ICT and Agriculture in the Global South

Photo Credit: David Borish

About Us

We are a group of students at the University of Guelph who share a passion for the world around us. We major in International Development Studies, and are interested in exploring issues that pertain to social justice, inequality, poverty, and long-term change. We represent all of the 7 areas of emphasis in the programme: Environment and Development, Economic and Business Development, Gender and Development, Historical Perspectives in Development, Latin American Studies, Political Economy and Administrative Change, and Rural and Agricultural Development. Each of us drew on our expertise in our chosen area of emphasis in order to collaborate for this research paper. For many of us, 2016 is our final year of study, and we have decided to focus our efforts and areas of expertise on exploring the opportunities and constraints related to ICT and agriculture in the Global South.

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Abbreviations

AIS - Agricultural Information System(s)

CHWs - Community Health Workers

CKW - Community Knowledge Worker(s)

FMD - Foot-and-Mouth Disease

GHG - Greenhouse Gases

GIS - Geographic Information Systems

GOe - Global Observatory for eHealth

GM - Genetic Modification; Genetically Modified

GPS - Geographic Positioning Systems

hiPAPD - Holistic, Interactive and Persuasive Model to Facilitate Self-care of Diabetics

HIV - Human Immunodeficiency Virus

ICRISAT - International Crops Research Institute for the Semi-Arid Tropics

ICT - Information and Communication Technology/Technologies

ICT4D - Information and Communication Technology for Development

ICU - International Communications Union

IDRC - International Development Research Centre

IFAD - International Fund for Agricultural Development

INFSS - Integrated Nutritional and Food Security Surveillance

ISP - Internet Service Providers

Abbreviations Continued

M-apps - Mobile Applications

MDG - Millennium Development Goals

mHealth - Mobile Health

MMT - Mobile Money Transfer

mVAM - Mobile Vulnerability Analysis and Mapping

NGO - Non-Governmental Organization

NTDs - Neglected Tropical Diseases

PDA(s) - Personal Digital Assistant(s)

RFID - Radio-Frequency Identification

SDGs - Sustainable Development Goals

SMS - Short Message Service

UN - United Nations

UNICEF - United Nations Children's Fund

voIP - Voice Over Internet Protocol

WFP - World Food Programme


Photo Credit: David Borish

Introduction

There are currently 3.4 billion people living in rural populations globally, with 34% classified as extremely poor (IFAD, 2011). These rural populations in developing country contexts, face issues such as isolation, lack of agricultural information and innovative technology leaving 60% living off $2 USD per day (IFAD, 2011). Mobile technologies present a unique opportunity as they are increasingly being integrated in the daily lives of individuals throughout the Global South, a region encompassing the transition economies of Africa, Latin America, Asia, and the Middle East (Rees, 2016). It is estimated that there are approximately 3.6 billion mobile phone users worldwide, with numbers on the rise, particularly in rural areas (Rees, 2016). As such, the ubiquitous ability to bridge information and accessibility of mobile technologies present an opportunity for immense innovation and impact on agriculture around the world, especially within the Global South. This report will outline the ways in which mobile technology can be harnessed to help small farmers around the world improve access to information, production, environmental sustainability, food security, and health. After a thorough review of case studies of initiatives employing mobile information technologies (IT) to solve various issues facing smallholder farmers around the world, this paper finds mobile technology to have enormous potential to aid in overcoming many social, economic, and informational barriers present within smallholder agriculture in the Global South.

Based on the successes and failures of the various cases examined, we argue in this paper that programmes which combine information dissemination with a participatory approach to data collection via mobile IT are most likely to ensure information is relevant and usable by beneficiaries. Combining simple health messages and relevant health data collection in broader rural livelihood and mobile IT initiatives may also significantly reduce frequent shortages of human capital due to illness and death in remote, rural communities. We further find that while mobile IT holds significant potential to empower marginalized groups including women, youth and the elderly in rural communities by providing information relevant to their specific needs as well as to help network them in and beyond their communities, technologies can as easily serve to further marginalize these groups if the various factors which intersect to isolate them are not simultaneously addressed.

In addition, we will outline various extension models throughout the paper. By extension model, we mean both the technological model of information gathering and dissemination (e.g. SMS vs Internet vs Voice Calls) and the personnel model (whether individual farmers use their own phones or a community knowledge worker disseminates information gathered in their smart phone, etc.). Which model is most appropriate will depend on financial resources available, connectivity, and literacy in individual contexts. In sum, this paper argues that to be successful, mobile IT applications will need to be tailored to individual contexts and be implemented in conjunction with broader efforts to address inequalities and work collaboratively with beneficiaries to ensure information disseminated is accessible, relevant and adaptable.


Photo Credit: David Borish

What are Information Communication Technologies (ICTs)?

It is estimated that there are approximately 3.6 billion mobile phone users worldwide, with numbers on the rise. Mobile technologies are increasingly integrated in the daily lives of individuals throughout the Global South, a region encompassing the transition economies of Africa, Latin America, Asia, and the Middle East (Rees, 2016). As such, the ubiquitous ability to bridge information, and accessibility of mobile technologies present an opportunity for immense innovation and impact on agriculture around the world, especially within the Global South. This report will outline the ways in which mobile technology can be harnessed to help small farmers around the world improve access to information, production, environmental sustainability, food security, and health. It argues that mobile technology has the potential to aid in overcoming many social, economic, and informational barriers present within smallholder agriculture in the Global South.

Case Study: M-Pesa

Worldwide, there are approximately 2.5 billion people that do not have a formal account at a financial institution (Kirui, Okello & Nyikal, 2012). Access to affordable financial services is linked to overcoming poverty, reducing income disparities, and increasing economic growth (Kirui, Okello & Nyikal, 2012). Some of the obstacles smallholder farmers face in access to financial services include high costs and travel distance involved (Kirui, Okello & Nyikal, 2012).

The introduction of prepaid cards and fallen prices of mobile handsets have led to a rapid adoption of mobile phones in the Global South, enabling a lower cost alternative to traditional banking in the form of mobile banking (D'Auria, 2016). The cost of a bank transaction is USD $1, compared to a USD $0.05 using a mobile platform (D'Auria, 2016). This allows mobile-money services to attract customers that would otherwise be shut out of formal payment systems (D'Auria, 2016). Mobile money is reshaping financial services across the developing world.

One of the most successful money transfer service is M-Pesa. Launched in 2007 by Vodafone for Safaricom, it is one of the largest wireless service providers (Vodafone, 2016). With M-Pesa, all that is required is a mobile phone. Users do not need a bank account, credit history, or much money (Vodafone, 2016).

MMT Impact on Agriculture

M-Pesa allows for agricultural households to reduce the time and cash expense involved in accessing the funds needed to invest in agriculture. M-Pesa can help resolve some of the challenges that agricultural households face in accessing finances. Farmers would no longer have to input time and travel costs to banking facilities (Kirui et al., 2012). MMT can improve investment in, and allocation, of human capital as well as physical capital through facilitating cheap and timely transfers of small amounts of money across larger distances (Kirui et al., 2012). Payments and loans through M-Pesa are enabling smallholder farmers to access simple and secure products and services (Kirui et al., 2012).

M-Pesa is already proving to be a success among smallholder rural farmers. A study found that the use of MMT services significantly increased household agricultural commercialization by 37% (Kirui et al, 2012). Additionally, the largest proportion of money received and sent through M-Pesa services were used for agricultural-related purposes (Kirui et al., 2012).

Encouraging Growth

The success of M-Pesa has supported small business growth by opening up a series of opportunities for users. For example, credit that may have been previously denied due to a lack of information, is now an option, enabling a farmer to work with the bank as they can show them their history of transactions. In turn, these loans that farmers can gain access to through the bank will allow for investment in their businesses (Murphy, 2013).

Barriers

Several factors can challenge the introduction and successful integration of Information Communication Technologies (ICTs) in the Global South, including problems with connectivity, content, capacity, and cost. A lack of connectivity primarily affects those living in remote, rural settings that have been overlooked by the products of the information revolution. Consequently, they suffer from a lack of access to mobile phones and computers, poor telecommunications infrastructure and a limited number of Internet Service Providers (ISP). Regarding content, issues with providing local and culturally relevant content remain prevalent; applying appropriate language and the relevance of content to the local setting is often neglected in ICT programmes (Chetley, 2006). The financial burden of integrating ICTs is another hindrance that must be considered. Handsets are still relatively expensive to purchase and the cost of using them for services such as outgoing calls can be as much as $1.30 per minute (Kaplan, 2006). Finally, there are issues with capacity to service and maintain ICTs effectively, which can lead to the abandonment of an ICT program. These issues are prevalent throughout all sections of the report, in addition to more case specific barriers.

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Practical Constraints to Consider

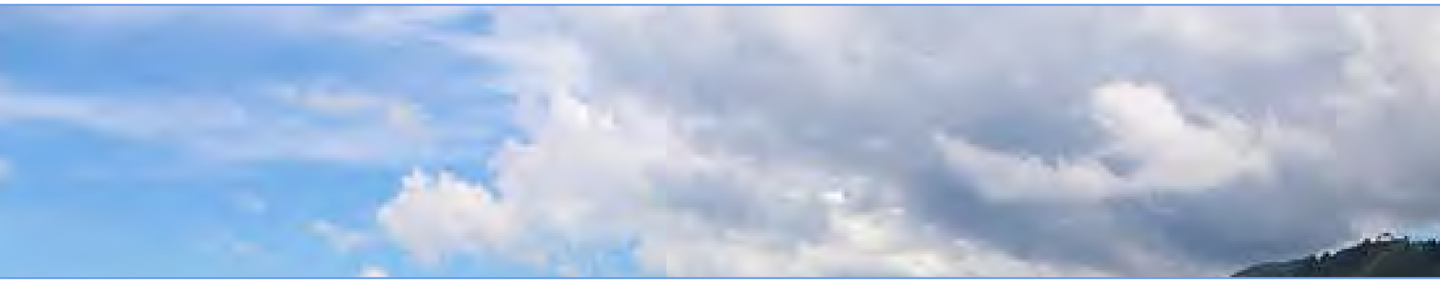
1. The 'Food and Agriculture Organization of the United Nations' (FAO) found that whether the device allowed a PDF, .mov (a multimedia file format), or .m4v file to be uploaded and stored on the mobile device determined its success due to connectivity constraints (Palmer, 2012). This allowed instruction and information to be accessed directly from the device without connectivity (Palmer, 2012). Without this feature, the application may be of little value when a wifi network is inaccessible.

2. Though it is imperative that the device be affordable, the FAO observed that quality decreased as cost decreased (Palmer, 2012). Consequently, farmers were found to be having difficulty with visibility while in sunlight (Palmer, 2012). It's also important to note that excessive heat (which is often found in hot, rural, and semi-arid communities) can cause irreversible damage to the battery (Palmer, 2012).

3. Theft is another major problem. The Africa Soil Information Services (AfSIS) conducted a soil research initiative in 2010, which sent two staff members to Ethiopia to collect soil supplements (Kpeng, 2012). Each member carried with them a mobile device to have access to a digital camera and a GPS satellite (Kpeng, 2012). Their experience highlighted the importance of the "Jean Pocket Test." In this procedure, the phone must be placed in the back pocket of a pair of jeans (Kpeng, 2012). AfSIS suggests that a mobile phone, and thus the ICT application, is utilized more when the device can easily fit in the back pocket. Anything bigger requires you to have a satchel, case, or bag with you which increases the likelihood of theft (Kpeng, 2012).

Precision Agriculture

Precision agriculture is a modern farming practice that improves agricultural efficiency by optimising site-specific inputs. This practice first came into use in the 1980s as global positioning system (GPS) technology became cheaply available for farmers to incorporate into their practice (Headly, 2015). The use of GPS technology allows farmers to more accurately map the movement of farm machinery, reducing overlap and gaps in nutrient dispersal. Modern precision agriculture makes use of GPS, sensors geographic information systems (GIS) and advanced software to further improve efficiency by creating a comprehensive and detailed map of the farmland. This map allows farmers to know the exact irrigation and nutritional needs of the soil, allowing for the optimal application of inputs, reducing waste and runoff. Precision agriculture is an emerging tool for agricultural development and will undoubtedly continue to grow as new technologies develop, and old technologies become more affordable. Utilising these ICTs in development currently runs into the inevitable constraint of the technologies high cost.



Sustainable Agriculture, The Environment, and Climate Change

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Climate Change

Climate change is a topic that must be discussed worldwide. It has had, and will continue to have, negative impacts on global agriculture if not addressed. Its greatest impacts will, however, be felt among smallholder farmers in the Global South (Harvey et al. 2014).

Harvey et al. (2014) argue that the countries that will feel the most severe effects of climate change are tropical countries with large populations of poor, smallholder farmers. Given that agriculture plays a large role in most Global South climate change is of great significance. For instance, in Uganda, agriculture accounts for over 40% of the country's GDP, employs 80% of the labour force, and provides 85% of all exports (Enabling Farmers to Adapt to Climate Change, 2014). Therefore, losses in agricultural production (as a result of climate change) can have devastating effects on the economy, not to mention the overall well-being of most citizens. For this reason, it is necessary to identify adaptation measures that can provide farmers with appropriate coping mechanisms (Harvey et al., 2014). Mobile IT can help with the important task of disseminating coping mechanisms to rural farmers (Vanden Heuvel, 2016).

The Climate Change Adaptation and ICT (CHAI) Project in Uganda, for example, has reached over 120,000 Ugandan farmers, providing them with a new means of receiving adaptation information through ICTs, along with other tools to ensure the continued well being of their families (Vanden Heuvel, 2016). Positive results have come from the incorporation of mobile phones and ICTs in farming areas affected by climate change, providing tools for those who had earlier been neglected by such agricultural extension services

The Rio+20 documents on climate change noted that ICTs are fundamental for achieving this climate-smart agriculture because of their relative low cost and ability to reach remote locations (Adenle et al. 2015). Their ability to open networks and create an information sharing environment further gives farmers the opportunity to educate themselves more thoroughly on climate change, as well as the possible negative effects of their current farming habits (Munyua et al., 2008). See Case Study Box 1 on page 16 for an example in which projects can combine ICT use with other methods of information distribution which helps increase information access by the illiterate, women, and other marginalized groups as well as increasing the adaptation of suggested climate-change innovations.

Case Study Box 1: The Climate Change Adaptation and ICT Project (CHAI)

Combining ICT with various information diffusion mechanisms can extend reach to illiterate farmers and increase adaptation

Uganda is a country that relies heavily on rain-fed agriculture for maintaining livelihoods. However, due to the effects of climate change (e.g. an increase in average temperatures), Ugandan farmers have struggled to keep production consistent. The country has experienced frequent droughts over the past few decades, which is causing great concern for the agricultural sector (Vanden Heuvel, 2016).

The Climate Change Adaptation and ICT project, better known as the CHAI project, was created as a solution for these issues faced by Ugandan farmers. By using mobile and wireless technology, CHAI has strengthened the capacity of rural farmers and communities to adapt to the shocks of climate change (Climate Change Adaptation and ICT, 2016). The main purpose of this project has been to create a climate information system using ICT to gather, analyze and broadcast adaptation information to farmers (Climate Change Adaptation and ICT, 2016).

The CHAI system uses mobile phone-based tools to enable farmers to access crop and livestock market information, hyper-local seasonal weather forecasts, as well as daily weather data. Data is collected by CHAI representatives and is disseminated to farmers who receive directions on their mobile phones via SMS, email, or phone calls (Climate Change Adaptation and ICT, 2016). These directions might include low-cost water harvesting techniques or guidance for drought and flood coping mechanisms (Climate Change Adaptation and ICT, 2016). This allows farmers to decide what, when, where, and how much to produce and sell for each growing season (Climate Change Adaptation and ICT, 2016). Information distribution mechanisms are also implemented through interactive radio and community meetings with local authorities to make sure that even farmers without access to phones themselves can access the information (Climate Change Adaptation and ICT, 2016). It also connects households to different community support organizations, which in turn provide them with the necessary help to put collected information into action (Climate Change Adaptation and ICT, 2016).

The CHAI project is currently estimated to be reaching more than 120,000 Ugandan farmers. The system provides these farmers with a new method of obtaining adaptation information and resources that will help protect their family's well-being (Vanden Heuvel, 2016). Furthermore, research involving 640 households has shown that the information being provided by this project has resulted in reduced crop loss and damage by 67 percent, approximately $474-573 USD per year (Enabling Farmers to Adapt to Climate Change: Uganda, 2014)

This project has been made possible through a partnership between FHI 360, Uganda Chartered HealthNet, Makerere University and the International Development Research Centre (IDRC), as well as the Ministry of Water and Environment (Climate Change Adaptation and ICT, 2016).


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Sustainable Agriculture and ICT's

Since the Green Revolution of the 1960s, countries in the Global South have struggled to recover from the side effects of harmful pesticides and intensive agricultural practices (Cheripelly & Chand, 2015). The increased dependence of small-scale farmers on these methods negatively impacts the environment and threatens the livelihoods of future generations. Many smallholder farmers face barriers such as a lack of market knowledge, weak and inadequate information systems, economic instability and a shortage of resources (Munyua, 2008). To overcome these challenges, farmers need innovative solutions that are both practical and affordable.

Several innovative sustainable agriculture techniques are being employed around the world that are simple and relatively easy to adapt to local contexts and adopt by small-scale farmers. In Cuba for example, coffee, mangos, and avocados are intercropped and reach their ideal nutrient level, go to seed and are harvested, all at different times, promoting biodiversity and sustainability (Nelson, 2016). In contrast to an intense harvest period where farmers receive a single profit sum, these farmers receive payment for their crops and apply their labour and assets at different intervals (Nelson, 2016). Other examples from Cuba include simple lantern light traps attract pests away from crops and planting oregano, basil, or colourful flowers at the ends of rows achieves other pest management goals (Nelson, 2016). In Burkina Faso, digging "zai" or water pockets in rows during the dry season works to mitigate the droughts that climate change continues to intensify (Sibanda & Wilson, 2013). These water pockets are packed with manure and leaves - termites are attracted to the manure and they then construct tunnels in the soil that enable water and nutrient access (Sibanda & Wilson, 2013). As a result, sorghum and millet seed can begin to grow almost immediately upon the return of rainfall (Sibanda & Wilson, 2013).

Manish Raizada, a professor at the University of Guelph, empowers smallholder farmers North America, Sub-Saharan Africa and South Asia through low-cost technologies. One example of this technology is a tool that shells 17.5 kgs of maize in 30 minutes, as opposed to the regular 2 to 2.5 hours. Another example is a picture book that explains agricultural practices through visual means, thus combatting the barrier of illiteracy (Borish, 2016). These examples demonstrate the number of simple innovations that farmers have developed themselves, in their communities or in tandem with scientists that really work to promote sustainable agriculture and could be relevant to farmers all around the world. Some innovations will of course also require local adaptation. Microrisal, which has the capacity to mimic soil fungi's symbiotic relationship (thus increasing root nutrient and water absorption), is one example. Cultivation and application of Microrisal is simple and can adopt in various locations, but modifications for context must be included to ensure that its potential to increase resiliency and productivity is retained (Nelson, 2016). A remaining challenge is helping to scale up these innovations, making them available and adaptable by other farmers.

Again, mobile technologies can play a major role in diffusing such innovations in rural communities. They are most valuable, however, when they not only provide information to farmers, but also tailor the information specifically to farmer's needs by also collecting information from farmers themselves. This can help farmers adapt technologies and practices to fit their particular context. In India, for example, an innovative system called e-Sagu was invented to provide education on the use of sustainable farming practices (Cheripelly & Chand, 2015). Through this system, farmers can send pictures and texts to research centers and receive scientific expertise back via text message to help them increase their yields while protecting the environment (Cheripelly & Chand, 2015). This relationship is bilateral, as smallholder farmers can also share information about the land, which in turn helps scientists develop best practices for that particular region (Cheripelly & Chand, 2015). Since this concept is relatively new, many farmers are skeptical of sustainable practices such as biotechnology (Scott et al., 2014). By implementing mobile IT, we can ensure there is transparency between key stakeholders, which reassures rural farmers that these practices will not only benefit the environment, but their livelihoods as well (Scott et al., 2014). Farmers that outline their needs and obstacles via SMS systems or social media can receive assistance and become educated on new practices. This networking should result in a supportive policy environment, one where government subsidies and tax discounts encourage sustainable agriculture (Thrupp, 2000).

In India, an ICT project which uses mobile text message service that has resulted in net income increases beyond US$100/Ha per season on rice yields. Similarly, maize yields in Kenya are anticipated to double from e-farming SMS text messages that inform smallholders on agronomic details, varieties, and crop and fertilizer management. This is making cellular devices "like a piece of farm equipment, [a] key to determining [the] productivity in the field" (Palmer, Etyang & Okoth, 2012).

Not only can cellphones address issues of uncertainty and information gaps, but they can also help promote and teach farmers about sustainable agriculture. Frequently, the most available information is not the most accurate or up-to-date, such as that passed down from other farmers or market vendors (Cheripelly & Chand, 2015). With the promotion of mobile IT, farmers will be able to access information from the various stakeholders involved at multiple levels of the agricultural process. By incorporating an equal, two-way communication network, scientists and farmers at the local, national and global tiers can distribute information on sustainable practices. See Case Study Box 1 for an example of how this works.

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Photo Credits: Grameen Foundation (2012)

Case Study Box 2: Community Knowledge Worker (CKW)
Making information available to all using ICTs

Accessibility is a key concern for projects using ICT. The Grameen Foundation, a global nonprofit organization, addresses this by providing a physical human being, referred to as a Community Knowledge Worker (CKW) as an agricultural resource (Kreep, 2011). This program began in 2010 and it currently provides 700 CKW within 15 districts across Uganda (Kreep, 2011). The CKW is democratically elected as a representative by the community to be the person in possession of a mobile phone through which he or she acts as an "information intermediary." He or she can access agricultural extension information through cloud computing and relay this to a community member. This is especially beneficial if the individual is illiterate or does not have access to a mobile phone (Palmer, 2012). It also ensures that those who can not afford a smartphone or internet connection can access the information. The use of the CKW also helps ensure information disseminated is relevant to specific communities. Members of the community are surveyed so that the representative is aware of what local needs are (Kreep, 2011). The information gathered by all CKW across Uganda is analyzed through the use of an electronic dashboard (Kreep 2011). The Grameen Foundation then takes this gathered content and provides general and specific recommendations which can be accessed through the CKW. The Grameen Foundation acknowledges the constraint of energy, in that it is often scarcely available. In response to this constraint, they work together with Fenix International Inc. and provide a "Ready Set" off grid charging solution. This solar kit can power approximately 10 mobile devices per day or provide as much as 10 hours of light, thus significantly reducing energy costs (Lin, 2011). According to the FAOs, farmers in Eastern Uganda with access to a CKW are able to successfully market their product, on average, 17% higher than those who do not have access to a CKW (Palmer, 2012).

Photo Credit: David Borish

The Food System, Agriculture and Global Health

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Food Security and Malnutrition

Local and global economies, the environment, and the political economy, all affect, and are affected by, a person's ability to be food secure, influencing their overall health, wellbeing, and their ability to participate in an appropriate livelihood (Clapp, 2016). Challenges related to health and food security disproportionately affect marginalized and impoverished rural communities, resulting in a cyclical health-related poverty trap that reinforces barriers (De Schutter, 2014; FAO, 2016). We must consider agriculture, health, and nutrition as being intimately linked if they are to successfully integrate ICTs into smallholder agriculture and its associated livelihoods in the Global South.

Recently, many scholars have established that the issue of food security is not actually one of supply, but of unequal distribution and utilization (Clapp, 2016; De Schutter, 2014). Advanced by Olivier De Schutter (2014), the former UN Special Rapporteur on the Right to Food, the "Three A's" of food security provide a comprehensive gauge of food security. Availability; the kinds of food that are grown or provided in an area, access; the ability to acquire certain foods within an area through purchase or other means, and adequacy; consumption of nutritionally and culturally appropriate foods, are all required to achieve a well-balanced food system and food security (De Schutter, 2014).

Case Study Box 3: High Tech Solutions for Diabetes
Self-Care but at a Prohibitive Cost

Holistic, Interactive and Persuasive Model to Facilitate Self-Care of Diabetics (hiPAPD) was a pilot project implemented in Panama, which provided technologies to diabetics that could be used to manage their illness. The Technological University of Panama funded the program, and targeted it towards diabetics with low economic, social and educational status, who would not traditionally have access to the technologies provided. Technologies provided included Bluetooth pedometers, Bluetooth scales, embedded glucometers and blood pressure monitors. These technologies connected to a tablet device given to the patient. The tablet analyzed the information from the other technologies and provided customized advice as to what the person should do to best manage their diabetes at that given time. Moreover, the tablet provided access to virtual forums in which participants could engage with other diabetics for support and advice.

This technology received high feedback from diabetics that participated in the project. Nearly all participants reported that they liked the project, felt it benefited their health and increased their access to social support for self-care. Despite this, the project was unable to continue, due to the high costs of providing the technologies (Lombardo et al., 2012). HiPAPD shows the potential for ICTs to improve management of type 2 diabetes, critical in ensuring full productivity of these individuals. However, costs must be considered when determining whether a project has the potential to last in the long run or scale up.


Photo Credit: Rebecca Forbes

Food insecurity can lead to various forms of malnutrition, “an abnormal condition caused by deficiencies, excesses or imbalances in energy, and/or nutrients necessary for an active, healthy life” (FAO, 2016). Previously described as a double burden, malnutrition is now seen as a triple burden, referring to undernutrition and overnutrition, and conditions arising from dietary imbalance leading to diet-related noncommunicable diseases (FAO, 2016; Pinstrup-Anderson, 2007). Chronic malnutrition, also known as chronic hunger, occurs when an individual does not have a sufficient intake of food over a sustained period, leading to irreversible effects such as stunting, compromised immunity, and overall impaired physical and mental development (FAO, 2016; Pinstrup-Anderson, 2007).

Overnutrition is characterized by excessive macronutrient intake, leading to overweight and obese individuals, and increasing the likelihood of developing non-communicable diseases such as metabolic syndromes, type 2 diabetes, congenital heart disease, cardiovascular disease, hypertension, and various cancers (FAO, 2016). Hidden hunger, or micronutrient deficiencies, is the result of inadequate dietary diversity, particularly a lack of vitamins and minerals vital for growth and development (FAO, 2016; Pinstrup-Anderson, 2007). Low-income families, and women and children especially, are often deficient in vitamin A, iron, and iodine, and other essential nutrients, which limits their health, development, growth, and working capacity (FAO, 2016).

Jomo Kwame Sundaram (2014), the former Assistant Director-General and Coordinator for Economic and Social Development in the Food and Agriculture Organization (FAO) within the UN, maintains that good nutrition is not only beneficial from a health perspective, but is crucial to economic prosperity. He estimates that each year, malnutrition is responsible for a 5% reduction in global economic due to forgone output (eg. decreases in current productivity and loss of work force) and additional incurred costs (eg. increased pressure on healthcare systems) (Sundaram, 2014).

Malnutrition caused by food insecurity is resulting in the loss of lives and impedes livelihoods, and with them their potential to contribute to the economy, particularly for present and future farmers and agriculturalists (Sundaram, 2014). Rising levels of nutrition is the ultimate goal and ensures our focus is on farmers (people) rather than on just farms (production) or on pharmacies (supplements) as a solution ("Global Nutrition Report", 2016; Hoddinott, 2011). ICTs can provide a means of improving local and global understandings of food security and make sure that agricultural and health initiative consider nutrition as a key part of their solutions aimed at combatting food insecurity (International Telecommunication Union, 2009).

Case Study Box 4: RapidSMS

The benefits of gathering data via SMS

In Malawi, the Integrated Nutritional and Food Security Surveillance (INFSS) is a government program that collects information on child nutrition, using data from growth monitoring clinics (GMC); clinics that measure key indicators of nutrition (Blaschke, et al., 2009). Workers at GMCs record measurements on paper, then mail the data to the INFSS headquarters where they are inputted into the database (Blaschke et al., 2009).

The Malawian government and UNICEF implemented a pilot project, RapidSMS, in three districts of Malawi, which aimed to increase the speed of data transmission. RapidSMS provided GMC workers with a cellphone that they used to send an SMS containing nutritional measurements of each child, to a central number. This directly inputted the measurements into the INFSS database. An alert was sent if a measurement was physically impossible, or if it indicated malnutrition, in which feedback was given on how to address the issue (Blashcke et al., 2009).

RapidSMS decreased the time for records to be inputted into INFSS's database, from one to three months, to an average of two minutes. This enabled the Malawian government and other actors (e.g. UNICEF), to analyze up-to-date nutritional information and create appropriate policies or programs based on the information. Moreover, RapidSMS improved quality of records, by notifying GMCs if a measurement was physically impossible. In turn, malnutrition issues were treated more rapidly, due to the immediate feedback provided through this system (Blashcke et al., 2009). Immediate and accurate treatment of malnutrition that was facilitated through RapidSMS, helps to minimize the risk of decreased productivity, including that of agriculturalists.


Photo Credit: David Borish

Malnutrition and ICTs

Within rural areas characterized by agricultural livelihoods, ICTs present a means of compiling and sharing information concerning food access, consumption, prices and coping mechanisms to better address those in the most dire need (FAO, 2016; “Global Nutrition Report”, 2016). They also offer potential tools for incorporating nutrition information into smallholder farming practices and addressing various health outcomes due to malnutrition (*see Case Study Box 3 on page 21*), leading to increased control over diets, livelihoods, and overall well being (International Telecommunication Union, 2009).

The vast majority of the world's hungry people live in developing countries, where 12.9 percent of the population is undernourished (WFP, 2016).

Case Study Box 5: Cell-Life

Gathering and disseminating data via mobile phones

One of South Africa’s most pressing MDGs is to reduce the number of deaths due to HIV/AIDS. The disease was the leading cause of death in 2012, killing an estimated 200, 000 people (WHO, 2012). For the over 5 million South Africans living with HIV and the many others affected by the epidemic, there remains an urgent need for communication between those affected and support structures regarding the course of treatment. In efforts to combat the prevalence of deaths from HIV/AIDS, Cell-Life has integrated the expertise of healthcare professionals to develop solutions that support HIV/AIDS management and monitoring efforts (Benjamin, 2010). *Aftercare*, for example, is a data collection tool that enables health counselors to gather information about their patients using cell phones equipped with software developed by Cell-Life. By using *Aftercare*, counselors can record data right from the comfort of the patient’s home and can relay this information to a central Cell-Life database via text message, where a manager can then use a web-based system to access and monitor the incoming patient information. Additionally, the manager can also communicate with *Aftercare* workers and provide supplemental information to improve patient care. The information collected not only facilitates individual patient care, but is also used to build a database of information on the prevalence of the South African AIDS epidemic.

Epidemics and Neglected Tropical Diseases

The creation and use of new ICTs present a means of mitigating the food security and health symptoms created by epidemics and diseases. One example is Ebola, a deadly viral disease without a known cure. The most recent outbreak of Ebola, originating in Guinea and spreading to Sierra Leone and Liberia, has an overall estimated fatality rate of 40% (CDC, 2016). Liberia has been most affected by it, accounting for 4,810 deaths out of a total of 11,310 in West Africa (CDC, 2016). Shortages of qualified healthcare workers, poor occupational safety, and a weak overall healthcare distribution system are among the causes of the intensity and spread of the epidemic. This has been worsened by a reluctance among healthcare workers to address the virus, due to high (8%) mortality rate among healthcare workers (World Bank, 2015).

The demobilization and death of farmers due to the Ebola outbreak, as well governments' imposed quarantines and restrictions on people's movements, contributes to a significant disruption in food production in West Africa and other affected areas (IFPRI, 2016). Furthermore, in an effort to contain and combat the spread of Ebola, governments imposed quarantines and restrictions on people's movements, disrupting market economies (IFPRI, 2016). These factors intensified food scarcity and led to dramatic increases in food prices, reducing many families to a single meal per day (IFPRI, 2016). For instance, cassava, a staple food for many households in Liberia, saw a 150% increase in price during the Ebola outbreak (FAO, 2014). These high food prices disproportionately affected already impoverished and marginalized communities, threatening their food and nutrition security immensely (IFPRI, 2016).

Neglected Tropical Diseases (NTDs), which include Buruli ulcers, Chagas disease, Dengue and Chikungunya, Leprosy, and several more, affect over one billion people in tropical and subtropical regions (WHO, 2016). NTDs disproportionately impact people living in poverty, without adequate access to sanitation or clean water (WHO, 2016). Several NTDs bear side effects that directly harm health and food security, such as anaemia and malnutrition or parasites which consume key bodily nutrients (Samuels & Pose, 2013). NTDs also have an indirect impact on food security because, like all diseases and epidemics, they limit the conditions in which people can work. This includes farmers who have a more challenging time producing food for themselves and their families. There are also medical and time costs associated with treating NTDs, which greatly disadvantage people who carry them (Samuels and Pose, 2013).