Climate Change Impact on Food Security and Policy Adaptations
A Synthesis from Selected African Countries

Tanveer A. Butt and Bruce A. McCarl, Texas A&M University, College Station, Texas

Climate Change Impacts Agriculture

- Plant growth is altered by
  - Heat stress
  - Changes in precipitation (dry and wet conditions)
- Irrigation water supply changes
- Pest/disease incidence can increase
- Animals may lose weight due to loss of appetite (lower meat production)

Broad Findings by Others

- Climate change does not pose a threat to global food supplies
- Agriculture in high latitude regions (mostly colder north) might benefit to increased growing season
- Agriculture in low latitude regions (tropics), is often at risk
- Regions like Sub Sahelan Africa where climatic conditions have worsened in the recent past are likely to come under additional stress
- Adaptations can partially or totally mitigate climate change

We examined climate change and Agriculture in select African Countries

- Like most of the world regions, Africa has experienced an increase in temperature in the last 100 years.
- During the last century many regions experienced increase in rainfall but parts of Africa experienced a decrease in rainfall.
- In Mali and Senegal rainfall has decreased by 30 to 50 percent, while temperature has increased by 0.4 degree (C°).
- GCM projections suggest that African countries will experience hotter and drier conditions.
- In our assessment of climate change impact, we considered Mali, Senegal, Uganda, and Kenya.

Agricultural and Geographic Scope of Assessment

Countries	Crops	Grasses	Livestock
Mali	7	3	3
Kenya	8	6	3
Uganda	5	x	x
Senegal	4	x	x

Assessment Methodology

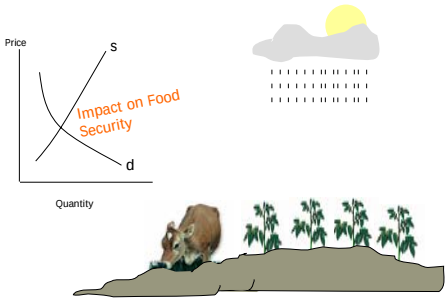
An integrated Biophysical and Economic assessment

Biophysical Assessment

- Obtained future rainfall and temperature changes as projected by *Global Circulation Models*
- Used *Erosion Productivity Impact Calculator* (EPIC) to simulate climate change impact on crops
- Used *Nutrition Balance* (NUTBAL) model to simulate climate change impact on livestock
- Used *Phytomus Plant Growth* (PHYGROW) model to simulate climate change impact on rangeland

Economic Assessment

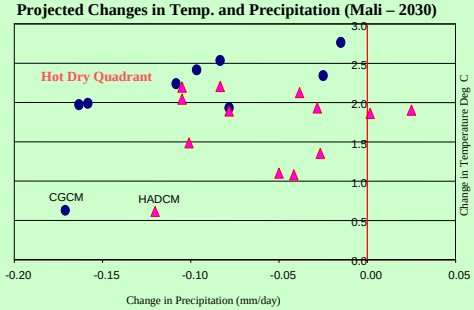
- Used an Agriculture Sector Model to assess the impact on markets and availability of food and to finally compute the percentage of undernourished population



Climate Change Projections

- We used climate change projections from two of the Global Circulation Models – the Hadley (HADCM) model and the Canadian (CGCM) model.
- The projections are for a hot and dry future except in Kenya where rainfall increased in some cases

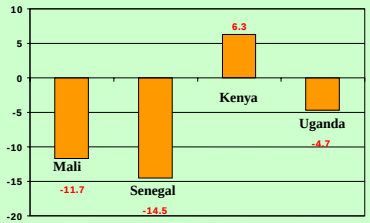
Projected Changes in Temp. and Precipitation (Mali – 2030)



Findings on Yield Effects

- In Senegal yield losses ranged between 15 to 22 percent
- In Uganda, yield losses ranged between 2 to 24 percent
- In Kenya, yields of maize, millet, and beans increased while for sorghum and wheat the yields decreased.
- In Mali, the yield changes ranged from +8 percent for cotton to -17 percent for sorghum

Projected Changes in Cereal Production (%)



General findings - climate change effects

- Worsens conditions for African agriculture
- Worsens malnourishment (from 30+% to over 50+% in Mali)
- Increases dependence on food imports
- Increases degree of price instability
- Adaptations to climate change can effectively mitigate the climate change impact (In Mali, the malnourished population reduced to 22% - even lower than the base level of 34%)
- Adaptations through trade may be realized if markets are allowed to adapt.
- Investing in heat resistant varieties may have high pay-off.

Adaptations Can Help Reduce Losses

- Farmers can adjust cropping patterns that would mitigate some of the climate change related losses
- Losses in production can be mitigated through higher imports and/or smaller export.
- Yield loss induced by heat-stress can be mitigated by shifting planting and harvesting dates. However, the applicability of this adaptation might be restricted to irrigated areas.
- Effect of higher temperature on yield comes through hardening of grain crust that keeps the grain from reaching its potential size. A variety whose maturity stages are better adapted to the projected hot and dry climate may reduce some of the yield losses