Impacts of climate change and adaptation measures on smallholder cropping system levels

27 June 2023 - WEnR

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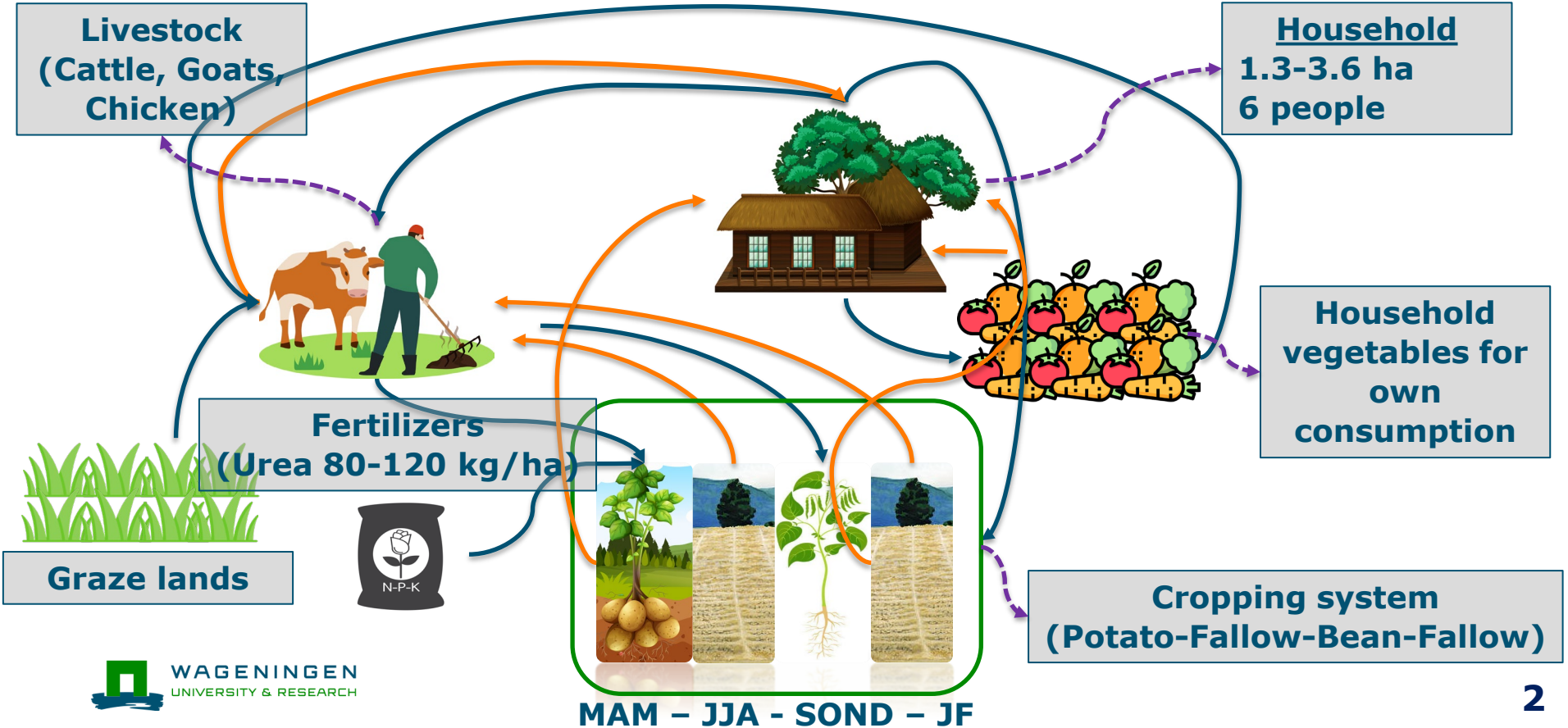
Small holder farming system



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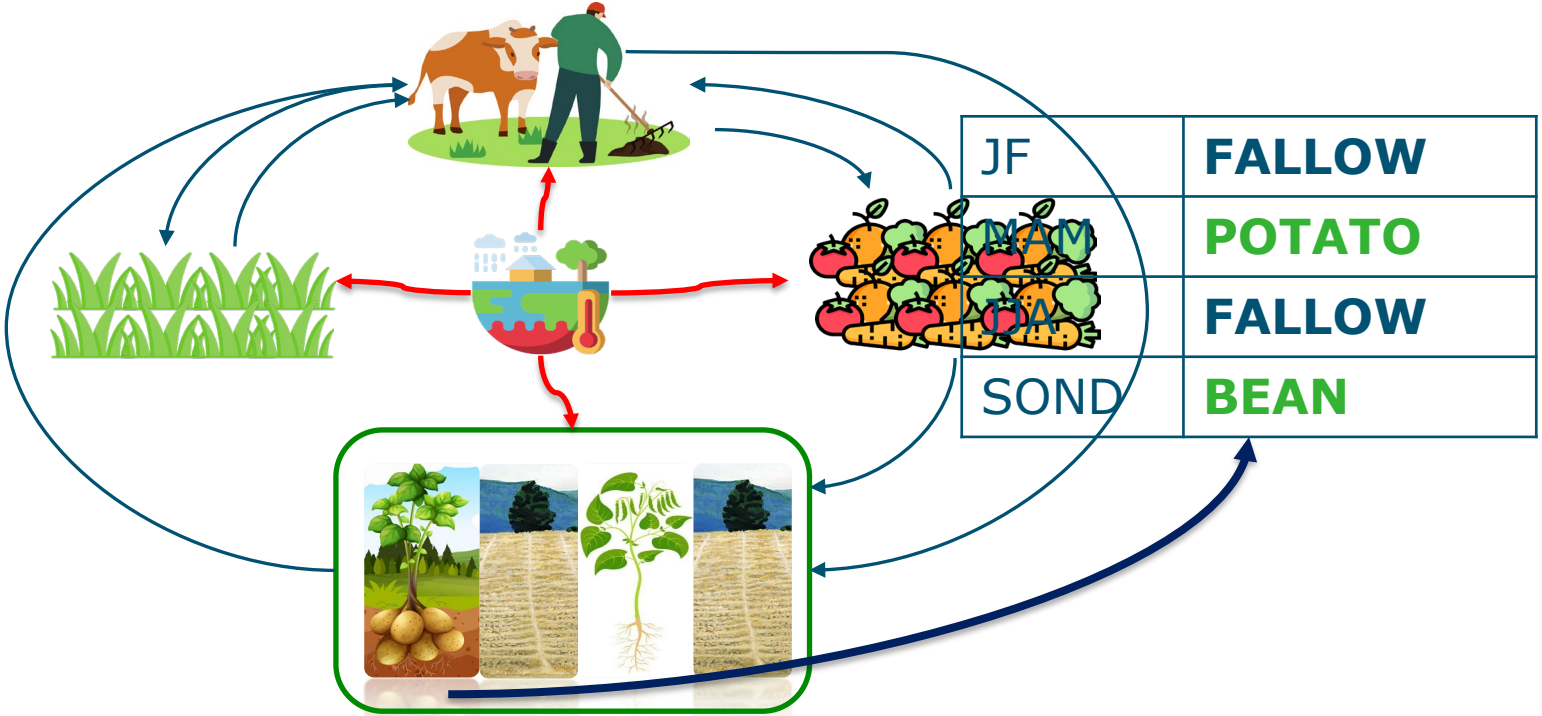
Assessment of CC impact on the cropping system



Household characteristics at the cropping system level

Poor

- Urea-80kg/ha
- Landhold-1.5 ha
- Mulches-300 kg
- Tillage – Traditional

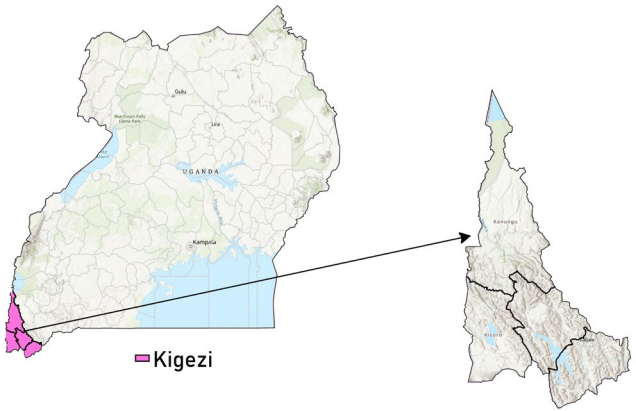
Moderate

- Urea-100kg/ha
- Landhold-2 ha
- Mulches-500kg
- Tillage - Machinery

Well off

- Urea-120kg/ha
- Landhold-2.5ha
- Mulches-750kg
- Tillage-Machinery

Study region and CC scenario



Agriculture is the primary economic activity in Kigezi. The main crops grown include bananas, **Irish potatoes**, **beans**, maize, and vegetables.

RCP 7.0
2030-2060

RCP2.6 and RCP4.5 are only feasible with some climate mitigation efforts.

Global Carbon Budget (2019); SSP data: ref. 19/J. Rogelj et al. Nature Clim. Change 8, 325–332 (2018)/SSP Database (v2); IEA data: Ref. 7

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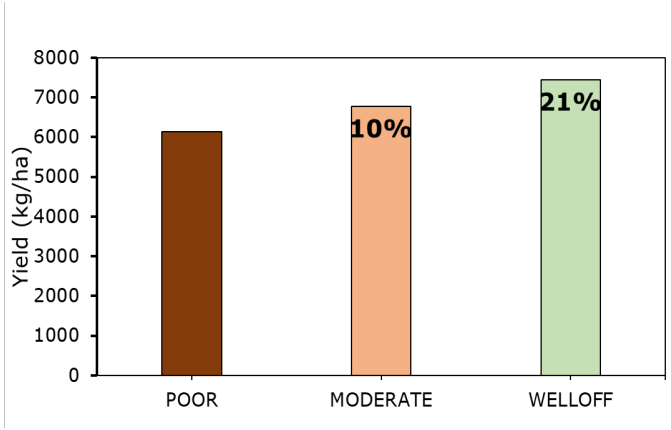
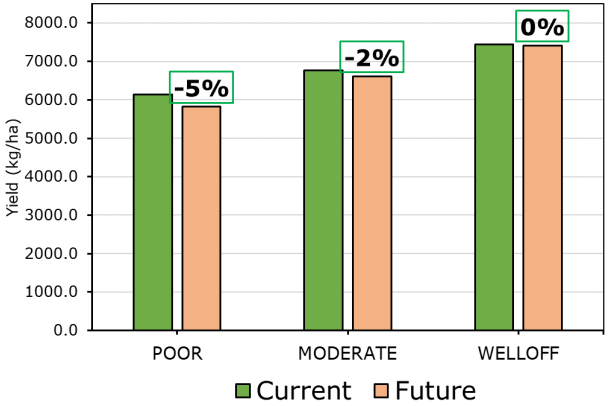
Climate change impacts potatoes in various households

Potato yields in the current



Potato yield changes in the future



Crop yields with moderate and well-off households are **10%** and **21%** higher than poor farmers (approx.6000 kg/ha) in the current.

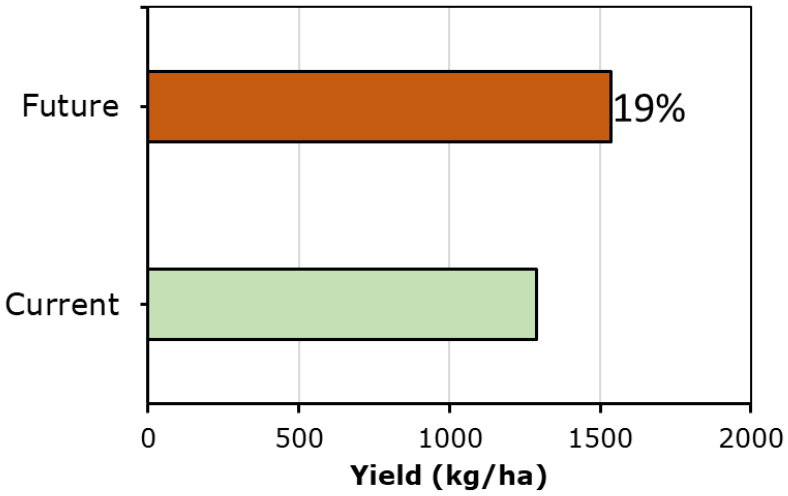
Climate change events could cause significant impacts on poor households **(yield reduction up to 5%)** than moderate **(yield reduction up to 2%)** and well-off farmers **(nearly no impacts)**

Climate change impacts **beans** in various households

Farm inputs for common beans are similar **(rainfed & no fertilizer)** over various households; hence **no difference** in yields between various households.

However, relatively **higher rainfall** than MAM in SOND in the future;

SOND season is favorable to beans cultivation, projected to have a **19%** increase in the near future than current.



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Adaptation measures

Mulching with dry residues

Crop rotation with a legume (Soybean)

MULCHING with dry residues

- ✓ Mulching helps reduce water evaporation from the soil surface, particularly in areas with limited rainfall or during dry seasons.
- ✓ Mulch acts as a physical barrier, preventing weed seeds from germinating and competing with the potato plants for nutrients and moisture.

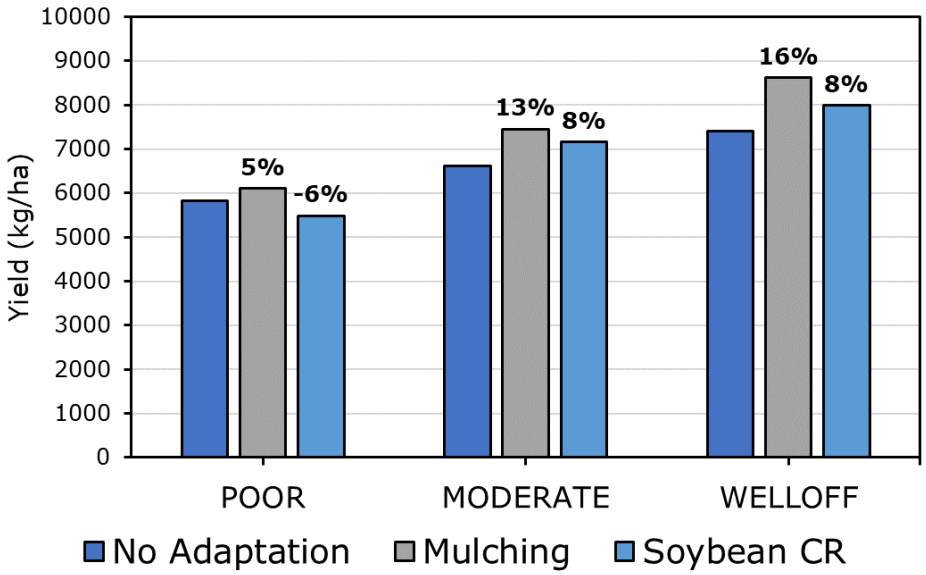
CROP ROTATION with soybean in the fallow season

- ✓ Soybeans are leguminous crops that can fix atmospheric nitrogen through a symbiotic relationship with nitrogen-fixing bacteria in their root nodules. This can enrich the soil with nitrogen, benefiting subsequent crops in the rotation.
- ✓ Soybeans during the fallow period can serve as fodder for the livestock.
- ✓ It breaks the cycle of pathogens and pests that may have built up in the soil from previous crops, reducing their impact on subsequent crops.

Potato-Soybean-Bean-Soybean
(MAM - JJA - SOND - JF)

Impacts of adaptation measures on Potato under climate change

The adaptation measures improve potato yields from 5-16%



Poor

yields by up to **5%** in poor

would not increase
lecrease it to **6%**;
upply and higher nutrient
oybean and potato and traditional

Moderate

ould increase yields up to
nd **8%** with soybean crop

er nutrient supply (which could
ce) and machinery in land

Well-off

ould increase yields up to **16%** with mulching and **8%** with soybean crop rotation.

due to a relatively higher nutrient supply (which could avoid nitrogen imbalance) and machinery in land preparation.

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Impacts of adaptation measures on Beans under climate change

Bean yields have no significant impact from mulching and soybean crop rotation.

Mulching

Mulching is practiced to **reduce evaporation and enhances water use efficiency**. Due to higher rainfall in the SOND, beans would reach their potential evapotranspiration, where mulching has no significant impact.

Soybean crop rotation

Regarding **soybean crop rotation**, growing two legume crops sequentially can result in a **higher nitrogen demand from the soil**. If the second legume crop is planted too soon after the first one, it may need more time to fully benefit from the residual nitrogen left by the previous crop.

Conclusion

- Climate change **negatively impacts** potato yields, and mulching and soybean crop rotation could **increase potato yields** under a climate change scenario.
  - Soybean crop rotation might impact **potato yields negatively in poor households** due to nutrient imbalance between soybean and potato and traditional land preparation.
  - More nitrogen inputs (organic or synthetic fertilizers) and machinery land preparation could help attain the potential benefits of soybean crop rotation in poor households.

- Climate change **positively impacts bean yields**, and mulching and soybean crop rotation **do not significantly impact** bean yields.
  - Both adaptation measures have no significant impacts due to the mentioned reasons. However, in the long future impact of temperature can be significant.
  - Sowing the following crop (Beans) with proper interval could potentially benefit the yields.

Work ongoing

- More regions
  - Mubende
  - Bukedea
- Various cropping systems
  - Maize-Fallow-Beans-Fallow
  - Soybean-Fallow-Beans-Fallow
- Impact of adaptation measures and sustainability assessment
  - Conventional Tillage
  - Irrigation
  - Organic manures
  - Improved varieties
  - Integrated soil fertility management
  - Agroforestry
  - Compound fertilizers
  - Planting techniques/time







Discussion

- What are other prioritized regions?
- What are the major cropping patterns and rotation in the prioritized regions?
- Who will be the user for these assessments, and how can it support them?
- What are the CSA interventions in which BCs are invested and interested?
- What are the interventions currently followed by smallholders?

Sustainable adaptation measures are required to adapt/mitigate climate change and ensure food security.

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