2022

PxD
PRECISION
DEVELOPMENT

Precision Development - PxD
Annual Report

Contents

Executive Summary

2022 was a year of great progress for Precision Development (PxD) and the users we serve. We scaled up our reach from 5.7 million users in 2021 to 7.3 million in 2022, including smallholder farmers and other users across 20 initiatives in nine countries in Africa, Asia, and Latin America. We successfully completed the transition of our largest program, Ama Krushi, to the Government of Odisha in India for long-term operation and financial sustainability, and that program has continued to grow after the transition. We developed and tested several new innovative products, including hyper-local weather forecasts in India and Pakistan, leaf color charts to optimize use of nitrogen fertilizers and reduce harmful nitrous oxide emissions, linkages to a variety of complementary agricultural services provided by private sector agri-businesses in India, access to asset-collateralized loans to finance investment in productive assets for farmers in Kenya, a digital financial advisory service for "agri-preneurs" in Nigeria, and the next generation of our digital education product serving students and teachers in Kenya. We also moved forward with an exciting new area of research exploring the evidence on a range of existing and emerging climate mitigation technologies which have potential for application in low- and middle-income countries, especially in equipping smallholder farmers as agents of climate change mitigation in ways that can also earn direct tangible returns for smallholder communities. Crucially, 2022 saw PxD return to the extensive field work that we are accustomed to after two long years of limited contact with our users, due to the COVID-19 pandemic. As we close 2022, we have also refined our medium-term strategy to better articulate our priorities for the current four-year period (2022-2025), and this strategy has been approved by our Board. As ever, we are grateful to our many partners and funders for their continued support, and we look forward to continuing to work together to enable millions of people around the world to live more dignified and productive lives.

PxD at a Glance

Precision Development (PxD) is a global development non-profit organization with a vision to end information poverty. Our mission is to provide actionable information and other evidence-based, cost-effective, scalable services to people living in poverty in low- and middle-income countries to empower them to sustainably improve their lives. The majority of our programs provide customized Digital Agricultural Advisory Services (DAAS) to smallholder farmers via mobile phones to help improve their yields and net incomes, and enhance environmental sustainability. We are also applying our platforms and core competencies in digital information to deliver value in new sectors outside of agriculture, including education, nutrition, financial services, and climate adaptation and mitigation. PxD implements this model in partnership with national and local governments, non-profit organizations, private agri-businesses, and other partners. As of the end of 2022, we have reached 7.3 million farmers and other users across nine countries in Africa and Asia, with low average unit costs of less than $2 per user per year. The marginal cost per additional farmer is low at scale, and these services are highly scalable, so these interventions can be very cost-effective and with high social returns on investment. Our long-term goal is to improve the lives of 100 million people living in poverty.

7 294 997
TOTAL USERS SERVED IN 2022

$1.58 AVERAGE COST
PER CURRENT USER IN 2022
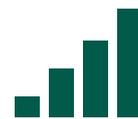
+27.4% USER
GROWTH IN 2022

768 860 WOMEN
USERS SERVED IN 2022

20 Programs reaching
current users in 2022

Restructure and New Strategy

At the end of 2022, we conducted a restructure of the organization to prioritize our most impactful and cost-effective programs. A critical part of our strategy is that our operations should prioritize services that demonstrate the potential for measurable impact on people's lives, declining costs at scale, a high degree of cost-effectiveness, and financial sustainability. We have streamlined our programs and our staff to focus our efforts and resources on our most high-priority programs according to these criteria. We have closed our programs in Nigeria, Rwanda, and Uganda where we had completed our funded activities and reached the end of local crop cycles. We have also reduced our scope in Kenya and Pakistan to stop unfunded activities, and scaled back on shared support functions. We are excited about the year ahead, having positioned ourselves for continued growth. We plan to continue to invest in building high-impact services in a more focused set of geographies where we can make the most impact in people's lives.

In parallel, we have also refined our medium-term strategy to better articulate our priorities

for the current four-year period (2022-2025), and this strategy has been approved by our Board. The main pillars of this strategy are the following:

- We continue to focus on our primary intervention of **Digital Agricultural Advisory Services** to help smallholder farmers increase their incomes, productivity, and environmental sustainability.
- We are focused on **increasing the impact per user** of these core services. This includes both developing high-value services that deliver as much positive impact as possible for the people that use them and adopt them (for example by more rigorously identifying the optimal agricultural recommendations in each context), and increasing user engagement so these services can deliver a positive impact to as many people as possible (for example by improving user experience, increasing customization, and targeting the users that are most likely to adopt our recommendations).
- We are investing in **developing new high-value services in agriculture** that complement our core agricultural advisory services, such as high-resolution weather forecasts, real-time information on pests and diseases, access to loans to purchase productive assets, new technologies to enable smallholder farmers to adapt to and mitigate climate change, and improved linkages to agricultural markets.
- We are investing in **developing high-value services in other sectors**, such as nutrition, financial access, and education, that deliver a positive impact to new populations of users.
- We are **establishing an Innovation Lab** (described in more detail below) to help us identify and prioritize the most promising opportunities to improve the impact of our services, and to develop new high-value services in agriculture and other sectors that have a long-term, sustainable impact on smallholder farmers and other people living in poverty. The Innovation Lab will help us put the most promising of these ideas into action to catalyze the next generation of high-value PxD innovations.
- At the same time, we will **scale our impact** through organic, demand-led growth by forming large-scale partnerships with governments, non-profit organizations, and private businesses, and by deploying a variety of models for service delivery at scale, such as Build-Operate-Transfer, in which we build a service and transition it to a partner, and Build-Operate, in which we deliver a service for the long term.

This strategy is a living document, and we plan to update it regularly as our work evolves. We would be delighted to receive feedback from any of our partners to help strengthen our strategy and our plans to put this strategy into action. We are excited about the trajectory we are on, and we look forward to continuing to work with our many partners in the coming years to build on the success we have achieved together and to positively impact the lives of millions more smallholder farmers and other people around the world.

Research

8
A/B test experiments and impact evaluations

20,000
survey respondents

27
surveys

5
Countries: Kenya, Ethiopia, Colombia, Pakistan, India

PxD's research and operations teams were busy in 2022 with research to improve our existing products, develop new innovative products, and rigorously measure the impact of our work. Our latest blog post, Research in Review: 2022, details the tremendous progress we made in 2022 towards our ambitious research agenda. Research highlights in 2022 include:

- We completed eight A/B test experiments and impact evaluations.
- We collected data in person and over the phone from approximately 20,000 survey respondents across 27 surveys.
- We conducted product innovation research to generate insights and develop proof of concept for potential future products, including to reduce input market information frictions, deliver information via WhatsApp, incorporate climate adaptation and mitigation into our existing services, help farmers organize and communicate in digital groups, and crowdsource information from farmers and agro-dealers.
- Through a large-scale randomized controlled trial (RCT) in Rwanda, we demonstrated

that digital tools can be effective in improving in-person agricultural extension services, in addition to delivering services directly to farmers. Sending goal reminders to community extension volunteers (called farmer promoters - FPs) increased the number of farmers trained by 3.1 percent, led to 4.3 percent more training sessions being delivered, and increased farmers' registration for subsidized inputs by 1.9 percent (statistically insignificant) over FPs who did not receive goal reminders. Given that the unit cost for each SMS is $0.006, this is likely to be a highly cost-effective way to increase the effectiveness of the approximately 14,000 FPs across Rwanda. These results support the expansion and replication of extension agent interventions in other settings, and point to areas for future research and development to enhance the effectiveness of extension agents.

- We found empirical evidence in Kenya that providing a digital directory of agro-dealers with real-time stock and price information helps farmers optimize their input search and purchase choices. Farmers who had access to the agro-dealer directory and stock information contacted 21 percent more agro-dealers, but visited 4 percent fewer agro-dealers relative to the control group which did not have access to the tool. This suggests that farmers used the contact information to call more agro-dealers before spending time and money to travel to the shops themselves. We also observed that farmers given access to the agro-dealer directory were more likely to purchase PxD-recommended inputs and experienced fewer stockouts. Consistent with PxD's advisory recommendations, farmers given access to the directory were 6 percent more likely than control farmers to use hermetic bags to store maize (a practice shown in rigorous studies to prevent post harvest losses from pests), and farmers with access to the directory but not stock information were 22 percent less likely than the control group to report facing an input shortage when they shopped.

- We intensified our research efforts to identify ways to provide information to farmers to support climate adaptation and, in partnership with the Institute for Governance and Sustainable Development (IGSD), to encourage farmers to participate in climate mitigation activities, with the guiding principle that smallholder farmers cannot be expected to pay the price for climate change mitigation, but can be part of the solution. In 2023, we are co-authoring a series of analytical reports with IGSD on promising opportunities for innovation in climate change mitigation in the Global South.

In 2023, we look forward to continuing to build our evidence base, with forthcoming insights on PxD's impact on farmer welfare from several large-scale RCTs with rice farmers in India, coffee farmers in Uganda, and dairy farmers in Kenya.

Over the last year, we deepened our partnership with GiveWell to scope and design new digital agricultural advisory services and expand the evidence base on the impact of these services. In April 2022, GiveWell awarded PxD a scoping grant to design new services in multiple geographies and design evaluations to rigorously evaluate the impact and cost-effectiveness of these services. Through this work, we conducted deep due diligence on the most promising farming practices to recommend to farmers to maximize our impact on farmers' profits across several settings and crop and livestock value chains. We will be able to apply what we learned through this partnership to our current work and future proposals.

TECHNOLOGY
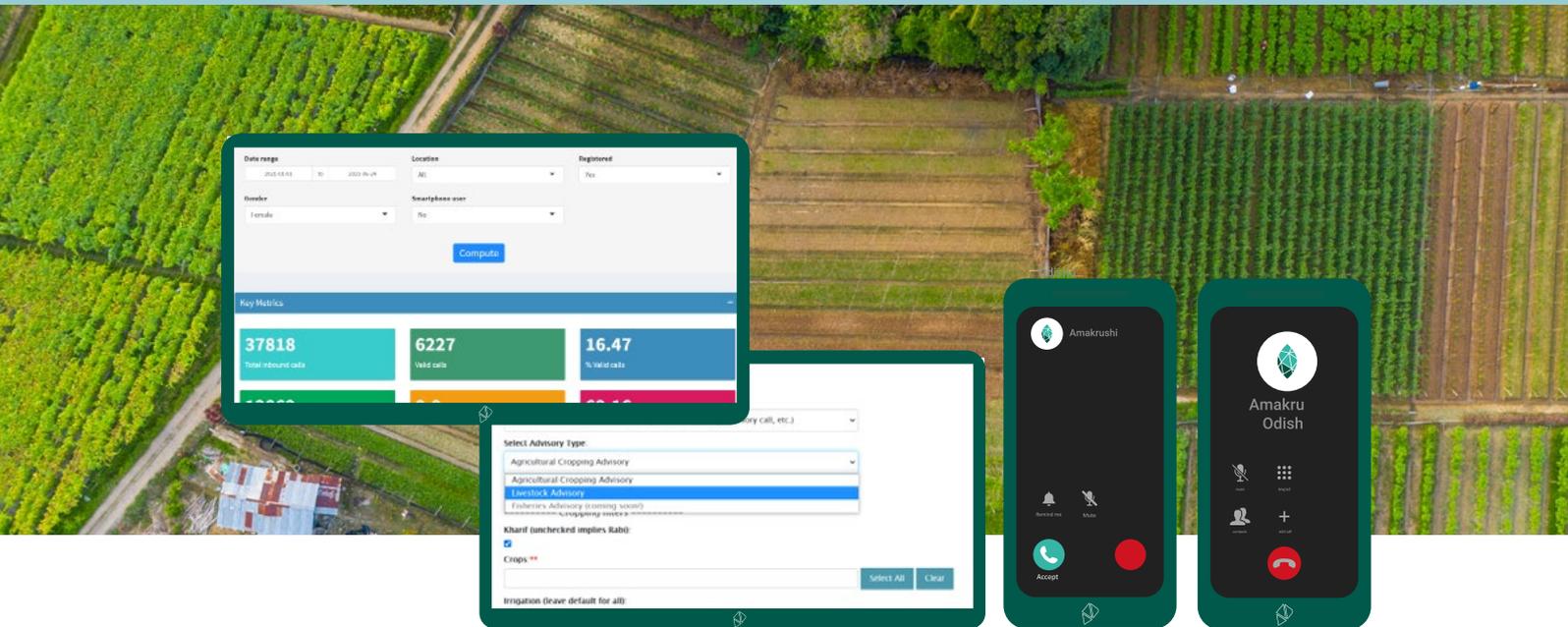
In 2022, PxD has broadened its in-house technology platform, Paddy, in several areas. While SMS and interactive voice response (IVR) are well established and operating across most of PxD's program countries, this year PxD added capabilities for WhatsApp and USSD (Unstructured Supplementary Service Data), a platform for providing interactive two-way information flow over mobile networks. Adding USSD to the platform provides another ultra-low cost communications medium to many of our users. USSD has been predominantly used for mobile banking, and now digital agricultural advice becomes another valuable use case. During 2022, Meta, the parent company that owns the messaging platform WhatsApp, launched the WhatsApp Business Platform to all SMEs, which had very compelling pricing relative to third party WhatsApp integrators. PxD built Paddy adapters for WhatsApp integration in 2022, which is now being used in some of our services in India, opening the door for us to deliver much more sophisticated content to our users, using media such as photo and video.

We also used the Paddy platform to make several enhancements to PxD's services. These included building dashboards and reporting tools to generate quarterly insights in India, enhancing our data collection tools to survey users, building a new version of our education service in Kenya, building a new digital directory of agro-dealers in Kenya, and completing the technology transfer to Tatwa Technologies, Ltd. as part of the transition of our flagship Odisha program (all described in more detail below).

Lastly, with support from Schmidt Futures, we built a first iteration of our Data Warehouse and began integrating data from multiple data sources for many of our services. The Data Warehouse will provide our Country Program and Research teams with the requisite tools to analyze data at scale and leverage artificial intelligence (AI) frameworks to extract actionable insights and improve the customization of our advisory content.

Continuing Programs

Ethiopia

In 2022 PxD concluded Year 3 of the 5-year DAAS initiative in partnership with Digital Green, the Agricultural Transformation Institute (ATI) and the Ethiopia Ministry of Agriculture (MoA), and with support from the Bill and Melinda Gates Foundation (BMGF) and the UK Foreign Commonwealth and Development Office (FCDO). PxD's role in this consortium is to lead the mobile-based component of the initiative, with a focus on strengthening mobile channels for digital extension in Ethiopia and developing a new use case centered on the dairy sector in partnership with Land O'Lakes and SNV Netherlands Development Organisation (SNV). In September we authored a blog post detailing the new possibilities for value-added agricultural advisory services made possible by this initiative through increased data sharing and integration. In 2022, PxD expanded the number of farmers reached by this initiative to roughly 69,000 dairy farmers that were reached via our outbound push call service, and another 372,000 farmers reached through our partnership with the ATI by supporting the ATI's inbound Farmers' Hotline. In 2022, the focus of PxD's push call service was disseminating advisory content to dairy farmers on artificial insemination to increase the proportion of crossbred cows, and on how to care for pregnant cows, lactating cows, and newborn

calves to reduce calf and cow mortality. As female farmers in Ethiopia are disproportionately involved in dairy farming but have low access to mobile phones, we implemented a mechanism to enhance women's access to PxD's advisory services by encouraging farmers to listen to push calls together with their spouses. In late 2022 we also obtained authorization from Ethio Telecom to introduce Paddy, PxD's two-way communications platform, to increase our capacity to provide our push call service to more farmers and to complement the other digital agricultural advisory services available in Ethiopia.

PxD also began a new partnership with SNV in 2022 to support their Building Rural Income through inclusive Dairy Business Growth in Ethiopia (BRIDGE) Project. PxD and SNV are partnering to provide customized advisory services to improve dairy farmers' milk productivity. Using data collected by SNV, PxD's advisory content is customized to the lactation curve of each dairy cow, and targets specific lactation periods with the highest potential impact. In this project, we are reaching approximately 3,000 dairy farmers and 100 service providers (artificial insemination technicians, animal feed suppliers, veterinarians, etc.).

Lastly, in 2022 PxD's Ethiopia team supported the MoA and ATI to develop a long-term roadmap for Digital Agricultural Extension and Advisory Services (DAEAS) to enhance collaboration between various actors in the digital agriculture sector. PxD has a central role on the task force which was responsible for authoring the roadmap and now meets regularly to develop plans to put the roadmap into action in the coming years. PxD supported the development of a scoping study to document the state of the digital agriculture sector in Ethiopia, and this study will serve as a benchmark for the implementation of the DAEAS roadmap in 2023 to 2030.

India

Ama Krushi

In March 2018, PxD began a journey in partnership with the Odisha Department of Agriculture and Farmers' Empowerment (DAFE) of the Government of Odisha, India with support from BMGF. The goal of this partnership was to build a digital agricultural extension service on behalf of the Government of Odisha that could scale up to 1 million farmers, and to conduct a "Build-Operate-Transfer" (BOT) program to demonstrate that such a service could

be transitioned to government ownership for long-term sustainability. In May 2022, PxD reached the end of this journey by successfully completing the transition of our flagship program Ama Krushi, which is Odia for "farmers' friend", to the Odisha state government, with the day-to-day management of the service successfully transferred to Tatwa Technologies Ltd., a third-party firm that won a competitive government tender. PxD remained on board for a further two months to build the capacity of the staff of Tatwa Technologies and to provide technical support, and the transition formally concluded in July 2022. PxD's role in Odisha is now limited to monitoring the success of the transition, and documenting lessons learned, which we intend to share internally at PxD, and externally with the Government, BMGF, and other stakeholders.

Today, we can proudly say that Ama Krushi is an entirely government-funded and govern-ment-owned service running at scale. At the time of transition, Ama Krushi had grown to become PxD's largest program in the world, reaching more than 2.7 million smallholder farmers with customized information on 29 value chains spanning crops, fisheries, four types of livestock, poultry, and kitchen gardens. The transition of Ama Krushi has highlighted key lessons for the design of future BOT initiatives and the transfer of such services, which we hope to apply to future PxD work. Built by PxD from scratch, Ama Krushi has continued to grow after it was handed over to the government, and it was serving more than 3.4 million registered farmers by the end of 2022. The full story of Ama Krushi's development and transition is detailed in a recent blog post.

Coffee Krishi Taranga

2022 was a big year of growth for our Coffee Krishi Taranga (CKT) service, which PxD India delivers in partnership with the National Coffee Board of India and with support from the Walmart Foundation. In the first quarter, we completed the migration of the CKT service to our in-house tech platform, Paddy, which is now hosting most of PxD's services around the world. We also completed a landscape analysis to more systematically understand the challenges faced by users of the service, with a focus on sustainability, market linkages, and gender. In the second quarter the team began exploring the possibility of integrating weather information into our advisory services for coffee growers, in partnership with Climate Forecast Applications Network (CFAN). As part of our broader weather-related research that we are conducting across India and Pakistan, we completed qualitative interviews to understand coffee farmers'

perceptions of probability-based weather forecasts. Based on farmer interviews and surveys, we found that farmers prefer a combination of quantitative and qualitative information in their weather forecast messages, and prefer to receive these messages with a seven-day lead time on average. Weather advisory messages will be piloted in Karnataka beginning in the first quarter of 2023.

In the third quarter we expanded to a fourth coffee-growing state, Andhra Pradesh, where, unlike traditional coffee-growing states, coffee production is concentrated among indigenous communities working small farms using traditional methods. The CKT service is now reaching approximately 84,000 coffee farmers across four states in India – Karnataka, Kerala, Tamil Nadu, and Andhra Pradesh. In the fourth quarter, PxD piloted a Live Call Center in Karnataka to allow farmers to call in and ask a live operator agronomic questions. We also got approval from the Coffee Board to incorporate advisory content on spices (pepper) into the CKT service in 2023, to support the many farmers who practice intercropping.

Krishi Tarang

Our Krishi Tarang service for farmers in Gujarat doubled in scale from 54,000 in 2021 to 108,000 in 2022, with the support of the Swiss Re Foundation. The Krishi Tarang service is our oldest continuously delivered service, operating in our first state in India, and has expanded from an initial focus on cotton to now include digital advisory services covering cotton, wheat, groundnut (peanut), soybean, sesame, pigeon pea, castor oil plant, cumin, mustard, potato, onion, chickpea (gram), coriander, and fennel. In collaboration with the Aga Khan Rural Support Program (AKRSP), Ambuja Cement Foundation (ACF), and Action for Food Production (AFPRO), we have on-boarded several thousand cotton farmers associated with the Better Cotton Initiative to the Krishi Tarang service. Through PxD's digital extension service, these farmers can now access free advisory that allows them to grow cotton in compliance with the Better Cotton standard.

Because PxD fully owns and operates Krishi Tarang, the service acts as a "sandbox" for testing new innovations. For example, with support from the Swiss Re Foundation, PxD investigated the viability of new forms of partnership with private sector firms to create value for both the farmer and the firm. PxD conducted a series of pilot projects that connected farmers to PxD's advisory services as well as to additional services offered by private firms, while

ક્રિષી તરંગ **GROW BETTER CROPS**

FREE AGRICULTURAL ADVICE ON YOUR PHONE

REGISTER NOW

Give a missed call to **079 6902 0120**

Pest management
Cultivation
Pre-planting
Harvesting
Post-harvest

investigating the potential for PxD to generate revenue from these partnerships to offset the cost of delivering our digital advisory services to farmers at no cost to the end-user. A report published by PxD in November presents findings from these pilot projects. Through these pilot projects, PxD has connected farmers to a wide range of private sector services, such as agricultural inputs from our partner AgroStar.

PxD's team in Gujarat also undertook other innovation-related activities in 2022. With funding from an anonymous donor, PxD piloted the use of Leaf Color Charts (LCC) – plastic, ruler-shaped tools containing panels of varying shades of green that assist farmers to decide how much fertilizer to apply – which have been demonstrated to increase farmer profits by reducing input expenditure, and reduce harmful nitrous oxide emissions. PxD conducted qualitative research with women's groups, convened by SEWA, a national federation of organized collectives of self-employed rural women, to refine our understanding of women's informational needs and their preferred channels for information delivery. Lastly, we conducted exploratory work to assess the feasibility of bundling agricultural advisory with financial services (based on early-stage work done with Asset Collateralized Loans in Kenya).

Kenya

MoA-INFO

Throughout 2022, PxD implemented several variations of our MoA-INFO service, a collaboration between PxD and the Kenya Ministry of Agriculture, Livestock, Fisheries, and Co-operatives (MoALFC). In the first quarter, we reached roughly 40,000 users with one or more "cropping series" (weekly or bi-weekly messages covering comprehensive farming practices for a particular crop), and roughly 100,000 users with priority messages (a condensed version of the service focusing on the most important practices). PxD implemented several refinements to the MoA-INFO service to improve its value proposition to farmers by focusing on dedicated decision support tools to inform specific high-priority decision points, new content to help farmers deal with specific challenges such as pest and disease outbreaks, and support to Counties that don't have existing digital extension services. We updated our customized decision support tools available on MoA-INFO, including by updating the seed selector decision support tool with new seed varieties, in consultation with seed companies and the Kenya Agricultural and Livestock Research Organization (KALRO), and developing a new pesticide selector tool to help farmers make informed decisions about pesticide choice and use.

PxD received reports from many farmers, via the two-way MoA-INFO platform, that they were affected by the African Armyworm (AAW), a pest that can be even more devastating than the invasive Fall Armyworm that was the impetus for our initial launch of the MoA-INFO service. This year's AAW outbreak was triggered by irregular and delayed rains, and affected farmers across nearly all crop farming counties. PxD Kenya quickly responded to this issue by updating our existing AAW content, testing it through Focus Group Discussions, getting it approved by the MoALFC, and sending it to farmers in 19 counties to help them manage the pest, in collaboration with the World Bank, Mercy Corps Agrifin, the MoALFC, and the Centre for Agriculture and Bioscience International (CABI). The PxD Kenya team also conducted an evaluation of messages encouraging farmers to use hermetic bags to store their maize

in order to prevent losses from AAW and other pests. We found that sending a series of messages over several months led to a 20% increase in hermetic bag use.

In the third and fourth quarters, PxD delivered its advisory services to farmers, across three counties in Kenya, who are beneficiaries of the World Bank's Disruptive Agricultural Technology (DAT) Challenge, a continuation of the World Bank One Million Farmers platform which was initiated in 2019. We reached approximately 15,000 farmers with free advice through the MoA-INFO platform on key farming practices, such as the use of certified seeds, nursery management practices, transplanting of seedlings, use of inorganic and organic fertilizers, staking, pest management, and disease management, among others.

Dairy

Our project providing Asset Collateralized Loans (ACL) for dairy farmers reached a significant milestone in 2022 through the completion of an in-person baseline survey with 1,512 farmers from two dairy cooperatives, Lessos and Sirikwa. As part of an ongoing RCT to measure the impact of ACLs to finance the purchase of water tanks, the baseline survey aimed at collecting data on multiple outcomes, including milk production and sales, health indicators, such as the incidence of diarrhea, time use (time spent fetching water, grazing/ watering livestock, etc.), and subjective and mental well-being (self-reported overall satisfaction with life, index of mental well-being, and access to water). Following the completion of the baseline survey, farmers were randomly assigned to receive an offer for an ACL for a water tank. A loan officer was hired at each dairy cooperative to issue the loans and monitor them through the lifespan of the project. We expect the first batch of farmers to receive their water tanks in the first quarter of 2023.

Education

In 2022, we developed a new version of ElimuLeo, PxD's digital education service, to better support teachers and increase engagement among students, particularly during school terms. This new version, called "ElimuLeo for Teachers", allows teachers to assign phone-based homework to their students through a 5-letter keyword system. Students can use any phone to send a keyword by SMS and receive a predetermined set of math exercises corresponding to a specific grade level. Students submit their answers via phone and receive instant feedback on whether the submitted answers are correct or wrong. Students' responses are then automatically graded by our system, and a report with each student's

individual responses and overall scores at the class level is generated and shared with the teachers via WhatsApp. The report allows teachers to see which students have performed well and which students need additional attention, without having to spend time marking exercises manually. This new iteration complements PxD's original education service, "ElimuLeo for Students", in which students can do adaptive math practice problems that are customized to each student's learning level.

Pakistan

At the end of the second quarter, our 20-month grant from IFAD for "Development and Expansion of Digital Agricultural Advisory Services for Smallholder Farmers in the Context of COVID-19" came to an end. Through this support from IFAD, PxD Pakistan provided digital agricultural advice to more than 1.3 million cotton, wheat, oilseed, and dairy farmers in 2022. Following the conclusion of the project, IFAD showcased our collaboration via a story published on its website. This support from IFAD allowed us to expand our work to livestock farmers in Pakistan, who confronted a range of challenges in 2022. In March-May, an outbreak of lumpy skin disease killed hundreds of cows and reduced milk yields. Surviving animals receive a lower price at market due to the scarring of hides. These challenges are further compounded by misinformation regarding the possibility of transmission to humans (which is not possible) and eating meat from infected animals (it is safe to eat parts of the animal that do not have lesions). We responded to this misinformation with accurate information from credible sources, and provided information about how to identify the disease and cost-effective disease management strategies. Farmers who acted on our advisory regarding vaccinating animals against lumpy skin disease reported that they were able to save cows from dying, or that cows that were infected after vaccination had mild, non-lethal infections.

Summer also brought searing heat followed by floods to Pakistan. Working with our partner the Rural Community Development Society (RCDS), we designed a series of disaster management and flood warning messages. The PxD Pakistan team worked to preemptively identify areas prone to flooding, and targeted farmers in these areas with information on adaptive strategies to protect their assets and livelihoods. We received reports from many

farmers who harvested their crops early due to rain alerts from our weather advisory, which ended up saving their harvests. These floods in Pakistan – among other recent catastrophic climate events – have been highlighted by leaders from the Global South to focus attention on losses and damages incurred in poorer countries arising as a consequence of emissions largely associated with wealthy economies.

With support from IFAD, PxD Pakistan developed and launched a free digital weather forecasting product for farmers in Punjab Province. Based on PxD surveys, 87% of cotton farmers and 72% of wheat farmers in Pakistan had faced weather-related challenges in the past three years. As part of the design process for this service, we completed in-person qualitative interviews to explore: (i) farmers' understanding of weather uncertainty, including their interpretation of quantitative and qualitative probabilities, (ii) their usage and trust in alternate information sources, and (iii) their social learning mechanisms and/or rules-of-thumb that they use in decision-making for key farming practices. We used the information gathered in these interviews to understand how each critical farming practice is affected by the weather, and how forecast information can enable better decision-making. These interviews found that harvesting and planting decisions are most affected by weather-re-lated challenges, and that farmers were most concerned about rainfall and temperature data. Based on these insights, PxD worked with CFAN to set up the in-house data infrastruc-ture needed to receive and store forecast data, and to develop and deliver weather forecasts and related advisory content accurate to the village ("tehsil") level, based on local conditions. In 2022, this service sent weather-related advisory content to roughly 194,000 cotton farmers. Farmers registered to the service received mutually reinforcing SMS and push calls with relevant weather information customized to their tehsil, including when to plant crops and when to dig channels to divert floodwater.

Closed Programs

Colombia

In February, PxD completed a 12-month initiative in Colombia in partnership with Rare and The Nature Conservancy (TNC), and with support from the UK Partnering for Accelerated Climate Transitions (UK PACT). As part of this initiative, we designed and implemented an SMS-based service called *Un mensaje por el campo*, with a focus on recommending

climate-smart agricultural practices. Through this service we reached roughly 2,700 farmers growing cocoa, coffee, and plantains in the Meta region of Colombia, an area known for limited connectivity and high exposure to armed conflict. The PxD Colombia team also experimented with WhatsApp services to gauge the interest among farmers with smartphones, and learn from their interaction with the service, due to the higher smartphone penetration in Colombia compared to PxD's other markets. Through a combination of in-person and phone surveys, we found that farmer adoption of PxD's recommended practices ranged from 36 to 67 percent depending on the practice, with the proportion of farmers adopting each practice for the first time ranging from 14 to 20 percent.

Nigeria

In November, we completed Stage 2 of the IFAD Innovation Challenge, an initiative started by the International Fund for Agricultural Development (IFAD) in 2019 to foster innovation in agriculture. Together with the IFAD Nigeria country team, we co-designed a digital service to provide financial advice and a Digital Financial-Phone-Book-Directory (FPBD) of financial service providers to smallholder farmers and youth "agri-preneurs", who are Nigerians under 30 who operate agriculture-related micro-enterprises. The PxD Nigeria team conducted a series of scoping exercises to identify key financial service providers for inclusion in the FPBD platform, and to identify what type of financial advice was valued by agri-preneurs. Through this service, we reached approximately 2,000 agri-preneurs and smallholder farmers in six states in southern Nigeria, who are beneficiaries of IFAD's Livelihood Improvement Family Enterprises Project for the Niger Delta (LIFE-ND). This initiative marked the first time PxD provided financial advice to farmers to complement our agricultural advice, and the first time we offered a service using USSD.

Rwanda

In collaboration with One Acre Fund, in 2022 we completed the implementation of a research project studying the potential role of digital messaging in supporting in-person extension services. From February to August, we conducted an endline survey with 9,615 community extension volunteers and gathered administrative records, and we completed the preliminary analysis during the fourth quarter. Based on these preliminary results, we observed that receiving performance goal reminders via SMS messages led to an increase in farmer promoters'

Financial Service Digital PhoneBook (FSDP)
PILOT TEST

Areas covered

The financial service digital phonebook was piloted in three states: Abia, Delta and Bayelsa

Why is it important?

The financial service digital phonebook helps solve the problem of low access to and use of financial products among agribusiness owners caused by information barriers.

Target users

1,638 agribusiness owners (agripreneurs) **50% women** in the three target states

Timeline

The pilot test of the financial literacy mini-course training and the financial service digital phonebook was done over a period of nine days **31st October - 8th November, 2022**

Features of the pilot

A baseline survey was conducted on 300 agripreneurs, randomly selected from the three states to ascertain the gaps in their financial literacy and their knowledge and use of financial service providers

A financial literacy mini-course training was conducted through free pre-recorded voice calls for the first set of 300 agripreneurs in three states, covering five topics (Microloan, Business account, Insurance, Loan application and repayment) in their language of choice. The second set of financial literacy mini-course training was conducted for 2,055 agripreneurs in six states, covering two topics (Loan application and repayment)

The financial service digital phonebook was introduced and made freely accessible to 1,638 farmers in the three pilot states (Abia, Bayelsa and Delta States)

performance, which could further lead to meaningful improvements in farmers' practices and productivity. The impacts of goal reminders were highest among farmer promoters who set ambitious but attainable goals. Customizing motivational nudges by farmer promoters' personality traits had limited impacts on their performance. A working paper (co-authored by Martin Abel and Michael Kremer along with PxD staff Tomoko Harigaya and Jessica Zhu) on this project is currently being drafted, and preliminary results were presented at the North East Universities Development Consortium (NEUDC) 2022 Conference (by Abel) and will be presented at the Centre for the Study of African Economies (CSAE) Conference 2023 (by Zhu).

Rwanda and Uganda

In both Rwanda and Uganda, PxD implemented a pilot project in partnership with Aceli Africa, combining both in-person and digital training on agroforestry and coffee farming. The pilot project aimed at testing the effectiveness of hybrid agricultural extension training models, and targeted farmers' cooperatives affiliated with Aceli Africa's lending partners. The training covered key practices of integrated pest management, agroforestry and reforestation, soil management (mulching, composting, animal bio-fertilizer), and coffee agronomy. Aceli Africa provided the in-person training while PxD provided digital training via SMS messages sent to farmers from six cooperatives in Rwanda, and pre-recorded voice messages sent to farmers from two cooperatives in Uganda. The digital training addressed relevant topics tailored to specific seasons and contexts in each country. At endline, 51 percent of participating farmers in Uganda, and 21 percent in Rwanda, reported having adopted a recommended practice for the first time. Lack of resources and time was reported as the main challenge faced by farmers in adopting new practices. Overall, participating farmers reported that they valued the combination of in-person and digital training.

Uganda

In August, PxD completed its digital component of the Uganda Coffee Agronomy Training (UCAT) initiative. PxD implemented UCAT in partnership with the Hanns R. Neumann Stiftung (HRNS) and TechnoServe. Between 2019 and August 2022, PxD designed and deployed a two-way IVR platform which delivered information to farmers about coffee Good Agricultural Practices (GAP) via push calls and a dynamic IVR menu. As part of this initiative, PxD collaborated with the International Food Policy Research Institute (IFPRI) to jointly design and conduct a RCT. The objective of the RCT is to evaluate the relative impacts of: (i) agronomy training conducted at in-person farmer field schools (FFS) by HRNS and TechnoServe, (ii) digital reinforcement programs consisting of 2- to 3-minute voice messages delivered by mobile phones by PxD, in alignment with the FFS curriculum of HRNS and TechnoServe, and (iii) a stand-alone digital extension service provided by PxD containing the same 2- to 3-minute voice messages and an inbound IVR menu. Endline surveys and analysis for the RCT remain ongoing and will be available in 2023.

Innovation Lab

PxD plans to make big investments in the coming years to increase our impact per user as we scale. There are many ways PxD can increase our impact per user, and we are committed to using rigorous evidence and deep user research to identify important user problems, understand multi-faceted constraints users face, and develop solutions to address these constraints. For each potential product-solution match, we will use existing evidence and scientific knowledge, insights from experts and local stakeholders, and user research to determine whether the problem represents an important challenge for users, whether we can innovate to address this challenge, what the potential impact of the solution will be, and whether it is feasible and cost effective to scale up this solution to the users who need it.

In 2022, we began the work of establishing an Innovation Lab to help us answer these questions. Through this Innovation Lab, we will identify and prioritize the most promising opportunities to improve our impact, focus our resources on the ideas that are most likely to be successful, and deliver long-term, sustainable impact at scale. The primary purpose of the lab is to pursue new paths to impact alongside our core digital agricultural advisory services.

We are exploring a variety of new, evidence-based product innovations for farmers, which can complement our core digital agricultural advisory services, either as additions to current services or as standalone offerings. The choice of innovations will be prioritized based on user feedback, consultations with agricultural experts, a review of published evidence on the size of the problem and the potential impact of the solution, and initial scoping and piloting. Innovations currently being explored include: providing accurate, customized, high-resolution weather forecasts to improve farmers' climate adaptation; providing real-time information to farmers such as information about pest and disease outbreaks; increasing farmers' access to loans and other financial services to increase their investment in productive assets; providing access to new climate adaptation technologies to help farmers improve their climate resilience, manage climate-related risk, and improve their environmental sustainability; and providing access to climate mitigation technologies to empower farmers to help reverse the negative impacts of climate change while at the same time improving farmers' livelihoods, such as by earning money from carbon credit payment schemes to compensate them for the environmental benefits of their farming practices. A key part of increasing our impact per user is investing in our methodology for combining agronomic research, user research, and other due diligence to achieve a thorough understanding of the constraints that farmers face in each setting and identify the highest-impact, evidence-based interventions to address these constraints.

How the Innovation Lab will work

The Innovation Lab is focused on finding problem-solution matches, assessed against four primary factors: (i) relevance of the problem, (ii) potential for impact, (iii) cost-effectiveness, and (iv) potential for scale. Ideas will be sourced in a decentralized manner from across PxD, from our expert Board, and from our external partners and collaborators. Dedicated Innovation staff will conduct ongoing due diligence of new ideas, and we will scope, design, and pilot ideas that move past the due diligence stage in a set of one or more geographies to gather additional insights and feedback from users. Ideas that appear to be viable in these pilots will continue to be iterated and tested at scale, while those that don't will be discontinued or adapted.

We are actively pursuing funding to launch this Innovation Lab to catalyze the next generation of high-value PxD services.

User Voices

Throughout PxD's work, we try as much as possible to travel to the field, spend time in rural communities, and listen to the voices of our users. Conversations with our users are invaluable to help us understand the constraints that smallholder farmers and other users face, and to effectively design services that can address these constraints. Over the last year, we have gathered the following testimonials from users of our services, which illustrate at the individual level how digital agricultural advisory services can improve people's lives.

"I was introduced to CKT three and a half years back by a friend by giving a missed call to CKT from [my] mobile phone. I have been helped by regular information from CKT on shade regulation, drip irrigation, fertilizer information… CKT advisory should be given to every farmer as the information shared by CKT will help in improving yield, pest and disease management, and all coffee estate activities by way of proper fertilizer application, irrigation management, shade regulation… CKT is a good initiative and has helped [me] in improving [my] coffee estates and it may be helpful for many more like me." Farmer in Laxmi Pura village, Alur block, Hassan district, Karnataka, India

"I have been receiving coffee-based information weekly or biweekly from CKT for four years. I am adopting all the recommendations suggested by CKT and this has helped me to improve the yield. Lime information, soil testing, pulping, and other various information was very helpful. In one and a half acres of coffee land, 3 lakhs [roughly $3,600] income is earned. I am receiving 4 to 5 bags of higher yield compared to other farmers because I follow all the practices regularly. If all the farmers will receive CKT information and if they follow proper practices everyone will be helpful and can receive good yield. Thank You" Farmer in Karajuvalli village, Alur block, Hassan district, Karnataka, India

"When I was informed by the 40130 people on good farming practices, I was very excited about it and I followed the messages and even asked questions. As I was learning, I improved my farm greatly. When I learnt of mulching from that platform and mulched my bananas throughout this current dry season my bananas are doing well, if you see them you will appreciate. I also learnt about the use of certified seeds, and I thus use certified seeds nowadays. My maize is doing very well because I also used manure on them. Currently, we are having a problem with fertilizers but my maize is not suffering much because of the manure I used. Where I used to grow maize, I have grown cassava because I have learnt about crop rotation too. I was not used to growing millet, but I have tried growing it in an effort to do crop rotation and I see it is doing very well. My wife has also made her kitchen garden and we are saving a lot since we are growing our own vegetables like kale, cowpeas, African nightshade and jute mallow. I am very glad to 40130 since my skills and knowledge have increased. I am updated by the information, and I believe that Information is power. With information, I will get more money than previously." Farmer in Chiliba village, Mabusi sub-location, Bumula ward, Bungoma county, Kenya

> "Thank you for your services this year we were with you, you have taught us over the phone… We thank you so much and please continue with your service because we still need it so much, we hope it will be of great help and benefit us." - Farmer in Rwengaju Katooke town council, Kyenjojo District, Uganda

> "Information about the weather is very useful. Just in the past, when we got to know from the phone call of 6007 that there will be rain, we picked the cotton early, which saved the crop from getting ruined. Apart from this, advice about cotton is very useful." Farmer in Khanewal district, Kabirwala tehsil, Pakistan

> "Weather information is sent and crop information is given which is quite helpful. By following the advice given in it, our harvest becomes quite good. Otherwise, when insects used to fall in the crop, we were quite worried about what to do now. These calls tell us about various things that let us know what we have to do." Farmer in Khanewal district, Kabirwala tehsil, Pakistan

> "I have been getting calls from 6007 for the past one or two months, they have advice regarding weather and crop which is very helpful. For example, I got to know from the phone call of 6007 that it will rain today and on the same day I was supposed to spray… I didn't spray because rain spoils the spray." Farmer in Khanewal district, Kabirwala tehsil, Pakistan

Partners

PxD's work in 2022 benefited from partnerships with a wide range of partners from all over the world, including with government agencies, non-profit organizations, and the private sector. PxD also partners with many excellent research collaborators and organizations in the design and implementation of our research studies to bring in external perspectives and expertise that add value to our work. Our country-based partners include:

Colombia
Rare
The Nature Conservancy (TNC)

Ethiopia
Digital Green
Ethiopia Ministry of Agriculture (MoA)
Ethiopian Agricultural Transformation Institute (ATI)
Land O'Lakes
SNV Netherlands Development Organisation

India
Action for Food Production (AFPRO)
Aga Khan Rural Support Program (AKRSP)
Agri10x
AgroStar
Ambuja Cement Foundation (ACF)
BigHaat
Climate Forecast Applications Network (CFAN)
Coffee Board of India
Department of Agriculture and Farmers' Empowerment (DAFE), Government of Odisha
Development Innovation Lab (DIL)
Fruitfal
IDH, the Sustainable Trade Initiative
Impagro
Krishi Tantra
SEWA Co-operative Federation
Syngenta Foundation
West Bengal Accelerated Development of Minor Irrigation Project, Government of West Bengal

Kenya
Centre for Agriculture and Biosciences International (CABI)
Development Innovation Lab (DIL)
Kenya Agricultural and Livestock Research Organization (KALRO)
Kenya Ministry of Agriculture, Livestock, Fisheries, and Cooperatives (MoALFC)
Kenya County Governments (Kericho, Taita Taveta and Kwale Counties)
Lessos Dairy Cooperative
International Maize and Wheat Improvement Center (CIMMYT)
Mercy Corps Agrifin
One Acre Fund
Sirikwa Dairy Cooperative

Nigeria
International Fund for Agricultural Development (IFAD)

Pakistan
Agriculture Department of the Government of Punjab (AD-GoP)
Climate Forecast Applications Network (CFAN)
International Rice Research Institute (IRRI)
Kala Shah Kaku Rice Research Institute
Rural Community Development Society (RCDS)
Center for Economic Research in Pakistan (CERP)
The Urban Unit Pakistan

Rwanda
Aceli Africa
One Acre Fund

Uganda
Aceli Africa
Hanns R. Neumann Stiftung (HRNS)
International Food Policy Research Institute (IFPRI)
TechnoServe

Cross-Cutting Geographies
GiveWell
Institute for Governance & Sustainable Development (IGSD)

Communications
and Events

PxD is committed to sharing lessons learned and insights from our work with partners, donors and the broader development sector. In 2022, we published several blog posts which can be found on our PxD Blog. We also wrote or were featured in several publications in other outlets:

- PxD Chief of Programs Niriksha Shetty was interviewed for a Devex article on "How to realize the potential of digital extension services for farmers."
- PxD's work was featured on the UNDP Digital X Solution Catalogue, a marketplace for proven digital solutions that solve global development challenges.
- PxD's work was featured in a GSMA report on "Data-driven advisory services for climate-smart smallholder agriculture."
- PxD research affiliate Raissa Fabregas, PxD Chief Economist and Director of Research Tomoko Harigaya, PxD co-founder Michael Kremer, and co-author Ravindra Ramrattan published a chapter titled "Digital Agricultural Extension for Development" that was featured in the book "Introduction to Development Engineering."

- PxD Chief Strategy Officer Jonathan Lehe, Research and Program Development Manager Gautam Bastian, and Director of Development Nicholas Milne co-authored a memo featured on the Day One Project website entitled "Investing in Digital Agriculture Innovation to Secure Food, Yields, and Livelihoods" that served as a call to action to USAID and other global development stakeholders to make ambitious investments to spur innovation in digital agriculture.

In 2022, we participated in a wide range of events to share our research findings, spread awareness of our work, and learn from other partners in the development space. These events included:

- On International Women's Day 2022, the PxD Nigeria team convened a symposium to discuss how Nigerian women and girls can be powerful leaders and change-makers for agriculture, technology, climate adaptation and mitigation.
- In March, several PxD colleagues attended the virtual 2022 ICT for Ag Conference, co-sponsored by USAID's Feed the Future initiative and the German Agency for International Cooperation (GIZ).
- In April, PxD Nigeria Country Manager Uzoamaka Ugochukwu was selected to present a "tech demonstration" of PxD's services in Nigeria at the 2022 Global Digital Development Forum.
- In August, Jonathan Lehe participated in the Global Development Moonshot Accelerator in Mexico City, organized by Unlock Aid and the Day One Project, representing PxD in a gathering of 40+ social innovator organizations tackling various global development challenges around the world.
- In September, Jonathan Lehe presented at a webinar organized by HarvestPlus to share PxD's work in Pakistan to deliver information to smallholder farmers on the nutritional benefits of biofortified seeds.
- In October, Jonathan Lehe presented PxD's work at the virtual Next-Gen Agritech Conference, which had the theme of "Changing Agriculture Paradigms and Improving Food Security."

Funders

We are grateful to the many funders who supported our work in 2022:

Aceli Africa

Anonymous

Bill and Melinda Gates Foundation (BMGF)

Centre for Agriculture and Biosciences
International (CABI)

Development Innovation Lab (DIL) at the
University of Chicago

Digital Green Foundation

Dioraphte Foundation

GiveWell

Horace W. Goldsmith Foundation

International Fund for Agricultural
Development (IFAD)

International Maize and Wheat
Improvement Center (CIMMYT)

King Climate Action Initiative (K-CAI) at
J-PAL

Mercy Corps

Montpelier/Hampshire Foundation

Mulago Foundation

National Bureau of Economic Research
(NBER)

Private Enterprise Development in Low -
Income Countries (PEDL)

Sall Family Foundation

Schmidt Futures

SNV Netherlands Development Organisation

Stichting Coffee Agronomy Training (SCAT)

Swiss Re Foundation

UK Partnering for Accelerated Climate
Transitions (UK PACT)

Vitol Foundation

Walmart Foundation

Wellspring Philanthropic Fund

World Bank

FINANCIALS

$7.77 M
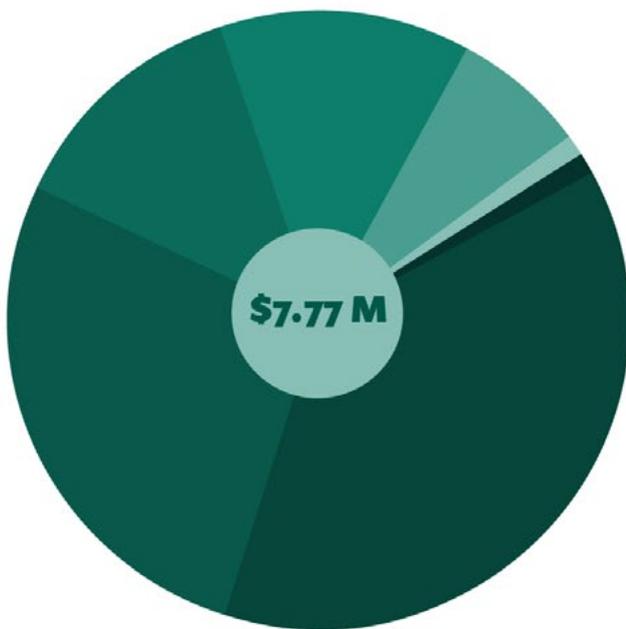
- 1% **Emerging Programs**
- 38% **South Asia**
  INDIA, PAKISTAN
- 27% **Sub-Saharan Africa**
  ETHIOPIA, KENYA, NIGERIA, RWANDA,
  UGANDA, ZAMBIA
- 13% **Admin**
- 13% **Global Programs**
- 7% **Fundraising**
- 1% **Latin America**
  COLOMBIA