Agriculture Extension and Advisory Services under the New Normal of Climate Change

Speakers
Brent M. Simpson, Michigan State University
Gaye Burpee, Catholic Relief Services

Facilitator
Zachary Baquet, USAID Bureau for Food Security
Upcoming Agrilinks Events:

- #AskAg Twitter Chat | March 8th | Int’l Women’s Day
- #AskAg Twitter Chat | March 22nd | World Water Day
- Ag Sector Council | March 27th | GrainPro
The MEAS symposium will feature presentations based on case studies and other research conducted through the MEAS project over the past year. The detailed program is available at: www.meas-extension.org/workshops/.symposium-2013

Please register by May 1, 2013.
Brent M. Simpson
Michigan State University

Brent M. Simpson is Associate Professor, International Development, in the Department of Agriculture, Food and Resource Economics at Michigan State University (MSU). Over the past 30 years he has worked in over twenty countries, primarily in Africa. Currently he serves as the Deputy Director of the USAID-funded Modernizing Extension and Advisory Service (MEAS) Project, a Feed the Future initiative, and manages MSU’s involvement several international agricultural development efforts. Dr. Simpson has his M.Sc. in Agriculture Extension and Education, and Ph.D. in Resource Development, both from Michigan State University.
Gaye Burpee
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Gaye Burpee is Catholic Relief Services’ Senior Advisor on Climate Change and Rural Livelihoods for Latin America and the Caribbean. She oversees the region’s work at the nexus of climate change, rural livelihoods and natural resources. Dr. Burpee studied sociology and Latin American studies at Scripps College in California and has M.S. and Ph.D. degrees in soil science and sustainable agriculture from Michigan State University.
Agriculture Extension and Advisory Services under the New Normal of Climate Change

Brent M. Simpson
Michigan State University
Deputy Dir. Modernizing Extension and Advisory Services (MEAS) Project

Gaye Burpee
Catholic Relief Services, Senior Advisor
Climate Change & Rural Livelihoods in the LAC
Major Themes Covered

- Context
- The *New Normal* of Climate Change
- Important Concepts & Perspectives
- Current Practices & Best Prospects
World Bank: 100 percent increase in cereal production by 2050;

FAO: 70 percent increase in cereal production by 2050.

USAID: 60-70 percent Increase in cereal production by 2050

*A 60 – 70 % increase is equivalent to the addition of the total global cereal production in 1979/1985.
Context – Agricultural Land

WORLD CEREALS PRODUCTION AND YIELDS

Million metric tonnes / million hectares

Production (MMT)
Yield (Tonnes/Ha)
Area Harvested (Million Ha)

Tonnes / hectare

SOURCE: UN Food and Agriculture Organization
Context – Closing the Yield Gap

Context – Agricultural Input Usage

Agriculture uses 70 – 80 percent of fresh water.
Agriculture – Big Picture
Agriculture uses approximately **12 percent** of total energy.
• Direct energy costs of fuel and fertilizers account for roughly 28% of the crop budget in industrialized agriculture;
• Transportation costs contribute 40-50% to final food costs.
Context – Food & Energy Prices

FAO Food Price Index vs Brent Oil Price

- Oil price in $ per barrel
- Food Price Index

Graph showing the comparison between the FAO Food Price Index and the Brent Oil Price from January 2000 to January 2011.
Context – Food Prices

FAO Food Price Index

Nominal

Real*

* The real price index is the nominal price index deflated by the World Bank Manufactures Unit Value Index (MUV)
Context – Food Prices & Social Tensions

Climate Change:
- Trends
- Disruption
The New Normal

For 650,000 years, atmospheric CO₂ has never been above this line ... until now

**CO₂**

Current level

1950

YEARS before today (0 = 1950)

CO₂ parts per million

160 180 200 220 240 260 280 300 320 340 360 380 400 420 440

400,000 350,000 300,000 250,000 200,000 150,000 100,000 50,000 0
The New Normal

CO₂ Concentrations and Temperature Have Tracked Closely Over the Last 300,000 Years

Jan., 2012

395 ppm

350 ppm
The New Normal

Variations of the Earth's surface temperature: year 1000 to year 2100

Departs in temperature in °C (from the 1990 value)

Observations, Northern Hemisphere, proxy data

Global instrumental observations

Projections

Several models all SRES envelope

Bars show the range in year 2100 produced by several models

Scenarios
- A1B
- A1T
- A1F1
- A2
- B1
- B2
- IS92a

United Nations Environment Programme / GRID-Arendal
New Normal – Trends

Gravity Satellite Ice Sheet Mass Measurements

Greenland Ice Sheet

Antarctic Ice Sheet

Blue: Sea level change from tide-gauge data (Church J.A. and White N.J., Geophys. Res. Lett. 2006; 33: L01602)
Red: Univ. Colorado sea level analyses in satellite era (http://www.columbia.edu/~mhs119/SeaLevel/).
New Normal – Trends

Diagram showing the trend of total glacier ice decline (in cubic miles) from 1960 to 2000.
East Asia Monsoon

- The mean wind speed (m/s) decreased from 2.0 in 1965 to 2.5 in 2000.
- The number of windy days with daily mean wind speed greater than 5 m/s increased from 15 in 1965 to 45 in 2000.

Mathematical Expressions:

- Mean wind speed (m/s): $Y = -0.02161X + 45.275$ ($R^2 = 0.94$, $p < 0.001$)
- Windy days with daily mean wind speed >5m/s (day): $Y = -0.8022X + 1620.66$ ($R^2 = 0.95$, $p < 0.001$)

New Normal – Trends
New Normal – Trends

Precipitation changes: trend over land from 1900 to 1994

Precipitation decreasing by:
- 20%
- 10%
- 5%
- 2%

Precipitation increasing by:
- 2%
- 5%
- 10%
- 20% between 1900 and 1994

Sources: Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge press university, 1996; Hulme et al., 1991 and 1994; Global Historical Climate Network (GHCN), Vose et al., 1995 and Eschaid et al., 1995
Temperature trends (in standard deviations) for maize, wheat, rice and soy producing areas 1980 – 08

Precipitation trends (in standard deviations) for maize, wheat, rice and soy producing areas 1980 – 08

(Source: Lobell et al., 2011)
New Normal – Investment Impacts

Africa Region

Rainfall

5 year GDP per capita growth rates

Indicators presented as mean relative variables


Source: Barrios et al 2003
Climate Change:

- Trends
- Disruption
New Normal – Disruption

National Rainfall Deviation
from the mean 10 Years Running Mean

Source: Zimbabwe Department of Meteorological Service at http://weather.utande.co.zw/climate/climatechange.htm
New Normal – Disruption

Annual Frequency of North Atlantic Tropical Storms
(ten-year running average)


1948-1957
1992-2001
1998-2007
New Normal – Disruption

Flooding

Source: Millennium Ecosystem Assessment
*It is projected that by 2100 average temperatures will exceed current maximums in areas such as W. Africa.
New Normal – Disruption

Wild fires

Source: Millennium Ecosystem Assessment
New Normal – Disruption

Number of Extreme Weather Events Worldwide, by Year

- Drought
- Extreme temperature
- Flood
- Storm
- Wildfire
The New Normal -- Summary

- Climate change...
  - Complex & non-linear
  - Linkages & feedback loops
  - Tipping points & inertia
  - Very long lasting
Agriculture under New Normal -- Summary

- Greenhouse Gases
  - Temperature Increases
    - Seasonality
    - Daytime highs
    - Nighttime highs
    - Melting land/sea ice
    - Increased atmospheric moisture
    - Increased Frequency & Severity; out of season
    - Sea level rise
    - Inundation/Salinization
    - Loss of irrigation water
    - Rainfall Patterns
    - Continental/sub-Continental monsoon
      - Plant maturation
      - Grain fill
      - Sterilization
      - Respiration
      - Flowering
      - Pollinators
      - Pests
      - Photosensitivity

New Normal --
Risk, Vulnerability, Resiliency

Locating, Scaling, Phasing and Pairing of Interventions
- Spatially appropriate for the need/opportunity (plot vs landscape)
- Temporal phasing to maximize benefits during window of opportunity
- Pairing technical and infrastructure investments with those strengthening social capacity to match the needs/opportunities

Systems Thinking
- Responding to and anticipating linkages between system components
- Applying broad principles that achieve multiple objectives

Technology Transfer
- Lessons from the past, and from other places
  - Practices from areas that are already drier/wetter, hotter, more risk prone (this will buy time for research to address anticipated needs)

Innate Adaptive Capacities
- Relying on farmer’s abilities to adapt new tools to their local context
  - When to apply new practices/tools
Agricultural Extension and Advisory Services:

- Mitigation
- Adaptation
- Vulnerability & Resiliency
Agriculture is responsible for up to one-third of all GHG emissions -- the very act of feeding ourselves is a major part of the problem.

By necessity, extension and advisory services will need to become involved in mitigation efforts.
There are approximately 1.8 billion small-holders managing 22.2 million sq. km of the earth’s surface that have tremendous potential in sequestering carbon in soils and woody biomass.

12.5 billion trees have been planted
Agricultural Extension and Advisory Services:

- Mitigation
- Adaptation
- Vulnerability & Resiliency
Agriculture -- Adaptation

How did farmers’ adapt?
- changed location of where crops were planted;
- acquired new varieties of existing crops;
- adopted or expanded cultivation of new crops;
- changed land use

*EAS did not respond – the assumption was that things would return to “normal.”
Agriculture under the *New Normal*

Agricultural Extension and Advisory Services:

- Mitigation
- Adaptation
- Vulnerability & Resiliency
1998 Hurricane Mitch & Honduras

- 1998: 200-yr. hurricane
- 180 mph winds
- 1270 mm (50 in.) rain
- HN - 22,000 deaths
- HN -500,000 lost homes
- CA -- economic losses of US$7 billion
- Agricultural losses-$2.3b
- HN-32% farmers total crop losses
- HN -10,000 ha – topsoil stripped
  (World Neighbors, 2000)
Post-event analysis (1)

• Conservation agriculture plots (permanent veg. cover, rotations), SWC - contour hedges, vetiver, rock barriers, etc.
  – 58-99% less damage than conventional
  – 28-38% more topsoil
  – 2-3 times less surface erosion

• Gullies, landslides above – same damage to conservation and conventional plots

(World Neighbors, 2000)
Post-event analysis (2)

- Increased demand for, adoption of NRM extension
- Lessons:
  - EAS needs to support and seek behavior change at HH, plot and watershed management levels
  - Crisis as a catalyst for change
# Trends in Agriculture - Investments

<table>
<thead>
<tr>
<th>Year</th>
<th>Global Foreign Aid (%)</th>
<th>US Foreign Aid (%)</th>
<th>World Bank Aid (%)</th>
<th>Latin America Budgets (% to Agric.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978-80</td>
<td>17</td>
<td>25</td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td>1988-90</td>
<td></td>
<td>6</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>2002-6</td>
<td>3</td>
<td></td>
<td>8</td>
<td>2.5</td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td>1</td>
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</tbody>
</table>


- Globally, public investment in agriculture and extension decreased from 1980 to the 2000s.
- $\leq 70\%$ drop in $ to LAC extension over 3 decades. Yet agriculture = 15 - 30\% of national economies. (IFPRI, 2009)
• 70+% of soils in Africa and 80% soils in Central America are degraded
• Soils research virtually stopped in 1990s (Lutz, 1994) and has not been a priority since.
Predicted temperature & precipitation changes by 2020, Honduras

Mapping changes in bean production, 2020s & 2050s

- **Adaptation Spots:**
  - 25-50% yield losses of maize, beans
  - Focus on adaptation of production systems

- **Hot Spots:**
  - > 50% yield losses
  - Maize-beans, no longer an option. Transition out of current livelihoods.

- **Pressure Spots:**
  - > 25% yield gains
  - High risk of agricultural incursion and deforestation
Managing uncertainty: Hot spots for bean production
- Estimated CA maize & bean losses - $122m annually (conservative)
- Soil health – critical for maize resilience
Maize Losses by 2029 – Central America

<table>
<thead>
<tr>
<th>DECADE</th>
<th>POOR SOIL (% yield loss)</th>
<th>GOOD SOIL (% yield loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020s</td>
<td>32.2</td>
<td>1.1</td>
</tr>
<tr>
<td>2050s</td>
<td>33.5</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Source: CRS, CIAT, CIMMYT; 2012.

- Maize losses by soil quality, El Salvador
- 30-33% on poor soils vs. 1-2% on good soils

- Central America: Maize losses by 2029
- Production losses -328,000 tons
- Economic losses-$102,400/year
The migration of coffee, Nicaragua

**GRANJA JUAN ANA**

Análisis de capacidad post-cosecha

- **640 m²**
- **5.68 QQ pergamino/m²**
- **90 días de cosecha (35 días pico)**
- **promedio de 14 días/partida**

The migration of coffee, Nicaragua (CUP, 2011)

*Optimal altitudes for coffee production + quality*

- **1200 m (2010)**
- **1400 m (2020)**
- **1600 m (2050)**
Impact of temperature rise on robusta coffee in Uganda

Establish close working relations with research programs to identify:

- Risk & profile of impacts
- Location and geographic extent of threats & opportunities
- Likely timing of impact
- Vulnerability and resilience of human populations & natural resource systems
• Seek interventions that capitalize on multi-win, no regret options:

  ➢ Technologies to improve well-being (productive/profitable/secure) and improve mitigation/adaptation/resiliencies

  ➢ Address both technical and social organization aspects to reduce vulnerability and enhance resiliency

  ➢ Identify potential market and non-market incentives
Best Prospects/Recommendations (3)

- Enhance technology transfer capabilities:
  - Aggressively develop/refine new technical and social management options
  - Establish national platforms for networking and exchange of experience
  - Participate in regional fora; become skilled at prospecting cross-regional and global resources
  - Streamline procedures for technology release
Best Prospects/Recommendations (4)

- Identify different ICT applications for different target audiences:
  - Forecasting and early warning systems for policy-makers
  - Weather information for farmers
  - Warning systems for at risk populations, floods for example
• Upgrade pre-service education and in-service training programs:

  ➢ climate change dynamics

  ➢ a broad systems orientation on issues of scale, multi-benefits and biophysical relations

  ➢ technical competencies in areas relevant to adaptation, mitigation and the strengthening local resiliencies

  ➢ Learn to communicate the essential character of climate change to farmers
• Conduct organizational reviews on core roles and responsibilities:

  ➢ identify and remove programmatic barriers

  ➢ capitalize on potential operational synergies between separate EAS programs (e.g., crops, forestry, livestock, etc.)

  ➢ bring coordination and coherency to public and donor funded EAS efforts

  ➢ help orientate private sector interests to emerging climate change challenges and opportunities
• **Balance policies and investments:**

  - scales that matters
  - harmonize conflicting policies
  - plan for building-up accompanying EAS capacities (starting with investments in education and training programs)
This presentation was given by:

Brent M. Simpson, Michigan State University
and
Gaye Burpee, Catholic Relief Services
on behalf of the Modernizing Extension and Advisory Services (MEAS) Project
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