The Smartphone Revolution: Can Technology Benefit Data Collection in Rural Ethiopia?

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PERSONAL REMARKS

Since I can remember I have had the dream of becoming a veterinarian. Throughout my life I've lived in rural areas where agriculture was important, but I never realized how important it was to me until I reached high school. I wasn't raised in a family that farmed, actually I had no idea what I was doing in an Introduction to Agriculture class my freshman year of high school. I just knew it was a prerequisite for Animal Science and Vet Science, which I had to take because it had something to do with animals. I fell in love with agriculture throughout my freshman year. I became extremely involved in FFA and signed up for two more Ag classes second semester of my freshman year. The rest is history. After landing a job at the local vet's office I became extremely aware of how much production animals mean to the farmers and how much they mean to everyone in the world.

My junior year of high school my biology teacher at Webster City High School, Ayn Eklund, approached me and told me she had an amazing opportunity for me: the World Food Prize Iowa Youth Institute. I was ecstatic to talk and write about agriculture, a topic that I had become extremely passionate about. I chose to write about Rwanda and developing and implementing sustainable agricultural practices. In this paper I shared my ideas about combating erosion, registering land to get farmers to work together to share resources and ideas, educating women, and, my favorite, implementing a cattle donation system. When learning about Rwanda, and about how little people that lived there had, I realized how much I wanted to make a difference working with other countries.

At the 2011 Iowa Youth Institute I had the opportunity to talk to and make a lot of connections with Iowa State professors. After the Iowa Youth Institute I was then one of the eighty Iowa students invited to the 2012 Global Youth Institute. I was mesmerized by how many people were there to share ideas about improving food security. So many world leaders and researchers were in attendance and they wanted to hear my ideas!

Participating in the World Food Prize Global Youth Institute was one of the most rewarding experiences of my high school career. Talking to the researchers and past Borlaug-Ruan Interns influenced me to apply for the internship this year. Everyone at the Institute really made me feel like I had a role to play in the issue of food security. Participating in both of the institutes made me realize that each person, no matter how significant or insignificant their contribution is, has a voice when it comes to fighting to give each person in this world the adequate food supply that they deserve.

After attending the Global Institute I knew that the Borlaug-Ruan Internship would allow me to pursue my interests in science, agriculture, animals, and traveling. I was so excited when I was chosen for an interview but I didn't get my hopes up too much because I knew a hundred other qualified students were also wanting this internship as much as I was. I just knew that if I was chosen I would do my best to take advantage of the life-changing opportunity.

When I received my internship award letter notifying me that I would be spending my summer at the International Livestock Research Institute in Addis Ababa, Ethiopia, I didn't know what to think. It wasn't until I saw dik diks running around outside my hostel window at the IRLI campus that it really hit me that I had this amazing, once in a lifetime opportunity to help advance international agriculture.

BACKGROUND INFORMATION: ABOUT ILRI

The International Livestock Research Institute (ILRI), founded in 1994, is sponsored by the Consultative Group on International Agricultural Research (CGIAR). The institution envisions a world where all people have access to enough food and livelihood options to fulfill their potential. ILRI headquarters are in Nairobi, Kenya with a second campus in Addis Ababa, Ethiopia, where I was placed. ILRI's mission is to improve food and nutritional security and to reduce poverty in developing countries through research for efficient, safe, and sustainable use of livestock (Home, 2013).

INTRODUCTION

Why Livestock Matters

Scrambled eggs, bacon, and a tall glass of milk are American breakfast staples. Where would we be without the animal products that we all know will be waiting for us on the grocery store shelf? Animals are a vital, renewable resource that could pull countries, such as Ethiopia, out of poverty. Around the world, six hundred million rural poor people rely on livestock for their livelihoods. Demand for livestock is projected to double over the next twenty years because of the always-growing human population. The 'livestock revolution' offers many of the world's poor a pathway out of poverty (Home, 2013). For rural poor, livestock provides people with food, income, fertilizer, and skin to make household products. Livestock products are reliable sources of high-quality, readily absorbed protein and micro-nutrients that humans need to survive. Livestock has the potential to change subsistence farming into income-generating enterprises, in-turn helping to improve the lives of people across the world. ILRI's goal is to use livestock as a development tool as a pathway out of poverty (Home, 2013).

The Importance of Goats to Smallholder Farmers

According to the Population Reference Bureau, the human population is predicted to reach 9 billion by the year 2050. Because of the rapid population growth, farmers are being forced to convert their grazing lands into croplands to keep up with the increasing demand. Not only is the demand for crop production increasing, the demand for livestock products is rising, while room for these animals is decreasing. With the lack of space, small ruminants, specifically goats, are fulfilling roles once played by cattle. Their small sizes and adaptability are making them the easy choice for smallholder farmers in Africa.

The *Capra hircus,* the domestic goat, is a subspecies of goat domesticated from the wild goat of southwest Asia and Eastern Europe. The goat is a member of the family Bovidae and is closely related to sheep, as both are in the goat-antelope subfamily Caprinae. Ethiopian goats are phenotypically classified into 11 types, but recent genetic characterization showed only eight distinctively different types. Like every animal, goats have evolved through natural selection. Goats are selected more for adaptation and survival rather than production. The goat population in Ethiopia is about 23.3 million (Merkel, 2013). In the lowlands goats are reared for mainly milk and meat. In the highlands they are mainly kept for meat. They are also sources of manure, valuable skins, and cash income. Goats are found in all production systems and have lower feed requirements when compared to cattle. They require small initial investment and are a more efficient use of the natural resource base in rural Africa. Droughts are always a factor while raising animals in Africa, especially Ethiopia, and goats have higher survival rates during these challenging times. More internal fat production and short reproductive cycles mean more cash income for the poverty stricken farmers. Increased demand of goat products is also a factor that farmers consider when raising livestock (Merkel,2013).

With all of these positive factors encouraging goat production, there are also some limitations for the producers. The major constraints include scarcity of feed, high mortality rates because of diseases, inadequate veterinary coverage, lack of infrastructure, and low product quality. Because of the frequent droughts there is a scarcity of feed for any animal that is raised in rural parts of Africa. Ruminants have the ability to consume and digest coarse fibrous materials, so even though there are issues with feed scarcity, goats survive on whatever vegetation they can find (Merkel, 2013). Diseases such as PPR (Peste de petitis), goat pox, and many others are causing a 25% mortality rate for goats (Rashid, 2013). Inadequate veterinary care when these diseases are contracted is also a major constraint when raising animals.

There is also a lack of infrastructure in Ethiopia. It could take many days of traveling on foot for farmers to be able to get their products to market. The long market channels and lack of market information hinders maximum production levels. Products in Ethiopia cannot be exported because they don't meet other countries' regulations. The product is low quality (Merkel, 2013). Researchers believe that each problem has a solution. ILRI sees a lot of potential in goats in rural Ethiopia and Cameroon, which is why they are implementing The Goat Project.

The Goat Project

In 1970 the Ethiopian Institute of Agricultural Research (EIAR) conducted small ruminant research on the Highland and Afar goat breeds. They conducted management studies associated with breed evaluation and improvement programs. A full-fledged goat research program representing the semi-arid mixed farming systems has been carried out at the Adami Tulu Research Center since 1992. Goat research has always been a secondary component of the small ruminant research program (Dessie, 2013). One of ILRI's most recent projects is the goat project led by project coordinator, Dr. Tadelle Dessie. The project is led by the Biosciences

eastern and central Africa (BecA)- International Livestock Research Hub and is financed by the Swedish International Development Cooperation Agency (Goat, 2013). The goal of this project is to harness genetic diversity to improve goat productivity in Africa. Biodiversity is defined as the number, variety, and variability of livestock. The project is concentrated in Cameroon and Ethiopia. There are three major objectives that scientists and students at ILRI are working toward. The first objective is to "develop and support implementation of graduated participatory goat improvement strategies for three communities of goat keepers (Goat, 2013)." There is a lot of flexibility when implementing the community based breeding program because the cooperation, input, and support of the community is vital when trying to improve and reap the most benefit from the program. The second objective is to "assess the genetic diversity of the *Walia ibex*, undertake comparative whole genome sequencing of the domestic goat breeds and the *Walia* with the aim of selecting sweeps for growth, feed conversion, and sets of adaptive traits in the *Walia ibex* relative to the domestic goat (Goat, 2013)." Lastly, ILRI hopes to "develop, support, and enhance technical, organizational, institutional capacities of the key actors in the related value chains to sustainably implement the designed improvement programs (Goat, 2013)." There are two ways of improving productivity/performance: improving the environment of the animal and/or improving the genetics or genotype of an animal. "Characterization is the distillation of all the information or knowledge on and about a livestock breed or population (Merkel, 2013)." Phenotypic characterization involves describing the external characteristics associated with an animal. These could include pests or pathogens, management practices, and geographic distributions. Genetic characterization observes the pattern of trait inheritance, genetic parameters, how the breed performs when crossed with other breeds, and the genetic integrity/diversity and/or uniqueness. In order to understand and comprehensively describe the animal production and environment, characterization is needed (Merkel, 2013). Without knowing how things work, how can we make it any better?

Agriculture and Technology

Many young Americans would struggle to remember a time without a cell phone in their pocket or a computer available for school or work. Technology has been a huge part of my generation, and over the last 10 to 15 years technology has changed the way the world works, plays, shops and communicates. Information and Communication Technologies (ICT) is a term that includes any communication device or application encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems, etc., as well as the various services and applications associated with them, such as video conferencing and distance learning (BFCP, 2013). Many changes encompassing technology are seen across the world, but for various reasons, the average population of some countries, such as Ethiopia, have not had the same access to fast paced technological advances occurring in other parts of the world.

Even before computers, technological innovation has been a huge part of American agriculture. Technology promises major impacts on U.S. food production and processing industries. The transition from horsepower to mechanical power (1929-1950) boosted the productive capacity

of agriculture tremendously (U.S., 1992). By 1954 the number of tractors on farms exceeded the number of horses and mules for the first time. From 1950 to 1980 chemical fertilizers, feed additives, and pesticides increased yields and helped farmers control pests and disease. American agriculture is now booming as the result of new biotechnology. Technology has increased the U.S.'s productivity levels, competitiveness, enhanced the environment, and helped to improve food safety and quality (Hutchins, 2013).

The computer technology of global positioning systems, or GPS's, are driving tractors across fields. Human error has decreased, making productivity increase. Variable rate technologies controls the amount of water or chemicals each field gets depending on the needs of the soil or plants. In the past, a field was viewed as a uniformed unit. If a part of the field needed watered, the whole field was watered. But in reality, not every part of the field has the same need for water, pesticides or fertilizer. This is where remote sensing comes in. Remote sensing tells the farmer what part of the field needs more attention. Multi-spectral images from satellites and aircrafts provide farmers with a wide range of information about their fields. Images reveal levels of silt, sand, calcium, and clay in the soil. Infrared readings tell farmers which areas receive more water and how water moves in the field. Infrared can also detect weed coverage. Thermal images can tell a farmer if his plants are healthy or not because unhealthy plants are unable to cool off through transpiration and overheat. Variability is part of the fields. Every field is different. Computer software can calculate the amount of water or chemicals needed for each field, leaving hard decisions out of the farmer's hands (Murray, 2011).

A farmer who adopts the technologies of precision agriculture saves about $2 to $8 per acre. The 60 percent of Alabama farmers who have adopted these technologies have saved an estimated $10 million in 2009 (Murray, 2011). The farmers are not the only individuals that benefit. The land does as well. Applying chemicals only to sites that need it cuts down on pollution due to run off (Murray, 2011).

With remote-sensing imagery, computer modeling software and high tech tractors, the American farming practices are extremely different from what rural Ethiopian farmers are currently able to conceive. Precision agriculture is still extremely young, but as the variable rate technologies become more capable and user friendly, they'll reach more farms across the world (Murray, 2011). Computer technology is a perfect catalyst that would benefit rural farmers in economically under-resourced countries.

The Impact of Smartphones Around the World

Taking away an American teenager's smartphone would be like cutting off their right arm. How did smartphones get so important to the Western world in the first place? What kind of impact could smartphones have in under-resourced countries?

In 1878 Alexander Graham Bell made the first ever phone call. Telephones have come a long way since Mr. Bell's time. Motorola introduced the first cellphones to the public in the 1980s.

These cell phones are nothing like the phones of today. They were not compact, weighing over two pounds, and were not cost effective. Some phones cost as much as $4,000 each! The first smartphone was developed by IBM and BellSouth, which came out to the public by 1993. Smartphones are extremely different from simple cell phones. Smart phones not only have the calling and texting functions, but internet connection, GPS capabilities, and the ability to take high quality picture and video recordings. Smartphone capability does not just end at Internet access or document editing, some have the ability to talk to you, answer questions, lock doors when you are hundreds of miles away, turn on lights, and can be used to watch full length movies (History, 2013).

Smartphones have had many positive impacts on society. Through social media applications people can communicate even if they are across the world from each other (Banerjee, 2013). With this technology farmers in America and farmers in Ethiopia can share ideas, solutions to problems, and even valuable experiences in the field. Having a pocket computer gives you access to anything on the internet, making information readily available. In under-resourced countries information could be easily passed between farmers and scientists and back to improve productivity levels. The mobile Web provides the capacity for news to become more "journalistic" than ever (Banerjee, 2013). People can connect easily, leave comments, and connect and discuss issues with people from across the world. Smartphones could spark business development in rural areas. For example, if a farmer had a product that they wanted to sell, the consumer would just have to get on their smartphone and see on a public forum or board where that product is for sale.

When it comes to smartphone technology, popular applications are developed because they can make simple tasks more efficient. With any advancement there are positive and negative impacts. Western populations are extremely reliable on their smartphones, sometimes even bordering on addiction to social media and the internet. The extent each person relies on their smart phone varies according to how they use it. Smartphones have been made to make life easier and, without a doubt, is an excellent means of communication (Banerjee, 2013). Bringing smartphones to rural countries would advance their access to national and international communication, and could be an asset in advancing their agricultural success. By providing rural Ethiopian farmers with a form of communication between other farmers around the world, they could be educated about more efficient, safe, and modern practices related to breeding, meat processing, and market strategies. If a rural farmer is having issues with a mastitis outbreak in his goat herd, he can easily contact a local veterinarian using the smartphone provided in his area to receive vaccinations as soon as possible. Increased access would not only affect communication, but they could enhance farmers knowledge, practices, market, access to income through an increase in sales, and so much more. By having internet access the farmers have an unlimited amount of information at their disposal. Smartphones are always changing and people are using them more and more. Why should their capabilities only be quarantined to more developed countries?

What is ODK?

The Open Data Kit (ODK) was developed by the Department of Computer Science and Engineering at the University of Washington. ODK is a free and open-source set of tools used for collecting and managing data in low-resource environments (Harnessing, 2013). The project "Harnessing genetic diversity for improving goat productivity in Africa" is currently testing the ODK for baseline production system and phenotypic characterization as well as on-farm productivity monitoring studies in Ethiopia and Cameroon. ODK runs specifically on android powered phones and has three primary tools: build, create, and aggregate. ODK Build allows the user to build simple forms in xml format that are then saved onto a phone's memory to be taken into the field to gather data. ODK Collect allows data to be collected on a mobile device and sent to a server in Addis and Nairobi through Wi-Fi or a mobile internet connection. Pictures, videos, sound bites, bar codes, and GPS waypoints can also be collected while out in the field and sent to servers as attachments. The ODK Collect enables users to ask questions not only in linear sequence but with a predetermined if-then logic system, relying on answers from previous questions. The next and final tool is aggregate. On the server, data is collect and extracted to be analyzed. ODK Aggregate manages the collected data and makes visual representations of the collected data by using maps and simple graphs, making it easy for researchers to export and publish the data collected. "ODK is a system that immediately digitizes data for analysis, allows for remote monitoring of the collection process, and facilitates the gathering of data, eliminating the need for paper surveys (Open, 2013)."

(Harnessing, 2013)

MY PROJECT: THE SMARTPHONE REVOLUTION: CAN TECHNOLOGY BENEFIT DATA COLLECTION IN RURAL ETHIOPIA?

When I first arrived on the ILRI campus I was put to work researching and summarizing information found on the DAGRIS database about each goat breed in Ethiopia. After I had a good background knowledge about goats and the work that ILRI had done throughout the years, I had the opportunity to choose which area of ILRI that I would like to focus my research. Through my investigations, I found that ILRI is trying to use smart phones to collect data out in the field for the goat project. Coming from a more technologically advanced background, I knew that I could make a contribution to their efforts. Before I left for the field I was trained on

the ODK software on the Samsung Galaxy 3S smartphones. When I was in the field I assisted with training two enumerators on how to use the smartphones and ODK. The enumerators that I had the opportunity to work with were educated individuals who worked at the local agriculture centers. They could speak the local languages and helped to translate what the farmers said into English. I then developed and conducted questionnaires for the enumerators, the project coordinator, project assistant, and research fellows asking about the difficulties and limitations while using smartphones and the ODK software when collecting data in the field.

When interviewing the enumerators I concentrated on operation and collection errors and difficulties. Being able to talk to individuals that weren't exposed to very advanced technology helped to show the complications there may be when training the lees-educated village enumerators. While interviewing the enumerators I found that typing was the biggest challenge that they would have to overcome. Both enumerators appreciated the new technology and agreed that it could make a difference when collecting data, but they really stressed that there needed to be a huge amount of training when the village enumerators are exposed to the new technology.

The project coordinator mostly deals with budget restraints, human resource management, and communication between all aspects of the project. Dr. Tadelle pointed out that the initial investment of the smartphones may be expensive, but the phones could be used for a long period of time. When dealing with communication between each party in the project he stated that feedback and between every aspect is crucial. Being able to deal with issues virtually will save time, paper, and, most importantly, money because paper will not have to be printed continuously.

The project assistant was asked about the difficulties when controlling data management, data export, and supervision and training of the field enumerators. The biggest issue that Grum has to deal with is data validity. Enumerators are not providing genuine data when they are left alone in the villages. With the smartphone's ability to automatically enter GPS points, enumerators will have to provide genuine data because the GPS points cannot be manually manipulated.

When interviewing the MSc and PhD students connected to the project I asked about the problems with data entry, analysis and presentation of data. None of the students have been able to use smartphones to collect data in the field. It takes an average of fifteen minutes to enter the data from each paper survey into the database. More than six hundred surveys were collected by students in the field. A copy of the interview questions can be found attached as Appendix 1.

Collecting Data in the Field

I spent two weeks in the field assisting graduate students connected to the goat project with ear tagging and taking pictures of tagged goats. During the two weeks I also trained two enumerators in two different locations. The first enumerator was named Adane and he worked

with me in the Ziquala woreda. The second enumerator, Minister, worked with me at the Tanque woreda. My job was to assist the assistant project coordinator, Grum, with training the enumerators, and then we went into each village and interviewed farmers using the ODK software. We interviewed six different farmers in each location with questionnaires that were previously conducted in the same area. We compared the time taken when conducting questionnaires with ODK software to data collection with paper surveys. Farmers were completely selected at random, and there was no gender preference. The only requirement was that they owned at least one goat. The household survey was conducted when talking to each farmer. Two farmers from each village agreed to take four different questionnaires. These included the household survey, production and management system survey, feeding and grazing management survey, and a breeding questionnaire. After recording and analyzing the times it took to conduct each survey, on average, it took 83 minutes or 1 hour and 23 minutes to conduct all four surveys. According to my data the average time to conduct a household survey was 11.25 minutes. Appendix 2 shows information gathered in the field. It was found that after practice each enumerator became significantly more efficient at using the smartphones.

While my enumerators and I were interviewing farmers, the graduate students were interviewing local educated people that will serve as enumerators for the next year. The new enumerators will be based in each village where the genetic research is taking place. Throughout this next year they will be collecting data such as growth rates, birth weights, diseases, deaths, etc. out of each tagged herd in the village. The ODK software will make it so that each enumerator can easily access, complete and send in data wirelessly to the ILRI campuses in Addis Ababa and Nairobi to ultimately improve genetics and productivity levels of goats in Ethiopia. There are many positives to ODK, but there are also many negatives impacting the growth and possibility of using this new technology.

Smartphone vs. Paper: Advantages and Challenges of ODK

After returning to the field, I conducted various interviews with individuals that were involved in the goat project. After interviewing each person, the advantages and challenges of using smartphones for data collection were very clear. Time is the biggest issue each person talked about in my interviews. It takes an hour to two hours to interview each farmer using paper surveys. Then the packet of information has to be delivered to the research center either my hand or through the postal service, which takes about five to ten days to deliver the information. After the information arrives at the center, students have to take more time entering all of the information into the data base to then eventually analyze the data. Grum, the project assistant, stated that the huge delay isn't what the researchers would like to see after spending so much time in the field collecting all of the data. His hope is that the information would be easily accessible as soon as researchers return from the field, and that is exactly what the ODK software can do for ILRI. While interviewing times in the village weren't significantly different from what they are when paper surveys are collected, the time entering

the data is much faster using the ODK software. According to the data collected while entering the questionnaires into the database the average time spent entering data from paper surveys is fifteen minutes. See Appendix 3 for the time taken to enter data from 88 different surveys into the database. When using ODK, the data is entered electronically into the database from the start, making it so that the only data entry is during the initial interview of the farmer. The biggest issue with paper surveys that the enumerators reported is that having large stacks of surveys was extremely hard to manage. ODK also saves time, money, space, and the environment by eliminating the need to print hundreds of copies of a twenty page questionnaire.

Converting the questionnaires from Word to xml format takes time and technical skill. Without trained professionals that understand the technicality of the questionnaires and the program ODK Build, it'd hard to collect any data in the field. It takes time to enter the survey into ODK Build, but not as much time as it takes to enter ever single answer from the hard copies after interviews. The survey only has to be entered into ODK Build once, making it the obvious choice when comparing it to paper surveys and the time it takes to enter each answer.

Just like any human, the enumerators sometimes make errors on the surveys. Their handwriting could be hard to read or they might have put an extra zero on a number throwing off some of the data. With the smartphones, errors and issues could be handled virtually. Communication between ILRI and the villages would be a hundred times easier and faster if there were any issues that could arise. Another advantage to using ODK is that the researchers themselves can virtually change or tweak questions at any time. New questions can be easily added into the questionnaire. Paper questionnaires are concrete after being printed, making it hard for researchers to change anything related to the questionnaire without reprinting another hundred copies.

ODK harnesses other aspects of research that may have previously been looked over. By adding GPS, sound bites, pictures, videos, and bar codes during data collection research findings can only be improved. While the research fellows conducted community meetings when we were in the field, I was able to take multiple videos and pictures to send back to the research centers in Addis and Nairobi. By having these new aspects integrated into data collection researchers will know different information, such as what a specific plant that the goats frequently eat looks like in its natural habitat.

In both villages that I visited 3G connection was easily accessible. In one village 3G service was not available at the houses, but internet connection is only six kilometers away. This would be no more than an hour walk from their home. In this village, the enumerator would need to go to the closest town to send data stored on the smartphone at least once a week. The phones have plenty of storage capacity, making the option of saving a week's worth of data highly attainable.

The most important benefit of using ODK is that feedback can easily go between scientists at the ILRI campuses to smallholder farmers in the villages. With access to technology farmers will be able to contact researchers if there are any problems with the livestock that they could help solve. Researchers will be able to send their findings directly to the people that it impacts the most.

Throughout this project there has been a problem with enumerators not providing genuine data. With paper surveys the enumerators sat in their houses and just filled in the questions without contacting anyone actually involved with raising livestock. With the smartphones GPS will be able to track where the enumerators are and if the data being provided is genuine or not. Using the smartphones will help to better manage the enumerators and the data that they provide for scientific research.

While out in the field I experienced problems with the battery life of the smartphones. The phones were constantly used, making them prone to a low battery. To solve this problem I supplied the project with my battery powered charger. In Picture 5 there is a picture of the Samsung Galaxy smartphone used in the field connected to my battery powered charger. The portable chargers worked perfectly out in the field. Battery powered chargers would be a solution to battery life issues when this project is put into place.

In the field we did have a problem with the ODK application randomly crashing. This wasn't a huge problem because the app always saved the information from the last time it was opened. The only thing the enumerators had to do when it crashed was reopen the application. I think that this glitch will soon be fixed by the University of Washington because each crash was reported back to their servers.

In the U.S. you barely ever see a smartphone without a protective case. The two Samsung Galaxy phones that we took into the field were brand new and did not have cases. I noticed that when we got back to the ILRI campus there were a lot of scratches on the face and back of the phones. Smartphones are extremely easy to break and very expensive to fix in Ethiopia. The first time a Samsung Galaxy was taken into the field it came back to ILRI with the screen completely shattered costing about $3,000 birr or about $160 USD to fix. Normal wear and tear takes a toll on smartphones and protective cases will help to prevent delicate smartphones from being broken.

One challenge facing the goat project is the limited supply of smartphones. Currently the project only has two Samsung Galaxy S3 phones that support the ODK software. Each phone was bought for nine hundred USD each, making it near impossible for the project to buy any more smartphones. The phones have a high start-up cost, but they are a one-time investment, unlike the continuous expense of printing packet long questionnaires. The limited number of cell phones makes it hard to train the eight enumerators stationed in the villages because the phones cannot be left with the enumerators. With little to no exposure to this kind of technology the enumerators need as much practice time as they can get. Since the ODK

software runs specifically on android phones and android phones are extremely popular in the U.S., one idea is to try and receive donations of old phones that Americans don't use any more. Using social media such as Facebook and Twitter the word of my project has reached many people. My hope is to have ten android phones donated to the goat project. With these phones the project will expose rural Ethiopians to the technology that is extremely important in Westernized countries.

The biggest challenge regarding the ODK software will be the field enumerators' lack of skills running and dealing with technology. The enumerators that I trained from the local agriculture centers had some past experience with technology. They could efficiently use cell phones and computers, which made it easy to show them the touch screen Samsung Galaxy S3. The new enumerators from the villages haven't had access to really any kind of technology except the occasional cell phone. The only way to make the village enumerators better at handling technology is to expose them to it. A one to two hour training on how to use the phone and the software will be beneficial, but to really figure out how to use smartphones the enumerators will need hands on experience interacting with the devices. Videos saved on the smartphone about how to work everything on the phones could help enumerators solve issues that may arise when researchers from ILRI leave the sites. When I was out in the field, the enumerators that I trained had troubles typing. But after practice the enumerators got considerably better at entering information with the touch screen. Since ODK can work on any android device I think that the goat project may need to look into getting phones with keyboards instead of touchscreens. From past experience I think that it is easier to type with a full keyboard with keys instead of a touchscreen keyboard. If smartphones with touchscreens are more preferred the data that I collected in the field does show that with practice the enumerators will be get proficient and faster at typing. In Chart 1 you can also see a difference between the two enumerators. Enumerator 2 didn't improve as fast as Enumerator 1. Enumerator 1 was extremely excited about the technology and practiced during the evenings on the Notepad application. On the first day Enumerator 1 was not as proficient entering data as I expected, but on day two he came to me and had extremely improved because he had practiced. Enumerator 2 was not as excited about the new technology as Enumerator 1. Enumerator 2 definitely did not put as much time into his typing skill as Enumerator 1. I really believe that it depends how excited the enumerator is about the new technology. If the enumerator isn't excited about the technology they're not going to put in the extra work to learn how to use it. The time it takes to interview also depends on the interviewee. In the second village there were a couple farmers that were really talkative and that also made the time a little more than the first village. But with this factor influencing the time taken into consideration, Enumerator 1 improved with typing faster because he practice more often than Enumerator 2. Time saved during the interview process isn't as significant as the time saved during data entry and simple analyzing of the data. Chart 1 shows that practice makes a difference when trying to learn this new technology, and without dedication from the village enumerators to learn how to type on

the touch screen smartphones, the time taken to enter and analyze data will significantly decrease.

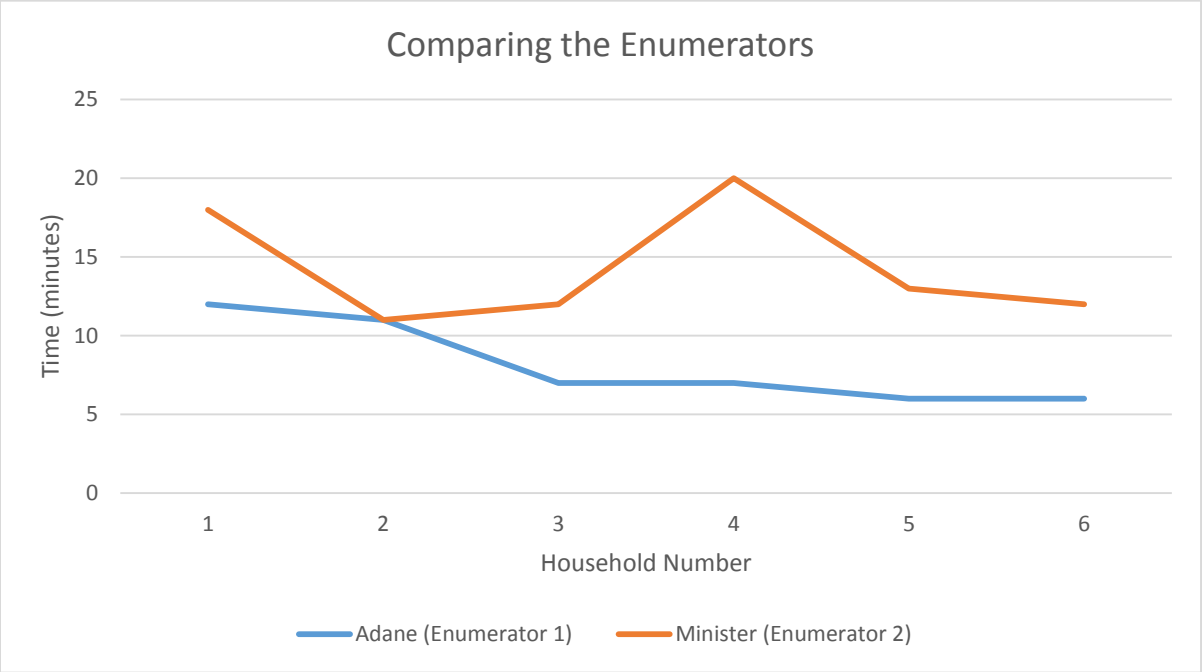

Chart 1

Household Number	Adane (Enumerator 1)	Minister (Enumerator 2)
1	12 minutes	18 minutes
2	11 minutes	11 minutes
3	7 minutes	12 minutes
4	7 minutes	20 minutes
5	6 minutes	13 minutes
6	6 minutes	12 minutes

Conclusion: Technology is Key

Throughout my research I have found that introducing new technology to rural Ethiopia is a huge step in improving the livelihoods of poor rural farmers. ODK was very beneficial in the field because it took less time to collect and aggregate the surveys than the traditional paper surveys. There are some challenges when looking at implementing the smartphone data collection idea, such as more training and the limited supply of smart phones, but each problem that we faced we were easily able to find a solution. Technology is spreading like wildfire in Westernized countries and Ethiopia and other under developed countries could benefit immensely by using it.

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PICTURES

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Picture Discriptions:

1. Welcome to ILRI!!
2. Interviewing a farmer with the ODK Software
3. Children in rural village
4. Interviewing an enumerator
5. Samsung Galaxy phone and battery powered charger
6. The Nile Falls
7. Lucy (the first homosapien) at the National Museum of Ethiopia
8. Young girl shepherd in a rural village
9. Plowing a farmer's field

APPENDIX 1

STAFF QUESTIONNAIRES

Dr. Tadelle Questionnaire- Project Coordinator

What administrative issues are there when it comes to data collection? (budget, human resource management, communication, etc.)

Grum Questionnaire- Project Assistant

What are the difficulties when controlling data management, data export and supervision of the field enumerators?

What other problems do you face when dealing with the ODK software?

How many smartphones are needed to go through with the project?

How will the field enumerators be trained to use the smartphones and ODK software?

Enumerator Questionnaire

Village:_____

Kebele:_____

Woreda:_____

Name of Enumerator:_____

What are the challenges when using a paper survey to gather data in the field?

What are the advantages and disadvantages of using technology while gathering data?

Do you have to travel to access internet connection or a 3G network? If so how far will the enumerators have to go to access it?

Do you think that we could use ODK in the field?

Student Questionnaire

What problems do you face when collecting data out in the field?

What are problems you face during data entry, analysis and presentation of the data?

What are the advantages and disadvantages of using technology while gathering data?

How long does it usually take to collect data in the field without using technology?

APPENDIX 2
DATA FROM THE FIELD

Sekota Abergelle Information

Enumerator Adane

Village: Bilaku

Kebele: Tsitsika

Woreda: Ziquala

HOUSEHOLD NUMBER: 01

Household 1:40-1:52 –12minutes

Production 1:52-2:33 – 41minuites

Feeding 2:33-3:23—50minutes

Breeding 3:23-3:45 – 22minutes

Full Survey: 125minutes or 2hours and 5minutes

HOUSEHOLD NUMBER: 02

Household 2:13-2:24 – 11minutes

HOUSEHOLD NUMBER: 03

Household 9:29-9:36 –7minutes

HOUSEHOLD NUMBER: 04

Household 10:03-10:10 – 7minutes

Production 10:10-10:28 – 18minutes

Feeding 10:28-10:46 –18minutes

Breeding 10:46-11:08 –22minutes

Full Survey: 65minutes or 1hour and 5minutes

HOUSEHOLD NUMBER: 05

Household 11:21-11:27 –6minutes

HOUSEHOLD NUMBER: 06

Household 11:35-11:41 –6minutes

Tigray Abergelle Information: Enumerator Minister

Village: Dungor

Kebele: Hadinet

Woreda: Tanque

HOUSEHOLD NUMBER: 01

Household 1:22-1:40 –18minutes

Production 1:40-2:06 –26minutes

Feeding 2:06-2:34 –28minutes

Breeding 2:34-2:47 –13minutes

Full Survey: 85minutes or 1 hour and 25minutes

HOUSEHOLD NUMBER: 02

Household 12:45-12:56 – 11minutes

HOUSEHOLD NUMBER: 03

Household 1:10-1:22 –12minutes

HOUSEHOLD NUMBER: 04

Household 1:22-1:42 –20minutes

HOUSEHOLD NUMBER: 05

Household 8:42-8:55 –13minutes

HOUSEHOLD NUMBER: 06

Household 9:21-9:33 –12minutes

Production 9:33-9:50 –17minutes

Feeding 9:50-10:02 –12minutes

Breeding 10:04-10:20 –16minutes

Full Survey: 57minutes

Average Time it took to do a Full Survey on ODK: 83 minutes or 1hour and 23minutes

Average Time for Household Survey on ODK: 11.25minutes

APPENDIX 3

TIME TAKEN TO ENTER PAPER SURVEYS INTO COMPUTER

Survey Number	Start Time	End Time	Total Time Taken to Enter Info
1	7:59	8:24	25mins
2	2:25	2:42	17mins
3	2:42	3:10	28mins
4	3:13	3:40	27mins
5	3:51	4:13	22mins
6	4:27	4:50	23mins
7	1:53	2:08	15mins
8	2:09	2:27	18mins
9	2:28	2:48	20mins
10	2:49	3:05	16mins
11	3:09	3:22	13mins
12	3:22	3:38	16mins
13	9:34	9:51	17mins
14	9:53	10:07	14mins
15	10:07	10:22	15mins
16	10:44	10:59	15mins
17	10:28	10:44	16mins
18	11:00	11:12	12mins
19	12:13	12:26	13mins
20	12:27	12:50	23mins
21	1:26	1:47	21mins
22	1:48	2:04	16mins
23	2:05	2:22	17mins
24	2:23	2:35	12mins
25	2:36	2:48	12mins
26	3:21	3:33	12mins
27	3:34	3:48	14mins
28	3:49	4:02	13mins
29	4:03	4:17	14mins

30	4:17	4:32	15mins
31	9:00	9:13	13mins
32	9:14	9:27	13mins
33	9:39	9:53	14mins
34	9:58	10:11	13mins
35	10:52	11:08	16mins
36	11:13	11:31	18mins
37	11:31	11:48	17mins
38	11:48	12:02	14mins
39	1:14	1:31	17mins
40	1:32	1:42	10mins
41	1:43	1:57	14mins
42	3:03	3:13	10mins
43	3:14	3:36	22mins
44	3:38	3:50	12mins
45	3:55	4:09	14mins
46	4:30	4:45	15mins
47	4:50	5:04	14mins
48	8:13	8:30	17mins
49	8:31	8:45	14mins
50	8:46	9:00	14mins
51	9:19	9:34	15mins
52	9:35	9:47	12mins
53	9:48	10:09	21mins
54	10:12	10:25	13mins
55	10:30	10:43	13mins
56	10:44	10:57	13mins
57	11:02	11:16	14mins
58	11:19	11:34	15mins
59	11:36	11:54	18mins
60	12:03	12:19	16mins
61	1:28	1:41	13mins
62	1:41	1:55	14mins
63	1:56	2:08	12mins
64	2:10	2:26	16mins
65	2:30	2:43	13mins

66	3:27	3:40	13mins
67	3:40	3:51	11mins
68	3:52	4:05	13mins
69	4:06	4:20	14mins
70	1:13	1:31	18mins
71	4:00	4:14	14mins
72	10:49	11:02	13mins
73	10:36	10:48	12mins
74	10:19	10:35	16mins
75	8:19	8:33	14mins
76	8:34	8:47	13mins
77	8:48	9:06	18mins
78	9:07	9:20	13mins
79	12:00	12:15	15mins
80	12:16	12:30	14mins
81	12:34	12:50	16mins
82	12:54	1:11	17mins
83	8:20	8:33	13mins
84	8:07	8:18	11mins
85	7:45	7:58	13mins
86	7:31	7:44	13mins
87	4:33	4:45	12mins
88	4:14	4:29	15mins
			Average: 15minutes