

# Rural youths and ÷Push-Pulløfarming in Western Kenya: The present and future of agriculture in Africa

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## Abstract

Rural youths and ÷Push-Pull÷ technology in Western Kenya: the present and future of agriculture in Africa. How can the youths and ÷Push-Pull÷ technology lead to a food secure nation and continent? My responsibility consisted of finding how rural youths and ÷Push-Pull÷ technology can end hunger. Many aspects play into the success of farming in Western Kenya. I researched the youths' challenges, ideas, perception of farming, and role in achieving a prosperous agricultural sector in Western Kenya's future.

The age of farmers in Western Kenya continues to increase. Children who grew up surrounded by their parents' farm and farming methods move to the city to find office jobs. In order for Western Kenya and the rest of Eastern Africa to achieve food security, the youths need to stay involved with agriculture. Without the youths' involvement, food security is only a fantasy.

Many agriculture developments and technologies are continuously being discovered, but how should these developments and technologies be taught and incorporated into the youths' farming operations? Also, what struggles do the youths find with farming? What actions should be done to address these struggles? What can the youths do to help themselves? In order to answer these questions, I, with the help of my mentors, developed a questionnaire administered to 40 youth farmers in the area. After these individual interviews, I talked with 12 of the farmers in a group discussion to further answer their role in agriculture, their view of agriculture, and what needs to be done to help the youths live a prosperous career and livelihood in agriculture. For further information of the dissemination of farming knowledge, I dispersed ÷Push-Pull÷ comic books amongst school pupils. Then, I interviewed them and their guardians to determine whether or not this technique is a valid way to disperse agricultural knowledge.

Many farmers spoke great words about agriculture while a few lacked the knowledge of what the future holds for agriculture in Western Kenya. The data collected helped identify certain trends between their personal thoughts of farming, methods of farming, and common difficulties between the youths. Ways to address the identified difficulties will be used by ICIPE and others trying to make a positive difference on Western Kenya's agriculture sector.

In the research conducted, many ideas, information, and thoughts were gathered. Information and knowledge seems to travel between group members. All of the farmers face daily challenges, but nearly all of them consider agriculture as a very promising career for their future. Their perception of the ÷Push-Pull÷ technology also remains positive. One common challenge is the need for farm inputs in the farmers' initial years. The lack of market to sell the surplus produce was another common issue. The common solution consisted of the farmers pooling their resources together to help each other with start-up inputs and equipment. The government, non-government organizations (NGOs), and research institutions should provide trainings: teaching the youths how to farm productively and efficiently. Another way to disperse agriculture knowledge is through the comic books. The agricultural knowledge will lead to success. 100% of the farmers wanted more training. ÷Everything comes from the soil,÷ one youth farmer exclaimed. With the help of local groups and organizations, I also believe everything can come from the soil.

## Acknowledgements

First and foremost, I must express my appreciation to Dr. Norman Borlaug, Mr. John Ruan, and Ambassador Kenneth Quinn for making the Borlaug-Ruan Internships possible. Due to the leadership and inspiration of these three men, I had the opportunity and motivation to work on food security issues in Kenya for two months. It was a great honor to be a Borlaug-Ruan Intern. I would also like to thank the Youth Programs Director, Lisa Fleming, for inspiring myself and all the other young adults to become involved with the World Food Prize. Lisa, thank you for organizing my internship and continuously checking in to make sure it was the best experience possible.

I would also like to thank the Director General of ICIPE, Dr. Segenet Kelemu, for allowing me to become a part of ICIPE. Thank you to -Push-PulløProgram Leader, Professor Zeyaur Khan, along with Senior Scientist, Dr. Charles Midega, for assigning me to such an interesting research project and taking time to help me throughout it. Thank you to the staff who helped me throughout my research and traveled with me to the field, especially Aloice Ndiege, David Winyo, Rachel Owino, Jimmy Pittchar, Alice Murage, and Eunice Mumbo. You all made my research project operate efficiently, for you helped me collect very valuable data in a short amount of time. Thank you to the drivers for driving me throughout Western Kenya's country side. Thank you to all the participants in my research, especially the many youths. Without your participation, none of my contributions would have been possible. Erokamano!

Thank you everyone within ICIPE and Mbita, especially George Genga, Geoffrey Odoyo, Frank Hamza, and Kennedy Okoth for teaching me about Kenya's culture and customs and accompanying my travels. Thank you to all the children I met; each one of you left a lasting impression on me. Whether teaching you about -Push-Pull,øplaying frisbee, or greeting one other, I always enjoyed your presence. Thank you for the many great experiences.

Thank you to Michael Obondo and all of his staff for making my stay very comfortable and preparing the best food I have ever eaten! Thank you to the ICIPE security for keeping me safe throughout my time at ICIPE. Thank you to all of ICIPE's staff and security for making my experience very safe and comfortable.

I would like to thank all the people who were instrumental in bringing the World Food Prize Program to my school, especially my agriculture education teacher and FFA advisor, Mrs. Bond, for allowing me to take advantage of the many opportunities. Thank you for encouraging me to participate in the World Food Prize Youth Institutes and to apply for the Borlaug-Ruan Internship. You always pushed me to go above and beyond, and I really appreciate it.

Lastly, I would like to thank my friends and family. Thank you for staying in touch with me over the summer with the many conversations. Thank you to my three sisters: Kaylyn, Jenna, and Morgan; thank you for your continuous support and for keeping me informed about activities occurring at home. Most importantly, thank you to my parents, Kevin and Amy Brandt, for supporting me in all I do and for always being there when I needed you. Thank you for your continuous love and support. Thank you both friends and family for always encouraging me to reach my goals.

## **Introduction**

### **Life in Iowa**

I grew up on my family's corn and soybean farm just outside of Sumner, Iowa: a small town in Northeast Iowa. Agriculture always interested me but I was unsure what I exactly wanted to accomplish with my interest. I graduated from Sumner-Fredericksburg High School in the spring of 2015 and plan to attend Iowa State University in the fall majoring in Agriculture Engineering. The summer leading up to a new beginning of college was the unknown as I applied for a Borlaug-Ruan Internship offered through the World Food Prize.

I grew up surrounded by agriculture. My dad sells John Deere equipment and farms with my uncle, and Iowa leads the United States in corn, soybeans, hogs, and egg production (Kids ag facts, 2015). Furthermore, 90% of Iowa's land is used for agriculture production (Kids ag facts, 2015). I was, indeed, immersed in agriculture. Because of the influences surrounding me, agriculture always intrigued me; before conducting research at ICIPE, I was unaware of the need for progression in the agricultural sector for small-holder farmers.

In 2013, my sophomore year, my agriculture education teacher and FFA Advisor, Mrs. Bond, approached me about writing a paper discussing food security for the World Food Prize's Iowa Youth Institute. Never wanting to turn down an opportunity, I wrote a paper discussing issues and facts of Algeria's food security. When I attended the 2013 Iowa Youth Institute, I learned about a different world from the one in which I live; I wanted to learn more. The following year, I wrote another paper for the 2014 Iowa Youth Institute; this time, about Burundi's food security issues. Fortunately, the 2014 Global Youth Institute selection included me.

The Global Youth Institute inspired me to continue looking into agricultural issues around the world. I learned about a separate way of farming at the Global Youth Institute. Honored of the opportunity, I listened to Dr. Emma Naluyima from Uganda speak. She talked of the productivity of her one acre farm consisting of a pig breeding operation, a fish farm, a banana plantation, and a vegetable farm. From one acre of land, Dr. Emma Naluyima made a successful career for herself. In comparison, this would be hard to accomplish on one acre of land in Northeast Iowa; her story inspired me to want to learn more about the farming in Africa and other places around the world by experiencing their agriculture systems first-hand.

Because of my great experience at the 2014 Global Youth Institute, I decided to apply for a Borlaug-Ruan Internship. I knew it would be a great experience, and I looked forward to sharing my knowledge of agriculture and learning about the practices used around the world. Thankfully, I opened the letter in the mail announcing I would be a Borlaug-Ruan Intern placed in Mbita, Kenya at a research institution known as ICIPE. I would be working with Professor Zeyaur Khan and his Push-Pull team. After reading more about Push-Pull, I knew this was the perfect internship for me as the Push-Pull technology is meant to be incorporated with maize and helps the other entities of the farm. I looked forward to seeing it in action.

## **International Centre of Insect Physiology and Ecology (ICIPE)**

ICIPE was established in 1970 by African entomologist, Professor Thomas Odhiambo, due to the special problems of developing tropical countries (About us, ICIPE, 2015). ICIPE's mission states as follows "to help alleviate poverty, ensure food security, and improve the overall health status of the people living in 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 (About us, ICIPE; 2015, p. 3)."

Originally, I thought I would be working with insects all summer. Though insects are one of ICIPE's main focuses, they work on a much broader range of subjects to better meet their goal of improving the livelihoods of communities in Africa (About us, ICIPE, 2015). ICIPE has three objectives for this millennium: help ensure food security and better the health for humankind and its livestock, protect the environment, and conserve and make better use of natural resources (About us, ICIPE, 2015). Nairobi, Kenya houses ICIPE's headquarters, but many other ICIPE campuses are located throughout Kenya. Each ICIPE campus works with the 4-H research areas: human, animal, plant, and environmental health (About us, ICIPE, 2015). Four goals span all four of these areas: create knowledge, build capacity, develop policy, and reduce poverty (About us, ICIPE, 2015).

ICIPE performs many research projects to better improve the livelihoods of the people. Although time consuming, they take it upon themselves to disseminate the results of the experiments to the ones who need it through presentations, articles, publications, extension staff, and field days. The social workers and extension staff of ICIPE works extensively to put their results in the hands of the people: educating them in every way possible to help improve their lives.

### **Thomas R. Odhiambo Campus**

My summer was spent in Mbita, Kenya at the International Centre of Insect Physiology and Ecology (ICIPE) Thomas Odhiambo Campus named after the institutes founder and first Director General. In 1977, the facility was founded with the main purpose of providing a campus capable of performing field research (About us, Mbita; 2012). It is located on the shores of Lake Victoria within the Mbita Point Township (0°25'56.5"S 34°12'35.0"E). The facilities within the campus include state-of-the-art laboratories and offices, staff housing, a guest house, a clinic, a school, screen houses, and field experimental plots.

Research is continuously performed to develop environmentally-friendly, sustainable, and affordable technologies to help resource-limited farmers. The research at the Thomas Odhiambo Campus broadly falls under four categories: Habitat Management, Mosquito Research, Tsetse Research, and African Fruit Fly Initiative Project (About us, Mbita; 2012). Many universities, organizations, and visiting scientists work to solve some of Africa's most pressing issues. I was assigned to work on Habitat Management; more specifically, I was assigned to work with the Push-Pull technology.

## Purpose of the 'Push-Pull' Technology

Growth in Africa's agriculture production is essential to keep up with the demands of the growing population. However, many constraints within the agriculture sector prevent Africa from eliminating poverty and food insecurity. Poor soil quality, striga, and stem borer contribute to Africa's low crop productivity. The production dramatically increases when controlling these three problems. 'Push-Pull' technology accomplishes the elimination of striga, stem borer, and soil degradation.

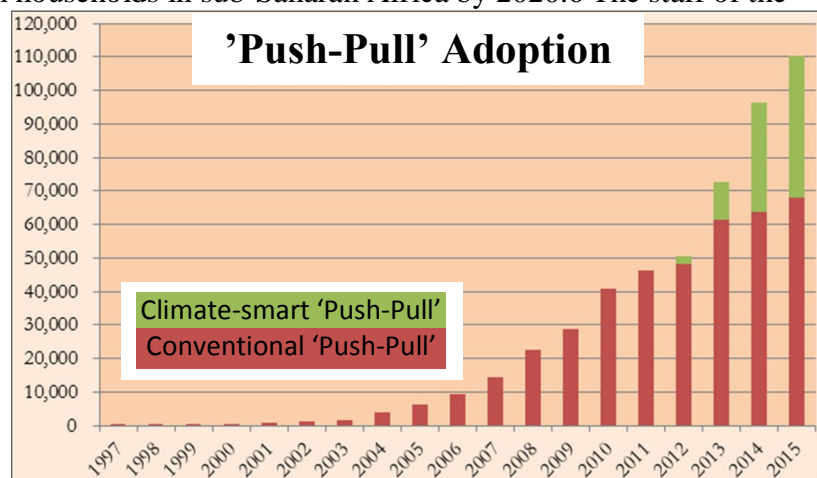
Principal Scientist Professor Zeyaur Khan leads the 'Push-Pull' technology team. Instead of using expensive, toxic chemicals to reduce the striga and stem borer within a corn or sorghum crop, 'Push-Pull' exploits the natural relationships between plants and insects. In essence, nature's way of staying balanced incorporated into a man-made, maize field. It involves intercropping Desmodium within maize and planting Napier grass along the outside of the field--the system is both effective and sustainable.

Currently, 110,245 smallholder farmers in Western Kenya use the technology (Push-Pull, 2015). The technology is being rapidly adopted for good reasons. Resource limited farmers possess capability of incorporating the technology into their existing farm operation. The access to the knowledge and resources to make 'Push-Pull' technology work are readily available. The corn yields for the 'Push-Pull' farmers triple in production due to the elimination of striga, stem borer, and soil degradation; the Desmodium adds organic matter to the soil acting as a nitrogen fixing legume. Other areas of a 'Push-Pull' farm also have noticeable increases in production. The Desmodium and Napier grass provide nutritious fodder for the livestock, increasing their meat and milk production. Because these animals no longer need to graze along roadsides for fodder, their manure can be applied to all of the farmers' crops. This causes all entities of the farm to receive a boost in production; with 'Push-Pull' incorporated on Western Kenyan farms, food security will become obsolete.

## Future Goals of the 'Push-Pull' Technology

Professor Zeyaur Khan, Principal Scientist and 'Push-Pull' Program Leader, stated the future goal of the 'Push-Pull' Program: "To end hunger and poverty for 10 million people by extending Push-Pull technology to 1 million households in sub-Saharan Africa by 2020." The staff of the

'Push-Pull' Program continuously works towards this goal; with the current rate of adoption, the goal should be achieved. The 'Push-Pull' team has not settled for what has been discovered; instead, they are looking for more drought and disease tolerant plants to be used within a 'Push-Pull' plot. With every adoption of the 'Push-Pull' technology, another family achieves food security.



## **Mentors**

I had the honor of working with many wonderful people throughout my internship. They were all very encouraging and helpful. Each mentor tremendously impacted me during my time at ICIPE. They taught me about food security in Western Kenya and helped me with my research, allowing me to make a difference in the two months I spent in Kenya.

My assignment and research would not have been possible without Professor Zeyaur Khan, Principle Scientist at ICIPE. He has been an international scientist for the last 30 years, having a great impact on agricultural sciences including substantial advancements in his research of the -Push-Pull technology. In the past, he has been involved with many research institutions and universities. Professor Zeyaur Khan speaks at many events, sharing his knowledge of agriculture. Due to his agricultural findings and leadership, he holds ownership of many prestigious awards such as the Nan-Yao Su Award and the Louis Malassis Prize.

Many mentors worked with me throughout my research. Jimmy Pittchar, a social scientist, helped me develop a questionnaire for my interviews and group discussion. He works to up-scale the -Push-Pull technology throughout East Africa by conducting social science research and developing partnerships with other research institutions and non-governmental organizations (NGOs). Aloice Ndiege accompanied me on my trips to the field and helped with translations when needed. As a field technician at ICIPE, his main responsibilities consist of educating farming groups about the -Push-Pull technology. Also assisting me in the field was David Winyo, a field assistant, responsible for meeting and talking with the farmers daily. Rachel Owino supported me throughout my research of conducting interviews, group discussions and talking with the school children. She is a technology dissemination officer, responsible for coordinating -Push-Pull dissemination activities. Without the help of all these inspiring ICIPE staff members, my research would not have been possible.

## **Research and Analysis**

### **Responsibilities and Objectives**

My research consisted of developing an understanding of the youths' views of agriculture and their role in Western Kenya's agriculture. Additionally, I was to determine whether the youths could be used as a pathway to pass knowledge about agriculture and -Push-Pull technology to their farming guardians. To eliminate food insecurity faster, -Push-Pull technology needs to be rapidly adopted by as many farmers as possible. Both of these assignments were perfect to determine what the next generation of farmers is going to accomplish within agriculture to work towards a food secure Africa. I took upon myself three main routes to achieve my objectives.

The first route included interviewing 40 farmers from three farming groups: discussing various points of agriculture including their challenges, perception, and ideas of what needs to be done to improve farming. Also, I gathered background information about their farm such as the techniques used and the amount of acres farmed. Many of the questions I left open-ended to accurately gather the farmers' thoughts and opinions of agriculture. After gathering the data, I analyzed it to determine if any trends and common answers needed to be addressed. The second



route towards learning about the youths in agriculture was a follow-up to the interviews. I lead a group discussion with 12 youths, 4 youths from each farming group, to further learn about their perception of their agriculture outlook for their future. We discussed both positives, negatives, and what needs to be done to address the negatives and further improve the positives. By understanding the youths in agriculture, it becomes much easier to help them achieve a prosperous future in agriculture.

The third route to my research aimed towards younger youths. I briefly talked with a local primary school about the advantages of -Push-Pull technology. After discussing how -Push-Pull technology works with the children, I handed out comic books with a story line of a farmer adopting the -Push-Pull technology. All the information needed about how and why it is important to adopt the -Push-Pull technology is in the comic book. The children were held responsible for the important part; they read the book and took their knowledge back home to their guardians. A couple weeks after visiting the school, I visited their guardians to discover whether or not the children effectively dispersed the information, and I visited the children to see what they thought of the book and teaching their guardians about the -Push-Pull technology.

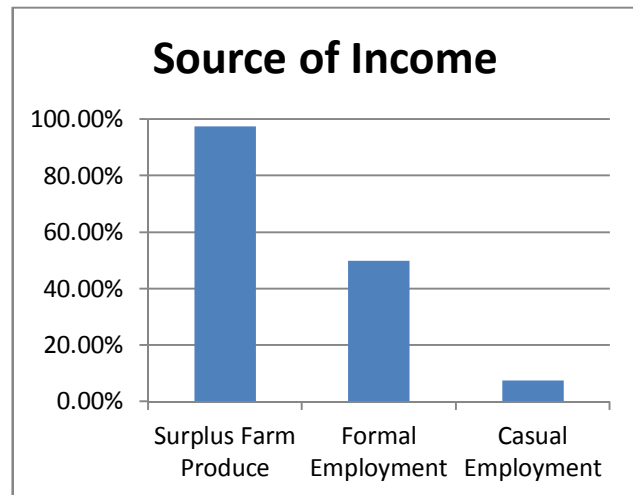
Within these three routes, I gathered relevant information which helped develop a clear understating and conclusion. A lot of the work was spent in the field; the rest of my time was spent preparing, organizing, and analyzing the results. The results shall be put to use by ICIPE staff and other organizations that find the information helpful.

## **Individual Interview Results**

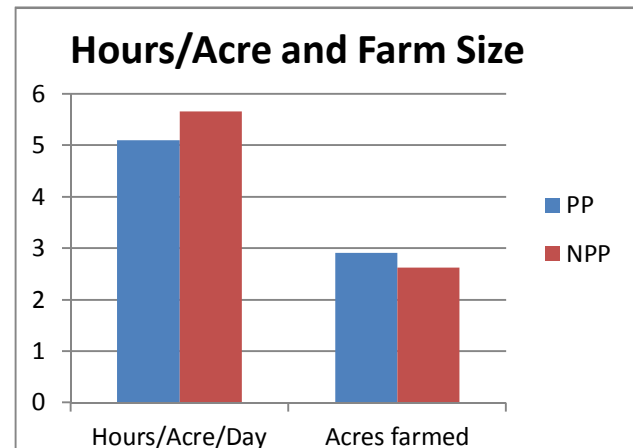
**Demographics:** The interviews involved 40 youth farmers: 19 males and 21 females ranging between 21 and 35 years of age, with the average age of 32 years. 14 members were selected from Ndiru Youth Group, 14 from the Wajuko Youth Group, and 12 from Nguvu Youth Group. All members resided in the Lambwe division in the Suba district (0°34'31.6"S, 34°22'10.3"E). 34 farmers were married, 3 were single, and 3 were widowed. 22 farmers top education level was Primary, 12 received Secondary Level, and 6 attended College. These farmers were selected specifically to meet the criteria for the research while keeping equality in age, gender, youth group, and geographical location.

**About the farms:** On average, the youths have access to 2.77 acres which is acquired in several ways. 60% of the farmers inherited their land from their parents, while 17.5% both inherited and purchased/rent their land, 12.5% rent their land, 5 % purchased land, and 5 % are not farming independently. 47.62% of the interviewed farmers were practicing -Push-Pull. In total, 10 crops accounted for the top four crops the farmer grew. The order of popularity is as follows: maize, beans, sorghum, ground nuts, vegetables, green grams, cassava, soybeans, sunflower, and butter nuts. All farmers owned livestock; in total, they owned five types of livestock. The popularity of livestock raised is as follows: chickens, cows, goats, sheep, and donkeys. The farms were very diverse, raising many types of crops and livestock.

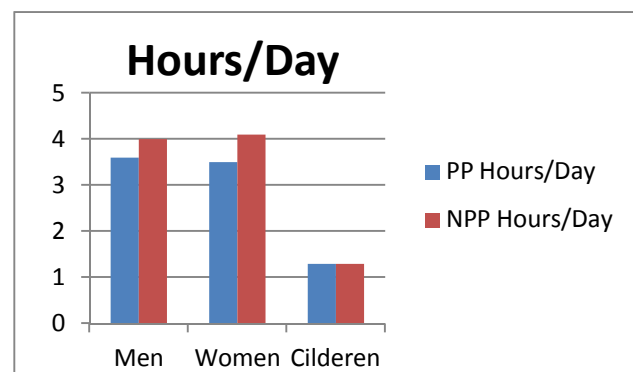
Farming was a necessity for all of the youth farmers; it provides food security along with income for the youths. 97.5% of youth farmers reported farming as being a source of income for their family; while, 50% reported formal employment and 7.5% reported casual employment as a source of income for their family. One farmer reported buying motorcycles with the money he made in agriculture. Not only does farming provide the necessities for the youths in Kenya, they now afford luxury items: improving their standard of living.



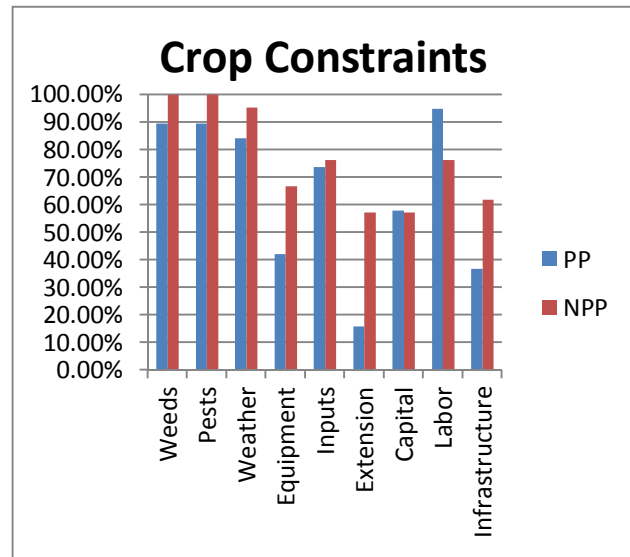
Push-Pull farmers reported working slightly less hours per acre each day at 5.1 hours versus the non-Push-Pull farmers 5.6 hours. In addition, the Push-Pull farmers' farm size averaged 2.92 acres versus the non-Push-Pull farmers' 2.63 acres. Though the differences may seem minute, it is a difference worth noting when looking at the efficiency and productivity of the farmers based on their practices such as Push-Pull. The more efficient practices allow the farmers to farm more land to produce a large plentiful harvest.



The youth farmers reported struggling with many problems for both crop and livestock production (charts on following pages). The Push-Pull farmers reported fewer problems than the non-Push-Pull farmers. The complaints of labor from Push-Pull farmers appear to be slightly skewed as Push-Pull farmers reported working less hours per day compared to non-Push-Pull farmers.



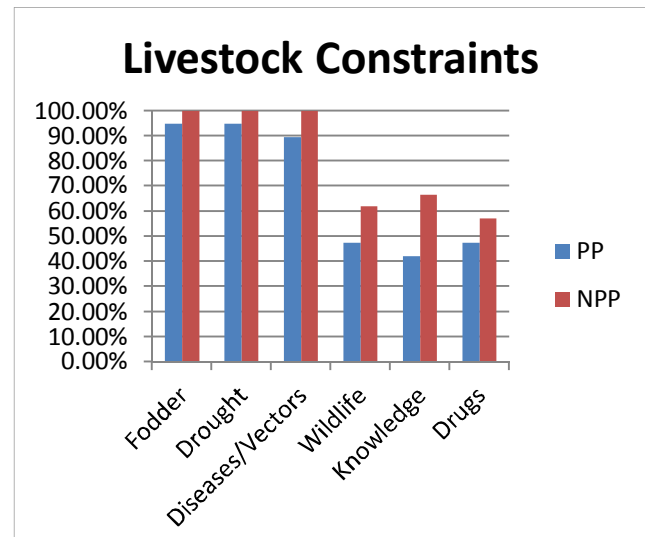
Many of the crop constraints correlate directly with lack of knowledge about farming practices, and this knowledge comes from extension staff. Only 15.79% of Push-Pull farmers reported lack of extension services while 57.14% of non-Push-Pull farmers reported lack of extension services. The majority of the problems are positively affected by Push-Pull farming. Using Push-Pull technology slows the effects of a drought on the farmers' crops. Along with poor weather, lack of fodder can be reduced when Push-Pull is implemented. Many youths stated they did not have enough seeds to establish or expand Push-Pull when all the seeds are in their or their neighbors' already existing Push-Pull field. The weeds and pests were commonly reported as being a constraint for both groups. All of the constraints can be reduced or eliminated by the knowledge taught by extension staff of the Push-Pull technology.



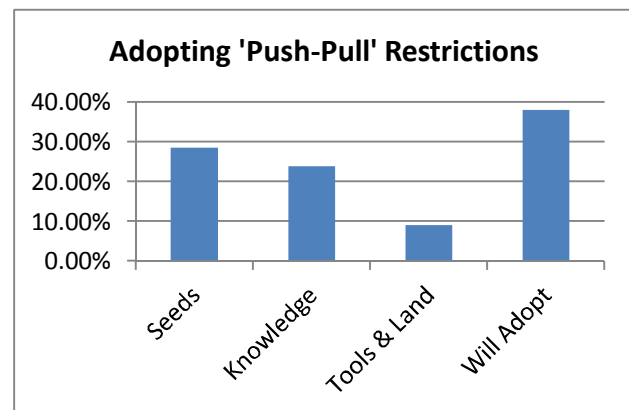
Lack of equipment contributes to the lack of labor. 54.25 % of farmers reported equipment as a concern. Farmers struggle to accomplish a day's task; proper equipment would eliminate the struggle. Improper farming methods and inadequate tools cause labor problems for the youth farmers. The proper farming equipment and methods would make farming more promising for the youths' future.

One concern seen by driving down local roads is infrastructure. 49.4% of the youths reported infrastructure as a concern because it limits the producers to their small geographic area when selling their produce. In the other category, market was the most common answer for both crop and livestock production. Though this problem is not an issue until surplus crop becomes a reality, it needs to be addressed to see growth in the industry. The market problem is a result of both poor infrastructure and knowledge about a market for specific produce. The concern varied greatly by youth group: youth groups were located different distances from the main road. Ndiru Youth Group is the closest, followed by Nguvu Youth Group, and then Wajuko Youth Group. 21.43% of Ndiru Youth Group, 57.14% of Nguvu Youth Group, and 75% of Wajuko Youth Group reported infrastructure as a constraint. The distance away from the main road limited the markets the farmers were able to reach.

The livestock constraints also correlate directly with the youths' farming methods, as 'Push-Pull' produces fodder for the animals along with limiting the effects of drought which effects fodder availability. Because the 'Push-Pull' farmers produce fodder, they control the whereabouts of their animals, allowing the collection of manure to improve soil fertility. This causes a decrease in problems with both diseases/vectors and wildlife. The 'Push-Pull' farmers subtly reported less of an issue with knowledge than non-'Push-Pull' farmers. This was the largest spread on the graph: 42.11% compared to 66.67%. Lack of drugs was reported the least amongst the farmers at 52.26%.

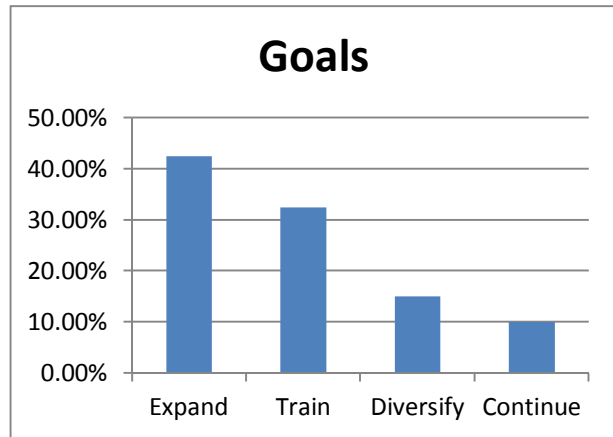


Why hasn't everyone adopted the 'Push-Pull' technology? 28.57% stated they didn't have the seeds to establish a 'Push-Pull' plot. Another 23.81% explained they have inadequate knowledge about the technology. 9.05% lacked proper tools and adequate land, while the remaining 28.57% said they plan on adopting 'Push-Pull' next season; they stated various reasons for not yet adopting such as not being around during planting and just learning about the technology.



Agriculture and 'Push-Pull' both received high ratings from the youths at 2.76 and 2.74 out of 3, respectively. Along with providing food security and an increasing amount of income due to the growing population, the youths ranking agriculture at a 3 stated new technologies are continuously being discovered along with the many people are trying to help them contribute to a positive outlook on agriculture. Those who ranked agriculture lower stated the weather, market, and inadequate knowledge concerned them. Furthermore, inadequate land prevents them from expanding. The 'Push-Pull' farmers ranking 'Push-Pull' at 3 explained it increases production throughout the farm by improving soil quality, providing nutritious fodder, and eliminating striga and stem borer. Those rating 'Push-Pull' lower than 3 explained the extra initial labor and lack of knowledge to expand limits them. Others imply they had really high expectations for the technology.

The youths set many positive goals for themselves correlating with their very positive perception of Push-Pull and agriculture. 42.5% explained they wanted to expand their farm; one farmer even wanted to double her farm size from two acres to four acres. 32.5% want trainings to incorporate new technologies to make farming more efficient. 15% wanted to diversify their farm. The remaining 10% simply wanted to continue farming to improve their lives. Goals like these will drive the future of agriculture in Western Kenya.



If agriculture is so great, why isn't everyone involved with it? In an open ended question, I collected information of the youths' major limitations and constraints for venturing into farming. Though the questions were open-ended, the answers were very similar. The youths are aware of the general limitations agriculture is facing, and the limitations their fellow youths face.

The current farmers will reach success as they are committed to agriculture. Visible success motivates farmers to continue achieving in agriculture. The struggle now includes helping and creating motivation for the youths not involved in agriculture. Only 2 farmers or 5% reported acquiring land solely by purchasing the land. This along with input expenses keeps youths from venturing into agriculture. Even if they know the benefits of agriculture, it remains difficult to start a farm. 80% of the youth farmers reported either initial costs or knowledge of the benefits to be the limitation of the youths venturing into agriculture.

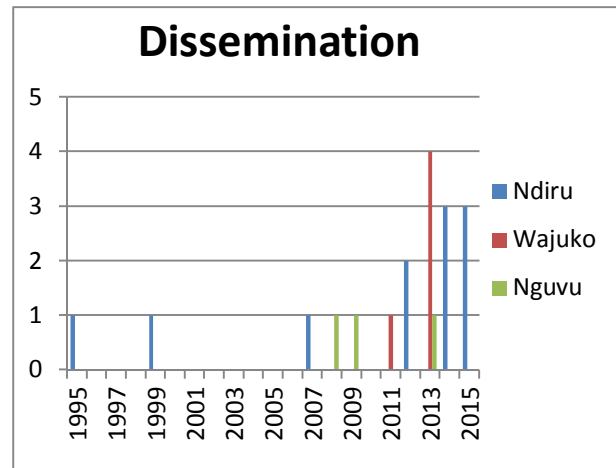
Grandmother Sarah Obama emphasized youths' attitude limits the future of agriculture throughout my visit with her. Furthermore, attitude was stated as a limitation multiple times throughout the individual interviews, but the youth farmers rated agriculture 2.76 out of 3, indicating a very positive attitude towards agriculture. When asked why attitude presents problems, most farming youths responded the youths not involved in agriculture think it is labor intensive and lacks instant returns. In this instance, the challenge is not improving the ways of farming, but instead, to develop agriculture interest within the youths. They do not know the benefits of agriculture and won't until they become involved in it.

Everyone believed the actors: the government, NGOs, and research institutions, need to do a lot to help them. Some tasks were reasonable while others were not. Providing financial support every year is unreasonable while providing yearly trainings is not. The three common roles of the government, NGOs, and research institutions included providing trainings, initial inputs, and networking. The specific roles of each organization varied greatly due to the lack of knowledge about the organizations. Between the three organizations; trainings, initial inputs, and networking need to be accomplished. All of the farmers said one or more of these three tasks when asked what the actors' role shall include. The one specific role stated by several farmers included the government developing policies to out-law roaming domestic animals which destroy the crops and reduce emission outputs of industries which contribute to climate change.

The youth farmers had many different thoughts of what they could do to help themselves; a couple had no idea of what they could do to improve agriculture. Although, there were a few prominent answers of what they thought they could do to help themselves including forming groups, finding trainings, and committing to agriculture. 32.5% stated form groups, 30% stated to find trainings, and 30% stated to commit to agriculture. These three roles accounted for 92.5% of the farmersøthoughts of what they can do to help.

The -Push-Pulløadoption backs up the group learning suggestion. It is apparent, farmers enjoy learning in group. Once one farmer within a group establishes -Push-Pull,øthe rest were soon to follow. A member of Ndiruø Youth Group first adopted -Push-Pulløin 1995; currently, 10 of the 14 Ndiru Youth Groups use -Push-Pull.ø5 of the 14 Wajuko Youth Group members use -Push-Pulløwith the first member adopting in 2011. 3 of the 12 Nguvu Youth group members use -Push-Pullø with the first member adopting in 2008. 90% of the youth farmers stated visual

demonstration as the best way to learn and teach the new technologies. One farmer exclaimed, òSeeing is believing.ö Another common way of spreading agriculture knowledge is through groups. They see other membersøsuccess with a certain practice and desire the same success.



The youth farmers enjoyed the interviews, as did I. I received many words of thanks for taking the time to visit with them. Some even mentioned how the interview òopened their eyes,ö for they were unaware of the importance of farming and -Push-Pulløtechnology until the conducted interview. They now plan to exert more effort into spreading their own knowledge amongst their peers. All of the farmers reported a need for more training. They want to do well in agriculture but are unaware of how. One youth farmerø comment applies to all, òIf I get the knowledge, I will go far.ö

## Group Discussion Results

The purpose of the group discussion was to complete the truth triangle. The three points include the interviewed farmers, the group discussion, and me. With these three inputs, I will determine the truth about the farming youths in Western Kenya. The last point needed was the group discussion. The group discussion helped validate the answers and data gathered during the individual interviews; although, a few answers differed greatly from the individual interviews.

To gather views from all the youth farmers, I made several criteria brackets, consisting of an equal number of males and females. The first criteria bracket was for age; I selected 4 youths between 18-23 years old, 4 between 24-29 years old, and 4 between 30-35 years old. 4 youths were selected from each youth group. These demographics put many different opinions in one room creating a great discussion and a few intriguing debates.

Contradicting the interviews, the group agreed on Secondary Level as the most common level of education versus Primary. Additionally, they agreed upon the average female marrying at the age of 22, and the average male marries at the age of 27. The average household size is approximately 5 people with the children beginning to work on the farm at 8 years old. The youth begin farming independently at 25 years old. The first debate occurred when the group was asked about the work proportion between males and females. They settled on 25% of the work completed by males and 75% done by females. This contradicted the interviews, as the interviews reported the men working 3.7 hours a day and the women working 3.71 hours a day, nearly identical time spent working on the farm. The men's tasks include acquiring and clearing land, plowing, and animal care; the women's tasks include planting, weeding, harvesting, and selling. One big constraint in the interviews appeared early in our group discussion, land. Most youths do not own land; although, most youths want to own land to achieve food security and provide income. Furthermore, farming is the youths' main source of income; owning land impacts profit earned for the youths.

Farming is the main source of income; although, many challenges still face the youth, reducing the amount of income earned. Their top three constraints for crop production include weeds and pests, weather, and inadequate inputs. The top three methods to combat these constraints were Push-Pull technology, weeding, and chemicals. Most youths own small livestock such as goats, sheep, and chicken, for they lack the space, capital, and feed to own other, larger types of livestock.

70% of the youths are aware of Push-Pull according to the discussion group. The youths are a great target to introduce new technologies such as Push-Pull, for they are more willing to adopt. Everyone agreed the youths are willing to adopt Push-Pull, but a few constraints prevent them from adopting. The top 3 constraints prevailed: initial labor, land, and knowledge, all comparable to the individual interview reports. The youths' favorite way to learn about agriculture was through groups, seminars, and field days.

Lower than the individual interviews, the youths rated agriculture 2 out of 3. The limitations lowering agriculture's rating included initial inputs, lack of land, peer influence, and agriculture not taken seriously. Besides the initial inputs and land, the youths' peers influence them to participate in unproductive activities or seek easy, white collar jobs, for agriculture is not seen as a legitimate job or source of income. The youths' solution and role to eliminate these constraints consists of committing to agriculture by speaking at barazas, attending trainings, and participating in groups.

Though the youths are willing to improve agriculture, actors' help tremendously impacts the pace of improvement. The group agreed upon the government needing to provide start-up inputs and improve the infrastructure in the area. NGOs shall provide training and follow-ups along with initial inputs. The research institutions need to provide trainings, certified seeds, and soil sampling. They stated that research institutions should perform soil samplings; although, 7 out of the 12 or 58.34% said they would pay for soil sampling. These questions were better answered within the group discussion than the interviews; the tasks and roles of the actors were more specific and realistic.

Trainings were a very common solution to the common constraint of lacking knowledge. The farmers in attendance attend field days, seminars, and agriculture shows throughout their career. Those three trainings were also the most requested. Farmers enjoy the field days, although complained they are too short to gather an adequate amount of knowledge. The group planned to spread its knowledge learned at these trainings through visual demonstration and talking at social gatherings such as youth groups, barazas, and churches.

All of the youths agreed on their future goals: diversify and expand. To meet their goals, they agreed upon needing more knowledge and improving market access. All of the youths enjoyed agriculture and want to operate a successful farm. Those involved with agriculture were all committed, for they know of the many benefits it has to offer.

The group discussion confirmed and verified many of the results from the individual interviews. The results disproved the time spent between males and females working on the farm, 25% male and 75% female; the most common level of education, Secondary Level; and land ownership, most youths do not own land. Whether the responses verified or contradicted the interview results, a better understanding of the youths and agriculture was gathered through the group discussion.

### **‘Push-Pull’ Comic Books Results**

The final step in my research took a short amount of time but left a huge impact on myself and the future of the ‘Push-Pull’ technology. At Lambwe Primary School, ‘Push-pull Improving Livelihoods’ comic books were handed out to all 6<sup>th</sup> and 7<sup>th</sup> grade pupils. About two weeks later 10 pupils, five from each class, four females, six males, and their guardians were randomly selected for interviews, six mothers, two fathers, and two grandparents were interviewed. The results were outstanding.

The children all found the book very interesting rating it at 3 out of 3. They found it easy to understand, taking between 10 and 90 minutes with an average of 42 minutes to interpret the comic book’s message. From the short amount of time studying the book, all went into detail of how the ‘Push-Pull’ technology works. All the pupils eagerly explained they feel capable of teaching the technology to their pupils, teachers, and guardians; they explained it was easy to pass the information they learned, rating the ease of passing the knowledge at 3.9 out of 4. The children explained their parents seemed eager to adopt the technology after further looking through the comic book. They thought the comic books were a great way to disseminate the ‘Push-Pull’ technology as it provides a great, relatable story line along with pictures. However, one studious pupil recommended a correction; the name of the main and the secondary character is the same in the Swahili version. This made it very confusing to follow the storyline throughout the book.

The results from talking to their guardians promised a great future for the dissemination of ‘Push-Pull’ technology through the use of comic books. All but one pupil read and thoroughly explained the comic book to their guardian. One parent was not taught by her child, but she read the book and understood the book very well. The guardians found the book interesting and gained a lot of knowledge about the ‘Push-Pull’ technology; their ‘Push-Pull’ understanding



explanation received a 2.8 out of 3 rating. The only suggestion involved offering the comic book in the local language along with Swahili and English to make the books easier to understand. One parent already adopted the technology and explained she now better understands how to use, benefit from, and expand -Push-Pull technology. The 9 guardians not using -Push-Pull stated various reasons for not adopting; all the reasons diminished after understanding the benefits and methods of adopting -Push-Pull technology. All farmers agreed the -Push-pull Improving Livelihoods comic book is a creative way to disseminate the -Push-Pull technology; explaining the pictures and the relatable story-line are very helpful.

Both the youths and the parents enjoyed the comic book; it was both relatable and entertaining. It is a great hard-copy of knowledge which can be referred to when needed. The comic book teaches how and why to adopt the -Push-Pull technology. With its explanation, -Push-Pull technology can become a common farming method across Western Kenya.

## **Conclusion**

No easy routes exist when trying to solve the world's food security issues. Everything must be done in steps, and no one size fits all approach exists. By taking the proper steps, food security can be diminished easier and faster. ICIPE and the -Push-Pull team would like to solve all of Africa's issues today, but they know steps must be taken. The first step shall be the dissemination of the -Push-Pull technology throughout Eastern Africa.

The youths cannot be helped if they never become involved with agriculture. Initial funding was a huge concern for the youths trying to become involved in this sector. They do not necessarily need money, but they need inputs and tools during their first year of farming. They also need the seeds to establish the -Push-Pull plot as they are very expensive for the farmers to purchase; however, many of the seeds can be harvested directly from neighbors' -Push-Pull fields. The government has a youth fund that could be tapped into for funding of inputs and equipment, and NGOs could help by providing microloans to these farmers for their beginning year. By destroying this barrier, many more youths will be able to venture into agriculture.

Once the youths are involved, learning the knowledge to farm properly constrains the youth farmers' future in agriculture. Many routes are available to address this. The farmers all enjoy the field days and agricultural trainings provided by ICIPE; they all want more education brought to them through these methods. One suggestion gathered from the group discussion is to lengthen the field days, allowing more information to be taught. The two routes I discovered that would work well include dispersing information within a group and to the school children. Farmers develop close connection amongst group members; they are willing to try new technologies together, learning from each other. In many schools, nearly all the pupils and their parents are involved in agriculture. A fast, cheap way to disseminate -Push-Pull knowledge is through the comic books; all 6<sup>th</sup> to 8<sup>th</sup> grade pupils in each school across Eastern Africa needs the -Push-pull Improving Livelihoods comic book. The children bring enthusiasm to agriculture and willingness to try new technologies. They are ready to make a difference. Working with groups and the school children is a great way to teach agricultural knowledge to the farmers.

Many of the physical problems the youth farmers face are in the government's control. Infrastructure needs improvement, especially the roads. Many of the farms are only accessible by foot: neither car nor dirt bike. In addition to improving the accessibility of farms with roads, building railroads for cheap shipment of goods would increase the size of their market. Railroads were once in the works for Kenya but have since stalled. Better transportation methods would solve the issue of farmers not having a place to sell their produce. Although, the market doesn't need to be addressed if no surplus is consistently produced; Push-Pull technology needs to be adopted by farmers across Eastern Africa. Several youths reported a need for government policies to regulate emission output of industries contributing to climate change and to regulate roaming domestic animals destroying standing crops. Two policies will make farming much easier for the youths to produce a constant surplus in their future.

Soil testing was another common request from the youth farmers. They are unsure of what fertilizers to apply because they do not know what nutrients the soil already contains. This could be a task for research institutions, NGOs, or private businesses. A private business performing these tests for the farmers would be a great addition to the agriculture sector in Eastern Africa.

Forming groups was the most popular way to solve multiple problems. Forming farmer groups would help the farmers with initial funding, tools, marketing, and most importantly, knowledge. Various organizations could help with networking, enhancing farmer to farmer extension. Farming groups solve many problems and create pride and competition amongst the groups, all very helpful to improve agriculture in Eastern Africa.

Many constraints exist for the farmers; though, many people are willing to help. It is up to the farmers to decide what they want their future to look like. Their attitudes must be positive, and they must be willing to try new technologies, determining which methods work best for their farming operation. With the help from other people and by helping themselves, agriculture can become a thriving sector in Western Kenya.

### **Contributions to Food Security**

Though my time at ICIPE in Mbita, Kenya was short, the ICIPE staff helped me make the most of it. By traveling to interview farmers, meeting with the farming groups for discussion, and talking with the school children and guardians about Push-Pull, I was always collecting information and data to be shared with those willing to make a difference for the future of agriculture in Eastern Africa. Although I, personally, did not make much of a physical impact on the people in Africa, I know that many distinguished people will continue working towards a food secure continent; using the data I collected to further advance their knowledge of ways to help the farmers. Many of the farmers and children who participated in my research directly benefited, for they bought into the Push-Pull concept, ready to adopt and teach others about the great technology.

## **The Experience**

### **Personal Growth and Experience**

After 18 hours of flying, I finally arrived in Nairobi, Kenya. I picked up my luggage and found the sign with my name on it. The ICIPE driver greeted me with a friendly smile and handshake. On the walk to the car, we spotted a big yellow clamp on the front tire. He ran to find help as I waited by the car. After a few minutes that felt much longer, I spotted the driver. At the time, I felt like my entire trip had been saved, for the driver came back with a friend who had a key. Little did I know of all the great experiences to come beyond my memorable arrival.

Many of my friends and family back home encouraged me to travel to the well-known tourist sights. One tourist destination I visited was the exquisite Ruma National Park. I saw both amazing animals and beautiful scenery. The animals included giraffes, buffalos, baboons, reedbucks, topi, and rhinos. The rhinos we saw were astounding. They grow up to six foot tall and can weigh as much as 8,000 pounds (White rhino species, 2015). The rhinos are very calm and friendly as long as you respect them. We sat within 10 meters of them for almost 30 minutes. The park and other tourist destinations had many beautiful sights; although, these sights could be found throughout Kenya.

Although I greatly enjoyed the tourist destinations, I liked traveling through the community speaking with the people living in and around Mbita: the farmers and the children. Many of the people in town knew me from seeing me at church on Sunday mornings. All welcomed me with joy. The people I talked with had so much knowledge to share about Kenya. They are truly proud of the place they call home. They face many physical challenges; although, you could never tell by having a conversation with them. They had many positive stories to share about the way they live and about Kenya.

A lot of people before me and before the people who live in Kenya today have bettered this community. I was fortunate to have witnessed a couple celebrations honoring the people who helped make Kenya the country it is today. The first event I went to was a funeral for the father of an ICIPE worker. This was a festive event with lots of people, food, singing, and dancing. It was a wonderful experience to see all the people celebrating the life of a man who affected them. The second celebration I attended was for a hero, Thomas Joseph Mboya. As a politician, he strived for more education and freedom for the people of Kenya. At the celebration, many performances displaying Kenya's culture and heritage took place. It was neat to see such a thriving culture still being lived. The people knew of the success and values of the heroes who came before them. They made sure to celebrate and learn from the success of these people by having a wonderful ceremony displaying their culture.

Another celebration I was fortunate to be able to attend was a wedding. It was very simple compared to the extravagant weddings in the U.S. Yet, it was a very nice celebration looking ahead to the years the couple will spend together. A lot of food and soda was passed around for everyone to share, and towards the end, speeches were given wishing the couple a happy marriage together. A gentleman even volunteered for me to give a short speech to the newlyweds! It was a great experience.

I was fortunate to make good friends while in Kenya. One of the many activities we took participated in included taking a trip to a nearby island. We ate supper on the beach watching the sunset. A less relaxing experience was the climb to the top of Gembe Hill. It was a great climb with a rewarding view at the top. All of these amazing experiences are within a couple miles of Mbita, a truly beautiful place.

Kenya's agriculture potential revealed itself while visiting Grandmother Sarah Obama and the Kisumu Agricultural Show. With the correct technologies implemented, success is inevitable. The crops and livestock at Grandmother Sarah Obama's home and the Kisumu Agriculture show looked outstanding. At both these locations, adequate knowledge had been learned and implemented. The knowledge and technologies for Kenyan agriculture are advancing. With the right resources, the agricultural sector in Kenya possesses no limits.

At the Guest Centre, I met many great scientist and humanitarians, all trying to make Kenya and the rest of the Africa a better place. They were from all around the world: Japan, Netherlands, Switzerland, Germany, England, Australia, Columbia, Tennessee, Georgia, and Pennsylvania. Talking with these people about their institutions and projects fascinated me as each had a specific task to accomplish. Everyone came together to make the world a better place.

I also took part in the founding meeting of an organization with the goal of connecting Christians across Kenya to better fulfill needs of the community. Everyone explained what was needed in the surrounding community and what could be done to address these needs. It was a great experience to witness the citizens of Kenya working to make a positive impact on the world.

Hope resides with the people of Kenya. They reside with hope for good reason. Many people along with themselves are trying to improve the livelihoods for the people of Kenya. Also, they have many iconic people whom to look up to as role models. Kenya has great potential; although many people do not see it, it is there. Whether it is a child shouting "Mzungu," or a person on the street greeting me with a handshake, they all have hope. They hope that one man, the friend with a key, will help them out, unlocking the clamp on their wheel, unlocking their potential, changing their lives forever.

Grandmother Sarah Obama



Pictures

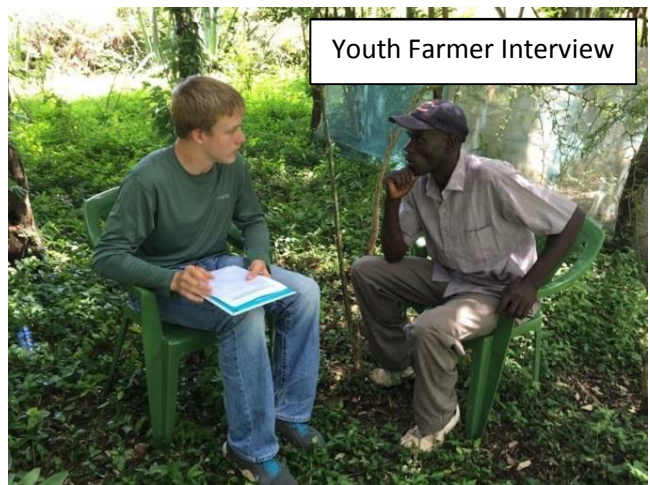
Kisumu National Museum







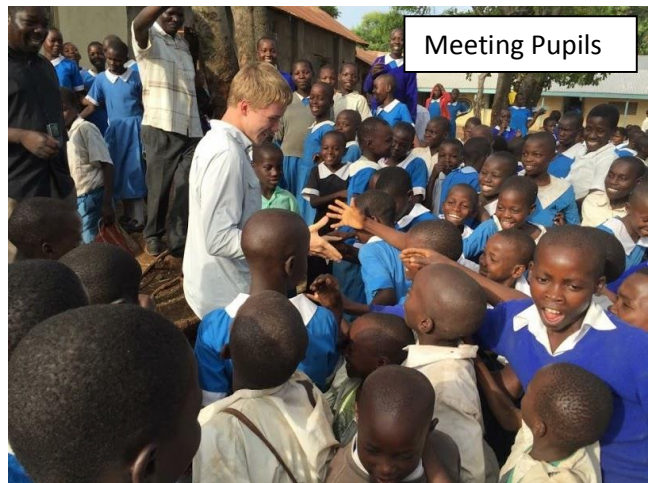
Pupil Interview



Youth Farmer Interview



Group Discussion



Meeting Pupils



Viewing Farmer's 'Push-Pull' Plot



Helping Farmer Carry Water



Ruma National Park

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