Esri News
for Agriculture
Winter 2013/2014

GIS Helps Maintain Quality at California Vineyard

By Jim Baumann, Esri

Scheid Vineyards (originally known as Monterey Farming Corporation) was founded in 1972 in Monterey, California. The business has progressively grown, and today it farms approximately 4,500 acres of varietal wine grapes, making it one of the leading independent producers in the United States.

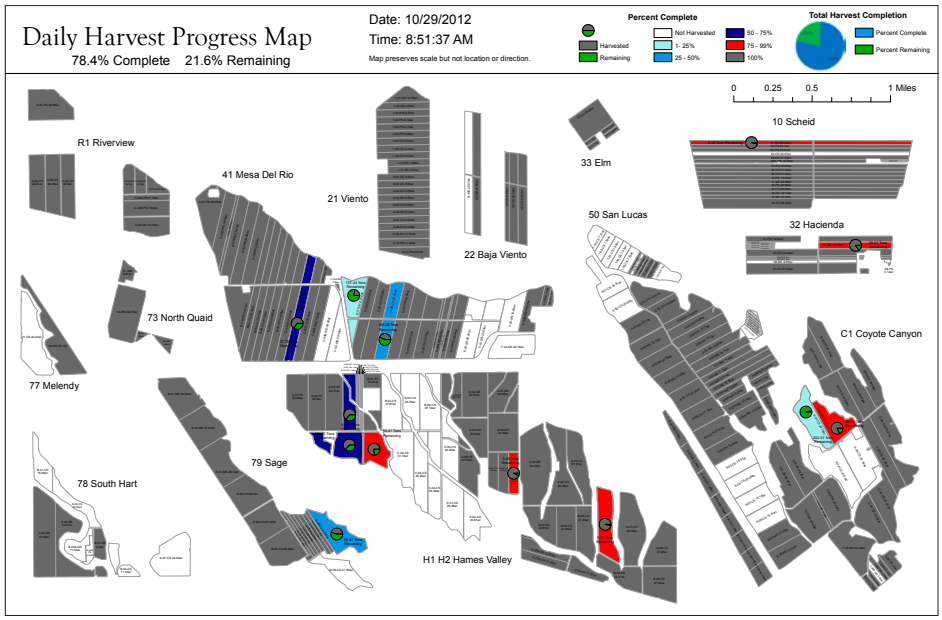
The vineyard began using geographic information system (GIS) software in 1998 to map its acreage and collect related geographic data. However, it didn't begin using the technology for analysis until Gregory Gonzalez joined the company in 2009 as an intern after graduating from nearby California State University, Monterey Bay, with a degree in GIS. Today, Gonzalez is the GIS technologist at the vineyard. Other GIS/vineyard technology team members include Jonathan Vevoda, a GIS specialist, and Tyler Scheid, vineyard technology coordinator. Together they have implemented an enterprise-wide precision farming system with the Esri ArcGIS platform at its core. The GIS is used for data management, harvest analysis, selection of prospective planting sites, in-field data collection, and determination of irrigation requirements and as a company-wide information portal.

"A GIS is the backbone of any precision farming operation," says Vevoda. "It is the spatial data reservoir from which you can draw in order to make informed decisions in a timely and efficient manner. Using a GIS as the information hub in an agricultural operation ensures that everyone within the company is looking at the same data, and the entire operation is aware of what is going on in the individual departments and can react accordingly."

In addition to ArcGIS, Scheid Vineyards uses complementary geospatial software in its operations. Equipment tracking via Global Positioning System/code division multiple access (GPS/CDMA) at one-minute reporting intervals is provided by Geoforce. It was integrated with ArcGIS software so that it could feed ArcGIS for Server at 15-minute intervals with its postprocessed tracking data. In addition, geofences were established based on the vineyard's infrastructure features so that equipment usage can be tracked to the block level with the GIS. A geofence is a virtual perimeter that encloses a specified area. When used with a location-based service, an automatic notification is generated and sent to the server whenever the geofence is entered or exited.

With Esri's announcement of ArcGIS GeoEvent Processor for Server, the vineyard hopes to take advantage of its real-time data streaming capabilities. "This will be a good product for our asset management program as we continue to build our geoinfrastructure," says

continued on page 3



↑ This map was made for neutron probe site distribution analysis. The neutron probe is used to monitor soil moisture throughout the vineyards.

Contents

Winter 2013/2014

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GIS Helps Maintain Quality at California Vineyard

continued from cover

Scheid. "It will allow us to track not only equipment movement but also the critical hours of usage, which will help us evaluate service schedules and overall equipment use. We also plan to use Esri's Tracking Analyst and Network Analyst extensions to ensure the maximum efficiency and profitability from our equipment fleet."

For personnel and production management, the vineyard has partnered with AgCode, a production/payroll company that helps track costs and production at ranch, section, and block levels. It also has the ability to track these variables by crew or individual.

By using AgCode, the vineyard was able to eliminate paper-based production records and capture field-level production data directly into the database, which then feeds ArcGIS. This gives the software the capability to catch inefficiencies in near real time and then investigate and make adjustments when needed.

Scheid's Innovative Approach to Precision Agriculture

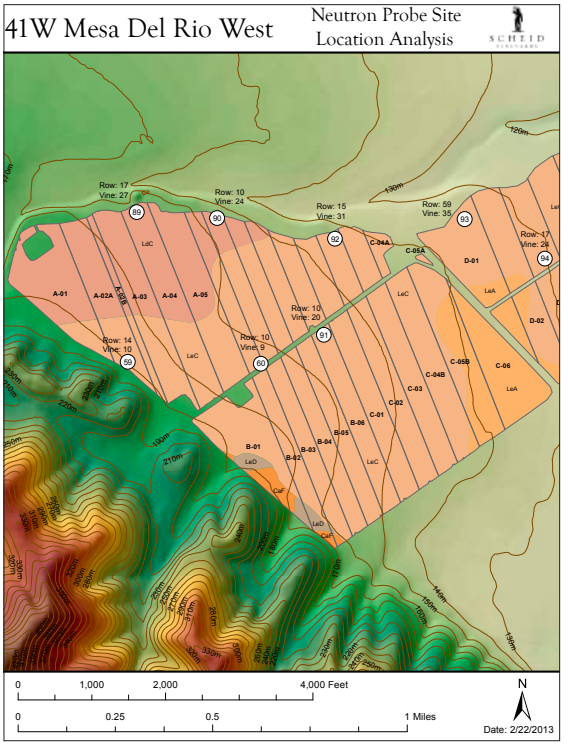
Neutron probes have been installed throughout Scheid Vineyards to monitor the amount of moisture in the ground in a specified area. The information collected from each probe is added to the GIS so that all the data can be interpolated to create a raster map that represents soil moisture levels across the entire operation. This soil moisture map then becomes another layer in the vineyard's enterprise GIS. The map will be used as part of the vineyard's irrigation geoinfrastructure, which is currently under development. The GIS/vineyard technology team is planning to integrate weather station and irrigation data with the soil moisture map and remote-sensing data so that the GIS can become more dynamic and precise in the application and monitoring of its irrigation processes.

The team is currently testing various pest-scouting data collection methods for use with its ArcGIS for Windows Mobile platform. Throughout the growing season, the vineyard is constantly monitoring the vines for the presence of harmful insects, diseases, and mildew. Recording pest sightings and their locations in the field and then directly transmitting that information to the GIS for analysis allow ranch managers to take immediate action to combat a disease or insect invasion and minimize damage to the vines.

The vineyard also uses Web Soil Survey, a US soils database produced by the National Cooperative Soil Survey and maintained by the US Department of Agriculture (USDA) National Resources Conservation Service. This service provides information on soil types and crop suitability for specified areas. The site is regularly updated and is the single authoritative source of soil survey information in the United States. Scheid Vineyards uses the soils map layers for site evaluation for prospective plantings. This helps determine the most suitable vine rootstock and clone combinations in the areas selected for cultivation.

GIS is also used to track the special treatment of some vines for Scheid's Estate Row program. This program involves the careful monitoring of specific rows of vines within the vineyard that are cultivated differently from the others, depending on the winemaker's needs. The treatment of these rows varies from year to year, and the winemakers carefully evaluate the quality of the wine produced after each harvest. The goal is to replicate an especially good wine by following the same procedures and treatments previously performed on that row. The data collected for the Estate Row program is maintained in the GIS so that it is accessible throughout the entire company for review.

"By developing an operations central GIS, we can integrate essential data from a variety of sources and eliminate a large portion of the tedious, time-consuming processes that previously made a major impact on our operational efficiency," concludes Gonzalez. "Broad access to the ArcGIS platform ensures that everyone in our organization is on the same page, which allows us to do more with less: less paperwork, less double data entry, less driving, less fuel, less confusion, less contradiction, and so on. In turn, we are creating more time for mission-critical tasks such as evaluating production quality and overall work force attitude. We can spend more time with the vines and, by doing so, increase our understanding and knowledge so that we can continue to produce fine-quality wine."



↑ This is an example of a service-based map indicating the grape harvesting status. It is continuously updated in near real time via mobile in-field data collection.

ArcGIS Improves WFP's Food Security Program

By Jim Baumann, Esri

"ArcGIS is an invaluable tool for both the mitigation of natural disasters and the coordination of response operations."

Andrea Amparore, GIS analyst, World Food Programme Operations Department of Emergency Preparedness

The World Food Programme (WFP) is the food assistance branch of the United Nations (UN). George McGovern, the first director of the US Food for Peace program, proposed the creation of WFP to the UN's Food and Agriculture Organization (FAO) in 1961. WFP was formally established in 1963 by FAO and the United Nations General Assembly.

Today, WFP is the largest humanitarian organization fighting hunger worldwide. Its primary mission is providing food to those who are unable to obtain it for themselves. On average, WFP delivers food to more than 90 million people per year, 58 million of whom are children. In addition to food security, WFP works to reduce child mortality, improve maternal health, and combat disease.

WFP is a longtime user of Esri ArcGIS software. According to Andrea Amparore, GIS analyst in the organization's Operations Department of Emergency Preparedness (ODEP), "ArcGIS is an invaluable tool for both the mitigation of natural disasters and the coordination of response operations."

The ODEP actively supports various emergency relief efforts around the world with GIS analysis. To facilitate this work, it has developed a methodology using ArcGIS software to understand the higher vulnerabilities among populations living in areas prone to natural disasters. This analysis considers factors such as environmental degradation, food insecurity, malnutrition, and the historical occurrences of natural hazards. Satellite images are analyzed to identify poor growing seasons and years of low crop production. The analyses help WFP quickly develop intervention strategies when disaster strikes.

In addition to data acquired from the host country and the data it collects, WFP obtains regular updates regarding seasonal food insecurity conditions throughout the world from the US Agency for International Development (USAID) Famine Early Warning Systems Network. USAID analyzes the data it receives from US agencies, including the National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, United States Geological Survey, and the United States Department of Agriculture, to produce its reports and forecasts, which it provides to WFP and other relief agencies.

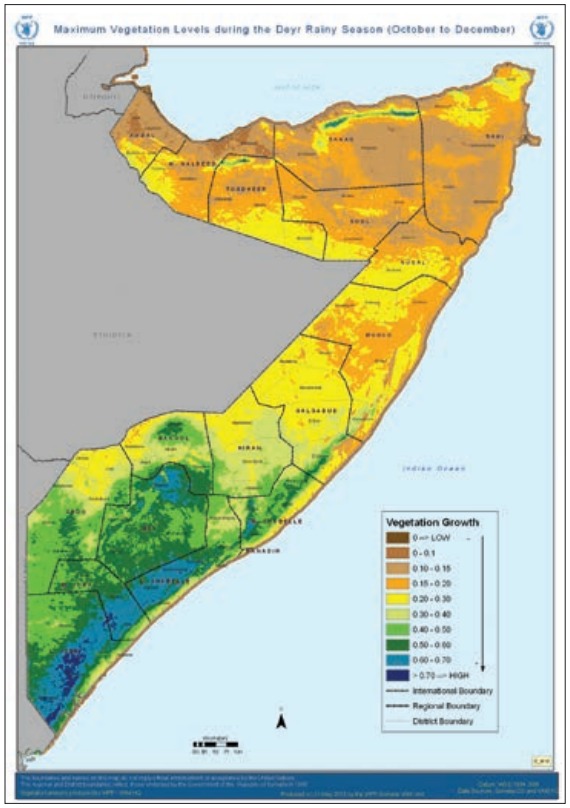
Managing the Disaster Cycle

The four recurrent steps in the disaster cycle are prevention, preparedness, response, and recovery. There is no actual beginning or end; however, GIS plays a strategic role throughout the entire cycle.

"GIS is used extensively in the prevention step of the disaster cycle," says Amparore. "Prevention includes the evaluation of man-made features, such as dams and levees, to make sure they can withstand rising floodwater, as well as determining the structural integrity of buildings, the reseeding of hillsides after deforestation to reduce mudslides, the evaluation of building codes and land-use zones to make sure they meet current safety standards, instigating community awareness campaigns to help residents better prepare themselves in the event of a disaster, and so on. Using GIS throughout this step provides management tools for project planning, review, and implementation."

Preparedness includes risk identification and assessment; the development and maintenance of emergency communication services; stockpiling essential

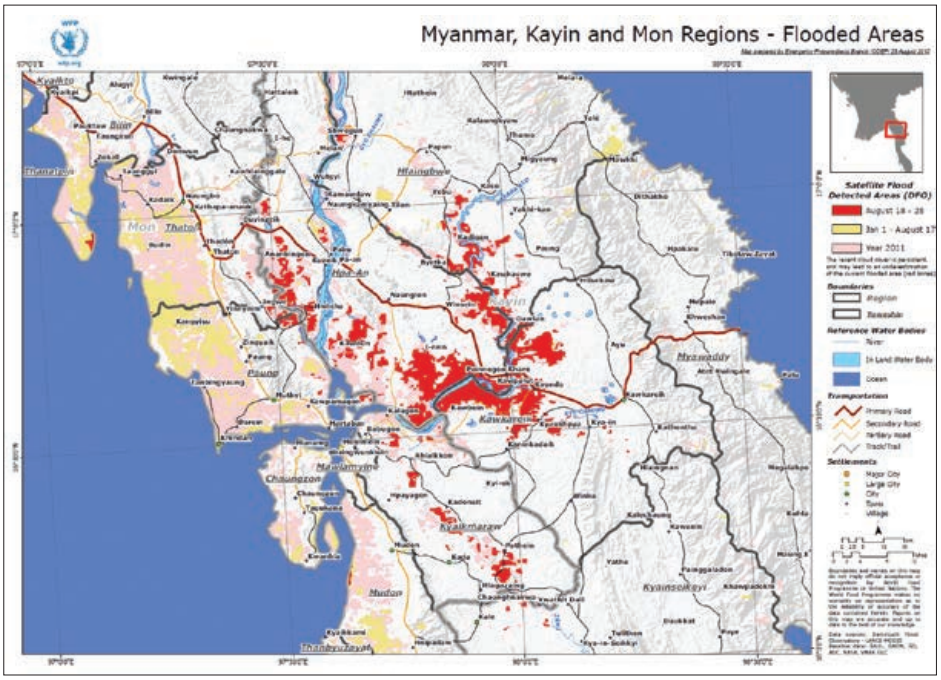
↓ Maximum vegetation levels in Somalia during the Deyr rainy season from October through December.



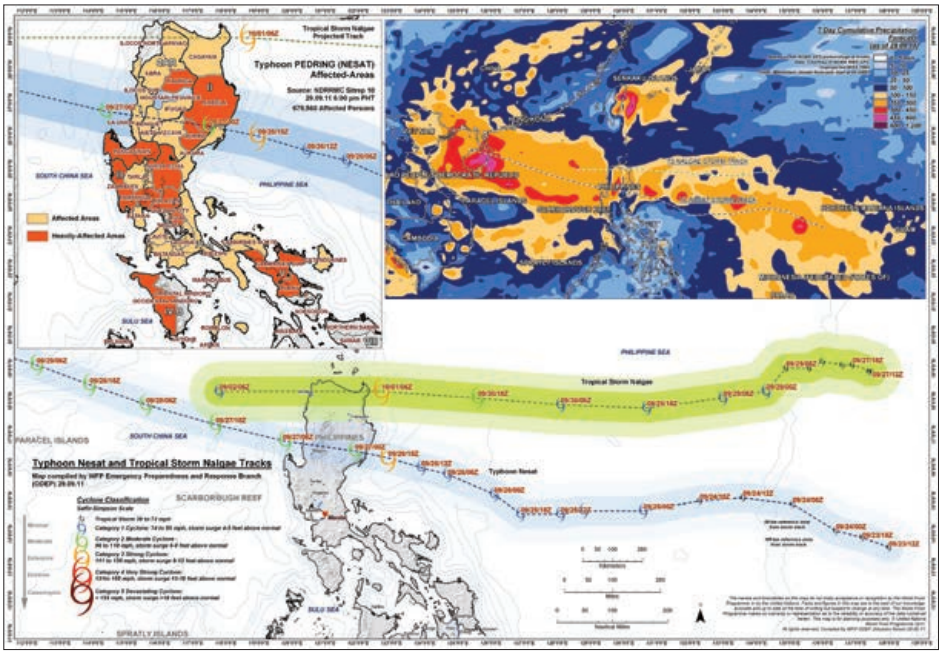
supplies including food, water, and medicine; and the establishment of evacuation routes. "GIS is used here in the evaluation and categorization of potential risks as well as determination of the optimum locations for emergency food stockpiles, the development of evacuation plans, and determination of the optimum routes for refugees if it becomes necessary for them to evacuate," says Amparore.

Response requires real-time monitoring for disaster relief efforts such as resource allocation, the status of transportation routes, and the relocation of civilian populations. GIS is used for forecasting the impact of imminent natural disasters, tracking human and livestock migration, monitoring the effectiveness of relief operations, and allocating resources.

The recovery step includes the provision of temporary relief, such as food and shelter for disaster victims, as well as damage assessment, repair, and reconstruction. "GIS is ideal for logistics management and is used to determine where resources are needed so that recovery efforts can be prioritized," says Amparore. "It is also used to specify where distribution stations should be positioned; evaluate the condition of existing humanitarian corridors; and establish the location of refugee camps, emergency supply depots, and relief worker staging areas."



↑ Satellite-detected flooded areas in the Kayin and Mon States of Myanmar (formerly Burma).



↑ Typhoon and tropical storm tracking in the Philippines.

The Future of GIS at WFP

Because GIS is used throughout WFP, the organization decided to implement an enterprise system based on ArcGIS for Server technology to better organize and manage its expanding geospatial databases. This has stimulated new projects in the agency and an evaluation by WFP of how GIS can be better used by its departments and partners.

For example, WFP's Vulnerability Analysis and Mapping unit recently created the Spatial Information Environment in an effort to increase access to original and derived spatial information within WFP and its partners. In addition, it is working with FAO to develop an ISO-standard metadata clearinghouse to enable greater compatibility and promote the sharing of spatial data between agencies.

"Standardization is the key to the continued growth of GIS at WFP," concludes Amparore. "This will allow us to expand our analytical capabilities and adopt an even greater scientific approach to data analysis. I also think the involvement of local universities, when possible, would help facilitate our work and provide the host country with a greater sense of involvement in our relief efforts."

Tracking Vessels Supports EU Sustainable Fishing Policy

Croatia Extends the Value of Its Fisheries with GIS

The European Union (EU) requires that fisheries be sustainable and not jeopardize fish stocks for future generations. Even so, Europe's fish populations continue to decline. Therefore, the EU Commission Reform of the Common Fisheries Policy (CFP) has been assessing the way EU fisheries are managed and the challenges they face. The commission concluded that the main contributor to overfishing is that the fleet's fishing capacity is greater than its fishing opportunities.

To counter this problem, the commission has recommended baseline standards that will reduce the fleet's capacity, including the gross tonnage of a vessel, gear selectivity, trawler equipment, and twine thickness. It also recommended stabilizing fish stocks by implementing catch quotas by species, creating seasonal closures, and restricting access to areas where young fish are developing. In addition, the commission noted that waters need to be managed within a regulated, transparent, and sustainable framework so they are not overfished.

This is easier said than done. Tracking vessels and monitoring catches can be an overwhelming task. In 2010, the EU's 27 member countries registered a total of 83,796 vessels. Fortunately, the EU's soon-to-be newest member, the Republic of Croatia, has an effective GIS fishing industry solution that helps it monitor vessels, gear, catches, seasonal fishing areas, and more.

Croatia's Ministry of Agriculture, Department for Fisheries, asked GDi GISDATA LLC, Esri's distributor in Croatia, to build a geoinformation system for fisheries. GISDATA developed the Vessel Monitoring System (VMS). The department uses it to identify and track the country's 260 large fishing vessels. This information can be used for monitoring boat activity and as evidence for law enforcement.

The main components of VMS are the department's centralized database, tracking devices, and ArcGIS. Whether at the department, in the harbor office, or on a boat, an inspector can access the GIS to track a vessel and get information about its owner, type, and gear on board and a host of other information.

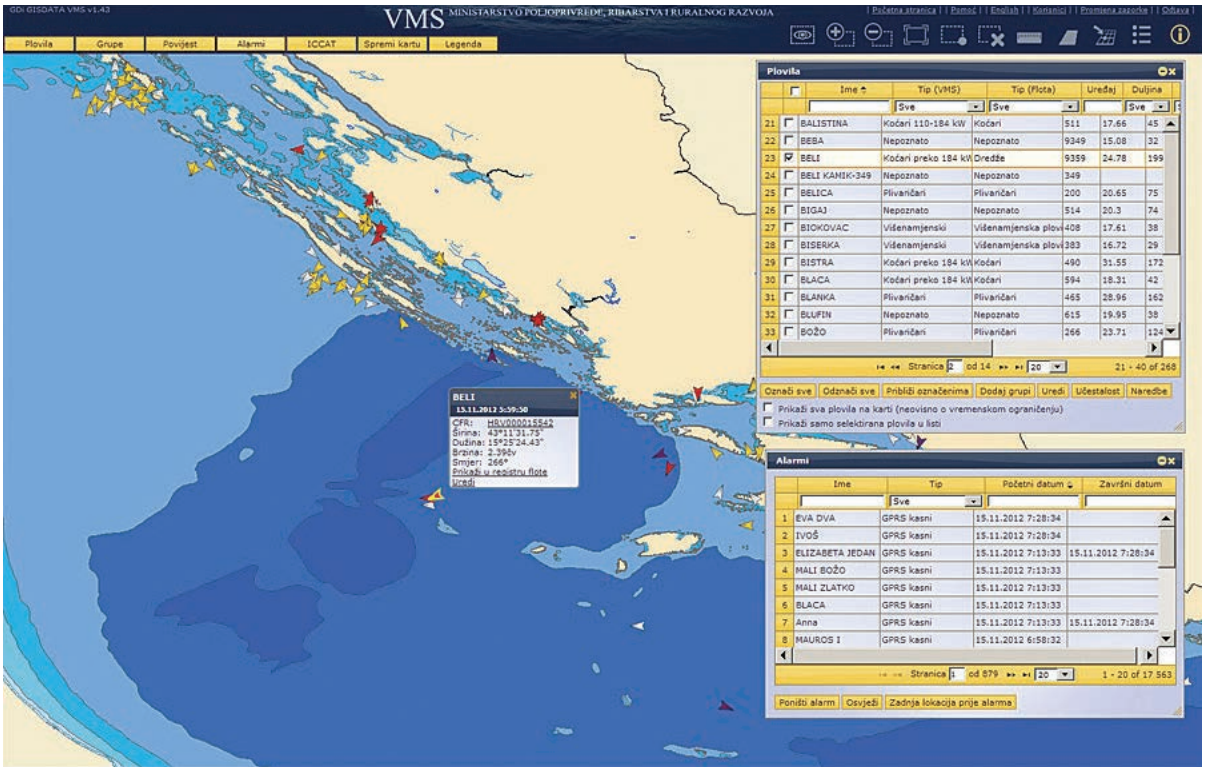
The fishery information system, built to accommodate the EU's fisheries registry requirements, includes nine data modules. It is capable of providing additional information for various other uses. The person-register module contains ID numbers, owner information, and fishing licenses, as well as vessel information such as title, registration, length, gear, and equipment. In accordance with the EU regulation, Croatia's fleet register keeps track of the vessel's entire life cycle from entering to exiting the fleet. Every data change for the vessel is recorded as an event, thereby keeping the entire fleet database current.

A catch module includes information that fishers complete on an inquest register, as well as descriptions of the catch, catching effort, and rejected catch. An analyst can filter the catch module by date; regional unit; type of sea organism; fishing gear; and vessel type, length, strength, and weight. This gives the analyst a good picture of the relationship of fishing capacity and fishing opportunities.

The first sale module is used to compare catch data with sale data to reveal any discontinuity. The blue diesel module monitors fishing vessels' fuel consumption to gasoline quota. The aquaculture model contains fishers' preferences for farming freshwater organisms, and the marine culture module holds breeding site data. Other data modules include the sport and recreational sea fishing license, tuna fishing, and administration.

VMS in the Adriatic Sea is used to acquire, send, edit, and process data. Large vessels 14 meters or longer have onboard tracking devices that send vessel data to the database via general packet radio service (GPRS) and SAT (Iridium) satellites in different time intervals. GPRS/EDGE/UMTS (depending on signal quality and

↓ A Croatian Fishing Vessel



← This overview of the last available positions of every vessel gives the Croatian Department for Fisheries a near real-time picture of vessel activity.

strength) have been customized to send data every 15 minutes or less (remote control) and over SAT every two hours.

VMS collects vessel information in real time, such as location, speed, direction, and even battery status. Developed on ArcGIS for Server using ArcGIS API for JavaScript, the system integrates with vessel data stored in the Microsoft SQL Server database and publishes dynamic content.

Users are then able to review and send detailed data reports about a vessel's position, speed, type, and so forth. Along with this, users can selectively manage and track historical and up-to-date data through filters and alarms. Alarms are divided into system and spatial alarms, alerting the department of problems in protected, forbidden, or time control areas. Alarms are automatically transmitted as text messages to inspectors in the field.

Department for Fisheries staff members use a web browser to access GIS web applications to see this information:

- An overview of the last available position of every vessel
- An overview of archive positions of monitored vessels during certain time periods
- An overview of basic data from the informational system of fisheries—a chosen vessel's owner, dimensions, and so forth
- Statistical data about vessel movement

The application also gives users tools to perform analysis, such as determine a path or calculate fuel consumption. They can also choose raster or vector data background layers and generate reports.

Staff whose job it is to do complete surveillance and vessel monitoring may want to use VMS tools in ArcGIS for Desktop. GDi GISDATA's ArcGIS extension, Vessel Analyst, enables users to generate spatial data from alphanumeric data in the VMS database for defined time periods, analyze it, and produce fishing vessel location maps. Depending on their work requirements, staff members can access VMS and work with basic GIS tools or have the full range of GIS functionality in a desktop application to perform analysis. Security tools allow only authorized users access to the system. These users can perform top-level content management and build maps using many GIS and cartographic functionalities. The desktop application enables users to do these tasks:

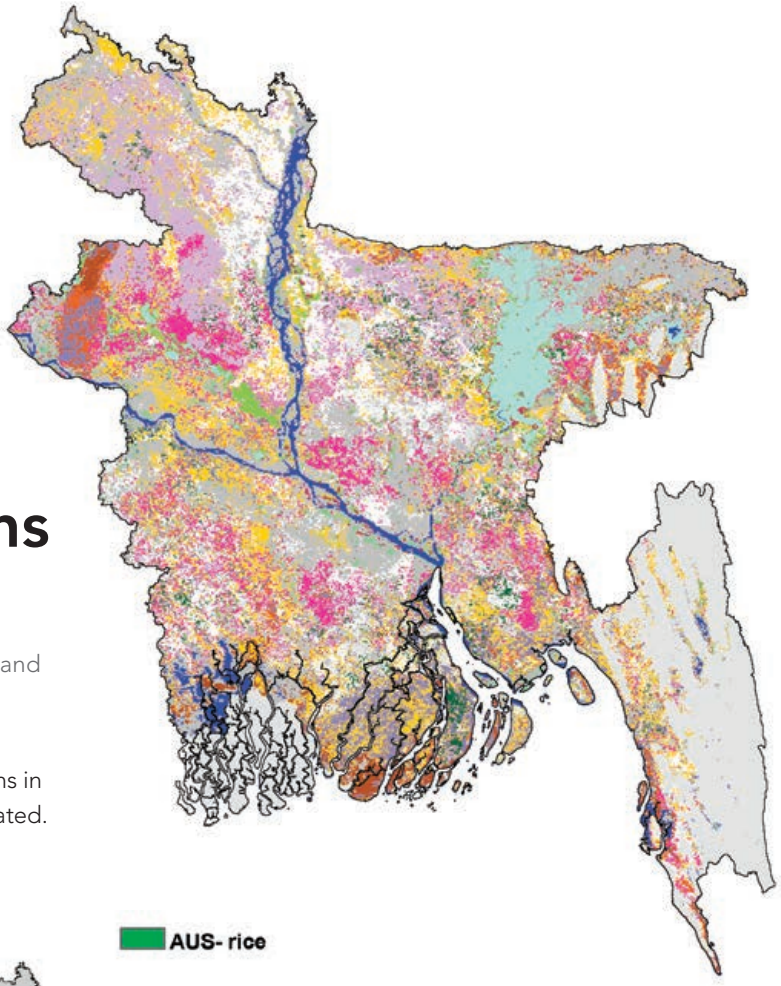
- Create rich cartographic presentation in arbitrary scales and data layers
- Execute database SQL queries
- Publish configurable reports containing cartographic presentations
- Perform various spatial analyses using intersect, merge, and buffer tools

VMS is an open system based on standards and is compatible and easy to integrate with existing GIS environment and informational systems. It supports distributed workflows in the central office of the Department for Fisheries, county offices, and fishing vessel business offices.

Croatia can now use the system to study the impact of aquacultures on the environment. And in the event of a storm, responders can alert vessels and rescue vessels in distress.

For more information, contact Andrej Loncaric managing director, Core Markets, GDi GISDATA at andrej.loncaric@gdi.net.

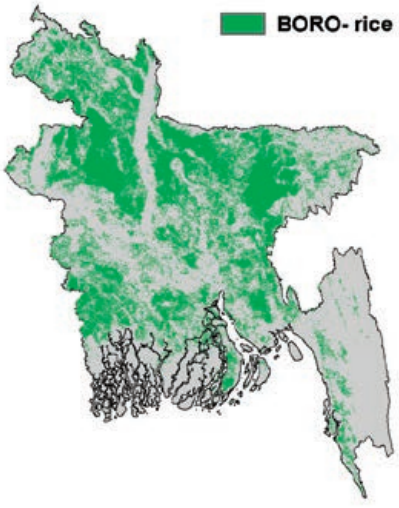
Published since the mid-1980s, the annual *Esri Map Book* presents a broad collection of maps that illustrate the current use of GIS technology. The agriculture maps included here are from volume 27, the latest version of the map book.

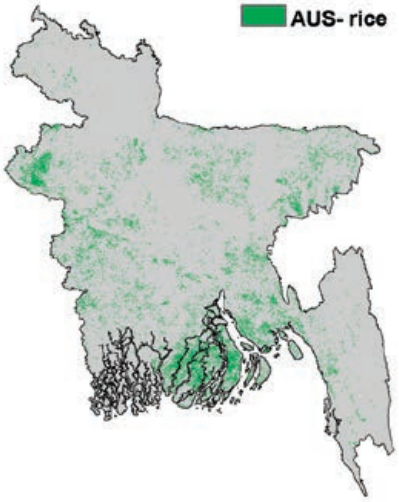


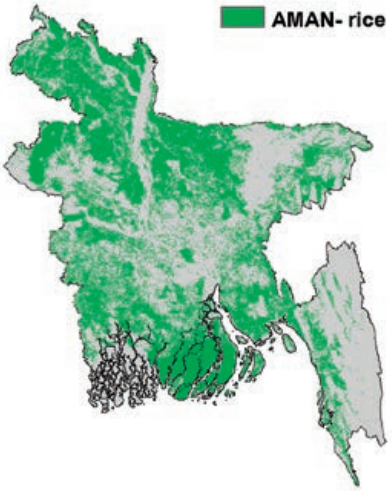
Mapping Complex Rice-Cropping Patterns in Bangladesh

By Murali Krishna Gumma, Andy Nelson, Aileen Maunahan, and Saidul Islam, International Rice Research Institute (IRRI)

These maps identify seasonal rice-cropping areas and patterns in Bangladesh and classify those areas as either rain fed or irrigated.







Rice growing areas (season & water application method)

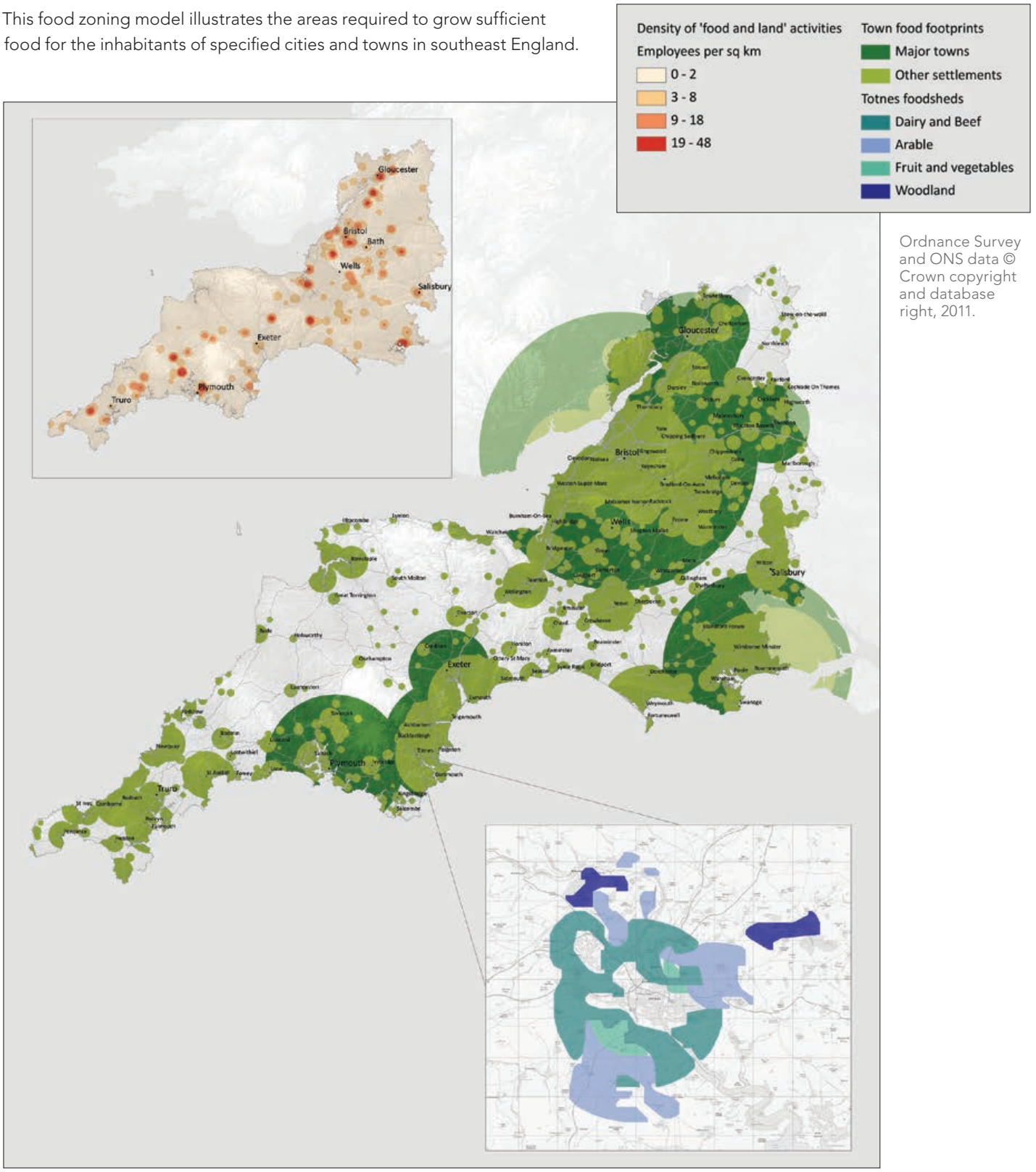
- 01. Submergence-DC-rice-water-other crops
- 02. Irrigated-GW/SW-DC-rice-water-other crops
- 03. Irrigated-GW-TC-rice-other crops-other crops
- 04. Rainfed-SC-fallow- fallow -rice
- 05. Irrigated-SW-DC-vegetables/rice- fallow - rice
- 06. Irrigated-GW/SW-TC-other crops-other crops-rice
- 07. Submergence-DC-rice-water-rice
- 08. Irrigated-GW-DC-rice-fallow-rice
- 09. Irrigated-GW/SW-TC-rice-rice/other crops-rice
- 10. Irrigated-GW-TC-rice-rice/other crops-rice
- 11. Irrigated-GW/SW-DC-fallow- rice-other crops
- 12. Irrigated-GW/SW-DC-rice-rice-other crops
- 13. Irrigated-GW/SW-DC-mixed crops - rice - rice - SS
- 14. Irrigated-GW/SW-DC-rice - rice - rice - LS
- 15. Water bodies
- 16. Forest/Savanna
- Other land use

SC/DC/TC : Single/Double/Triple crops
SW/GW : Surface water/Groundwater

How Can Britain Feed Itself?

By Mark Thurstain-Goodwin and Gaynor Astbury, Geofutures

This food zoning model illustrates the areas required to grow sufficient food for the inhabitants of specified cities and towns in southeast England.



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The NAIP History 2002–2013 Map Tour

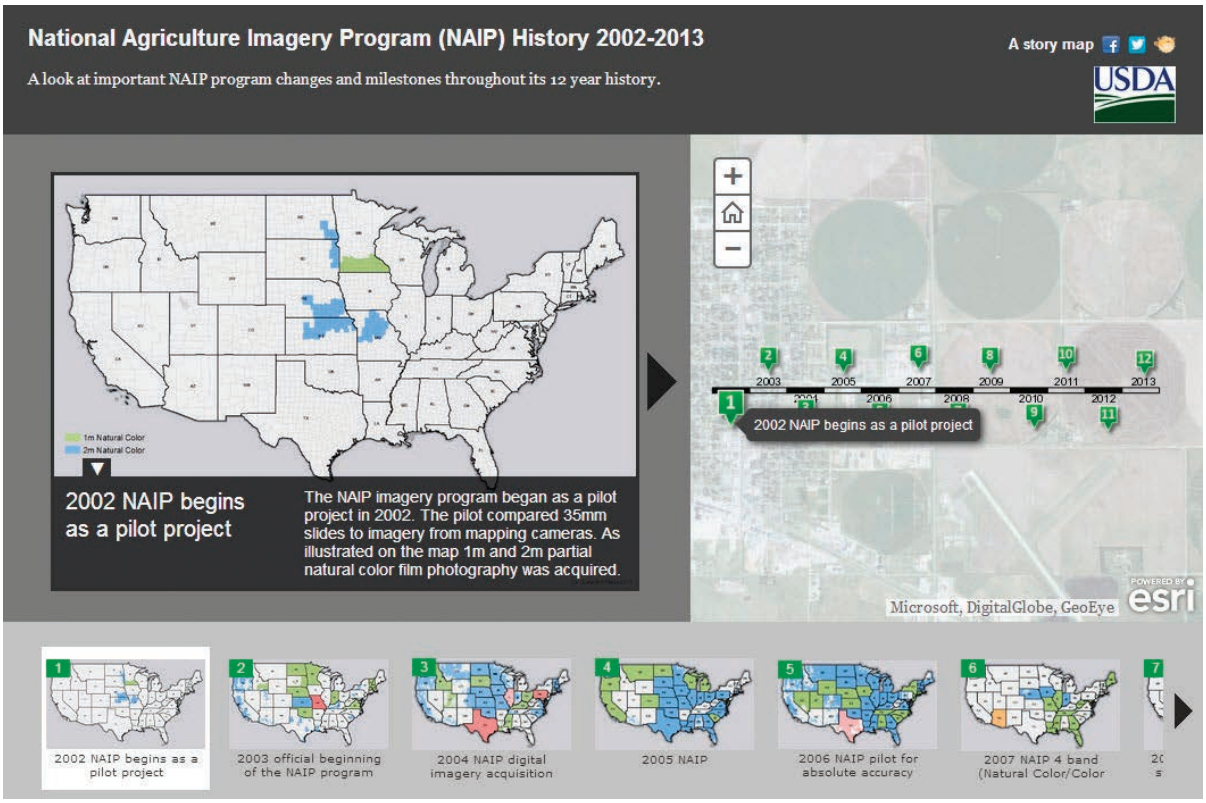
By Joan Biediger, USDA-FSA Aerial Photography Field Office

See NAIP's story map.

Imagery is essential in the support of many agricultural activities from land-use/land-cover classification to vegetation biomass estimation. The National Agriculture Imagery Program (NAIP) is administered by the USDA's Farm Service Agency (FSA) through the Aerial Photography Field Office (APFO) in Salt Lake City, Utah. NAIP acquires "leaf on" imagery during the peak growing season for states in the continental United States on a cyclical basis. NAIP imagery is used as a base layer for FSA and other USDA agencies to support day-to-day program administration, such as farm record maintenance, crop reporting, compliance activities, and change detection, and to update and maintain agricultural field boundaries. Change and growth have marked this imagery program since its beginning as a pilot program in 2002. NAIP began as a film photography collection consisting of a mixture of 1- and 2-meter resolution imagery with full and partial state coverage. Milestones include all digital image acquisition in place of film, 1 meter or higher spatial resolution, 4-band spectral resolution, full state coverage, and more accurate spatial accuracy testing. These are significant accomplishments for an imagery program collection of this magnitude and frequency.

Every NAIP acquisition year is different and often includes variables that change such as spatial and spectral resolution. It is challenging to represent multiple overlapping variables effectively in a single map. The Esri Storytelling Map Tour template offered a good solution to both tell the story of change and effectively show the history of the program. The hosted version of the Map Tour template was used to leverage both the interactive builder supplied with the template and automatic updates. One of the unusual things about this map is that the place points are used to depict time rather than location. A custom tiled base was created that incorporated a closeup view of NAIP imagery and a time line. The map tour location points are placed along the time line so that the user can follow the history of the program.

The National Agriculture Imagery Program History 2002–2013 Map Tour consists of 12 maps, one for each year of the program. As viewers explore the time line, they are presented with an imagery coverage map and a brief explanation of the historical milestone/change for that particular year. Users have the opportunity to learn more about this important source of aerial imagery used across many GIS and remote-sensing projects today. The story map paradigm worked well as a vehicle to present the history of NAIP, where the spatial progression of change over time and the written history are enhanced by a visually appealing and user-friendly application.



→ The National Agriculture Imagery Program map tour shows both the history of the program and the change in agriculture crops in the United States since 2002.

CropScape: Accessing and Analyzing Agricultural Data

By Joseph Kerski, Esri

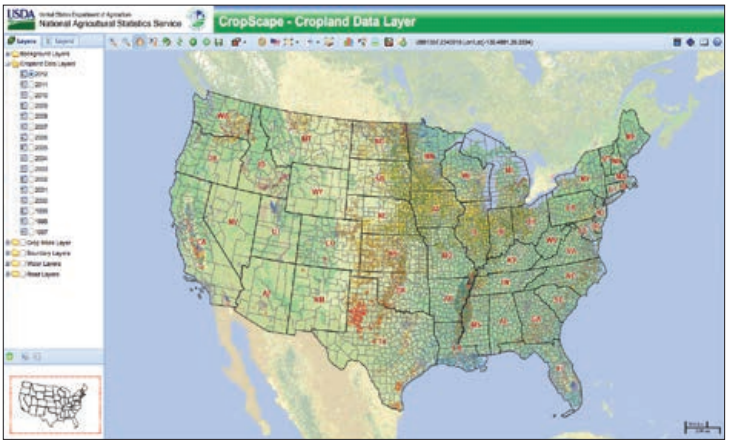
Give CropScape a try.

As Jill Clark and I explain in our book *The GIS Guide to Public Domain Data*, agriculture data is available in an increasing number of formats and portals. One of these portals is called CropScape, developed by the US Department of Agriculture (USDA) National Agricultural Statistics Service (NASS). CropScape hosts the Cropland Data Layer (CDL), a raster georeferenced land-cover data product created annually for the continental United States by NASS using moderate-resolution satellite imagery as well as extensive agricultural ground truthing.

CropScape allows the data user to browse annual crop data spatially and temporally from 1997 to the present. Tools allow the user to swipe images of two different years in the map panel, to access agricultural census data by county, and to identify crops at individual pixels. CropScape lets the data user download crop data in a GeoTIFF format for any customized area of interest or use the service as a basemap in ArcGIS Online.

The dataset is available each year back to 2008 as a ZIP file for the entire United States and is over 1 GB in size for each year. Statistics range from grapes to pumpkins, but the primary focus is on large-area summer crops such as wheat and corn. The spatial resolution is 30 meters. The interface is fairly intuitive, but if additional assistance is needed, an extensive FAQ exists.

A great many well-intentioned data portals exist, but many are not designed with the data analyst in mind. CropScape is definitely designed from the data and GIS analyst's perspective, which is welcome given the importance of and need for agricultural data. Give CropScape a try! [Previously published in *Spatial Reserves*, August 2013.]



↑ CropScape provides US crop data from 1997 to the present.

New Agriculture E-book Available

***Farming the Future: GIS for Agriculture*, Volume 2**

This free downloadable e-book contains a collection of articles highlighting the many ways GIS is used in agriculture throughout the world.

Winfield Solutions Implements Esri GIS for Field Data Management

Winfield Solutions LLC, a leading provider of agricultural inputs, has selected Esri ArcGIS for Server to streamline Answer Plot field data collection workflows. ArcGIS for Server will enable Winfield Solutions Central Research group's distributed operations to quickly and easily capture and update data in the field while also providing a central point of storage and access to enhance collaboration and ensure a single source of information for its Answer Plot research data. "Having ArcGIS for Server in place will make our field crews more efficient," says Jason Ribbens, manager of Central Planning, Winfield Solutions.

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