Using Data Science to Support Indian Farmers

GLOBAL IMPACT ARTICLE SERIES

For generations, agriculture has been the primary means of employment for over half of the population in Telangana, India. But climate change, the increasing frequency of drought, a lack of irrigation access, and volatile market prices for popular cash crops have left many rural farmers deep in debt. These changes, coupled with complex political issues, have led to high poverty and farmer suicide rates; more than 300,000 farmers have committed suicide since 1995, and over 60 percent of those farmers were from the semi-arid states of Maharashtra and Telangana.

ACCESSSING DATA

Large agricultural companies like Monsanto have created algorithms based on long-term climate and soil data, and farmers' experiences to help farmers make informed decisions about their businesses. Farmers can access this data to manage risks, get recommendations about management practices, and improve crop productivity. But in India, only about seven percent of rural residents have access to the internet. Yet smartphone use is growing, opening up an opportunity to use data science to help Indian farmers make more informed decisions about their farming practices, potentially leading to higher yields and improved profits.

The U-M project team, supported by a Dow Distinguished Award for Interdisciplinary Sustainability, proposes to establish big data frameworks appropriate for small farmers in Telangana to inform the best management practices and proper risk management for Indian farmers. It is crucial for farmers to be equipped with the right set of risk management tools to address unpredictable circumstances, such as climate change and market instability.

PROJECT GOALS

The project team's overarching goal is to design and establish a framework to collect and analyze high resolution spatial and temporal farming data on a regional or national scale. This framework will be used to subsequently engage big data science to inform nutrient management practices among small farmers.

To achieve this goal, the team worked on two key components during the 2015 crop season: conducting soil tests for local farmers, and creating a data collection infrastructure to gather high resolution spatial and temporal farming data.

Additionally, the team analyzed crop data from a 2015 pilot study of 250 farmers in the region. This preliminary analysis serves as a baseline and launch point for developing machine-learning algorithms that can be applied in a decision-making service for famers across the region.

This work builds on a previous project in Telangana, which focused on de-silting irrigation ponds, and using that silt as a partial replacement for inorganic (commercial) fertilizers. During that project, the team surveyed 1,100 farmers and discovered vast differences in both crop yields and fertilizer application practices among farmers. They also discovered that the majority of cotton farmers had never conducted soil tests on their land, and lacked access to sufficient irrigation resources. Based on these findings, the team identified a need among farmers for increased knowledge of best management practices with respect to irrigation and soil nutrients.

SCALING UP

For the 2015 pilot study, the team focused on the agricultural villages of Chandaram and Goliwada, building a database to help guide farmers' decisions. With help from on-the-ground field coordinators, they developed and deployed a survey to collect information about land acreage, cropping history, planting and harvesting, and management actions. Soil samples from 50 farmers in Chandaram and 200 farmers in Goliwada were collected for analysis.

The team also collected 35 years of historical weather data, and digitized government land survey maps to integrate farmer data collection with individual land parcels. This allowed the team and others to visualize differences in land layout within each village. Currently, the team is working on the second phase of the project, which includes 3,600 farmers across 54 villages

PRELIMINARY RESULTS AND RECOMMENDATIONS

Based on the results of initial soil tests, the project team determined that the majority of plots are deficient in both phosphorous and nitrogen. Using visualizations based on these results and the farmer surveys, the team discovered that fertilizer was variably applied across different plots and yield varied widely even when farmers reported they had applied the same amount of fertilizer. This suggests an ongoing need to communicate best practices to farmers, focusing on proper timing and placement of fertilizer.

In 2016, the team will present their findings to local farmers, with a goal of building a community network of agricultural best practices. Each participating farmer will receive a recommendation sheet outlining best nutrient practices for their specific plot of land. In addition to personalized soil nutrient recommendations, the sheets will have information on the 20-year historical climate data from the nearest weather station and information on both locally available fertilizers and alternative sources of nutrients, such as manure or silt.

ANTICIPATED OUTCOMES

The team will continue working with field managers and participating farmers to collect real-time data on farming practices and outcomes. So far, they have collected soil data from 2,700 of the 3,500 farmers from 51 villages in Telangana. The team will install weathers stations to ensure the collection of high-quality climate data to inform farmers' cropping decisions. Over the next several years, the team plans to:

- Collect farming practices data to create finely tuned algorithms;
- Craft data driven crop models to aid small farmer decision-making; and
- Establish a sustainable economic model for funding a decision-making service.

Once a data-driven model is established, it will help determine how much yield a farmer can expect given a certain amount of soil nutrients and climatic conditions. This new knowledge should increase productivity and incomes, potentially increasing the yield of an average cotton farmer by 7,000 to 8,000 rupees (approximately $100-$120 USD).

KEY PROJECT PARTNERS

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Read More:

- Full Project Report
- Dow Sustainability Fellows Program

Once the team has created an effective model, they will explore options for making the service economically sustainable. Efforts will include working directly with farmers to sell the service to partners, regional seed companies, or ginning mills. Additionally, the team will work with farmers to identify methods to increase and expand knowledge about specific farmer best-practices, such as through expanded use of smart mobile computing and communication devices.

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