2017–2018 YOUTH THINK TANK REPORT:

Building Inclusive Agricultural Technologies for Young People

JANUARY 2018

mastercard
foundation

Table of Contents

2017–2018 Youth Think Tank members from
Ghana, Kenya, Malawi, Rwanda, Tanzania,
Uganda, and Zambia.*

*This year's cohort was divided into two groups. Half of the members in this photograph conducted
research for the 2017–2018 Youth Think Tank Report. The other group will share their research on
the hospitality and tourism sector in the summer 2018 report.

Preface

In February 2017, Restless Development and the Mastercard Foundation introduced us to youth-led research methodology. Under this methodology, we as young people were empowered to take the lead at all stages of the research process, from question design to analysis to the conclusions we shared in this report. Most of us were new to the whole research process — and what better way for us to experience it than through a radical and youth-focused approach!

Young people are best placed to understand and clearly voice issues that their fellow youth are facing.

Our main goal as researchers was to investigate the barriers and opportunities around agricultural technologies ideation, promotion, and uptake by young people in Uganda, Kenya, Tanzania, Rwanda, Ghana, Malawi, and Zambia, where the research was undertaken.

We invite you to accompany us and the voices of the respondents included in this report by reading about their experiences, challenges, and successes. It was an exciting venture for us as young researchers to talk to amazing young men and women who are battling all odds to make their agribusinesses a success. It was also compelling to discover that young people across Africa are already solving the problems we saw them encountering in the agrifood system.

With this research paper, we hope to do two things: with our findings, we hope to inform government and development actors about the extent of the innovation and uptake of agricultural technologies; with our process, we hope to create awareness of the power of youth-informed policies and projects. The youth-led research that we conducted is a clear example of how you can effectively engage young people from start to finish on a project and attain remarkable results.

Young people are best placed to understand and clearly voice issues that their fellow youth are facing. We bring a unique perspective to the table because we can connect with the diverse experiences of our peers.

This report is a call to action for all stakeholders to change their concept of youth programming and to invest in approaches that involve young people throughout the process.

We would like to heartily thank all the youth researchers for their hard work and commitment in developing this report. We would also like to take this opportunity to convey our special thanks to the Restless Development team for the guidance and insights that they gave us on this research journey. Finally, we would like to acknowledge the Mastercard Foundation for its genuine interest and investment in Africa's young people. We thank you for walking with us through this amazing journey.

2017–2018 Mastercard Foundation Youth Think Tank

Executive Summary

POLICYMAKERS AND DEVELOPMENT practitioners have become increasingly enthusiastic about the ability of emerging technologies to unlock the potential for agriculture in Africa.

While these technologies are both creative and compelling, few sector experts have explored both sides of this promise: determining how well innovation is supported and how well technologies have reached communities. Our research contributes to closing this gap.

We have captured the experience of young people in the agrifood system — both those who innovate (innovators) and those they design solutions for (adopters). Instead of looking separately at these groups, our research sees innovators and adopters as part of a larger interconnected landscape, supported by those who contribute to building the enabling environments that help get technologies to communities (promoters).

Our research finds areas where the community of practice could do better to help improve collaboration.

1. Agricultural technologies should be tailored to optimize opportunities for young people — particularly rural young people — to maximize their on-farm activities and facilitate their entry into off-farm activities.
2. To ideate, young people need a resourced space where they can share ideas and access mentorship.
3. The dissemination of information through inappropriate channels, such as social media, is a barrier to the uptake of technologies at scale.
4. Young people have unaddressed gaps in the skills required to operate agricultural technologies.
5. Both adopters and innovators are constrained by inadequate accessible financial products to invest specifically in agricultural technologies — with respect to both ideation and uptake.

Unlike improving infrastructure or communications connectivity, the changes that young people like ourselves are calling for are more immediately solvable and actionable. We call on policymakers and practitioners, as a community of problem-solvers, to listen to what young people suggest and to adjust their support accordingly.

Technologies and support need to be prioritized based on what is most likely to be impactful. The rural young people we spoke to say some of their peers are constrained by the amount of land they can access for on-farm activities. Some respondents also state that young people are unaware of the off-farm opportunities in the agrifood system.

Innovators should prioritize developing on-farm technologies that maximize what can be produced from small tracts of land, such as vertical farming innovations. Innovators should also prioritize off-farm technologies that facilitate young people's awareness of farm activities and access to those opportunities.

Policymakers, practitioners, and those in the private sector need to do more to support young innovators. When young innovators described how they developed their technologies, the lack of access to information, resources, expertise, skill development, and tools for prototyping was prominent in their stories. Collaborative teamwork across a range of expertise also emerges as prominent in co-designing solutions. However, there are few innovation spaces that combine all the above and even fewer that are broadly accessible to all young people.

Those promoting agricultural technologies (promoters) need to build awareness of them through the channels that young people use most. Many promoters use social media, TV, and other high-tech communications channels to showcase technologies. But most of the young people we spoke with took up technologies when

FRANCIS OKO ARMAH, YOUTH THINK TANK MEMBER, INTERVIEWS IBRAHIM SULEMANA, INNOVATOR, ON SITE AT HIS PROJECT IN HAATSO, WHERE HE HAS BUILT A HANGING GARDEN TO INCREASE A FARMER'S YIELDS.

they heard about them directly through their local, informal social networks — through their friends, families, and those in their communities. They did so when they saw the applicability of technologies to their personal context through in-person demonstration. When promoters reach young people through information channels that are most meaningful to them, we believe they will be able to create awareness at scale.

It is not enough to build awareness. Promoters also need to ensure young people have the skills to effectively take up these technologies. Young respondents explained that offline technologies require basic mechanical operation and repair skills, and digital technologies require a knowledge of how to operate high-tech devices and use online resources. Rural young people — particularly young women — report that they do not have a way to develop these skills. Instead, it must be provided. Digital skills are of importance for preparing young people for the future of work. Instead of placing the responsibility of closing

the skill gap on adopters themselves, who might not be aware of what their skill gap is, promoters of technologies should provide training in all requisite skills.

Specific financial products for investment in agricultural technologies need to be developed. The reach of existing financial products is limited, and where available (e.g., microfinance), they are not tailored to the needs of young innovators and young adopters. Young innovators require financial products that accommodate the risk associated with innovation, acknowledging that failure is part of the design process. They need financial products for every part of the innovation process, from ideation to prototyping and piloting, to roll-out — not just when scaling up proven solutions through a vetted business plan. Young adopters need financing that reflects the cost of investment in agricultural technologies, and repayment periods that better reflect agricultural seasons. Governments and financial institutions need to examine how they provide financial

products and determine how they can be more creative in responding to these specific needs.

Our research has highlighted challenges and suggested pathways for addressing them. Our findings move beyond proposing single responses to specific problems; instead, they suggest a new way of working in this sector.

Innovators, promoters, and adopters need spaces where they can connect and share ideas. Some of the young people we spoke to have already solved the challenges highlighted in this report and outline ways in which others could follow. These strategies stop short of being transformational, though, when the community of practice is disconnected. Instead, young people — both innovators and adopters — need a more responsive and inclusive system with better and deeper collaborative links between all actors involved in agricultural technologies, from design right through to adoption.

Key Terminology

There are many words — often used interchangeably — to describe participants and activities within the agrifood system. For the purposes of this study, we have made a number of semantic choices. Below, we describe what we mean by each of the keywords that we have used.

Agrifood system is defined as the set of activities, processes, people, and institutions involved in supplying a population with food and agricultural products. The agrifood system encompasses the provision of farming inputs and services, crop and livestock production, marketing, processing, packaging, distribution, and retail, and the policy, regulatory, environmental, and economic conditions in which these activities take place.

The agrifood system comprises a range of activities. We make a distinction between two predominant categories of activities. We define **on-farm activities** as all activities that entail the growing of a crop or raising of livestock, from land preparation to all steps in cultivation to harvesting. We define **off-farm activities** as all those activities that take a product to the final consumer.

Within the range of off-farm activities, we draw another distinction between those that add value to and prepare a product for sale and those that sell and deliver a product to an end consumer. We use **value-addition** to describe the former, which entails any processing done to the crop

as well as packaging of the product for sale. We use **aggregation** to describe the latter, which entails bulking and transporting goods from the farmer to various markets and marketing goods to buyers, wholesalers, and consumers.

Agricultural technologies represent all innovations in the agrifood system — solving for on-farm and off-farm challenges, whether online or offline, physical assets or new ways of working.

When we talk about agricultural technologies, we mention two distinct categories of technologies. By **digital technologies**, we mean electronic innovations, such as mobile devices and online applications, that facilitate access to information, data, and people in the agrifood system. We use **offline technologies** as a catch-all term for any technology that is not electronic, ranging from drip irrigation systems to processing machines, improved seeds to greenhouse technologies.

When looking at the agrifood system through the lens of agricultural technologies, we identify

three broad categories of participants who conduct three core activities:

Innovators are those who either design and execute an innovation (its original creator) or who tweak an initial innovation to adjust it to a context and improve its operation (adapters). We describe the process of designing or adapting technologies as **ideation**.

Promoters endeavour to motivate others to use an innovation. This is a diverse group that may include innovators themselves, as well as those who have started using the innovations, NGOs, governments, and other groups who see potential benefit in using these technologies. We describe the exercise of broadening awareness of a technology and encouraging its use as **promotion**.

Adopters are those who have begun using an innovation, making no more than minimal changes to it in doing so. We describe the act of both accessing and beginning to use an innovation as **uptake**.

THE CONSTRUCTION OF A CLAY COOK STOVE THAT WILL ALLOW THE FARMER TO GROW AND SELL MUSHROOMS AT THE MARKET.

Research Methodology

We share the findings of our research as 14 members of the Mastercard Foundation Youth Think Tank. We come from and collected data in seven countries: Ghana, Kenya, Malawi, Rwanda, Tanzania, Uganda, and Zambia. We used Restless Development's youth-led research methodology to conduct this research, and directly led every stage of the research process.

Our findings reflect the lived realities of young people captured by young people.

RESEARCH FOCUS

With this report, we contribute to discussions on how to maximize the reach and utility of agricultural technologies for young people like ourselves.

Previous research has conducted scoping exercises to understand which problems innovators are developing solutions for and to capture the range and variety of agricultural technologies they have designed.[1] Other studies have endeavoured to identify which part of the agrifood system offers the most potential and deserves the most investment.[2] We do not seek to replicate either of those tasks.

Instead of identifying existing agricultural technologies, we examined how well available technologies have reached young people who

AN AERIAL VIEW OF ACCRA, GHANA.

are working in the agrifood system. And instead of analyzing which activities offer the most income potential, we acknowledge that young people are — and will continue to be — engaged in each part of the agrifood system regardless of potential income. We considered the agrifood system in this analysis, examining the experience of young people in various activities across the agrifood system.

We offer our unique perspective to an existing conversation. As young people capturing the voices of other young people, we can speak with nuance to the experience of young people working in the agrifood system and that of young innovators solving challenges in the sector. We prepared the most compelling questions that we could ask.

Through this research, we wanted to understand what drives innovation: what challenges have young innovators faced? How have they overcome these challenges, and what does that mean for building an enabling environment for innovation in agricultural technologies?

Because technologies are only as valuable as the way in which they are perceived by the people that they target, we also wanted to understand how young people have — and have not — taken up agricultural technologies: how well have available technologies reached those who need them? What technologies have young people seen, used, and found useful in their communities? What barriers have they faced in taking up technologies? How have they found ways around these barriers, and how can their solutions be used or adapted by innovators and promoters?

DESIGN, SAMPLING, AND DATA COLLECTION

Because of the nature of our research focus and questions, our study is predominantly qualitative. Qualitative data enables a deep understanding of young people's experience with agricultural technologies. While this data is not representative of all young people, the rich narrative detail we captured through this design provides an indicative, nuanced picture of young people's realities that are often lost in quantitative studies.

We supplemented this qualitative data with survey data. Unless specified, mention of "respondents" refers to qualitative respondents.

We collected data through focus group discussions and semi-structured interviews. For both, respondents were sampled, though according to different criteria aligned with what each method was seeking to achieve. Whereas key informant interviews focused predominantly on the experiences of young people who are innovating, adapting, and adopting agricultural technologies, in the focus group discussions, we looked beyond these individuals to cover general young people at several points in the value chain.

For our focus group discussions, we separately sampled young people engaged in sets of activities in the agrifood system: those engaged in on-farm activities, those in aggregation activities, and those in value-addition activities.

We used these focus group discussions to capture young people's perceptions of opportunities along different points in the agrifood system and to understand their general awareness of agricultural technologies. Where focus group participants were aware of available innovations, we probed to understand the enablers and barriers that young people face to taking them up. Convening separate discussions for those engaged in different activities allowed us to probe specifically around the technologies relevant to that stage.

Not all young people experience entry points into the agrifood system and in taking up agricultural technologies in the same way. We used focus groups to facilitate discussions across various perspectives to explore the perceptions of different groups of young people: younger (those aged 15–24) and older (aged 25–35); rural and urban; and young women and young men.

Because gender constraints can be difficult to discuss frankly among groups of mixed gender, we held separate focus groups with mixed gender respondents and with young women alone. We then compared responses given in the first, mixed focus group to those given by young women when they were speaking among themselves.

Through semi-structured interviews, we focused on understanding in-depth narratives of innovators (those who have designed or adapted technologies) and adopters (those who have begun using agricultural technologies).

For innovators, we prioritized learning about how they designed their technologies, what resources helped to build them, what challenges they faced in doing so, and what challenges they have seen young people face in taking up their technologies.

While the research includes a third group, promoters, the research design did not identify this group. The role of the promoter arose from both innovators and adopters commenting on a third role in the landscape — that of promoters.

For adopters, we prioritized learning about how they came across the innovation, what enabled them to take it up, what challenges they faced in doing so, and how they have — and have not — overcome them.

Table 1 summarizes the number of focus group discussions and key informant interviews we conducted.

TABLE 1.
QUALITATIVE RESPONDENTS

DATA TYPE	N
Focus group discussions	22
Interviews, innovators	24
Interviews, adopters	22

As the table shows, we strove for equal balance in the number of focus group discussions and key informant interviews we conducted with both innovators and adopters to ensure we equally prioritized all perspectives.

We captured our qualitative data electronically through a dual-step process. We recorded discussions and interviews in full and in local languages through an application on the tablets supplied to us. We then typed full transcripts of the recordings, translating them into English. We uploaded both the audio files and transcriptions to our electronic system.

To complement our qualitative analysis, we also collected quantitative survey data. Across all seven countries, we surveyed 215 respondents. Table 2 summarizes our survey respondents.

TABLE 2.
SURVEY RESPONDENTS

TOTAL	N = 215	
Rural vs. urban	129 (60%)	86 (40%)
Young people and adults (35+ years)	198 (92.1%)	17 (7.9%)
OF THE YOUNG PEOPLE	(N = 198)	
Young women and young men	86 (43.4%)	112 (56.6%)

As with the qualitative data, we strove to achieve balance along two primary demographic characteristics: capturing data equally from rural and urban young people and from young men and young women. While largely balanced, we captured data from slightly more rural young people than urban young people, and slightly more young men than young women. We also surveyed a few adults (those over 35) to triangulate their perspectives with those of young people.

ANALYSIS

We took a deductive approach to the analysis of the qualitative data, where we drew out general themes emerging from the data that we later condensed into specific findings.

We coded, transcribed, and reviewed data according to pre-specified key codes of interest drawn from our primary and secondary research questions. We then analyzed the coded data to find emerging patterns that could be developed into themes. We then re-verified themes against our dataset to ensure they were data-driven — that every emerging theme had a strong basis in our primary data. Finally, we mapped evidence-based themes against one other, drawing connections between them, and then described them in detail. This last step became the basis of our report.

VALIDATION

Because we are invested in being data-driven, we also found that it was important to take our findings back to the communities with which we worked through exercises to validate the data. By presenting the initial findings to them, we ensured that they felt this report accurately reflected their perspectives and experiences, adjusting anything that did not.

This process also allowed respondents to understand what is done with the information that they share. At this touchpoint, respondents had the opportunity to add any further clarifications. We found the feedback from these exercises to be critical input that further informed the report.

For more information on the methodology used in this research, please visit: *restlessdevelopment.org/our-youth-led-research-methodology*

Some innovators are intentionally designing technologies that respond to the land access issues that they have seen young people in on-farm activities facing.

Findings

1. Agricultural technologies should be tailored to optimize opportunities for young people — particularly rural young people — to maximize their on-farm activities, and facilitate their entry into off-farm activities.

Young people experience challenges in securing land because of the hereditary allocation of land and their role as dependents in their households.

The young people that we spoke with highlighted the challenges they face in increasing the scale of their on-farm activities and improving the income that they derive from them. They reflected on other young people facing related barriers.

An emerging theme in young people's reflections was the challenge of securing land.[3] One Kenyan onion farmer explained: "[The] accessibility of land is a problem for young people because most of the land belongs to your parents, who usually hesitate in giving you a portion of it."

This respondent is not alone. Twenty-seven percent of adopters and 21 percent of innovators that we interviewed mentioned limited land access as a key challenge to young people deriving a meaningful income from on-farm activities.

These respondents reported that often land is not acquired by purchase, but through a hereditary, communal system, whereby they can only access a segment of family land for their own activities and only with parental approval.

In the absence of accessible family land, one respondent mentioned that young people have begun "obtaining leased land where they can practise their farming without so much interruption from their parents." While leasing is an option for some, it is not an option accessible to all young people. It is only available to young people with access to capital.

Respondents reminded us that young people are not a homogeneous group and do not experience land constraints equally. One respondent told us that because those at the younger end of the age range often still live with their parents and relatives, they are dependents and cannot access land independently. Instead, most 25 to 35-year-olds "have leased lands or have taken over ancestral lands," and thus have more land for their on-farm activities.

One respondent clarified that in his experience, young people are often able to secure land through their parents or by leasing. As he described, the problem is not whether young

people have land or not, but rather in the limited acreage that they can access. This has implications for whether young people can derive a meaningful income from the land available.

The role of technology in this context, then, is in "maximizing small land," as expressed by a Rwandan respondent.

Against land constraints, agricultural technologies should focus on improving land productivity. Some innovators are doing exactly that.

A YOUNG WOMAN IN A FARMING COMMUNITY IN RWANDA.

One innovator, who designed an inexpensive greenhouse, explained that the structure "saves up on the little land space [young people] have." For the same quantity of produce, an adopter "does not need to have huge tracts of land." This innovator also mentioned that the controlled environment that greenhouse cultivation provides also improves the quality of the produce, increasing its marketability. Not only does this technology address young people's land constraints, it does so intentionally.

A Kenyan innovator described a similar intentional design, developing a vertical garden system. Originally designed for space-constrained urban areas, this technology has an application for rural young people who struggle to find cultivation space of their own. This respondent also said that the sophisticated and innovative system serves to attract young people to cultivation by rebranding it as "modern and cool."

Both technologies address multiple barriers simultaneously: the greenhouse technology seeks to increase the quality of farm produce so that it can be sold in more sophisticated markets, while the vertical gardening technology flips the assumptions that typically inform young people's negative perceptions of on-farm activities. Both technologies do so while intentionally addressing land constraints. This should be a goal for more technologies in development.

Young people said that other young people are not aware of the opportunities in off-farm activities.

Where rural young people find value-adding and aggregation opportunities, they often look more favourably on them than on production. A Kenyan respondent described young people's perception of on-farm activities as "being too dirty or for failures in life."

Conversely, the young people we spoke to do not express a similar negative perception of off-farm activities. Respondents described off-farm activities — value-addition and aggregation — as desirable because they perceive them as offering higher income opportunities.

One respondent observed that since packaging and processing activities "add value to a product, its price increase[s]." Many respondents shared the perception that increasing the value of the good increases their profit and their income.

Respondents perceive aggregation as desirable because such activities "do not require much start-up capital and resources," if starting at a small scale. A Malawian respondent explained that young people reach a break-even point more quickly in aggregation, thereby increasing their income.

While respondents mentioned that there is high employment and income potential in off-farm activities, they stress that the average rural young person is not aware of these opportunities. As a Ugandan focus group respondent outlined, this is largely because "young people are not sensitized. Technical support to sensitize them is not there. Those to support them to grow in the sector are not there."

Information on sector opportunities might be broadly available, but it does not penetrate to the community level. A Rwandan respondent expressed that rural young people "are not aware of most of the opportunities, as information stops in towns." Beyond sensitization, without visible, local examples of young people engaging in off-farm activities, young people are often not aware that these options exist.

It is not only that young people are unaware of the potential of the off-farm sector broadly, but they also lack an awareness of the range and variety of possible activities that the off-farm sector encompasses for both value-addition and aggregation.

One Kenyan respondent explained that most young people "think of just one activity in this sector: selling to the final consumer." In contrast,

he described aggregation as a set of linked activities from the farmer to the consumer — a complex system with many potential entry points and thus opportunities.

Respondents explained that other young people also have limited understanding of the opportunities in value-addition. A Malawian respondent said that while there are opportunities for young people at several stages of processing produce, "all [young people] know is cultivation and marketing."

There are isolated examples of innovators designing technologies to create off-farm roles for young people; more could be done in this space.

There are many technologies for off-farm activities that improve specific aspects of preparing agricultural produce for and connecting it to the market. In most cases, however, these technologies stop short of either enabling new opportunities for young people in off-farm activities or connecting these individual off-farm activities to the broader agrifood system.

Because young people are not aware of distinct activities within the off-farm sector, technologies that make it easier for young people to take up off-farm activities would be most helpful.

Some have started innovating such technologies. In Kenya, an app called 2KUZE connects farmers to buyers through the role of an agent responsible for all the interim steps. In doing so, the app has not only improved the connection between producers and the market — it has also created a new income opportunity for young people that would not have otherwise been as clearly defined. More technologies should follow suit, demystifying and building out roles for young people.

There are isolated examples of innovators designing technologies to create off-farm roles for young people; more could be done in this space.

While young women face more barriers to engaging in on-farm activities than young men, they have a unique opportunity in off-farm activities due to both the societal acceptance and the local relevance of their role in marketing farm produce.

Respondents across all contexts mentioned that young women face additional gender barriers to accessing land due to culturally constructed roles relating to women, family, and the household.

As one Kenyan respondent described: "It is quite easier for males to have land than females. As we know, most females are expected to get married and move to the man's household, and

hence men are favoured as they are said to remain at home." Respondents in Zambia, Kenya, and Uganda all mentioned that since men are considered the heads of their households, they often retain decision-making over land.

Young women can also find it difficult to access land for on-farm activities where these activities are deemed outside of what is considered appropriate for women. One respondent said that this depends on local cultural norms in that "some tribes allow for women to take part in the cultivation and harvesting stage, and others view it as a taboo for women to interact with the farm."

Conversely, though, respondents suggested that young women have a unique opportunity at another point in the agrifood system — marketing.

A young Kenyan woman explained: "My neighbour is a man who sells watermelons, then Esther here sells tomatoes. I sell cereals, and over there is a friend of mine who sells paw paws. There is not a job that has been designated as male and female, especially here in the market. It all depends on your creativity and aggressiveness in terms of

running your business." The market in particular — whether physical or virtual — is a space where soft skills matter more than gendered roles.

Across all contexts, respondents mentioned that marketing activities are predominantly done by women within the community.

In part, this is because marketing is considered women's work, as a Ugandan respondent described. A Kenyan respondent explained further: "Boys are oriented to do farming at an early stage, while girls are left to do the selling, as this is deemed not taxing." While cultural perceptions constrain opportunities for young women, particularly relating to the manual labour involved in on-farm activities, they also offer them opportunities in activities perceived to involve less exertion, like marketing.

This places young women in a good position to maximize opportunities in this field. One Malawian respondent explained, however, that young women struggle to reach a higher scale because "young men are exposed to advanced knowledge. Hence, it's easy [for them] to sell the products using other sophisticated channels than with community selling by young women."

In other words, young women often face limitations in expanding the scale of their enterprises because they are unsure of the pathway to accessing markets beyond the local level.

Innovators and promoters seeking to specifically target young women should prioritize existing and under-utilized opportunities such as marketing agricultural products.

2. To ideate, young people need a space where they can access resources and mentorship, and share ideas.

To support widespread dissemination of agrifood solutions, it is important to ensure that innovators have the space to design appropriate technologies. Innovators we spoke with largely described generating individualized solutions as opposed to collective ones. Creating opportunities where innovation teams can interact could facilitate collaboration to comprehensively address challenges in the agrifood system.

Respondents' reflections of the processes they use to develop agricultural technologies provide insight into which supportive structures are needed by innovators. To design solutions, innovators require spaces[4] dedicated to the sharing of information, knowledge, and expertise. Almost every innovator initiated ideation with a period of "deep research," as one innovator puts it.

Innovators we spoke with described this as desk research using a combination of information channels. They mentioned using online resources — publications, reports, academic journals, YouTube instructional videos, etc. They also mentioned supplementing what they gathered from these resources with print publications and field observations. Online and offline resources were not used equally. Some innovators exclusively used online resources, while no one spoke of exclusively using offline resources.

Opening space for innovation must include broadening access to online resources.

It is not enough, however, to ensure that young people have access to general information. As one innovator stressed, it is important to get "the right information." Another innovator from Tanzania said that it is necessary to get "relevant information and knowledge. [...] Then you will be in charge of everything."

As these innovators explained, not every resource is applicable to every context. To help young innovators determine what is relevant, these spaces would optimally provide access to both expertise and information.

Not everyone with an idea has all the skills to actualize that idea. Innovators mentioned many ways of tapping the technical expertise of others.

Sometimes innovators described consulting external expertise. One Tanzanian innovator of a tool to produce export-quality, ridge-less onions consulted with other skilled experts to operationalize the idea: "We consulted carpenters and other people with the skills to create the device [...] and they created them for [the team]." Similarly, an irrigation innovator mentioned needing to contract plumbing experts to help him set up the prototype pipes.

Sometimes innovators move from consulting external expertise to bringing them onto the innovation team to co-create the solution. One Kenyan innovator of a digital soil testing system recounted bringing experts together to form the team: "I needed a team to build a business with, as I needed some expertise in marketing and in agronomy. I was dealing with farmers who were more comfortable with someone who understood their needs. And that is how I brought on board my co-founder."

Other innovators also indicated that they consulted expert perspectives to better understand the dimensions of a problem. For example, a Ugandan soil-testing innovator brought together a collaborative problem-solving team with diverse technical expertise: "I got together with soil scientists, agricultural technicians, agribusiness specialists, business developers, and IT experts: all graduates. We brainstormed about the challenges our community faces and realized that the information gap affects the crop choices a farmer has when growing crops."

While some innovators described bringing together teams in different ways, all innovators appreciated the value of teamwork as a critical component to developing their technologies.

To design solutions, innovators require spaces dedicated to the sharing of information, knowledge, and expertise.

Innovation team members list contributions such as sharing expertise, collaborative brainstorming, and mobilizing financial resources. One respondent explained the importance of teamwork in its ability to help them "overcome so many [more] challenges together than if [we] tried solving them on [our] own."

Teamwork appears to be an underutilized opportunity. Only 29 percent of innovators we spoke to mentioned designing their technologies in teams.

Spaces to share information, knowledge, and expertise should be intentionally designed to encourage co-creation.

There are some existing spaces that foster innovation, but these spaces are not sufficient, in part because they are not accessible to most young people.

All innovators mentioned the importance of accessing information and expertise. When describing how they develop their technologies, however, only a few innovators mentioned spaces where they can access information and expertise at once.

A YOUNG MAN ENTERS A CAMPUS IN ACCRA.

Two innovators pointed to formal higher education institutions as a pathway to access the resources needed to translate their ideas into reality. As one Kenyan innovator expressed: "I tested and piloted [the technology] as my final year project. So, I had the school's materials and expertise [at] my disposal." By incorporating the technology design into his coursework obligations, the innovator was able to leverage institutional resources.

A Rwandan innovator described a similar experience: "We have the necessary materials at school to make machine and device prototypes. So, I had to plan on how to better make use of them so that my idea could come to life." In addition to information and expertise, both innovators mentioned the importance of having access to tools for prototyping through their educational institutions.

Young people face constraints, however, in accessing the resources within educational institutions. One young Ugandan innovator said that there are machines available at his institution, but those interested in value-add activities cannot access them unless they are students of a particular department. That there are restrictions on students within these institutions suggests that constraints are even larger on those who are not students at all.

Formal higher education environments are one example of a resourced space for innovation, but they are not necessarily the best option for many young people given the constraints in accessing them. Yet, alternative innovation spaces are not widely available, according to the experience of innovators. They only mentioned three other such resourced spaces — two in Uganda and one in Tanzania. These examples could act as blueprints for how governments can build incubation centres in other countries.

Innovators need to be better connected to resources for designing and developing technologies. Awareness and information about existing innovation centres should be enhanced, and more investment should be directed to developing comprehensively-resourced innovation centres.

To ensure that technologies are needs-responsive, innovators should broaden their co-design process to include the very people that their solutions hope to assist.

While innovators in teams discussed the importance of sharing perspectives and expertise, the innovators we spoke to largely left out those of a crucial group — the end-users. Only four out of 24 innovators mentioned involving end-users in designing and adapting technologies.

Innovators largely expressed that the inspiration for their technologies came from the "identification" of a problem or a need that they had witnessed or experienced personally. One innovator spoke of designing on-farm solutions based on the challenges he had faced in cultivating alongside his family as a child, while a Ghanaian innovator described a more intentional process of building knowledge "by surveying the areas that might require the service."

While both processes do reflect needs-oriented design, they do so from a personal understanding of needs, not one that has been triangulated with the perspective of the intended end-user.

Other innovators, meanwhile, have used processes that bring these perspectives into the design stage. The innovator of a vertical garden structure explained: "We also use feedback we receive from our clients to change the structure [and adapt the technology's design] [...] and this is the most relevant of all." While this process helps to make improvements, the process could have been more participatory if end-users were brought in earlier.

Both an irrigation innovator in Tanzania and a greenhouse innovator in Kenya mentioned visiting farmers to understand what barriers they faced prior to ideating a solution. Neither innovator had irrigation or greenhouse technologies in mind before consulting farmers; both innovations are responses to witnessed gaps. This is an example of designing with a well-informed, needs-oriented approach.

One respondent in Zambia described developing a consultation website based on a farmer-led needs-identification process. He used a WhatsApp group of farmers across Zambia as a platform to administer a survey to identify which challenges farmers face and how best to address them. We believe that such a participatory process improves the relevance of the solution and creates end-user buy-in, which in turn facilitates uptake.

Instead of designing agricultural innovations in a high-tech, high-skilled vacuum, more can be done to encourage engagement of the target audience at the design stage.[5]

3. The dissemination of information through inappropriate channels is a barrier to the uptake of technologies at scale.

The concept of "if you build it, they will come" does not appear to apply to agricultural technologies. Across all countries, respondents report that one of the most prominent barriers to uptake is a lack of awareness by the target audience of available technologies. Without awareness, there can be no uptake.

Our data revealed that much of this awareness gap is attributable to a mismatch between the channels that promoters are using to highlight innovations and the channels that adopters report are most effective at informing their uptake.

We believe that it comes down to a question of scale: which channels can promoters of technologies use to most effectively reach young people with information on available technologies? Identifying and leveraging the most appropriate information channel is the answer to unlocking scale in uptake.

There are limitations to the reach of high-tech and social media information channels, although innovators often mentioned favouring them.

This disconnect in information channels used for promotion versus access is particularly significant for rural young people.

Forty-two percent of innovators reported using social media to promote their technologies. They mentioned using predominantly Facebook, Twitter, YouTube, and to a lesser extent WhatsApp.

These results do not match responses from young people in rural areas when asked which channels they use to access information (Figure 1). One adopter associates these communications channels with "big, commercial, and rich youth" — not the main profile of the young people that agricultural technologies predominantly target.

When we surveyed rural young people and asked how they learn about agricultural technologies, not one responded that they learn about them through social media.

Operating under the assumption that these channels are another means of reaching a large audience quickly, two young innovators mentioned using television and one mentioned using radio as their primary means of promoting their technologies.

Yet, as one young Ugandan respondent explained, "TVs are not good for farmers because there is no power, and there are lots of expenses [that limit their ownership and use]." This adopter suggests that access constraints preclude the utility of using television to reach young farmers.

Another Ugandan respondent mentioned, "TVs are present in the community, but they

are for watching Manchester and other entertainments." TVs are not a prominent platform for accessing information.

Adopters in Zambia shared that radio is more accessible because information is broadcast in the local language. However, no adopters in any other country mentioned the use of radio.

Instead, other respondents see similar access issues with both TV and radio. As a respondent in Ghana expressed: "Most farmers cannot use radio and TV to connect. They can only use the technologies if they come across one." This respondent said that the pathway to uptake is through seeing technologies in person in a local context, not through hearing about them on TV and radio.

This is not to say that adopters never mentioned receiving information on agricultural technologies through TV and radio; rather, it is that no adopters mentioned TV and radio as the ultimate influence on their uptake.

For a specific subset of young people — who are particularly enterprising and minimally risk-averse — promotion of technologies through TV and radio might be an appropriate strategy. Adopters' responses suggest that promotion through these channels exclusively, however, is not the most meaningful way to reach most rural young people.

Rural young people explained that localized means of information-sharing — leveraging social networks and in-person demos — are more meaningful.

FIGURE 1.
SURVEY RESPONDENTS' PERCEPTION OF THE MOST PROMINENT INFORMATION CHANNEL BY WHICH YOUNG PEOPLE LEARN ABOUT TECHNOLOGIES.

FAMILY	PEERS	RADIO/TV/NEWSPAPERS	NGO/GOVERNMENT
80%	15%	5%	3%

TEACHING THROUGH DEMONSTRATION, KENYA
Moses Mbusi Owuor, 33, described promoting his produce-drying technology, powered by renewable energy, through demos he and his team organized for the community.

He explained the large scope of uptake he can achieve through this promotion approach. "After exposing them to the technology and to its benefits, we have been able to engage a majority of farmers in Makueni County [...]." Beyond the outreach, he also presented a powerful story of how this promotion approach is uniquely able to encourage young women's uptake despite their initially negative perceptions: "One of the stories that really touched me in this journey that I am on is the fact that in the factory in Wote where we usually do the drying of vegetables and fruits, the plant is usually operated by a group of women that we trained and empowered. [...] When we first started our demonstration sessions, these women were hesitant about the whole technology. [The] majority of them were fearful of the technology, as most were illiterate and conservative in their thinking. But in a span of a few months, they had adapted well enough to operate the machines and also to organize the rest of the community to take up the technology." Teaching this group of women through demos and coaching countered their negative perceptions about using the technology, ultimately leading to its uptake.

Survey respondents overwhelmingly mentioned that social networks are the most prominent means by which young people learn about available technologies, as Figure 1 summarizes.

Young people find the people that they know — their family and friends — to be the most important point of information on technologies. Interestingly, no respondents mentioned social media for receiving information on available technologies.

In interviews, young adopters across all contexts stressed the significance of word-of-mouth and in-person connections in adopting agricultural technologies.

Each adopter described this in different terms, such as "listening to advice from friends" or describing the usefulness of "oral conversations." Regardless of the words they use, most adopters point to the value of informal social networks to help them evaluate the local relevance of technologies — even those that they might have heard of elsewhere.

One Tanzanian respondent recalled adopting a value adding drying technology as follows: "I see people using this innovation, one in Moshi and another in Kibaha. The one in Moshi is the sister of my friend and the one in Kibaha is an old woman we just met." While the respondent mentioned originally hearing about the technology being used in China via social media, it was through meeting other adopters in person in his social network that he understood the innovation's contextual relevance to his life.

This individual example is illustrative of a common pattern among adopters. Adopters do not describe being influenced by a single information channel, but rather by some combination of multiple channels of different levels — yet all culminate in an experience involving hearing about and seeing technologies directly.

Seeing another young person like themselves using a technology is motivational because it is relatable. As a Ugandan respondent engaged in value-addition described: "I borrowed the

experience from one of my friends, who is a food processor. This also inspired me, and it also inspires other young people."

This has also informed the way that those who have adopted a technology consequently promote it to other young people. One Tanzanian youth, who has taken up drying technology, replicates the way in which he became aware of the innovation's benefit by encouraging others' uptake. "I try to teach and guide those young people who were interested in this innovation. Honestly, I have never done these kind of promotions [referring to large-scale promotions using high-tech information channels]."

Social networks are useful in building awareness of the applicability of technologies to a particular context. Without being shown the steps in how to adopt and begin to operate a given technology, however, young people often do not know enough to adopt it.

BUILDING TECHNOLOGY AWARENESS THROUGH MULTIPLE INFORMATION CHANNELS, TANZANIA
William David, 27, described the information channels that led to his uptake of mushroom house technology.

He described coming across mushroom farming technologies through multiple information channels — starting with YouTube, where he watched how it is done in China. Later, he saw mushroom farming on TV, where a woman doing mushroom farming was being interviewed in Tanzania. But he did not see the full potential of taking up mushroom growing technologies. His perspective changed when the message came more directly from someone in his social network. He described the moment the idea piqued his interest: "My friend came with the same idea of mushroom farming. He had already found people to teach us. This time I was very interested [...] and that's how I first became involved with the whole idea of mushroom farming." Together, he and this friend acquired the knowledge they needed to set up the mushroom house through the training they received. His uptake was informed by learning about the technology through multiple information channels. However, his increased interest in the product coincided with understanding its applicability to his local context. He finally became engaged through the encouragement of his peer, who also offered practical information — not just the potential of mushroom farming, but also the details regarding where they could both learn how to do it.

One young Ugandan respondent spoke about this knowledge gap aptly: "A young man sees a cotton and seed [processing] machine but doesn't know what it is called because he saw it once, and [he] doesn't know how to use it or how it works." Without demonstrating how a given agricultural technology operates, there is still an unaddressed gap in a young person's awareness of how to access and use it.

Within the government structure, demonstration of agricultural technologies would fall naturally under the remit of extension services. Yet extension services do not always reach those who need them. A Kenyan innovator explained that young people engaged in agribusiness "do not know how to access extension officers who might help them acquire the relevant knowledge [...], there are 5,000 extension officers in the country, and they rarely penetrate into the rural areas."

In the absence of extension services in communities, a young respondent in Uganda recommends that civil society organizations should take service delivery of agricultural technologies to the local, grassroots level.

In the meantime, some innovators and promoters are filling this gap by conducting demonstrations themselves. Two innovators mentioned demonstrating technologies to young people directly through experiential sessions. One described only doing so opportunistically, when young people come to them soliciting advice. However, another described a more intentional process of trying to identify young people to train in a given technology.

Those promoting technologies intentionally seek to leverage existing networks. They often focus on either coaching those they already work with in how to use the technology, or work through established structures and groups, such as agricultural exhibitions, community youth groups, and farmer groups. The four innovators mentioned above leverage existing social gatherings to promote their technologies.

While in-person communication and demonstration are critical to awareness, there is a limit to which a single innovator can promote their technology. Reaching young people at scale then requires mobilizing more promoters or demonstrators. One Tanzanian respondent has done so by training young farmers to act as technology ambassadors, training these ambassadors through a training-of-trainers model that greatly expands their reach.

These experiences suggest that the most effective means of reaching young people with promising agricultural innovations could be in formalizing and expanding structures of in-person promotion.

Even when using localized information channels, attention should be given to targeting young women through approaches tailored to their specific context.

Social dynamics play a role in how information on agricultural innovation is disseminated through a community. One young respondent in Tanzania indicated that one of the main challenges for women in accessing and taking up technologies is "poor support from society and even communities." Promotion within communities needs to align with how the community operates. Without emphasis on developing community-based support for women's uptake of technology, reach is limited.

Respondents described targeting young women through promotional approaches tailored to their specific context. Multiple adopters of agrifood processing technologies in Zambia mentioned the importance of promoting them through women's farmer groups and women's cooperatives. They described adapting to young women's specific context by targeting them where they already gather for their agribusinesses.

A promoter in Malawi said that leveraging existing roles is not enough. Instead, this innovator works to create new roles for young women as well. This innovator reaches young women through farm organizations, then goes one step further by connecting them with other women for training and demonstrations in technologies. In doing so, the respondent identifies that there is a need to "support them [young women] to take up more leadership positions [in these fora]."

Supporting young women's uptake of agricultural technologies depends not just on localizing information and mobilizing social networks. Young women who take up technologies should be supported to encourage others. Innovators in Zambia, Ghana, and Kenya have done so by creating workshops and events where young women who have taken up technologies shared their "success stories" and demonstrated how to use them.

More attempts should be made to have young, female technology adopters lead by example. A Kenyan innovator, for example, brings in women from outside the community who have successfully adopted technologies to promote them. Because adopters stress the importance of localized information, however, there could be more value in supporting young female adopters from within a community. While the external role models act as an aspirational example, young women adopters from within the community could be more persuasive in relation to local relevance.

Mambepa Nakazwe, a 22-year-old Youth Think Tank member from Zambia.

4. Young people have unaddressed gaps in the requisite skills to operate agricultural technologies.

While young people are aware of available, relevant technologies, they are not necessarily immediately able to apply them. Most technologies require certain skills to operate them effectively. From our findings, 59 percent of adopters interviewed mentioned technical and soft skills as critical to their uptake.

Yet respondents generally — including both innovators and adopters — mentioned end-users' skill gaps as a barrier to uptake. An innovator in Malawi mentioned that, together with the lack of an enabling environment, end-users have a "lack of expertise" that impedes their ability to adopt technologies.

Low functional literacy and numeracy skills among rural young people impede their ability to adopt both digital and offline technologies.

Different technologies require different sets of skills to operate them effectively. However, functional literacy and numeracy skills emerge as a crosscutting enabler for all technologies — though in different ways for digital and offline technologies.

Mobile apps rely on and assume literacy, almost exclusively. Ugandan respondents in a focus group said that to operate technologies by mobile phone, young people need to have knowledge of the phone, but also "need to be able to read and write." Even more accessible technologies that use SMS platforms require literacy, often in a language other than the user's first language.

Respondents also said that while literacy is not generally a necessity to using offline technologies, it is often an enabling factor.

One Ghanaian respondent described how reading about technologies eased their usage: "Because we are able to read and understand how technologies work, we can easily adopt. For example, we are able to read and understand the composition of chemicals to use during cocoa rehabilitation and the side effects of the various chemicals." In the absence of training and other in-person sources of information, written resources facilitate their use of the innovation.

Beyond functional literacy, respondents described that rural young people often have prohibitive gaps in their numeracy. This is particularly limiting for those that are interested in expanding or deepening their connection with markets. Connective technology that links farmers with markets requires functional literacy as well as numeracy skills, as one Ghanaian respondent explained.

Despite reported gaps in these skills, no respondents mentioned innovators or promoters addressing literacy constraints. To reach uptake at scale, innovators need to work within the literacy constraints of rural young people, instead of working solely with those young people who have higher levels of literacy.

A YOUTH THINK TANK MEMBER USES A MOBILE PHONE TO CONDUCT RESEARCH.

Lack of familiarity with technology and knowledge of how to operate high-tech devices constrains the capacity of young people to use mobile and digital technologies.

When assessing barriers to digital technologies, promoters often look at barriers to access, predominantly cost and infrastructure. While these barriers do constrain young people's ability to acquire and use mobile devices, there is another barrier that often remains unseen — that of the skills needed to operate the devices.

Some innovators neglect to consider these gaps because they assume all young people are like themselves. One Kenyan innovator of a mobile app mentioned: "Millennials are tech-savvy. They are connected to each other through technology, and this has become a natural way of life for them. This background in technology enables them to easily comprehend how my innovation works."

His response highlights the fact that digital solutions require proficiency and experience with the technology for uptake. One Ugandan respondent said that in order to access digital technologies, an adopter must "have knowledge of the phone or technology."

Respondents stressed, however, that not all young people have this familiarity. A Ghanaian respondent explained the gap: "Most young people do not know how to manipulate digital devices, and most of the market stakeholders in our area do not know about such systems. We do not know how to navigate those websites. Only a few farmers have [a] phone that can access the internet." Even where young people have been able to access mobile devices, they are not necessarily proficient enough to use the devices to their potential.

Young people need to possess digital literacy to take up mobile, digital technologies. They need to know how to use the devices they have access to and how to access and use both the internet and apps. Another respondent asserts: "Young people are aware of connecting technologies such as mobile applications, Google traders, and Tonaton.com, but do not use those technologies [...] due to illiteracy in digital technology." Even if young people are aware of technologies and have the appropriate devices to use them, unaddressed digital literacy gaps still prohibit them from taking up these solutions.

Many digital technologies are connective technologies, designed to remotely link users to information and to one another. These technologies often require a certain number of users to work well.

A Ghanaian adopter of a mobile marketing app described the challenge: "The only digital agriculture technologies we [are] using is the use of mobile phones to call already known customers. We do not necessarily use digital software because they may not be understood by our target market." Beyond individually being able to take up the technology, the digital literacy gap of others hinders getting the critical mass to find the technology useful.

To use offline technology most effectively, young people need both an understanding of how it operates and wraparound skills in maintenance and repairs.

While the assumption may be that offline technologies are easier to use, adopters still need to know how to apply them. One Tanzanian respondent using an irrigation technology expressed difficulty in using the pump because of limited machine skills. Understanding how to work with and operate machinery is a skillset that must be taught, not assumed.

This respondent is not unique. Instead, this is demonstrated by other responses that mentioned capacity-building in technical skills, particularly the operation of specific machinery, as imperative to taking up an innovation. Adopters — from those using innovative irrigation systems to those utilizing value-adding processing machines — say that acquiring the technical skills to operate the technology is an instrumental step in their uptake.

Despite the necessity of these skills, respondents lament that it is often young people themselves who are left to work their way around this skill gap. As one Tanzanian respondent reported, adopters "overcome this challenge by looking for experts to help them or other people who are using this kind of technology." However, without a structured network of skills support, the responsibility to acquire the skills to operate an innovation falls on the adopter.

Training how to operate a technology demystifies its complexity. While an innovator might think their innovation is simple to use, often they assume so from their deep skill base; not all potential adopters feel the same way. A Kenyan respondent promoting the use of a multipurpose thresher explained that a challenge to uptake was the "perception about the innovation as being [...] too difficult to use. [Most saw the innovation] as [more] complex to use than the manual way."

Part of this complexity arises not just with respect to operating the technology when it is working properly; potential adopters also struggle to find training in trouble-shooting a technology when it is not operating as it should.

This skill gap is not limited to technical skills alone. A Tanzanian respondent, who processes and packages spices, explained that young people "do not have training on such mixing skills, and they don't have marketing skills." Young people require training to address both the wraparound hard and soft skills required to maximize a technology.

Young women face larger gaps in wraparound skills because of gendered perceptions of what skillsets are appropriate for young women to acquire.

Respondents variously mentioned skillsets where young women have a larger gap than young men, from functional literacy to technical, mechanical knowledge to mobile technology operation. Respondents do not, however, express any consensus around which young women's skill gaps are most prominent.

A consensus does exist around the gendered perception of certain skills. This is the case for the skills that underpin both digital and offline technologies. Young women have more limited knowledge of how to operate mobile technologies because they lack the finances to acquire them, a Zambian respondent explained. Beyond exposure, there are perceptions that "ICT education is mostly for men," as a Ghanaian respondent shared.

Offline technologies often require knowledge in mechanical operation, maintenance, and repair. Respondents in Ghana, Kenya, and Malawi all mentioned mechanical skills as men's work. Perceptions that these skillsets are not appropriate for women influence whether young women seek to acquire these skills. Ultimately, these gaps impede young women's ability to access and apply more mechanized technologies.

Some innovators conflate perceptions of what is appropriate for young women with the idea that women "fear technologies more," as one Tanzanian respondent expressed. A negative perception of innovation and a perception that certain skillsets are not appropriate for young women are not one and the same.

To encourage young women's adoption of technologies, innovators and promoters need to engage in awareness and dialogue. Young women who have taken up these skills are impactful role models.

This step must precede endeavouring to close skill gaps between what young people possess and what skillsets technologies require.

Instead of placing the responsibility of closing the skill gap on adopters, promoters of technologies should provide training in the skills required to use them.

Without appropriate and thorough training, adopters described a trial-and-error method of getting familiar with innovations. Several adopters of grain shelling and milling machines in Zambia asserted that because they were not familiar with the technologies, they "made a lot of mistakes using them in the beginning," though eventually they became "experts."

Many innovators are aware of critical skill gaps that constrain the ability of young people to take up their technologies. However, few respondents spoke of promoters doing anything directly to address these gaps.

Ugandan respondents in a focus group suggested that innovators should "develop more technologies that can be used. [For example,] if they produce fertilizers, they should also teach farmers how use [them]." One Ugandan biogas innovator shows responsiveness to these needs through a pathway that other innovators could follow: "The technology requires training ... [to even] be able ... to use [it]. Most youth don't possess these skills. I solve this by constantly training and engaging youth whenever I have the platform."

A Malawian innovator similarly mentioned the importance of training in that it "exposed [adopters] and [...] made it easy to adopt [the technology]." Both responses provide an example of an approach that other promoters could follow.

This is not to say that young people do not try to take up the relevant technologies they are aware of, without having the requisite skills. Many young people might not be aware of the extent of the gap in their skills and, where they are aware, they are unlikely to have opportunities to build their skills.

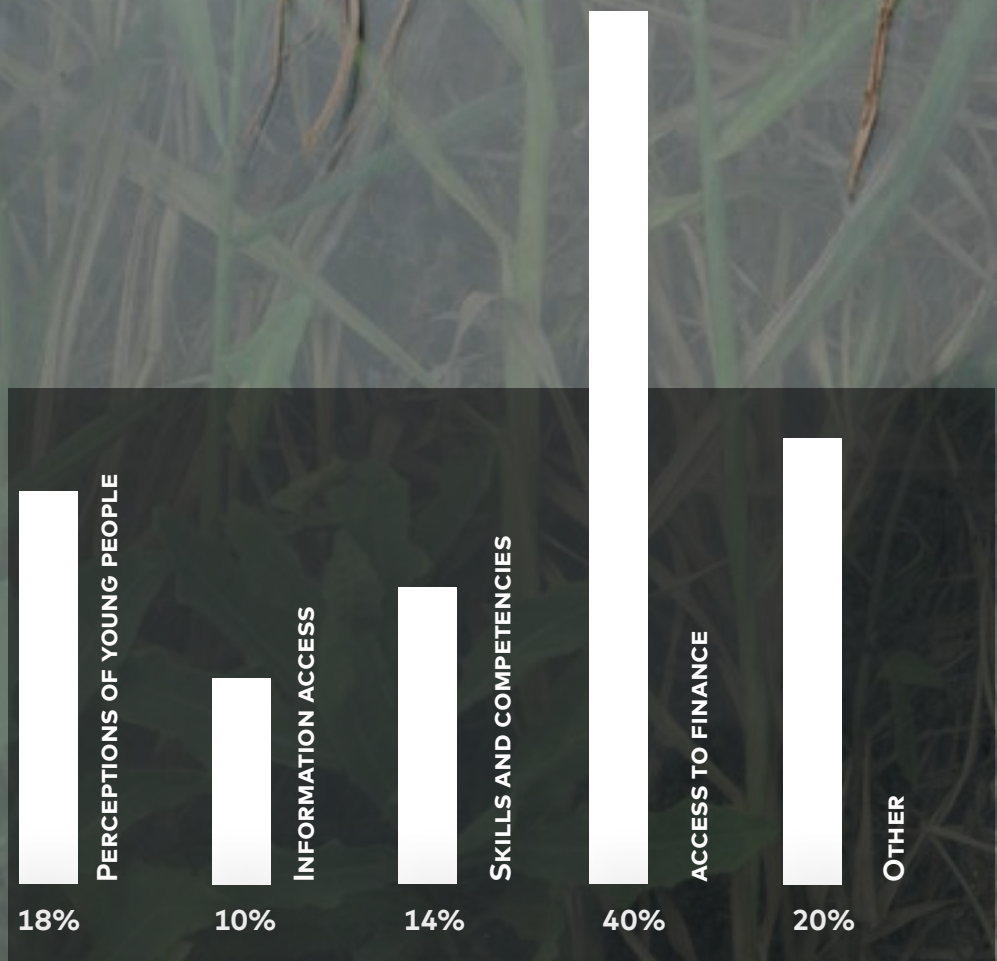| PERCEPTIONS OF YOUNG PEOPLE	INFORMATION ACCESS	SKILLS AND COMPETENCIES	ACCESS TO FINANCE	OTHER
18%	10%	14%	40%	20%

FIGURE 2. SURVEY RESPONDENTS' REFLECTION ON THE MOST PRESSING BARRIER TO YOUNG PEOPLE'S ADOPTION OF AGRICULTURAL TECHNOLOGIES.

There is potential to dovetail closing the gaps both in young people's awareness of available technologies and in their skill base to operate and use them. Both information and training must be brought to the grassroots level.

This creates an opportunity where technologies are promoted in person; wraparound skills training can be embedded in demonstrations to minimize touch-points and cost. We suggest using a network of technology ambassadors, who are trained effectively under a training-of-trainers model, for promotion to deliver wraparound skills.

5. Both adopters and innovators are constrained by inadequate access to financial products to invest specifically in agricultural technologies — with respect to both ideation and uptake.

In both interviews and surveys, respondents mentioned limited access to finance as one of the most prominent barriers to young people's creation and adoption of agricultural technologies.

Figure 2 at left shows survey data on respondents' perception of the barriers to young people's adoption of agricultural technologies. Survey respondents mention other barriers — such as access to information and skills — as prominent, but they see access to finance as the most prominent barrier of all.

Financing for uptake requires both designing financial products that are specifically tailored to adopters' needs and broadening awareness of available financing options to the grassroots, community level.

Respondents reported a lack of available and tailored financial products that enable them to invest in agricultural technologies.

While they mentioned microfinance loans as a source of financial capital, no adopters mentioned using them to fund their uptake. This is not surprising because the microfinance loans are ill adapted to agricultural investment. A key aspect is that repayments follow a regular schedule, instead of the agricultural season. Additionally, respondents say that they acquired technologies as individuals, whereas available microfinance options are typically delivered to groups.

Some young people have found creative strategies to self-finance. One Ugandan fruit processor described "starting small and growing," slowly building in technology by "reinvest[ing] all the profits [...] from the business back in the business." Other respondents described

pooling their finances to purchase agricultural technologies as a group.

Though these financing techniques are useful to adopters, they represent individualized solutions, not necessarily strategies that can be formalized.

Adopters are not the only group experimenting with how to improve access to financing for agricultural technology uptake. Innovators also expressed devising inventive solutions to make their agricultural technologies more broadly accessible.

Some innovators are facilitating access to financing options by leveraging existing channels. Two Kenyan agricultural technology innovators are creating these linkages. One explained, "[we are] link[ing] [adopters] up with banks, where [we] act as their guarantors for some of the loans."

Even with this support, adopters do not always find bank products accessible or appropriate. At times, a more localized and smaller-scale source of financing, such as a local VSLA or SACCO, is more appropriate. A Ugandan biogas innovator identified "promot[ing] the innovation through [a local] savings society, which now sells the technology as one of its products." This strategy leverages a local system where the potential adopters already have a source of financing.

Outside of explicit financing channels, a Kenyan vertical gardening innovator offers adopters the option of paying in installments as a "flexible payment plan." She offers this financing because most young people do not have a regular source of income that they can use to purchase the innovation at once.

Similarly, another Kenyan innovator solved the issue of a large investment that most farmers cannot afford up front. He offers an electronic soil testing machine as a service instead of a product. "At first, the product was 30,000 Kenyan shillings, which was not affordable to the farmer, but the service is worth 2,000 Kenyan shillings, which is cost-effective."

These examples provide creative solutions to enable better access to technologies. Systematizing these solutions through government programs may be a viable option.

Instead of designing separate solutions for how to expand financing, space should be created for "dialogue between banks [and other financial institutions] and agricultural innovation stakeholders on how to [improve] access to capital," as one Ghanaian respondent recommended. Through exchanging ideas, banks and other financial institutions can leverage these lessons in designing financial products for uptake.

As with the previous theme of appropriate information channels, information and awareness of financial products must be delivered at the community level.

Roselyn Mugo, a 22-year-old Youth Think Tank member from Kenya.

Financing for innovation requires developing incubation grants and seed capital products that are responsive to innovators' needs at each step of the design process.

Riziki Augustino Assey, a 24-year-old Youth Think Tank member from Tanzania.

Like adopters, the financial products that are available to innovators are maladapted to their comprehensive needs. Respondents assert that innovators of agricultural technologies require financial support in different ways than those who will eventually take up what they have developed.

Innovators mentioned seeing others in their community benefitting from small loans acquired from banks and microfinance institutions to expand their farm-based businesses. Innovators access these loans when seeking to "commence commercial production of [an] innovation," as an innovator in Ghana explained. No respondents mentioned that these products helped them in the incubation phase.

A Tanzanian adapter of produce-drying technology explained that there should instead be "increased access to effective financial services and products" which are specifically tailored to young innovators. This would require financial institutions and others offering financial products to recognize their unique needs.

Young innovators pointed to specific ways in which government grant schemes are inappropriate for their needs. One Ghanaian innovator said that the requirement of a business plan is unnecessarily prohibitive for accessing innovation grants. While comprehensive business plans showcase the feasibility of an innovation, such requirements are an onerous burden for those at the earlier stages of development, such as prototyping and testing.

Respondents reported that creating an enabling environment for innovation requires the provision of incubation grants. Current financial services do not tend to provide for "young innovators, especially in the early stages of production and investments," as one Tanzanian respondent explained.

Innovators mentioned that grant schemes also typically provide funding to groups rather than individuals. As one Kenyan innovator shared, this requirement disadvantages many enterprising individual innovators and creates perverse incentives to form groups solely to capitalize on and divide funding.

These disconnects are indicative of the disparity between the way governments and grant-makers envision young innovators and how innovators address their financing needs. Innovators require financing options tailored to support every stage of the development process, from designing to prototyping to testing to redesigning and — eventually — to roll-out.

Despite these challenges, young innovators are creatively addressing the gap in financing their technologies through tactics such as crowdsourcing capital through their social networks.

Governments and other institutions seeking to design incubation grants should build on the foundation of what innovators have already found successful in financing the development of their technologies. Once designed, these institutions should build awareness of these financing options at the grassroots level to reach a broader range of possible innovators.

Lack of awareness of funding for agricultural technology innovation hinders young people's investment in these technologies.

Where funding schemes do specifically target technological development, innovators are only vaguely aware of them. A Tanzanian organic farming innovator explained the information gap: "I heard, some banks, they do have financial services and products to help support young innovators, but I have never seen any young innovators that have benefitted from them." Innovators are only minimally aware of which institutions offer funding for technology development and are even less aware of the specific products and grant schemes they offer.

The information and awareness gap operates simultaneously in both directions: between those offering financing, and those who require it. One Kenyan respondent said that governments are unaware of youth innovation needs and thus offer "what they think is needed, [which] is totally different" from what is actually needed by youth. Innovators also are not aware of youth-oriented innovation funding schemes, particularly those offered by government bodies.

To a large extent, young people — particularly rural young people — are not aware of these financing options. Instead, as a Ugandan respondent suggested, "services must be brought to the grassroots, to the village through elders or trusted youth. This will increase the number of youth who access them."

Even when young people are aware of available grant and fund options, there still may be obstacles to them. One Ghanaian respondent stated that the policies on acquiring funding through these schemes "are too complex for anyone I've seen to benefit." Confusing policies, limited information, and bureaucracy produce a system that is not accessible to most young people for agricultural investment.

Recommendations and Conclusion

TOWARD RESPONSIVE, INCLUSIVE AGRICULTURAL TECHNOLOGIES

Our findings identify several key gaps both in maximizing the design of agricultural technologies and in their subsequent uptake. Some young innovators and adopters are creatively responding to these constraints. Some of these solutions may provide models and examples for others to emulate. Most, however, are individualized, and therefore cannot be taken to scale.

Solving these gaps comprehensively and systemically at scale requires a different approach — one that is based on responsiveness and inclusion.

We understand innovators, promoters, and adopters of agricultural innovations as players in an interconnected landscape. To respond to the challenges that young people highlighted for us, each of these groups can make changes to the way in which they work in this sector. To deliver transformative change, however, all groups need to fundamentally change the way they interact with one another.

Many of the problems highlighted by the findings are related to a lack of information. Those for whom solutions are designed lack awareness of the innovations themselves, and those who are designing solutions lack the information on user needs and experience to adapt technologies appropriately.

The challenge of information gaps needs to be addressed at a systemic level. Instead of improving information sharing through specific channels, groups must change the way they interact with one another within this sectoral landscape.

Systemic change requires moving beyond envisioning a linear system of innovators who design technologies that are then promoted to adopters. In this understanding, adopters are simply end-users who mark the endpoint of a solution design and uptake process. This model, however, limits the critical agency and input of the masses of young people who are involved in the agrifood system.

Instead of being receivers of solutions, young adopters should be seen as partners in solving barriers in the agrifood system. Their input and influence should be leveraged more to collaboratively design technologies, and to mobilize young people at the community level to take up these innovations.

Without fundamentally involving young people at the community level, the sector is missing out on opportunities to drive uptake at scale and to maximize the income generated by the agrifood sector. Youth do not need to wait for other actors

Solving these gaps comprehensively and systemically at scale requires a different approach — one that is based on responsiveness and inclusion.

to include them this space. Young people in the agrifood system should demand more space to inform and influence the sector.

Restructuring interactions between innovators and those they serve toward a partnership requires building supportive environments for these interactions. Developing such an environment for more meaningful and horizontal interactions is complex and includes: building coalitions of sector actors to foster cooperation, cohesion, and information-sharing; creating platforms where young people can connect as individuals to co-lead change; and designing resource labs where young people can come

together to share and develop ideas. Through these structures, the agrifood sector can harness the collective energy of young people.

For agrifood solutions to result in lasting change, the way in which they are designed must be transformed. Young people can play a pivotal role in this transformational change, not just in taking up technologies. They can provide information about their experiences at the grassroots level, and they can influence the design of the enabling environment to harness the potential of agricultural innovation and design.

Calls to Action

IN ADDITION TO the general approach that we have highlighted above, our findings have helped us identify specific ways that individual actors can support improved innovation and uptake of technologies in the agrifood system.

THE 2017–2018 YOUTH THINK TANK MEMBERS.

To governments, donors, and those in the private sector:

Invest in agricultural innovation hubs and incubation centres.

More investment needs to be allocated to building innovation hubs and incubation centres.

Ideally, these would be spaces that:

- **provide access to online and offline resources;**
- **act as the access point for innovators to build skills and use tools;**
- **are staffed with trained experts to offer technical support and motivate innovators; and**
- **offer connections for innovators to idea-share.**

While building these spaces, efforts must be made to intentionally design them in such a way that they are broadly accessible to young people, regardless of their level of exposure or expertise. Consideration must be given to how these spaces can be more accessible to rural young people, who make up the bulk of the end-users of agricultural technologies.

To promoters:

Promote agricultural technologies through targeted, audience-specific channels.

Promoters should use appropriate channels to promote their agricultural technologies. They should focus their promotion on identifying the information channels that their target end-users predominantly access. While social media and TV can build an initial awareness, most effective approaches involve experienced demonstration.

Work with local ambassadors to promote the innovations.

To achieve uptake at scale, agricultural technology promoters should engage local ambassadors identified from youth and farmer groups under a training-of-trainers (TOT) model. These ambassadors can then deliver in-person demonstrations at the community level. When targeting young women, it is beneficial to identify successful young women from the target communities as technology ambassadors to act as local role models.

Identify requisite wraparound skills and provide training.

Promoters of agricultural technologies must identify which skills are required to operate a specific agricultural technology. Skill development can then be embedded into the TOT training such that ambassadors deliver wraparound skill training to end-users.

To target young women specifically, promoters must devote effort to identifying where young women have larger skill gaps and must develop training modules with their specific needs in mind.

Address negative perceptions about young women's abilities.

Promoters must build in cross-community support involving young women role models, as well as young men and community leaders, to support young women's technology uptake against stereotypes of what skills may or may not be appropriate for young women.

To financial institutions and funders:

Build seed capital products and competitive incubation grants.

Government and donor funding schemes should allocate more funds to building competitive incubation grants. When considering grant requirements, they should construct eligibility not only to produce proven technologies but also to allow for prototyping to take innovators from ideation to scale. Such grants should provide additional funding to account for failures, which are part of the design process.

Financial institutions and funders should design specific products for agricultural investment for both on-farm and off-farm activities. Available lending amounts should consider the cost of investing in agriculture. Repayment and interest rates should reflect an understanding of agricultural seasons and, thus, realistic repayment structures.

Formalize youth resource mobilization strategies and let creative solutions modelled by youth drive new approaches to financing.

Since young people are already using creative and multi-source means to finance the uptake of agricultural technologies, financial institutions and governments should look to formalize these strategies in the design of financial products for agricultural investments.

To innovators:

Design responsive technologies.

Innovators should move beyond designing agricultural technologies that address individually observed agricultural gaps to creating those that are responsive to a wider audience of young agricultural entrepreneurs. This will require them to work with other innovators and end-users to better understand the actual barriers. Meaningfully involving end-users entails going to grassroots and making them partners, better appreciating their needs, and better tailoring innovations to suit them. The technologies they design should: a) target more innovative on-farm technology that makes creative use of limited land space; and b) develop off-farm technologies that facilitate new entry points and roles for young people that are well-connected with other stages in the agrifood system.

Tailor agricultural technologies to young women's entry points into the agrifood system.

When designing and promoting agricultural technologies for young women, innovators and promoters should consider at which points in the agrifood system young women are already playing a strong and well-accepted role, and they should support them to achieve higher scale.

To young people, particularly adopters, in the agrifood system:

Take the lead in driving agricultural transformation through technology.

Building on their respective interests and expertise, young people should join their peers in agricultural technologies as innovators, ambassadors, and adopters. Young people are best placed to understand their own needs. They must demand a bigger voice in determining how to promote solutions and reach young people like them. Beyond their own cohort, young people can and should take a leading role in designing solutions that can transform the broader agrifood system.

2017–2018 Mastercard Foundation Youth Think Tank Biographies

Benedict Kwarteng

22, Ghana

Benedict holds a Bachelor of Science in Environmental Science. He is a participant in the Next Generation Cocoa Youth Program (MASO).

Francis Oko Armah

24, Ghana

Francis is a youth engagement champion and gender activist in Ghana and is involved in national and global initiatives on sexual and reproductive health and rights.

Lolung Ekaru Patrick
25, Kenya

Patrick is a YALI alumnus. He holds a Bachelor of Science, Community Resource Management and Extension. He is a founder of the Young Ambassadors of Change Network, a network of youth that engage in community-centred activities on entrepreneurship and financial literacy. Patrick also mentors 23 secondary school students from The Equity Group Foundation.

Roselyn Mugo
22, Kenya

Roselyn is a law student at the University of Nairobi and team leader on the Youth Think Tank alumni leadership committee. She is a YALI fellow and the founder of the "Book A Child" initiative with the Literature Africa Foundation, where she organizes and facilitates the establishment of libraries and shelter homes in marginalized public schools. She represented the Youth Think Tank at the 2017 Making Cents Global Youth Economic Opportunities Summit and at the UN General Assembly.

Elina Mkandawire
25, Malawi

Elina is finishing her Master of Science in Environmental Science at the University of Malawi. She is also a research assistant at the Bunda College of Medicine.

"It was exciting to collaborate with other like-minded fellows. I have learned a lot about data analysis, which has further sharpened my skills in research and has opened career opportunities for me in this field."

Jabulani Nyengere
25, Malawi

Jabulani is currently pursuing a Master of Science, Geography and Earth Sciences. He is also an active member of the Association of African Universities, representing Malawi, and represented the Youth Think Tank at the 2017 Making Cents Global Youth Economic Opportunities Summit.

Kwizera Adams
25, Rwanda

Adams is a Bachelor of Science, Civil Engineering graduate from the University of Rwanda, a Young African Leaders Initiative (YALI) alumnus, and a founder and Managing Director of Silikkon Investments. He is also passionate about using his position and skills as an engineer to impact other people's lives, especially ending hunger and malnutrition by promoting agriculture.

"It was such a tremendous opportunity to work on something I believe shall make a positive impact on my fellow African young people."

Ruhimbana Muzamil
22, Rwanda

Muzamil holds a Certificate in Entrepreneurship and runs a charcoal briquet company formally registered with the Rwanda Development Board.

Riziki Augustino Assey

24, Tanzania

Riziki is a final-year Bachelor of Arts, Statistics student at the University of Dar es Salaam, an AIESEC alumnus, and co-founder of Desapoint, an online platform for university students to access learning materials and information.

Edson Eddie Mhenga

22, Tanzania

Edson is a statistics graduate from the University of Dar es Salaam. He is also the Country Entrepreneurship Project Director at Cambridge Development Initiative and a member of the AIESEC National Support Team.

"To me, the research was a mind-opening journey and it was really a journey of many discoveries. It exposed me to the different existing opportunities for young people in agriculture and how I can help my fellow young people to engage in agriculture."

Nyegenye Julius
24, Uganda

Julius holds a Bachelor of Science, Agribusiness from Makerere University and is an alumnus of Restless Development's International Citizenship Service program, an initiative that promotes global active citizenship among young people.

Ndagire Moreen Maria
21, Uganda

Moreen is a Mastercard Foundation Scholar currently pursuing a Bachelor of Science in Agriculture at EARTH University in Costa Rica. She is also the founder of a youth initiative called "I have a future," which empowers young people to engage in community work.

"While working with young people, you get to realize that there is so much untapped potential and great ideas. You just have to listen."

Faith S. Kaoma
22, Zambia

Faith holds a degree in Business Administration from Copper Belt University in Zambia. She is a founding member of Project Forward, an initiative that allows non-profits to incentivize young people to take up and value volunteering as a viable way of creating transformative change in their communities. She led a panel session on the "Ideathon" on youth employment hosted by RTI International in New York.

Mambepa Nakazwe
22, Zambia

Mambepa is an undergraduate student at Kasama College of Education earning a Bachelor of Education in secondary teaching, majoring in Computer Studies. She is also co-founder of "girls with different abilities in ICTs," an initiative that provides young Zambian women and girls with special needs with free ICT and entrepreneurship training.

ENDNOTES

1. Caribou Digital, Digital Lives in Ghana, Kenya, and Uganda (Farnham, Surrey, United Kingdom: Caribou Digital Publishing, 2015). Accessed September 25, 2017. http://cariboudigital.net/new/wp-content/uploads/2015/12/Caribou-Digital-Digital-Lives-in-Ghana-Kenya-and-Uganda.pdf.

2. Michael Hailu, "Transforming agriculture through innovations," Innovate for Agriculture, Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA), 2016, 5. Accessed October 19, 2017. https://issuu.com/ashokachangemakers/docs/1924_pdf_ilgfwf6.

3. This is particularly strong in specific contexts. For example, the Agrifood Youth Employment and Engagement Study notes that "Rwanda's severe land constraints limit further agricultural area expansion and especially youth access to land." Andrea Allen et. al, Agrifood Youth Employment and Engagement Study (Michigan State University, 2016). Accessed October 20, 2017. http://www.isp.msu.edu/files/4814/7249/7008/AgYees_Report_FINAL_web.pdf.

4. By "spaces," we mean both physical environments and creative platforms for young innovators to share ideas with their peers and mentors.

5. The Global Innovations Index (2017) stresses that to scale up local initiatives and ensure technology diffusion, building "links between public research institutions, firms, and the grassroots level are key. Efforts to enhance the efficiency of the innovation system should focus on reducing lags between successful R&D efforts and the widespread adoption of agricultural innovation." Cornell University, INSEAD, and WIPO, The Global Innovation Index 2017: Innovation Feeding the World (Ithaca, Fontainebleau, and Geneva, 2017). Accessed October 21, 2017. https://www.globalinnovationindex.org/gii-2017-report.