What Works to Strengthen Climate Resilience for Smallholder Farmers? Evidence from Kenya

Introduction

Smallholder farmers face increasing climate uncertainty that makes investing in agriculture both more important and more risky. Droughts, erratic rainfall, and other weather shocks threaten crop production, while rising input costs and volatile markets make it difficult to recover from a poor harvest. As a result, many farmers hesitate to invest in technologies that could improve productivity and resilience, including crop insurance, stress-tolerant crop varieties, agronomic advice, and other productivity-enhancing innovations.

Many of these technologies already exist, yet adoption remains low. Insurance products may not inspire confidence, farmers may not understand how different technologies complement one another, digital advisory services may fail to engage users, and women often face additional barriers to accessing agricultural services and participating in agricultural decision-making. Strengthening farmers' resilience therefore requires more than developing new technologies—it also requires designing, delivering, and scaling them in ways that reflect how farmers make decisions and the constraints they face.

To better understand how to strengthen farmers' resilience to climate-related risks, researchers from the International Food Policy Research Institute (IFPRI) and Wageningen University partnered with Innovations for Poverty Action (IPA), Agriculture and Climate Risk Enterprise (ACRE Africa), and the Kenya Agricultural and Livestock Research Organization (KALRO) to evaluate a package of innovations across seven counties in Kenya. Through randomized evaluations and complementary qualitative research involving more than 6,000 smallholder farmers, the partnership generated evidence on how the design, delivery, and accessibility of agricultural risk-management tools influence farmers' adoption decisions and resilience to climate shocks.

This brief synthesizes the key lessons and highlights their implications for governments, insurers, agricultural service providers, and development partners.

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STUDY TYPE

Randomized Evaluation (RCT) and Qualitative Research

Key Lessons

1. Reducing basis risk can increase farmers' trust in and uptake of agricultural insurance.

Weather index insurance helps protect farmers against climate-related losses by linking payouts to rainfall measurements or other weather indicators rather than assessing damage on individual farms. While this approach lowers administrative costs, it can leave farmers uncompensated when weather stations fail to capture local conditions. This mismatch between actual losses and insurance payouts—known as basis risk—can reduce farmers' trust in insurance and discourage adoption.

To address this challenge, researchers evaluated Picture-Based Insurance (PBI), an innovative insurance product that uses smartphone images of farmers' fields to verify crop damage and determine payouts. By linking compensation more closely to farmers' actual losses, PBI was designed to reduce basis risk while maintaining a scalable insurance model (Kramer, Cecchi, Levine, & Waithaka, 2025).

The study found that PBI substantially increased insurance uptake. Between 29 and 35 percent of farmers offered free trials of Picture-Based Insurance purchased coverage, compared with 20 to 21 percent of farmers offered free trials of traditional weather index insurance and 13 percent of farmers who were not offered a subsidized insurance product. PBI also improved farmers' confidence in insurance. Farmers were 15.6 percentage points more likely to trust the product, 17.2 percentage points more likely to perceive it as high quality, 14.1 percentage points more likely to understand how it worked, and 12.1 percentage points more likely to expect a payout after crop losses (Kramer, Cecchi, Levine, & Waithaka, 2025). The largest increases in uptake were observed among women and farmers in Kenya's arid and semi-arid lands, suggesting that reducing basic risk can help expand access to agricultural insurance among underserved populations.

2. Insurance products should be designed to reflect how farmers manage agricultural risk and household finances.

Expanding access to agricultural insurance requires more than increasing availability or lowering premiums. Farmers' decisions to purchase insurance are also shaped by how products are designed, including whether they are offered alongside complementary technologies and how insurance payouts are delivered after a shock.

Researchers conducted experimental auctions with more than 1,300 farmers across seven counties in Kenya to examine how different product features influenced farmers' willingness to purchase insurance. The studies found that farmers placed greater value on insurance when it was bundled with stress-tolerant crop varieties than when insurance was offered as a stand-alone product. Bundling had a larger positive effect on willingness to pay for insurance than for seed alone, suggesting that farmers recognize additional value when complementary risk-management tools are offered together (Malacarne, Kramer, & Waweru, 2023).

The research also found that who controls future insurance payouts matters. Farmers were willing to pay substantially more for insurance when payouts were deposited into their own mobile money account. Directing payouts to a spouse's account reduced willingness to pay by 29 percent, while directing payouts to a rotating savings and credit association (ROSCA) reduced willingness to pay by 54 percent relative to payouts made directly to the insured farmer. These findings highlight the importance of maintaining control over compensation after a shock and suggest that household financial dynamics should be considered when designing agricultural insurance products (Kramer, Malacarne, & Waweru, 2023).

Together, these findings support that product design—including bundling complementary technologies and ensuring farmers retain control over insurance payouts—can substantially increase the value farmers place on agricultural insurance and encourage greater adoption.

3. Farmers need support to understand how climate-smart technologies complement one another.

Climate-smart technologies address different sources of agricultural risk, but farmers may not always recognize how these tools work together to strengthen resilience. Agricultural insurance helps protect farmers against catastrophic weather shocks, while stress-tolerant crop varieties help reduce production losses under moderate drought conditions. Maximizing the benefits of these technologies often requires adopting both.

Researchers evaluated whether providing farmers with trial packs of a stress-tolerant maize variety would increase awareness of its benefits and encourage future adoption. The study found that the promoted variety produced higher yields than commonly grown varieties under farmer-managed conditions. However, the variety did not consistently appear more drought tolerant in the field because visible differences largely disappeared under severe moisture stress and as crops reached maturity. As a result, farmers who received trial packs did not perceive the variety to be more drought tolerant than other varieties and were more likely to plant it only while receiving free seed (Kramer, Wellenstein, Waweru, & Kivuva, 2025). These findings suggest that simply providing access to new technologies is not enough to drive sustained adoption.

This finding also helps explain results from the insurance research. While farmers valued bundles that combined insurance with stress-tolerant crop varieties, they often did not perceive drought-tolerant varieties to be complementary to insurance. Instead, the benefits of each technology were not always apparent, making it difficult for farmers to appreciate how they address different dimensions of climate risk.

Together, these findings suggest that successful climate adaptation programs should combine access to complementary technologies with communication and extension strategies that help farmers understand when, how, and why different tools work together to strengthen resilience. Continued opportunities for learning and experimentation may be just as important as improving access to the technologies themselves.

4. Digital advisory services are most effective when farmers engage with the information they receive.

Digital advisory services have the potential to deliver timely, low-cost agronomic recommendations to large numbers of farmers. Advances in artificial intelligence and smartphone technologies have also made it possible to tailor recommendations to the conditions of individual fields. Researchers evaluated whether personalized picture-based advisories generated from images of farmers' own crops improved agricultural outcomes compared with more general advisory messages.

The study found that personalized advisories did not significantly improve agricultural outcomes compared with generic advisories. Instead, farmers who actively received, read, and engaged with advisory messages achieved better outcomes regardless of whether the recommendations were personalized (Ceballos, Chugh, & Kramer, 2024).

These findings suggest that increasing farmer engagement is more important than increasing the sophistication of recommendation algorithms alone.

As digital extension services continue to expand, investments should prioritize user-centered design, accessible communication, and strategies that encourage farmers to engage with advisory messages. Improving the quality of farmer interactions with digital tools may generate greater benefits than focusing exclusively on personalization.

5. Gender-responsive approaches can strengthen women's participation in agriculture and improve the reach of agricultural services.

Women often face barriers to accessing agricultural services, participating in household decision-making, and expanding agricultural enterprises. The research program evaluated complementary approaches to address these barriers by promoting more equitable household decision-making and strengthening women's roles in agricultural service delivery.

One study evaluated The Wise Woman, a 24-minute edutainment drama developed in collaboration with the producers of Shamba Shape Up. The film explores how gender norms, joint household decision-making, and intimate partner violence influence communication and agricultural decision-making within farming households. The intervention increased women's participation in productive household decision-making by 5 percentage points and eliminated gender bias in whose agricultural advice farmers trusted. The effects were strongest when the film was combined with facilitated community discussions, demonstrating the value of pairing mass media with opportunities for dialogue and reflection (Aju, Kramer, & Waithaka, 2022).

Complementary research on champion farmers found that women can play an important role in delivering agricultural services—including stress-tolerant crop varieties, agricultural advisories, and crop insurance—to underserved communities. However, women champion farmers also face gender-specific barriers, including time poverty associated with caregiving responsibilities, mobility constraints, limited access to capital, and lower trust from some farmers. The research also found that providing insurance alone is not sufficient to sustain the champion farmer model; integrating insurance with complementary services, such as seeds and advisories, creates a more viable and inclusive delivery system (Biketti, Gumucio, Kramer, Waweru, Waithaka, & Cecchi, 2022; Waithaka et al., 2022).

Together, these findings support the idea that strengthening agricultural services requires more than improving technologies. Programs are more likely to achieve lasting impact when they intentionally address the social norms, household dynamics, and structural barriers that shape how women and men access information, adopt innovations, and participate in agricultural markets.

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