Geographic Information System (GIS)
INFORMATION SHEET
May 2008

🌐 What's a Geographic Information System?

A Geographic Information System (GIS) describes any automated system for spatially managing and analyzing geographic information.

In simplest terms, most everything has a physical location on the face of the earth; by default it has a spatial component. GIS is the managing, leveraging, and/or virtual display of information about things that have a spatial component.

Most but not all geographic data has a projection, which is a mathematical attempt to place what is seen on a flat computer screen, or printed page, at the coordinates/location of where it really exists in the three dimensional world.

GIS is part of a larger field called Geographic Information Science, a more overarching, and academic field dealing with the totality of hardware, software, geospatial data, and their interactions.

🌐 What kinds of data can GIS use?

Generally speaking, GIS stores two types of spatial data: Vector format data and Raster format data.

Vector data is a coordinate-based data structure commonly used to represent linear map features. Each linear feature is represented as a list of ordered x,y coordinates. Attributes can be associated with the feature. Vector data includes:

1. Point features (signs, tractors, grain silos, etc.)
2. Line features (roads, fences, sidewalks, etc.)
3. Polygon features (fields, land use, wetlands, etc.)

Raster data is data displayed as discrete picture elements (pixels). It is a cellular data structure composed of square rows and columns. Groups of cells represent features. The value of each cell determines the tonal value of the feature. Raster data can include aerial photography, scanned images, and any other information displayed and stored as pixels.

GIS can also store almost any kind of attribute data. Attribute data is data that further describes spatial data. For example, a point feature may be a sign, but the attribute data could specify what type of sign it is: stop, yield, or speed limit. Attribute data is stored in associated tables, text files, or databases. The real power of GIS is in accurate attribute data.

🌐 For what purposes do people use GIS?

1. Map the location of things: Mapping where things are located assists users in finding geographic features, and in measuring distances or transportation routes between features. Visualizing locations on a map can assist in decision making.

2. Finding patterns: Observing the distribution of features on the map can reveal patterns, which can assist in analysis.

3. Map densities: Mapping features will display their geographic concentration, but in areas with many features it may be difficult to determine which areas have a higher concentration than others. A density map displays measurements of the number of features, so you can clearly see the distribution.

5. Map quantities: Quantities are mapped to assist with study objectives, or to compare data in different places. This type of map can aid with decision making, because it gives an additional level of information beyond simply mapping the locations of features.

6. Find what's inside something: Mapping quantities or densities in specific areas could help to monitor what's happening and to take specific action. For example, maybe within a particular city district, crime is higher than in other districts. This finding could lead police to increase patrols.

7. Find what's nearby something: Create buffer zones and discover what's occurring within a set distance of a feature. This type of analysis is crucial to environmental planning.

8. Map changes: Map changes in a particular area in order to predict future conditions, decide on a course of action, or to evaluate the results of a previous decision.

🌐 How does the Farm Service Agency (FSA) and Aerial Photography Field Office (APFO) use GIS?

USDA 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.

GIS helps FSA staff to more efficiently measure land features by allowing computer-generated maps to interact with databases that store information about the land (attribute data). This technology gives local offices tools to:

1. Help producers to exercise sensible land stewardship;
2. Provide quicker, more accurate information for decision-making purposes; and
3. Reduce the amount of time a producer must spend working with local FSA staff in order to participate in USDA programs.

USDA-FSA-APFO helps manage 2 primary datasets:

1. Aerial Imagery
2. Common Land Unit (CLU)

Aerial Imagery, a raster dataset, is the base layer in GIS over which other data, such as CLU, which is a vector dataset, are overlaid and digitized.

Depending on the purpose of the work, other data layers may also be added. 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; the attributes could be used to create an entire series of maps. 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 to propagate efficient data management practices. A simple GIS query can locate one farm number from thousands, in just seconds.

Further uses of GIS by USDA FSA relate to:

1. Farm Commodity and Conservation Programs
2. Farm Loan Programs
3. Emergency Preparedness
4. Compliance

What is a CLU used for?

The most critical component of GIS for FSA is the development and maintenance of the Common Land Unit (CLU). CLU is the smallest land unit with a permanent contiguous boundary and land cover; in other words, a farm field. USDA FSA digitizes CLU into Geographic Information System (GIS) shapefiles (soon to be ArcSDE feature classes) and populates associated attribute data.

There are many uses for CLU, including but not limited to:
1. Providing a link between tabular farm records and a map or image of the land;
2. Using GIS for acreage calculations;

3. Replacing paper maps with digital images that can be easily updated and can produce high quality prints whenever necessary;
4. Drawing crop boundaries to better define or use with other data, such as:
   a. Crop Patterns
   b. Subdivisions
   c. Conservation Plans
5. Creating a central database for land unit boundaries and linking it to customers; and
6. Speeding up the process for implementing disaster payment and other specialized systems.

How do farmers benefit from GIS?

GIS technology can help agricultural producers improve production history and farm planning through precision agriculture. Producers can request copies of USDA imagery, farm and field boundaries, and soils data to help them with:

1. Planning, such as determining crop planting strategies
2. Crop production, such as mapping and monitoring fertilizer and herbicide application.

Can I build my own GIS?

Yes. All you need to get started is software and data.

Do I have to purchase GIS software?

No. Software for basic GIS functionality is free for download; more advanced GIS software does come with a substantial associated cost.

For more information on free GIS software and downloads, go to the following sites:

http://software.geocomm.com/viewers/
http://gislounge.com/ll/freedataviewers.shtml
http://spatialnews.geocomm.com/features/viewers2002/

This list is provided for convenience; USDA-FSA-APFO does not support or endorse these products or services.

Do I have to purchase GIS data?

No. There is an abundance of free data, in numerous data warehouses, on the web. The key is to having a clear objective in seeking data. The Geospatial Data Gateway, at http://datagateway.nrcs.usda.gov/ , contains a great deal of imagery and vector data available for public consumption. Many state governments also have their own clearinghouses.

Who do I contact for more information?

1. For APFO sales and product information, contact USDA-FSA-APFO at 2222 W 2300 S, Salt Lake City UT, 84119-2020, call 801-844-2922, or visit www.apfo.usda.gov.
2. For further information on GIS, contact GIS Specialists at APFO: Louise Mathews, 801-844-2934; or Nathan Pugh, 801-844-2927