Climate Change and Water: What’s the future of Caribbean Agriculture?

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Husbands, St. James
Barbados
Order of Presentation
CIMH and CAMI Perspective

• Introducing CIMH
• Some Climate Change projections for the Caribbean (rainfall & temperature)
• Current Climate Trends (rainfall & temperature)
• Implications of Current and Future trends for Caribbean Agriculture
• What next for a potentially brighter future
• CAMI as part of the solution
Caribbean Institute for Meteorology and Hydrology (CIMH)
CIMH

• The Training, Research and Data Archiving arm of the Caribbean Meteorological Organisation
Caribbean Meteorological Organization

**Organs**

- Caribbean Meteorological Council (CMC)
- Caribbean Meteorological Organization - Headquarters Unit (CMO-HU)
- Caribbean Institute for Meteorology & Hydrology (CIMH)
- Caribbean Meteorological Foundation (CMF)
The Caribbean Meteorological Organization

Membership

- Anguilla, Antigua and Barbuda
- Barbados
- Belize
- British Virgin Islands
- Cayman Islands
- Dominica
- Grenada
- Guyana
- Jamaica
- Montserrat
- St. Kitts/Nevis
- St. Lucia
- St. Vincent and the Grenadines
- Trinidad and Tobago
- Turks and Caicos Islands
CIMH MANDATE

“…to assist in improving and developing the Meteorological and Hydrological Services as well as providing the awareness of the benefits of Meteorology and Hydrology for the economic well-being of the CIMH member states. This is achieved through training, research, investigations and the provision of related specialized services and advice”.

PRIMARY FUNCTIONS

- Train various categories of meteorological and hydrological personnel
- Operate as a centre of research in meteorology, hydrology and associated sciences
- Data collection, storage, & dissemination
- Maintain, repair, and calibrate meteorological & hydrological instruments
- Advise regional governments on matters related to meteorology & hydrology
- Provide consulting services to industry
Climate Change
What Has Been Predicted for the Caribbean?
• Increases in concentrations of these gases since 1750 are due to human activities in the industrial era. Concentration units are parts per million (ppm) or parts per billion (ppb), indicating the number of molecules of the greenhouse gas per million or billion molecules of air.
Observed and Projected Global Average Temperatures

- Observed and projected changes in the global average temperature under three IPCC no-policy emissions scenarios. The shaded areas show the likely ranges while the lines show the central projections from a set of climate models. A wider range of model types shows outcomes from 2 to 11.5°F. Changes are relative to the 1960-1979 average.
Warmer Temperatures

Mean changes in the annual mean surface temperature for 2071-2099 with respect to 1961-1989, as simulated by PRECIS (ECHAM) and PRECIS (HADCM3) for SRES A2 (high emissions) and SRES B2 (low emissions). CSGM, UWI.
Extremely hot days (\(T_{\text{max}} \geq 35^\circ\text{C}\))

- Northern Caribbean present simulation shows approximately up to 20 days with the future projection to increase to over 80.
- Eastern Caribbean shows a modest increase from practically no extremely hot days to up to 20.
- For the Southern Caribbean and Guyana in the Present simulation there are areas where there are no extremely hot days projected to experience up to 20 in the future.
- Southwest Guyana the Present range 20-80 extremely hot days per year is projected to be over 100.
Tropical nights ($T_{\text{min}} \geq 25^\circ\text{C}$)

- Northern Caribbean Present simulations show up to 20 tropical nights with a projected increase to 100-250
- Eastern Caribbean the projected increase goes from 20-40 tropical nights to at least 80-200
- Southern Caribbean from 0-20 tropical nights projected to 20-40+
- Southwest Guyana projected increase from up to 20 tropical nights to over 250
Annual precipitation change

Caribbean

percent

-40 -30 -20 -10 0

1900 1925 1950 1975 2000 2025 2050 2075 2100

- 20th century simulations
- Low emissions scenario (B1)
- High emissions scenario (A2)
General tendency for drying (main Caribbean basin) by end of the century. Drying between 25% and 30% Possibly wetter far north Caribbean NDJ and FMA. Drying exceeds natural variability June-October – wet season dryer!

Mean changes in the annual rainfall for 2071-2099 with respect to 1961-1989, as simulated by PRECIS_ECH and PRECIS_Had for SRESA2 and SRESB2. CSGM
Projections for the Caribbean region

Scenarios for Future Climate

• 0.5-4.2 °C from 2010 to 2099
• Drier mid-year, wetter end of year
• Sea level rise - 35-50 cm over the next 50 years
• Indications of more persistent ENSO-like conditions: less but more intense more intense tropical storms (10-20% wind speed increase)
• Ocean acidification
Current Climate Trends
Temperature Trends in Grenada

No. of Days Minimum Temperature >25 Degrees in June [MBIA, Grenada]

No. of Days Maximum Temperature > 30 Degrees - June [MBIA, Grenada]

No. of Days Minimum Temperature >25 Degrees - Annually [MBIA, Grenada]

No. of Days Maximum Temperature > 30 Degrees - Annually [MBIA, Grenada]
Temperature Trends in Trinidad and Tobago

June Temperature Trends
[St Augustine, Trinidad]

Annual Temperature Trends
[St Augustine, Trinidad]

June Temperature Trends
[Piarco, Trinidad]

Annual Temperature Trends
[Piarco, Trinidad]
Temperature Trends in Trinidad

No. of Days Minimum Temperature > 25 Degrees - Annually
[St Augustine, Trinidad]

No. of Days Maximum Temperature > 30 Degrees - Annually
[St Augustine, Trinidad]

No. of Days Minimum Temperature > 25 Degrees - Annually
[Piarco, Trinidad]

No. of Days Maximum Temperature > 30 Degrees - Annually
[Piarco, Trinidad]
Not much Statistically Significant Difference noted for RAINFALL
Implications of Current and Future trends for Caribbean Agriculture
Agriculture and CC

- Temperature – more days above optimum threshold, shorter duration in fields
- Temperature – heat stress in animals and plants (floral drop)
- Increased duration of cropping season poleward (change in markets?, increased imports to the regions of traditionally tropical products?)
- Sea Level rise – salinisation of agricultural soils
- Reduced total rainfall – lower soil water availability for crops and livestock.
- Coupled with the lower moisture regimes and higher temperature will be an increase in evaporation with even lower water availability
- Increased rainfall rates – flooding, increased soil erosion
- Shifts in rainfed growing season
- Cyclones – damage to crops, loss of animals, loss to agricultural infrastructure, increased insurance premiums
Crop Simulation Modelling
Application to Climate Change

Belize
Crop Simulation Modelling
Application to Climate Change

Grain Yield Planting on July 4th

Grain Yield Planting on July 19th

Grain Yield Planting on August 4th

Grain Yield Planting on August 19th
Historical vs Future yield of Maize in Grenada

Box Plot of Harvested yield (kg/ha)

Treatments 1-4 historical; treatments 5-8 end of century on four different planting dates – 4 July, 19 July, 4 August, 19 August
Irrigation requirements (mm) for maize Historical vs Projected for four planting dates

Grenada
Droughts Always A Feature of Caribbean Climate
More Frequent In The Future

3-month SPI for Maurice Bishop International Airport

Years
Index
## Occurrence of Drought

### Occurrences of Drought for MBIA (3mth SPI)

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<th>July</th>
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# Occurrence of Drought

## Occurrences of Drought for MBIA (6mth SPI)

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Agriculture the First to be impacted
What next for a potentially brighter future

ADAPTATION
Adaptation

• Reduced rainfall – Planting dates, efficient irrigation, drought tolerant crops, water harvesting, variety/species…

• Increased rainfall intensity – Improve drainage, avoiding flood prone areas…

• Higher temperatures – Heat tolerance,

• Tropical Cyclones – Germplasm banks, root crops

• Mainstreaming CC into Agri Sector

• EARLY WARNING SYSTEMS
EWS

- An early warning system facilitates the provision of timely and effective information, through identifying institutions, that allow individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response (ISDR, 2003).
- Weather and Climate Extremes (hazards?) a concern with Climate Change
- Weather and Climate Services – need to keep pace
- Climate Change is a Climate Issue!!
- Creating a culture of weather/climate data and information use in agriculture - CAMI
The Caribbean Agrometeorological Initiative (CAMI)

- Funded by the European Union’s African Caribbean Pacific Group of Countries, Science and Technology Programme
- Partnership between CIMH (Applicant), World Meteorological Organization (WMO), Caribbean Agricultural Research & Development Institute (CARDI), Ten Meteorological Services
- The total cost of the Action is estimated at 1,112,714.40 EURO
- The Contracting Authority undertakes to finance a maximum of 720,388.20 EURO, equivalent to 64.74% of the estimated total eligible cost of the action
The overarching objective of the Action is to increase and sustain agricultural productivity at the farm level in the Caribbean region through improved applications of weather and climate information using an integrated and coordinated approach.
Specific Activities of the Action

• Rainy season prediction through analysis of long-term climatic data and use of seasonal to inter-annual climate prediction models

• Use of rainy season prediction and near-real time weather information to support management decisions such as especially irrigation scheduling

• Working with the agricultural research and extension agencies in developing an effective pest and disease forecasting system
• Preparation and wide diffusion of a user-friendly weather and climate information newsletter for the farming community

• Organization of regular forums with the farming community and agricultural extension agencies to promote a better understanding of the applications of weather and climate information

• Building capacity of the Meteorological and Agricultural Services and research institutions
Caribbean probabilistic rainfall forecasts

Deciles for January to March 2010

Drought and rainfall monitoring

Irrigation efficiency necessary
Caribbean probabilistic rainfall forecasts

Drought and rainfall monitoring

Precipitation Outlook for the Caribbean
January - February - March 2011
Prepared by
The Caribbean Institute for Meteorology and Hydrology
3CM probabilistic $T_{2m}$ forecasts – UKMO (left), ECMWF (right)

Probability of tercile categories Jul/Aug/Sep Issued Jun 2012

above-normal 2m temperature

near-normal 2m temperature

below-normal 2m temperature

ABOVE

NORMAL

BELOW
Pests and Diseases Modelling

- CAMI working with the University of Florence
- Untested models developed for Black Sigatoka, Citrus Greening, Whitefly and Soyabean Rust,
- Need validation in the field to finally calibrate model
- Data on the diseases/pests needed
ANNOUNCEMENTS
CAMI will be conducting an e-discussion that will embrace the suite of issues related to weather and climate influences on agriculture in the Caribbean, particularly issues that would have been raised in last years farmers’ forums. If interested in joining the discussion send an e-mail to atrotman@cimh.edu.bb. CAMI continues to urge the National Meteorological Services to maintain regular contact with their farmers and extension services. The formation of tripartite (meteorologists, farmers and extension officers) committees to sustain activities at the national level have been recommended and are being pursued. CAMI encourages and will assist its meteorological services in developing their own national bulletins. CAMI collaborators continue to encourage feedback from farmers and the wider agricultural community on this bulletin.
THE END
Thank You!