

Innovating Kenya's Trading System Through Mobile Technology: A Case Study of
M-Farm In Nairobi, Kenya

A Project Paper

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by

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ABSTRACT

This project paper explores the use and impact of mobile money in Kenya, with a focus on Mobile Farm (M-Farm), a mobile agritech platform co-founded and led by women in Kenya. A literature review and analysis of Kenya's agricultural supply chain illustrates the impact of an Information and Communications Technology (ICT) centered economy on the livelihoods of farmers in the country's rural areas. A more in-depth review of literature highlights Kenya's main technology centered initiatives, including the *Vision 2030 Campaign* and *Digital Economy Blueprint*, which are government instituted ventures to grow both the country's urban and rural economies. Building on the M-Farm experience, special attention is given to how women, in the technology sector, are using basic mobile technology to close infrastructure deficiency gaps throughout Kenya's agricultural supply chain. This paper concludes by outlining how Kenya's technology campaigns are systematically prioritizing development in urban areas over rural regions. It also sheds light on how women are making strides to combat the deficiencies across the country's rural economy, by promoting agriculture-based mobile technology applications that are easily accessible by farmers, while working to connect women entrepreneurs across Kenya's female centered agriculture sector.

BIOGRAPHICAL SKETCH

Fante was born in Fort Campbell, Kentucky and grew up in various parts of the United States and The Republic of Panama. She attributes her interests to the teachings of her mother, father, and stepfather who all emphasized the importance of remaining current to global affairs and pursuing an understanding of the world from a lens of observing and learning and observing from the communities she visited or lived in. Fante's interests are in food justice, climate-smart agriculture, and civil rights. Prior to attending Cornell, she volunteered with a healthcare team in Soweto and Johannesburg, South Africa to provide basic access to medical care for adults and children. Fante graduated from Marymount Manhattan College, in 2015, with a Bachelor of Arts in International Affairs. During her undergraduate program she studied in Angers, France and Brussels, Belgium with the ESSCA Ecole de Management to pursue European Union Studies and Economics. In the Fall of 2019, she enrolled in the MPS Program in International Agriculture and Rural Development at Cornell University.

I would like to dedicate this project paper to my parents. Thank you for the continuous love and support.

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LIST OF ABBREVIATIONS

AGOA	:	African Growth Opportunity Act
BPO	:	Business Process Outsourcing
CBO	:	Community Based Organization
COMESA	:	Common Market for Eastern and Southern Africa
CRBC	:	China Road and Bridge Corporation
CTA	:	Technical Centre for Agricultural and Rural Cooperation
EAC	:	East African Community
EU	:	European Union
FAO	:	Food and Agriculture Organization of the United Nations
FTA	:	Free Trade Agreement
GDP	:	Gross Domestic Product
ICT	:	Information, Communication and Technology
IFAD	:	International Fund for Agricultural Development
IMF	:	International Monetary Fund
IT	:	Information Technology
ITA	:	International Trade Administration
KARI	:	Kenya Agricultural Research Institute
KNBS	:	Kenya National Bureau of Statistics
KMICT	:	Kenya Ministry of Information, Communication and Technology
NBS	:	National Broadband Strategy

SMS	:	Short Messaging Services
SSA	:	Sub-Saharan Africa
UN	:	United Nations
US	:	United States
USTR	:	United States Trade Representative
USAID	:	United States Agency for International Development
VC4A	:	Venture Capital for Africa
WB	:	World Bank
WTO	:	World Trade Organization

CHAPTER I

INTRODUCTION

” After decades of ‘technology takers’ in the global digital divide between North and South, many African countries are today prioritizing investments in science, technology, research and innovation. The African Union’s Agenda 2063, which sets the development vision pathway for Africa over the next five decades, recognizes the importance of technology as a catalyst for the continent’s structural transformation, economic development and social progress.”

- Peña-Méndez & Vickers, 2015, p.2

In the realm of culture, politics, economics, and trade, African countries tend to be recognized as an all-encompassing single society with one solitary background, rather than an extremely diverse continent consisting of a network of varying countries with different historical, cultural, political, and economic backgrounds. Throughout Sub-Saharan Africa (SSA), countries like South Africa, in particular, are one of very few post-colonial societies that have succeeded in pursuing development through the more traditional commodity export driven trade approach.

South Africa is a rare conundrum when it comes to international trade throughout the African continent. This nation is one of the few Sub-Saharan African countries which are already very open to international trade. International trade makes up 59.4% of its Gross Domestic Product (GDP) – as it exports heavily in “platinum (8.4%), coal and

similar solid fuels (6.6%), motor vehicles (6.6%), gold (5.8%), and iron ores (4.6%)”.

South Africa is a top trading partner for “China, the United States, Germany, India, The UK and Saudi Arabia” and is, currently, the European Union’s (EU) largest African trading partner (Santander Trade, 2020, p.1).

While South Africa is having a lot of success within the international global trading field, most Sub-Saharan African countries do not have strong commodity driven export economies. This is largely due to a lack of resources, infrastructure, and investments that have kept most developing SSA countries on the outskirts of global trade. They simply do not have access to an excess of cheap natural resources, raw materials, and cheap skilled labor. Additionally, they do not possess the financial ability for their governments to back preferred domestic markets with substantial subsidies to produce even cheaper goods that could be widely exported.

This has led many SSA countries to be heavily reliant on international aid and monetary loans provided by developed countries and international institutions, such as the World Bank (WB) and International Monetary Fund (IMF), whose provisions often consist of short-term development projects and conditional monetary loans that have the potential to further stifle long-term opportunities for self-sustained development throughout many African countries (IMF, 2020). Without strong economies, most SSA countries deem it necessary to institute high import tariffs to protect their most lucrative domestic industries, which tend to be centered around agriculture and more rural-based markets (Agbeyegbe, Stotsky & WoldeMariam, 2006).

This short-term and conditional approach to development that is widening the gap between the majority impoverished and few wealthy groups of society throughout SSA countries, unfortunately, will continue to be the norm until sustainable development that benefits the whole over the few is prioritized. Fortunately, there are still some SSA countries that are taking the initiative to dismiss traditional approaches to development – which heavily rely on the conditional support of the global north. Instead, they are choosing to pursue more modern advancements to long-term self-sustained development, by prioritizing domestic investments in the technology sector that will enable new innovations and boost economic productivity and competitiveness throughout the global trading field (Nguimkeu & Okou, 2021).

CHAPTER II

EXPANDING TRADE THROUGH TECHNOLOGY IN KENYA

Background: Kenya's Economy

Kenya is among Sub-Saharan Africa's fastest growing economy, ranking 27th in the world with a GDP of \$70.53 billion, which means "strengthening and improving the performance of the agricultural sector and enabling the engagement of the poorest and most vulnerable in this process is...a necessary condition for achieving continued recovery and growth throughout Kenya" (FAO, 2019, p.1). Agriculture is a major portion of Kenya's economy, accounting for 50% of the country's total exports and nearly 65% of its export earnings (World Bank, 2019).

However, infrastructural gaps, such as the lack of adequate roads and means of public transportation outside of urban areas, persist throughout the region (StatisticsTimes, 2020). These infrastructural development discrepancies have made it extremely difficult for smallholder farmers, in rural areas, to connect with buyers in urban markets, leading to a disaggregated agricultural supply chain and an increase in severe poverty throughout Kenya's smallholder farming community (Njogu, 2020). With Kenya's agricultural sector being critical to the livelihoods of more than 80% of its population, "strengthening and improving the performance of the agricultural sector and enabling the engagement of the poorest and most vulnerable in this process is...a necessary condition for achieving recovery and growth in Kenya" (FAO, 2019, p.1).

Kenya is a SSA country that has recognized it does not have the resources, investments, and infrastructure to produce enough commodity-based exports to compete on even a minor level within the global trading field without negatively impacting some sectors of its own economy. As many other SSA countries have done, Kenya “continues to use instruments under the Common Market for Eastern and Southern Africa (COMESA) and East African Community (EAC) agreements to limit food imports”, since the country “perennially faces supply deficits in most of its food sectors (ITA, 2019). Both agreements also provide for high non-member tariffs on sensitive commodities including meat, dairy, poultry, maize, rice, wheat, and beans” (FAO, 2019, p.1). However, despite suppressing food imports and providing limited subsidies on some agricultural products, like seed and fertilizer, Kenya’s overall agricultural productivity has remained extremely low, with a substantial infrastructural development discrepancy between rural and urban markets that has devastated the livelihoods of smallholder farmers throughout its agricultural sector.

Therefore, Kenya has begun to construct a new path for itself within the global trading field. Specifically, bypassing the traditional methods of achieving developmental success as an export commodity producer within global trade and, instead, seeking self-sustainability through government-backed investments in technological innovations. Kenya is prioritizing services in Business Process Outsourcing (BPO) and Information Technology (IT) that can be easily and cheaply exported virtually without the need for

customs, transportation fees, and the many World Trade Organization (WTO) regulations exclusive to the commodity-driven export trading sectors (ITA, 2019).

The premise of Kenya's approach to trade is, since they cannot focus on generating the necessary amount of export commodities needed to participate in the traditional global trading field, they will invest their resources in developing a hub of innovative technologies within the Information and Communications Technology (ICT) sector (ITA 2019; Peña-Méndez & Vickers, 2015). This tech-centered approach to trade will permit Kenya to bypass the more traditional means of development, through commodity-based global trade, and construct a new and innovative technology-driven lane for themselves in the global trading field.

Kenya's Agricultural System

According to the Food and Agriculture Organization of the United Nations (FAO), agriculture directly contributes to 26% of Kenya's GDP, and further contributes to another 27% of the GDP through its interactions with other agribusiness sectors, such as restaurants and grocery stores (FAO, 2019). Over 68% of Kenya's rural population (roughly 32.73 million people, according to the Kenya National Bureau of Statistics (KNBS)) are directly employed in the agriculture sector (KNBS, 2020). While Kenya's agricultural system is one that is constantly changing, it remains heavily reliant on smallholder farmers.

There are over 4.5 million farmers throughout Kenya with plots of land less than 5 acres (around 0.2-0.3 hectares) producing roughly 75% of Kenya's agricultural output (Birch, 2018; KARI, 2019 as cited in Bradford et al., 2020). Although its economy is fast-growing, infrastructural gaps, including adequate roads and means of public transportation outside of urban areas, persist throughout the region and make it extremely difficult for farmers, in rural sectors, to connect with buyers in urban markets (Hope, 2011).

Kenya's Infrastructure Discrepancies

Access to Roads & Transportation

Lack of adequate infrastructure, such as paved roads and widespread public transportation, have made accessing urban markets nearly impossible for Kenyan smallholder farmers. With the lack of paved roads and the lack of access to consistent and affordable transportation across the rural sector, a farmer's ability to easily travel in and out of rural areas, to access their main consumer base in Kenya's urban city centers, is nearly impossible (Hope, 2011).

Brokers take advantage of farmers' lack of physical access to their main consumer base throughout urban markets, as well as farmers' lack of access to daily market pricing information for their crops. This increases farmers' vulnerability for unfair pricing for their harvests, leaving many unable to sustain themselves and their families. Currently, two-thirds of Kenyans live below the poverty line on \$3.20 per day, with 70% of Kenyan

families susceptible to vulnerabilities due to lack of access to food, adequate nutrition, and medical treatment (USAID, 2021).

Access to Electricity

The infrastructural development inequities that have caused for a severe lack of paved roads throughout the rural sector have also caused a lack of consistent, affordable electricity. This eliminates the ability for the average smallholder farmer to store their crops once harvested. Lack of cooling storage facilities leaves farmers with a very small window of time to access a buyer to sell their crops before their entire harvest spoils (Ulsrud et al., 2015).

If a smallholder farmer must endure residing in a particularly difficult area to reach, due to the lack of roads, having no access to consistent public transportation, limited access to electricity which prevents them from accessing their main clientele, and lack of reliable electricity to maintain cooling storage facilities that would extend the shelf life of their harvests, they have no other option but to engage in business with brokers (Salon & Aligula, 2012).

Access to Information

The deficit between farmers and information drastically impacts farmers' ability to maintain productive agricultural and marketing practices, such as in dealing with the effects of climate change. Traditionally, farmers in Kenya have practiced rain-fed methods of farming. However, as land in the region becomes more vulnerable to

droughts and unpredictable weather patterns, due to climate change, traditional farming methods become increasingly inefficient. Without the necessary information needed for farmers to learn and adopt new farming methods to apply to their changing landscapes, farmers' overall yield and income continue to decrease (FAO, 2019).

Access to Fertile Land

Fertile land is also becoming more of a dwindling resource throughout Kenya's agricultural system. This makes it more difficult for farmers to cultivate large enough yields to produce a liveable wage each season. According to the United States Agency for International Development (USAID), only 20% of Kenya's land remains sufficient enough for farming, in terms of retaining the necessary bio-diversity and soil fertility needed to sustain crops. This increasing land degradation is the result of many culminating factors, such as the lack of crop rotation due to the prioritization of monoculture farming practices (USAID, 2019). Farmers often only grow one type of crop on the same plot of land, repeatedly, leading to a depletion of soil nutrients needed for soil fertility.

Another critical factor to Kenya's agricultural system is the increasing seasons of inconsistent rainfall throughout crop cycles. Kenya's agricultural practices rely heavily on consistent rainfall to water crops throughout each season. Kenya's agricultural supply chain has incurred increased vulnerabilities due to erratic seasonal changes and excessive droughts. These impacts on land fertility, water accessibility, and adequate

infrastructure pose serious constraints to the physical and economic growth of Kenya's agricultural sector (Britannica, 2016).

CHAPTER III

KENYA'S TECHNOLOGY BLUEPRINT

Vision 2030 Strategy

“The vision aspires to make Kenya a globally competitive and informed society that effectively participates in the knowledge-based economy.”

– International Trade Administration, 2020

In 2010, reforms led by former Kenyan President, Uhuru Kenyatta, ushered in the passage of a new constitution that enabled for substantial economic and social (quality of life) improvements throughout the country. These improvements have been implemented via the Big Four development priority goals that prioritize manufacturing, universal healthcare, affordable housing, and food security in the President's Vision 2030 Development Strategy. With these implementations, Kenya's GDP reached 5.7% growth in 2019 (World Bank, 2019).

The Vision 2030 campaign has streamlined generous investments into Kenya's urban economy, enabling for substantial infrastructural developments of roads, offices, apartment buildings, and even a \$1.5 billion railway, contracted through the China Road and Bridge Corporation (CRBC) (Miriri, 2019). To ensure that Kenya's *Vision 2030 Strategy* is successful, the government of Kenya has implemented a *Digital Economy Blueprint* to be followed by all domestic market sectors, so as to ensure that the digitization of Kenya's economy is a collective effort being pursued across the country.

As illustrated in Figure 1 below, the Digital Economy Blueprint is based on five key pillars as the foundation for Kenya’s economic growth, including: digital government, digital business, infrastructure, innovation-driven entrepreneurship, and digital skills and values. This blueprint incorporates rural and urban communities, as well as high, middle, and low-income socio-economic groups. The Digital Economy Blueprint is meant to ensure a strategy for digital development that is not centralized within the higher wage-earning groups of society, but incorporates all of society across sectors (ITA, 2020).

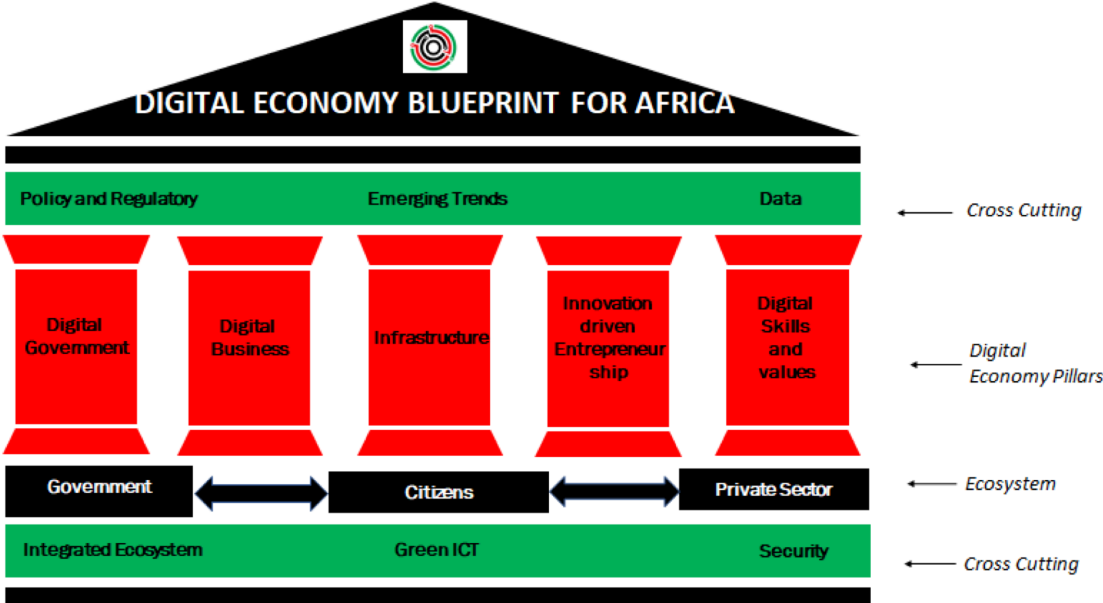


Figure 1: “The Pillars that have been identified to drive the digital economy for Kenya.”
(Ministry of Information, Communications and The Digital Economy, 2020)

Kenya's United States (U.S.) Free Trade Agreement

“This would be the first free trade agreement of its kind between the United States and a Sub-Saharan African Country. This Agreement would build on the objectives of the African Growth and Opportunity Act, which is set to expire in 2025. It sets the stage for a future trade relationship between the U.S. and Kenya.”

-Robert Lighthizer, United States Trade Representative (USTR), 2018, p.1

Kenya's rapid growth throughout its ICT sector has drastically improved the livelihoods of its urban population – leading to a sizable middle class that now consists of about 25% of Kenya's population. However, the approximately 75% of Kenya's population that resides in the rural sector is not benefitting very much from the economic growth afforded to their urban counterparts (Peña-Méndez & Vickers, 2015). Casey Torgusson, World Bank Senior Digital Specialist, explains the benefit in developing and investing in digital infrastructure that will, not only, lead to economic growth for Kenya, across urban and rural sectors, but enable Kenya to become a driving force in the digital trading field (World Bank, 2019).

As Kenya has been making strides in the digitization and increased productivity of its economy, the government of Kenya has started to pursue the free trade agreements (FTAs) that will propel them into the global trading scene. Kenyan President Uhuru Kenyatta met with the former United States President, Donald Trump, to begin negotiations of Kenya's first free trade agreement with the United States. This

conversation was the United States' first free trade agreement with a Sub-Saharan African (SSA) country and is a very important agreement, not only for Kenya, but for all African countries. This agreement, including negotiations focusing on technical barriers to trade, intellectual property, digital trade, subsidies and more, has had one of the largest impacts on US-Africa trade relations since the African Growth and Opportunity Act (AGOA) in 2000 (Dawson & Schneidman, 2020; Lighthizer, 2018). According to U.S. Trade Representative, Robert Lighthizer, if completely successful, this Kenya/U.S. FTA will serve as the blueprint for future U.S. FTAs with other African countries in the future (Dawson & Schneidman, 2020).

Moving forward, Kenya is continuing to pursue its *Digital Economy Blueprint*, which is focused on completely organizing and developing each of the region's disaggregated market sectors through the digitization of its economy. According to former President Kenyatta, the pursuit of more FTA's are already in the works with other countries and will continue to be a priority of Kenya's *Vision 2030 Development Strategy* throughout the next decade (Dawson & Schneidman, 2020).

The Silicon Savannah

The growth of Kenya's Information, Computer and Technology (ICT) sector has evolved, due to the *Vision 2030 Development Strategy*, which, as previously highlighted, prioritizes the implementation of a *Digital Economy Blueprint* across all major business sectors (ITA, 2020). Kenya has entered into what many are calling a "mobile tech

revolution,” with increasing innovations in mobile money-transfer services that enable Kenyans to send and receive money at a relatively instantaneous rate; digital apps that provide services linking farmers to buyers within the market; and Short Messaging Service (SMS) platforms that provide farmers with access to market pricing information in real-time to aid them in securing maximum profit for their yields (Mengistu & Imende, 2013).

The strategic management plan of mobile technology within Kenya’s agricultural sector is to close the gaps throughout the supply chains that perpetuate inefficient market systems. According to the FAO, agriculture is one of the main drivers of Kenya's economic development - producing 26 percent of the Gross Domestic Product (GDP) and 27 percent of GDP directly and indirectly through other, non-agriculture based sectors (FAO, 2019). In prioritizing efficiency throughout agriculture, mobile technology is inadvertently contributing to the efficiency of Kenya’s economic system.

Mobile Money

“Mobile technology has played a crucial role in promoting financial inclusion in Africa, where less than 20 percent of households have access to formal financial services”

- Peña-Méndez & Vickers, 2015, p. 3

Kenya’s mobile technology sector has steadily gained traction since its successful implementation of mobile money in 1993 by Safaricom - Kenya’s leading

telecommunications provider and one of the highest profit driven companies throughout East and Central Africa (Peña-Méndez & Vickers, 2015). The necessity to seamlessly conduct transactions between buyers and sellers, without the logistical and safety hazards that come with using cash, was reformed by Safaricom and their mobile money transfer service, M-PESA (Safaricom, 2019). The mobile app is the ultimate micro-financing service provider that paved the way for what is now known as Kenya's "Silicon Savannah" (Safaricom, 2019).

Safaricom, alongside Britain's Vodaphone Group Plc, which owns 40% of the company, founded M-PESA, which is a mobile money transfer service, incorporating systems of payment and micro-financing that paved the way for what is now known as Kenya's *Silicon Savannah* (Safaricom, 2019). With the substantial changes throughout Kenya's financial technology (fintech) sector, following Safaricom's immense success with its mobile money platform, M-PESA, there has been a rapid increase in the development of mobile start-ups designed to innovate and streamline other fractured regional systems throughout Kenya, in the past two decades (Nzomo et al., 2020).

M-PESA is not just used within the agricultural sector. This mobile money platform accounts for around 80% of Kenya's money transfers in rural and urban areas, alike. It gives users the ability to send and receive money for any type of financial transaction by sending a simple SMS text message from a basic mobile device (Safaricom, 2019).

M-PESA also has more advanced service features for smartphone users through the

mobile application (app), including access to a savings account, the ability to pay bills, and request loans (Safaricom, 2019).

M-PESA is just one example of how Kenya is using mobile money to increase the region's financial productivity; removing internal non-tariff barriers to trade by improving unorganized financial systems that have prevented Kenyan market sectors from being productive and, therefore, lucrative enough to participate in global trade (Agbeyegbe, Stotsky & WoldeMariam, 2006).

CHAPTER IV

MOBILE AGRITECH

“We are digitizing our agriculture [system] to help ease agricultural processes, boost electronic commerce and provide data for future farm use.”

Mwangi Kiunjuri, Cabinet Secretary of the Ministry of Agriculture and Irrigation in Kenya

- Devdiscourse on Development, 2018, p.1

One sector of the economy that Kenya is currently prioritizing, in the digitization of its economy, is agriculture. The agricultural supply chain in Kenya is inefficient due to the disconnect between smallholder farming communities and larger urban markets.

Throughout the last decade, with Kenya’s increased investments in mobile platforms, digital technology has begun bridging the gap between farmers and markets, information, and access to capital. Digital apps provide services linking farmers to buyers within the market and Short Messaging Service (SMS) platforms facilitate access to market pricing information in real-time to aid farmers in securing maximum profit for their yields. Mobile agriculture technology (agritech) is inadvertently contributing to the efficiency of Kenya’s economic system as a whole and increasing Kenya’s overall economic productivity within the global trading field (Mengistu & Imende, 2013).

When smallholder farmers have access to buyers to purchase their products and the information necessary to produce, store, transport, and sell their products at the best value, they can begin to build a consumer base that will enable them to generate

consistent capital. This will enable a more efficient agricultural system that will, inevitably, aid in furthering the growth of Kenya's economy and securing stable livelihoods for farmers. Mobile money platforms, like M-PESA, make it easy for farmers to conduct transactions without the need for a middleman (e.g. banking institutions; brokers) and without the time delays and issues of security that come with generating cash-based transactions (Kikulwe, Fischer & Qaim, 2014).

However, with Kenya's increased productivity in agriculture, these initiatives are still rather recent. This means that many gaps continue to persist within the market. Many farmers, especially women, still struggle to gain enough income from farming to support themselves and their families. To close this financial gap, within agriculture, the Grameen Foundation and Musoni Kenya, micro-financial institutions in rural Kenya, have partnered to create Kilimo Booster, a loan service geared to the needs of smallholder farmers (Grameen Foundation, 2015). Loans are disbursed directly into a farmer's mobile money accounts and repayment requirements correspond with each individual farmer's harvest cycles. The organizers also work to facilitate cash flows that ensure the loans are not due at a random time of year before crops have been harvested. They want to confirm that the farmers have generated cash flow from cultivating and selling their crops to meet their financial deadlines (Nyawira, 2017).

The Kilimo Booster mobile platform has been extremely productive for further engaging women in agriculture. It maintains the group methodology that many women are already familiar with. It utilizes community relationships as a replacement for the

traditional need to prove financial stability through forms of collateral or the presentation of financial statements that most farmers, especially women, do not have access to. Women in Kenya tend to be linked informally, through social networks based on common bonds which often facilitate economic opportunities for them (Hennink, Kulb & Kiiti, 2013).

In addition to providing financial loans – which provides women with short-term, immediate support – Kilimo Booster also provides farmers with information and training that teach them how to use their financial loans to expand their agricultural activities, develop more productive methods of production, and increase their overall profit.

In prioritizing efficiency within agriculture, Kenya's most important regional industry, mobile agriculture technology (agritech) is contributing to the efficiency of Kenya's economic system. Agritech is promoting development throughout rural and urban communities, alike, and increasing Kenya's overall economic productivity within the global trading field. In rural communities, where food is grown, farmers are able to utilize mobile platforms to gain access to information regarding new farming techniques that are compatible with the changes in the land and environment caused by climate change.

They are also able to understand consumer demand, within the market, to ensure the crops they are cultivating will sell. Finally, they gain direct access to buyers within the market to generate sells and build long-standing relationships with buyers that lead to

farmers achieving more stable incomes for their households (#VALUE4HER, 2019). In urban areas, regular access to fresh, whole foods contributes to the improvement of business throughout the food services industry. It provides more produce varieties within marketplaces, as well as access to higher volumes of diverse, fresh foods made available to individual consumers throughout urban communities. Therefore, this contributes to the improved health of Kenya's overall population - including rural and urban communities.

Kenya's National Broadband Strategy (NBS) 2023

“By implementing NBS 2023, the Kenyan government aims to increase access to broadband coverage of 3G to 94% of the population, increase digital literacy in schools by 85%, expand broadband to its 47 counties, and obtain 50% digital literacy amongst the workforce.”

-International Trade Administration (ITA), 2020, p. 1

All of these advancements in Kenya's technology sector are directly linked to the country's decade-long investments in a government-backed National Broadband Strategy (NBS) that provides all of these mobile platforms, and the consumers taking advantage of their services, with seamless mobile connectivity. This connectivity is accessible regardless if they are farmers who reside in Kenya's rural sectors of society or corporate executives located in Nairobi, Kenya's capital city.

As highlighted in Figure 2, NBS 2023 consists of a network of underwater fiber optic cables that are located off the coast of Kenya, including: TEAMS, LION2, SEACOM, and EASSY that contribute to making Kenya’s internet and mobile service “the highest, fastest and most reliable in the region” (ITA, 2020, p.1).

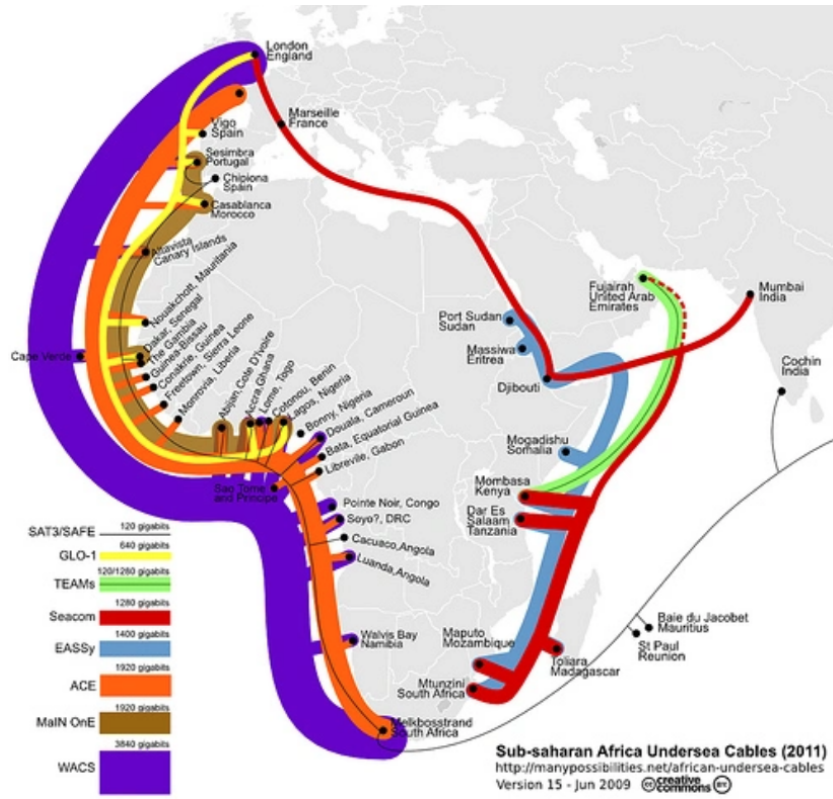


Figure 2: “The 4,500 kilometer (2,790 mile) East Africa Marine System (TEAMS) underwater cable connected the Kenyan port town of Mombasa with Fujairah in the United Arab Emirates” (Wilkerson, 2009).

Kenya’s Ministry of Information, Communications and Technology (KMICT) are pursuing this NBS 2023 Strategy as a part of the country’s goal of completely digitizing the economy by 2030. This would establish Kenya as a global exporter of information

technology services. (Government of the Republic of Kenya, 2013). As Kenya begins to make serious headway in a variety of modern sectors, notably business and technology, agriculture continues to play a critical role in the growth of the country's overall economy.

CHAPTER V

ADVANCING GENDER INCLUSIVITY IN KENYA'S AGRICULTURAL SECTOR

Women in Agriculture

“According to the World Bank, women make up 80 percent of Kenya's farmers. Despite their majority, they still have many challenges to overcome, like gaining ownership of the land they work... In 2010, Kenya drafted a new constitution guaranteeing equal rights for women: they can now inherit property and own land. But in Kenya's rural areas, many people are unaware of the new constitution. Entire communities live under the old system that puts women and girls at a disadvantage, particularly concerning property rights. ”

- Wasike, 2013, p. 1

The increase in mobile money technology has provided women with the tools needed to participate in local market economies and further contribute to Kenya's continued economic growth. However, before the boom of mobile money, women in rural areas were very much involved in financial transactions, even though they didn't always retain autonomy over those transactions. Many Kenyan women have participated in microfinance lending systems for decades, organizing savings circles and micro-insurance systems within their local co-operative groups and community organizations (CBOs). “These social relationships established through social networks

often become the safety nets within communities that provide support during household economic shocks” (Hennink et al., 2013, p. 1036).

CBOs have contributed to the increase in agricultural productivity, specifically amongst women in Kenya’s rural sector. They have shown to be beneficial for a number of reasons. First, they have been effective in opportunities for farmers when they pursue business opportunities as a collective unit, rather than individually. The benefit of formally participating in a CBO is the consolidation of land to increase crop yields and profit margins for all of the farmers involved in the groups.

Another benefit is increasing farmers’ negotiating power on profit margins from crop yields and minimizing the cost of transportation, since many farms are often only near poor, unpaved roads that can be upwards of four, six, and even eight hours outside of an urban area with a sizable market. This makes it extremely difficult for individual farmers to access and afford adequate transportation of their produce in a timely manner - in time for their produce to reach the market to be sold before spoilage and overall crop loss which, unfortunately, happens often for many farmers. Therefore, CBOs are frequently seen as the best way for farmers, especially female farmers, to earn a liveable income from farming.

The introduction of mobile money technology has provided women, who were already participating in their local economies, with a secure and wireless platform. This has enabled them to actually retain the profits they make; aiding women in gaining further financial independence. Utilizing mobile money as a more regulated and simplified

approach to money transfer has provided an avenue for many Kenyan women to independently participate in domestic market spaces, especially within agriculture (farming) and agribusiness (producing specialized food commodities) (Nyawira, 2017).

The #VALUE4HER platform provides women with access to market information and intelligence, as well as investment and capital building opportunities, to aid women in forming strategic partnerships and enable them to access global markets to generate further profits (CTA, 2019). Throughout the last decade, with Kenya's encouragement of female equity and inclusion in the market, Kenyan women have benefited the economy greatly through the development of mobile platforms. These have drastically improved female farmers' access to markets, information, and capital throughout the country's agricultural sector (Bradford et al., 2020).

Kenya's "mobile technology revolution" has not only introduced more innovative methods of agricultural production but has also further increased women's already heavy engagement in agriculture throughout its rural economy. The economic reforms, put in place by Kenya's political system, have prioritized female engagement in the agricultural market. According to The World Bank, more than 50 percent of farms in Kenya are run by women (2019). Within the country, the Technical Centre for Agriculture and Rural Cooperation (CTA) has even invested in developing an agribusiness entrepreneur digital platform specifically geared towards women. The #VALUE4HER platform was launched by CTA in June 2019 and is Africa's first online network for women agribusiness entrepreneurs. CTA provides women with access to market

information and intelligence, as well as opportunities for building strategic partnerships leading to increased investments (CTA, 2019).

Women In Mobile Technology

“Ironically, because the Africa tech sector is still nascent and not yet labeled as a male-dominated field, women find fewer barriers to success than in many of the high-status corporate jobs on the continent that are still, discouragingly, controlled by men.”

- Novitske & Mathias, 2017

Kenya’s mobile technology revolution has not only introduced more innovative methods of agricultural production, but has also increased women’s engagement in agriculture. This eruption of women flooding the digital market, not only in Kenya, but, throughout the African continent, stems from the unconventional nature of the mobile tech scene in emerging markets. Traditionally, in developing regions, women have been the ones to dominate the informal markets to make extra money while men dominated the conventional positions that were most likely to generate consistent income. Women have had a lot more experience engaging in riskier, haphazard endeavors and are, in turn, applying these skills within the growing tech scene (Novitske & Mathias, 2017).

As emerging markets, like Kenya, have begun prioritizing investments in technology to improve market systems and elevate their economies to the level of more competitive,

industrialized countries, there's an increased urgency for tech developers to generate new ideas. This need for innovative talent has led tech industries, in emerging markets, to operate relatively gender-blind, due to their focus on rapid innovation and the lack of male-dominated stigmas that are so prominent throughout the tech industry in western societies (Novitske & Mathias, 2017).

Over 40% of Kenya's population work in the agricultural sector, and a large majority of the region's mobile technology is geared directly or indirectly towards improving agricultural systems (FAO, 2019). The mobile tech boom in Kenya has not only generated female inclusion in the tech industry, but has also increased women's engagement in agriculture. With Kenya's encouragement of female equity and inclusion in the market through its #VALUE4HER platform developed by the Technical Centre for Agriculture and Rural Cooperation (CTA), Kenyan women have benefited the economy greatly, over the past decade, with the development of mobile platforms that have drastically improved farmer's entrepreneurial pursuits. Women in Kenya have taken advantage of new opportunities available in the mobile tech sector and are becoming developers who are directly impacting farmers' access to resources, while also encouraging gender equity throughout the technology sector.

According to *Venture Capital for Africa (VC4A)*, over 46 percent of African ventures are founded by women, which is well reflected throughout Kenya's burgeoning mobile tech scene (VC4A, 2020). This eruption of women flooding the digital market, not only in Kenya, but throughout the African continent, stems from the unconventional nature of

the mobile tech scene in emerging markets. As emerging markets, like Kenya, have started prioritizing investments in technology to improve market systems and elevate their economies to the level of more competitive, industrialized countries, an increased urgency for tech developers to generate new ideas has occurred. This need for innovative talent has led tech industries, in emerging markets, to operate relatively gender-blind, due to their focus on rapid innovation and the lack of male-dominated stigmas that are so prominent throughout the tech industry (Novitske & Mathias, 2017).

In Kenya, this mobile tech boom has not only generated female inclusion in the tech industry, but has increased women's engagement in agriculture. The #VALUE4HER platform is Africa's first online network for women agribusiness entrepreneurs. It provides women with access to market related information, as well as opportunities to invest in women-led companies and develop strategic partnerships that will enable them to further generate profits for their business and increase their income (CTA, 2019).

M-Farm, Twiga Foods, and DigiFarm are some of Kenya's leading agritech platforms that are bridging the gaps throughout Kenya's agricultural supply chain and connecting farmers to buyers in the market. This enables farmers more choice in who they sell their produce to and for how much. This increases the farmers' ability to be self-sustainable, leading to a higher quality of life for more Kenyans and an agricultural system that is progressively becoming productive enough to efficiently export agricultural products by the *Vision 2030 Development Strategy* deadline.

CHAPTER VI

M-FARM CASE STUDY

Mobile Farm (M-Farm)

Mobile Farm (M-Farm),¹ was co-founded by three women in 2011 and has been individually directed by Linda Kwamboka (one of the original co-founders) since 2019. The company's main goal is to supply farmers with an easily accessible mobile application (app) that utilizes mobile technology (tech) to digitally connect farmers to buyers in urban markets. M-Farm's service focuses on closing major gaps within Kenya's agricultural supply chain, as it relates to: access to buyers in urban markets, access to real-time market pricing information, and viable methods of timely transportation of goods once farmers' produce is sold (Bradford et al., 2020).

With M-Farm's relaunch in 2019, under Linda's leadership, the company chose to base its headquarters at Strathmore University - an institution housing experts and field researchers, some in agriculture. This helped M-Farm maintain a direct office space in the university's @iLabAfrica Centre, a hub for data science and digital marketing classes (Strathmore University, 2019). M-Farm decided to move away from a corporate-driven approach to their mobile platform and pursue the company's advancement through an academic understanding of their consumer. Rather than developing a platform and services to market to farmers, by telling them what kind of

¹ ****Disclosure Note:** Please note that this case study was researched and written prior to the COVID pandemic. Thus, there has been a two year period where things might have changed tremendously.

platform they should want, M-Farm chose to pursue a better understanding of what the average farmer in Kenya's rural economy actually needs (Bradford et al., 2020).

With this strong foundation, Linda and her team understood that they couldn't rely solely on research to determine the needs of farmers. M-Farm needed to be in direct contact with farmers, on a regular basis, to understand what aspects of their platform are relevant to farmers' needs and what requires improvement.

Following M-Farm's 2019 relaunch, Linda enlisted six field agents to recruit farmers into the M-Farm network. Field agents cultivated relationships with farmers and farming communities or CBOs, and M-Farms' direct consumer contacts. This led the company to expand its network from 1,000 farmers in 2012 to 40,000 farmers by the end of 2019 (Bradford et al., 2020).

However, with growing gaps in Kenya's agricultural supply chain (e.g.. farmers' lack of access to market pricing in real time, farmers' lack of consistent access to buyers in urban markets, and decreasing access to basic resources) it is becoming difficult for farmers to generate enough income, within the agricultural sector, to support themselves and their families. Supply chain inefficiencies are increasing poverty rates throughout Kenya's rural economy and M-Farm's field agents have had to adapt their focus to fit consumers' immediate needs (Bradford et al., 2020).

Kenya's Supply Chain

Farmers

There are roughly 4.5 million farmers in Kenya, with the average smallholder farmer owning less than five acres of land (Birch, 2018). Due to climate change and, in some areas, the depletion of land fertility through excessive monoculture farming practices, viable farming land in Kenya is beginning to decrease (USAID, 2019). Therefore, some smallholder farming communities, like that of the Mwakini CBO, interviewed by the SMART team, will purchase or rent land with other farmers in their CBO, farm the land together, and split the profits (Bradford et al., 2020).

During planting season, farmers' incur their main cost when purchasing seed. First, the farmer must decide what to plant, based on what kind of seed they're able to afford and what they believe will garner the largest yield and highest profit for the upcoming season. At times farmers are unable to afford the amount of seed needed and may opt to recycle seed from a previous yield. This is where the phases of the farmers' work become significant. Phase one is the planting and cultivating and phase two is the harvesting process (Bradford et al., 2020).

Brokers

Phase one and two were highlighted above. Phase three of a farmers' work comes into play when it is time to sell their produce. Most farmers have a limited window of time to

sell their produce, because they do not have ample storage space to keep their produce fresh for an extended period of time. So, the average farmer attempts to sell their produce as quickly as possible. Due to infrastructural constraints, throughout the rural sector, the average farmer does not have the ability to travel into urban city centers and access marketplaces where buyers reside. This causes two main issues for farmers. First, they lack access to real-time market pricing information and second, they face difficulty tapping and securing buyers. Most farmers must resign themselves to selling directly to brokers. These middlemen purchase produce from farmers in the rural sector and sell to buyers in urban markets (Bradford et al., 2020).

Brokers are known for taking advantage of farmers' vulnerabilities when it comes to their lack of access to up-to-date market pricing information and inability to directly connect with buyers in urban markets. Therefore many brokers have a reputation for providing unfair prices to farmers knowing the farmer has no other choices for selling their produce and no means to negotiate the price. This has left many farmers at an extreme disadvantage and increasingly unable to make a liveable wage (Bradford et al., 2020).

Buyers

The average buyer no longer has direct access to farmers, leaving buyers at a disadvantage when negotiating sales with brokers. Instead of purchasing produce from farmers at a slightly increased price, they also have no other option but to purchase

from brokers who tend to mark up prices. In Nairobi’s city center, the Cornell SMART team visited some marketplaces and spoke with buyers. The team found that it is common for buyers to have to show up to marketplaces extremely early and bargain with multiple buyers before they are able to get the produce they need. This happens because there is a large demand for produce from buyers in the market, but a limited number of brokers. This gives the brokers an upper hand when it comes to negotiating pricing and limits buyers’ access to produce. The complete supply chain is outlined in Figure 3 below.

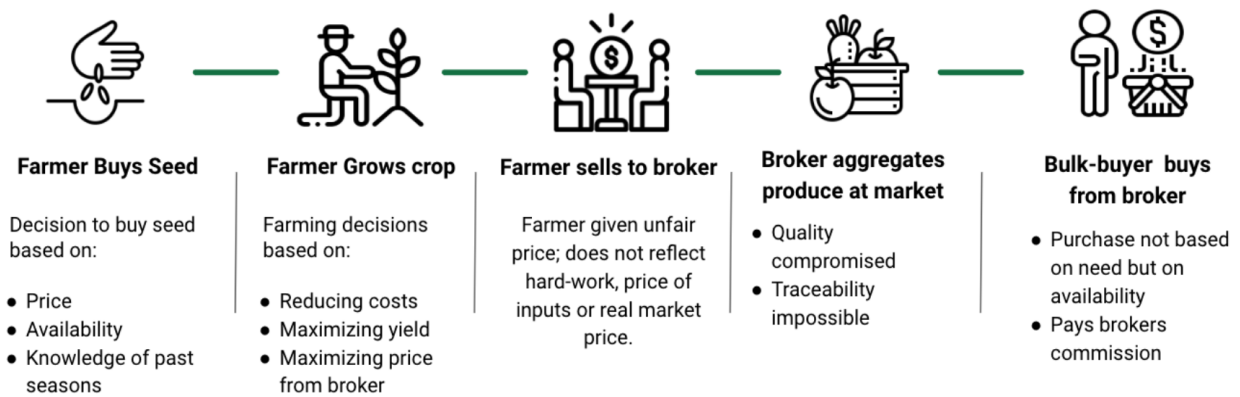


Figure 3: Kenya’s Rural Economy Supply Chain (Bradford et al., 2020)

The Research and Consultation Process

Cornell University’s SMART team began working with Linda and M-Farm’s Sourcing Manager, Rachel Rasugu, as apprentices to gain a better understanding of Kenya’s overall emerging market and the role that M-Farm plays. The team included: Dani Cohen, Axel Letondot, Alex Li and me. There was an understanding that, while we

maintained some knowledge of emerging markets based on our own studies, M-Farm is the specialist and expert. In their field of work, they have the best knowledge and understanding of what their company needs to further improve their business model, how to reach more consumers, and provide farmers with the resources and information they need to be successful. Like many companies in emerging market economies, M-Farm had the knowledge of what they needed to do, they simply lacked the manpower required to complete the field research necessary to gain a better understanding of their consumers (Bradford et al., 2020).

Our SMART team met with Linda virtually over the course of a semester leading up to our 2-week visit to M-Farm's headquarters in Nairobi, Kenya. This was followed by field visits to two of M-Farm's CBO affiliates in Kwa Mikuyu and Mwakini, in Eastern Kenya. The aim was to carry out some research, on behalf of M-Farm, based on information gathered from individual interviews with M-Farm staff and networks. Linda and Rachel expressed the necessity for a comprehensive overview of farmers' current experiences in Kenya's rural economy; what major gaps in the agricultural supply chain affect each community the most; how M-Farm has improved those supply chain deficits; and where M-Farm needs the greatest improvement (Bradford et al., 2020).

Kenya's Rural Economy

Kenya's rural economy is the sector of their economy in which farmers and those affiliated with the agricultural industry directly operate (Hope, 2011). The main players

in Kenya's rural economy are smallholder farmers. According to the International Fund for Agricultural Development (IFAD), there are over 7.5 million smallholder farmers in Kenya, and these farmers account for close to 80% of the country's agricultural production (IFAD, 2021).

Unfortunately, smallholder farmers' high production rate has yet to translate into increased profit margins, due to a rapid increase in Kenya's population, almost tripling since the 1990s. This population growth has put a strain on the country's natural resources (IFAD, 2021). Additionally, as Kenya's agricultural production has increased, so has the nation's consumer base, hitting hardest smallholder farmers and individuals living and working in Kenya's rural sector, where economic and infrastructural growth is not as heavily prioritized by Kenya's government as it is for their urban counterparts (Bradford et al., 2020).

The SMART team gathered information from interviews with Linda, Rachel, and M-Farm community affiliates to develop an in-depth survey that would provide M-Farm with more clarity on farmers' experiences participating in Kenya's rural economy, where growth is occurring throughout Kenya's rural sector, and where farmers lack the most access. We conducted sit down interviews and surveys with farmers in the Kwa Mikuyu CBO and the Mwakini CBO (see Appendix A) (Bradford et al., 2020).



Figure 4: Farmers interviewed at the Mwakini CBO.

Source: Bradford et al., Kenya SMART Project, 2020

CBO Survey Data Findings

Limited Access to Commodities

Many farmers are having difficulty accessing commodities that are not grown within their communities. The CBO survey respondents said that the most difficult commodities to access included: sugar (the most expensive commodity), followed by cooking oil and bread (the most difficult to find). Farmers must purchase their commodities in bulk from the market, when they have the access and funds to do so. Some CBO groups have opted to put their money together to make one large commodity bulk purchase, which can significantly reduce the individual price for farmers. Along with bulk commodities, farmers will also purchase their seed in bulk.

Limited Access to Storage

Another survey finding included many farmers' lack of access to proper storage mechanisms and facilities to extend the life of their produce and protect it from pests once crops are harvested. This leaves farmers at a disadvantage to brokers who know they must sell their produce immediately to avoid total crop loss. The result is that brokers drastically reduce the amount they are willing to pay farmers for their produce.

There are alternatives to storage facilities, such as hermetic bags that both CBO groups that we interviewed had experience using. Hermetic bags can be useful in protecting produce from pests when they are able to access a legitimate hermetic product, however many of farmers in the groups we spoke had multiple experiences with purchasing bags they thought were legitimate, but turned out to be counterfeit and ended up losing mass amounts of crops (Bradford et al., 2020).



Figure 5: Farmers interviewed at the Kwa Mikuyu CBO.

Source: Bradford et al., Kenya SMART Project, 2020

M-Farm's Services

Providing Farmers with Access to Direct Pricing Information

M-Farm currently provides an SMS mobile service that enables farmers to access pricing information in real-time. Farmers don't need to have access to expensive smartphones or computers to access M-Farm's services. M-Farm's platform is specifically developed to be accessed through the most basic of mobile devices.

According to Kenya's *Business Today*, 95% of Kenyans have regular access to a basic mobile phone, whether it be directly owning their own mobile phone, or indirectly having regular access to the mobile phone of a relative, neighbor, friend or fellow CBO member (Nangunwa, 2019).

Farmers can send a direct text message using SMS (a basic texting feature available on all mobile devices) to an M-Farm number, and include the name of the crop they wish to receive a current price for. Within 30 seconds, the farmer will receive an automated response listing the current real-time price of their requested crop in the market. This small service equips farmers with knowledge of what their produce is currently worth in the urban market. This does not do away with farmers' negotiations with brokers, but it does provide them with more authority when engaging in negotiations, because they are no longer in the dark regarding market pricing. While this feature is definitely a positive addition to the way farmers do business, it does not eliminate farmers' vulnerability to

brokers, due to farmers' lack of access to transportation and storage (Bradford et al., 2020).

Providing Farmers with Direct Access to Buyers

M-Farm is steadily working on a Rootshelf Platform that will connect farmers with buyers in the market; permanently eliminating the need for brokers. The platform will act as an online marketplace with interchangeable platform interfaces which will enable users to easily interact with the platform regardless of the digital device they are using - a basic mobile device, smartphone, laptop, iPad or desktop computer. The platform will work in favor of both the farmer and the buyer, enabling both parties greater autonomy over how they do business and who they choose to do business with (Bradford et al., 2020).

When a farmer has produce available for sale, they can send an SMS message to the M-Farm number, listing the produce type and amount that they have available to sell. M-Farm developers will take the information sent in by the farmer and create a posting that can then be bid on by multiple buyers until the farmer accepts the sale. Farmers will now have a choice of who they sell to and how much they are selling their produce. In addition, buyers have the option to choose who they buy from and what they are willing to pay (Bradford et al., 2020).

M-Farm's Rootshelf Platform is meant to be easily accessible and simple to navigate for farmers and buyers alike. However, it is a hefty undertaking on the side of mobile

platform developers on M-Farm's team. The Rootshelf Platform feature of M-Farm's services continues to be a steady work in progress for the mobile agritech company and will undoubtedly impact the livelihoods of farmers and buyers, alike, in a positive way (Bradford et al., 2020).

Providing Farmers with access to Transportation

In tandem with launching the Rootshelf platform, M-Farm is also in the process of partnering with transportation companies to provide services transporting farmers' crops. The produce would come from their farms in rural sectors of Kenya to buyers throughout Kenya's urban markets. Kenya's rural sector continues to struggle with the lack of infrastructural developments, including limited drivable roads, which minimizes transportation options and makes for expensive transportation services throughout the rural sector when it is available. To mitigate transportation expenses, M-Farm will look to offer transportation to CBOs and general groups of farmers, rather than individuals. This will help to transport as much produce in bulk and greatly reduce the transportation fees across individual farmers, within these groups (Bradford et al., 2020).

Using the same transportation vehicles, M-Farm also plans to increase farmers' access to necessary commodities by transporting items that are difficult to secure. These are often supplies and goods that are not grown and produced in their communities; and sell them to farmers upon arrival. As an example of M-Farm's desired transportation process, a group of Mikuyu CBO farmers will plan to harvest their crops, within the

same amount of time, and post their yields for sale on the rootshef platform. Buyers in urban markets will bid for produce orders and, once a number of farmers have conducted a sale, M-Farm will use their monthly group fee (used to pay for M-Farm's services) to hire transportation from Kenya's urban sector to Mikuyu. Before the vehicle departs the city, M-Farm will have gathered desired commodity orders from the CBO group and will work to gather the requested commodities that farmers will buy. Upon the vehicle's arrival to Mikuyu, farmers will receive their ordered commodities that were brought on the vehicle and load the crops they've sold on the Rootshelf Platform to be taken back to the city and delivered to their buyers (Bradford et al., 2020).

With the completion of this next phase in Kenya's business model, M-Farm will have successfully met all of the major needs farmers outlined in our CBO interview and survey responses from the Mikuyu and Mwakini CBOs including: a need for direct market pricing information in real-time, a need for direct access to buyers in urban markets, and a need for services to transport crops from their farms to buyers in urban markets once they are sold.

While M-Farm has increasing competition throughout the rapidly growing mobile agritech industry, the company is making major strides in combating the effects of Kenya's infrastructural discrepancies that have perpetuated increasing levels of poverty throughout Kenya's rural farming population (Bradford et al., 2020).

CHAPTER VII

CONCLUSION

In conclusion, Kenya's new political structure is paving the way for substantial economic, social, and technological expansions. Political reforms that prioritize the inclusion of women amidst Kenya's economic progression is at the core of the success of platforms like M-Farm, Gro Intelligence, and Kilimo Booster. Prioritizing women through government-backed channels, like CTA's platform, #Value4Her, sets a precedent for the type of gender inclusive society that Kenya is aiming for and will only continue to expand throughout all sectors of the economy, including agriculture. This has the potential to be successful if it remains a priority of those in political seats of power. Mobile tech, and agritech in general, stabilizes formerly unpredictable systems. The more stable Kenya's economy becomes, by improving overall quality of life for Kenyan's and strengthening Kenya's internal markets, the more the government can invest in tech services and that will continue to improve marketing systems within Kenya's economy and increase profits.

The benefits of investing in mobile technology platforms in Kenya are cyclical and will continue to increase the country's economic productivity. This will hold true if the leaders continue to prioritize removing barriers of gender inclusion and promoting productivity within the agricultural sector by providing farmers with: more platforms with access to market information, improved systems for connecting farmers with buyers to generate more capital within rural communities, and access to mobile money loans. Capital and

loans are especially important for women who still maintain very little financial independence, to invest in improved agricultural activities.

A recommendation for Kenya's government, to further engage women in agriculture through mobile technology, would be to invest in existing mobile agriculture platforms that have either been developed by or for women. This would ensure these platforms don't remain small and inaccessible but continue to grow and improve to reach more women and farmers across Kenya.

As these digital platforms receive more funding to expand their services, they can begin to exchange or export their services to other neighboring countries. This would not be very difficult or costly since the bulk of these services are digitally organized. In creating a forum of exchange or exporting these mobile services across borders, not only will Kenya have the opportunity to improve the agricultural communities in other countries, but they will be able to deepen and grow their participation within the global market. This increases Kenya's economic growth as its mobile technology sector continues to expand.

APPENDICES

Appendix A

M-Farm SMART Project Survey²: Becoming a Better Farmer

Overarching question: How could M-Farm make you a better farmer?

M-Farm

- Connects farmers to markets
- Updated prices for informed decision making
- Farmers can register online
- Transport services to leaders

Survey Questions

Background

Farm 1:

CBO- Kamicuo- 13 attendees, 10 women 3 men

1. Name:
Location:
Gender:
Age: 40-55
Sub-location/Sub-county:
Size: 13 farmers, 10 women
2. How long have you been a farmer?
3. What crops do you grow?
4. Do you package or add any value to your produce?
5. How many acres do you farm on?
 - a. Do you own or rent the land you grow your crops on (do you have a title deed or do you rent)?
 - b. Do you have farm help on your land? If so, do you pay them?

² This survey was designed by the Cornell SMART Team in consultation with team leader and country hosts.

6. Are you part of a farmer based organization (FBO)
 - a. If yes, what is your experience with FBO? What are the advantages or disadvantages? Challenges or opportunities?
 - b. If not, what criteria would you use to decide if you should join?

7. Do you have a mobile device or access to a mobile device?
 - If yes, do you have a smartphone? How often do you have access to the internet?
 - Do you have access to any other technology (ex. Computer, laptop, family members with tech)?

Becoming a better grower

Personal need

8. What goods and commodities (eg. sugar, salt) do you use often at home?

9. Which goods and commodities are the most expensive or difficult to get?

10. Where do you get the commodities you use at home?
 - a. How do you get them?
 - b. How often do you consume these commodities?
 - c. How could this process be easier?

Inputs

11. Where and how do you currently get/access to your inputs (eg. seeds, fertilizer)?

12. How do you decide what input to get ? Multiple Choice
 - a. Agrovet
 - b. Recommendation from buyer
 - c. Neighbor
 - d. Training/Education
 - e. other

Agricultural Education

13. What education or training have you received (if any)? (FBO Management leadership, setting prices, record keeping, writing business plans and proposals, post harvest management, GAP (good agricultural practices)
 - a. Which have been the most valuable?

14. What farming education information do you feel you lack (and would like more access to)?

15. How is information generally shared amongst farmers? What kind of information?
- How do you feel other farmers can help you?
 - What advice do you give other farmers?

Financial Services

16. Where do you get your money for your farming? *What financial tools/services do you have access to?*
17. Have you ever taken out a loan?
- What did you use it for?
 - Where did you get the loan?
 - What were the challenges?
 - How could this be made easier?
18. When/What for would you take out a loan?
19. Do you/ have you ever participated in credit or community lending groups?
- Which ones and why?
20. Rank what you wish you had more access to:
Trainings, Financial Services, Better Inputs, other...
- 1: _____
- 2: _____
- 3: _____
- 4: _____

Becoming a better seller

Buyers

21. Who do you sell your crops to?
- How do you find them?
 - How much do you sell to them?
 - Do you sell crops to the same people? Does this change?
 - How many people do you sell crops to?
22. When you sell, what is the payment process? Method, timing...

Transport

23. How do you transport your crops to the market?
- Why?
 - Where are they transported to?

Storage

24. Do you have storage?

a. If yes, how?

25. Are there any post-harvest losses due to lack of storage?

a. Are there post-harvest losses not relating to storage?

26. Rank what you wish you had more access to:

Buyers, Transportation, Storage, other...

1: _____

2: _____

3: _____

4: _____

Qs for value added farmers:

27. What additional X do you require ?

a. Where do you get X

b. How do you make X

28. How often do you process value added products?

29. What additional storage/transportation do you require ?

Others

30. What is your experience as a farmer?

31. What are the top 3 hardest part of being a farmer?

32. If you could change anything about the agricultural system, what would it be?

33. Have you heard of M-Farm?

Which other companies like M-Farm have you heard of? ... like DigiFarm

REFERENCES

- Agbeyegbe, T., et al. (2006). "Trade Liberalization, Exchange Rate Changes, and Tax Revenue in Sub-Saharan Africa." *Journal of Asian Economics*, North-Holland, 3 Mar. 2006, <https://www.sciencedirect.com/science/article/abs/pii/S1049007806000157>.
- Birch, I. (2018) "Agricultural Productivity in Kenya: Barriers and Opportunities - Gov.uk." *Knowledge, Evidence and Learning for Development (K4D)*, Dec. 2018, https://assets.publishing.service.gov.uk/media/5c70028ee5274a0ecbe9a1c2/483_Agricultural_Productivity_in_Kenya_Barriers_and_Opportunities.pdf.
- Bleiberg, J. & West, D. (2016). "Three Ways Mobile Is Helping Farmers in Kenya." *Brookings*, Brookings, 29 July 2016, <https://www.brookings.edu/blog/techtank/2015/04/23/three-ways-mobile-is-helping-farmers-in-kenya/>.
- Bradford, F., Cohen, D., Letondot, A. & Li, A. (2020). M-FARM Mobile Agritech Platform: A Case Study. Student Multidisciplinary Applied Research Team (SMART), Cornell University, Ithaca, N.Y.
- Britannica. (2016). "Climate of Kenya." *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., 2016, <https://www.britannica.com/place/Kenya/Plant-and-animal-life>.
- (CTA) Technical Centre for Agricultural and Rural Cooperation. (2019). Africa's First Online Network For Women Entrepreneurs in Agribusiness Launched in Nairobi. Retrieved December 1, 2019, from <https://www.cta.int/en/gender/article/africa-s-first-online-network-for-women-entrepreneurs-in-agribusiness-launched-in-nairobi-sid03f342b3e-1e1f-4076-877c-d19584d01261>.
- Dawson, B. & Schneidman, W. (2020). "The US and Kenya Launch Negotiations on a Free Trade Agreement. Will They Succeed?" *Brookings*, Brookings, 29 July 2020, <https://www.brookings.edu/blog/africa-in-focus/2020/07/29/the-us-and-kenya-launch-negotiations-on-a-free-trade-agreement-will-they-succeed/>.
- Devdiscourse News. (2018). "Kenya Introduces 14 Mobile Apps for Farmers to Improve Agriculture Industry: Agency-Wire." *Devdiscourse*, Devdiscourse, 29 May 2018, <https://www.devdiscourse.com/article/agency-wire/9670-kenya-introduces-14-mobile-apps-for-farmers-to-improve-agriculture-industry>.
- FAO. (2019) "Kenya At a Glance." *FAO in Kenya | Food and Agriculture Organization of the United Nations*, 2019, <http://www.fao.org/kenya/fao-in-kenya/kenya-at-a-glance/en/>.

Grameen Foundation. (2015). "Musoni Launches an Agricultural Loan for Kenya's Smallholder Farmers." *Grameen Foundation*, Jan. 2015, <https://grameenfoundation.org/>.

Government of the Republic of Kenya. (2022). "The National Broadband Strategy - A Vision 2030 Strategy." *Communications Authority of Kenya*, 2022, <https://ca.go.ke/wp-content/uploads/2018/02/National-Broadband-Strategy.pdf>.

Hennink, M., Kulb, C. & Kiiti, N. (2013). Vinya wa Aka: an Expanded Microcredit Model for Community Development. *Development in Practice*, 23(8), 1034-1047.

Hope, Sr, Kempe Ronald. (2011). "Infrastructure Constraints and Development in Kenya." *Journal of Infrastructure Development*, vol. 2, no. 2, 2011, pp. 91–104., <https://doi.org/10.1177/097493061100200201>.

IFAD. (2022). "Kenya." *IFAD (The International Fund for Agricultural Development)*, 2022, <https://www.ifad.org/en/web/operations/w/country/kenya>.

IMTFI. (n.d.). The Mobile Money Experience in Sub-Saharan Africa. Retrieved November 29, 2019, from https://www.imtfi.uci.edu/files/articles/The_African_Technopolitan_MTankha%20article.pdf

IMF (International Monetary Fund). (2020). "The IMF and the World Bank." *International Monetary Fund (IMF)*, 25 Mar. 2020, www.imf.org/en/About/Factsheets/Sheets/2016/07/27/15/31/IMF-World-Bank.

International Trade Administration (ITA). (2019). "Kenya Agriculture." *Export.gov*, 13 Aug. 2019, www.export.gov/apex/article2?id=Kenya-Agriculture.

KARI (Kenya Agriculture Research Institute). (2019). "The Major Challenges Of The Agricultural Sector In Kenya." KARI, 2019. <https://www.kari.org/the-major-challenges/>

KNBS (Kenya National Bureau of Statistics). (2021). "Kenya National Bureau of Statistics, Nairobi, Kenya." *Kenya National Bureau of Statistics*, 14 Oct. 2021, <https://www.knbs.or.ke/>.

Kikulwe, E., et al. (2014). "Mobile Money, Smallholder Farmers, and Household Welfare in Kenya." *PLOS ONE*, Public Library of Science, 6 Oct. 2014, <https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0109804>.

Mboya, D. (2018). Kenya Launches 14 Mobile Apps to Transform Agriculture. Retrieved December 1, 2019, from <https://www.scidev.net/sub-saharan-africa/news/kenya-mobile-apps-transform-agriculture/>.

Mengistu, A., & Imende, S. (2013). Kenya's Mobile Tech Revolution. Retrieved November 18, 2019, from <https://www.selamtamagazine.com/stories/kenyas-mobile-techrevolution>

M-Farm. (n.d.). M-Farm Homepage. Retrieved November 30, 2019, from <https://www.mfarm.co.ke/>.

Ministry of Information, Communications and The Digital Economy. (2022). "Ministry of Information, Communications and Technology." *Ministry of Information, Communications and The Digital Economy, 2022*, <https://www.ict.go.ke/wp-content/uploads/2019/05/Kenya-Digital-Economy-2019.pdf>.

Miriri, D. (2019). *Kenya opens \$1.5 billion Chinese-built railway linking Rift Valley town and Nairobi*. Reuters. <https://www.reuters.com/article/us-kenya-railway/kenya-opens-1-5-billion-chinese-built-railway-linking-rift-valley-town-and-nairobi-idUSKBN1WV0Z0>.

Mrinalini, T. (2019). *Mobile Money Experience in Sub-Saharan Africa in Inclusion, and Design*. Berghahn Books, 2019.

Namunwa, K. (2019). "Kenya Leads Africa in Smartphone Usage." *Business Today Kenya*, 11 Mar. 2019, <https://businesstoday.co.ke/kenya-leads-africa-smartphone-usage/>.

Nguimkeu, P. & Okou, C. (2021). "Leveraging Digital Technologies to Boost Productivity in the Informal Sector in Sub-Saharan Africa." *Wiley Online Library*, 9 Aug. 2021, <https://onlinelibrary.wiley.com/doi/abs/10.1111/ropr.12441>.

Njogu, E. (2020). *Millions of Kenyans go hungry every day. Why, and what can be done*. The Conversation. <https://theconversation.com/millions-of-kenyans-go-hungry-every-day-why-and-what-can-be-done-131782>.

Novitske, L. & Mathias, D. (2017). The Surprising Place That Promotes Women Entrepreneurs Better Than Silicon Valley. Retrieved December 1, 2017, from <https://www.entrepreneur.com/article/299590>.

Nyawira, B. (2017). How Mobile Money Is Closing the Agricultural Finance Gap for Women in Kenya. Retrieved June 1, 2021, from <https://www.centerforfinancialinclusion.org/how-mobile-money-is-closing-the-agricultural-finance-gap-for-women-in-kenya>.

Nzomo, V., Mwangi, J., Matu-Mureithi, L., Muchiri, C. & Rutenberg, I. (2020). "Modes of Innovation and Enterprise Development by Nairobi's Mobile Tech Startups." *SSRN*, Elsevier, 13 July 2020, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3630991.

Peña-Méndez, B. & Vickers, B. (2015). "Mobile Technology and Trade in Sub-Saharan Africa." *TRALAC Trade Law Center NPC*, 2015, <https://www.tralac.org/images/docs/9011/mobile-technology-and-trade-in-sub-saharan-africa-commonwealth-trade-hot-topics-december-2015.pdf>.

Pew Research Center. (2016). *Pew Research Center's Religion & Public Life Project: Kenya*. Washington, DC.

Lighthizer, R. (2018). "Statement of USTR Robert Lighthizer at the Opening Plenary of the 2018 U.S.-Sub-Saharan Africa Trade and Economic Cooperation Forum (AGOA Forum)." *United States Trade Representative (USTR)*, 2018, <https://ustr.gov/about-us/policy-offices/press-office/press-releases/2018/july/statement-ustr-robert-lighthizer-0>.

Safaricom. (2019). "Our Story." *Safaricom*, 2019, <https://www.safaricom.co.ke/about/who-we-are/our-story>.

Salon, D. & Aligula, E. (2011). "Urban Travel in Nairobi, Kenya: Analysis, Insights, and Opportunities." *Journal of Transport Geography*, Pergamon, 26 Dec. 2011, <https://www.sciencedirect.com/science/article/abs/pii/S0966692311002213>.

Santander Trade. (2020) "South African Foreign Trade in Figures." *South African Foreign Trade in Figures Santandertrade.com*, Dec. 2020, santandertrade.com/en/portal/analyse-markets/southafrica/foreign-trade-in-figures.

StatisticsTimes. (2020). *GDP Growth of Kenya*. Kenya GDP Growth 2020 - StatisticsTimes.com. <https://statisticstimes.com/economy/country/kenya-gdp-growth.php>.

Strathmore University. "@ILabAfrica." *ILabAfrica*, 2022, <http://www.ilabfrica.ac.ke/>.

Tankha, M. (2015). "The Mobile Money Experience in Sub-Saharan Africa." *IMTFI.UCI.edu*, University of California, Irvine, 2015, https://www.imtfi.uci.edu/files/articles/The_African_Technopolitan_MTankha%20article.pdf.

Trading Economics. (2019). *Kenya - Rural Population*. Kenya - Rural Population - 1960-2019 Data | 2021 Forecast.

<https://tradingeconomics.com/kenya/rural-population-percent-of-total-population-wb-data.html>

Ulsruda, K., Palit D. & Rohracherd H. (2015). Village-Level Solar Power in Africa: Accelerating Access to Electricity Services through a Socio-Technical Design in Kenya. *Energy Research & Social Science*, Elsevier, 3 Feb. 2015,

<https://www.sciencedirect.com/science/article/abs/pii/S2214629614001431>.

USAID. (2019). "Agriculture and Food Security in Kenya." USAID, 2019.

<https://www.usaid.gov/kenya/agriculture-and-food-security>.

USAID. (2021). *Economic Growth and Trade: Kenya*. U.S. Agency for International Development. <https://www.usaid.gov/kenya/economic-growth-and-trade>.

#Value4Her. (2022). "About #value4her." #VALUE4HERConnect, 2022,

<https://value4her.hivebrite.com/page/about-value4her>.

VC4A (Venture Capital for Africa). (2020). "About VC4A." VC4A, 2020,

<https://vc4a.com/about-us/>.

Vodafone. (2020). "M-Pesa." Vodafone, 3 Jan. 2020,

www.vodafone.com/what-we-do/services/m-pesa.

Wasike, A. (2013). "Food Security." *Deutsche Welle (DW)*, Deutsche Welle (DW), 9 Apr. 2013,

<https://www.dw.com/en/women-take-over-kenyas-farming-sector/a-16716322>.

Wilkerson, M. (2009). "Tuesday Map: Broadband Hits Africa." *Foreign Policy*, Foreign Policy, 23 June 2009,

<https://foreignpolicy.com/2009/06/23/tuesday-map-broadband-hits-africa/>.

World Bank. (2019). Retrieved June 1, 2021, from

<https://www.worldbank.org/en/country/kenya/overview>.

World Population Review. (2020). Retrieved from

<https://worldpopulationreview.com/countries/kenya-population/>

Worldometer, Kenya Population. (n.d.). Retrieved November 18, 2019, from

<https://www.worldometers.info/world-population/kenya-population/>