PROJECT NOTE 1 DECEMBER 19, 2019

PROMOTING SEED SYSTEMS FOR STRESS-TOLERANT VARIETIES AT SCALE

Potential for bundling with insurance-advisory services

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Background

Smallholder farmers may suffer losses from extreme weather events, pests and disease. This is expected to worsen in the face of climate change. Natural disasters are a threat to food security not only *ex post*, by inducing farmers to sell their assets, keep children out of school or borrow at high rates; they also threaten livelihoods *ex ante*, by discouraging farmers from investing in high-return practices and technologies (Elbers *et al.*, 2007). Fortunately, significant progress has been made in the past two decades in developing and releasing seeds with genetic traits that are more tolerant to weather shocks, pests and disease. These improvements in seed technology are offering promising pathways to improve farmers' adaptive capacity, increasing investments and thereby agricultural productivity (Emerick *et al.*, 2016).

At the same time, improvements in genetic traits have been mainly top-down driven, with a linear process where improved varieties developed by scientists are tested through performance trials, followed by field trials under controlled conditions by relatively more progressive farmers. Communication and distribution channels are mostly one-way, from seed providers to farmers through a system of wholesalers and retailers, meaning that there is limited space for two-way communication between seed providers in which smallholder farmers can express their needs for different traits of these seeds. Distribution channels for improved seed technologies are also often not inclusive because small and marginal farmers—often women—rely on informal seed markets.

To increase the reach and benefits of seed improvements, seed systems need to change. Information and Communication Technologies (ICT) could be a game-changer in this regard. It allows seed providers to interact with small-scale producers in a more inclusive way, facilitating two-way communication, thereby allowing the supply-side of the seed system to learn more about the traits that different types of smallholder farmers are looking for, the management practices that they use, the capacities that these different types of producers have, and the barriers they face in accessing improved seeds, which ultimately can inform seed providers on how to deliver more value to a largely untapped target population of small and marginal farmers. However, there also lie challenges

around the use of ICT for strengthening seed systems, not the least a gap in farmers' capacity to use smartphone technology. Those farmers that are currently excluded from the formal seed system—small and marginal farmers—are also least likely to have access to smartphones, and without a system in place to make the use of ICT inclusive, a data revolution could further widen these social gaps in access to high-quality seeds.

In addition, instead of treating stress-tolerant seeds as stand-alone instruments, existing technological, policy and institutional risk management measures should be strengthened and integrated to manage drought ex-ante and minimize ex-post negative effects (Shiferaw et al., 2014). Small and marginal farmers face a multitude of constraints to adopting stress-tolerant varieties. Addressing these requires a multi-sectoral solution that is going beyond the services that a seed sector can deliver on its own. The International Food Policy Research Institute (IFPRI), Wageningen University, ACRE Africa and the Kenyan Agricultural & Livestock Research Organization (KALRO) are hence implementing a project that analyses the sustainability and social impacts of a multi-stakeholder approach that leverages ICT and the seed system for strengthening agricultural risk management.

This research project, funded by the Netherlands-CGIAR research program for seed systems development, aims to address the following research questions: What are the needs and capacities for different types of smallholder farmers in managing agricultural risk, particularly from a seed systems perspective? How can ICT be used in the research, development and marketing around stress-tolerant seeds among smallholder farmers with limited access and familiarity with smartphone technology? What are the impacts, by gender and age, of interlinking stress-tolerant seed varieties with comprehensive ICT-based crop insurance and advisory services? Do impacts differ depending on the seed market actor that promotes the stress-tolerant seeds? And do impacts occur primarily by (a) reducing adoption risk through insurance, or (b) helping farmers overcome information barriers through advisories?

This project note describes results obtained from the project thus far. First, the project note will provide more detail around the context in which the study is being implemented, including a description of the intervention, the experimental design and our hypotheses. Second, the note will present initial findings from quantitative and qualitative data collected to inform a first round of implementation. We conclude with lessons learnt and their implications for the next phase of the project.

Context

Intervention

The main objective of this project is to pilot and implement a scalable approach to improve risk-management and resilience for smallholder farmers. Doing so, our interventions are combining the use of ICT—and smartphone technology in particular—with a network of local village entrepreneurs, or 'champion farmers', who work as service providers for ACRE Africa on a commissions basis—they act as the point of communication between seed providers and other actors in the market system on the one hand, and small and marginal farmers on the other hand. Their local presence in targeted villages itself and their ability to provide a wide range of agricultural services on a commissions basis opens up a way to reach these currently underserved farmers at a lower cost. ICT allows working with a large number of these champions and thus reach large numbers of farmers in one go.

As a first step, to start this project, ACRE Africa recruited and trained 85 champions from three counties in Eastern Kenya: Embu, Meru and Tharaka Nithi (see Figure 1).

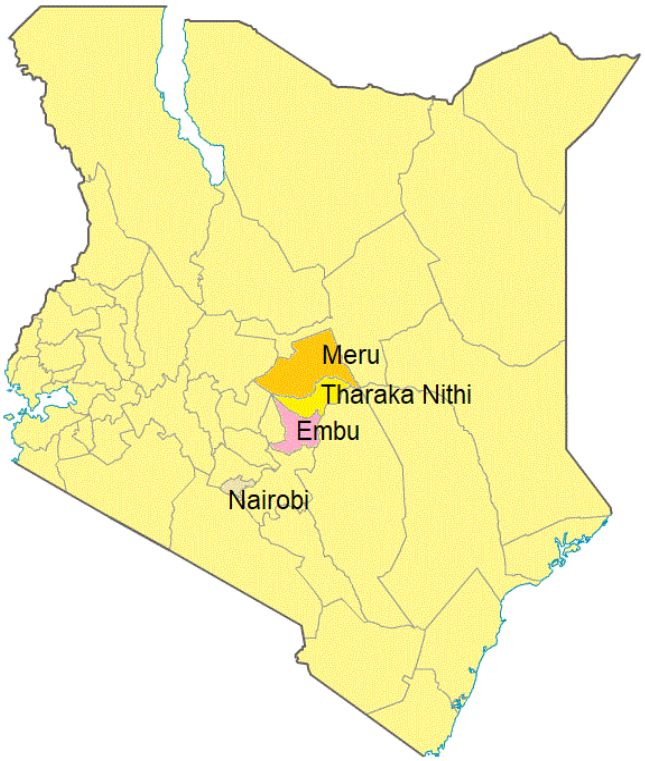

Figure 1. *Intervention Counties: Meru, Tharaka Nithi, and Embu*

These champions registered their farmers and provided, to a random sample of registered farmers, trial packs of new stress-tolerant varieties that seed providers were interested in promoting at a larger scale, while currently being grown by only a minority of farmers in the targeted counties. Farmers were asked to start their micro trials with these stress-tolerant varieties, which are being monitored using pictures taken with a smartphone app called SeeItGrow (see Figure 2). These pictures are taken on a regular basis with the help from the champion farmer and provide seed companies with "eyes on the ground" in order to better understand the management practices and context for different types of farmers. In the future, the champions will market these varieties to farmers in their communities. Commission from increased sales of these varieties, as well as other complementary inputs, could serve as their economic incentive to take on this intermediary role. Champions could also help producing the seeds that farmers would like to purchase, and selling the seeds produced within their communities to seed companies.

For now, the aim of the micro trials for these new, stress-tolerant varieties is to increase awareness, which is one barrier to the adoption of such seeds. There could however be other drivers behind (non-)adoption of stress-tolerant seed varieties, for instance perceived risks and information constraints around how to optimally adapt management practices for these new varieties. The intervention will therefore bundle the seeds with two other risk management instruments that reduce perceived risk exposure and relax information constraints: comprehensive affordable insurance coverage and advisory services, which are also informed by the images that farmers are sending in of their targeted crops. For instance, using images for indemnification can help improve the quality of crop insurance (Ceballos, Kramer and Robles, 2019) and the images give extension workers the information needed to document and convey better practices for sustained intensification.

Hypotheses / Theory of Change

We hypothesize that the ICT-based marketing approach in which farmers document their own field trials using smartphone pictures will improve demand for the varieties. Cai (2018) finds that ICT strategies may encourage farmers to try new seed varieties. We expect our strategy to be particularly effective with the youth, given greater familiarity with smartphone technology and photography. We also expect greater impacts for women if we can overcome barriers in smartphone ownership. The advisory service allows farmers to ask questions and receive personalized information about their crop throughout the farming season. This will assuage the concern that women and other less-advantaged groups will be excluded as they are not sufficiently knowledgeable to handle improved seeds. It also bridges a long-standing gap in the provision of advisory services by extension officers—the majority of which are male in Kenya (Manfre *et al.,* 2013).

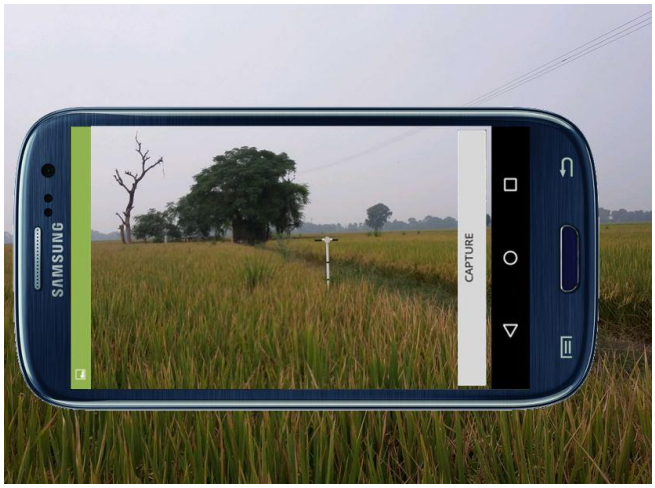

Figure 2. *An illustration of the SeeItGrow app*

Following recommendations to ramp up promotional efforts to ensure widespread awareness and understanding of new stress-tolerant varieties (Fisher and Carr, 2015), this project will develop a new marketing and distribution strategy for high-quality seeds, with more direct farmer engagement and a holistic risk-management approach. We aim at interlinking stress-tolerant seeds with comprehensive picture-based insurance (PBI) versus remote advisory services (RAS). PBI pays farmers when there is visible evidence of crop failure, whereas RAS advises them on how to optimize production, using regular georeferenced pictures of plots to monitor crop management and damage. The services improve upon ACRE's "replanting guarantee" (RPG) scheme, which revealed farmers' interest in comprehensive coverage throughout the crop cycle, not only the germination phase.

Bundling with insurance may help promote diffusion by overcoming the investment risk associated with adopting new varieties and the lack of access to credit due to farmers' default risk, whereas advisories can help improve trust in seed quality, and awareness around best practices and benefits of these new varieties. Major barriers to adoption of drought-tolerant maize, when accessible, indeed included inadequate information, high seed prices, and perceived attributes (Fisher and Carr, 2015). In fact, while often being more expensive than other varieties, high-quality stress-tolerant seeds fail to deliver under extreme weather conditions, improper adoption of suitable farming practices, or non-weather-related risks such as pests and disease. Finally, due to the presence of counterfeit seed on the market, many farmers have lost trust in improved seeds (Bold *et al.*, 2017; Ashour *et al.*, 2018).

Using images is expected to result in higher-quality services for farmers. By giving the insurer "eyes on the ground", PBI helps in verifying claims without having to send agents into the field for every claim received, while overcoming moral hazard – a classical insurance problem arising from the unobservability of management practices – reducing the cost of providing insurance. Likewise, the mobile advisory services are expected to have greater outreach for a fraction of the cost of standard extension services, yielding a scalable low-cost solution to disseminate information.

Experimental design

The experimental design is shown graphically in Figure 3. Champions have been randomized into one of three treatment arms, varying the type of marketing strategy for stress-tolerant seeds: (a) a "seeds only" group, in which champions are marketing only the seeds, without additional services; (b) picture-based insurance, in which they promote varieties by bundling with comprehensive insurance coverage for damage detected from a time series of georeferenced crop pictures; and (c) remote advisories, in which they bundle with personalized recommendations and weather information based on crop growth and health observed in pictures.

For every champion, 42 farmers have been randomly selected to be targeted with an ICT-based marketing strategy, in which farmers are growing their trial packs of the stress-tolerant varieties, and documenting their trials through the SeeItGrow app. Another set of 42 randomly selected farmers to be surveyed has not been exposed to this approach, thereby serving as a control group (although we may observe spillovers to this group).

The main datasets that will be used to estimate the impacts of these approaches include a 'registration' or baseline survey, a follow-up survey after the first season, and an endline season after multiple seasons. Through these surveys, we will measure primary outcome variables such as the adoption of the stress-tolerant seeds, secondary outcome variables such as management practices and credit access, and impact variables such as income, agricultural productivity, risk coping strategies and the ability to manage risk. These will be compared with the costs of delivering add-on insurance and advisory services to measure cost-effectiveness. We will also analyse whether impacts differ depending on sex and age.

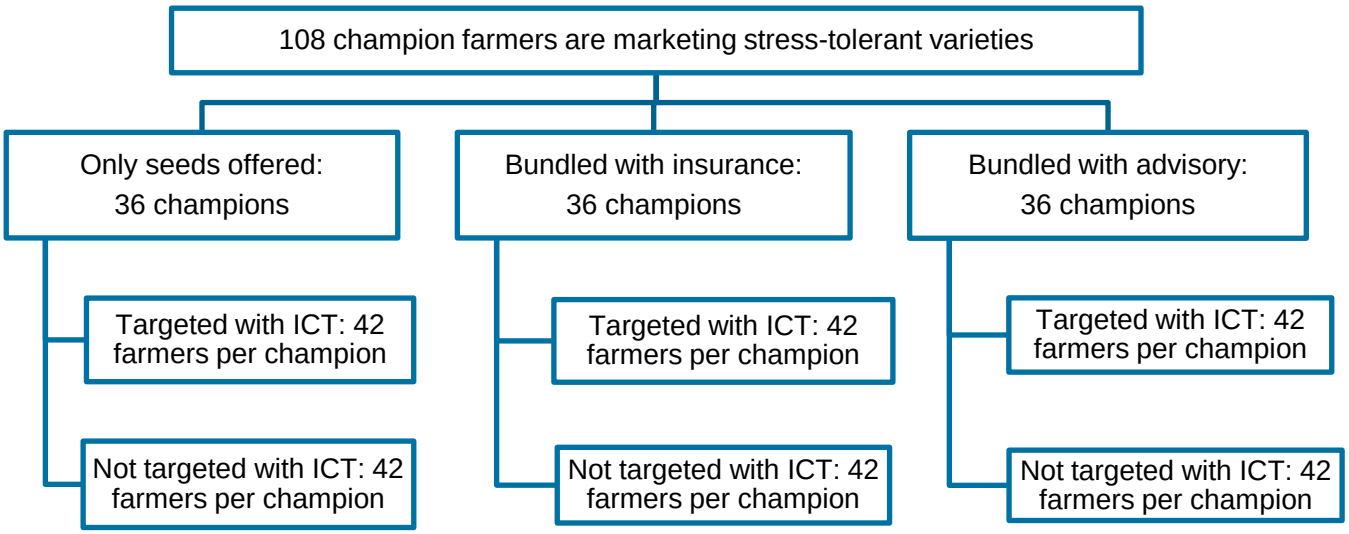

Figure 3: *Experimental design*

Findings at Baseline

Quantitative data

Each of the 85 champions listed all farming households in their villages to whom they could be selling improved, stress-tolerant seeds (on average, a champion listed about 160 households). Champions also recorded crops and varieties that a household was planning to cultivate in the coming seasons, along with crop-wise acreages under production (see Tables 1 – 3). These data were used to select the stress-tolerant varieties to be promoted through the trial packs.

IFPRI used these data as a sampling frame and randomly selected 42 farmers per champion to be targeted with interventions in the first season. Each champion provided these 42 farmers with a trial pack of their preferred variety, and enrolled them by taking an initial overview picture of the plot where the trial pack variety had been planted, and a second plot with a common variety (Figure 4).

Figure 4: *Training a champion farmer on how to register a plot by taking an initial picture*

Champions were instructed to take a repeat picture every week of this same plot, holding constant the view frame across all pictures of the same plot. All pictures were taken through the SeeItGrow app (see Figure 5), following similar procedures as those specified in Ceballos, Kramer and Robles (2019).

Table 1. Percentage of crop growers by county

	Embu	Tharaka Nithi	Meru	Total
Maize	94.4%	31.8%	82.6%	68.1%
Sorghum	18.4%	59.0%	11.3%	28.5%

Source: Analysis of data from the 2019 Listing Survey

Table 2. Maize Varieties grown in the short season

	Embu	Tharaka Nithi	Meru	Total
Duma 43	84.7%	75.9%	63.3%	71.0%
Sungura	4.3%	13.6%	4.2%	5.7%
Pioneer	2.3%	4.5%	10.7%	7.5%
De Kalb	1.4%	0.8%	6.6%	4.3%
Pannar	0.5%	0.5%	12.2%	7.2%
Local	2.5%	2.6%	0.4%	1.3%
Others	4.3%	2.1%	2.6%	3.0%
Total	100%	100%	100%	100%

Source: Analysis of data from the 2019 Listing Survey

Table 3. Sorghum Varieties grown in the short season

	Embu	Tharaka Nithi	Meru	Total
Sila	1.8%	15.9%	51.6%	20.9%
Advanta	1.0%	13.1%	3.7%	9.8%
Gadam	81.2%	69.5%	24.7%	62.5%
Seredo	10.6%	0.2%	0.3%	1.5%
Kari Mtama 1	3.0%	0.4%	16.8%	3.8%
Local	2.4%	0.9%	2.5%	1.4%
Others	0%	0.0%	0.4%	0.1%
Total	100%	100%	100%	100%

Source: Analysis of data from the 2019 Listing Survey

Qualitative data

In September and October 2019, KALRO scientists conducted key informant interviews in the three target counties through open-ended questionnaires that had been pre-tested in Machakos County. In total, the project interviewed 53 key informants in the maize and sorghum value chains, including not only champion farmers and agro-dealers but also various credit providers, traders, insurers, aggregators, seed merchants and extension officers (see Figure 6). This section provides a summary of the findings from these qualitative interviews.

First, all key informants emphasized the benefits of stress-tolerant varieties, particularly drought-tolerant seeds, since droughts have become more frequent and are a major stressor on farmers. Drought is felt along the value chain, affecting not only farmers but also agro-dealers, traders, credit providers, aggregators and seed merchants, since losses to agricultural production reduce farmers' liquidity to repay loans and purchase new seeds. Farmers also reported significant losses due to pests and diseases, but drought tolerance was a more salient trait among key informants.

Second, the common perception among key informants was that production shocks hurt women more than men, because agricultural income losses affect food security. Stakeholders did not use this insight, or broader insights around gender dynamics in agriculture, to engage more effectively with smallholder farmers. They recognized women's limited access to collateral, along

with its implications for access to credit, but did not proactively design high-quality products targeting women farmers without collateral. Stakeholders discussed gender mostly from a perspective of male- versus female-headed households, instead of treating farming as a family activity, and women in male-headed households having a large role in agricultural production and decision-making.

Third, key informants stressed the importance of commercial outlets for their crops, as having a buyer and a relatively stable price is a main concern for farmers. Stakeholders for instance expressed a preference for promoting drought-tolerant sorghum, not maize, because of East African Brewing's presence as a large buyer for sorghum. Interestingly, key informants indicated that men receive most income from selling sorghum, while the crop is grown by women. This is an important gender dimension that should be considered in the design of our interventions.

Fourth, PBI can play a major role in resolving disputes in claims settlement and misunderstanding around coverage (insurers covering a single or few perils, and farmers expecting everything to be covered). In addition, insurers pay little attention to gender, other than the notion that men and women are interested in insuring different commodities. They do not recognize, for instance, that if women carry the heaviest burden of risk, they might be an important audience even for male-grown crops.

Finally, smartphone access is still a real constraint. Informants reported that the youth use smartphones but not for farming. Involving champions is hence necessary when working with ICT.

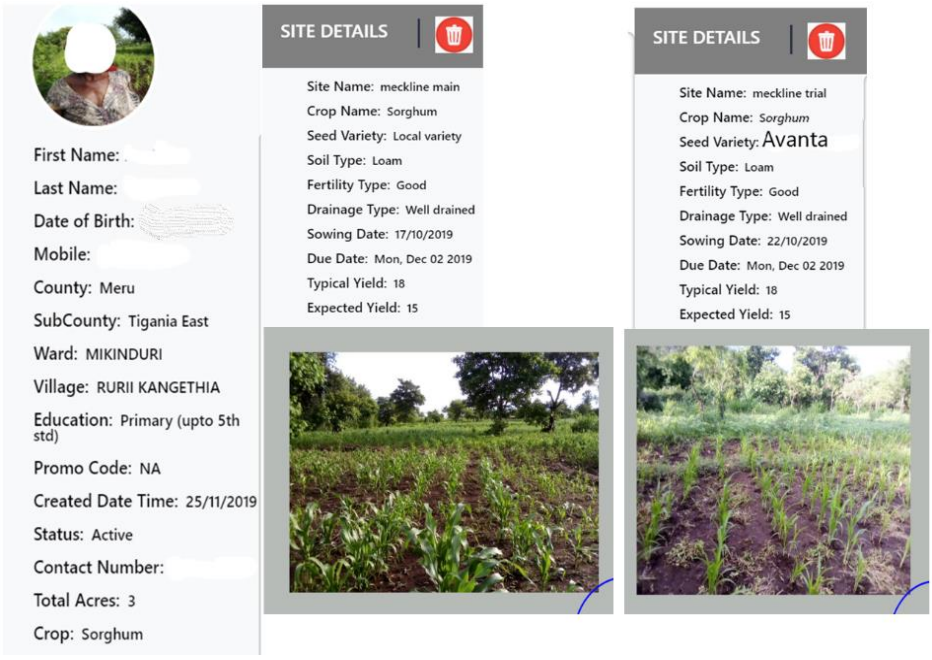

Figure 5: *Farmer registration and initial picture from SeeItGrow database*

Next steps

Champions are sending in crop images regularly, through the SeeItGrow portal, up until the harvesting phase for the short rain farming season. A follow-up survey will be administered to all participating farmers, to assess their demand for the new seeds, as well as farming decisions and outcomes. This will mark the completion of the short rain data collection cycle, which will be followed by a mirroring effort during the long rains, this time in more counties spread across Kenya, and building on lessons learned so far in order to inform and strengthen future design and implementation.

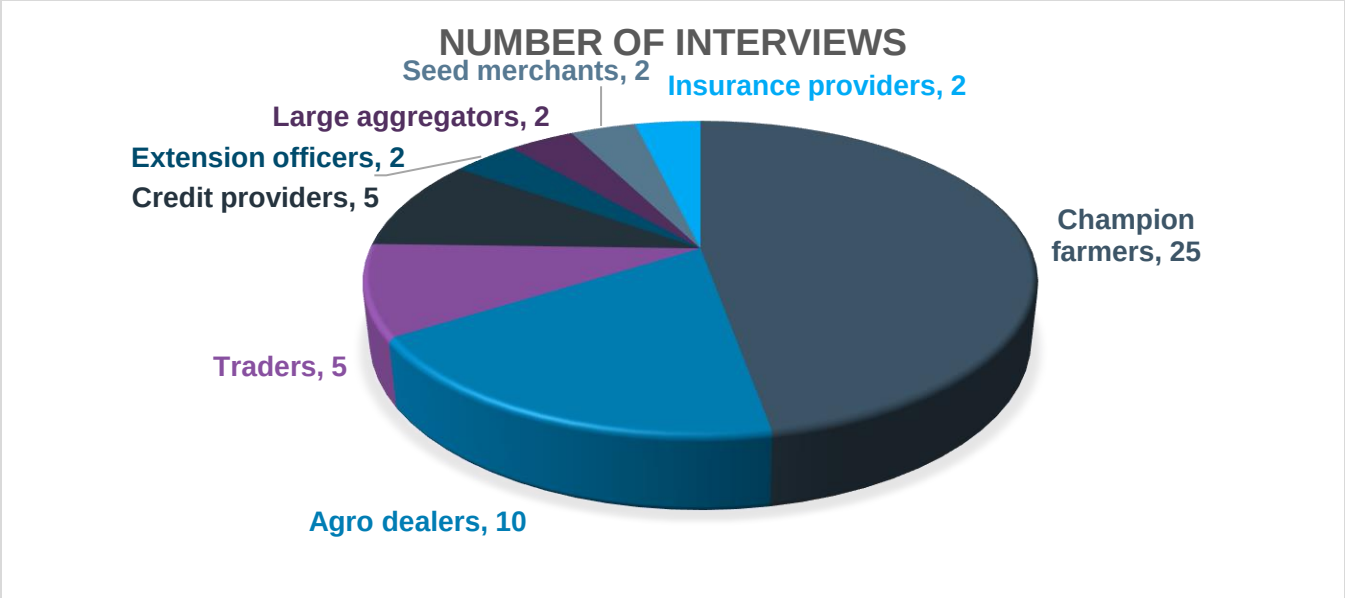

Figure 6: *Key informants interviewed prior to Short Rains 2019 in Embu, Meru and Tharaka Nithi*

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