Trans-SEC

Innovating pro-poor Strategies to safeguard Food Security using Technology and Knowledge Transfer

Yield gap analysis for Tanzania - The impact of climate and management on crop yields

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Introduction

The average maize yield in Tanzania is below 1.5 t ha^{-1}. Nevertheless, Tanzania has a large potential to increase the maize yield and enhance food security due to regionally adapted agronomic practices. The agronomic practices, which are formulated in the Trans-SEC upgrading strategies, focus on the issue of both food security and environmental (climate, soil) protection. To consider both issues under future climate conditions, crop models allow an impact assessment of agricultural practices and climate impact on crop yields.

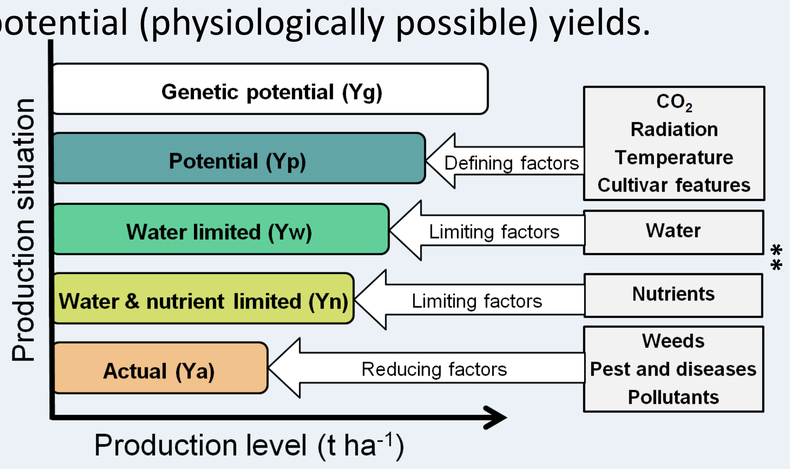
Material & Methods

Data

- Station/ reanalyzed weather data: *Tanzania Meteorological Agency/ ERA Interim WFDEI*
- Crop Calendar: *FAO, USDA*
- Soil information: *ILRI, FAO*
- Farm yields and acreage: FAO CountrySTAT *Ministry of Agriculture, Food & Cooperatives*
- Yields from field trials: *CGIAR, CIMMYT, FAO*

Yield gap: range between actual (farm) and potential (physiologically possible) yields.

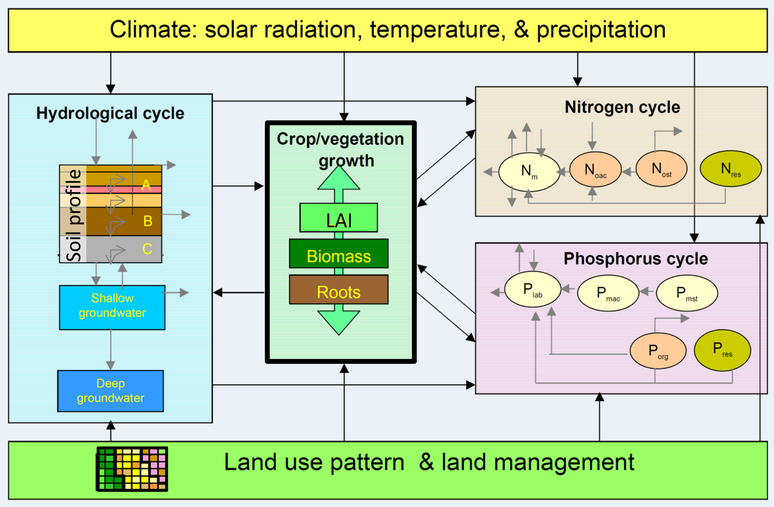
Method



SWIM

Soil and Water Integrated Model

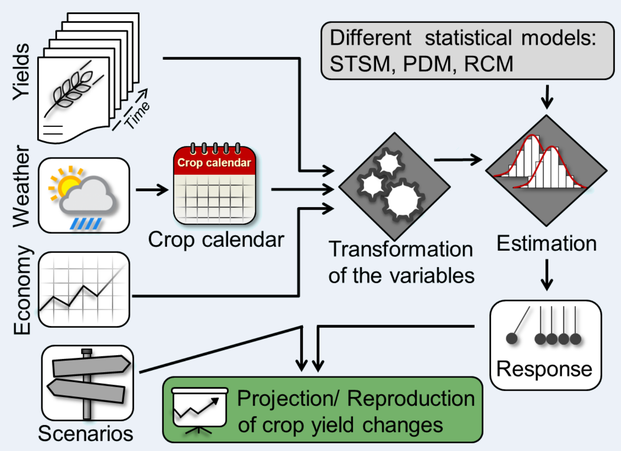
- Process-based eco-hydrological model
- Simplified EPIC approach (agronomic practices)



IRMA

Interregional Regression Model for Agriculture

- Statistical crop model driven by climatic and economic variables in a Cobb-Douglas function

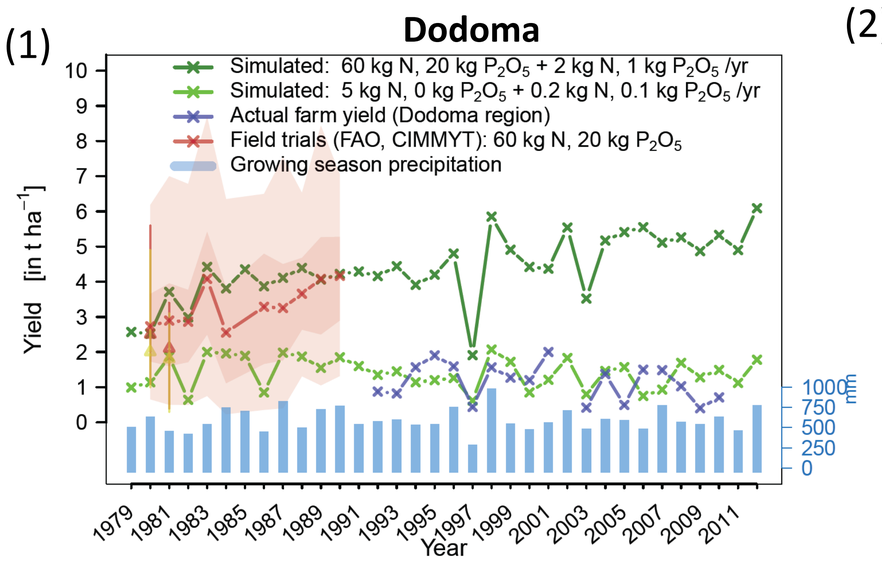


**after Van Ittersum (2013): Yield gap analysis with local to global relevance - A review

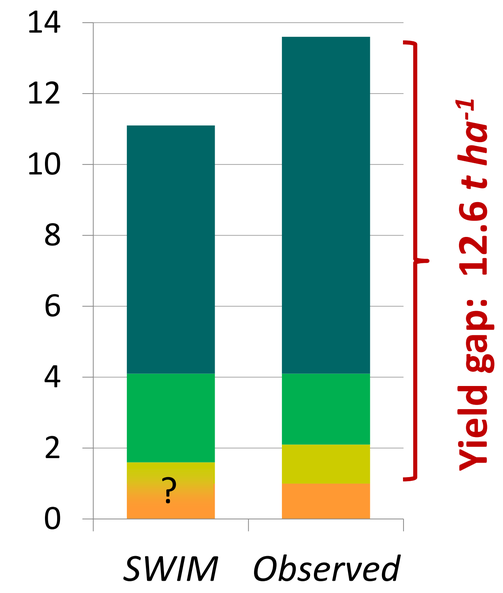
Results

SWIM

(1)



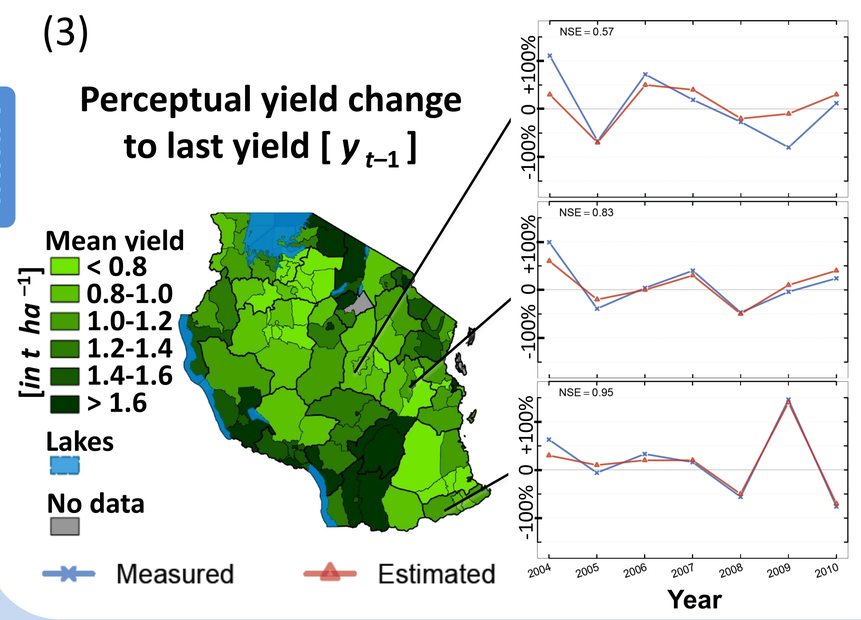
(2)



Crop variety: **2400 (°C) HU**; planting/ harvesting: **345/ ~100 doy**, soil type: **ferralic cambisol**; data source observed yields: MAFC | FAO | FAO | AgTrials .

IRMA

(3)



(1) SWIM yield simulations (different water stress varieties) by comparison to observed yield data sets

(2) Yield gap analysis for SWIM yields (l) and for the observed yields (r)

(3) Reproduction of yield changes on district level for Tanzania by IRMA (restricted maximum likelihood)

Agronomic practices – Yield and model uncertainty

Process-based models can be used for a large range of environmental conditions, but several yield influencing factors are difficult to consider. ***In Tanzania****, these are for instance:*

- Inventory management (e.g. slash and burn agriculture or pests, diseases, and weeds)
- Effects of intercropping and poor crop rotation
- Access to inputs (e.g. adaption of fertilizer programs, risk aversion and adaption of new practices)
- Knowledge gap (e.g. no or bad school education, cultural aspects (indigenous religions, superstition)

How can we model these influences?

- Farm yield data include all these information
- The statistical model IRMA can capture farmer behavior in collinear effects and proxy variables
- E.g. inventory management depends on climate; culture and economy influencing the proxy variable acreage

Conclusion

- Potential yields of different crop varieties are in SWIM as high as the observed potential yields (field trials)
- SWIM can model the relevant agronomic practices
- The calibration and validation results of SWIM and IRMA reproduce quite well the observed yields
- Specific agronomic practices, socio-economic or cultural effects can be captured by the statistical model IRMA
- The combination of SWIM and IRMA allows regional specific yield assessments

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