Foreign Agricultural Service (FAS) of USDA

Linking U.S. agriculture to the world to enhance export opportunities and global food security

FAS Attachés Cover Over 70% of Global Land Area, and 85% of Foreign Global Population

- FAS is primarily responsible for USDA’s:
  - Overseas activities with attachés located at 75 posts
  - Market development,
  - International trade agreements and negotiations,
  - Collection and analysis of statistics and market information.

United States: Crop estimates (supply/demand) prepared every month by USDA’s NASS (National Agricultural Statistical Service).

Foreign Countries: Crop estimates (supply/demand) audited & published every month by USDA’s ICEC (Interagency Commodity Estimates Committee):
- WAOB (World Agricultural Outlook Board)
- FAS (Foreign Agricultural Service)
- ERS (Economic Research Service)

- World Agricultural Supply & Demand Estimates (WASDE) estimates released to commodity markets on the 9-12th day of each month at 8:30AM.
- PSD Online from FAS provides historical and current crop estimates.

Chicago Board of Trade (CBOT) & other commodity markets

USDA/FAS Economic Analysis

USDA Publications

Trade Policy
Exporter Assistance & Export Programs
Food Aid & Export Credit Programs
UMR (Usual Marketing Requirements)

USDA decision-makers
U.S. Ag Producers & Traders
Commodity Price Discovery
Commodity Price Adjustments

March 31, 2010

USDA/FAS/OGA/IPAD
The Day of Lock-up

• **Why:** Maintain integrity with level playing field
• **How often:** Monthly, second week
• **When:** 2:00 a.m.
• **Where:** Secured wing in South Building
• **What:**
  – Incorporate NASS domestic estimates
  – Finalize PSDs and reports
  – Secretary Vilsack briefed and **WASDE report is released at 8:30 a.m.**, before markets open
  – FAS reports and databases released at 9:00 a.m.
USDA’s Economic Intelligence System

- **Lockup End Results:** Monthly estimates for each country are available on the internet at:
  - WASDE Circular from WAOB released on the **9-12th day of each month at 8:30AM.** (since Sept. 1973)
  - Monthly World Production, Market and Trade Reports
  - PSD Online from FAS
    - http://www.fas.usda.gov/psdonline/

March 31, 2010
Goals of USDA’s Economic Intelligence System

• Objective
  – Provide independent and unbiased information for commodity markets.

• Reliable
  – Best available information at current point in time.
  – Analysis based on sound data.

• Timely
  – Scheduled and immediate release for public, traders and commodity markets.
FAS Office of Global Analysis (OGA)
International Production Assessment (IPAD) Division

IPAD’s Mission Statement:
Produce the most objective and accurate assessment of the global agriculture production outlook, and the conditions affecting global food security.

• USDA’s “Production and Supply Database” (PSD Online) is used for market intelligence (http://www.fas.usda.gov/psd/)

  – LACIE (mid-1970’s): researched how to monitor agriculture with Landsat & NOAA satellite series.
IPAD Data Sources & Output Products

- FAS Field Travel
- Official Country Reports
- News Wire Services
- FAS Attaché Reports
  (http://www.fas.usda.gov/)

- Weather Data (stations & satellites)
- Crop models (stations & satellites)
- Vegetation Data (satellites)
  - Medium-resolution & temporal coverage
    - NOAA-AVHRR (1 & 8-km)
    - SPOT-IV (1-km)
    - MODIS (250-meters)
  - Fine-resolution satellites
    - Landsat-7 (30-meters with 185-km swath width)
    - AWiFS on IRS satellite (70-m with 740-km swath width)

Crop Production Estimates Released Each Month
- World Agricultural Supply & Demand Estimates (WASDE)
- World Agricultural Production (WAP) Circular
- Production & Supply Database (PSD Online)

10 GIS Regional Analysts

March 31, 2010

USDA/FAS/OGA/IPAD

NOAA-AVHRR (1 & 8-km)
SPOT-IV (1-km)
MODIS (250-meters)
Landsat-7 (30-meters with 185-km swath width)
AWiFS on IRS satellite (70-m with 740-km swath width)
Summary Satellites Used by IPAD

- **Geo-stationary satellites** monitor *weather (rainfall & temperature)* which is collected/processed by US Air Force Weather Agency (AFWA) at 25-km resolution
  - GOES (North & South America)
  - METEOSAT (Europe & Africa), and
  - GMS (Asia and Australia)

- **Polar-orbiting satellites** monitor *NDVI & generate false-color composites* for year-to-year comparisons (at 250-m resolution)
  - *Daily repeat cycle*
    - NOAA-AVHRR (1-km and 8-km resolution),
    - SPOT-VGT (1-km resolution),
    - Terra/Aqua Satellites (MODIS sensor with 250 meter resolution)
    - SSM/I (Special Sensor Microwave Imager (SSM/I, 25-km) to monitor surface wetness
  - *16-day and 24-day (5-day) repeat cycle*
    - Landsat-7 (30-m) and AWiFS (55-m) on IRS

- **Radar altimeter satellites** monitor lake water-level variations (with 10-day overpass)
  - **300+ lakes:** ERS and ENVISAT from ESA
Global Reservoir and Lake Monitor (GRLM)

Source: http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/

GRLM measures reservoir/lake height variations from 1992-present for 70+ lakes worldwide by utilizing satellite radar altimeters.
**Recent Events:**

- **Sept. 17, 2008:** End of Mission for GFO (Geosat Follow-On)
- **June 20, 2008:** Jason-2 or OSTM (Ocean Surface Topography Mission) was launched and follows Jason-1 orbit
- **Feb. 14, 2009:** Jason-2 continues along TOPEX/Poseidon/Jason-1 orbits and Jason-1 moved to new satellite orbit
1997/98 El Niño Effects on East Africa Lakes

Decrease in regional lake water levels after 1997/98 El Nino.

Global Reservoir and Lake Elevation Databases
Click on a blue circle to see Lake Level Variations

http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/
Historical Water Level Elevations for Lake Victoria

Data Source:
Water-level gauge data from Jinja, Uganda (near Lake Victoria’s outlet)
Satellite radar altimeter data from USDS/NASA/UMD at:
http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/

Rapid water level drop after the Kiira Power Station (Owens Falls Extension) is inaugurated in 2003.

Owens Falls Dam (Nalubaale Power Station) at Lake Victoria’s only outlet was commissioned in 1954 at Jinja, Uganda.

On October 21, 2006, water level the lowest since 1923.

Recovery

Graph:
- Water-level Gauge (1900-2004)
- TOPEX/Poseidon (1992-2002)
Different Satellite Orbits and Repeat Cycles

OSTM/Jason-2 Satellite Orbit with 10-day Repeat Cycle

ENVISAT Satellite Orbit with 35-day Repeat Cycle
Global Agricultural Monitoring (GLAM)

(Joint USDA/NASA funded project)

Area

AWiFS (56-m)
Landsat (30-m)

Semi-automated classification algorithms
Change in Area Estimates and Mid-season Dominate Crop Masks

Yield

MODIS-CropNDVI (250-meter)
Time Series Maps and Graphs

Regression and analog year algorithms
Mid-season to End-of-season Yield Estimates and Maps
Precipitation (25-km) to MODIS-NDVI (250-m)
World Meteorological Organization (WMO)

Daily Data Loaded Next Day:
- 24-hour precipitation
- Max Temp
- Min Temp
- Snow Coverage

PECAD Adds to CADRE:
- Average Daily Temperature
- Cumulative precipitation
- Potential ET
- Soil Moisture
- Crop Calendar
- Corn Hazard (Alarm)
- Winterkill Model

“Yesterday’s Weather Delivered Today”

Daily weather data provided by approximately 7000 WMO ground stations

USDA/FAS/OGA/IPAD
Air Force Weather Data (AFWA)

Daily AFWA Data Loaded Next Day:
- 24-hour precipitation
- Max Temp
- Min Temp
- Snow Coverage
- Actual and Potential ET
- Solar and IR Radiation

PECAD Adds to CADRE:
- Average Daily Temperature
- Cumulative precipitation
- Potential ET
- Soil Moisture
- Crop Calendar
- Corn Hazard (Alarm)
- Relative Yield Reduction
- Winterkill Model

Spatial Coverage of AFWA Weather Data

USDA/FAS/OGA/IPAD
CADRE
(Crop Assessment Data Retrieval & Evaluation)

CADRE is a *geospatial* database that stores (in Oracle):

- **Daily weather station data** (from WMO/GTS)
- **Daily weather grid cell data** (from AFWA)
  - Grid cell resolution (25km near equator & 51km near poles)
- **Daily TMPA** (from NASA), **Daily CMORPH** (from NOAA), and **Daily NEXRAD** (from NWS)
## Summary Global Precipitation Data Sets Utilized by IPAD

<table>
<thead>
<tr>
<th>Product/Source¹</th>
<th>Spatial Resolution</th>
<th>Coverage</th>
<th>Infrared Geostationary Satellites (IR)</th>
<th>Passive Microwave (PMW)</th>
<th>Active Radar</th>
<th>Ground Station Gauge (SG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTS/WMO and NOAA/NWS (for USA)</td>
<td>approx. 7500 stations report daily</td>
<td>Global</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>AGRMET/AFWA</td>
<td>47-km at 60° latitude (true) and 25-km at the equator</td>
<td>Global 60° N-S</td>
<td>Yes</td>
<td>SSM/I</td>
<td>No</td>
<td>Yes, GTS/WMO, NOAA/NWS, and others</td>
</tr>
<tr>
<td>CMORPH/NOAA-CPC</td>
<td>8-km at equator</td>
<td>Global 60° N-S</td>
<td>Yes</td>
<td>SSM/I, TMI, AMSR-E, AMSU-B</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>TMPA-RT (3B42RT)/NASA-DISC</td>
<td>0.25 degrees or approx. 28-km</td>
<td>Global/50° N-S</td>
<td>Yes</td>
<td>SSM/I, TMI, AMSR-E, AMSU-B</td>
<td>No</td>
<td>No²</td>
</tr>
<tr>
<td>NEXRAD/NOAA-NWS</td>
<td>4-km</td>
<td>USA/lower 48</td>
<td>Yes³</td>
<td>No</td>
<td>Ground Doppler</td>
<td>Yes, NOAA/NWS</td>
</tr>
</tbody>
</table>

1. USDA/FAS’ CADRE receives daily all precipitation products listed and Crop Explorer aggregates the daily products into 10-day time periods for agricultural monitoring.
2. Station gauges (SG) are added more than one month later to the 3B42RT product to produce an after real-time global precipitation product called 3B42 (V6).
3. Satellite precipitation estimates (SPE) are incorporated in regions where there is limited or no radar coverage.
NEXRAD, NOAA-CMORPH, and TMPA-NASA

NexRad Precipitation
03/11/10 - 03/20/10 Previous 10-day
Click on a U.S. region to view its thematic map.

NexRad Decadal Percent Normal Precipitation
03/11/10 - 03/20/10

TMPA Precipitation
03/11/10 - 03/20/10 Previous 10-day
Click on a U.S. region to view its thematic map.

TMPA Decadal Percent Normal of Precipitation
03/11/10 - 03/20/10
View in Google Earth

CMORPH Precipitation
03/11/10 - 03/20/10 Previous 10-day
View in Google Earth

CMORPH Decadal Percent of Normal Precipitation
03/11/10 - 03/20/10
View in Google Earth

All Cumulative Precipitation Comparison in Indiana CRD 30

Precipitation (Millimeters)
- > 400
- 200 - 400
- 100 - 200
- 50 - 100
- 25 - 50
- 10 - 25
- 1 - 10
- <= 1
- No Data

Decadal Percent of Normal (%)
- > 200
- 150 - 200
- 125 - 150
- 100 - 125
- 75 - 100
- 50 - 75
- <= 50
- No Data

USDA/FAS/OGA/IPAD
CADRE stores **baseline geospatial data sets**:
- Climate 30-year normals & NDVI multi-year averages
- Soils water holding capacity
- Average crop planting dates

CADRE calculates and stores daily soil moisture, crop calendar and crop modeling data.

**2-LAYER SOIL MOISTURE MODEL**
- Estimates soil moisture daily for stations and grid cells.

**CROP STRESS (ALARM) MODELS**
- Meteorological data filters that provide early warning to adverse weather conditions.
- Crop hazard algorithms monitor crop stress for corn, wheat, soybean, sorghum, and barley.
- Flag regional weather anomalies that exceed temperature and soil moisture thresholds for the particular crop.

**CROP MODELS**
- Crop calendar models crop stages for corn, wheat, and sorghum.
- Relative yield-reduction models based on crop water production functions.
- Models include wheat (CERES, AGRISTARS, Maas, & URCROP), corn (AGRISTARS & URCROP), soybean (Sinclair), sorghum (AGRISTARS) & barley (URCROP).
AFWA & WMO Soil Moisture
(modified 2-layer Palmer Model)

AFWA Percent Soil Moisture  View in Google Earth
03/11/10 - 03/20/10  Previous 10-day
Click on a U.S. region to view its thematic map.

WMO Percent Soil Moisture  View in Google Earth
03/11/10 - 03/20/10  Previous 10-day

Percent Soil Moisture (%)
- 90 - 100
- 80 - 90
- 70 - 80
- 60 - 70
- 50 - 60
- 40 - 50
- 30 - 40
- 20 - 30
- 10 - 20
- 0 - 10
- No Data
<table>
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<th>Passive Microwave</th>
<th>Ground Station with Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Station” 2-layer Soil Moisture Model (modified Palmer)</td>
<td>GTS/WMO and NOAA-NWS for USA (USDA/FAS)</td>
<td>16,000 total stations</td>
<td>Global</td>
<td>Daily rainfall and min/max temperatures for PET calculations</td>
<td>No</td>
<td>No</td>
<td>Yes, approx. 7500 stations report daily</td>
</tr>
<tr>
<td>“Grid cell” 2-layer Soil Moisture Model (modified Palmer)</td>
<td>AGRMET/AFWA (USDA/FAS)</td>
<td>47-km at 60° latitude (true) and 25-km at the equator</td>
<td>Global 60° N-S</td>
<td>Daily rainfall and min/max temperatures for PET calculations</td>
<td>Yes</td>
<td>SSM/I</td>
<td>Yes, GTS/WMO, NOAA/NWS, and others</td>
</tr>
<tr>
<td>“Corrected” (AMSR-E) 2-layer Soil Moisture Model (modified Palmer)</td>
<td>AGRMET/AFWA and MODIS/AMSR-E (USDA/ARS/HRS/L)</td>
<td>47-km at 60° latitude (true) and 25-km at the equator</td>
<td>Global 60° N-S</td>
<td>“Grid cell” Soil Moisture “corrected” every 3-days with MODIS/AMSR-E data</td>
<td>Yes</td>
<td>SSM/I and “corrected” with MODIS/AMSR-E data</td>
<td>Yes, GTS/WMO, NOAA/NWS, and others</td>
</tr>
<tr>
<td>Surface Wetness</td>
<td>SSM/I (WeatherPredict Consulting-WPC)</td>
<td>1/3-degree or approx. 37-km</td>
<td>Global/80° N-S</td>
<td>Current week compared to 20-year climatology</td>
<td>No</td>
<td>SSM/I</td>
<td>No</td>
</tr>
</tbody>
</table>
CADRE

CADRE allows data to be displayed:

- **Automatic:** “Crop Explorer” products are displayed on the Internet every 10-days and for summer/winter growing seasons
- **Interactive:** Arcview GIS extractions for any region and time period.
Crop Explorer

(displays numerous weather and vegetation condition data sets over major crop regions every 10-days)

Maps and time-series charts for:

- **Weather Data (AWFA, WMO, CMORPH, TMPA, and NEXRAD)**
  - Dekadal (10-day) precipitation & temperatures compared to climate normals

- **Soil Moisture & Crop Models**
  - Modified Palmer two-layer soil moisture
  - *Behind firewall:* Crop calendars for wheat, corn, & sorghum and corn hazard/alarm model.

- **Vegetation Indices (polar-orbiting satellites)**
  - GAC (8-km) (behind firewall)
  - SPOT-VEG (1-km)
  - MODIS (250-m)

- **Daily MODIS**
  - Aqua and Terra (250-m)

- **Lake/Reservoir Heights**
  - TOPOX/Poseidon, Jason-1, Jason-2
  - GFO
  - ERS, ENVISAT
FAS/IPAD & NOAA/CPC Are Partners with USAID’s FEWS-NET (Africa & beyond)

Growing Season Products for Africa

CPC Rainfall Estimate (RFE) product (8-km) with Meteosat, SSM/I, and ground stations merged

NOAA CPC Source: http://www.cpc.ncep.noaa.gov/products/fews/AFR_CLIM/afr_clim_season.shtml
Growing Seasons for Other Continents?

Regional Climate Maps: South America

Growing Season Products (4-6 months) for South America and other continents??

Southern Africa El Niño Comparison

Percent of Normal Precipitation (%) Based on NOAA/CPC RFE Climatology Method

October 1 2009 – March 28 2010

09/10 El Niño

Percent of Normal Precipitation (%) Based on NOAA/CPC RFE Climatology Method

October 1 2006 – June 3 2007

2006/07 El Niño

Major Grain Basket

NOAA CPC Source: http://www.cpc.ncep.noaa.gov/products/fews/AFR_CLIM/afr_clim_season.shtml
Dryness in southern Zimbabwe

Above-average crop conditions

Data Source:
http://earlywarning.usgs.gov/adds/
Above-average crop conditions along crop tour’s route.

Waterlogged region.
Bothaville, RSA (Feb 25, 2010)

Waterlogged corn near Bothaville

S 27° 21.214' E 026° 40.599'  1323 m  02/25/2010  2:36:44 PM
Albertshoek, RSA
(Crop failure May 2004, but bumper harvest May 2005)

Neutral Year: Feb. 24, 2004
Crop failure in 2004

El Niño Year: Feb. 22, 2005
Average to above-average crop in 2005

- GPS and digital camera data integrated with relative-yield model.
Historical Pacific warm (red) and cold (blue) episodes based on a threshold of +/- 0.5 °C for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)], calculated with respect to the 1971-2000 base period. For historical purposes El Niño and La Niña episodes are defined when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

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<th>FMA</th>
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<th>MJJ</th>
<th>JJA</th>
<th>JAS</th>
<th>ASO</th>
<th>SON</th>
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### Historical El Niño and La Niña Episodes
Based on the ONI computed using ERSST.v3b

<table>
<thead>
<tr>
<th>El Niño</th>
<th>ONI Value</th>
<th>La Niña</th>
<th>ONI Value</th>
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<tbody>
<tr>
<td>JAS 1951 - NDJ 1951/52</td>
<td>0.8</td>
<td>ASO 1949 – FMA 1951</td>
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<td>ASO 1962 – DJF 1962/63</td>
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<tr>
<td>MJJ 1965 – MAM 1966</td>
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<td>MAM 1964 – DJF 1964/65</td>
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<tr>
<td>OND 1968 – MJJ 1969</td>
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<td>NDJ 1967/68 – MAM 1968</td>
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<td>ASO 1976 – JFM 1977</td>
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<td>SON 1984 – ASO 1985</td>
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<td>ASO 1977 - DJF 1977/78</td>
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<td>AMJ 1988 – AMJ 1989</td>
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<td>AMJ 1982 – MJJ 1983</td>
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<td>JAS 2006 - DJF 2006/07</td>
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</table>

**NOTE:**
After updating the ocean analysis to ERSST.v3b, a new La Niña episode was classified (ASO 1962- DJF 1962/63) and two previous La Niña episodes were combined into one single episode (AMJ 1973- MAM 1976).

Above trend for three consecutive years.
The most recent ONI value (December 2009 – February 2010) is +1.7 °C.


Waterlogged corn fields in South Africa when should be drought.

El Niño neutral
La Niña
Historical Rainfall in Australia

Australia’s Variable Rainfall
April to March Annual Australian Rainfall Relative To Historical Records 1899–2004

www.LongPaddock.qld.gov.au
Climate Management Information for Rural Australia

Australia: Wheat

Yellow numbers indicate the average annual contribution of each state as a percentage of the national production from 1988–91 to 1994–95. States not numbered contributed less than 1% on average to national production annually.
Historical Rainfall in Australia

[Map showing historical rainfall patterns in Australia with color-coded regions indicating different rainfall levels and a time series graph at the bottom showing the Southern Oscillation Index (SOI) and the Pacific Oscillation (PO) over time.]
Near Future Observations

- Surface soil moisture (SMMR, TRMM, AMSR-E, SMOS, Aquarius, SMAP)
- Snow water equivalent (AMSR-E, SSM/I, SCLP, GCOM-W, MIS)
- Snow cover fraction (MODIS, VIIRS, MIS)
- Land surface temperature (MODIS, AVHRR, GOES, ...)
- Water surface elevation (Jason-2, SWOT)
- Terrestrial water storage (GRACE, GRACEII)
- Precipitation (TRMM, GPM)
- Radiation (CERES, CLARREO)
- Vegetation/Carbon (Landsat, AVHRR, MODIS, VIIRS, MetOp, DESDynI, ICESat-II, HyspIRI, LIST, ASCENDS)

Modified from NASA- Peters-Lidard
Possible CPC Assistance for Improving Global Agriculture Monitoring

• Improve **daily** global station gauge network from WMO/GTS, NWS & NOAAPORT/JAWF.

• Integrate daily global station network into daily CMORPH product (action: AFWA/NASA/NOAA)

• Set-up global growing season product for each continent
  – similar to RFE Africa/FEWSNET seasonal products at CPC.

USDA/FAS/OGA/IPAD
Summary OGA/IPAD & FAS Web Outreach

- FAS PS&D On-line
- FAS (attache reports)
- OGA/IPAD analyst updates
  - http://www.pecad.fas.usda.gov/search.cfm
- OGA/IPAD Crop Explorer (weather & NDVI)
- OGA/IPAD Archive Explorer (AWiFS Landsat images)
- OGA/IPAD PSD Mapper
- OGA/IPAD Photo Gallery (geo-referenced)
- OGA/IPAD Tropical Cyclone Monitor
  - http://151.121.3.217/TropicalCycloneMonitor/
- GLAM-MODIS Web Products-NASA/USDA
  - MODIS (2002-present) time series data
    - http://pekko.geog.umd.edu/usda/test/
  - Daily MODIS data from Rapid Response System
  - Global Reservoir Monitor
  - NASA Earth Observatory’s Agriculture Hazards

USDA/FAS/OGA/IPAD