

# Behavioral market intelligence and its implications for seed systems development

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## Abstract

In many countries, varietal turnover rates are stubbornly low in seed systems that target smallholder farmers. While there are several factors that contribute to low turnover, two important behavioral factors that limit adoption of new varieties are the difficulties that farmers may face in learning about new varieties and their hesitancy to assume risks associated with investing in new varieties. In this brief, we review part of the literature on behavioral constraints that result in slow varietal turnover and discuss the interventions that the CGIAR Initiative on Market Intelligence and Product Profiling for Impactful Breeding will be testing to overcome these behavioral barriers. We highlight areas for innovation to facilitate farmers' learning about new varieties, including leveraging social networks and information and communication technologies (ICT), and to strengthen farmers' ability to manage risks associated with investing in new varieties, including facilitation of experimentation, insurance and consumer marketing.

## Introduction

Rates of varietal turnover in small-scale agriculture remain low in many parts of the developing world. For example, a maize variety launched in 1986 remains one of the most popular varieties grown in Kenya (Rutsaert and Donovan 2020), and in 2011, only nine rice varieties, with an average age of more than 20 years, covered at least 75 percent of total rice area in lowland Nepal (Witcombe et al 2017). Low rates of varietal turnover often, in part, reflect newly released varieties that do not meet farmers' needs or have traits that are less desirable to farmers (Thiele et al 2021). Hence, carefully defining market segments and developing targeted products that cater to each segment's unique sets of needs and preferences will be a critical step towards increasing varietal turnover.

Farmers often also fail to adopt newer seemingly well-targeted, carefully designed varieties possessing attributes that could better serve their market segment, such as varieties that are higher yielding, more nutritious, better tasting, more tolerant to climatic stressors or less resource intensive. This is of particular concern to policymakers when these targeted products also have social benefits; for instance, a higher supply of more nutritious varieties or more drought-tolerant varieties could, respectively, improve public health outcomes or food security outcomes.

## Key points

- Low rates of smallholder uptake of new varieties may be due to difficulties farmers face in learning about new varieties and the risk associated with adopting and consuming new varieties.
- Leveraging developments in ICT and social networks can help farmers learn about the benefits of new varieties or products.
- Facilitating experimentation, reducing investment risk through insurance and increasing consumer exposure to new varieties can help address risk-related barriers to adoption.
- The CGIAR Initiative on Market Intelligence is testing behavioral interventions to inform strategies that accelerate varietal turnover.



INITIATIVE ON  
Market Intelligence

This Initiative aims to maximize CGIAR and partners' returns on investment in breeding, seed systems and other Initiatives based on reliable and timely market intelligence that enables stronger demand orientation and strengthens co-ownership and co-implementation by CGIAR and partners.

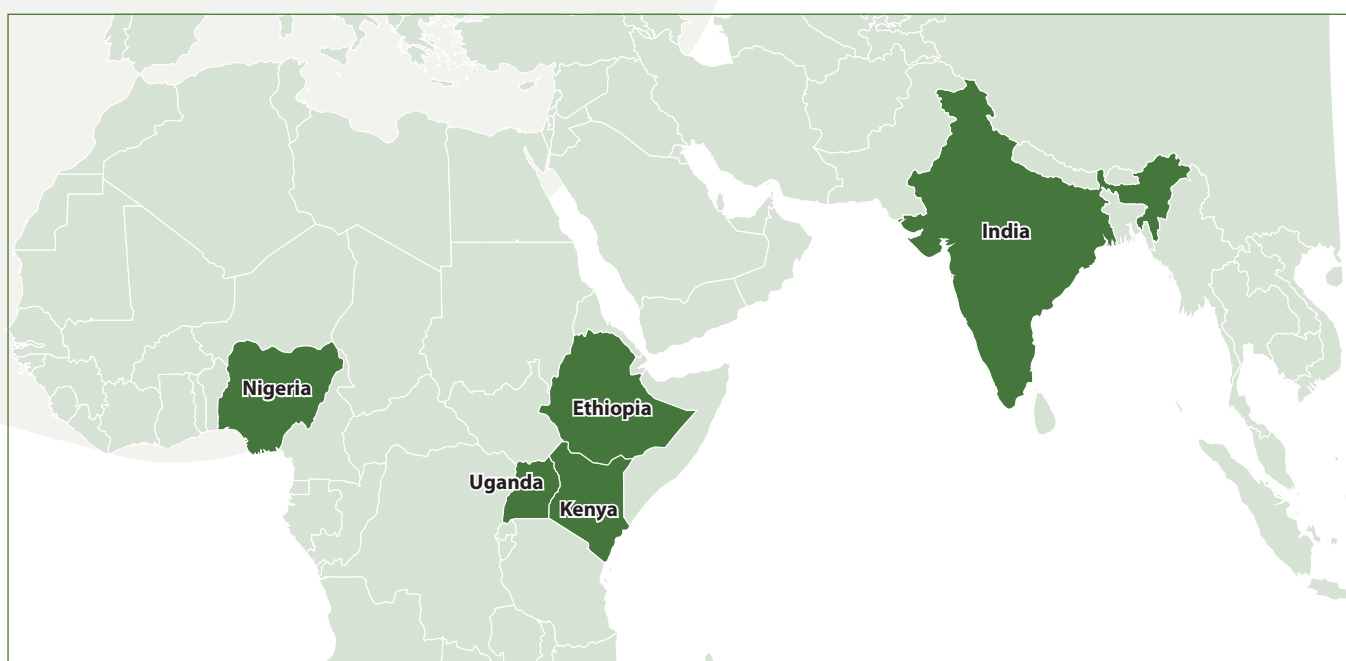
Key questions are why farmers do not adopt or upgrade to these newer targeted varieties when they are available and what types of interventions are needed to incentivize farmers to replace their old varieties. One important class of explanations has to do with behavioral constraints faced by farmers when deciding whether to adopt a new variety.<sup>1</sup> That decision may be even more problematic for a smallholder farmer to make than the decisions to adopt other agricultural technologies, such as fertilizer or pesticides. Adopting any new technology can be risky and require substantial learning on how to incorporate the technology into the production process. Choosing a new variety can pose even more risk to the farmer since the produce from new varieties can have a different taste, texture or color and, as a result, can be rejected by consumers (or other downstream actors, such as processors). Indeed, in many cases smallholder farmers are primary consumers of their own production, and so they risk producing goods that they might not want to consume. Thus, when it comes to the decision to replace an old variety, farmers face additional consumption- and market-related barriers to adoption.

Accelerating turnover to newer, better varieties will therefore require creative solutions to address key behavioral barriers, such as difficulties associated with (1) learning about new varieties and (2) risk taking faced by both farmers (in their roles as producers) and consumers (with farmers also being consumers of their own production). Behavioral Intelligence, a work package in the CGIAR Initiative on Market Intelligence and Product Profiling for Impactful Breeding (henceforth Market Intelligence), will study interventions to overcome these barriers through a three-year multicountry, multicrop social-science research program. Specifically, randomized controlled trials in Ethiopia, India, Kenya, Nigeria and Uganda (see figure 1) will explore the effectiveness of both a set of common interventions implemented across all sites and various context-specific interventions in each country. We discuss current evidence<sup>2</sup> about interventions that address these behavioral barriers as well as the opportunities to improve intervention effectiveness that our research will explore.

### Definitions

**Market Intelligence:** Practice of gathering and analyzing data to identify and describe opportunities for breeding and seed systems to optimize their contribution to CGIAR Impact Areas of nutrition and health, poverty reduction, environmental health, gender equality and social inclusion, and climate adaptation.

**Behavioral Intelligence:** A type of market intelligence analyzing what drives farmer, consumer and private-sector decisions to adopt new varieties and related products. This includes the generation of actionable evidence on how to (1) influence variety replacement and product substitution decisions by consumers and farmers and (2) encourage the private sector to invest in marketing new varieties and products that contribute to gender equality, healthier diets and social inclusion. This evidence can be leveraged to identify cost-effective and inclusive strategies to accelerate varietal



**Figure 1. Locations of Behavioral Intelligence experiments**

<sup>1</sup> There are also many policy-related and market-related factors that inhibit farmers' uptake of new varieties, often related to lack of quality regulation of seeds, lack of access to seeds and complementary inputs, and lack of access to financial markets. We focus less on those factors here to highlight the work surrounding behavioral intelligence being conducted under the Initiative on Market Intelligence.

<sup>2</sup> Much of the existing evidence on interventions to address behavioral barriers focuses explicitly on binary 'adoption' decisions, which may not well characterize the complex process of farmers' incorporating a new technology (variety) into their production process (Glover et al 2019), especially if they are switching between various improved varieties. For simplicity, we use the terms 'adoption' and 'uptake' here to refer broadly to the incorporation of new varieties in a farmer's production process.

## Interventions to help farmers learn about new varieties

Past work exploring technology adoption decisions by small-scale producers highlights the importance of farmers' learning about the benefits and proper use of technology. Traditional extension services, which generally involve public employees instructing farmers about the use of new technologies during household visits or farmer field days, have historically been used as a key policy lever to enable learning about new agricultural technologies. While these programs have been effective at increasing adoption in various settings (Anderson and Feder 2007), public extension systems are often under-resourced and may not enable effective learning among all farmers. For instance, female farmers may not be well-served by traditional extension services (Quisumbing and Pandonelli 2008). Further, farmers may fail to effectively learn from extension agents if they do not trust them or if the information is presented in a complex manner (Glover et al 2019, Islam and Beg 2021). Recent work has experimented with new intervention modalities to facilitate effective learning by all farmers, which may present exciting opportunities to promote new varieties more effectively. A discussion of such potential interventions follows.

### *From traditional extension to new providers of information*

Many modern learning intervention approaches have shifted towards farmer-to-farmer models, where local, agriculturally savvy farmers teach others in their communities about new technologies. Notably, such approaches may not only preserve public extension resources but potentially facilitate better learning. For instance, Krishnan and Patnam (2014) found that while both traditional extension and learning from peers have positive impacts on adoption of new varieties in Ethiopia, the impacts of traditional extension on adoption fade over time, while those from peer influence remain. There is an active literature on how to select these peer farmers to induce the highest levels of learning and adoption. Some studies exploited network analysis to identify particularly influential members of a community. Other studies examined whether information received from someone with a similar social identity was more influential. For example, there is evidence that individuals may learn better from someone more like them in aspects such as gender, kinship linkages and membership in community organizations (BenYishay and Mobarak 2019, Kabirigi et al 2022). Hence, using existing social ties may be an effective strategy to enable learning about new varieties and to increase adoption.

Research in India conducted by the Initiative on Market Intelligence seeks to understand whether we can leverage this behavioral insight to facilitate learning about improved legume varieties. In a context-specific intervention, community farming leaders within villages in Odisha will be given supplies to set up a demonstration plot where other farmers can learn about the new varieties by observing their on-farm performance. These demonstration plots are also meant to stimulate conversations among farmers about the new varieties, and demonstration-plot farmers will be paired with other farmers in their community with whom they are to discuss the demonstration plot and teach about the new varieties. Critically, the research design will

randomize whether the paired farmers are in the same caste as the demonstration plot farmers. The behavioral insights mentioned suggest that perhaps this pairing of farmers with a peer of the same caste will facilitate more effective learning.

Private-sector actors may also be able to play a larger role in providing information about new varieties to farmers. For example, in a survey of Kenyan farmers, Rutsaert and Donovan (2020) found that 80 percent of farmers purchasing seed from agro-dealers reported being influenced by the agro-dealer in their seed-purchasing decision. Over the past decade, the Alliance for the Green Revolution in Africa (AGRA) has experimented with various agro-dealer development programs that equip sellers with the knowledge and skills necessary to advise farmers on agricultural best practices, including the adoption of new varieties. Such approaches may be a promising step forward in contexts where farmers trust the advice of agro-dealers. Dar et al (2021) found that training input dealers on a flood-tolerant rice variety increased farmer-level adoption by more than 50 percent compared with a peer farmer extension approach in Odisha. However, there may be inequities in access to agro-dealer networks since not all farmers purchase seed in the formal sector, and farmers rely on informal seed systems for many crops (Almekinders 2000). Indeed, in the Rutsaert and Donovan (2020) study, only 20 percent of farmers purchase from agro-dealers.

Market Intelligence research in Kenya combines the above behavioral insights to test the effectiveness of a context-specific, private sector, peer-farmer information delivery model to encourage farmer uptake of drought-tolerant maize varieties. Specifically, a private sector company hires local peer farmers, called 'champions,' who are tasked both with providing information about new varieties and selling seeds to farmers. Notably, these champions are well-known in their local communities, and about half of them are women. This feature may help address some of the issues that especially female farmers typically face in trusting and communicating with public extension agents or private sector agro-dealers. This model has the potential to be both an effective and inclusive approach to enabling learning and adoption.

### *From traditional extension to new methods of information provision*

Besides varying the source of information, innovative approaches to the delivery and presentation of information may help farmers learn about a new variety. For one, the increased availability of ICT technologies among smallholder farmers provides opportunities to communicate with them relatively cheaply and frequently. This may be particularly critical for farmers adopting a new variety since knowledge gaps may require follow through during the production process. Cole and Fernando (2021) found that cotton farmers with free access to a service that both provides agricultural advice via voice messages and a call-in hotline increased the use of recommended seed varieties. As cell phone ownership increases, possibilities for such programs will expand. Yet, even in contexts with less widespread phone ownership, providing ICT technology to extension workers may improve farmers' willingness to experiment with new technologies (Fu and Akter 2016).

Increased access to ICT may also allow information to be presented in clearer and more engaging ways that are conducive to better learning. Television and video programming in the form of 'edutainment' has the potential to present information in an entertaining way, which may help viewers understand and retain information better. Areal et al (2020), for example, show that Kenyan farmers who watched the farm makeover reality-TV show *Shamba Shape-up* were more likely to purchase new maize seeds from an agro-dealer (rather than recycling old seeds), as recommended by the show. Moreover, ICT can create cheaper opportunities for interactive learning; simulating input decisions in a virtual farm app can help farmers make better input decisions on their real farms (Tjernström et al 2021).

Research under the Behavioral Intelligence work package in Kenya has also utilized the insight about the importance of engagement to encourage more effective learning among farmers in designing a context-specific intervention. Specifically, researchers developed a special episode of *Shamba Shape-up* called "The Wise Woman," which emphasized the importance of both husbands and wives in joint agricultural decision making (including the decision to grow a drought-tolerant maize variety). Preliminary results show that farmers who watched the episode are less biased when deciding whether to take agricultural advice from a champion of the opposite gender and that a few weeks after watching the episode, women and men were more likely to engage in joint productive decision making.

#### Educating consumers about new varieties

Given that producers are often also consumers of their production, the success of the adoption of new varieties also crucially hinges on consumers' willingness to incorporate new varieties in their diets. Therefore, information campaigns to inform farmers about the benefits of new varieties can also be a useful strategy to increase adoption. Educating potential consumers about these traits

can greatly increase their willingness to pay, especially when favorable attributes of new varieties are not directly visible (for instance the nutritional benefits associated with biofortified crops) (Birol et al 2015). As with information about agricultural production techniques, both ICTs and social networks may play key roles in spreading information about the consumption traits of new varieties. For example, Zossou et al (2022) found that in Benin video broadcasts and radio transcripts on the benefits of a locally produced improved rice product increased its market share by 14 percent, an effect further amplified by 11 percent through word-of-mouth exchanges with peers. Similarly, Meenakshi et al (2010) found that nutritional messaging delivered via radio campaigns and community leaders increased consumer demand for orange maize in rural Zambia. Given these insights, our Behavioral Intelligence research will test a common consumption-focused intervention with producers across Ethiopia, India, Kenya, Nigeria and Uganda (figure 2 describes the experimental design). Critically, the intervention will be the same in all countries. While this intervention is still in development, it will likely include edutainment videos that highlight positive consumption properties of the new varieties being promoted.

#### Interventions to help farmers cope with the risk of experimenting with new varieties

Smallholder agriculture can be a risky endeavor, and farmers' risk aversion may hamper investments in new technologies. Adopting a new variety can come with production-side risk. Farmers invest money and resources in cultivating a new variety for which the returns may be uncertain; how this new variety will perform on their land may be uncertain and it may require a few seasons to figure out optimal growth practices. The adoption decision can also come with consumption or market risk, in that consumers and other downstream value-chain actors may not want to bear the risk associated with processing and/or consuming a new variety.

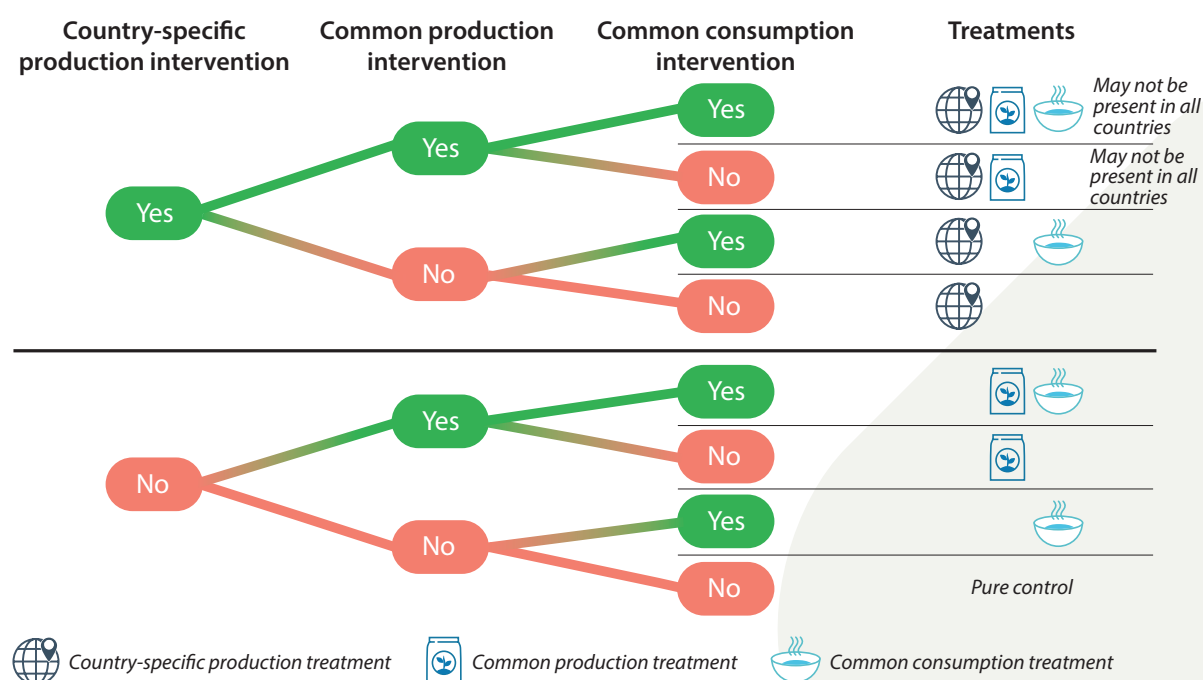


Figure 2. Experimental design diagram



### ***Facilitate experimentation***

Farmers may want to experiment with a new variety and learn about its benefits firsthand before fully adopting it, rather than simply learning from others (Laajaj and Macours 2017). Yet, improved seeds tend to be more expensive than traditional varieties, and this additional cost may deter experimentation. Reducing the cost of experimentation with new varieties may aid farmers in their adoption decisions. A short-term subsidy for the purchase of new varieties can be an expensive but effective way to facilitate such learning (Bernard et al 2019). Offering farmers the opportunity to buy smaller quantities of seeds (rather than having to invest in a full bag) can also encourage experimentation with new varieties (Yitayew et al 2022).

Behavioral Intelligence researchers are testing the effect of a common trial-pack intervention—providing free trial packs of new varieties—on the decision to grow those varieties in the subsequent season. Testing this common intervention in all study sites will allow us to potentially make more generalizable, externally valid claims about the effectiveness of this trial-pack intervention as well as enable direct comparisons across contexts. However, in some study sites, additional context-specific interventions will complement the trial packs. In Uganda, for instance, researchers will offer an additional set of randomly selected farmers the opportunity to purchase the same trial packs at a small cost, to understand whether receiving free trial packs causes farmers to value the packs less and, in turn, put less effort into learning about the new maize variety. In Nigeria, randomly selected farmers will receive a free supply of complementary inputs (such as fertilizer) with their trial packs to understand whether learning about a cowpea variety requires a more comprehensive input package.

### ***Innovative insurance products***

Traditional risk mitigation products aimed at smallholder farmers, such as weather index-based insurance, have suffered from limited uptake (Jensen and Barrett 2017). Innovations in the structure of insurance contracts may increase the demand for insurance among smallholder farmers and make them feel better protected, in turn increasing their willingness to experiment with new technologies. One challenge in scaling insurance is basis risk, meaning that insurance payouts are not sufficiently correlated with actual crop losses. Again, technological innovations may prove useful; picture-based insurance, where damages are assessed via smartphone images of insured crops, may serve as a relatively cheap way for insurers to lower the basis risk of their products (Ceballos et al 2019). This will be especially true if AI classification algorithms are eventually able to automate damage assessments with limited human intervention.

In both Ethiopia and Kenya, pioneering Market Intelligence studies will assess the effects of context-specific interventions offering picture-based insurance on uptake of new varieties. In the Kenyan case, the initiative is partnering with ACRE Africa, a private company that develops and implements solutions for agricultural risk management, particularly insurance. ACRE Africa's champion farmers take repeated smartphone photos of insurance clients' plots to help document crop damage as a base for insurance claims settlement. In Ethiopia, the initiative is partnering with the World Food Programme's R4 Rural Resilience Initiative,

which provides smallholder farmers with solutions to transfer, mitigate and prepare for risk through insurance, risk-reducing technologies and practices, and savings. It promotes prudent risk taking and improved livelihoods by increasing access to credit. In the context of this program, researchers will compare the effect of picture-based insurance and R4's standard weather-index insurance program in encouraging uptake of new wheat, maize, sorghum and teff varieties.

### ***Increase consumer exposure to new varieties***

Farmers may be hesitant to produce a new variety when a robust market for the variety does not yet exist, or when they are unsure whether the variety will be acceptable to downstream actors, such as processors or consumers. Farmers who consume their own production may also be hesitant to grow a new variety when they are unsure whether they will like its taste, texture or cooking suitability. Providing farmers with opportunities for low-risk experimentation with new varieties in their role as consumers may increase adoption. For instance, Adekambi et al (2020) found that attending a cooking demonstration to learn how to cook a new sweet potato variety is positively associated with adoption of that variety by Ghanaian farmers. Indeed, even having the opportunity to taste new foods can be instrumental to consumers in forming their valuations of those foods (Lewis et al 2016).

As mentioned, Market Intelligence studies across five countries will implement a common consumer-focused intervention among farmers to see whether this affects adoption of new varieties. The intervention will likely include a component that facilitates consumption-focused experimentation with new varieties. Examples may include provision of a meal kit or a cooking contest, either of which would provide consumers an opportunity to cook with and taste the new varieties.

## **Discussion**

For CGIAR breeding innovations to achieve their full potential for impact, it is important to understand how farmers decide whether to replace their current varieties and adopt new varieties. While farmers may face behavioral barriers that inhibit varietal turnover, Market Intelligence research builds on existing knowledge to design and test innovations that assist farmers in the process of learning about and experimenting with new varieties. This, along with understanding the other barriers and challenges faced by farmers, will be critical to moving the needle of adoption of new, improved varieties and products.

There are two additional innovations within our behavioral research program. The first is that the research takes seriously the idea that farmers are often simultaneously producers and consumers of their own production and that farmers likely consider consumption-related attributes when deciding which varieties to grow. So our research aims to compare the effectiveness of a more traditional production-focused intervention with the effectiveness of a consumption-focused intervention in accelerating varietal turnover. Specifically, we plan to cross-randomize the two common interventions discussed over the same samples of farmers across the five study countries. The provision of trial packs serves as a more traditional production-focused intervention, while the other treatment (likely a meal kit or edutainment cooking video) will serve as a

more consumption-focused intervention. In this way, we can test whether providing farmers with the production-focused treatment, the consumption-focused treatment or both treatments encourages them to grow newer varieties in subsequent seasons. Since this cross-randomized experimental design will be implemented in all countries, we will be able to compare the effects of the interventions across contexts and assess external validity of the results.

The second innovation to highlight is the model of collaboration between researchers necessary to implement a coordinated set of experiments that test a set of common interventions across contexts. Randomized experiments are expensive to conduct, especially within the social sciences, and hence are usually conducted within limited geographical contexts. It is also uncommon for independent teams of researchers to coordinate on experimental design features, because projects are generally conducted in an ad hoc manner based on the priorities of the researchers and their funders. Moreover, in academic publishing there is often a premium awarded to novelty rather than replication of previous results. As a result, even studies testing similar interventions can vary greatly in their methodologies and implementation strategies, making it challenging to conduct rigorous meta-analysis.

The Initiative on Market Intelligence has enabled coordination between various research teams within CGIAR that are studying behavioral barriers to varietal turnover. Teams in all five of the focus countries were already independently planning to study various behavioral barriers to varietal turnover, with existing bilateral funding collaborations. Under the status quo, we might have expected to get five sets of context-specific results that would be nearly impossible to compare. However, under this new working paradigm, the research teams collaborated via both in-person and virtual meetings to consider how they could alter their original designs to simultaneously answer questions that were important to the existing project (usually related to the context-specific interventions) and incorporate common components that allow for direct comparison of some interventions across settings. While compromises on both sides were necessary to achieve these dual objectives, the teams have been able to coalesce on research designs that are suitable in each setting. Given the success of this collaborative model so far, perhaps other research teams within the CGIAR and elsewhere can take this 'proof of concept' as an impetus to explore similar models.

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### About this series

The Market Intelligence Brief offers evidence-based insights into the potential for increased impact towards the CGIAR Impact Areas from investments in crop breeding and seed systems development. This peer-reviewed series brings together voices from diverse fields, including marketing and agribusiness, gender, plant sciences and climate change to inform debates on future priorities and investments by CGIAR, NARS, the private sector and non-governmental organizations (NGOs). This series is a collaborative effort of the CGIAR Initiative on Market Intelligence. For more information, including potential submissions, please contact Meliza Peña, editorial assistant, at [c.pena@cgiar.org](mailto:c.pena@cgiar.org).

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