The Implication of 1.5-2.0 degree Temperature to Uganda's Climate, Water and Agriculture Nexus

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Introduction

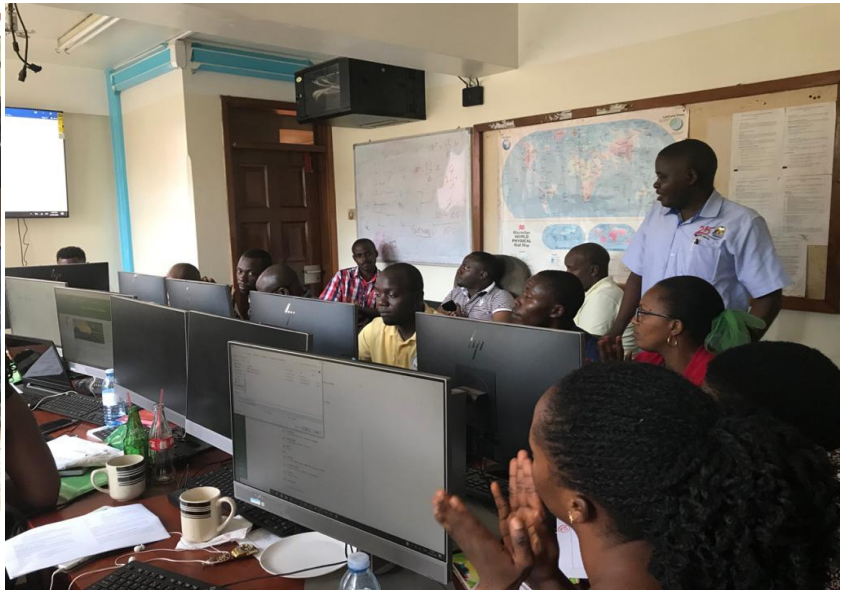
- Globally, about 40% of the world's population is suffering climate change, especially developing countries,
- extreme weather events such as floods; droughts; heat waves; & damaging wind
- Climate Change is thus leading to economic losses & impacting various sectors e.g. water resources, agriculture, health
- with increasing population & changing climate including environmental degradation, demand for water is expected to worsen
- **Scientific studies required to provide evidence-based decision making**

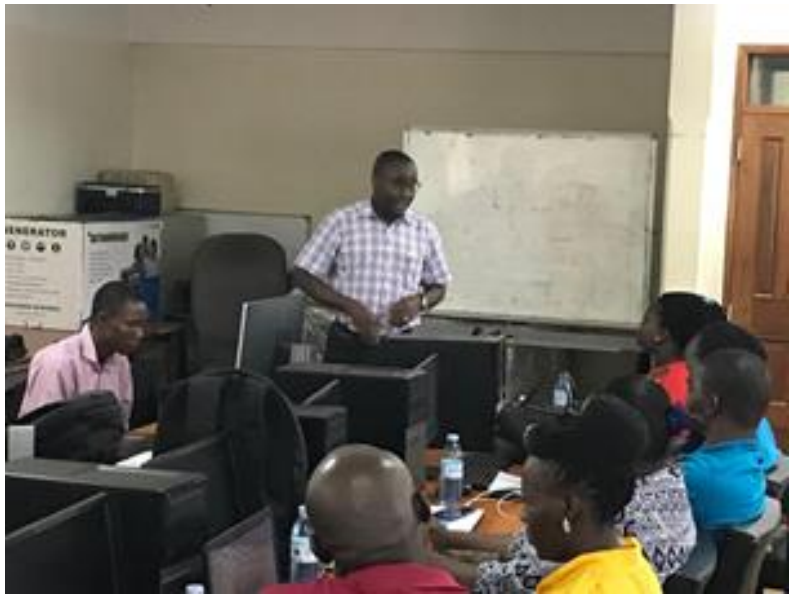
Study objectives

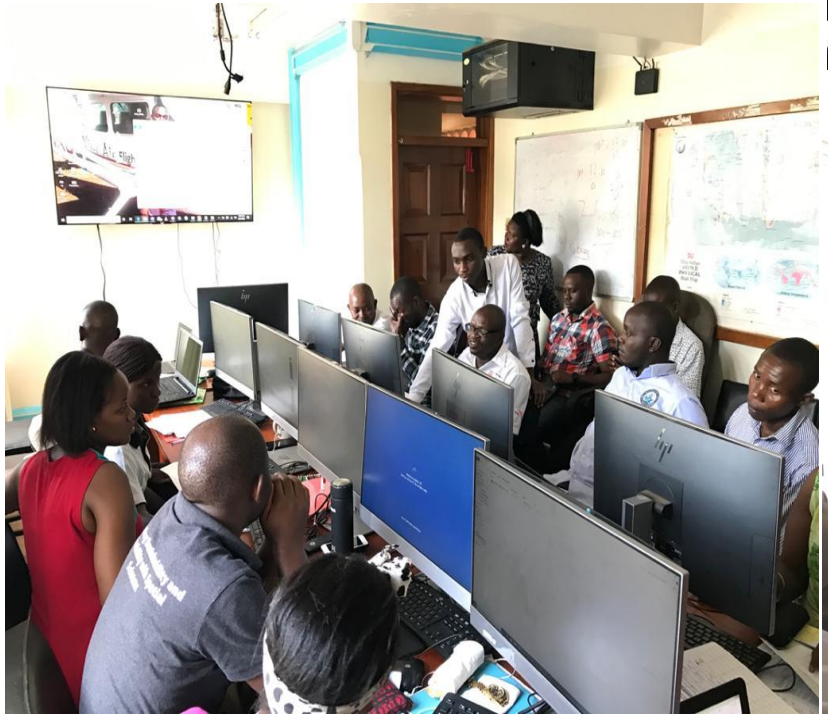
- To study the **climatic patterns** & **project their linkages with agriculture** and **water use** in view of the 1.5-2.0 degree Celsius temperature limit over Uganda".

Specific Objectives:

- Evaluate the present climate change scenarios;
- Assess the trends of Uganda's water demands (2000-2018);
- Examine Uganda's agricultural potential for selected crops (2020-2040);
- Project Uganda's future water needs over the period 2020-2040







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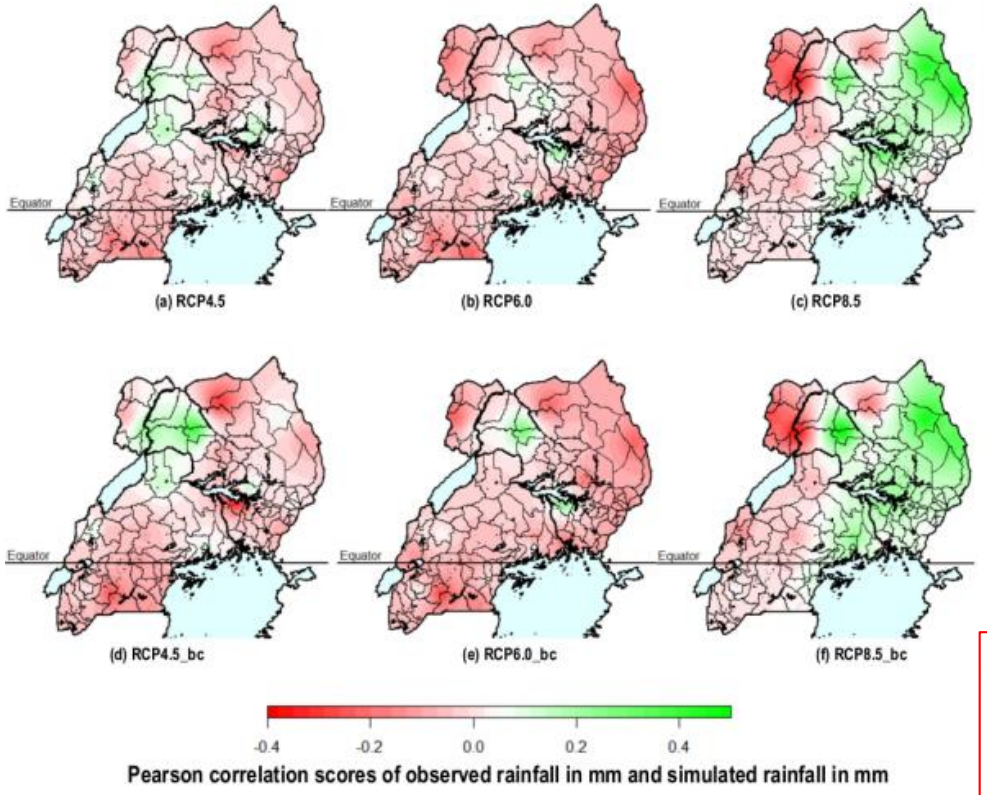
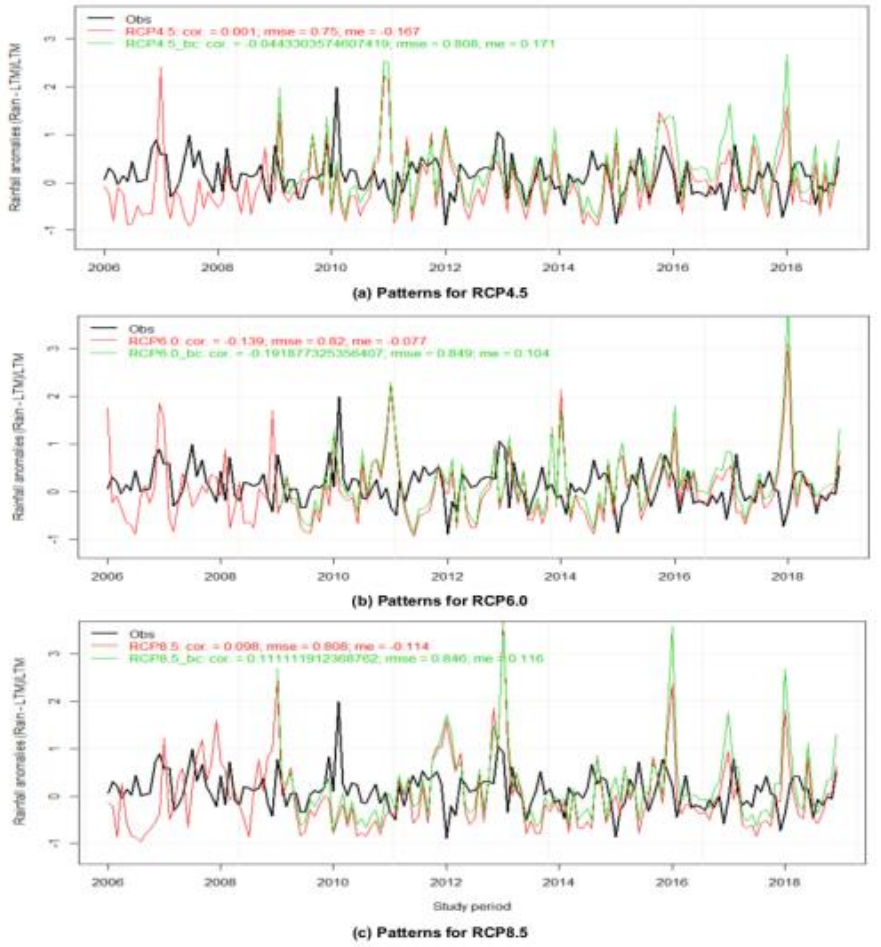
Obj.1: Evaluate the present climate change scenarios

- Simulation done over Uganda using WRF model
- RCPs 4.5, 6.0 & 8.5 used
- Bias correction done using quantile mapping
- **RCP8.5 presented better performance**





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Examining the Impact of Bias Correction on the Prediction Skill of Regional Climate Projections

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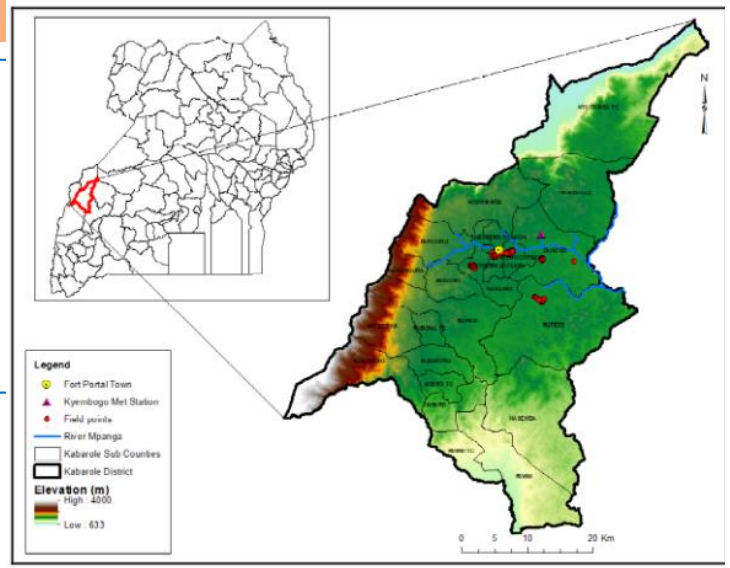
Obj.2: Assess the trends of water demands

- A catchment approach used
- River Mpanga & Kafu used as case studies
- Simulation done using WEAP model

COMMUNITY VIEWS ON CHANGING CLIMATE AND WATER NEEDS

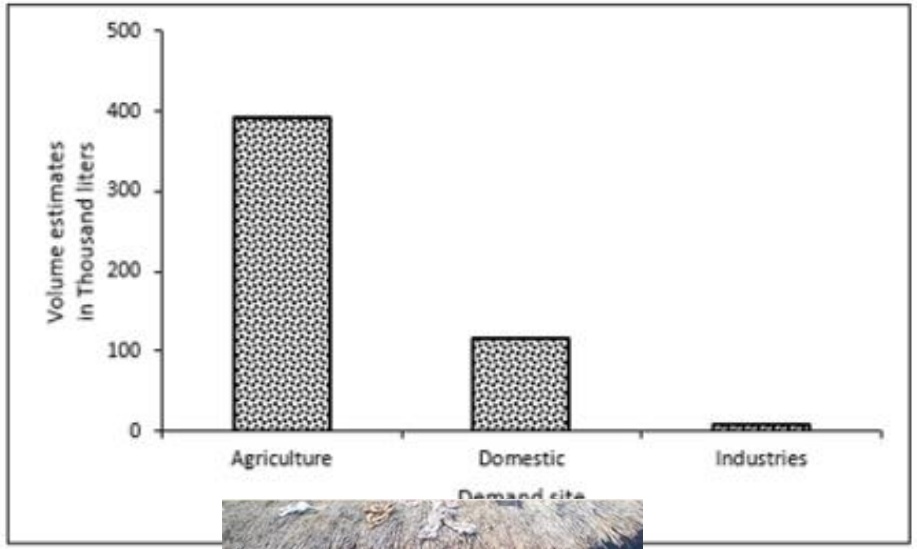


Water source	Frequency (Percent %)
Water tap	80(72.1)
Borehole	35(31.5)
River	16(14.4)
Water dam	4(3.6)
Spring well	4(3.6)
Rain harvesting	3(2.7)

- the distance to nearest water source $< 1Km$
- water harvesting still limited
- since 48.3% (41.4 + 7.2) for small–scale business & formal employment, can afford water

Water use/consumption	Frequency (Percent %)
Livestock	21(18.9)
Irrigation	7(6.3)
Others	5(4.5)
Industrial	3(2.7)
Domestic	75 (67.6)
TOTAL	111(100)

- water is mainly used for domestic
- due to increasing population, water demand is expected to increase, *see Adhikari et al. 2015*
- domestic water demand is expected to increase by 64% while livestock water demand by 44% and irrigation by 66%



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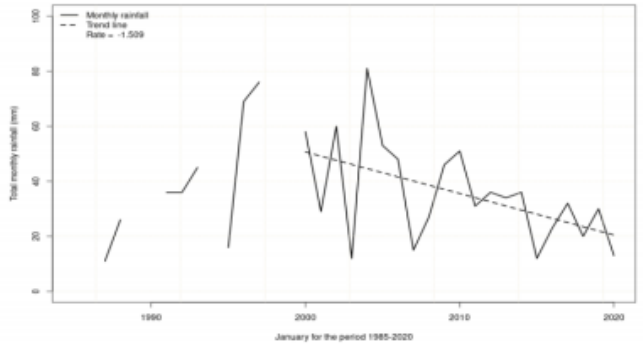
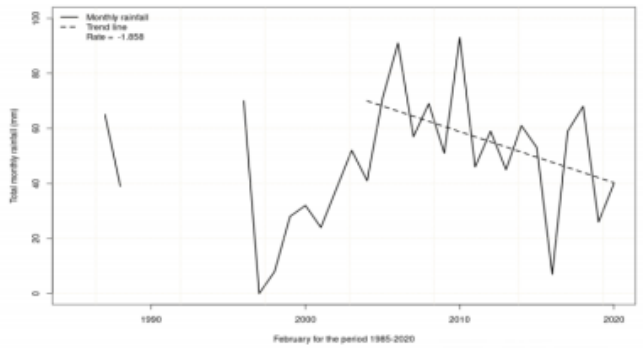
Obj.2: Assess the trends of water demands: Trend of floods and droughts

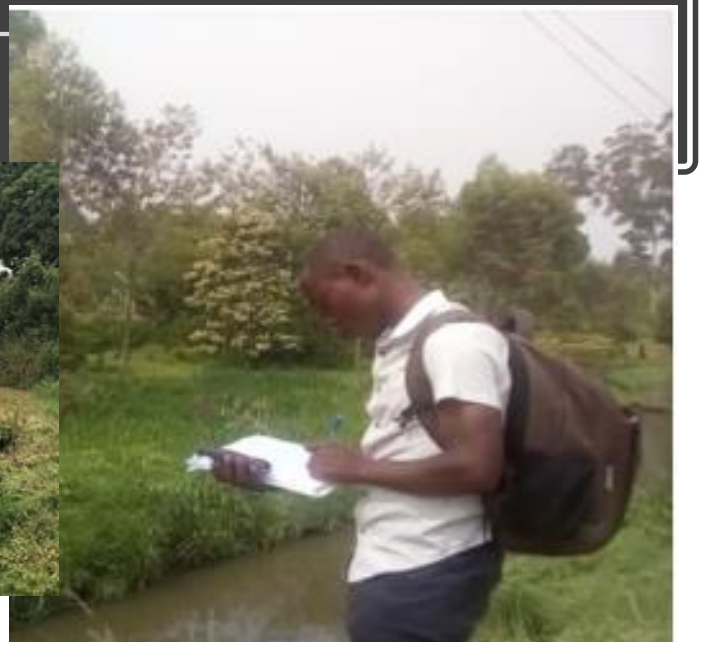
- 55.6% considered drought to be frequent a threat
- 65.5% that droughts will occur at least once a year
- community believe that droughts are increasingly occurring in Jan. & Feb.

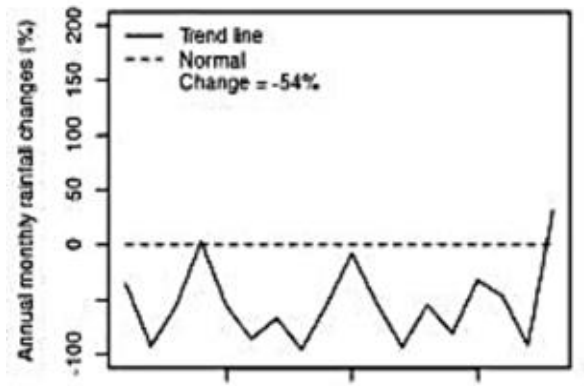


(a) January rainfall trends

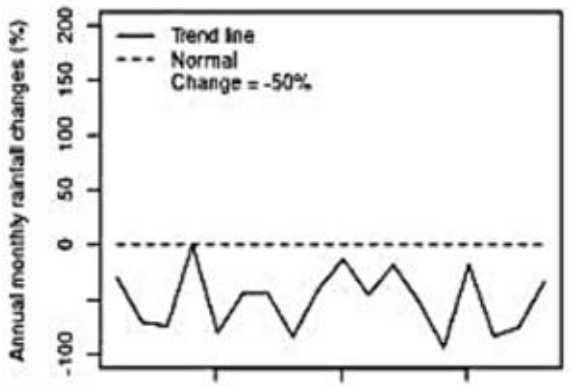


(b) February rainfall trends





(a) Jan. Trends



(b) Feb. Trends

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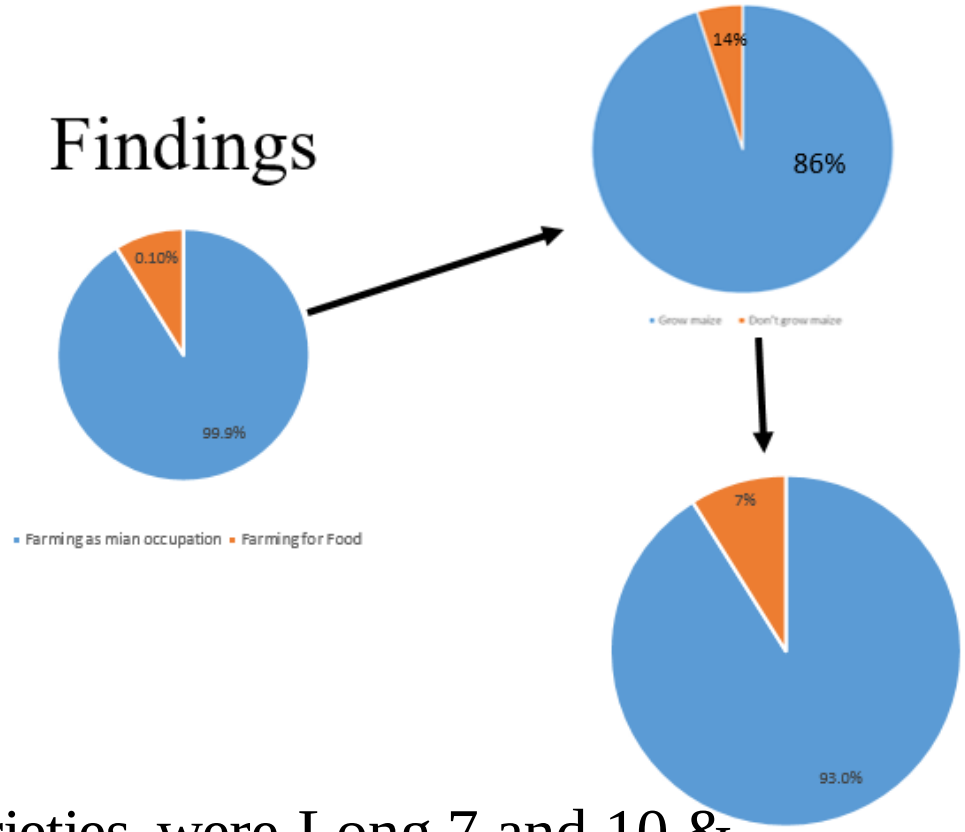
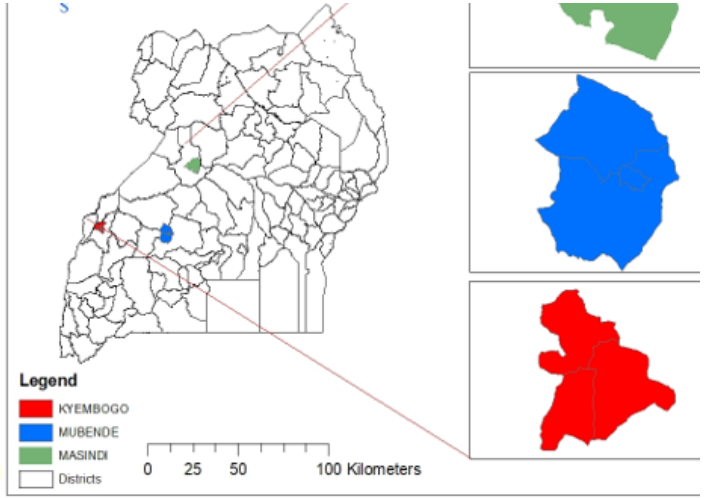
Obj.3: Uganda's agric. potential for selected crops



- ✓ Out of the total number of respondents, 90.3% practice agriculture as there main occupation and source of income
- ✓ Also 95.4% of the 90.3% do grow maize as one of their main crops
- ✓ And only 7% do apply fertilizers in their farming.

- Literature survey shows that Masindi, Kyenjojo, Mubende – Maize farmers
- WoFOST model used

- ✓ The commonly grown varieties were Long 7 and 10 & average harvest was 1.1t/ha (**avg: 2.8-3.5t/ha**); agriculture was mostly rain-fed (97.6%)
- ✓ 58.4% grow maize on small scale, 29.6% on large scale and 11.2% on both large and small scales.
- ✓ 55.6% preferred to grow maize in the MAM season than the SON season.



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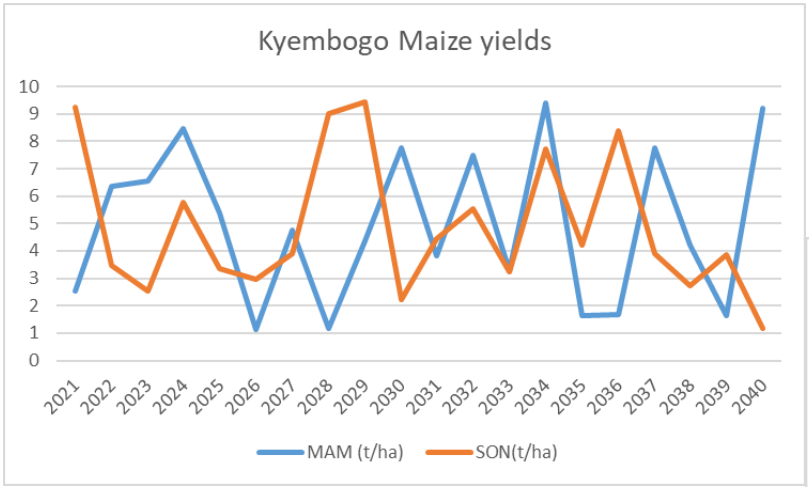
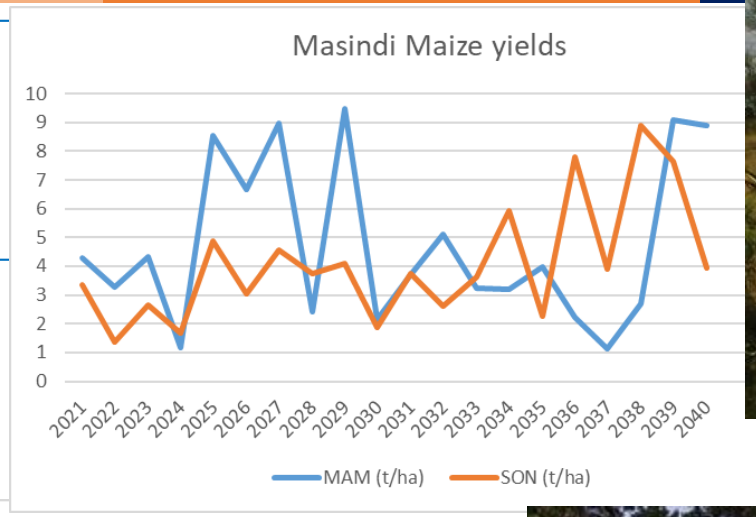
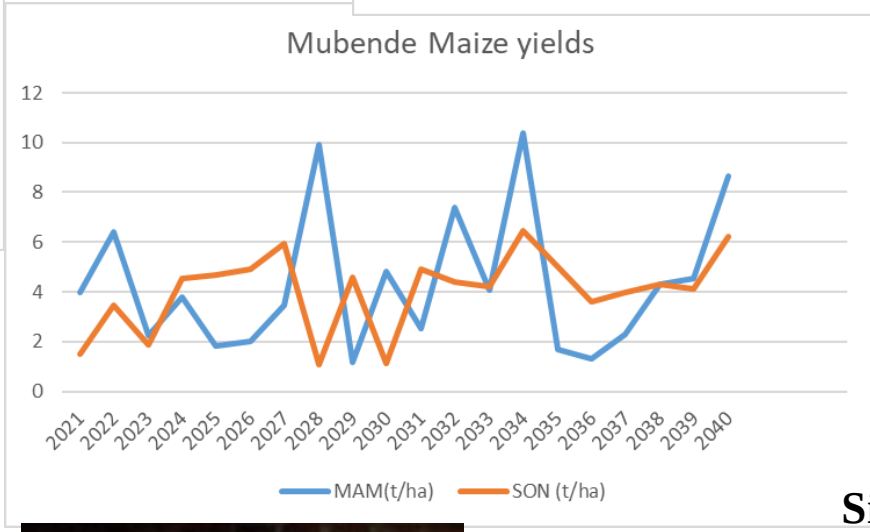
Obj.3: Uganda's agricultural potential for selected crops







Average planting calendar

- ✓ Sowing (MAM) :27Feb-20th Mar.
- ✓ Harvest (MAM): 30Jun. - 15th Aug.
- ✓ Sowing (SON) :1 August-18th Sep.
- ✓ Harvest (SON): 15th Dec-29th Jan

Simulated planting calendar

Sowing (MAM) :27th feb-29th Mar.

Harvest (MAM): 30th June - 20th Aug.

Sowing (SON) :7-20th Sept.

Harvest (SON): 15th Dec-2th Feb

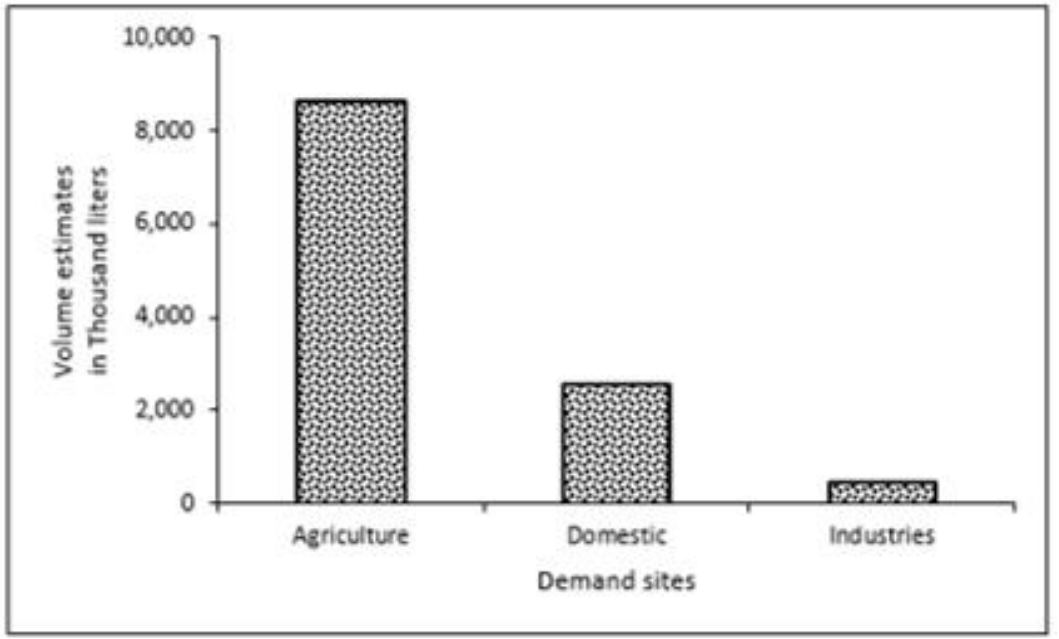
Obj.4: Project Uganda's future water needs

- Projection done using the WEAP model and results from WRF future simulations
- Projected increase in water demands (2020-2040) were found to be;

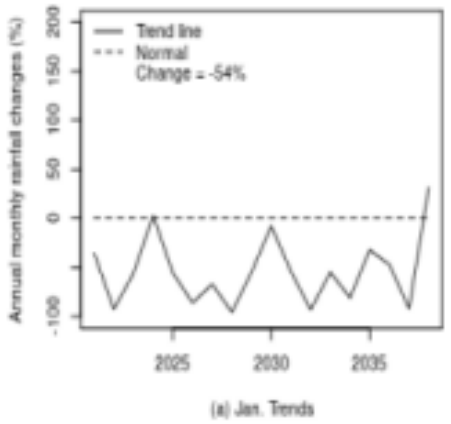
➢ Domestic :21.9% (2554 thousand litres)

➢ Agriculture:74% (8624 thousand litres)

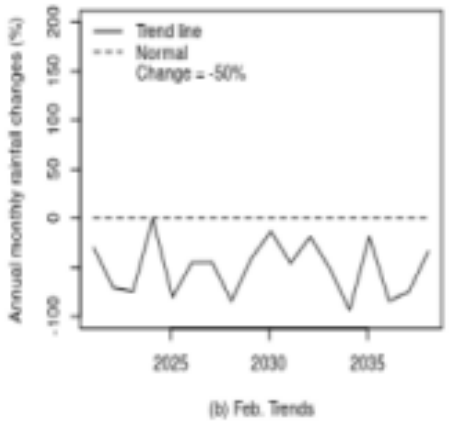
➢ Industries: 4.1% (474 thousand litres)



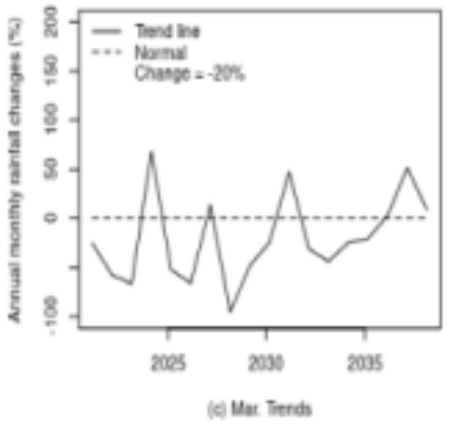
❑ Since projected temperatures & population increases, more water will be demanded by all sectors and water resources will be under pressure of depletion.



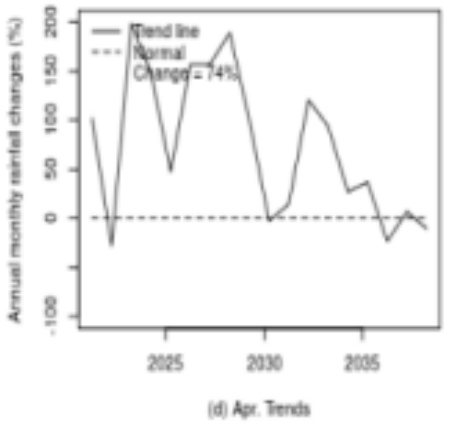
(a) Jan. Trends



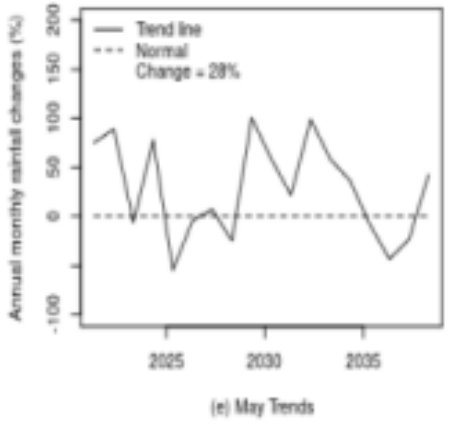
(b) Feb. Trends



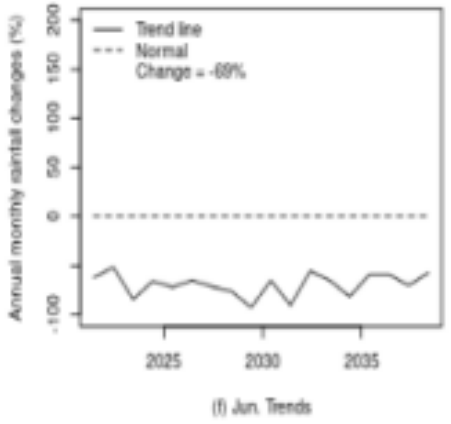
(c) Mar. Trends



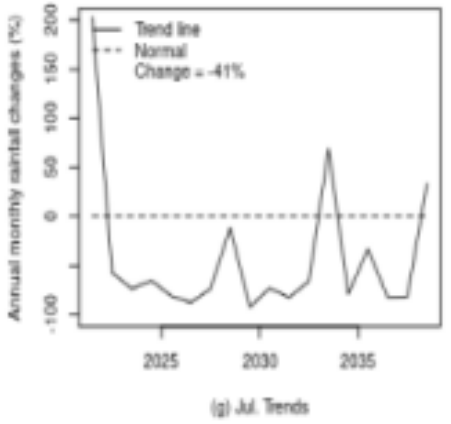
(d) Apr. Trends



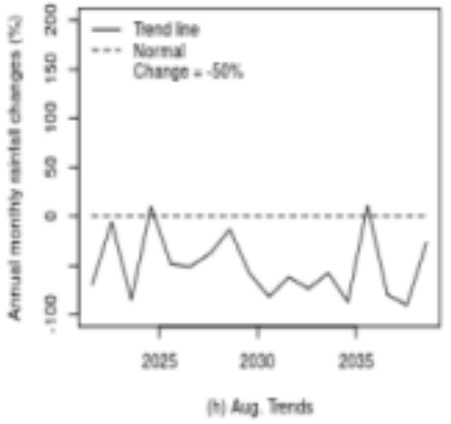
(e) May Trends



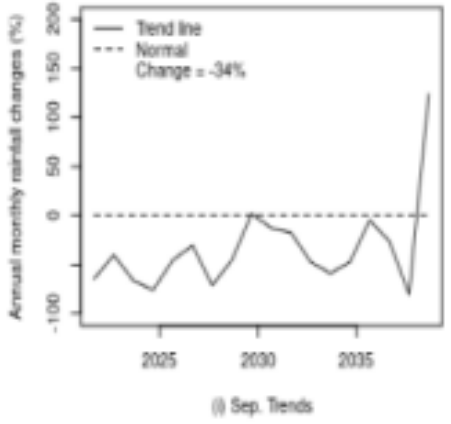
(f) Jun. Trends



(g) Jul. Trends

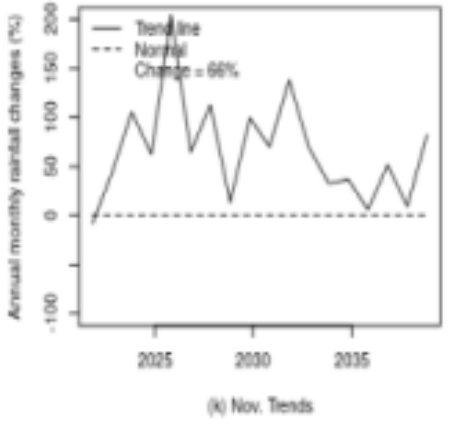


(h) Aug. Trends

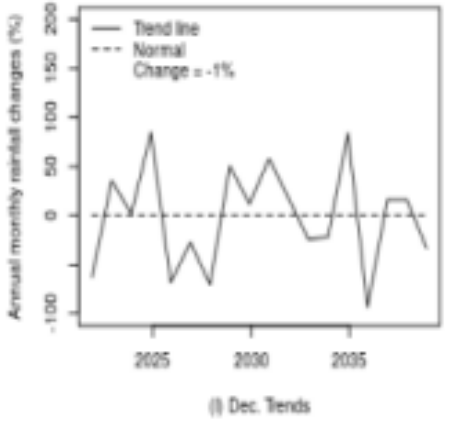


(i) Sep. Trends

(j) Oct. Trends



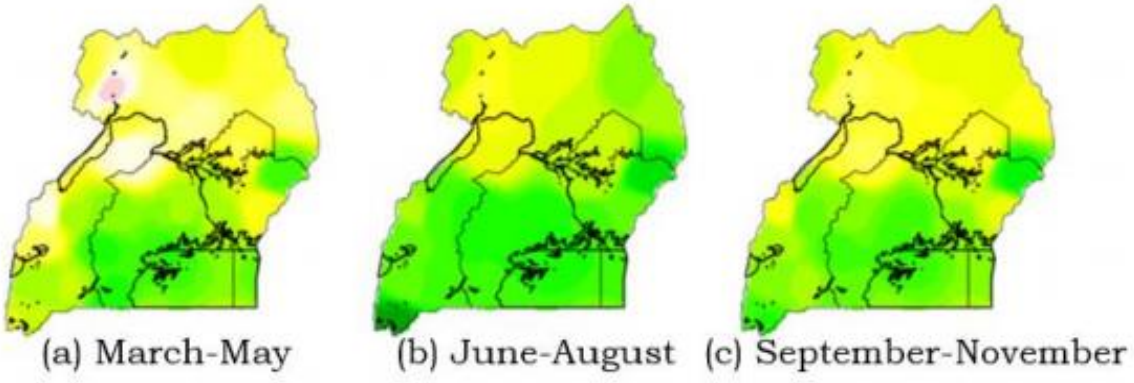
(k) Nov. Trends



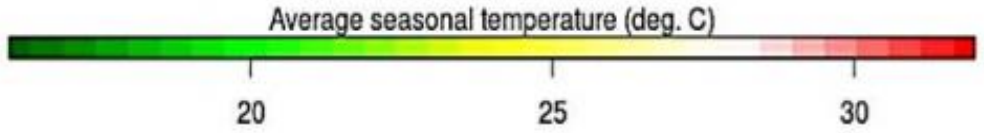
(l) Dec. Trends

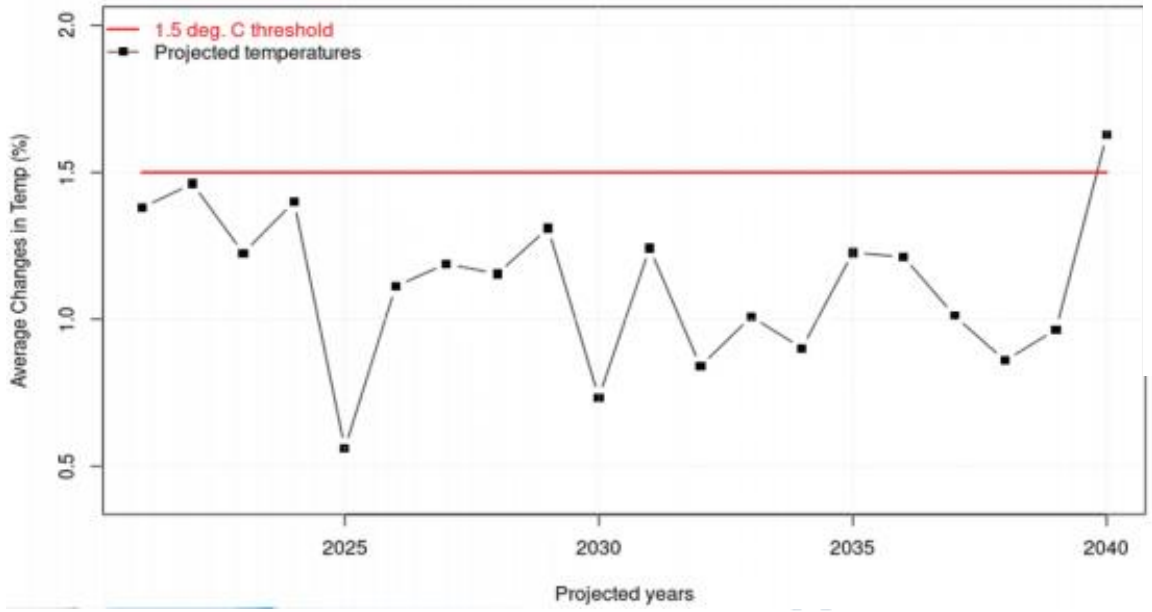
Projected monthly rainfall

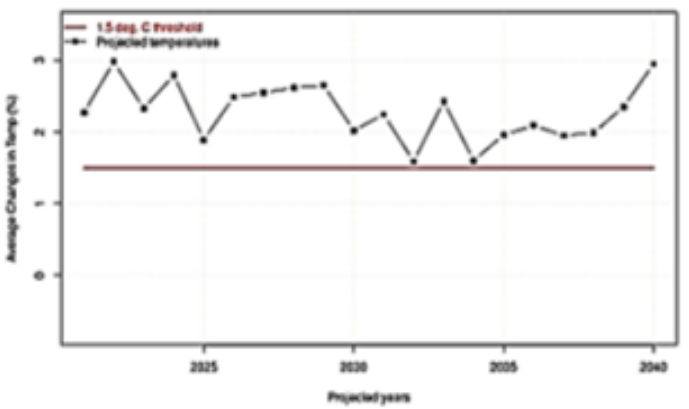
Projected Temperature



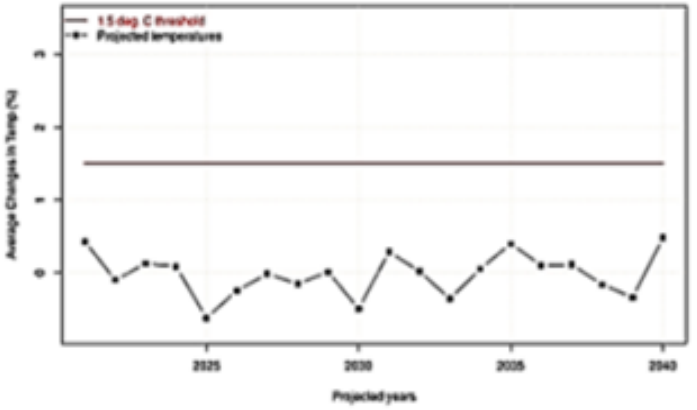
(a) March-May (b) June-August (c) September-November



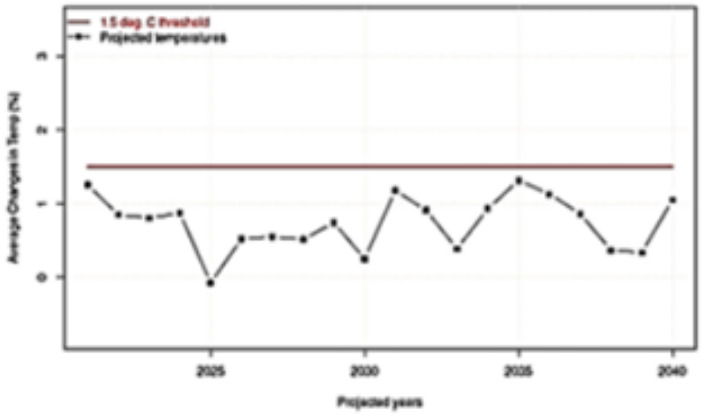




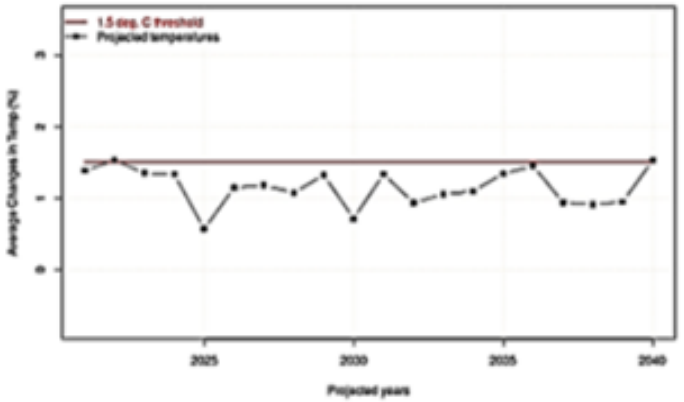
(a) West



(b) Central



(c) East



(d) North

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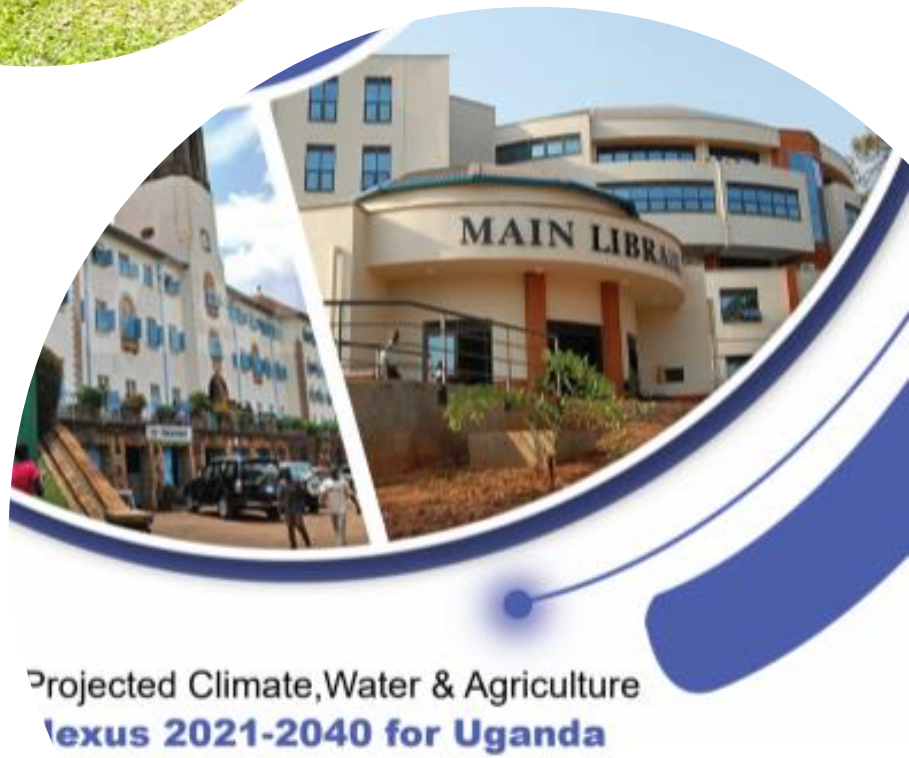
Conclusion and Summary

- Climate simulations using WRF still have limited skill but can be improved using bias correction; RCP8.5 fairly represents the realistic climate change scenario
- Main water use is for domestic; Generally climate has been changing; the months of Jan. & Feb projected to be drier
- Maize remains the main cereal crop; limited use of fertilizers noted; shift in planting calendar noted; MAM remains more favorable for generating high maize yields
- With increasing population and projected changes in rainfall & temperature … water planning remains critical

Policy implications

- Average temp. over Uganda. To increase within 0.5-1.7 deg. C
- With projected increase in temp. more H2O will be demanded by sectors e.g. water resources and crop production
- A likelihood of changes in planting calendar and with changes in temp. and rainfall – irrigation is encouraged
- Improved climate science to promote dry planting
- There's need to establish an integrated H2O resource mgt system with transparent allocation



Achievements and Challenges

Achievements

- Was promoted to Lecturer on 1st July 2020;
- Won two additional grants from RIF-Gov't of Uganda
- Appointed Director Forecasting Services
- Nominated to serve as General Secretary for African Meteorological Society.

Challenges

- COVID-19 & lockdown
- Death of one of my trusted Research Assistants
- Lack of dedicated Project Administrator

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Future plans

- Finalize and publish the remaining three papers **(1) Community views on changing climate**; (2) water demand study using WEAPS; (3) maize productivity study using WoFOST
- Conduct an analysis of improving weather and climate prediction using data assimilation and Artificial intelligence
- Pest and pollution monitoring using weather prediction and advisories

- Thank you very much for the attention
- **Asante Sana**