



The Rice Decision Support System (RiceDSS) provides mapping services to support NASA's contribution to the Group on Earth Observations Global Agricultural Monitoring Initiative (GEOGLAM) which produces and disseminates timely and accurate forecasts of agricultural production using Earth Observation data.

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Over 3.5 billion people depend on rice to survive. In addition to being a major food staple, rice has far-reaching economic implications. Tools to monitor rice production and manage risks associated with growing the crop are needed by farmers, investors, and governments. However, it wasn't until Applied GeoSolutions developed a Rice Decision Support System (RiceDSS) for NASA's small business innovation research (SBIR) program that improvements to real-time rice production forecasting and condition assessment was possible.

PROJECT

Rice Decision Support System (RiceDSS)

MISSION DIRECTORATE

Science

PHASE III SUCCESS

Raised approximately \$2.5 million in post Phase II (includes Phase II-X and Phase III funds) from NASA, international aid agencies and the private sector

SNAPSHOT

Applied GeoSolutions' real-time rice mapping and production forecasting tool piloted in the United States through SBIR is being further developed for a multi-million dollar initiative to reduce greenhouse gas emissions in Vietnam.

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To support both the rice futures market and NASA food security missions, Applied GeoSolutions is leveraging satellite imagery to generate information about rice growth, water management and expected yields around the globe. In the past, data on rice growing efforts were typically obtained by surveying farmers which could take days or weeks to collect information. More recently, Earth Observation data from satellites has transformed data collection, making quick analysis possible within hours of overpass collection.

"Timeliness is a key factor. Although satellite mapping of rice paddies has been available, translating vast amounts of optical and synthetic aperture radar imagery into consistent and meaningful information in a timely manner has been a big challenge," according to Applied GeoSolutions President William Salas. "Our RiceDSS application solves the problem by generating and delivering high resolution rice maps and timely rice production forecasts at state to national scale. We can now collect and analyze near real time data at time intervals only possible due to recent proliferation of Earth Observation satellites."

For more than a decade Applied GeoSolutions, based in Dunham, New Hampshire, researched various applications for Earth-imaging satellite data. The company's foray into rice research started with developing mathematical calculations to estimate greenhouse gas emissions associated with rice cultivation. Building on its use of mathematical modeling, Applied GeoSolutions developed an approach to monitor

LEFT:
RiceDSS was developed to provide improved monitoring of rice agriculture to generate near real time information on rice growth stages, production forecasts and statistical uncertainty.

RIGHT:
RiceDSS generates and delivers high resolution, georeferenced rice monitoring maps and rice yield forecast maps that are driven by calibrated satellite remote sensing observations and short and mid-term weather forecasts.



conditions and calculate risks to the global food supply by forecasting rice production.

The company's RiceDSS application provides timely information on how much rice has been planted and how well it is growing. This is a game changer for the agricultural sector, food monitoring programs and the commodity markets. The analysis of rice cultivation generated by RiceDSS can be used to quickly adjust to market needs and pricing as well as hedge a number risks associated with crop failure or low production.

time sensitive information through automated rice growth updates at weekly intervals which was a vast improvement to the standard monthly reports. Armed with this information, farmers can now monitor crop health in near real time throughout the growing season to help develop crop management plans.

This comprehensive forecasting is possible because Applied GeoSolutions collects data from multiple sources very early in the growing season. Data from Landsat 7 and 8 satellites, which capture images of the Earth's surface every 8 days, are combined with data from MODIS, a satellite which maps Earth every day, and satellites with new radar sensors, like Sentinel-1 and PALSAR-2. This allows for better monitoring of changes in crop stages, plants' responses to weather, and farm activities such as irrigation or tillage.

RiceDSS is now being used in Southeast Asia through AgResults, a \$118 million multilateral initiative financed jointly by the governments of Australia, Canada, the United Kingdom, the United States, and the Bill & Melinda Gates Foundation. Applied GeoSolutions was selected as the lead verifier role for a AgResults Vietnam Emissions Reduction Pilot (AVERP) project to provide low cost, low touch verification of rice management practices in Thai Binh Province. Through AVERP, Applied GeoSolutions will help improve small farmer livelihood while increasing yields and curbing greenhouse gas emission.

According to Salas, "SBIR provided us with a unique opportunity to help promote economic stability while addressing key humanitarian issues associated with climate change and global food supply system. With this success, we are further developing RiceDSS to be used for commercialization in a number of ways. We are planning to provide consulting services which leverage the use of forecasts to optimize efficiency and support adaptation and mitigation strategies."

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PRESIDENT
WILLIAM SALAS

Satellite remote sensing provides an important opportunity to consistently and broadly observe thousands of farm fields. Applied GeoSolutions found a way to leverage daily data streams of calibrated satellite remote sensing observations and combine with near real time estimates from crop models and short and mid-term weather forecasts.

This powerful analysis improved predictions of rice yields and production at scales ranging from individual farm fields to large regions. State-of-the-art open source web-geographic

information system and mobile technologies that includes mobile devices ("smartphone app"), and online analyses modules are used to organize, visualize, and deliver this critical information to decision makers.

As part of the SBIR program, Applied GeoSolutions developed and tested a prototype RiceDSS in Arkansas and California. Farmers were provided with critical,