Cassava Yield Gap and Variability: A Simulation Study in Nigeria

BiomassWeb

Amit Srivastava;Thomas Gaiser; Martina Pesch; Frank Ewert

Introduction

An increase in crop productivity is needed to ensure sufficient food supply for the continuously growing world population. Thereby, cassava production is of great importance for food security in Africa and a major source of human caloric intake for the local population particularly in Nigeria. To increase food production, identifying the regions with untapped production capacity is of prime importance and can be achieved by quantitative and spatially explicit estimates of yield gaps, thus considering the spatial variation in the environment and the production system. It provides an indicator for prioritizing the most important crop, factors limiting the current productivity, and identifying the yield gap hotspots, prioritizing the research focus where current information is scarce.

Materials and Methods

A gridded data set was built covering the 10 cassava producing states in Niegria combining climate data (from NASA) and soil data from ISRIC database. Within the SIMPLACE modelling framework (www.simplace.net), a combination of the LINTUL5 crop model with a detailed soil water balance model (SLIM) was used to simulate yield productivity of dominant maize varieties under prevailing agri-management practices.The simulations were run at 1 x 1 km grid cells and crop yield responses was calculated over 16 years (1995-2010) for each simulation grid and aggregated from the simulation grid to the state level for comparing them with the statistics.

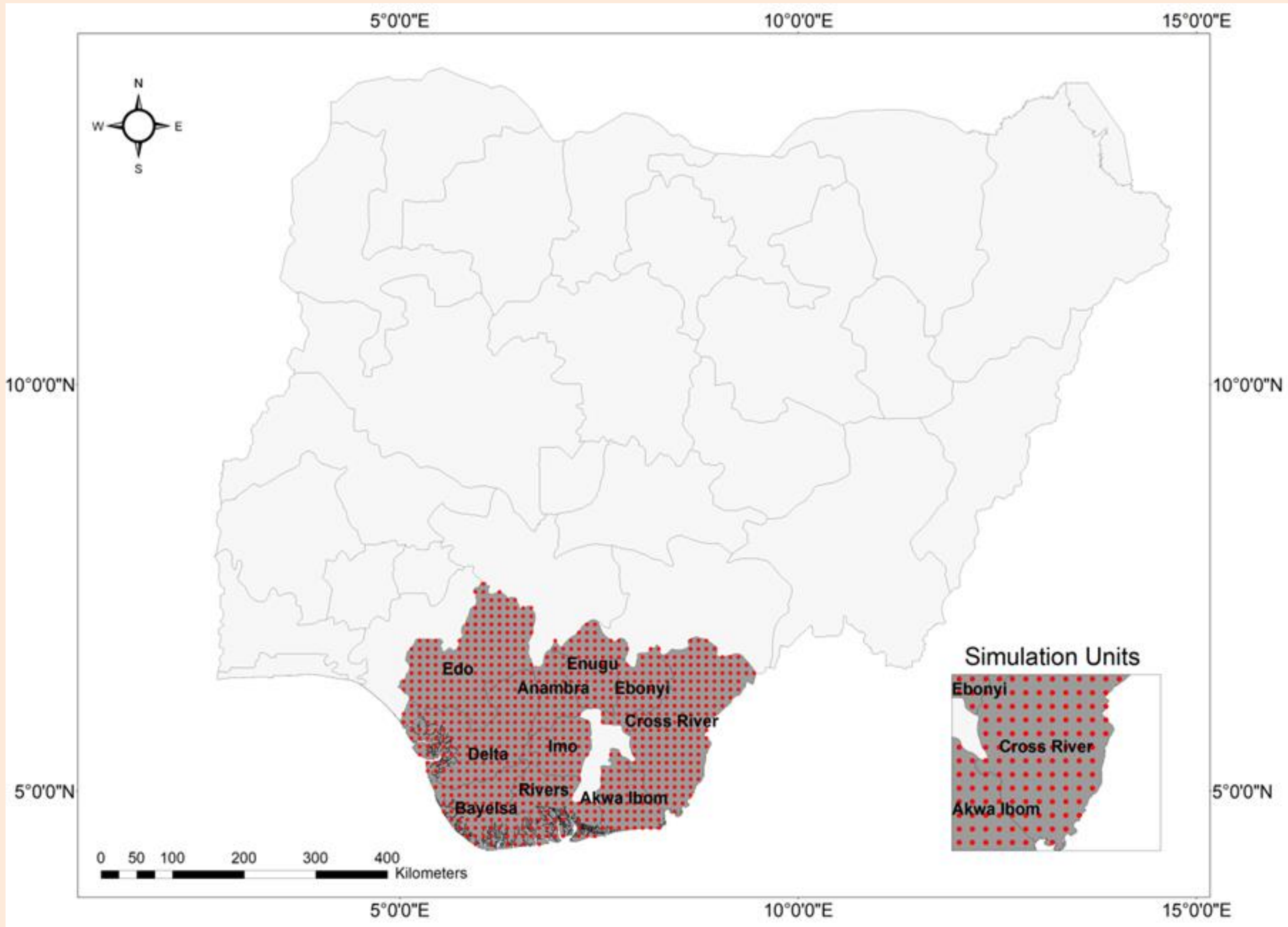

Fig 1: Map of Nigeria showing simulation units covering the 10 states of Cassava production.

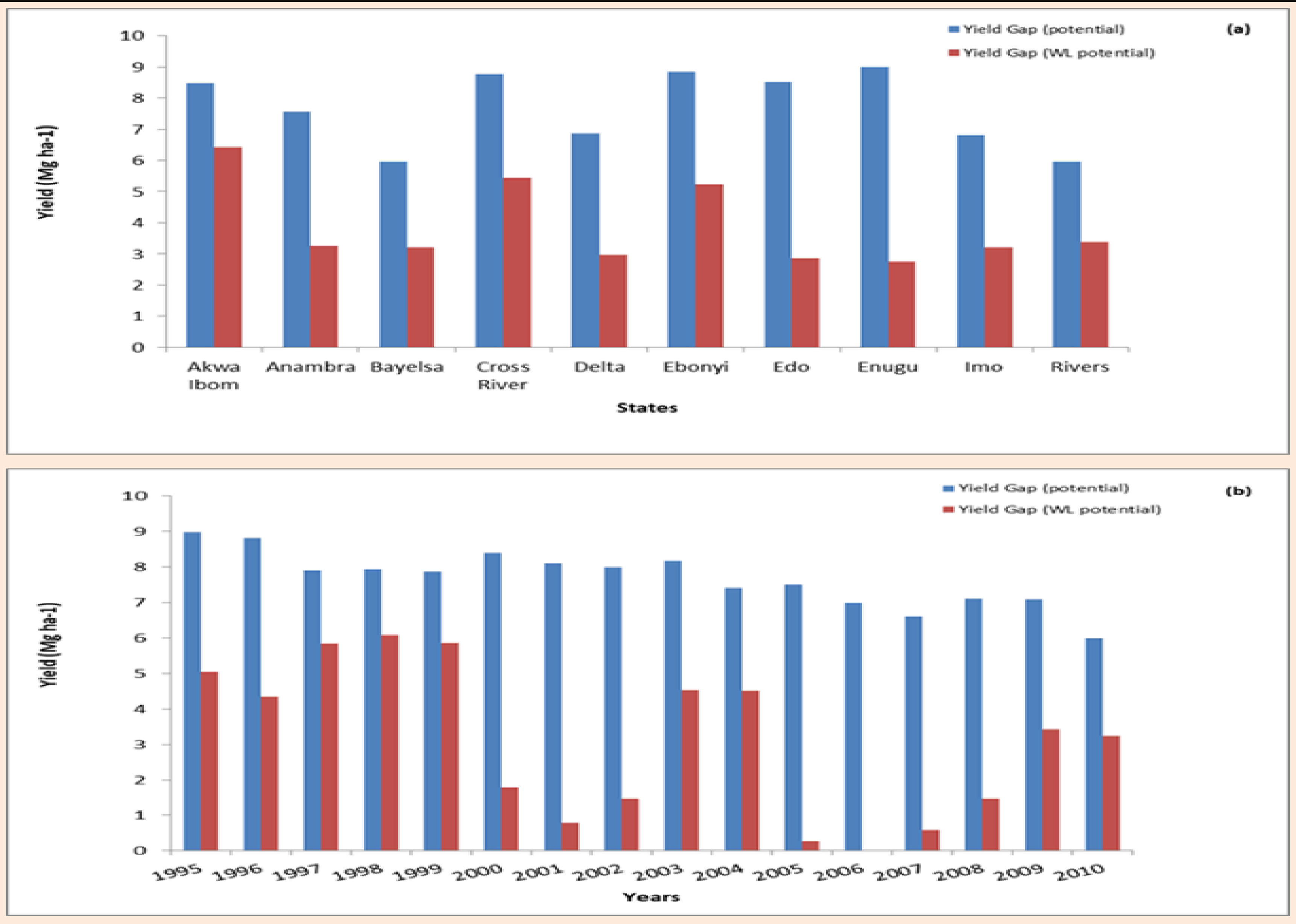

Fig 2: Spatial and temporal variability in cassava yield gap under potential and water-limited potential conditions in 10 sates of Nigeria.

Spatial variability Cassava yield N = 10 states	Tmean (deg C) coeff.	Tmean (deg C) p-value	Radiation (MJ/m2) coeff.	Radiation (MJ/m2) p-value	Precipitation (mm) coeff.	Precipitation (mm) p-value	Coeff. Of determination R2
Farmers actual yield (observed yield)	3.01	<0.05	0.0009	0.25	0.001	0.36	0.72
Potential yield (simulated)	-1.04	0.52	0.002	<0.05	~	~	0.88
Water-limited yield (simulated)	0.76	0.83	0.0037	0.21	0.003	0.25	0.37
Actual yield (simulated)	-1.22	0.47	0.0004	0.72	0.001	0.40	0.48
Yield gap (potential yield minus observed yield)	-4.05	<0.05	0.0018	0.16	-0.002	0.08	0.89
Yield gap (water-limited yield minus observed yield)	-2.24	0.58	0.0028	0.37	0.003	0.39	0.47
Temporal variability Cassava yield **N = 16 years**							
Farmers actual yield (observed yield)	0.78	0.17	0.0001	0.77	0.0001	0.72	0.23
Potential yield (simulated)	-0.83	0.34	0.0015	<0.05	~	~	0.68
Water-limited yield (simulated)	-1.7	0.73	-0.0002	0.94	0.0009	0.73	0.03
Actual yield (simulated)	-1.21	0.65	-0.0008	0.70	0.0005	0.74	0.03
Yield gap (potential yield minus observed yield)	-1.62	0.21	0.0014	0.18	0.0002	0.73	0.60
Yield gap (water-limited yield minus observed yield)	-2.48	0.63	-0.0004	0.92	0.0008	0.77	0.05

Table1:Correlations between potential, water-limited , and Farmers' actual (observed and simulated) yield with different climatic variables (mean temperature, radiation, and precipitation).

Results and Discussion

The mean potential yield gap ranges from 6 to 9 t/ha depending on the region concerned. Spatially, the potential yield gap correlates negatively with cummulative mean temperature & precipitation values and shows a positive correlation with radiation in the crop growth period (Fig 2). Temporally, it only correlates negatively with the mean temperature. Whereas, the water-limited (WL) potential yield gap ranges from 2.8 t/ha to a maximum of 6.2 t/ha. The associated variability correlates negatively with mean temperature & positively with cummulative radiation & precipitation values in the crop growth period.

Conclusion

The high yield gaps of Cassava in Nigeria indicate that there is a potential for Nigeria’s farmer’s to increase yields. Most farmer’s cultivate Cassava on infertile soils with little or no use of fertilizers. High yields can only be achieved when Cassava is cultivated under optimal conditions. Thus, it is of high importance that Nigerian farmers enhance their crop- and farm management practices to increase Cassava yields.

Acknowledgement

Funding by Federal Ministry of Education and Research (BMBF) of Germany is highly acknowledged for GlobeE project.

www.biomassweb.org

Contact: **Dr. Amit Kumar Srivastava.**
E-mail: amit@uni-bonn.de
Phone: +49 228 732876; **Fax:** +49 228 732870
Institute of Crop Science and Resource Conservation,
University of Bonn, Katzenburgweg 5, D 53115 Bonn, Germany.

SPONSORED BY THE
Federal Ministry of Education and Research
Federal Ministry for Economic Cooperation and Development