DEPARTMENT OF AGRICULTURE WEATHER PROGRAMS

Weather is the most important factor influencing the Nation's variability in crop yields and related production. The Nation's food and fiber products are a critical resource impacting our domestic and international economic position and have taken on new dimensions in foreign affairs and national security. The recent expansion in export markets has reduced stocks and benefitted our farm sectors as global consumption of total grains has exceeded production in 3 of the last 4 years. The United States Department of Agriculture (USDA) conducts supporting research that focuses on understanding the interactions of weather and climate with plants, animals, forests, and forest ecological systems, and assists the Department of Commerce in determining farmers' needs for weather information and in disseminating that information to them.

METEOROLOGICAL PROGRAMS

The World Agricultural Outlook Board (WAOB), in cooperation with National Weather Service's (NWS) Climate Prediction Center, staffs and supports the Joint Agricultural Weather Facility (JAWF). The JAWF monitors the daily weather patterns around the world, and serves as the Department's focal point for weather data received from the World Meteorological Organization's (WMO) Global Weather Observing System. These data are used at JAWF and other USDA agencies for a number of agricultural applications. WAOB agricultural meteorologists convert the weather data into information to assess crop development and yield potential of all major commodity crops for the major producing areas of the world. Special weekly briefings are provided to the Secretary of Agriculture and to the economic and commodity analysts of USDA. The Senate and House Agricultural Committees also request periodic agricultural weather briefings that focus on the severity and impact of drought, heat wave, and excessive wetness on major crop areas around the Nation.

Historically, the Forest Service (FS) has collected meteorological data to assist in the control of forest fires and in the management of smoke from prescribed burning. Other activities also require weather data to ensure sound management decisions. To support these needs and requirements, a national weather program was established to coordinate all FS meteorological activities and to meet the increasing need for diverse weather information. The major objectives of the program are to: (1) improve quality control of weather data, (2) improve the design and operation of data collection from networks, (3) increase data recovery from the weather stations, and (4) upgrade station maintenance. Meteorological data collected from manual weather stations and Remote Automated Weather Stations (RAWS) support research of weather effects on forestry management, forest fires, smoke management, visibility protection in wilderness areas, and atmospheric deposition (Figure 3-USDA-1). A weather information management system and a library to archive all FS weather data are being developed in cooperation with regional climate centers. The FS monitoring network will provide essential data for use in Global Change Research Program (GCRP) work.

Currently, the FS operates more than 900 RAWS and manual stations, many in the western United States. Air temperature, relative humidity, soil moisture, wind direction and speed, and precipitation are transmitted via NOAA's Geostationary Operational Environmental Satellite (GOES) telemetry. These data are received via a direct-readout ground site in Boise, Idaho, in cooperation with the Bureau

Figure 3-USDA-1. Forest Service meteorological programs include supporting firefighting activities during summer fire season.

of Land Management. The main use of the data is in the calculation of the fire danger rating for the FS and cooperating agencies. These data are also used by other resource managers, such as, road engineers, wildlife biologists, and hydrologists who monitor precipitation; silviculturalists (who are attempting to maximize tree-planting opportunities); and ecologists, soil specialists, and fisheries biologists (who monitor the effects of runoff). Another major user of RAWS data is the NWS for fire weather forecasting and flood warnings.

The Natural Resources Conservation Service (NRCS) operates a network of 1,400 manual snow courses and over 550 automated data collection sites in conjunction with the Snow Telemetry (SNOTEL) project for the western United States and Alaska. The primary objective of the project is to forecast water supplies and streamflow for the coming spring run-off season. These measurements are made in cooperation with other federal, state, and local agencies, power companies, irrigation companies, and the provincial government of British Columbia.

Water-supply forecasts help irrigators make the most effective use of available streamflow for achieving their agricultural production goals. Farmers, who collectively irrigate more than 10 million acres of land in the western United States, benefit from these water supply forecasts. Other federal agencies and private organizations also use water supply forecast information to help them carry out their missions. These forecasts also help the federal government in administering international water treaties.

NRCS continues to upgrade the SNOTEL data collection system. The effort includes upgrading the data collection sites in the existing SNOTEL system with new state-of-the-art equipment and adding additional sites. The data collection site upgrades include replacement of snow pillows, transducers, damaged precipitation gages, antennas, towers, solar panels, battery temperature sensors, and deteriorated shelter houses.

The Foreign Agricultural Service's (FAS) satellite remote-sensing program, operated by the Production Estimates and Crop Assessment Division (PECAD), is a critical element in USDA's analysis of global crop conditions and agricultural production providing timely, accurate, and unbiased estimates of global area, yield, and production. The PECAD mission of alert analysis requires rapid system response. Working in conjunction with the Farm Services Agency (FSA), PECAD provides alerts as well as routine crop condition assessments for crops in the United States. FAS provides early warning of environmental changes that affect the production and quality of commodities and renewable resources. PECAD is the world's most extensive and longest running (20 years) operational user of commercial satellite data for crop condition assessments, using numerous satellite platforms.

The FAS/PECAD analysts employ a proven "convergence of evidence" approach to crop assessment -- incorporating NOAA AVHRR, LandSat, and SPOT imagery, crop models, global weather data, United States agricultural attache reports, field travel, and ancillary data to forecast foreign grain, oilseed, and cotton production. To complement the remote sensing image data sets, weather data are also processed from 6,912 of the United Nations' WMO stations and from approximately 88,500 grid cells of the Air Force gridded weather data are processed on a daily basis. Crop models are based on daily data loaded from meteorological stations and/or Air Force gridded weather data. Some models add Vegetative Index Number (VIN) information. The goal of a crop model is to provide a number that can be quantified to yield per acre.

FAS/PECAD routinely forecasts global grain production to within roughly 3 percent of final output. FAS remote sensing supports Department of State assessments of food needs as situations arise. FAS prepares detailed analyses of global weather events, such as drought in Ukraine, dryness in China and North Korea, and flooding in Mexico and Central America. PECAD also provides in depth coverage of significant crop developments in specific countries, including the 1999 record Argentine soybean crop, bumper wheat crop in Australia, and bumper soybean crop in Brazil.

The Farm Service Agency (FSA), continued to share with FAS the cost of analyzing imagery of the United States. Timely analysis of United States crop conditions, combined with weather data, crop model results, and GIS products made possible the development of accurate and timely projections and comprehensive evaluations of crop disaster situations. During the 1999 growing season in the United States, the domestic analysts of FAS/PECAD provided early warning on anomalous crop conditions, including the severe droughts in the Mid-Atlantic States and Eastern Corn Belt as well as flooding from hurricanes and subsequent rainfall in North Carolina and southern Virginia. The impact of the sixth consecutive wet spring and early summer on agricultural interests in North and South Dakota was determined and reported in interagency briefings and published on the internal FSA/FAS web-site. FSA continued to be a partner in the National Aerial Photography Program (NAPP) and National Digital Orthoquad Program (NDOP). FSA started to field re-engineered business processes that combine the use of digital orthophotography, GIS, GPS, and satellite imagery to replace the use of hardcopy NAPP aerial photography and 35mm slides.

SUPPORTING RESEARCH

The mission of the USDA supporting research program is to develop and disseminate information and techniques to ensure high quality commodities and products while minimizing any adverse effects of agriculture on the environment. As part of the USDA reorganization, the Undersecretary for Research, Education, and Economics was created. This reorganization included the merger of the Cooperative State Research Service and the Extension Service, and the transfer of the Economic Research Service and the National Agricultural Statistics Service (NASS).

The research efforts of the Agricultural Research Service (ARS) relate directly to the effects of climate on agricultural production and the natural resource base. These efforts are directed toward developing technologies and systems for: (1) managing precipitation and solar energy for optimum crop production; (2) improving our understanding of water-plant-atmosphere interactions; (3) optimizing the use of energy, water, and agricultural chemicals; (4) reducing plant and livestock losses from pests and environmental stress; (5) developing improved techniques for irrigation and drainage; and (6) minimizing the adverse effects of climate and weather, including atmospheric contaminants, on the environment.

The Cooperative State Research, Education, and Extensive Service (CSREES) coordinates research programs in the state agricultural experiment stations, the 1890 Land Grant Distributions, and cooperating forestry schools. These institutions conduct a wide variety of research applicable to agriculture and forestry. Meteorological research in these institutions is practically all climatological. A proportion of each state's program is consolidated into broad regional research projects. Animals and plants are subjected to many climatic stresses and, therefore, are the focus of this research. Research on the changes in levels of ultraviolet (UV) radiation as part of the GCRP was significantly expanded through the CSREES competitive grants program in FY 1994. The work is coordinated with EPA's UV radiation program and will support assessment efforts to develop related national policy on the environment.

Investigations by NASS support domestic crop estimating programs for all major commodities. Promising studies are underway to develop models relating weather parameters and associated variables to corn ear weight and wheat head weight. Previous efforts to develop models for short-term forecasting have had only limited success. Research will continue in this area with the expectation that the relationships between weather variables and crop yield will improve as better plant process models become available and more information, such as soil moisture, are operationally observed.

A NASS program to explore the use of satellite and weather data for assessing crop conditions is continuing. A preliminary investigation using polar-orbiting meteorological satellite data showed a good relationship between crop conditions and reflectance data as determined by the agreement between measured and forecast final corn and soybean yields. The crop conditions assessment procedures, based on meteorological satellite data, are being automated and near real-time applications are being explored.

FS research includes efforts to: (1) understand and control forest fire initiation by lightning, (2) improve the translation of mid-range forecast elements to describe forestry conditions, (3) incorporate drought information into management decision-making, and (4) better describe how regional climatic variability affects the use of daily weather information by foresters. The FS long-term monitoring network will provide critical data for use in the GCRP work.