Modelling future crop yields and water discharge

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A bit of history

KB35 program "*Food Security and Valuing Water*"

Project
2019 – 2022 ➔ Multiple Scales and Extreme Events
2023 – 2024 ➔ Multiple Scales

Develop an integrated modelling approach for food system transition, with upscaling and downscaling among different spatial levels

One of the activities selected ***Ethiopia*** as case study area:

Various models:
- ❑ **MAGNET** (economic equilibrium model; *global* ➔ *national*)
- ❑ **BioSpacs** (linking diet, production, inputs + emissions; *national*)
- ❑ **LPJmL** (spatial simulation of crop yields; *sub-national* ➔ *national*)
- ❑ **SSID** (Spatial Simulation of Income Dynamics ➔ *sub-national*)

Some results, so far (-2022)

Targets of Zero Hunger and Improved Nutrition require large changes in food supply rates in Ethiopia.

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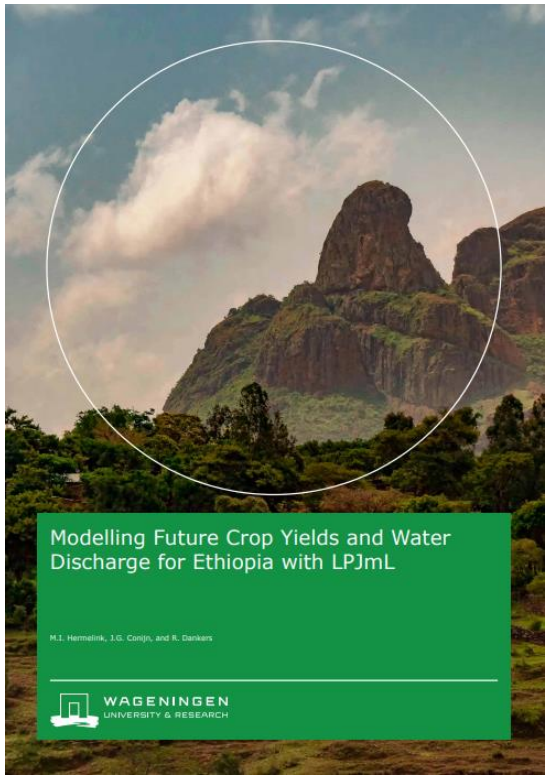
Impact of the transition to a healthy diet on food security, agriculture and the environment in Ethiopia

Jason Levin-Koopman, Sjaak Conijn, Marijke Kuiper



25th Annual Conference on Global Economic Analysis

10-June-2022

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Subnational projections of income and poverty for Ethiopia: A CGE-spatial microsimulation approach

Presentation prepared for the 25th Annual Conference on Global Economic Analysis, June 8-10, 2022

Michiel van Dijk, Marijke Kuiper, Thijs de Lange and Jason Levin-Koopman

Modelling future crop yields and water discharge

Simulation study with LPJmL by
Marleen Hermelink, Sjaak Conijn & Rutger Dankers

LPJmL:
Vegetation model for simulating crop production and water use

Goal:
Explorative study of alternative crop production scenarios for different climate change projections and possible impacts on food security and national water discharge

Five scenarios

A. Current situation
(current climate, current intensity: 2000 – 2016)

B. Business as usual
(~2050, current intensity)

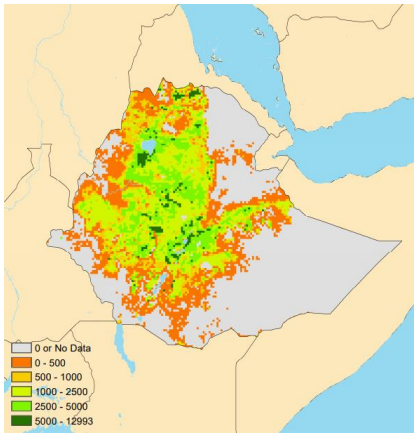
C. Rainfed potential
(~2050, intensification; current irrigated areas)

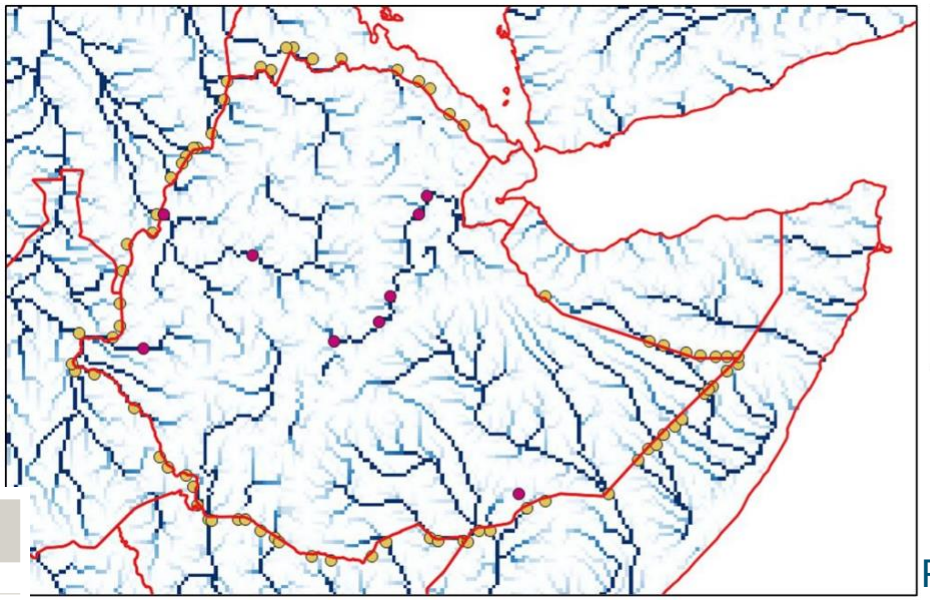
D. Irrigated potential
(~2050, intensification + irrigation where possible)

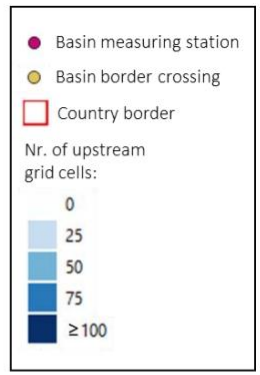
E. Unlimited irrigation
(~2050, intensification with full irrigation)

Model inputs

Land use

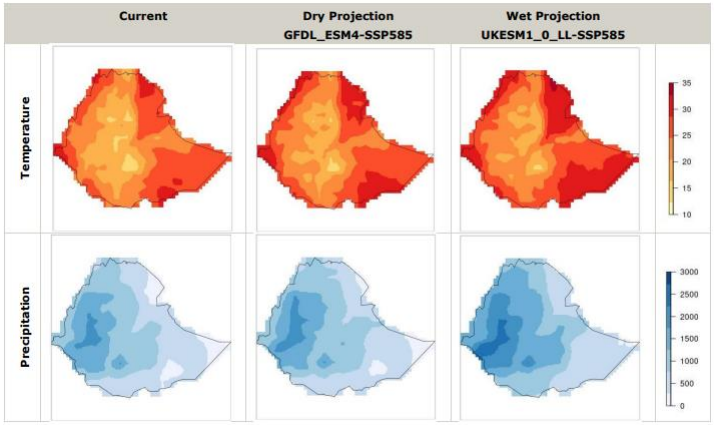






River network

Current	Dry Projection (GFDL_ESM4)	Wet Projection (UKESM1_0_LL)
880	934	1230
22.7	23.9	25.1



Climate

CFT	Dry Matter Content (gDM/gFM)
Temperate Cereals	0.87
Rice	0.86
Maize	0.85
Tropical Cereals	0.88
Pulses	0.89
Temperate Roots	0.21
Tropical Roots	0.27
Sunflower	-
Soybean	0.89
Groundnuts	0.93
Rapeseed	0.92
Sugarcane	0.25
Managed Grass	0.32

Crop parameters

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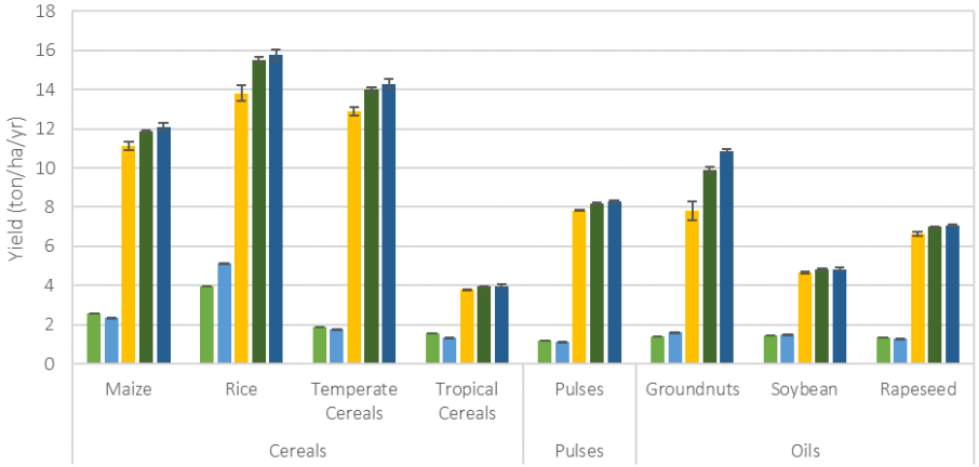
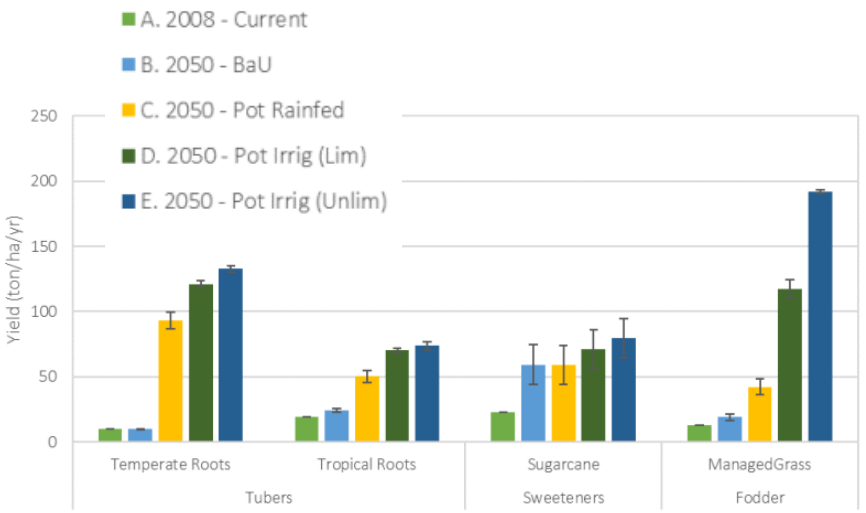
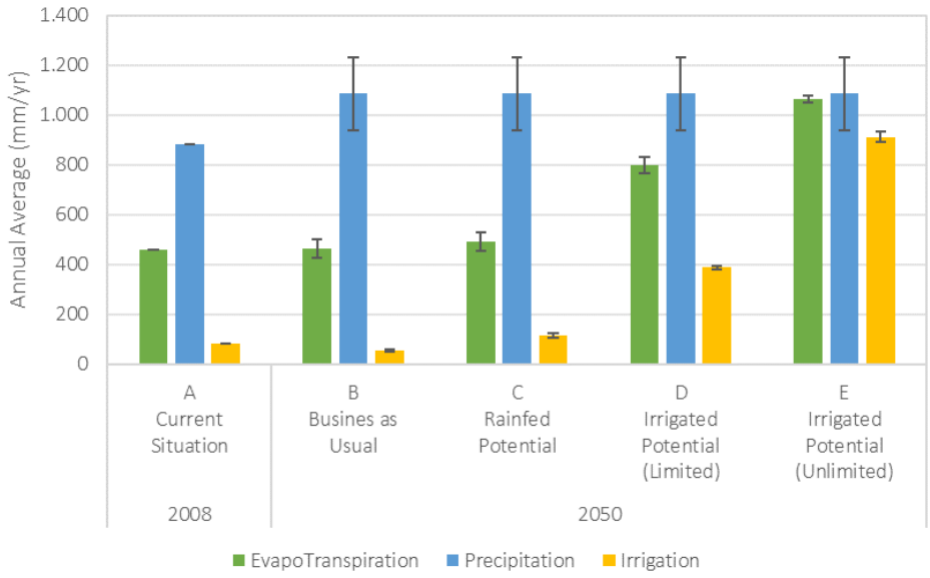
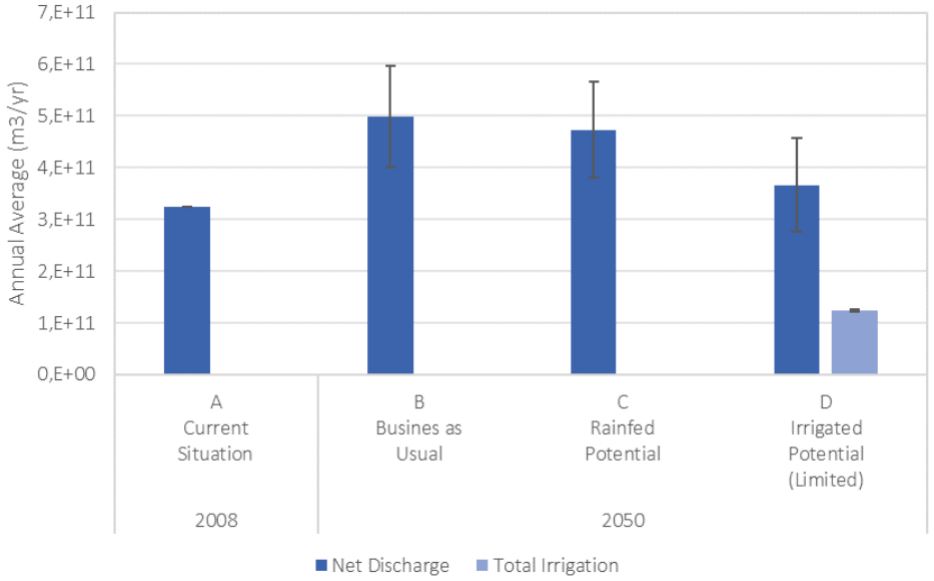
Results: crop yield, ET, P & I, Discharge









Conclusions and further options

Average annual crop productivity not strongly affected by projected climate change

Large yield gap between actual and intensified rainfed yields; yields gaps between rainfed and irrigated relatively small

Rainfed potential does not require much more water

Projected increase in precipation causes higher national discharge

Improvements in parametrization / calibration / model setup

Use LPJmL yield potentials in ***BioSpacs*** and compare with demands
➔ balance intensification and land expansion

Investigate lower resolutions, both spatially (regions) and temporarily (years)

Current & future work (2022 – 2023)

SSID/household data

BioSpacs

MAGNET

Modular Applied GeNeral Equilibrium Tool

Food System Transition & SDG's

LPJmL

Farming Systems

Upscaling

Downscaling

Upscaling

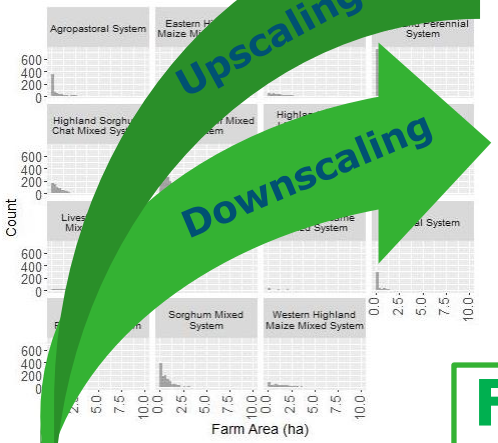
Downscaling

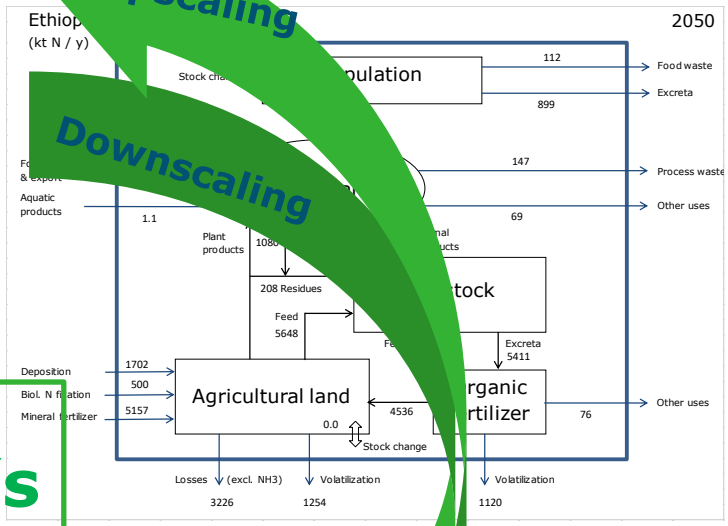
Downscaling

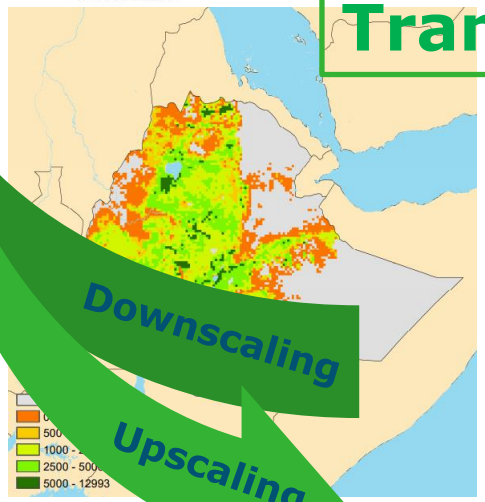
Upscaling

Downscaling

Upscaling







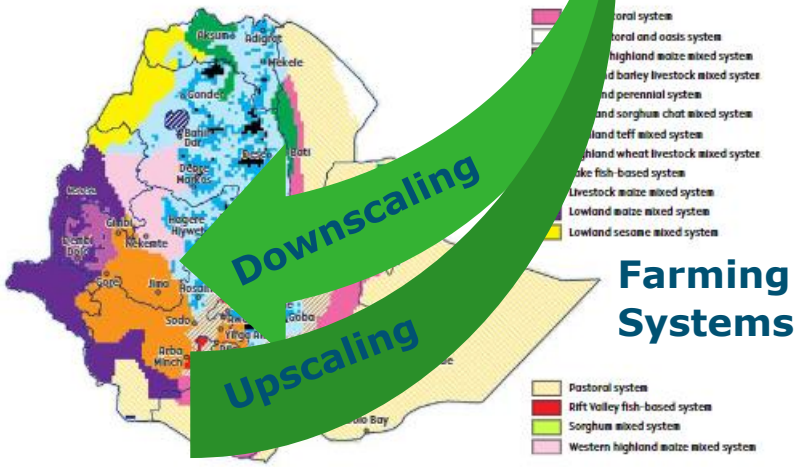


Figure 1. Ethiopian farming systems defined by the current study.