SCARCE NATURAL RESOURCES: THREATS TO AGRICULTURE
The Environment matters...

- Global food system is transforming
  - Links between food and fuel
  - Fiscal uncertainty adds complexity
- A changing climate reduces predictability and increases the likelihood of extreme events
  - Risk of weather-related agricultural impacts growing
  - The need for information that is comparable, timely and global is increasing
- Satellite remote sensing is a starting point for such information systems
- Allows detection of trends in observational networks which are far more certain than those seen in climate models
What can we see with remote sensing?

- Rainfall
- Clouds
- Humidity
- Soil Moisture
- Floods
- Biomass
- Photosynthetic Activity
- Land use
- ... and many others
Information on...

- Land use and land cover – where are the farms and what is being cultivated?
- Clouds, rainfall and moisture availability monitoring for agriculture
- Health of the plants and the consequence for crop yield
Global Analysis of Land Cover change

- Land transformation to increase agricultural production
- Impacts on biotic diversity worldwide, soil degradation, and the ability of biological systems to support human needs.
- Land-use/cover changes also determine, in part, the vulnerability of places and people to climatic, economic, or sociopolitical perturbations

<table>
<thead>
<tr>
<th></th>
<th>Forest/woodland (10^6 ha)</th>
<th>Steppe/savanna/grassland (10^6 ha)</th>
<th>Cropland (10^6 ha)</th>
<th>Pasture (10^6 ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1700</td>
<td>5000 to 6200</td>
<td>3200</td>
<td>300 to 400</td>
<td>400 to 500</td>
</tr>
<tr>
<td>1990</td>
<td>4300 to 5300</td>
<td>1800 to 2700</td>
<td>1500 to 1800</td>
<td>3100 to 3300</td>
</tr>
</tbody>
</table>
Increases in Agricultural Production

Increase in world food production and agricultural inputs from 1961 to 1996 based on FAO data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number-fold increase in 135 years (1861-1996)</th>
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<tbody>
<tr>
<td>World food production</td>
<td>1.97</td>
</tr>
<tr>
<td>Land under cultivation</td>
<td>1.098</td>
</tr>
<tr>
<td>Proportion of irrigated land</td>
<td>1.68</td>
</tr>
<tr>
<td>Nitrogen Fertilization</td>
<td>6.87</td>
</tr>
<tr>
<td>Phosphorus Fertilization</td>
<td>3.48</td>
</tr>
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Total Agricultural Production (2004-2006 = 100)
Food Demand, Markets and Ecosystems: influence of Climate Change

As populations and incomes rise, the global demand for food will also grow – probably roughly doubling by 2050 and shifting towards more water-demanding diets.

IAASTD 2008
Global Agricultural System
Information on...

- Land use and land cover – where are the farms and what is being cultivated?
- Clouds, rainfall and moisture availability monitoring for agriculture
- Health of the plants and the consequence for crop yield
Real-time rainfall data are being used for flood forecasting, but in many developing countries rain gauging stations are either not available or are too sparsely available to develop representative aerial samples. Satellite-derived rainfall products are useful for flood forecasting.

Flooding event in Pakistan, India, and Thailand 2004
Potential Landslide areas

Rainfall data from TRMM

November 6, 2011
Soil Moisture products

GLDAS Soil Moisture (% Vol)

2007-01-01 06:00
Information on...

- Land use and land cover – where are the farms and what is being cultivated?
- Clouds, rainfall and moisture availability monitoring for agriculture
- Health of the plants and the consequence for crop yield
Vegetation Index Seasonality
Monitoring production - wheat
Increasing the usefulness of these data products...

- Integrated management systems that bring economics and supply concerns together with weather

- Two examples described here:
  1. Early warning systems for famine early warning
  2. National Integrated Drought Information System (NIDIS) in the Colorado River basin

- Detecting and responding to trends
1. Famine Early Warning Systems Network

FEWS NET is a USAID-funded activity that works to strengthen the abilities of countries and regional organizations to manage risk of food insecurity through the provision of timely and analytical early warning and vulnerability information.

August-Sept 2011

Geographic Extent of FEWS NET’s 23 countries with offices and those with extended remote monitoring
Food Security is achieved with three elements:

**Individual:** Prevalent diseases, malnutrition, care of infants, feeding and food preparation practices, presence of health & sanitation facilities, water supply characteristics, etc...

**An area:** Crop planting date, vegetation or crop condition, amount & timing of rain, drought, market availability of food, food prices, imports, exports, public stocks, household stocks, wild food availability, etc...

**Household/community:** Local household food crop & animal production, household sales of goods & services, conditions of other income sources, labor wage rates, food aid, assets, etc...

From Gary Eilerts, USAID
Satellite Products

- Vegetation, rainfall and humidity for flood and drought detection
- Satellite data used together with Earth Science Models to link weather to food security impacts for quantitative assessments
Diversified and targeted information products
And an integrated early warning information system....
2. US National Integrated Drought Information System (NIDIS)

- Focuses on slow-onset droughts
- Absence of a universal definition leads to confusion and inaction on the part of national leaders
- Severity of droughts are described through multiple indicators and indices
- Impacts are non-structural and spread over large areas – mitigation is less obvious
- **Drought Preparedness** in the US has been slow
National Integrated Drought Information System (NIDIS)

- **Vision**: a dynamic and accessible drought information system that provides users with the ability to determine the potential impacts of drought and the associated risks they bring, and the decision support tools needed to better prepare for and mitigate the effects of drought

- **Requires**:
  - A national drought monitoring and forecasting system
  - A drought early warning system
  - An interactive information delivery system that links into response and decision making
National Integrated Drought Information System
U.S. Drought Portal
www.drought.gov

Area Drought Information

Maps & Tools
- Map & Data Viewer
- GCE Portal
- Drought Monitor Graphics
- CRN Soil Data

Events & Announcements
- 36th Annual Climate Diagnostics and Prediction Workshop
- Navajo Drought Declaration Reaffirmation June 2011
- 2011 Southern US Drought Impacts and Assessment Workshop
- May 23, 2011 Southern Drought Briefing
- NIDIS Engaging Preparedness Workshop June 8-9, 2011
- NIDIS Engaging Preparedness Communities WC Survey
- Workshop on Drought Monitoring & Early Warning – May 10th, 2011
- NHWC Training Conference and Exposition – May 9-13, 2011

Regional Drought Webinars
- Colorado - weekly, 12PM EDT
- Southeast - Briefing Presentation, October 25th, 2011
- South Central Drought Briefing – Oct 27th, 11 AM CDT

Drought In The News
- Hay Shortage Compounds Woe in Drought-Stricken Texas - NYTimes.com
- Texas winter vegetable outlook wets in drought - chron.com
- Drought plan amendment to preserve face levels needs approval from Ga., SC - The Augusta Chronicle

Featured Products

U.S. Drought Monitor
November 8, 2011

Regional Drought Early Warning Systems (DEWS)

Drought Information Statements

Click on a highlighted area to view the current NWS Drought Information Statement or Click Here to select from a list
Drought conditions for November 8, 2011

No drought
D0 Abnormally Dry
D2 Drought - Moderate
D3 Drought - Severe
D4 Drought – Extreme
D5 Drought - Exceptional
NIDIS seeks to understand climate risk for the Colorado River Basin.

- Climate data records
  - Temperature and precipitation – using observations to better understand and attribute trends to climate processes
  - Connecting trends in weather to socio-economic conditions
    - Demand for water in agriculture
    - Development policies for residential demand
  - Understanding weather impact within a context
Trend Detection and Attribution

- Long rains in central **Kenya** have declined more than 100 millimeters since the mid-1970s.
- This decline is probably **linked to warming in the Indian Ocean**, and seems likely to continue.
- A warming of more than 1° Celsius may exacerbate drying impacts, especially in lowland areas.
- The drying trends could particularly impact densely populated areas to the east, north, and north-west of Nairobi.
Climate Change in regions sensitive to food production declines

Precipitation declines linked to increasing sea surface temps in the Indian Ocean

Knowing about these changes allows adaptation in region


Figure 1. Climate change in Kenya: Average location of the 500 millimeter rainfall isohyets for the years 1975 (light brown), 1995 (dark brown), and 2025 (predicted, orange). The green polygon in the background shows the main crop surplus region of Kenya.
Summary

- Information on environment
  - Global satellite data provides information on land use, rainfall, soil moisture, vegetation vigor and crop yields
- Integrated analysis allows the transformation of these data into information that can be used to assess impact of weather on agriculture
- Trends in rainfall and temperature and their impacts on production can be mitigated with information
- Better understanding of weather impacts provides benefits to the entire food industry
Thank you!