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Modelling impact of climate change on maize (*Zea mays* L.) yield under rainfed condition in sub-humid Ghana

By

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Outline of Presentation

- Introduction
- Objectives
- Materials and Methods

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Introduction | **Materials & methods** | **Model framework**

- Cereal production is a major component of small-scale farming in West Africa.
- Maize is one of the major staple food in Ghana, contributing 20 % of calories to the diet.
- Decreasing trend in maize yields due to continuous cropping and low fertilizer use.

Source: wordpress.com

Introduction | **Materials & methods** | **Model framework**

- As farmers battle with low soil fertility, climate change and variability is another major threat to food security.

- More frequent and intense extreme weather events (heat waves, drought, floods).

- Extreme vulnerability and limited adaptation capacity; major threat to food security.

Source: myjoyonline news

Source: time.com Source: crs-blog.org

❖ Research Gap

- Little has been done on the use of models (eg. APSIM) to assess influence of nutrient management on maize yield.

- Little is known on the impact (quantifying) of climate change on maize yield in sub-humid Ghana using A1B and B1 scenarios.

❖ Research question

➢ What impact will climate change have on future maize yield in sub-humid Ghana?

❖General objective

The overall objective of the research is to model impact of climate change on maize yield under rainfed condition.

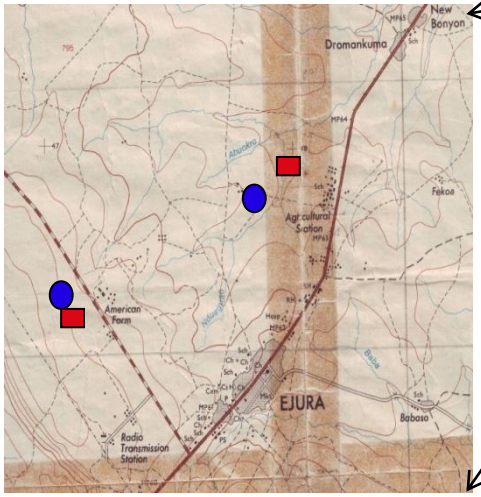
❖Specific objectives

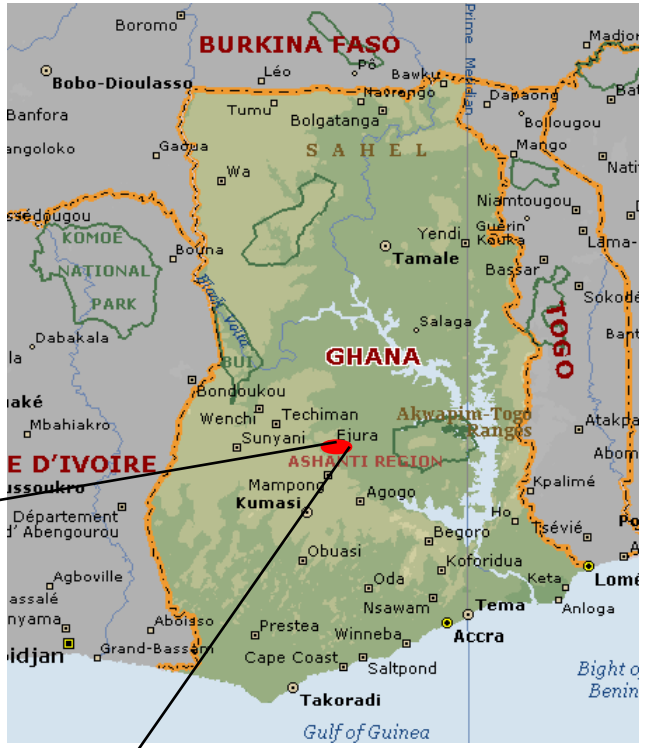
- Evaluate the capability of APSIM-maize model to simulate growth, development and yield of maize.
- Quantify the impact of climate change on maize yield

Introduction | **Materials & methods** | Model framework

❑ Study site

- Ejura, located in Ashanti region (150 – 250 m).
- One major food producing area
- Sub-humid climate; Bimodal rainfall pattern.
- ✓ major & minor rainy seasons.
- ✓Mean annual rainfall – 1300 - 1400mm.





major season site ● ■ minor season site

Fig. 1: Study area

❖ Field trials for APSIM parameterisation and evaluation

- Two sites, major & minor seasons in 2008
- Four levels of N (0, 40, 80, 120 kg ha^{-1})
- Three levels of P (0, 30, 60 kg ha^{-1})
- Two maize cultivars – Obatanpa (medium), Dorke SR (Short season)
- Experiment layout in RCBD with 3 replicates.

❖Field measurements:

Initial soil sampling

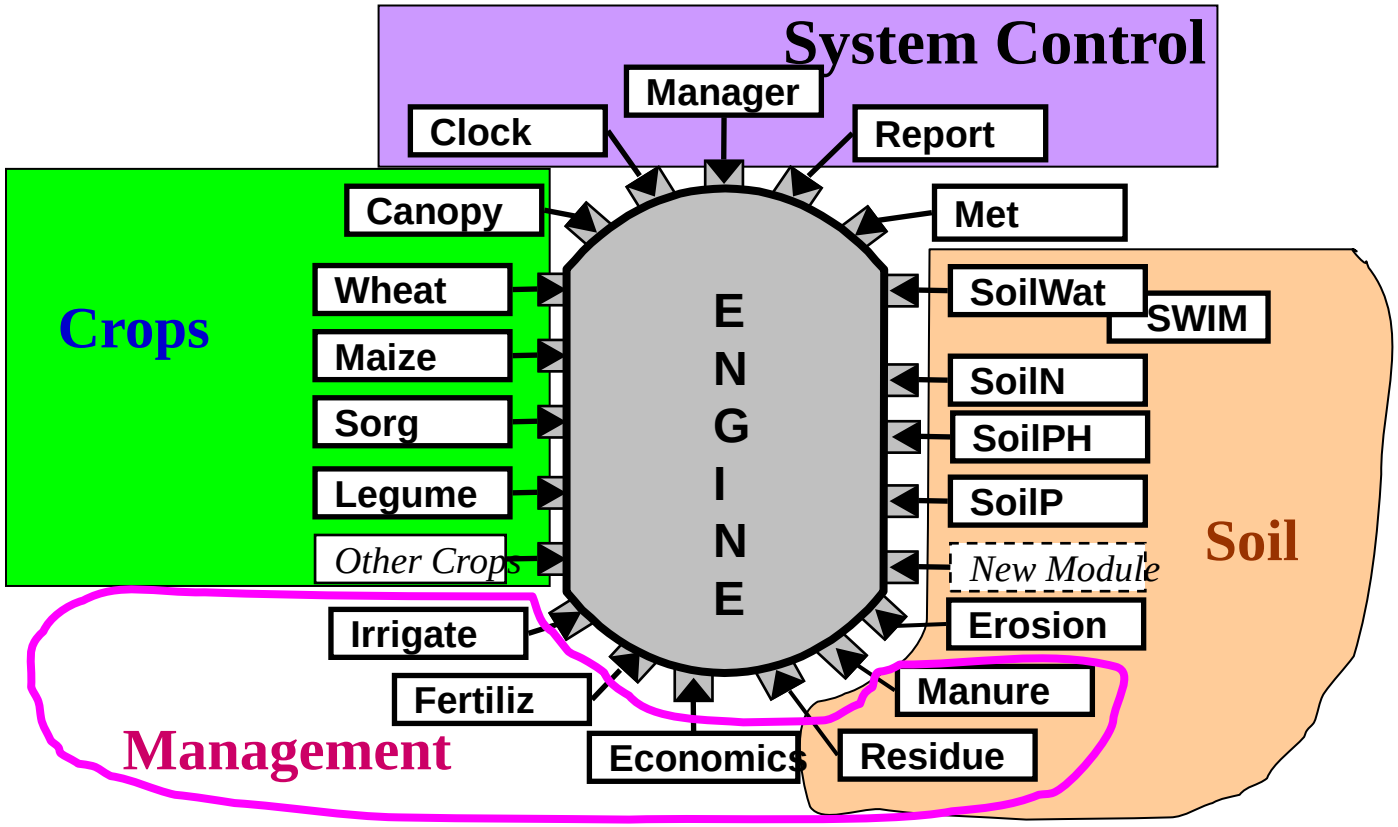
Time series biomass sampling, LAI using sun scan, soil moisture measurement

❖Field observations

Time of 50% emergence, flag leaf, tasseling and silking, and date of physiological maturity.

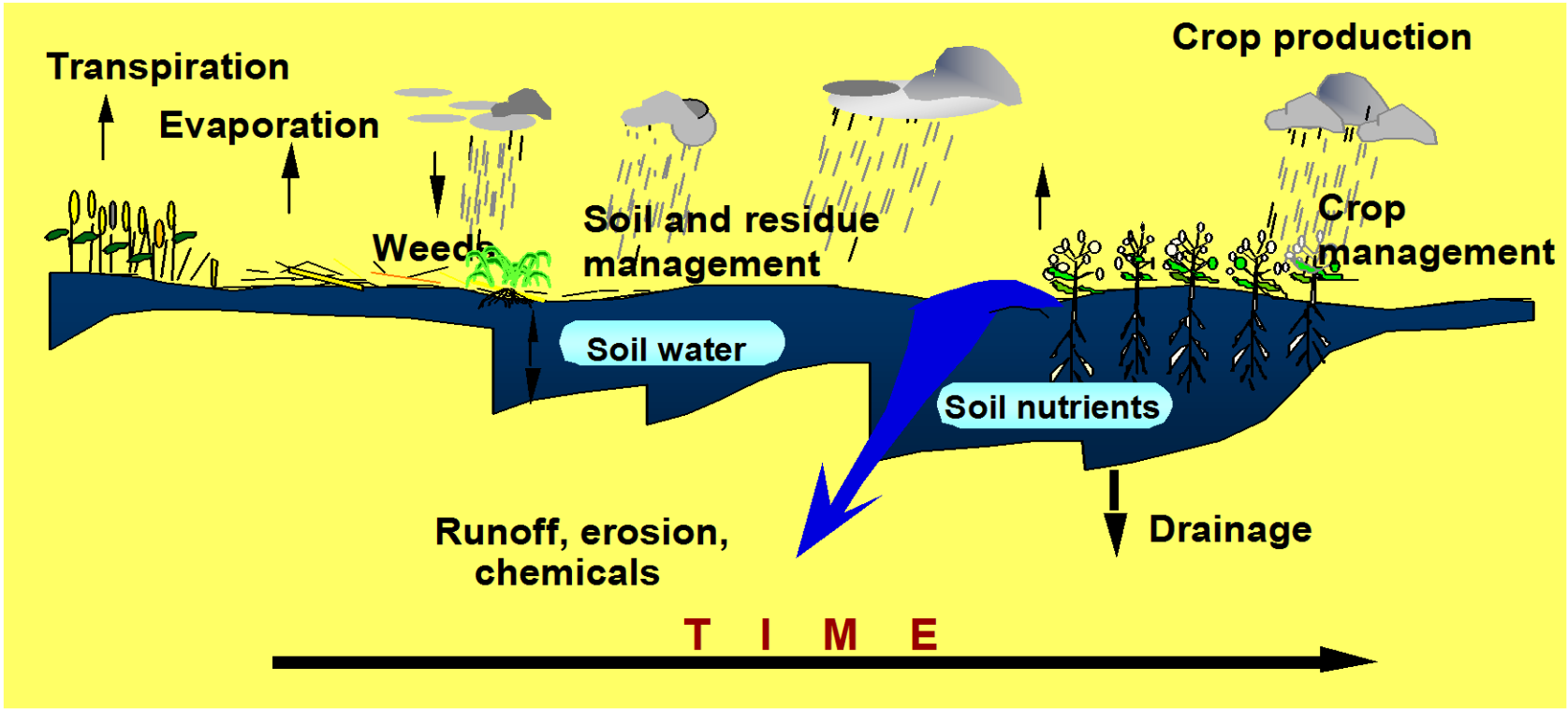
Final harvest: 4X3 m^2 harvested and grain yield calculated.

APSIM – A farming systems modelling framework



Introduction | Materials & methods | Model framework

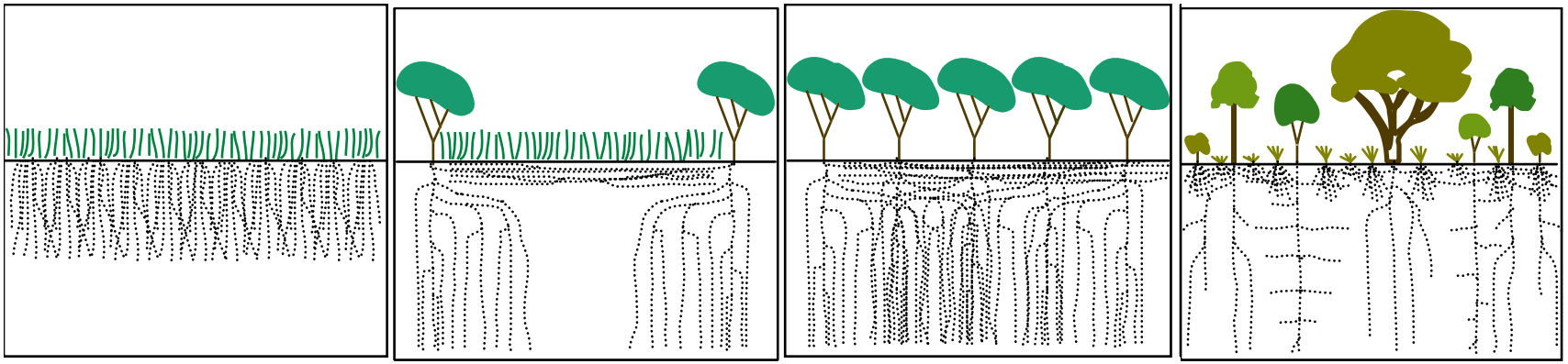
Systems simulation over time



- Systems simulation across different scales

crop – farm – catchment - region

- Systems simulation of the cropping, agroforestry systems and native woodland



APSIM Simulation Scenarios

- Historical climate data(1980-2000) use as base line.

- MM5/ ECHAM4 use in generating future daily climate data (2030-2050) from Institute for Meteorology and Climate Research;Garmisch.

❖A1B Scenario -
Future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies.

❖B1 Scenario –
As in A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies.

❖ APSIM Long-term Simulation Scenarios

➢ Maize sowing conditions:

- ✓ sowing windows - 15 March to 10 May
- ✓ 20 mm rainfall within 5 days

❖ Two crop rotation

- ✓ Maize-cowpea rotation (maize during major season and cowpea during minor season)

- ✓ Maize-fallow rotation (maize during major season and fallow during minor season)

Expected outcome

- Results will be use to exploy management options to reduce impact of climate change on yield.
- Recommendations and government intervention will be made to assist farmers adapt to claimte change.

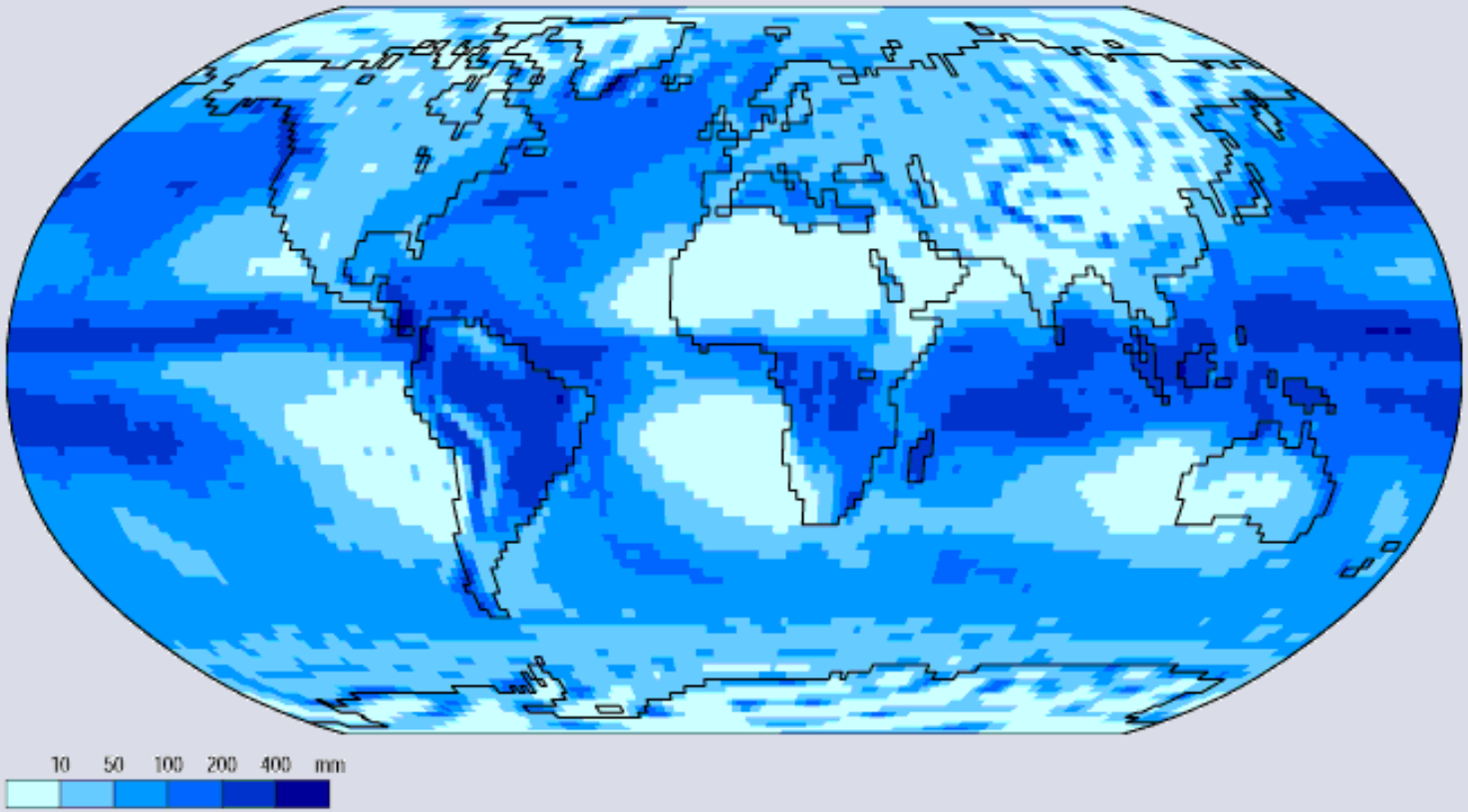
Progress report

- Review of relevant literature on the topic and information needed to write policy brief.
- Evaluation of the ability of APSIM-maize model (version 7.3) to simulate grain yield, total biomass, total N and P uptake as observed in experimental data at Ejura.
- Downscaling of future weather data using MM5
- Long term simulation run using historical weather data and simulated future (2030 – 2050) weather data for two cropping systems.

Work Plan from August to October 2011

Activities	Time (Week)								
	3rd wk August	4th wk August	1st wk September	2nd wk September	3rd wk September	4th wk September	1st wk October	2nd wk October	3rd wk October
Statistical Analysis of simulated yields									
Writing of working paper									
Writing of Policy Brief									
Seminar on findings									
Writing of paper for publication									

Thank You


Precipitation
Dec
10 50 100 200 400 mm
Data: NCEP/NCAR Reanalysis Project, 1959-1997 Climatologies
Animation: Department of Geography, University of Oregon, March 2000