



# Geographic Information Systems and Global Positioning Systems

## Overview

USDA's Farm Service Agency (FSA) programs help agricultural producers purchase and operate farms, stabilize farm income, conserve land and water, and recover from the effects of disasters.

In order to determine producer benefits for most FSA program areas, FSA must know the specific crop acreage or other land use information. Also, for many programs, producers agree to certain provisions on their land, such as conservation compliance.

In the past, local FSA staff's only option was to use aerial slides or to physically visit farms to assist producers with determining acres or other land-based information. Since much of FSA's business is directly related to the land, the Agency is in the process of modernizing its maps and related geospatial information.

FSA, along with other USDA agencies, is also in the process of implementing Geographic Information Systems (GIS) and Global Positioning Systems (GPS) technology. GIS and GPS are helping FSA staff more efficiently measure land features by allowing computer-generated maps to interact with databases that store information about land. These advances will give local offices tools to:

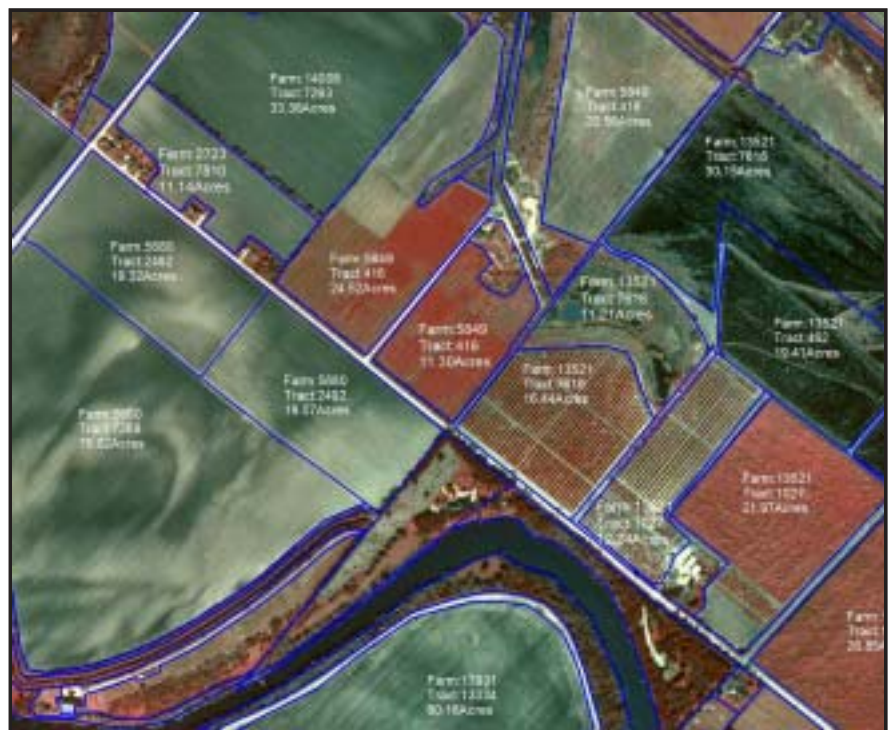
- help producers continue to exercise sensible land stewardship;
- provide quicker, more accurate information for decision-making purposes; and
- reduce the amount of time a producer must spend working with local FSA staff in order to participate in USDA programs.

## Geographic Information Systems

Geographic Information Systems (GIS) is a computer-based tool for mapping and analyzing geographic

information. GIS stores spatial and geographic information for three different types of areas:

- places that have area, like farms, fields, wetlands, and neighborhoods (GIS stores these features as "polygons");
- places without area, such as the location of a grain bin, building, or tractor (GIS stores these features as "points"); and
- places that have a beginning and end, such as major highways, private roads, and streets (GIS stores these features as "lines").



GIS effectively stores digital imagery, as well as farm, crop, and producer information, to provide FSA with a powerful program delivery tool.

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GIS stores this and other data and uses satellite imagery or aerial photography as a basemap for the overlay of these layers. The end product is a group of layers that represent real world features in the form of a map. GIS allows for much more detailed information than is contained in a hard copy map with a color-coded legend. Each GIS layer can store and display vast amounts of information, such as soil types, crops, land boundaries, place names, and populations.

No matter how vast the GIS database is, it can be queried and organized for efficient data management practices. A simple GIS query can locate one farm number from thousands, in just seconds.

FSA has installed desktop GIS at nearly 2,500 FSA offices nationwide. In the fall of 2003, FSA will upgrade to a shareable service center database environment. Full enterprise GIS implementation that incorporates web-based data storage and interactive applications is scheduled for late 2004.

#### **Common Land Unit**

The most critical component of GIS for FSA is the development of the Common Land Unit (CLU) data layer. A CLU is the smallest unit with a permanent contiguous boundary and land cover; in other words, a field. The CLU layer will ultimately include all farm fields, rangeland, and pastureland in the United States.

#### **GIS REPLACES:**

- ***paper maps with digital photography;***
- ***pencils and pens with PCs and GIS software;***
- ***wheels and chains with GPS to measure fields; and***
- ***35-mm slides with digital imagery.***

In conjunction with digital imagery and other data, FSA is using the CLU to administer programs, monitor compliance, and respond to natural disasters, among other tasks. FSA is in the process of integrating completed CLU data sets with GIS deployment. CLU data will provide FSA staff with powerful tools for program delivery and monitoring.

#### **Global Positioning Systems**

Global Positioning Systems (GPS) is an accompanying technology that can be integrated with GIS for even greater analysis of real world information. GPS technology, controlled by the United States Department of Defense, is a navigational system consisting of a constellation of 24 satellites that rotate around the Earth twice each day, in a very precise orbit.

The satellites within the constellation transmit signals to Earth; these signals carry information about the location and distance of the satellite to Earth. GPS handheld units use signals received from satellites and ground control stations on Earth to calculate the user's exact location.

The user's position is then displayed as an electronic map on the unit's handheld screen. FSA will have at least one GPS unit in each USDA service center and state office by the fall of 2003.

#### **Integrating GIS and GPS Technologies**

FSA is integrating GIS layers and GPS information to increase the efficiency, accuracy, and timeliness of FSA program administration. GPS data layers, ortho-photography, soils layers, public land survey data, and many other data layers can be placed atop one another inside of one GIS project.

GIS and GPS help FSA store and utilize information on field boundaries of land and attributes for each field, such as field number, crop type, and producer information. Aerial photography, grain bins, private roads, and field boundaries can all be displayed in GIS at the same time. Each of these layers, excluding the aerial photography, has a database associated with it which stores detailed information.

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#### FSA Program Area Uses

FSA is using GIS and GPS effectively in its program areas in the following ways:

##### ■ **Farm Commodity and Conservation Programs:**

- prepare “what-if” scenarios with maps and supporting text for producers to use to make informed decisions about program participation and benefits;
- measure and inventory fields, acres, and land-use categories;

- identify and map environmentally sensitive acreage;
- map and appraise type and extent of crop damage due to natural disaster events, such as hail, flooding, or tornados;
- map and inventory farm site information, such as storage facilities and well heads, when needed for program implementation; and
- maintain and share farm records and maps digitally with producers, and with

other agencies as appropriate.

##### ■ **Farm Loan Programs:**

- locate farms;
- track the location of farms under loan;
- determine the location of farms, buildings, and structures for appraisals; and
- locate areas of environmental concern, including easements, wetlands, and highly erodible land.

##### ■ **Emergency Preparedness:**

- assess the impact of disasters on agricultural facilities;
- assess the impact of weather events to help determine emergency declarations;
- assist with homeland security; and
- locate environmental hazards.

##### ■ **Compliance:**

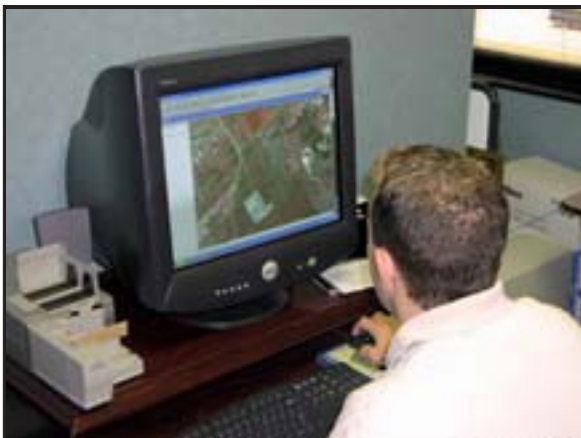
- verify compliance with program rules by checking farm acreage, field layout, and field boundaries; and
- identify discrepancies between reported crops and actual crops.

#### **Producer Benefits**

In addition, GIS and GPS technology can help agricultural producers improve production history and farm planning through precision agriculture. Producers



*Paper maps that required staff to manually transfer information are being replaced with computer-based mapping tools.*



*FSA staff is using state-of-the-art GIS tools to efficiently manage farm and crop information.*

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can request copies of USDA imagery, farm and field boundaries, and soils data to help them with:

- farm planning, such as determining crop planting strategies;
- crop production, such as mapping and monitoring fertilizer and herbicide application; and
- decision-making on the farm.

#### ***For More Information***

More information on GIS and GPS is available from FSA's GIS Web site at: <http://fsagis.usda.gov/fsagis/>

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