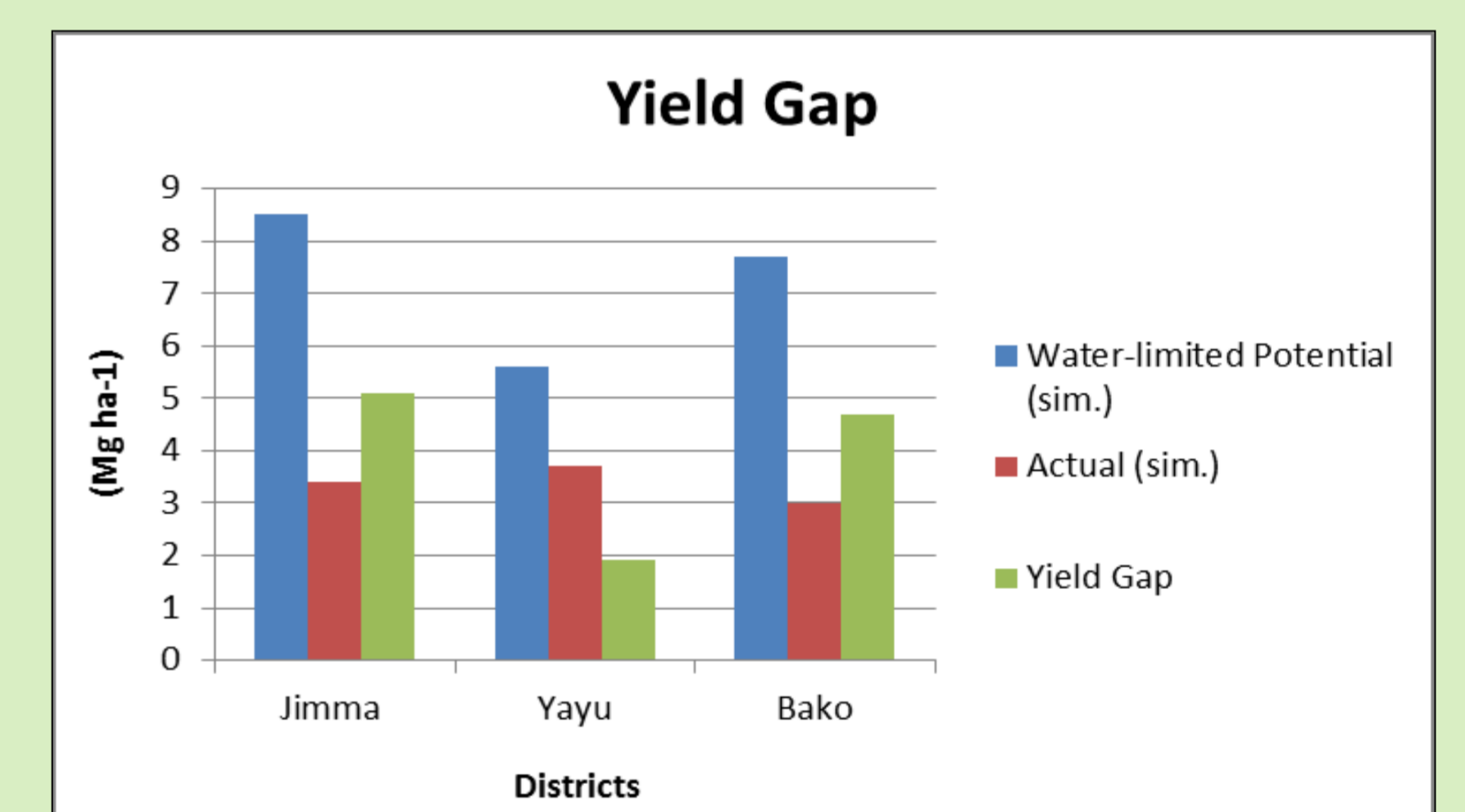


Figure 3: Maize Yield and Biomass gap in the three districts of Oromia region.

## Results

The mean yield and biomass gap in the period 2000-2011 varies from 5.1 to 1.9 Mg ha<sup>-1</sup> and 9.7 to 4.5 Mg ha<sup>-1</sup> respectively across the three districts (Figure 3). Average farmer's yield are around 46.3 % of the potential yields which is mainly due to nutrient limitations because of poor soil fertility management although there was also some days of water stress experienced by the crop in its growing season. The average farmer's N application rates to maize in this region are <20 kg N ha<sup>-1</sup> yr<sup>-1</sup> compared to >150 kg N ha<sup>-1</sup> yr<sup>-1</sup> in Europe for maize production. The model captures well the observed yield and explains that N and P supply are the major constraints.

## Conclusion

**There is ample potential to increase maize yield and biomass production in Oromia region of Ethiopia. BiomassWeb will identify measures to improve biomass production in a stakeholder driven process supported by model simulations.**

## Acknowledgement

We would like to gratefully acknowledge the funding by German Federal Ministry for Education and Research (BMBF).