IRAP
An IRI and UA Partnership



Innovating Decision Support Services for Coffee Risk Management in Jamaica

PHOTO: ZACK GUIDO

THE WORLD'S MOST VALUABLE CROP

It takes the right soil, sunlight, temperature, and precipitation to grow coffee. That mix is found in the tropics, home to all 85 coffee producing countries, most of which are developing economies, where small landholding farmers grow more than 70 percent of all coffee produced. While coffee is grown in some of the poorest regions in the world, it is largely consumed by industrialized nations such as the United States, the largest national importer of coffee. The U.S. coffee industry contributed an estimated $225.2 billion to the national economy in 2015, supporting about 1.7 million jobs and generating nearly $28 billion in tax revenue. Given the social and economic importance of coffee to millions of people, ensuring its steady supply, while improving the welfare of those who work across the supply chain, is of universal benefit.

Coffee producers are exposed to numerous economic, environmental, and political risks. Extreme weather conditions, like frosts and droughts, have repeatedly struck key producing countries. These events have caused supply shocks whose economic ripples have hurt growers worldwide. Similarly, plant diseases like coffee leaf rust (CLR)—particularly in recent years—have reduced production. In 2012–13, for example, CLR ravaged Latin America, costing more than US$500 million in lost income. When farmers earn less, they invest less in their farms, production declines, and coffee plants become more susceptible to future hazards.

IMPROVING COFFEE IN THE BLUE MOUNTAINS OF JAMAICA: OUR RESEARCH CASE

Coffee experts have called for improved monitoring and early warning systems as strategies to better prepare for and respond to interconnected risks such as CLR, market conditions, and droughts.

At its foundation, this project recognizes that coffee farming decisions are complex. Thus, improvements in risk management require innovative solutions drawn from a deep understanding of the local reality. We focus on Jamaica where experiences with CLR, droughts, and hurricanes, a rugged topography, and a developing economy make it comparable to many other coffee growing regions.

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We ask how improved knowledge about weather and climate patterns and their relation to coffee decisions can help farmers. We proceed through a structured inquiry of this topic by (1) assessing the barriers and coping strategies used by coffee farmers; (2) analyzing weather and climate risks, assessing forecasting capabilities, and identifying new informational science opportunities; (3) collaborating with Jamaican partners to develop new services that engage with farmers in capacity development; and (4) evaluating the impacts of the information service on social networks, coffee, decisions, and the resilience of coffee production.

To answer these questions, we conducted approximately 450 household surveys throughout the Blue Mountain coffee producing region, interviewed key informants, and held co-sponsored in-country workshops. Importantly, this baseline data allows us to evaluate with scientific rigor the impacts that future service interventions will have on coffee farming, producing insights generalizable beyond Jamaica.

MANAGING MULTIPLE RISKS

Our assessments reveal that Jamaican coffee farmers are most concerned about drought, CLR, and market risks **(Figure 1)**. These stresses trigger three principal responses: (1) farmers vary their expenditures on inputs such as fertilizers and fungicides—even under the most ideal economic conditions, the small landholder farmer is almost always using agricultural inputs less frequently and with lower amounts than is optimal; (2) farmers diversify their cropping patterns, expanding or prioritizing other cash crops while cultivating coffee; and (3) those farmers who face insurmountable stresses abandon coffee altogether.

These responses imply that many farmers choose some strategies that increase their susceptibility to future conditions. For example, the decreased use of fertilizers reduces the health of coffee trees, which, in turn, can lead to greater losses in yields during protracted dry conditions, CLR outbreaks, and/or other ecological threats. Conversely, conditions favorable for farm investment and more effective use of inputs can reduce the impacts of challenging future conditions.

NEW CLIMATE INFORMATION ACROSS TIMESCALES

Our assessments identified opportunities to help farmers manage inputs more effectively through the use of tailored climate information. For example, CLR infection occurs quickly after rains begin in the spring leading to the generation of hundreds of thousands of spores on a single leaf. Knowledge of the historical onset date for the rains, therefore, can help farmers identify the optimum period to spray fungicides in advance of a forecasted rain event. Additionally,

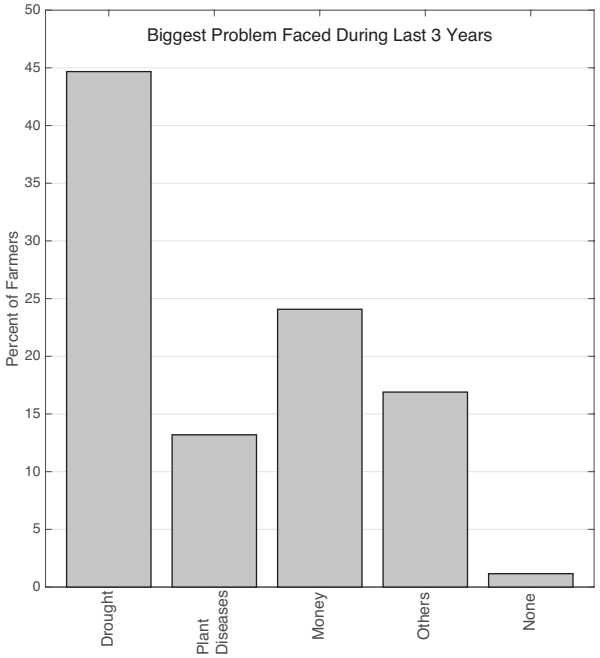



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Figure 1: Nearly 45 percent of the 432 farmers stated drought was the biggest problem they experienced over the last three years. Plant diseases are dominated by coffee leaf rust. The Others category grouped eight distinct choices: storms, fire, landslide, shortage of inputs, road conditions, availability of transport, lack of irrigation, and theft.



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forecasts for intense rainfall can help deter farmers from applying fertilizer immediately prior to the rains, thus limiting wasteful runoff. These and other examples have led to the research and development of the following products, all of which address specific coffee management activities within the iconic Blue Mountain region of Jamaica:

- High resolution, 4-km gridded modeled precipitation dataset that underpins monthly and sub-monthly climatologies
- Real-time fire risk conditions and fire-warning forecasts that incorporate recent past temperature and precipitation conditions
- Enhanced weather forecasts that may lead to improved spatial and temporal accuracy for extreme rainfall
- Seasonal forecasts for the onset of the spring rainfall season
- Seasonal forecasts with tailored date ranges (e.g., forecast can span mid-month periods that better reflect the timing of the early-season rains)
- Seasonal standardized precipitation index (SPI) drought forecasts that combine seasonal precipitation forecasts with past recent conditions

DEVELOPING SHARED SOLUTIONS

The Jamaican context suggests a need for routine interactions between scientists, extension officers, and farmers to build shared knowledge of the relationships between the social conditions that influence coffee management and weather, climate, and disease. These interactions will help farmers either reduce or enhance the feedbacks that influence future risk.

Our project brings together seven organizations[1] to conduct a series of progressive workshops with four goals: (1) develop the capacity to understand new information resources, (2) improve coffee management knowledge, (3) help form coffee extension services, and (4) refine and test innovative communications between technical experts like meteorologists and farmers.

These communications will involve peer-to-peer consultations between community project ambassadors (leaders from communities who will liaise with other farmers), routine bulletins developed by coffee experts and the Jamaica meteorological service, and text messaging sent by the Jamaican Coffee Board that directly reaches participating farmers. The project team will monitor and evaluate this process.

[1] The Jamaican Coffee Industry Board; the Inter-American Institute for Cooperation on Agriculture; the Jamaican Meteorological Service; the University of West Indies, Mona Campus; ACDI-VOCA, and IRAP (University of Arizona and the IRI)

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SCALING BEYOND JAMAICA

As part of the research design, our project explicitly crafted mechanisms that help scale up results and insight beyond Jamaica. Scaling up manifests in this project in three ways:

1. The new climate science products add to the body of tools available to others for risk management applications beyond coffee. Improved weather forecasts, for example, will help disaster managers. Additionally, the products are being developed in collaboration with the regional Caribbean Institute for Meteorology and Hydrology (CIMH). With local modifications they can be incorporated into CIMH's regional activities.
2. Our 450 household surveys and key informant interviews established baseline conditions from which we will conduct a rigorous evaluation of the impacts of the new tools and process. This will generate generalizable knowledge in science assessment, engagement, and climate services that will advance both scholarship and practice.
3. Our research and experiences will be presented and published, providing a strong scientific case example that will inform applications elsewhere.

PROGRAM INFORMATION: THE INTERNATIONAL RESEARCH AND APPLICATIONS PROJECT (IRAP)

IRAP advances research and applications of risk management by integrating human and physical science expertise, working across local and regional scales, and building local partnerships. The project supports research-based improvements in design, development, and provision of informational services—including new decision-science tools and processes—particularly as they contribute to development goals. IRAP works in the Caribbean and South Asia. IRAP is a collaboration between the University of Arizona and Columbia University's International Research Institute for Climate and Society. IRAP is funded by the National Oceanic and Atmospheric Administration's Climate Program Office, with contributions from the U.S. Agency for International Development. Funding began in the fall of 2013.

THE IRAP APPROACH

IRAP projects strive to integrate the following 5 pillars:

1. *Field assessments to determine how climate affects lives and livelihoods.* We conduct comprehensive reviews of published assessments of vulnerability components and complement this with field research to understand the demand for weather and climate information as expressed by user communities and institutional stakeholders.
2. *Systematic assessments of what is known about climate in the area of interest and the development of potential information products*. Through the physical science lens, understanding the climate variations identify the scientific possibilities for and limits to information products and decisions-support tools.
3. *Delivery of information products to the user communities and institutional stakeholders.* This element creates partnerships for the delivery of information services. This activity is translational and seeks to provide effective decision support.
4. *Integration of information into programmatic interventions.* This element defines the institutional and policy context that supports the beneficial application of weather and climate information through specific programmatic interventions, investments, policies, and partnerships.
5. *Monitoring and evaluation of the process.* This element defines a strategy for iteratively monitoring the use of the information and process of engagement as well as rigorously evaluating its impacts; initial assessments create baselines to which future assessments are compared.