Agricultural Development Scenarios

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Towards Innovative Solutions through Integrative Water Futures Analysis

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Overview

VISION (Why ?)

MODEL SUPPORT (How ?)
• Modelling Framework, Data
• Selected results

CONCLUDING REMARKS
The VISION

...+ more regional & local visions
Achieving SDG 2 requires consideration of interlinkages with several other SDGs
Interlinkages of SDG 2 in East Africa (EAC)

- 75% of water use for agriculture
- Low development of Irrigation infrastructure
- 75% rural population
- 25% of GDP from agriculture
- 70-90% of employment in agriculture
- 38% protected areas

Source: AQUASTAT, ILOSTAT, GAEZ, WDPA, KBA
MODELLING support towards the vision
Ecological-economic modelling framework

1. Development scenario
2. Climate model
3. Agro-ecological suitability and land productivity
4. Climate impact response relations
5. Global Food-Feed-Biofuel System
6. Spatial distribution of land use

- GHG Emissions
- Climate forcing
- RCP
- CO₂ concentration
- SSP narrative
  - Population
  - GDP growth
  - Urbanization
- Cropland use
- Irrigation water demand
Development scenario – “a narrative”

Shared Socio-Economic Pathways (SSPs) describe plausible trajectories of future demographic and economic development and characterize in broad terms the international setting (e.g. trade liberalization), technological progress and priorities in land use regulation.
The Shared Socio-Economic Pathways (SSPs)

SSP 1: (Low Challenges) Sustainability
Taking the Green Road

SSP 2: (Intermediate Challenges) Middle of the Road

SSP 3: (High Challenges) Regional Rivalry A Rocky Road

SSP 4: (Adapt. Challenges Dominate) Inequality A Road Divided
Representative Concentration Pathways (RPCs) describe the climate system and feed into Global Circulation Models (GCMs).

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Mean change by 2081-2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCP 2.6</td>
<td>Can achieve Paris agreement</td>
<td>+ 1 °C</td>
</tr>
<tr>
<td>RCP 4.5</td>
<td>Low climate change</td>
<td>+ 1.8 °C</td>
</tr>
<tr>
<td>RCP 6.0</td>
<td>Medium climate change</td>
<td>+ 2.2 °C</td>
</tr>
<tr>
<td>RCP 8.5</td>
<td>Strong climate change</td>
<td>+ 3.7 °C</td>
</tr>
</tbody>
</table>

*Source: Stocker 2014, based on IPCC*
3 Agro-ecological zoning Methodology (AEZ)

- Agro-ecological suitability & land productivity
- Calculates crop cultivation potentials
- Developed jointly by IIASA and FAO
Agricultural Economic Model

1. Development scenario
2. Climate model
3. Agro-ecological suitability and land productivity
4. Climate impact response relations
5. Global Food-Feed-Biofuel System

- GHG Emissions
- Climate forcing
  -> RCP
- CO₂ concentration

SSP narrative
- Population
- GDP growth
- Urbanization
Downscaling to grid-cell layer

Results of the World Food System Simulations are downscaled to the spatial grid of the resource database.

→ Land use change
→ Future Cropland Use (Rain-fed & Irrigated)
→ Irrigation water demand

Spatial distribution of land use
Key linkage Agriculture / Land use - CWAT

- Land use change (Forest, built-up)
- Future Cropland Use (Rain-fed & Irrigated)
- Irrigation water demand
Selected RESULTS in the African context
Demographic and economic drivers of the African food system development

Population

Population (Middle of the Road Scenario)

GDP_PPP (Middle of the Road Scenario)

GDP_PPP per caput
Population increase 2010 to 2050

2010

- Eastern African Community
  - 138 mio

Scenario ‘Middle of the Road’, 2050

- 277 mio (SSP1 Sustainability)
- 315 mio (SSP2 Middle of the Road)
Education in SSP1 (Sustainability)

Source: IIASA / Wittgensteincentre
Land use, 2010

Percentage of CROPLAND in 5-arc minute grid-cells (10 x 10 km)
Land use, 2010

Percentage of GRASSLAND in 5-arc minute grid-cells (10 x 10 km)
Land use, 2010

Percentage of SHRUB LAND in 5-arc minute grid-cells (10 x 10 km)
Land set-aside for environment & biodiversity

- World DB of Protected Areas (WDPA)
- Peace Park Foundation (PPF)
- Global Wetland Database (GLWD)
- Key Biodiversity Areas
- Highest Biodiversity Importance
- Strategic Water Resource Areas
- Buffer for WDPA & PPF

*Note: The map illustrates the distribution of these areas across different regions.*
Ruminant livestock distribution
2010 (TLU / km2)
EAC Land use, 2010

- Cropland
- Forest
- Bare/sparsely veg.
- Built-up
- Water bodies
- Shrubland for ENV & LVST
- Grassland for ENV & LVST
- REMAIN shrubland
- REMAIN grassland
EAC Land use change, 2010 - 2060
Cropland changes, 2010 - 2050
Irrigated cropland changes, 2010 - 2050
Concluding remarks
Dimensions in agricultural modelling

GLOBAL
- Climate change
- Agricultural markets & trade
- Invasive species (e.g. pests)

REGIONAL / LOCAL
- Biophysical pre-conditions
- Market access & integration
- Preferences (e.g. diets)
- ................

SPATIAL dimension

TIME dimension

Research & Development
Innovation
Technological progress

2030

2050

2050

2100
MODELS, DATA and implications

Input data  ->  Models  ->  Output data  ->  OUTCOME

Information & know-how for setting-up development pathways

Day 2 Scenario development workshop

- Hydro catchments
- Irrigated areas
- Soils
- Terrain slopes
- Land Use/Land Cover
- Legal Protected areas
- Biodiversity areas
- Administrative units

Climate
Biophysical

Storylines

Socio-economics
Population
GDP

Technology

Community Water Model
Thank you!

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