RTI INTERNATIONAL

Improving Food Security Through Remote Sensing and Analytics

Photo: Charis Unmanned Aerial Solutions

Short-Term Challenges

- How much land has been planted with which crops and where?
- What is the status of the crops during the growing season? What is the expected production at harvest?

Medium- to Longer-Term Challenges

- How should investments (e.g., improved seeds, erosion control, irrigation) be prioritized?
- What is the impact of climate change on crops?

Stakeholders want timelier and more actionable information to address food security.

RTI Grand Challenge Investment 2018–2019

Achieving global food security and resilience within the agricultural sector is a major and growing challenge that requires significant advances in production efficiency and sustainability. Agricultural stakeholders in many regions—particularly in low- and middle-income countries (LMICs)—need timely, reliable, and actionable information to make informed production, investment, and policy decisions—all of which affect food security. RTI International is tackling this challenge head-on by using remote sensing data, machine learning algorithms, and other analytics to develop new methods and data products that will bring the best-available agricultural information into the hands of decision-makers around the world.

The Need

Government officials, farmers, members of civil society, and other stakeholders need to make decisions regarding agricultural production, development priorities, and policies to enhance the agricultural sector's food security, resilience, and sustainability. However, in many regions, existing data to inform decision-making are incomplete or inconsistent, are located within disparate sources, and/or may not be spatially disaggregated. In addition, stakeholders need data-driven approaches to evaluate the impacts of interventions, test hypotheses for new interventions, and inform where and how to target agricultural interventions for the greatest impact. There are examples of worldwide efforts making use of remote sensing, big data, and analytics to inform this type of decision-making; however, few efforts are effectively reaching LMICs where the need is highest and continues to grow.

RTI's Response

In 2017, RTI announced a $1-million investment in a new Grand Challenge initiative that uses remote sensing and machine learning to develop new approaches and information products to inform food security decision-making in LMICs. The Grand

Challenge focuses on Rwanda, where RTI has helped the Ministry of Agriculture and Animal Resources (MINAGRI) develop a geospatial database under a separate U.S. Agency for International Development–funded project, Private Sector Development for Agricultural Growth, that our new initiative can leverage.

Remote sensing refers to the acquisition of information about an object without making physical contact with the object. Remote sensing typically involves using satellite or aircraft-based sensor technologies, including unmanned aerial vehicles ([UAVs] or drones), that are used to detect and classify objects on earth. With the Grand Challenge project, we are focused on classifying crop types and monitoring crop development.

Working with MINAGRI and local stakeholders, RTI is using drone imagery to characterize the land by labeling specific crops—such as maize, beans, bananas, and cassava. Machine learning models are then trained using the drone imagery classifications and applied to 10-meter resolution satellite data, which are freely available with global coverage. We use these baseline characterizations to then (1) overlay productivity, profitability, and nutritional information using data available from MINAGRI and other Rwandan government institutions and (2) project how crop status will change under different scenarios, including future climate change scenarios, to determine the potential impacts to crops and food security. The trained machine learning models and projected scenarios allow decision-makers to use satellite data to increase the accuracy and lower the cost of obtaining current data and assessing alternative strategies at a national scale. Following are just a few of the valuable insights that the data offer:

- Crop location and type
- Near real-time status of crops throughout the growing season(s)
- Projected productivity, profitability, and nutritional output from crops
- Projected impacts to crops under various climate change scenarios

Decision-makers at the national and subnational levels can use this information to target resources and interventions to improve food security, monitor and evaluate the impact of interventions at a national scale, and plan future investments and strategy.

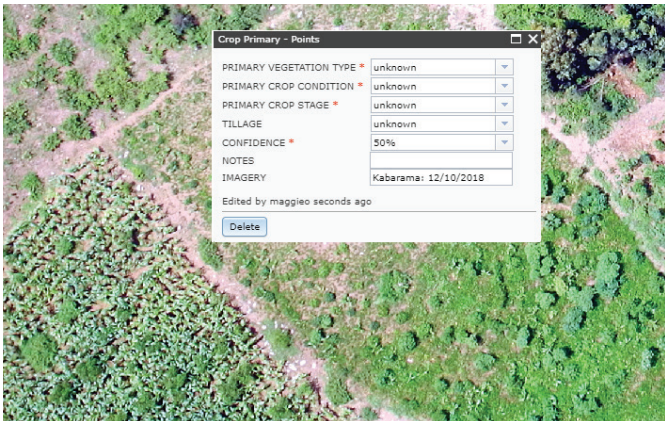
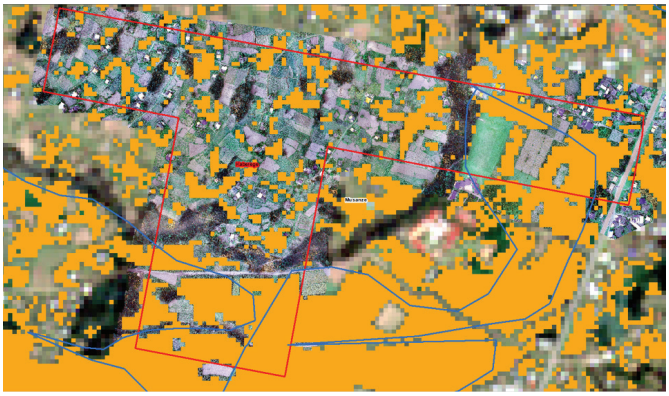


Image from drone flight and ground-truth classification process to identify crop type, condition, stage, and tillage. The ground-truthing process requires field staff to verify in-person crop information associated with each image. This information is then used to train machine learning models to apply the classifications to satellite data at a national scale.



This image shows maize classification on the satellite Sentinel 2 imagery at a 10-meter resolution. The part outlined in red shows drone imagery overlaid on the satellite imagery at a resolution of 3–5 centimeters. Using this information, we can calculate—at a national scale—how much land is growing maize.

More Information

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