Effective Methods of Learning Agricultural Technologies in Kenya and Uganda

CHEYENNE GERLACH

DE WITT, NEBRASKA TO MBITA, KENYA

The World Food Prize Foundation

Borlaug-Ruan International Internship 2017

International Centre of Insect Physiology and Ecology

Further reading provides an intensive description of the journey to Mbita, the research assignment with the International Centre of Insect Physiology and Ecology, and the growth that has accumulated from this incredible journey.

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Introduction

Background

I am Cheyenne Gerlach and I had my beginnings on a small pig farm in DeWitt, Nebraska. My parents are Rick and Amy Gerlach and I have four brothers and one sister. My dad is a commodities broker and my mom works at our local bank.

From an early age I was involved with 4-H and showing pigs, cattle, and goats. When I began high school at Tri County High School I became very involved with FFA livestock judging, parliamentary procedures, livestock management, and public speaking. Agricultural education is how I came to hear about the World Food Prize.

My sophomore year I was my agriculture teacher, Mr. Wissenburg's, teachers aid. One day I was cleaning out an old bookshelf, donating the majority of the books on it. But Mr. Wissenburg stopped me in my tracks by pulling out a single book of the "donate pile," and saying "You were wrong about this one – read it." It was a book called *The Man Who Fed the World: Norman Borlaug,* and I read it immediately.

This book and simple exchange is where I learned about the World Food Prize and decided I wanted to dedicate my career to the fight against global food insecurity, just like Borlaug did. So I wrote my first paper on education in Guatemala. Based on my research and presentation at the World Food Prize Nebraska Youth Institute, I was selected to attend the Global Youth Institute that October in Des Moines, Iowa. That was the most excited I had ever been!

At the Global Youth Institute, I heard from Joyce Banda, M. S. Swaminathan, and Ambassador Quinn. My mind was expanded and my heart was ignited. I was hooked. It was a special environment I will never forget. The attendees, the speakers, the laurates, all had the students all had a mindset focused on ending the battle against hunger. I was voted to be my group's spokesperson which meant I had the privilege of presenting my group's findings on the last day. My experience at the Global Youth Institute made certain that I would apply for the Borlaug-Ruan International Internship.

As I gave my valedictorian speech, I started by asking all those who have ever heard about Norman Borlaug to raise their hand. I was trying to make a point about how extraordinariness sometimes goes unnoticed, but an abnormal amount of people raised their hands. After the ceremony I confusedly (and excitedly) asked people how they knew of my friend Norm. They laughed and said "Cheyenne, you never stop talking about him." That's when I realized I may have been a little loud about this "#nextnorm" thing.

The spring of my senior year, right before I graduated, I was elected to be a Nebraska FFA state vice president. Even though this put my chance of being an International Borlaug-Ruan intern off for a year, my passion for food security was only highlighted through my year of service to Nebraska FFA. I wrote two rounds of curriculum, one based on food security in Nebraska, the other on a global perspective, that were facilitated at district leadership conferences, as well as at our chapter visit program. We also did a food drive for registration for all five of our chapter officer leadership training sessions, as well as have hunger-related reflections, exploring the food

insecurity rates in the student's home counties and what they could do to lower those numbers from the home front.

Whenever asked with what I wanted to do with my career or my passions during chapter visits, industry visits, or conference sessions my answer would always take me back to my experiences at the Global Youth Institute. When I got into conversations about Borlaug with FFA members, advisors, or sponsors, my teammates would kindly find a seat; they knew that this was going to take a while. I couldn't help it! I had found something that ignited a passion deep within, I didn't know why or how – I simply knew it was there.

Throughout my freshman year of college at the University of Nebraska-Linconl, I began pursuing my degree in Integrated Sciences, with focuses in One Health (a program partnering with the university that promotes animal, human, plant, and environmental health in Africa) and Social Entrepreneurship, with minors in Global Studies, Political Science, and Entrepreneurship.

I also started a business called Giving Gloves, which donates 25% of its profits to effective hunger-fighting organizations in Nebraska. Through the same entrepreneurship program, I'm working on an agricultural literacy based program called Sustaining Sprouts, that will increase food security in rural and urban families through the work of community gardens and greenhouses. The curriculum is for children aged three to eight.

As I had lots of free-time in the summer in Mbita, I began drafting a children's book titled *The Hunger Fighters' Shoes.* I'm excited to develop this further. The purpose of the book is to engage young people in the fight against hunger from an early age. I also enjoy blogging and my experience in Kenya gave me an incredible amount of inspiration and so many ideas.

My goal is to receive my Master's degree from Cornell in the International Agriculture and Rural Development program. Then I want to work in a developing country for two to three years learning about their process of development and the part that agricultural technologies plays in the process. I hope to work as an international consultant that works with NGOs. I want to help them match their resources to the needs experienced by individual communities throughout rural Africa. I am a strong advocate for the idea that there is no "one size fits all" solution – every community throughout our world is different. I then look forward to coming back to the Midwest to connect the things that I learned abroad to rural development in the United States, as I have an interest in rural development and food security from the home front also.

Mentors in Kenya

From the moment we landed in Nairobi, we were met with a genuine kindness that is incomparable to that I've experienced before. I want to thank a number of International Centre of Insect Physiology and Ecology employees, supervisors, and directors that made my travels comfortable and enjoyable. In Nairobi we were accompanied by Vivian Atieno, a research manager and Dr. Robert Skilton, the Head, Capacity Building and Institution Development. We even had the chance to meet one of my biggest role models, the Director General of ICIPE, Dr. Segenet Kelemu. The guest house staff also made our stay enjoyable and comfortable. Although our time in Nairobi short, it was lovely and I am so grateful for it.

Polycarp Bondo was our first and last driver to and from the Mbita ICIPE Guest Center where we were warmly greeted by many of the staff members. Polycarp also was our technician and translator a number of times as we worked on surveying farmers throughout Kenya.

Special thanks goes to Professor Zeyaur Khan, our supervisor. He is the lead scientist on the push-pull team and has many academic and scientific achievements for his work. He set the topic of my research, "Effective Methods of Learning Agricultural Technologies in Kenya and Uganda" and gave guidance on where to go from there.

The first smiling face who took us under his wing was Aloice Ndiege; he and many other ICIPE employees will always have a special place in my heart. We conducted ninety surveys with the help of Aloice, George Genga and Matilda Ouma. George was always great to work with, as he made sure we knew an impressive amount of Luo, the local language. Although our time with Matilda was short, she quickly took the place to become our "Kenyan Mama."

We also grew to work with great technicians and researchers who helped us find farmers to interview and communicate with. Some of these people include Dr. Charles Midega, Silas Ouko, Rachel Owino, Nahashon Otieno, Bernard Kimani, Eunice Mumbo, Joseph Ondijo. The employees at the guest center were especially outstanding. They made finding a home at ICIPE seamless and so much fun. I look forward to visiting again soon.

The last people that I want to thank are the ninety farmers that I had the opportunity to survey. I have never met someone with a busier schedule than a woman Kenyan farmer, yet somehow I had the chance to talk to, laugh with, and learn from such a number of these remarkable women. There was incredible value in each and every survey done with men and women, Kenyan and Uganda farmers. Although I wasn't able to pronounce every name with the perfect Luo accent, I will never forget their faces or more importantly their stories. None of my research would've been possible without this intelligent and giving people.

Acknowledgements

I have so much to thank the late Norman Borlaug for. Creating a legacy that will stand solid for years to come, paving the way for future hunger fighters, and instilling in me a passion that I believe will continue to move me and others are just a few. I find myself wondering if he knew what the World Food Prize would grow to become, the youth it would inspire, and the progressive change it would create in agriculture.

I want to thank my family and friends for supporting me. From the point where I decided to apply for the Borlaug-Ruan International Internship to the moment I got home I had support and love from a number of people. Special thanks to my sister and brother, Savannah and August Gerlach, and of course my very supportive parents Rick and Amy Gerlach.

I also want to thank my wonderful friends Sydni Lienemann, Emily Frenzen, and Matthew Brugger. Between serving as a Nebraska FFA state officer and having the opportunity to work as a Borlaug-Ruan International intern, my friends and family all sacrificed so much to communicate

through our busy schedules and a variety of time zones, and I wouldn't have been able to do it without any of you.

I also must extend warm thanks to the people working from Des Moines, Iowa to make sure that all of the 2017 Borlaug-Ruan interns stayed safe and were having great experiences. Lisa Fleming, the Director of International Internships and Career Development, has been an integral part of my journey. Her passion is as deep as it is wide and absolutely contagious. Thank you for always checking up on me and making sure everything was as it should be! President of the Foundation Ambassador Kenneth M. Quinn is also very deserving of thanks, as his support was very crucial and much appreciated. He has been a figure I've looked up to since first hearing him speak at the Nebraska Youth Institute in 2015.

Scholastically, I must first thank my two high school teachers, Mrs. Smith and Mr. Wissenburg. Mrs. Smith, thank you for opening my eyes to a world much beyond Nebraska, your passion and heart for knowledge and people has ignited with me the same passion. Mr. Wissenburg showed me my future just by handing me my first connection to the World Food Prize, the book, *The Man Who Fed the World: Norman Borlaug.* Thank you for your constant support and realistic outlook. Much thanks also goes to Brooke Talbott at the World Food Prize Nebraska Youth Institute. She welcomed me into the Nebraska program with lots of enthusiasm and open arms.

Assignment

Abstract

The International Centre of Insect Physiology and Ecology, or ICIPE, is currently working on life-changing advancements in agriculture. The research will help with the next step in the process; the dissemination of information about these advancements. Projects and technologies like push-pull not only increases food security for farming families, but also creates a stable and consistent income to help pay for things like education for future generations. These remarkable technologies and advancements are inconsequential if farmers don't have access to information about the technologies and advancements that can improve their lives.

A twenty question survey has been developed that will identify current methods of learning new farming technologies, preferred methods of learning, and why certain methods are preferred over others. Qualitative and quantitative data from surveys with ninety farmers will be collected. The anticipated outcomes will yield the best learning method to be utilized for all farmers in Kenya and Uganda. The data will be further dissected to find differences between the four groups—Kenyan men and women and Ugandan men and women. Lastly, the data will be utilized to develop innovative ways to reach farmers in the future. The hypothesis for this research is that farmers prefer to learn with a method that is convenient, social, and practical. An effective follow up experiment would be using the best found method to disseminate a new technology and then see how farmers learn and adopt it compared to how farmers were learning and adopting agricultural information through previous dissemination methods. The research will also create a greater awareness of the obstacles intrinsic to the fight against hunger and an understanding of the specific steps in finding solutions, which is valuable beyond measure.

International Centre of Insect Physiology and Ecology

With interests in social sciences and rural development, having heard the internship would be spent at the International Centre of Insect Physiology and Ecology there was initially some confusion. This feeling of confusedness did not last long. After researching ICIPE, or the International Centre of Insect Physiology and Ecology, and finding that they are on to something special, excitement grew. They don't only see insects as a pest, but a potential-full force of nature. They are visionaries with the food security of the people of the tropics in mind. Working with this organization has been inspiring as well as energizing. Because of the internship placement, more knowledge about insects, crops, and sustainable and realistic ways to end hunger in Africa has been gained than imagined possible.

ICIPE works throughout much of the continent of Africa, from Senegal to Somalia and from Tunisia to Botswana, even reaching Madagascar. ICIPE was founded by a Kenyan scientist named Thomas R. Odhiambo in 1970. With the help of American scientist, Carl Djerassi, the two went on a hunt to find motivated scientists ready to embark on the journey of making Africa self-sustaining agriculturally through the control of insects.

He envisioned the future of the status of science in Africa as a global leader. He saw collaboration and organizations and sustainable practices for agriculture production being spread throughout the tropics of the continent and beyond. At the heart of all of this, Odhiambo specified, was smallholder farmers.

The Cambridge graduate, Odhiambo, opened the center for research in 1970. The first scientist invited to participate in research did so in a garage that flooded when it rained. He budgeted on a week-to-week basis to make ends meet. Although the financial support was small, his objective was not – "to enable Africa to sustain herself and to lead the entire pan-tropical world in this area of endeavor."

As Thomas Odhiambo and his new team of young African scientists grew, they started gaining access to facilities from the Chiromo Campus at the University of Nairobi. They also added the name, ICIPE, the International Centre of Insect Physiology and Ecology. Little did they know (or maybe he did) that ICIPE would be known across the continent for life-saving technologies for their original audience – smallholder farmers. ("Our History.")

With a focus on environment safety and sustainability, ICIPE is leading the way for agricultural solutions all across Africa. They also have focuses on women empowerment and youth engagement, as both parties are incredibly crucial for food security in Kenya, and throughout Africa.

Mission and Vision

The mission of ICIPE leaves no room for question, "to help alleviate poverty, ensure food security and improve the overall health status of peoples of the tropics, by developing and extending management tools and strategies for harmful and useful arthropods, while preserving the natural resource base through research and capacity building." ("Mission and Vision .")

It seemed as though this mission was stamped onto the heart and mind of all of its employees, as they were welcomed into the arms of all smallholder farmers across Kenya and Uganda. The ICIPE mission and vision aligns hand-in-hand with the Millennial Development Goals set by the United Nations in 2000. This organization mission has been making huge leaps in agricultural development in Kenya, in Africa, and in the rest of the world.

Noticing the pride with which farmers spoke about his increasing stability of food sources because of technologies produced and disseminated by ICIPE, their goals to "alleviate poverty and to ensure food security" rang true. When farmers would excitedly talk about the educational opportunities her children were now enjoying "and improve the overall health status of peoples of the tropics" came to life. To hear a mission is to aspire, to see a mission face-to-face is to inspire.

The vision of ICIPE, "to pioneer global science in entomology, to improve the well-being and resilience of people and the environment to the challenges of a changing world, through innovative and applied research, alongside deep exploratory study, impact assessment, evaluation and sustainable capacity building" is equally inspiring and straightforward.

ICIPE realizes it is not enough to improve the well-being and health of the people and the environment. They emphasize the changing world and the challenges that are new and equally terrifying for farmer and the people of Africa. They will not be content with one or two solutions. They instead, focus on innovation and research to continue to find new solutions for a new era in science.

The Push-Pull Project

After hearing many farmers talk about their "staple crops" enduringly and dependently, understanding the importance and the significance of the push-pull technology is very simple. This technology improves yields and stabilizes harvests and incomes for farmers whose focus belongs to cereal grains including maize, sorghum, millet, and rice.

Throughout most of Kenya, Tanzania, Uganda, and even parts of Ethiopia subsistence farmers struggle with two major "yield killers." One is a weed called Striga, what locals call "witchweed"—and for good reasons. Striga is a parasitic weed that, instead of growing roots for itself, connects to the roots of maize plants, stealing all of the nutrients from its host, the maize.

The other, equally wicked, "yield killer" is a pest called the stemborer. This insect feeds on the maize leaves as larvae, then they move to the stem and other critical points causing "deadheart," or stunted maize. Then the large larvae build extensive tunnels inside of the stem, disrupting the crucial phloem and the xylem, the means of transporting nutrients. The rest of this pest life cycle takes place on the corn leaves and inside the stem, ensuring sustainable damage.

In fields where both "yield killers" are present, it is common for farmers to lose 100% of their crop. For subsistence farmers in Kenya this makes for a hungry season. Without a secure food source or supportive income this makes for a season of uncertainty.

This is where the push-pull project comes in. In 1998 ICIPE identified a plant that naturally repels the stemborer, called Desmodium. An odor or a chemical that Desmodium puts off, pushes the stemborers away. They also found a grass called Napier that attracts, or pulls, the stemborers in. After lots of experimenting and surveying farmers, the ICIPE team led by Professor Zeyaur Khan, created the push-pull field. In these fields Desmodium is planted between the rows of maize, pushing the stemborers away, while Napier grass is planted around the border of the field, pulling the stemborers towards it and away from the maize.

The Napier grass produces a sticky substance that suffocates the stemborers, terminating the pest. Additionally, the Desmodium roots are toxic to the "witchweed," or the Striga. Not only does the Desmodium block out the Striga from coming up, it also acts as a cover crop, conserving the topsoils and adding nitrogen to the soil.

The benefits of push-pull are many and are yield-saving. During the research many mothers reported that the extra income push-pull had provided was ensuring the education of her children. Some even gushed about sending sons and daughters to college. Securing the education of future generations through environmentally safe agricultural technologies? That sounds a lot like sustainable change.

Research

Methodology and Responsibilities

The research topic, "Effective Methods of Learning Agricultural Technologies in Kenya and Uganda," was chosen with the guidance of Professor Z. Khan. The significance of the research is simple. The International Centre of Insect Physiology and Ecology, widely known as ICIPE, is conducting research that has the potential to change the lives of subsistence farmers across Africa. These advancements in agriculture, however, are inconsequential if farmers do not have the means to learn and adopt the new technologies, specifically push-pull.

After the significance and topic was made clear, the objectives also became clear. The first being to determine all of methods that farmers are using to learn more about agricultural technologies and the second being to identify the most effective method for disseminating the push-pull technology specifically. The third objective of the research was to compare the ways that men and women prefer to gain to information about farming. Assessing differences between the learning methods of that of Kenyan farmers and Ugandan farmer is the next objective. The fifth and final objective is to investigate new ways of reaching farmers with new agricultural technologies.

A twenty question survey was written and tested with four farmers in Homa Bay county. After some gaps in the survey were found and fixed, the survey was finalized. Throughout the next three weeks, fifty-two farmers in Kenya were surveyed. From the fifty-two farmers in Kenya, there were twenty-seven males and twenty-five females. Thirty-eight farmers were from Migori county and fourteen were from Homa Bay County. The survey was administered to farmers who received no schooling all the way up to receiving a college degree. The research reached farmers aged from twenty to seventy-five.

After interviewing fifty-two farmers throughout Migori and Homa Bay, a focus group discussion was held. The outline was set with the guidance of Matilda Ouma. Eighteen farmers attended from Rongo, in Migori County. Eleven males and seven females were in attendance.

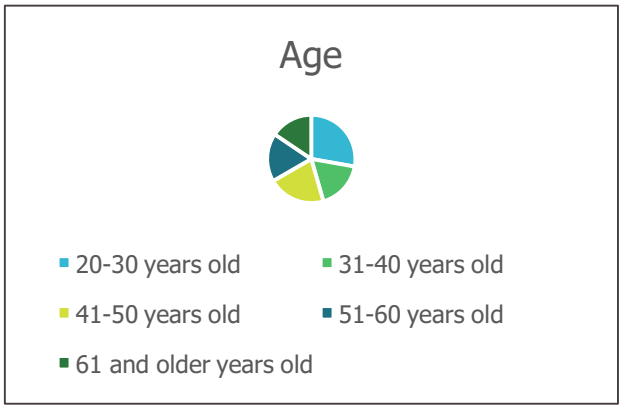
In late July, the research continued in Uganda. Thirty-eight farmers from throughout two counties were surveyed; twenty-one from Bukdi North and seventeen from Bukedea. However, with culture norms and the busy schedule of the women in Uganda, there was many more males than females surveyed. The numbers came out to fourteen females and twenty-four males. After surveying the farmers from Bukidi North, a focus group discussion took place. The same outline was used as the focus group discussion in Kenya.

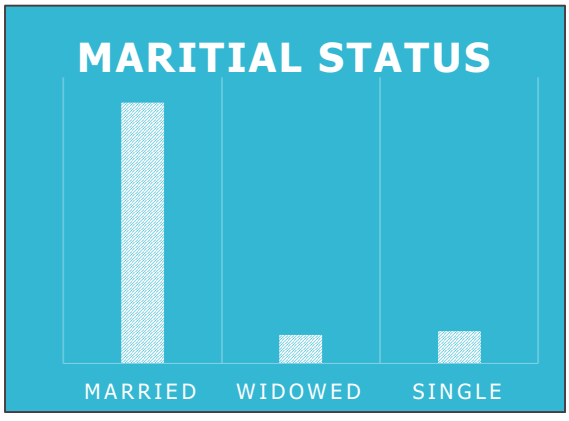
Analysis

To touch on the demographics before diving deeper into the data collected from the research, specific information was found from each farmer. When getting the background from the participant, the farmer's age, gender, education status, marital status, household size, the land and farm size, and the main source of income were all collected.

A great variety of age included 27.8 percent of the farmers that were included in the twenty to thirty years old demographic and another 15.6 percent of farmers were in the sixty-one and older age category. Because of the prime harvest season during the time of the survey collection, it was much harder finding available women to interview. This caused the percentage of the farmers interviewed being females to be at 43 percent. From the farmers interviewed, 58 percent were Kenyan, 42 percent were Ugandan. As far as education goes, 56.7 percent of farmers surveyed ended their education in primary school, 28.9 percent in secondary school, 5.6 percent either were pursuing a college degree or had a college degree, and 8.9 percent of farmers never had the opportunity to attend school.

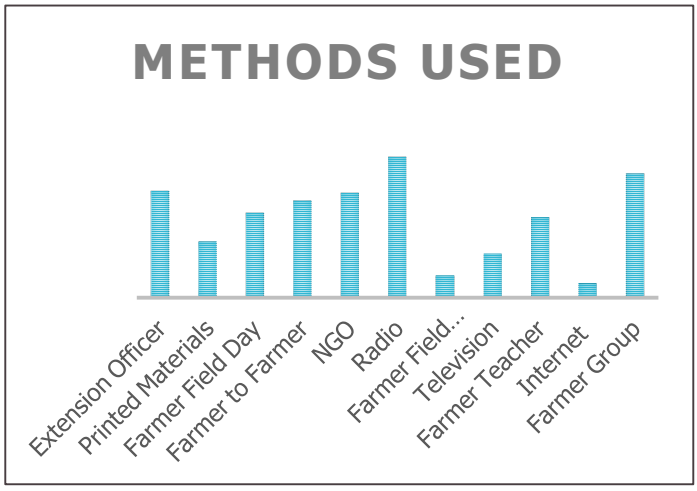
A majority of 81.1 percent of farmers were married, the others were single or widowed. Household sizes ranged from everything from one to seventeen people, with 31.1 percent of farmers living in a home with seven to nine people. Key demographics of the research are found below.



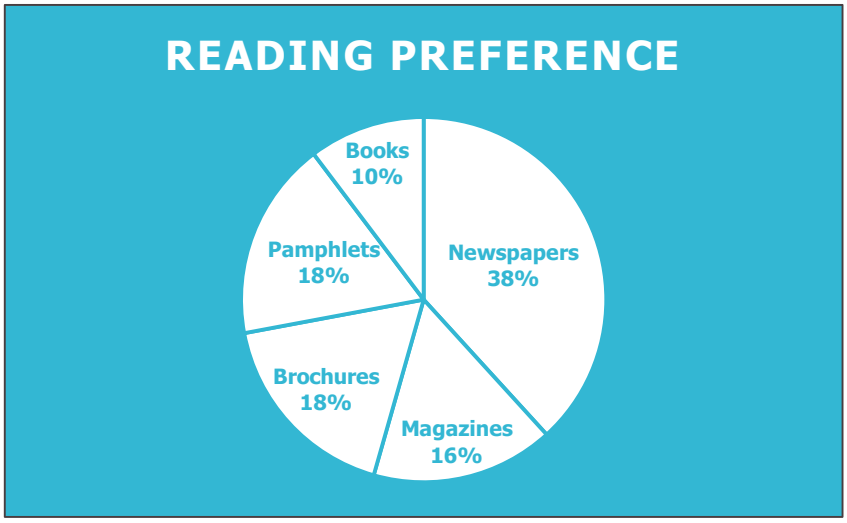


The first objective, to determine the methods that farmers are using to gain information about farming technologies, was met. The first thing the surveyed farmers did was name all of the sources

that they have ever used to gain information about a technology in agriculture. From there, the research identified and ranked the methods on frequency and utilization. In order from most utilized to least utilized the top five sources are: Radio, farmer group, extension officers, non-government organizations (NGO's), and farmer to farmer.



Other dissemination methods that were mentioned at a lower frequency are farmer field days, farmer teachers, printed materials, television, farmer field school, and the internet. Farmer field days are where many of the surveys took place early on in the research. Farmers attend to learn more about agricultural technologies and to increase their farming skills. Farmer teachers are usually at the head of farmer groups, and often times do individual farm visits, advising many farmers in their village and beyond.

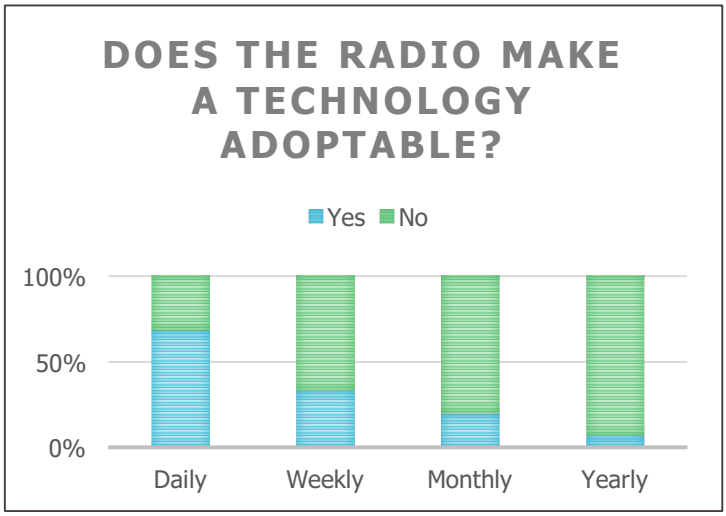


Printed materials include newspapers, magazines, brochures, pamphlets, and books. Even though printed materials were on the bottom half of frequently used sources, this is a method that is worth looking into. ICIPE uses a lot of brochures, pamphlets, and magazines to educate farmers and to promote push-pull. While 12 percent of farmers read about agriculture daily, another 33 percent of farmers report that they never read at all. The rest of the reading frequency percentages go as

follows: weekly at 28 percent, monthly at 12 percent, yearly at 11 percent. The research also looked into the preferred reading materials of farmers. The top printed material is newspapers, then tied for second is pamphlets and brochures.

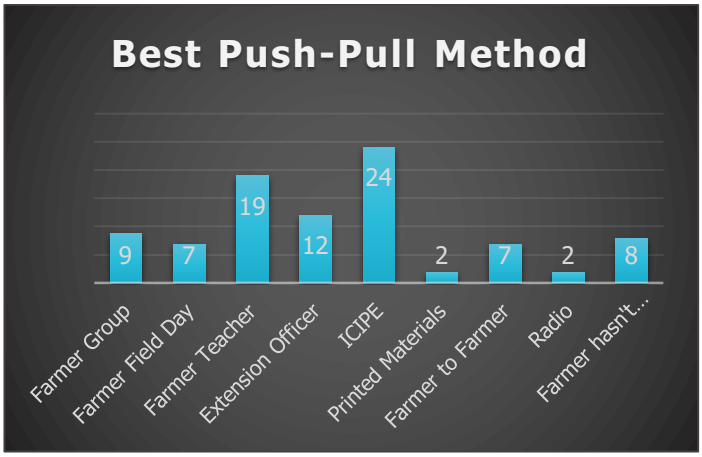
Television is used as a source for agricultural information by 10 percent of farmer surveyed. Farmer field schools are when a group of farmers are gathered with a specific agricultural topic in mind. Then an informed organization comes in and educates the farmers on this topic. Lastly, internet use is still limited but it is growing, especially in the younger generation of farmers. Still, only 6.7 percent of farmers named the internet as a source of information for new farming technologies.

Going back to the top five most frequently used sources, radio was labeled as a convenient and trustworthy source. However, only 68 percent of farmers who listen to radio daily claim that the radio alone is enough to adopt a new technology in farming. When looking at weekly listeners, that number drops to 33 percent of listeners who could adopt a technology from a radio program.



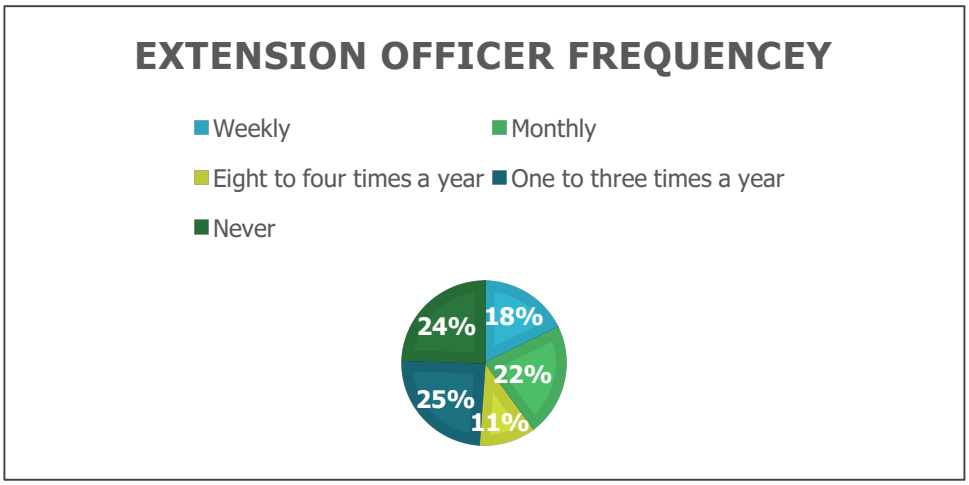
Out of the farmers surveyed, 82 percent are involved with a farmer group and 92 percent of those farmers claim that their groups are receiving information about new farming technologies. When farmers said that they were learning about new technologies through NGO's, 23% of the time they specifically mentioned ICIPE.

Farmer to farmer is a term that is used to describe when farmers get information from a fellow farmer. This could be a neighbor, a brother, a sister, or any other farming acquaintance. From the surveyed farmers, 27 percent report of speaking to their neighbors about new technologies in farming daily, 40 percent weekly, 14 percent monthly, another 14 percent yearly, and 5 percent of farmers report that they never talk to their neighbors about agricultural technologies.



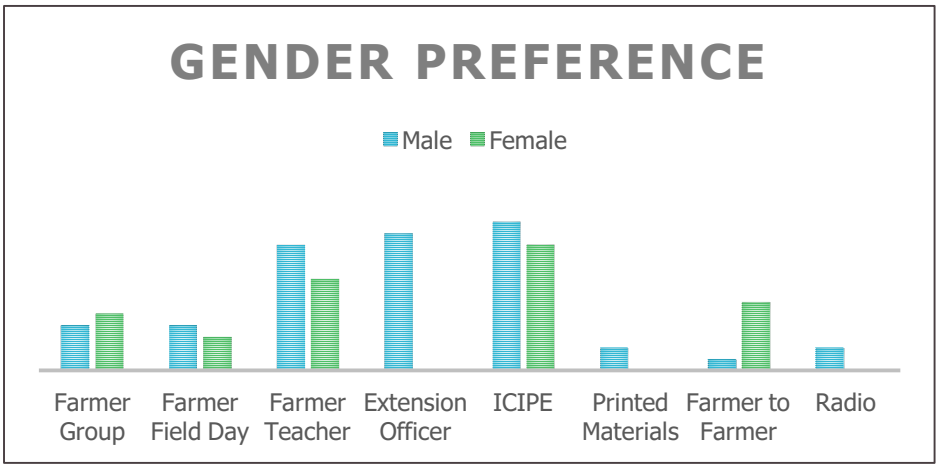
The next objective, to identify the most effective way to communicate push-pull technology to farmers, was also met with clarity. Twenty-four farmers, or 27% of the farmers surveyed, said that ICIPE was the best source for disseminating push-pull technology. With nineteen votes, the source farmer teacher came in second place. In third for the most effective method of disseminating push-pull, twelve farmers on board, extension officer came into play.

When asked why these top three methods were preferred there was a variety of reasons given. Farmers that preferred ICIPE said that the source was trustworthy and convenient. Farmers were very thankful for the times that ICIPE technicians and scientists have come to their homes and their farmer groups. Farmer teacher, the second best method to disseminate the knowledge-intensive agricultural technology, often times serves as the mediator between farmers and scientists. Farmer claim that this is a preferred source because farmer teachers have the opportunity to be visual and more social with the farmers.



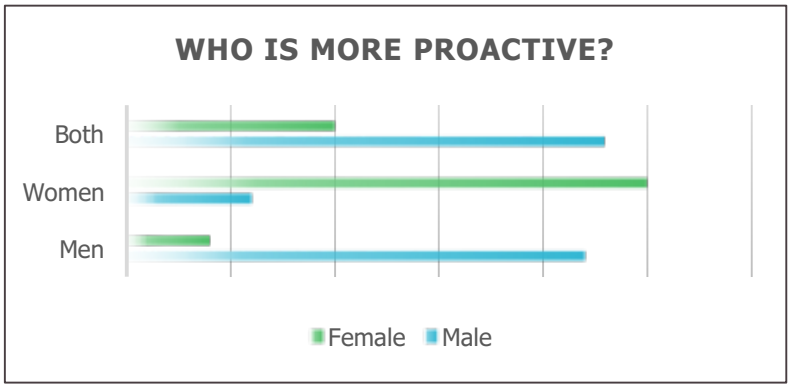
The third best source to disseminate push-pull technology is the use of extension officers. Even though 24 percent of farmer's report that they *never* see an extension officer, and another 25 percent say they only see them one to three times a year, twelve farmers claim that the extensions officer are the best source to disseminate push-pull technology. These farmers say that extension

officers are very direct. Extension officer are also the most practical source because they often give farmers inputs such as seeds.



To compare the ways that males and females prefer to gain new information, otherwise known as the third objective, was also completed. While both men and women prefer ICIPE for the source to learn new agricultural information, the comparisons almost stop there. Twelve men prefer extension officer, coming in second place for them, while no females reported that extension officers were the preferred source. Female's second choice and male's third choice both comes out as farmer teacher. The women's third preference came out as farmer to farmer, while less than two percent of males gave their preference to farmer to farmer.

The reasons of preference also saw some significant variance. Both genders say they prefer a source that is – in order of frequency – practical, convenient, trustworthy, and direct. With that being said, almost 59% of women prefer a source to be social with a community feel, where only 18% of men said that they care that the source is social or community-oriented. Also, 5 percent more men than women said that they want the source to be visual.

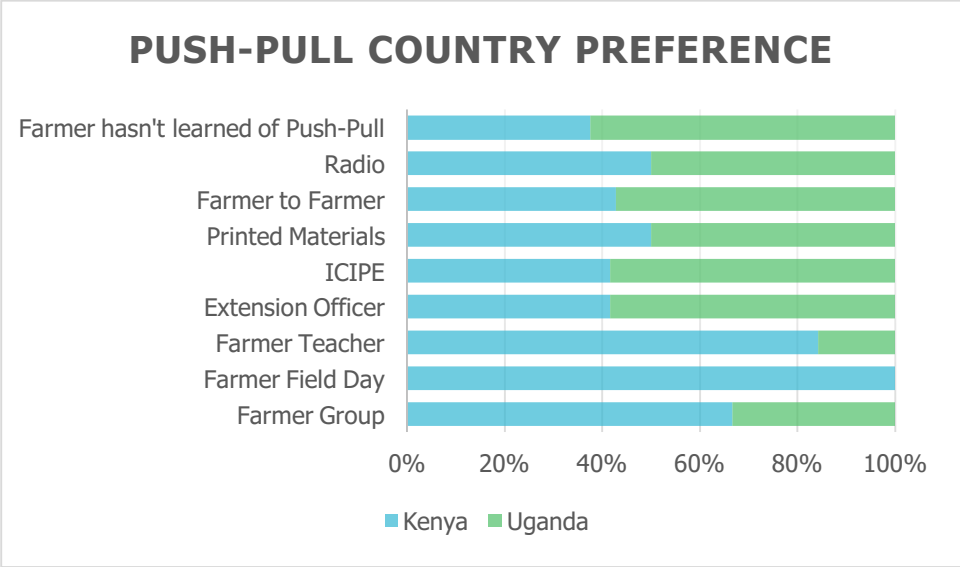


When sorting through the differences between male and female farmers, the research also points to which gender is perceived as more proactive in learning new farming technologies. If this can be clearly identified, ICIPE could use the gender involvement to find the most effective way to

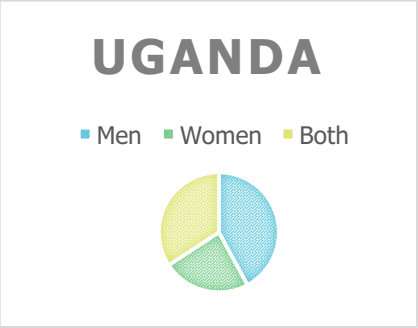
target the most proactive family member per household. However, because of two drastic differences in culture norms between Kenya and Uganda, the overall majority of farmers replied to the question with "both."

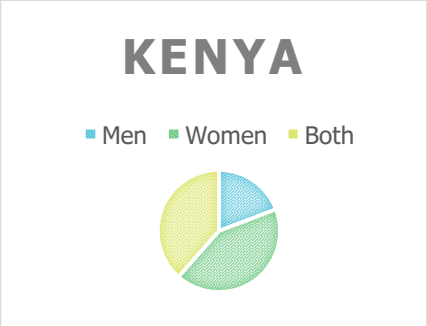
While "both" is the answer while looking at the entire survey sample, the next objective will explore how this varied over country borders and cultural perceptions.

The fourth objective, to assess any differences between how Kenyan and Ugandan farmers learn new technologies, was also met. The best source for Kenyan farmers were the farmer teachers. The best source for Ugandan farmers was ICIPE. While ICIPE comes in second for Kenyan farmers, the extension officers are the next best source for farmers in Uganda. In Kenya, the third most effective source was farmer field days, but in Uganda there was not a single farmer who said the field days were the most effective. The third best source in Uganda came out to be farmer to farmer. Ugandan women, especially, explained that their neighbors were very valuable sources because it was the most convenient, while it was also meeting an otherwise unmet social need.



As mentioned earlier when asked who is more proactive in learning new farming technologies, there was a significant difference in results. In Kenya, 19 percent replied "men," 42 percent replied with "women," and 39 percent replied with "both." However, when asked the same question in Uganda, 42 replied with "men," 24 percent replied with "women," and 34 percent replied with "both." With more than 20 percent more respondents in Uganda believing that men are more proactive, many questions are raised. Is this cultural? How do this affect the dissemination methods effectiveness? Is ICIPE targeting the wrong family member in Uganda? What about in Kenya? The graphs below reflect the almost "flip-flop" of reactions given by the two countries.





The last thing to analyze are the results from the focus group discussions. The number one source that farmers in the Kenyan focus group discussion recognized for disseminating agricultural technologies was farmer teachers. This confirms what the surveys found from the farmers surveyed in Kenya. Farmers also confirmed that the farmer teacher is a trustworthy and frequent source. They also appreciate the experience that farmer teachers come to them with. The next two sources mentioned were extension officers and farmer field days. Extension officers took the second most effective method just two votes ahead of the farmer field days. When it came down to it, the extension officers are much more frequent than the field days and the frequency helps enforce much more information. Something to take note is ICIPE or any other NGO did not come up in the focus group discussion until the conversation was specified about push-pull.

When asked what the most effective method to disseminate push-pull technology the rankings shifted. Farmer teacher still took first place, then ICIPE, then exchange tours that are organized by farmer groups and farmer teachers. Farmers appreciate how direct and convenient it is when ICIPE comes to their villages and homes. They also mentioned that there are many benefits of using farmer groups. The farmers spoke on how extension officer and NGO's can reach farmers very easily. The use of farmer groups make farmers feel less alone with their everyday struggles.

It was immediately noticeable that it was going to be much harder to get women involved with the group discussions. When asked who was more proactive in adopting new agricultural technologies, men or women, four of the eight women present did not vote. The strong female involvement in Kenya stood strong throughout the focus group discussion nonetheless. Seven votes went to "women," two to "men," and one to "both."

The farmers in Kenya believe that the future of disseminating agricultural technologies belong to distance learning. They grew excited as the use of videos within farmer groups came up in conversation. They reported that videos over projectors would be incredibly effective so that the farmers could pause or replay parts of the information that were confusing.

After interviewing the thirty-eight farmers in Uganda, a focus group discussion was also executed there. The number one source identified for disseminating any agricultural information was ICIPE field staff. They'll work with farmers face-to-face, they are current and relevant, and they connect with an entire community. This aligns with what was found in the surveys. However, the number two method found in the Ugandan discussion group was quite different, it was the radio. The explanation was short and sweet; almost everyone has a radio. The third source rang true to that

of the surveys with farmer-to-farmer. Getting information from the fellow farmer is convenient, approachable, and friendly.

When the conversation shifted to the push-pull technology the number one source was confirmed from the surveys: ICIPE. They appreciate how the ICIPE field staff gives information on the ground. The trainings and the farm tours that ICIPE runs ensures understanding before moving on to the next step. The extension officers through the government in Uganda was the second most effective source for disseminating push-pull technology, the focus group decided.

The third most effective source for disseminating the push-pull technology is a Uganda to Kenya exchange tour. The Ugandan focus group grew excited and intrigued when a woman in the group brought up how the government had taken her to visit push-pull plots in Kenya. She said that once she saw the benefits that the Kenyan farmers were reaping with her own eyes, she was sold. She returned home and adopted the technology immediately. Her experiences alone were enough to even get her neighbors to adopt.

This is the idea that needs to be expanded upon on as the fifth and final objective is covered, to investigate new ways to communicate push-pull technology to farmers. Ugandan's idea of exchange tours is in essence the key to producing the push-pull communities that the Kenyan farmers were dreaming about. Ugandan farmers reported that they would be more than leaving their farms and families for the days necessary to make the trip to Kenyan push-plots, they see it as an investment in their future. They believe that if even a small group made the trip it would increase believability for an entire community, village and beyond. They used the words "ripple effect" to describe the potential dissemination pathway.

The exchange tours don't have to stop between Kenya and Uganda. Many farmers involved with farmer groups in Kenya shared that their group would go and visit the plots of farmers belong to other groups. The groups could compare what was working and what wasn't working, share resources, and learn from one another. The Kenyan focus group discussion also brought something worth expanding on: the idea of a push-pull community.

These bright farmers shared that with a proper system in place, of knowledge sharing and facilitation, a push-pull community can be achieved – and with ease! They farmers shared that in their experiences the dissemination of the knowledge-intensive technology went the smoothest when ICIPE field staff worked with and facilitated farmer teachers. From there, the farmer teachers go to farmer groups and individual households teaching and guiding the farmers along with the execution process of push-pull. The last step would be other farmers observing the success push-pull adopters are having, which in turn would put the push-pull farmer in the position to teach the neighboring farmer.

The farmers in Uganda even had the idea of starting a demonstration garden. This would be a place where they could all farm and learn with one another. The community members that work the demonstration garden would get shares of the harvest. But even those who don't yield maize, would yield experience; and these farmers are all yearning for the long-term yields.

The farmers recognize that push-pull's benefits are not limited. They are very willing to see what a push-pull community could achieve through exchange tours, demonstration gardens, and group facilitation. The potential is quite possibly endless for these opportunistic farmers.

Connection to Food Security

The connection of food security is rather simple. The International Centre of Insect Physiology and Ecology is working on technologies that have the potential to change the lives of people living in the tropics. Many farmers confessed that adopting push-pull technology had created many opportunities for them and their families. Children were going to school and staying in longer, they were able to buy more diverse food products, adding to the nutritional value of each meal, and the labor per acre dramatically decreased, allowing the women to have leisure time or community and group time.

ICIPE's goal for 2020 as set by Professor Zeyaur Khan is "To end hunger and poverty for 10 million people by extending push-pull technology to one million households in sub-Saharan Africa." After a two months of working with this organization, there are no doubts that they are well on their way to this milestone. With this being said, the dissemination pathways are absolutely crucial to reach one million households.

The first objective of the research made certain that they were not missing any pieces of the way to reach farmers with new technologies in agriculture. The first objective was assurance that yes, farmers are utilizing these methods and ICIPE is reaching them. The second objective informs ICIPE field staff and technicians which methods are the most effective. While ICIPE as a whole was the best overall method for disseminating the push-pull technology, farmer teachers came in a close second. Is there an opportunity to increase farmer teacher facilitation from ICIPE? How can ICIPE farther enable these farmer teachers to help farmers adopt push-pull?

The third and fourth objective specified the target market. In Kenya, the women are more likely to bring home information about farming and implementing in, but in Uganda the opposite is true. What can ICIPE do to make sure the appropriate family member is receiving the information? If there's hidden value in engaging the opposite gender, how can that be obtained?

The fifth objective is the most directly connected to food security in a sense. The research heard from farmers whose food security relies on the adoption of new technologies – specifically push-pull. The fifth objective was answered with an open-ended question embedded in focus group discussions: Do you know of any other ways to communicate the push-pull technology to farmers? They practically answered with "Why didn't you ask us sooner?" There is no doubt that ICIPE will continue to work on ways to make the farmers' dreams of push-pull communities, demonstration gardens, and exchange tours come to life.

Although the research was not working to implementing any of these new and incredible ideas, the research identified these things. The research confirmed that ICIPE is indeed, on track to disseminate the technology to the one million households mentioned in its goal. The research wasn't the first step and it definitely wasn't the last, but it was a step. A step towards a food secure Kenya, Uganda, and beyond.

Conclusion

The hypothesis for this research was that farmers prefer to learn with a method that is convenient, social, and practical. The hypothesis was proven to be true. The five objectives of the research were certainly met and found to be meaningful information.

Knowing how farmers best learn knowledge-intensive agricultural technologies such as push-pull, is absolutely instrumental in creating the technologies as a whole. After attending the World Food Prize Global Youth Institute 2017 and hearing a variety of panels, this has become very clear. Every technology and advancement was under the scrutiny of dissemination potential. The very most life-saving technology may as well not exist if it is something that the average farmer cannot be taught and understand.

This research is relevant, it is timely, and it is worthwhile. It found that women and men take in new information drastically different. If push-pull is to be implemented in different cultures, it's important to take into account what that particular culture says about who in the household is to be bringing in new farming information. In Kenya that position is perceived to belong to the woman, however in Uganda it's by the majority the man.

The research observed that there are many potential options to educate farmers on the benefits of adopting push-pull. In Uganda this looks like farmer tours to communities in Kenya where farmers can see the advancement with their own eyes. In Kenya this looks like working with whole communities at a time to create a "push-pull community" using an adoption chain reaction.

From here, the research will be used to make decisions about funding dissemination. Why spend money on brochures if that's not the most effective medium for reading material? The International Centre of Insect Physiology and Ecology no longer has to guess on the most effective methods to teach farmers, because this research found all of those answers for them.

Personal Experiences

Growth

The personal growth that has been accumulated from eight weeks serving as an intern with the International Centre of Insect Physiology and Ecology, is more than thought imaginable. Not only has my knowledge of agriculture and scientific research expanded; but my heart for the fight against hunger and partnering with sustainable and positive disruptive organizations has also seen tremendous growth.

Adapting to a different culture and learning not only to work, but also to grow in that culture, has led to personal growth and a much greater understanding of what is at stake. A greater awareness of the obstacles intrinsic to the problem and an understanding of the specific steps in the fight to end hunger is knowledge that is valuable beyond measure. The length and severity of a small piece of the puzzle has already become clear. This new awareness not only creates an unlimited respect for those who are currently dedicated to the fight, but also a committed passion to do and learn

everything possible to stand beside and to assist those who have devoted their lives to making a real difference in this space – global food security.

The people that I have had the opportunity to work with created a lasting impression on me. The holistic environment throughout the ICIPE Campus in Mbita is one that is focused on creating a better life for their brothers and sisters throughout Africa. After reading a notebook that I carry that reads "Follow Your Dreams," a dear friend, Rachel Odhiambo, said "Follow your dreams… hmm. Well make sure you do!" She then walked away, into her office, and went about her day not realizing that her words would stick with me for years to come. Things like dreams, wishes, and goals often get taken as something soft or "wishy-washy" in our society. But Rachel almost commanded me to follow my heart like it was the only logic thing to do! I think she's onto something.

This internship has given me the confidence to set goals and tackle them in a whole new method. I remember listening to the Borlaug-Ruan interns present my sophomore year and thinking "If only." Despite my doubts in myself, I made a sticky note that read "I will be a Borlaug-Ruan intern" and didn't take it off of my wall until I was leaving for the airport. I also remember watching the Elaine Szymoniak and John Crystal award winners being announced and thinking "I wish." Nonetheless, I wrote it down on a sticky note and put it on my wall. I also took that one down as I was leaving for the airport. But only to put it in my backpack and take it along. I know that I am the biggest questioner of my abilities, but because of my time in Mbita I am working to change that mindset to be the biggest believer in my abilities.

The real personal growth comes to me in flashes. As I have started classes in my third semester in my college career at the University of Nebraska- Lincoln, I am finding myself more engaged and inspired in my Plant Science, Innovations in Agriculture, and Science Literacy classes. I have a real life example to turn back to, to reflect on, and to build upon for every page I may turn to and every assignment I may submit. When we talk about environmentally sustainable ways to fight against insects, I always argue the use of intercropping with natural-chemical enemies. When running experiments in the greenhouse, I am drawn to contrasting the effects of climate change on legumes native to different places in our world. When talking about the process to become published in the scientific community in Science Literacy I grow excited – and I know it's because my time as a Borlaug-Ruan intern ignited in me an interest that I will soon not forget or extinguish.

Another example would be when I recently ran my first focus group discussion for Sustaining Sprouts – a program I am working to start in Lincoln that engages young people in agricultural literacy by connecting them to an urban garden, which in turn enables them to bring home fresh produce to their families. I was instantaneously brought back to the first focus group discussion I ran in Mbita. We had more than twenty farmers attend from Migori county. Instead of a back yard, shaded and warm, we sat in front of white boards and projectors in an upstairs classroom of an old university building. After running the focus group discussion, a professor who attended asked me how I knew that a focus group would be successful. I told him I learned it from a mentor back in Mbita, Aloice Ndiege.

When I try to get a glimpse of my ever-changing future, pieces of my time in Mbita remain. In the decisions I make, the program and organizations I build, and the places and people with where and

whom I spend my time. I believe that the foundation was built when I boarded that first plane out of Omaha.

More Pictures

Bibliography

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