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Precision Agriculture for Development (PAD) is a global non-profit organization that harnesses technology, data science and behavioral economics to provide targeted information to farmers in developing countries to improve their lives. By providing actionable information to the right people, in the right way and at the right time, PAD helps smallholder farmers improve their productivity, increase their profitability, and advance environmental sustainability. PAD is pioneering a new model for agricultural extension: delivering to farmers personalized agricultural advice through their mobile phones. PAD implements this model in collaboration with partner organizations to maximize scale, and PAD continuously experiments, iterates, and gathers evidence on impact to improve services and demonstrate value. PAD currently works in seven countries in Africa and Asia and is rapidly expanding as more governments and organizations look for innovative ways to utilize new technologies to deliver actionable information to people who need it. PAD aims to empower 100 million farmers in developing countries to improve their lives.

The issue

A majority of the world's farmers live in developing countries where they grow crops and tend livestock to generate income and feed their families. Households engaged in smallholder farming collectively account for more than two billion people - almost a third of humanity and two-thirds of the world's poor. An immediate and direct cause of their poverty is what is known as the yield gap: the difference between potential and actual on-farm production. Smallholder farmers typically harvest only 30 to 50 percent of what their land can produce. Whether it is a misapplication of inputs such as fertilizer and pesticides, the use of low-quality seeds, or too much or too little water—the *potential* yield of these farms is not reached. Smallholder productivity and income in many instances can also be boosted through crop diversification, the adoption of new drought or flood resistant crop varieties, or knowledge about how to combat pests and infestation. Climate change presents an additional, confounding challenge and risk, particularly for smallholders who rely primarily on rainfed cultivation. Studies in developing countries suggest that small changes in agricultural practices can substantially improve productivity and profitability and reduce poverty. Traditional agricultural extension confronts many challenges: in-person information sharing is expensive relative to its effects, contact with farmers is irregular, and advice is difficult to customize and deliver on time. Despite significant resources supporting the work of over one million agricultural extension workers, farmers continue to lack the advice they need to close the yield gap and maximize their incomes.

We are optimistic. Today, the globe is more connected than ever before. Most people, including farmers in developing countries, already use **mobile phones**. Mobile handset ownership in developing countries ranges between 50 to 70 percent, while access to a mobile phone through a household member is even higher, ranging from 70 to 90 percent. For the first time in history, a majority of smallholder farmers are in a position to use *digital* agricultural advisory services delivered to the palm of their hand. PAD leverages this opportunity to empower farmers with relevant and customized information, delivered at low cost, to improve on-farm practices, input utilization, pest and disease management, climate and weather resilience, environmental sustainability, and access to markets.

Our approach

PAD's approach harnesses innovations in technology and research to improve the lives of smallholder farmers. We provide a two-way flow of information that delivers customized advice to farmers through their mobile phones. PAD's unique approach to mobile agricultural advice consists of four components:

1. We deliver **simple** and **effective** messages that farmers can understand and act upon. We draw on behavioral economics to inform messaging that more effectively influences farmer behavior, and social learning theory that facilitates more widespread diffusion of information across farmer networks.
2. Our systems allow us to **customize** our messaging to farmers to ensure that the information we provide is useful, timely and actionable. Big data and machine learning techniques make it possible for us to tailor information at scale to conditions revealed in existing and new sources of data. These recommendations can be tailored to optimize inputs (seeds, water, fertilizers, pesticides) and management practices conditional on geographic and temporal-specific conditions (soil types, weather, agro-ecological zone, etc.), market conditions (input and output prices and availability, etc.), and farmer-specific information (education, experience, risk tolerance, demographics, etc.). Our goal is to develop intelligent platforms that provide farmers with context-relevant and personalized agricultural recommendations through their mobile phones to improve productivity, profitability, and advance environmental sustainability.
3. Our interventions are **evidence-led**. We develop systems that are continuously monitored and constantly improving. PAD's interventions draw on the power of new research methods to improve agricultural extension. A/B testing – comparing two or more service design options to assess which is preferred or more effective – allows for near instantaneous upgrading of content and service delivery to concurrently improve user experience and deliver more appropriate information. The use of rigorous assessment tools such as randomized controlled trials (RCTs) provide opportunities to systematically understand impact and we feed this information back into our model to refine it over time. Mobile phones allow for the collection of large datasets from users which PAD uses for rapid experimentation and analysis to iteratively improve user experience and user-centered design.
4. **Working through partners** who are already providing services to farmers at scale – including governments, NGOs, and for-profit agribusinesses – allows PAD to rapidly reach scale, with extremely low customer acquisition costs and rapidly falling marginal costs per farmer per year.

Our work

The initial phase of PAD's work consisted of testing the impact of mobile phone-based agricultural extension services in multiple developing country contexts. That research demonstrated that mobile phone-based agricultural extension can increase the adoption of appropriate farm management practices, improve yields between 8 and 28 percent, and improve farmer incomes. These results suggest that mobile agricultural extension is extremely cost-effective, with point estimates suggesting a benefit-cost ratio between 6:1 and 10:1 - very high relative to other development interventions. PAD currently operates in seven countries in Africa and Asia (Ethiopia, Kenya, Rwanda, Uganda, India, Pakistan, and Bangladesh), and has reached **2.9 million farmers** as of the third quarter of 2019 with agricultural advice delivered through mobile phones. We are pleased to support the work of the Governments of Odisha and West Bengal (India), Punjab (Pakistan), Ethiopia (through the Agricultural Transformation Agency), and Kenya to design, build, evaluate, and improve mobile phone-based advisory systems integrated into existing public extension infrastructure. We also support efforts to design and evaluate services in partnership with One Acre Fund in Kenya and Rwanda and the Coffee Board of India in addition to several other partnerships with NGOs and agribusinesses.

Our team

PAD's senior leadership team has expertise that draw on years of experience working in and studying agriculture in sub-Saharan Africa and South Asia, business, development economics and behavioral economics, technology, data science, and monitoring and evaluation. PAD's co-founders and board members are 2019 Nobel Laureate for Economic Sciences Michael Kremer (Harvard University), Shawn Cole (Harvard Business School), Daniel Björkegren (Brown University), and Heiner Baumann (PAD). PAD is led by Chief Executive Officer Owen Barder, who brings to the organization more than three decades of experience as a development practitioner, scholar and advocate.