Esri News
for Agriculture
Summer 2014

GIS Improves Pest Inspection and Suppression in Australia

By Jim Baumann, Esri

Shortly after Australia was established as a British penal colony in the late 1700s, it began receiving convicts transported from the United Kingdom. As work was considered an essential part of the rehabilitation process, the early farms in Australia were developed with inmate labor.

Gradually, farm production became a cornerstone of the Australian economy, and today, over half of the country's agricultural output is shipped abroad, making Australia one of the world's top exporters of produce and livestock.

Historically, wool has been the backbone of the Australian agricultural industry, but in more recent times, grain has dominated. Grain is a significant part of Australia's agricultural production, and harvests include wheat, barley, oats, sorghum, maize, triticale, and rice. Depending on the grain, it is processed for either human consumption or animal fodder.

Because of the importance of agriculture to the country, the Commonwealth Scientific and Industrial Research Organisation

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↑ Western Australian wheat field with Stirling Ranges National Parks in the background.

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Agriculture Is All about Minimizing Risk to Optimize Production

By Susana Crespo, Esri Agriculture Specialist

Growing threats from a changing climate are driving the private and public sectors to optimize production through comprehensive strategies that support long-term sustainability. From small growers to large corporations, the issue of sustainability is on the forefront as farmers scramble to cope with producing more from less. Likewise, if corporations don't act now to secure raw agricultural materials for the future, their bottom line will suffer as they have to seek out raw materials to feed production.

Agriculture benefits from an intimate understanding of the complex forces that act on the landscape to affect production. Agriculture is inherently a spatial and temporal activity, where having the right information at that right time in the right place minimizes risk and increases production. Given its complete reliance on spatially explicit information, the industry intuitively understands the importance of GIS technology and is ready to invest in leveraging this tool to improve production.

At the same time, there is increasing frustration with the fragmented nature of existing spatial solutions for agriculture. The industry now has come to expect a platform solution where interoperability and fluid exchange of information between earth, machines, and humans can make farmers' lives easier, not harder. In the end, there are relatively few parts of the agricultural production system that farmers can act on:

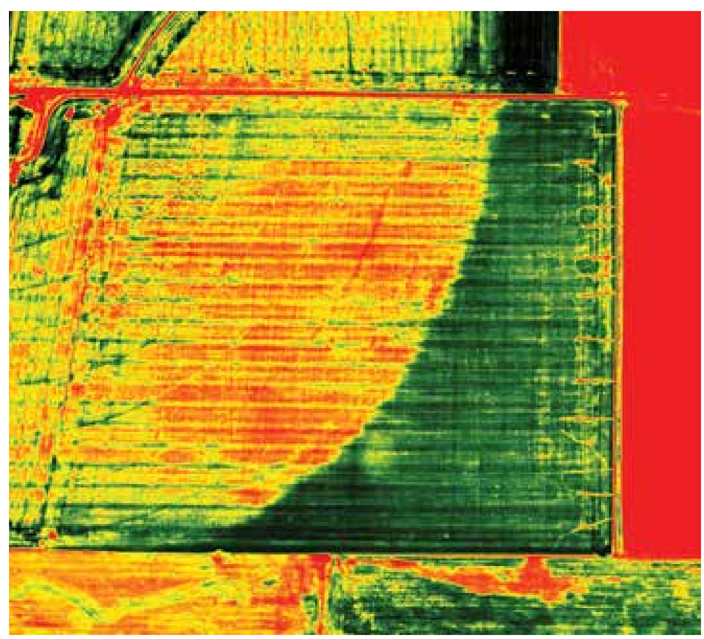
- What, when, and where to plant
- How many inputs to apply (water, fertilizer, pesticides)
- When to apply them
- How to manage production (support throughout season)
- When to harvest

The rest of the production's success depends on variables just outside growers' control, which therefore create risk. The more farmers can exert control and understanding on variables through place-based intelligence, the more profitable farmers become. This is what drives the whole industry of precision agriculture.

The profits from using spatial understanding to optimizing production are amplified throughout agriculture's life cycle, from seed companies that market the right seed to the right place to growers that increase revenue by optimizing production *within* their fields. This can guarantee against failure by having an intimate understanding of the place-based probability of variables (such as weather) that affect growers.

The relationship between imagery and agriculture is strong. It will undoubtedly grow as farms increasingly use it to take advantage of understanding subfield variability to optimize production. Earth-observed imagery—gathered by either photogrammetry, unmanned aerial vehicles (UAV), or satellites—is the backbone of the precision agriculture workflow. Pixels are transformed into prescriptions by a series of analyses that result in a farmer customizing management practices to optimize production within a field. Raw data is transformed into the Normalized Difference Vegetation Index (NDVI), which is commonly used as a proxy for crop health. The NDVI is generalized into contours, or management zones, within which farmers or farmer and consultant teams devise a plan to apply more or fewer pounds of fertilizer, water, or seeds.

At harvest time, additional spatial data from combines can be generalized to produce a yield map that allows farmers to correlate crop performance to the original subfield prescriptions. By getting a more granular level of understanding and management within a field, farmers mitigate risk and increase production and, therefore, profitability.



↑ NDVI: ArcGIS processes multispectral imagery to deliver crop health.

Smart Maps Gives Ravensdown a Competitive Advantage

By Harley Prowse, Director, Geographic Business Solutions

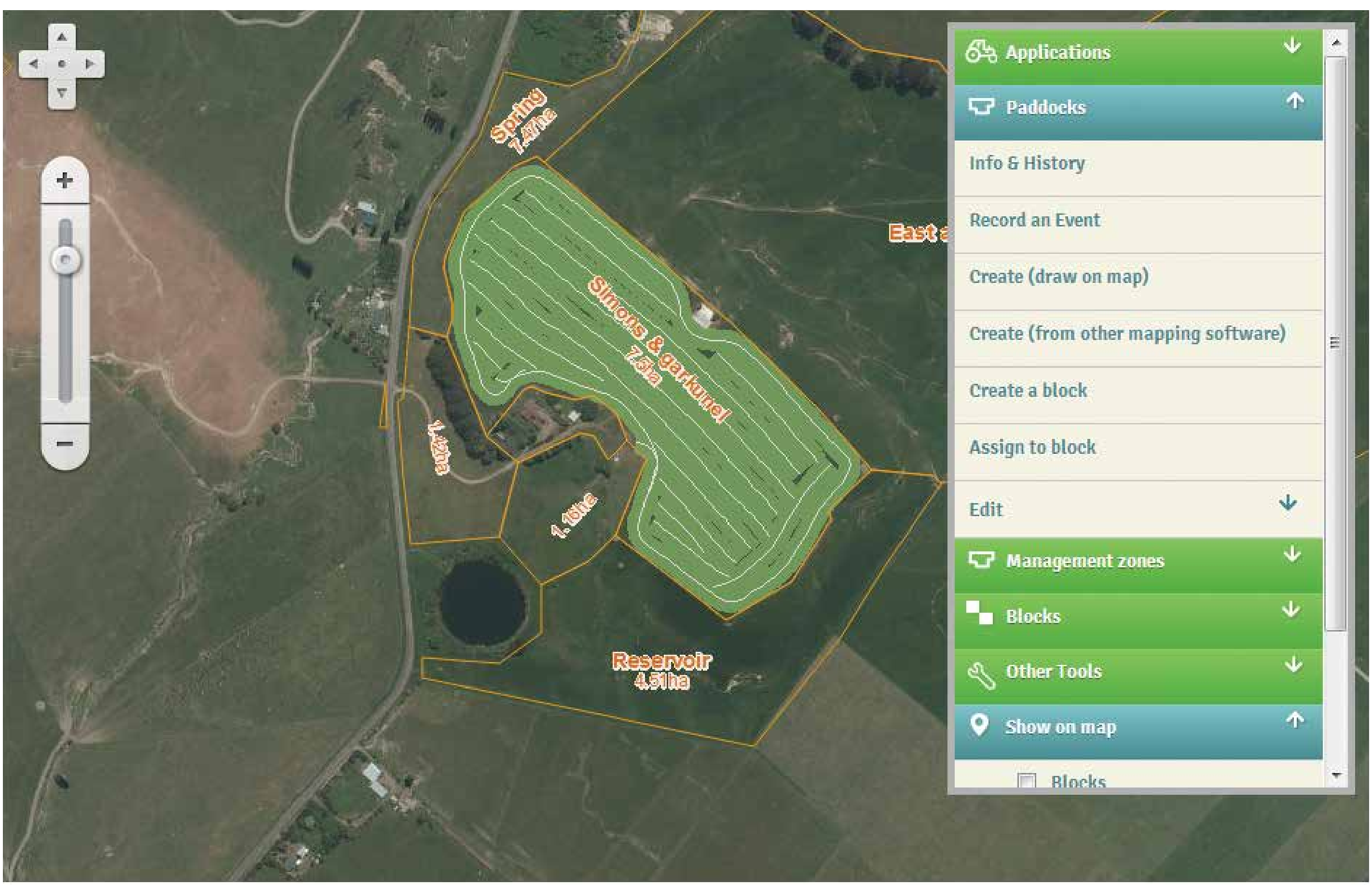
In June 2013, Ravensdown launched Smart Maps, the latest feature of the My Ravensdown hosted application for farmers. Collaboratively designed and built by Geographic Business Solutions (GBS), Smart Maps is a mapping tool and information repository built with Esri ArcGIS for Server that lets farmers see their records, test results, nutrient plans, and fertilizer placement, all in one place. To the best of Ravensdown's knowledge, it's the only fully integrated geospatial farm management tool of its kind in the world.

A cooperative company 100 percent owned by farmer-shareholders who are also customers, Ravensdown supplies close to half of New Zealand's agriculture fertilizer. For several years, Ravensdown has been making farm management easier with My Ravensdown, which gives farmers access to information about their interactions with Ravensdown. My Ravensdown has been evolving steadily over the years as new technology has become available. An early addition to My Ravensdown was a map viewer. It had minimal functionality, but it was enough to give farmers a glimpse of what might be possible with a map-based tool.

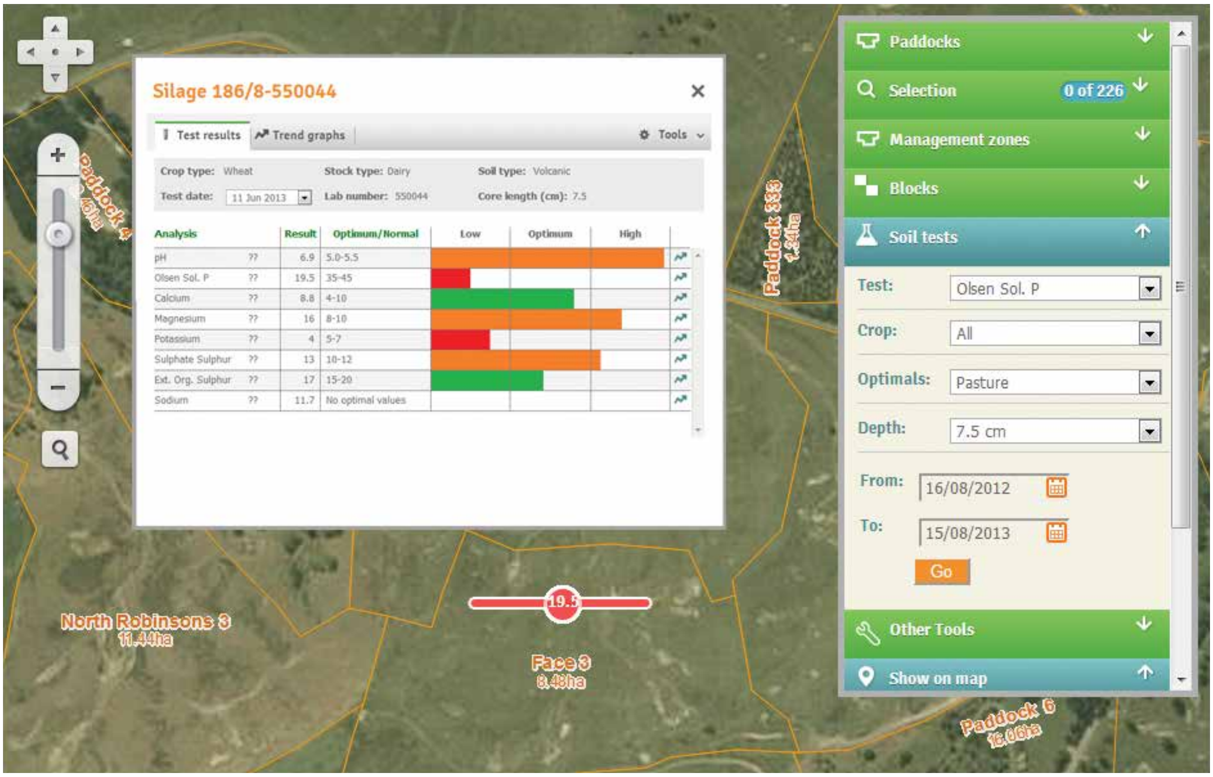
Mark McAtamney, chief information officer at Ravensdown, says that adding the viewer started a torrent of farmer feedback. "We'd teased our customers with the simple map viewing function, which resulted in a raft of suggestions about how to make it better. We listened to all the ideas and created a vision and scope of work for Smart Maps."

Launched at Fieldays in June 2013, Smart Maps (and C-Dax) received a great response and was awarded the Fieldays International Innovation Merit award—C-Dax for the Smart Control with Smart Maps system. Smart Maps is now the star feature of My Ravensdown. A comprehensive farm mapping and fertilizer management tool, the solution was designed, built, and implemented by GBS.

The relationship between Ravensdown and GBS began in 2006 with RavTrak, a solution for tracking on-road/off-road truck



↑ The Smart Maps user interface shows farm paddocks and a recent fertilizer application.



↑ The Smart Maps user interface shows a soil test result.

mileage. Previously, GBS had supported a proof-of-placement solution that allowed Ravensdown customer-shareholders to see where and how fertilizer had been spread on their farms. RavTrak was delivered on time, and Ravensdown staff were highly impressed by the consistent quality of the GBS team's work. Consequently, GBS was named Ravensdown's preferred supplier of geospatial services.

Smart Maps took nine months to design and build.

The GBS team worked closely with Ravensdown during the creation process to ensure the grand vision for Smart Maps was more than achieved.

Key Benefits of My Ravensdown Smart Maps

- Farmers can accurately draw and name their paddocks on an aerial map.
- Fertilizer applications by trucks, aircraft, and C-Dax spreaders are automatically recorded for each paddock.
- Farmers can record farm events for each paddock, such as cultivation, irrigation, seeding, or spraying.
- Feed wedge information can be displayed for the whole farm or any paddock.
- Farmers can see nutrient summaries by paddock, block, or management zone.
- Soil test results can be viewed and interrogated on the map—including trend graphs of nutrients from the same test position.
- Fertilizer plans that are designed by Ravensdown staff can be viewed on the map.

Smart Maps has been enthusiastically welcomed by Ravensdown customer-shareholders. After just two months, more than 1,000 farmers have drawn up their paddocks, which is a strong indication they're getting value from the new tool.

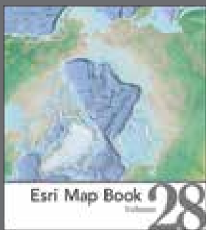
"Smart Maps has given us a market advantage and has become a cornerstone of our negotiations with new prospects. When they see how the level of functionality we give them compares to our competitors, it's easier to convert them into customers," says McAtamney.

McAtamney also indicates that working with GBS added real value to the development process.

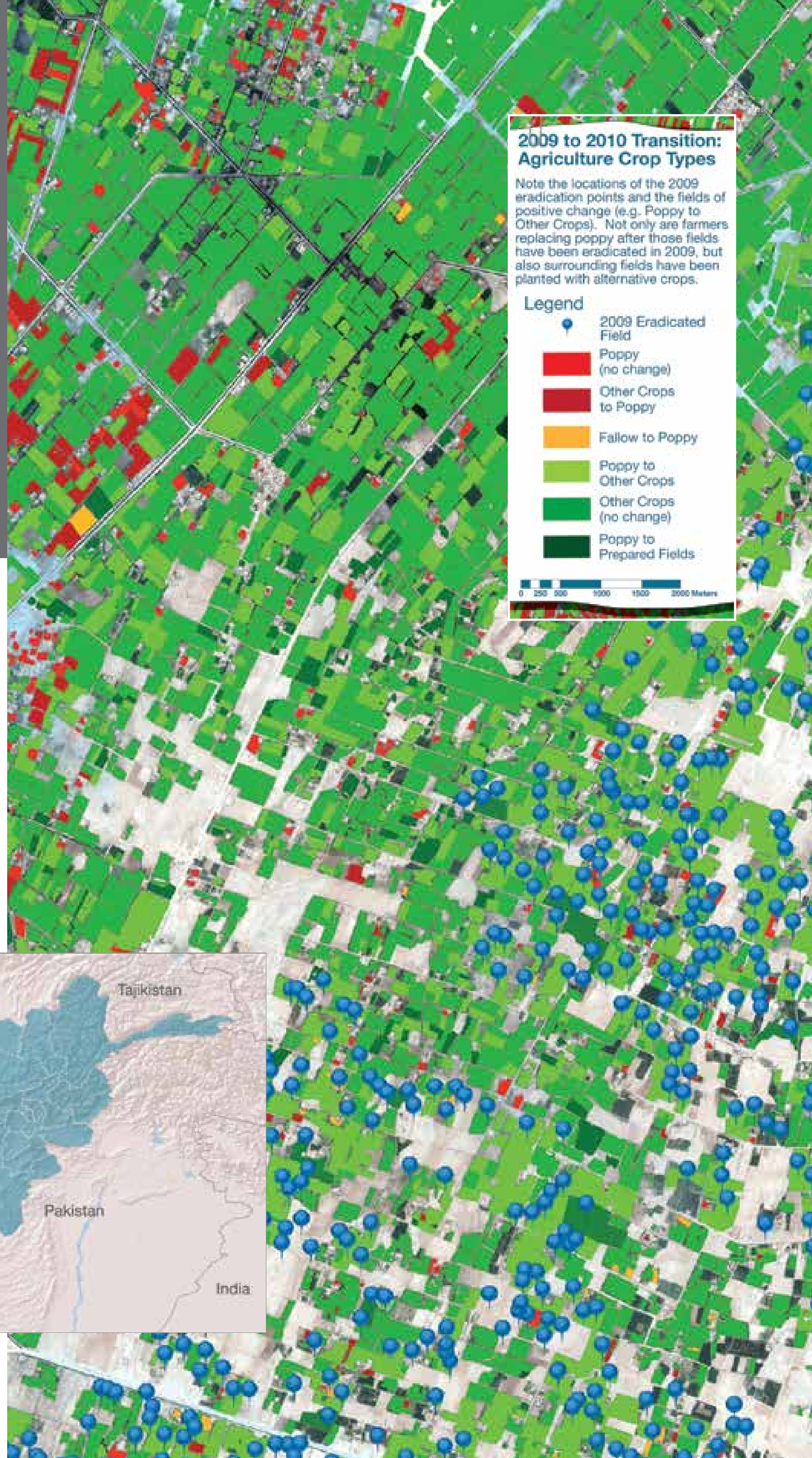
"The GBS Smart Maps solution has more than lived up to our expectations," says McAtamney. They often came up with things we hadn't thought of."

Smart Maps builds on all the work GBS has undertaken with the Ravensdown team since 2006 and considerably extends Ravensdown's geospatial capability, creating a broad platform for ongoing innovation.

Harley Prowse is a director at Geographic Business Solutions, a New Zealand-based Esri Gold Tier Partner specializing in custom Esri solution design and development.

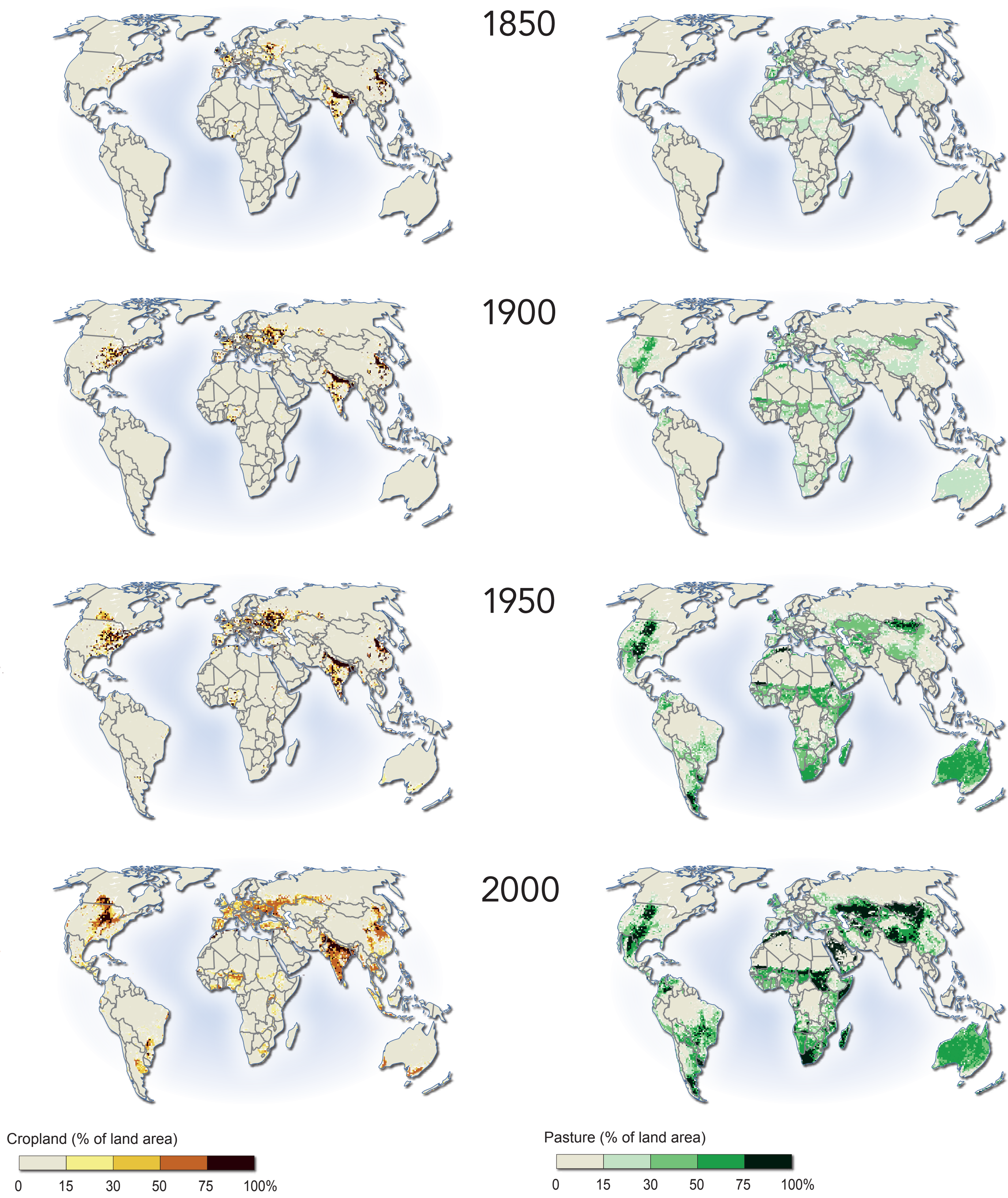


Published since mid-1980, the annual *Esri Map Book* presents a broad collection of maps that illustrate the current use of GIS technology. The agriculture maps included here are from volume 28, the latest version of the map book.



Measuring the Deterrent Effect of Poppy Eradication in the Helmand Food Zone

Agricultural Development 1850–2000



media.esri.com/mapbook/volume28/index.html

Predictive Technology Signals Farming Revolution

By Daniel Lato, Esri Australia Pty. Ltd.

Farmers in Queensland's peanut capital of Kingaroy are at the front line of a precision agriculture program that could revolutionize the Australian farming industry.

The program, which uses Esri ArcGIS enables farmers to accurately forecast harvest yields and predict crop disease outbreaks. By using geospatial technology, farmers can access interactive maps that incorporate satellite imagery and other real-time data such as soil, irrigation, pest, and nutrient conditions.

From this data, growers can analyze the health and maturity of their crops, develop and shift farming strategies, and submit detailed reports to industry stakeholders from anywhere on the farm.

Dr. Andrew Robson, who developed the project in partnership with the Peanut Company of Australia (PCA), said GIS provides an excellent framework for storing, displaying, and analyzing yearly crop variations identified from satellite imagery.

"At this stage the most important use of the technology for peanut growers and industry stakeholders is yield prediction," Robson said. "We create GIS maps which display yield variability layers derived from satellite imagery that have enabled accurate yield predictions at the regional, farm, and crop level."

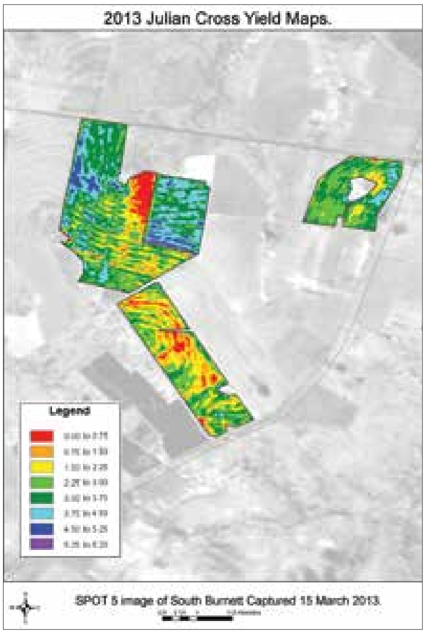
Queensland produces over 95 percent of Australia's peanut crop with the main growing areas in the Burnett region, Bundaberg, Central Queensland, and Atherton Tableland.

Robson said the groundbreaking technology has a wide range of other potential uses in the industry, including the ability to determine the maturity of underground peanut pods which, until now, has been very difficult.

Esri Australia managing director Brett Bundock said similar GIS applications are currently being developed across a range of Australia's other major agricultural industries, including sugar cane, avocados, and cotton.

"For example, avocado growers could map each tree to monitor quality and

↓ Dr. Graeme Wright from the Peanut Company of Australia is hoping to more accurately forecast harvest yields and predict crop disease outbreaks with new smart mapping technology from Esri Australia.



↑ 2013 Julian Cross Yield Maps

yield capability and from this generate data that would show disease ratings for trees across an entire plantation," Bundock said. "By analyzing seasonal and change detection images, farmers can identify which regions contain disease-related canopy loss and focus treatments to prevent further spread."

The information could help Australia's entire agribusiness industry make assessments on the best timing and pricing for export—giving the country a huge competitive advantage.

"This farming expertise and technology can also be exported as a service to overseas markets," Bundock said.

PCA Breeding and Innovation manager Dr. Graeme Wright said the delivery of the project meant farmers no longer had to be GIS experts or have expensive software to use the cloud-based technology.

"GIS technology is at a stage where anyone can access it, understand it, and apply it." Wright said. "And, as the use of this technology grows, it is going to revolutionize the paddock-to-plate concept—by allowing us to trace produce right back to an individual supplier."

UN Partners with Private Sector to Map Disaster Risks for Local Communities

By Denis McClean, Media Relations, UNISDR

Technologies that enable communities to visualize disaster risk and take action are to be made available for cities worldwide as a result of collaboration between Esri and the United Nations Office for Disaster Risk Reduction (UNISDR).

↑ UN secretary-general Ban Ki-moon speaks at the opening ceremony of the Abu Dhabi Ascent climate change conference, held May 4, 2014, in the United Arab Emirates. (UN Photo/E. Debebe.)

Esri, the world leader in GIS technology, and the UNISDR announced their new partnership at the Abu Dhabi Ascent, a high-level meeting to generate momentum ahead of the September 23, 2014, Climate Summit being convened by UN secretary-general Ban Ki-moon. The two-day meeting brought together government representatives and leaders from business, finance, and civil society to develop proposals for action on climate change.

The new initiative will support the efforts of the 1,800 cities of UNISDR's Making Cities Resilient campaign to improve land use and urban planning by providing access to the very latest mapping technology and encouraging the development of new apps for urban resilience.

Responding to the UN secretary-general's call for world leaders to mobilize their most ambitious plans for climate action, the initiative leverages the same technology platform that US president Barack Obama unveiled for American cities last month. The maps provided through the partnership establish the foundation for mobilizing larger, tangible commitments to disaster risk reduction that will be announced at the Climate Summit in September.

Esri president Jack Dangermond said, "Just as we're supporting President Obama's climate resiliency initiative in the United States, we are committed to providing expertise, support, and capabilities on a global scale for the Making Cities Resilient effort. Populations and economies are becoming increasingly concentrated in urban areas. The experience of cities already working to build their resilience is essential for helping us all to understand climate impacts and plan measures to reduce exposure to disaster risk in the twenty-first century."

Margareta Wahlström, the head of UNISDR, said, "Land use and location of critical infrastructure, such as schools and hospitals, are key to good planning for all communities, large and small. Planners must deal with spatial information if they are to reduce risk and build resilience to disasters. This partnership with Esri can help bridge the gap between aspiration and implementation by putting the latest science and technology at the disposal of those who have joined the Making Cities Resilient campaign."

As part of the initiative, Esri will launch an app challenge centered on UNISDR's 10 Essentials for Making Cities Resilient in July at the Esri User Conference, with the announcement of prizes and awards to follow. (Republished with permission from the United Nations Office for Disaster Risk Reduction.)

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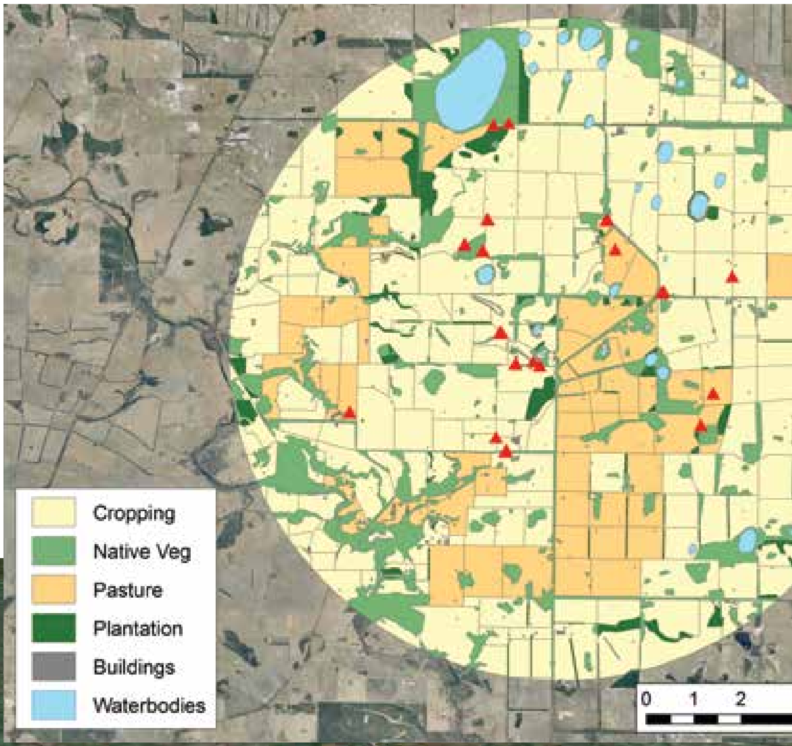
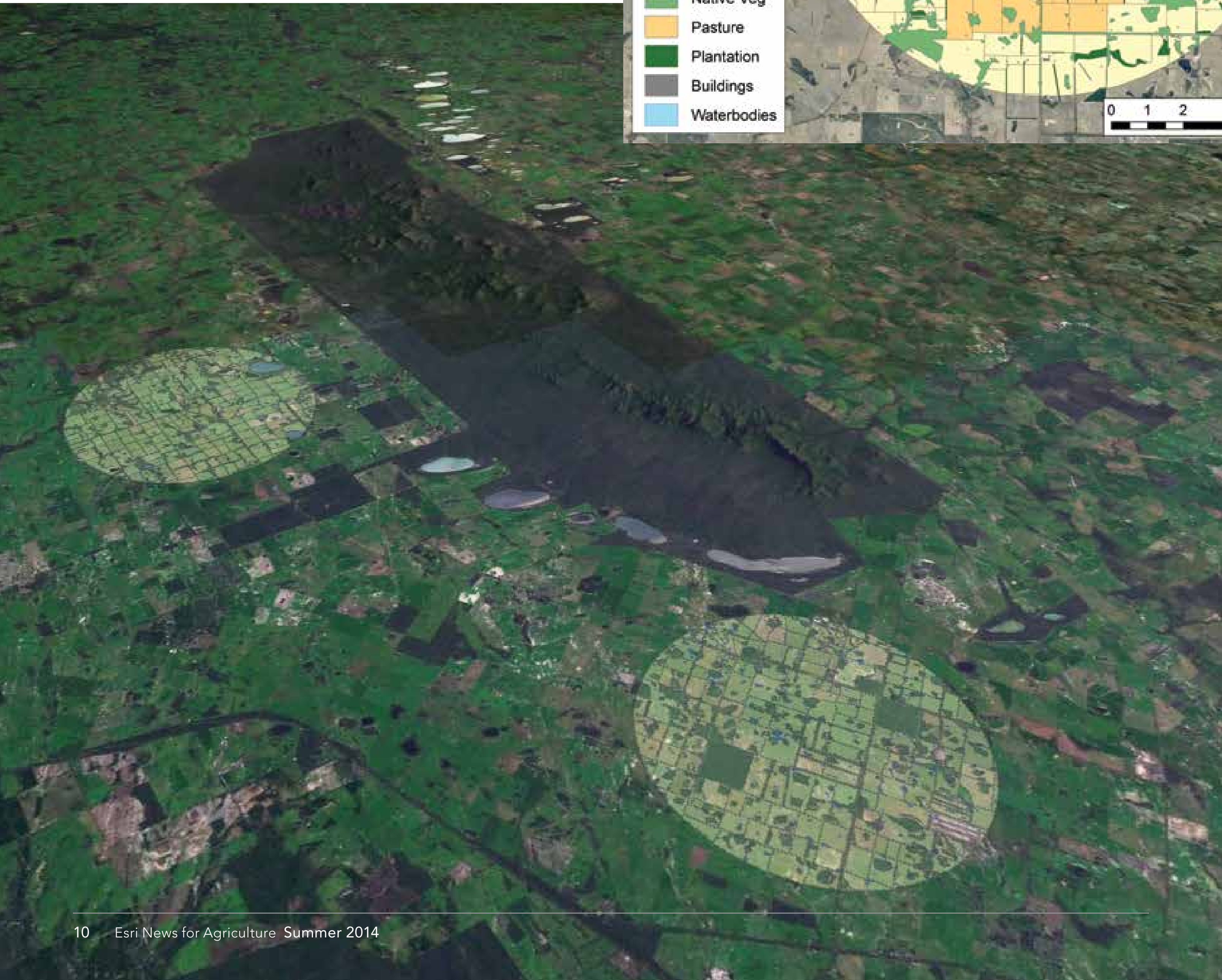
(CSIRO), Australia's national institution for scientific research, along with the Grains Research & Development Corporation (GRDC), conducts significant research in grain production systems. Researchers from the spatial ecology team in Brisbane investigate insect populations within both native and cultivated habitats by conducting field surveys during specified times and mapping the resultant "snapshots." This helps the team create predictive models to better understand how specific insect populations interact with their environment and, subsequently, to develop methods to help facilitate pest suppression.



↓ Below is an ArcGIS for Desktop view of the two experimental landscapes near Albany, Western Australia, on the southern edge of the wheat belt region.



↑ Western Australia Land-Use and Sampling Sites

"One of the problems with large-scale ecological surveys is that it's sometimes difficult to visualize spatial and temporal trends," says Andrew Hulthen, GIS analyst and field researcher at CSIRO. "GIS allows us to visualize data, which makes it much easier for us to interpret our findings and share our results with other researchers."

Hulthen recently analyzed the data collected in the field by a CSIRO-led team conducting a study to better understand how population dynamics of pest insects are affected by landscape composition. The team identified the source habitats of both pests and their natural enemies, then Hulthen used ArcGIS to examine insect movements between habitats and the length of time for specified insects to establish crop colonization. As native vegetation can harbor many beneficial insects that eat destructive species attracted to the grain in cultivated fields, preserving the native vegetation remnants promotes an ecologically sound method of pest control.

The scope of the study included monthly surveys of insect populations at more than 80 sites within six landscapes in Queensland, New South Wales, and Western Australia. The landscapes were selected based on the field crop, the distance from the field to native vegetation remnants, and the proportion of native vegetation to the area being farmed. In each region, two landscapes were chosen for comparative purposes, one with a low proportion of native vegetation remnant and one with a high proportion. Each was 14 kilometers (8.7 miles) across, and each pair was at least 20 kilometers (12.5 miles) apart. Within each landscape, multiple crops and native remnant sites were chosen. The study was conducted over a two-year period, and the researchers netted more than 100 insect species, 29,000 samples, and 300,000 individual specimens.

The features in the selected landscapes were digitized and classified as cropland, native vegetation remnant, pasture, forest replantation, and water body. Hulthen used ArcGIS to create multi-ring buffers of 500, 1,000, 1,500, and 2,000 meters around each native vegetation remnant. The buffers were intersected with the land-use feature class as well as the data collected on the insects inhabiting the native vegetation and their travel range. Hulthen used Python scripting to automate the data processing. The analysis provided him with maps that characterized the landscape features surrounding each survey site. It helped to identify the ecosystem benefits provided by these landscape configurations.

"The visualization and analysis allowed us to explore those landscape configurations that are less prone to insect pest attacks," said Hulthen. "It helps us develop pest-suppressive landscapes. This approach works toward reducing reliance on broad-spectrum insecticides and promotes the sustainable management of natural resources."

Announcements

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esri.com/industries/agriculture/community/usergroup

Events

Esri User Conference

San Diego, California

Agriculture Forum
Sunday, July 13
3:00 PM–5:00 PM
Room 25 C

Agriculture SIG Meeting
Wednesday, July 16
NOON–1:00 PM
Room 25 C

Permanent Crop User Group Meeting
Wednesday, July 16
5:30 PM–7:00 PM
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