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Digital Agriculture in Africa: An Ethnographic Study of Global Online Networking and Resource Mobilization on Mfangano Island

Ian James Muir Smith
Fordham University, ismith21@fordham.edu

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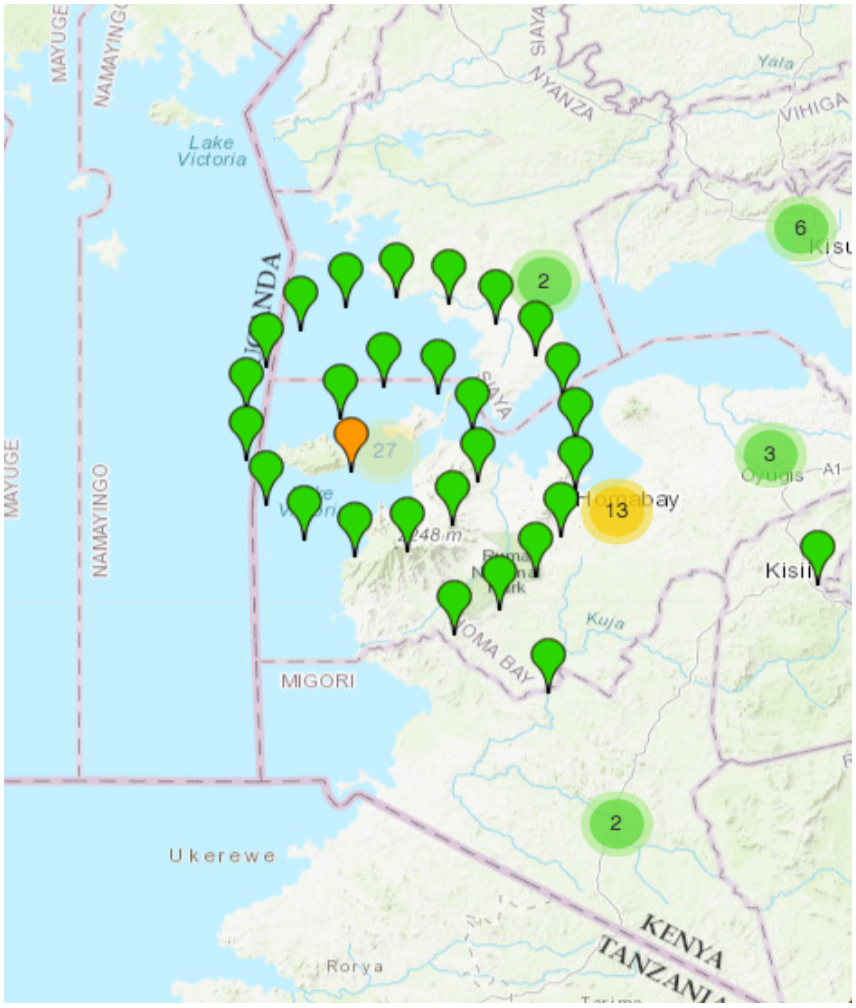

Ian Smith | Ianjamess2000@fordham.edu
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Seminar Instructor: Dr. Christopher Toulouse
Advisor: Dr. Vivian Chenxue Lu (Anthropology)

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Glossary

Acronyms

ICT – Information and Communication Technology
SSA – Sub-Saharan Africa
WWOOF - World Wide Opportunities on Organic Farms
NGO – Non-Governmental Organization
OHR – NGO on Mfangano Island cofounded by an American medical anthropologist and Joguta.
EK - Ekialo Kiona, the Kenyan counterpart to OHR
GDP – Gross Domestic Product
FAO – Food and Agriculture Organization
SMS – Short Message Service
CBO - Community Based Organization
DDS - Donor Dependency Syndrome

People

Joguta - My host, first WWOOF host on the island, cofounder of OHR.
Ero - My host, Joguta's wife, elementary school teacher.
Gotieno - Former chairman of the OHR volunteer-hosting program, cofounder of a youth empowerment foundation, WWOOF host.
Nolambo - WWOOF host. Environmentalist.
Dotedo - Environmentalist who showed me around the Gwasi Hills on the mainland.
Eodula - Son of Michael Odula and founder of Badilisha, environmental NGO on Rusinga Island
Modula - First WWOOF host in Kenya. Recognized by UN for environmentalism.
Majengo - WWOOF host. Showed me around the island.
Aokuku - One of the first WWOOF hosts in Kenya. Founder of two NGOs on Rusinga Island.
Gokomo - Highschool teacher and WWOOF host.
Wopiyo - A coxswain for the island's only emergency boat (run through OHR) and a boda boda (motorcycle) driver who gave me rides nearly everyday. The first person I interviewed.
Dagagwa - founder of NGO run with volunteer fundraising. Former employee at one of the two cyber cafes on the island.
Calmen - American medical anthropologist. Co-founder of OHR and EK.

*Note: To highlight the distinction between information from books and articles compared to my ethnographic research, all quotes from my fieldwork are italicized.

Introduction

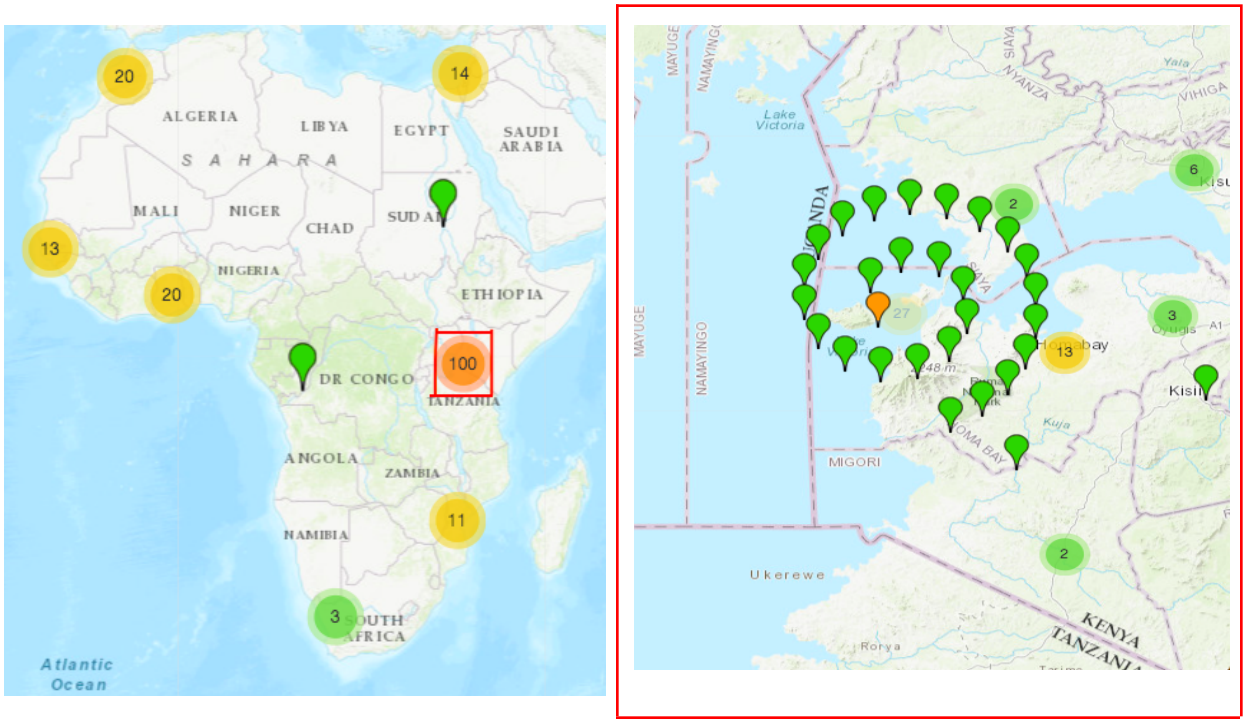
Abstract

In one of the most isolated parts of Kenya, on an island in Lake Victoria, small-scale farmers are using newfound internet access in a unique and innovative way. New Information and Communication Technologies (ICTs) are transforming agriculture around the world, and due to a political, infrastructural, and entrepreneurial environment conducive to ICT innovation, Kenya leads the African continent in this field, commonly referred to as “Digital Agriculture”. In the face of the climate crisis and environmental degradation, people living on and around Mfangano Island are using self-managed volunteering platforms, crowdfunding sites, and social media in order to network with people around the world and procure capital through these networks. These funds procured through volunteers and people online are then used to develop the farmers’ communities, improve upon their farming practices, and reinforce their resilience to climate change. The results from the hundreds of thousands of dollars mobilized through this phenomenon of “crowdfunded community development” demonstrate the power of unconditional cash transfers, internet access, and human connection in international development.

Methodology

I came up with the idea for this project while using WWOOF to look for organic farms in Sub-Saharan Africa that I could volunteer at this summer. Through online, self-managed volunteering platforms like WWOOF (Worldwide Opportunities on Organic Farms), subsistence farmers on and around Mfangano Island get connected with volunteers from around the globe. "Worldwide Opportunities on Organic Farms (WWOOF) is a worldwide movement to link visitors (WWOOFers) with organic farmers, promote a cultural and educational exchange, and build a global community conscious of ecological farming and sustainability practices."[1]

While browsing WWOOF, I noticed that there was a high concentration of hosts in one area. 40% of all African WWOOF hosts are located in Nyanza province, the Western most of the nine Kenyan provinces. 40% of that 40% are located on one island in Suba North Subcounty. In total, thirty-three out of the one hundred eighty-nine farmers (17.5%) signed up for WWOOF on the African continent live on Mfangano Island in Lake Victoria. So I asked myself: How and why did this phenomenon come to be? I decided to volunteer there and to answer that question and many others.



Screenshots from the WWOOF "Find a Host" page. In May 2021, at least 40% of all hosts in Africa on this online volunteering platform were from Nyanza province, Kenya. The image on the right shows the disproportionate concentration of farmers on Mfangano Island (located in Nyanza province) making themselves available to international volunteers through WWOOF.

[1] "WWOOF – World Wide Opportunities on Organic Farms," Wwoof.net, 2016.

My ethnographic fieldwork consisted of a 1.5 month long trip to Western Kenya, from late June to early August, 2021. I have maintained relationships through Whatsapp and email with many of my interlocutors, and daresay have become friends with some. For privacy purposes, I will use pseudonyms when talking about anyone I met in Kenya. My host and closest interlocutor was Joguta, a farmer, fisher, and family man of around 60 years old. Joguta has 5 sons, 1 daughter, a wife named Ero, and several chickens, goats, dogs and cats, all of whom (except the eldest son who is in college) live in the same 1-acre compound. I had my own room in the concrete-floored, iron-roofed family home.

After scouring through all 33 WWOOF host profiles that were based on Mfangano Island, I decided to message Joguta because of his stated connection to an NGO, Organic Health Response (OHR), that appeared to have a big presence on the island. Upon looking through the OHR website, I came up with a hypothesis regarding the diffusion of this internet-based

innovation. My initial hypothesis, that the first volunteers came through OHR and stayed with Joel, and that the idea to host volunteers was spread because of the observed success of those initial interactions, was proven correct. Joguta is also known around the community as Organic because of his role in teaching organic farming, as well as his connection to OHR.

As WWOOF is ostensibly based on a non-monetary exchange, I worked on Joguta's farm during the mornings in exchange for living with him and his family.[2] In the afternoons, I interviewed teachers, community leaders, directors of orphanages, schools, and NGOs, as well as fishermen, boda boda (motorcycle) drivers, other volunteers, and employees at OHR. Most of them (but not all) were hosts on WWOOF, and all of them live on or around Mfangano Island. Reaching out to hosts through the WWOOF website was how I connected with around 70% of my interlocutors. Another 20% were people that I was referred to, often by Joguta, and met after arranging meetings over Whatsapp. The rest were people that I just happened to meet, most often while on the veranda of the OHR community center. I asked about a huge range of topics, including climate change in the area, inorganic versus organic farming, subsistence versus commercial farming, volunteers and voluntourism,[3] and internet use.

Engaging in participant observation— being a volunteer while studying volunteering— lended itself to benefits and challenges. By living with Joguta, I experienced, if only ephemerally, what daily life may be like for a subsistence farmer in Kenya. Washing my clothes (and myself) in the mountainside stream, collecting water from the lake because there was a drought that emptied my family's 10,000 liter water tank, doing menial farmwork by hand, and following their low-nutrient, carb-heavy diet (supplemented only by peanut butter from the mainland) taught me many lessons that I could never have learned from reading. And by going through the volunteering platform being employed by many farmers, I witnessed some of the successes, failures, and challenges with self-managed voluntourism first hand. One of the most obvious challenges was that no interaction could be removed from the structural inequalities inherent to the volunteer-host/foreigner-Kenyan relationship. Being able to go anywhere and interview anyone that I wanted to was only possible because of my perceived gender and race. On Mfangano Island, there is a deep-rooted association between whiteness and wealth, and by extension, an association between whiteness and supremacy, and this association affected every interaction that I had.[4]

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[2] I, as well as most other volunteers, ended up contributing an extremely reasonable 2,000 Kenyan shillings a week ($20) in order to offset the cost of additional food that my presence incurred. So while WWOOF emphasizes the "non-monetary" aspect of their platform which sets them apart, many hosts from impoverished regions of the world need some financial contribution in order to make self-managed volunteering feasible.

[3] Voluntourism is a portmanteau of the words volunteer and tourism. It is volunteer work done by someone unqualified, typically white, financially privileged, and from a more developed region, traveling on a short term basis, typically to somewhere less developed.

[4] I recognize, of course, that this association between whiteness and wealth is not by any means unique to Mfangano Island. White supremacy is a global phenomenon that affects every interaction that I have everywhere.

I am incredibly grateful for the overwhelming hospitality that Joguta, Ero, Majengo, Aokuku, Dotedo, and everyone else in Suba North Subcounty showed me. It would take up well over a paragraph if I were to list every person who went out of their way to talk with me, feed me, share glimpses into their lives and beliefs, or generally make me feel welcome while I immersed myself in their community and culture. Many thanks also to Dr. Vivian Lu for her continual advice and support as advisor for the entire nine months that this project spanned.

Context

*"*The rate of change in Africa today as a result of ICTs is unprecedented and cuts across all sectors. There is no doubt that ICTs are changing the African narrative: Africa is no longer the Dark Continent.*"*

Bitange Ndemo,
Author of *Digital Kenya*

"People were just in darkness. But (the founder of OHR) came and showed us the light."

Gotieno,
Farmer and former chairman of the OHR volunteer hosting team

Internet in Africa

Information and Communication Technology (ICT) is a wide subject which includes many evolving subtopics. Broadly speaking, ICT concerns "any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form".[5] While this paper begins by reviewing ICT use in Kenyan agriculture in general, the focus overall is the internet.

The internet (a global computer network providing a variety of information and communication facilities) is far and away the most influential set of information and communication technologies that African people have ever had access to.[6] "The open, global internet has made a tangible difference in the lives of Africans who were traditionally locked out of knowledge, resources, and opportunities largely confined to the geographic borders of the West." Many Africans "are leveraging the democratization of access and opportunities through digital platforms for transformative social, economic, and political development."[7] As one person I interviewed said, "*Access to the internet changes everything*."

[5]"Information and Communication Technologies (ICT) | Agricultural Information Management Standards (AIMS)," aims.fao.org, n.d..
[6]Oxford English Dictionary, "Oxford English Dictionary," OED.com (Oxford University Press, 2021),.
[7]Bridget Boakye, "Africa's Open Internet Is at Risk – Its Leaders Must Act to Save It," African Business, October 4, 2021.

Internet access changes the lives of Africans from different demographics in different ways. African youth are employing social media to "shine light on the dark continent"[8], reframing narratives of homogenous despondency using banal, quotidien pictures and videos shot on cellphone cameras. "Networks have ended the isolation of African scientists and researchers", who are now contributing to emergent scholarly discourses more expediently than ever before. In her book *Digital Democracy, Analogue Politics: How the Internet Era is Transforming Democracy in Kenya,* Nanjala Nyabola details the prevailing effects the internet is having for Kenyan politicians and their electorate.[9] And for farmers, internet access means access to enhanced practices, improved outputs and income levels, more financial services, improved market transparency, and capital via global social networks.[10] This last point, the use of online networking to supplement the incomes of rural people engaged in farming, is exemplified by my case study.

The vast majority of Africans that access the internet do so through smartphones.[11] "In SSA, more people own a mobile phone than have access to electricity".[12] In fact, access to the mobile internet is the fastest global dissemination of technology in the history of the world.[13] Five years ago, there were "700 million mobile phone accounts on the continent, more than in Europe and the United States combined".[14] Despite having the fastest growing mobile adoption rate, SSA still lags behind the rest of the world in internet use and general ICT development.

ICT Development in Kenya

Kenya's Information and Communications Technologies (ICT) sector is "the digital technology epicenter of Africa writ large".[15] Kenya is sometimes called the "Silicon Savannah" or the "Digital Nyika" (digital referring to the type of ICT innovations bringing acclaim and nyika, the Kiswahili word for the grasslands which cover Kenya).[16] This section summarizes the major ICT

[8]George Alagiah, "New Light on the Dark Continent," *The Guardian*, May 3, 1999.
[9]Nanjala Nyabola, *Digital Democracy, Analogue Politics : How the Internet Era Is Transforming Politics in Kenya* (London: Zed Books, 2018).
[10]Faraja Nyalandu, "5 Ways Universal Internet Access Could Transform Africa," World Economic Forum, accessed December 26, 2021.
[11]In Kenya, 96.1% of internet users are connecting via a mobile device. This statistic and others throughout this section are pulled from a 2021 report by DataReportal: "Digital 2021: Kenya".
[12]"In Much of Sub-Saharan Africa, Mobile Phones Are More Common than Access to Electricity," The Economist, November 8, 2017.
[13]Paul Currion, "Network Humanitarianism HPG Working Paper," (ODI, 2018).
[14]Kofi A Annan and Sam Dryden, *African Farmers in the Digital Age: How Digital Solutions Can Enable Rural Development* (Council On Foreign Relations, 2016).
[15]Lisa Poggiali, "Seeing (From) Digital Peripheries: Technology and Transparency in Kenya's Silicon Savannah," *Cultural Anthropology* 31, no. 3 (August 9, 2016): 387–411.
[16]Bitange Ndemo, Tim Weiss, *Digital Kenya an Entrepreneurial Revolution in the Making* (London Palgrave Macmillan Uk, 2017).

developments in Kenya which brought the country to the forefront of Africa's tech innovation scene.

Internet use and ICT development are not evenly distributed throughout SSA. Every African country and individual has unique roadblocks and attitudes towards adopting the internet and other new ICT. Kenya has one of the most developed technology scenes in SSA. It is surpassed in ICT infrastructure by most North African countries, most African islands, and South Africa, but there's no other African country with a citizenship more engaged with the internet. Among African countries, Kenya has the highest ratio of internet uptake (85% of the country are internet users) and the third highest gross number of internet users.[17] Kenya is full of people eagerly using the internet and other new ICT to better their communities, nation and world.

The most well known invention that came out of the Digital Nyika and caused eyes around the world to take notice of Kenya's tech scene is M-Pesa. M-Pesa, meaning mobile money in Swahili, was created by Kenya's largest telecommunication company, Safaricom, in 2007. M-Pesa is one of the main reasons that Kenya has the highest internet adoption rate in SSA, and the mobile money innovation has quickly diffused to the rest of the continent. In 2018, two thirds of global mobile money transactions happened in SSA, making mobile money one of the most striking instances where digital development in Africa is beating out the rest of the world.[18]

Two storefronts on the left and three on the right sporting Safaricom's name and unmistakable green paint. In Kenya, buildings act as advertising media for Safaricom in exchange for discounted internet costs. While on a Matutu (an extravagantly painted mini-bus) going from Nairobi to "up-country", I saw Safaricom's bright green color splashed on at least one building in every settlement passing by (and sometimes, as much as ten in half a kilometer). Safaricom's advertising scheme, which pervades even the most rural parts of

[17]"Internet World Stats - Usage and Population Statistics," Internetworldstats.com, 2019.
[18]"The Rise of Mobile Money in Sub-Saharan Africa: Has This Digital Technology Lived up to Its Promises?," The Abdul Latif Jameel Poverty Action Lab (J-PAL), October 22, 2020.

Kenya, is a testament to how firmly they dominate the market thanks to M-Pesa. Safaricom has a 64% market share, well above the 50% rate nominally allowed by the Kenyan Competition Act.[19]

Another element to Kenya's ICT success is physical infrastructure. The most notable example of Kenya's exemplary ICT infrastructure is The East Africa Marine System (TEAMS), an undersea fiber-optic cable which has provided East Africans with some of the world's cheapest, fastest broadband[20] since 2009. Previously, Kenya relied mostly on satellite bandwidth[21], and the switch to fiber-optic bandwidth led to a "90% decrease in the cost of broadband".[22] Solid competition among providers of terrestrial fiber networks has also "significantly reduced the cost of broadband in Kenya", all the while "increasing connectivity speeds".[23]

A final example of ICT innovation that has made Kenya one of the tech leaders on the continent, and by extension, the most technologically advanced agricultural sector, is internet hubs. Internet hubs are collaborative spaces that often offer workshops, events, mentoring, and access to venture funding for startups. Speaking about African internet hubs, Al Jazeera explains that internet development "acts as an irrigation hose. Wherever the optical fiber cables are, new hubs grow like weeds and start to modify local ecosystems."[24] iHub (Innovation Hub) is seen as the first of these internet hubs in Kenya. It was started in 2010 in downtown Nairobi for technologists, investors, young entrepreneurs, designers, researchers and programmers. "The iHub was the pioneer among the numerous co-working and incubation spaces across Africa today", says Bitange Ndemo, Kenya's most iconic ICT champion.[25] Having publicly accessible co-working spaces where people can collaboratively concoct solutions using new technology has been an important factor in nurturing Kenya's tech entrepreneurial spirit.

Neither M-Pesa nor TEAMS nor the internet hubs would have come to fruition without the proper political landscape and policy development. Kenya's greatest ICT boom occurred under the leadership of President Mwai Kibaki (2003–2013) and Bitange Ndemo, the Permanent Secretary for the Ministry of Information and Communication from 2005 to 2013. Bitange Ndemo is the chief editor of the 2017 book *Digital Kenya* which is cited throughout this section. In it, Bitange Ndemo states that "a combination of the right policy environment, strong political will, smart investments in research and development, and good advisory networks led to effective policymaking and laid the foundation for Kenya's ICT boom".[26]

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[19] Emmanuel Abara Benson, "Safaricom Refutes Dominance Claims by Airtel, Says the Market Is Big Enough for Healthy Competition," Business Insider Africa, November 3, 2021.
[20] Broadband refers to high speed internet access. Broadband provides high speed internet access via multiple types of technologies including fiber optics, wireless, cable, DSL and satellite.
[21] Bandwidth is the maximum rate of data transfer, representable as network, data, or digital bandwidth.
[22] Ndemo, Weiss, *Digital Kenya,* pg 62
[23] Ndemo, Weiss, *Digital Kenya,* pg 68
[24] Angelo Attanasio, Jerónimo Giorgi, "Connecting Africa," Al Jazeera, n.d., Accessed December 27, 2021.
[25] Ndemo, Weiss, *Digital Kenya*, pg. 19
[26] Ndemo, Weiss, *Digital Kenya*, pg. 366

Agriculture in Kenya

As in most African countries, agriculture is the backbone of the Kenyan economy. Agriculture in Kenya is split into four sectors: Crop production, livestock, forestry, and fishing. Crop production is the focus of this paper, but many of the cited ICT innovations, especially online networking, can apply cross-sectorally. On average in SSA, 23% of GDP is from agriculture.[27] In Kenya, 33% of the country's GDP comes from agriculture.[28] According to a 2020 World Bank country profile, the sector employs 80% of the population.[29] In some remote areas such as Mfangano Island, the number is much higher. Electrical engineers, teachers, nurses, internet technicians, orphanage owners— all people except for a handful of government employees engage in farming. When I asked "*Do you farm?*" in an informal interview with a school teacher that I had just met, he smiled quizzically. "*Of course! Everyone farms*." Smallholder farmers like those on Mfangano Island produce 78% of total agricultural output in Kenya.[30]

The importance of smallholder farmers globally cannot be understated. While using only 25% of agricultural land, 20% of agricultural water, and 10% of agriculture's fossil energy, "the peasant food web" (small-scale farmers) produces 70% of the world's food and feeds 70% of the global population. Often used interchangeably, the terms subsistence, small scale, or smallholder farmer generally refers to anyone whose contribution to markets outside of their locality is marginal, i.e. people who farm mostly to feed their families and neighbors.[31] The majority of impoverished people in Kenya are smallholder farmers, which explains why "agriculture sector growth accounted for the largest share of poverty reduction between 2005 and 2015".[32] Approaching agricultural development in a way that benefits small scale farmers is crucial for ameliorating food insecurity, malnourishment, and poverty, but also for improving agricultural markets globally. Unfortunately, new policies being adopted by the government (such as the highly contested "Livestock Bill 2021" and the "Crops (Irish Potato) Regulations 2018"), which align with the Agricultural Sector Transformation and Growth Strategy 2019-2029 and favor commercialization, monocultures, and foreign multinational corporations, are intended to, in the government's own words, push "farmers out of farming and into more productive jobs".[33]

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[27] USAID, "Agriculture and Food Security | Kenya | U.S. Agency for International Development," Usaid.gov, July 2, 2019.
[28]World Bank, "GDP by Sector - Kenya | Data," data.worldbank.org, accessed December 27, 2021.
[29]World Bank Group, "KENYA CLIMATE RISK COUNTRY PROFILE," 2021.
[30]World Bank and International Center for Tropical Agriculture, "Climate-Smart Agriculture in Kenya," *Cgspace.cgiar.org*, January 15, 2016.
[31] The most widely used definition is actually "someone who farms on 2.0 hectares of land or less". However, people speaking about small scale farms are most often referring to "the economic scale of farming rather than the area of land".
[32]Birch, Ivan. "Agricultural productivity in Kenya: barriers and opportunities." K4D Helpdesk Report. Brighton, UK: Institute of Development Studies, 2018.
[33]Ministry of Agriculture, Agricultural Sector Transformation and Growth Strategy 2019-2029, December, 2018

According to a 2018 FAO study, Kenya's most abundant crops are sugarcane (5.2 million tons), maize (4 million tons), potato (1.8 million tons), and banana (1.4 million tons).[34] Even though maize is the second most produced crop, Kenya is a maize-deficit country, importing maize predominantly from other East African countries. "The country's reliance on agriculture and dependence on imports (especially of wheat, maize, and rice, among others) underscores the need for" sustainable increases in agricultural productivity for food security and economic growth.[35]

Kenya, along with every other Sub-Saharan African country, is striving to boost economic growth, living standards, and growth in non-agricultural industries by increasing agricultural productivity, which has remained generally stagnant in Kenya for the last two decades. The most significant roadblocks to improving the agricultural sector are declining average farm size, declining agricultural extension[36], declining public expenditure, and limited access to markets and market information. In the long run however, by far the greatest challenge is sustainably increasing productivity while preserving people's livelihoods, culture, dignity and self-worth in light of the unprecedented adversities that the climate crisis is already bringing about.

Climate Change in Western Kenya:

The climate crisis is affecting all aspects of Kenyan agriculture. Rural communities across Africa are suffering some of the worst effects of the climate crisis while contributing infinitesimally small proportions of CO2 to the atmosphere. That being said, however comparatively small Kenyan farmers' contribution to global climate change, agriculture is responsible for 33% of Kenya's emissions.[37] The phrase "climate smart" is effectively a prerequisite in anything written about the future of agriculture. And even though precipitation and temperature are controlled by complex global forces, agricultural issues like overfishing, deforestation, and soil degradation are most often caused by local action in rural Kenya, and can thus be addressed by local action as well. This section addresses some of the most pressing issues facing agriculturalists in the Lake Victoria region of Kenya, all of which are linked to or exacerbated by the climate crisis.

Every region of Kenya is experiencing the effects of climate change and environmental degradation differently. However, there are shared challenges across the board. Changes in precipitation timing and volume, increasing temperatures, desertification, deforestation, and overfishing lead to reduced agricultural productivity, reduced incomes, and increased hunger and malnutrition.

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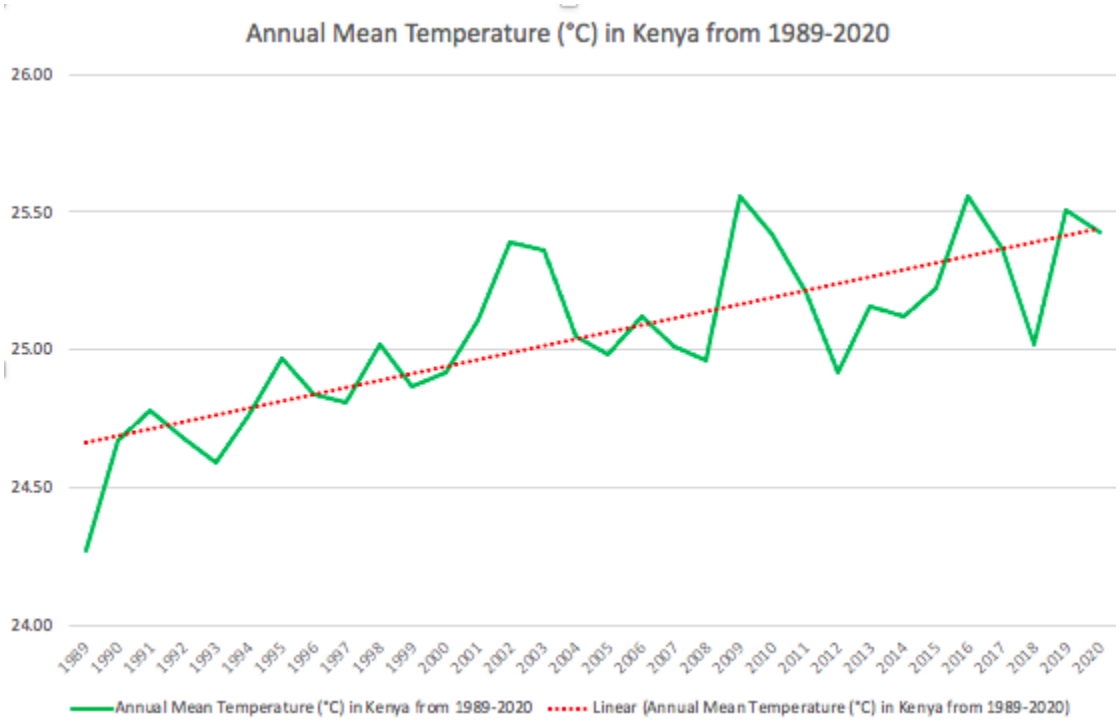
[34]FAO, "FAOSTAT," www.fao.org, n.d.. Accessed December 27, 2021.
[35]World Bank and International Center for Tropical Agriculture, "Climate-Smart Agriculture in Kenya," 2016
[36]*Agricultural extension* is the application of scientific research and new knowledge to agricultural practices through farmer education.
[37]UNDP, "Kenya Climate Smart Agriculture Strategy - 2017-2026 | UNDP Climate Change Adaptation," www.adaptation-undp.org, n.d.. Accessed December 27, 2021.



Source: Graph created by author based on data from "Climate Change Knowledge Portal", World Bank

An astounding 95% of Kenyan agriculture is rainfed.[38] Consequently, "short-term crop failures and long-term decreases in productivity" are inevitable because of increasingly unpredictable precipitation patterns caused by climate change. On Mfangano island, only a select few farmers have a water pump that supplements weather-based irrigation. "*We used to have Omugimbi* [rainmakers] *who could predict the rains to the accuracy of a few days. My grandmother is the last one on the island. The old ways just don't work anymore,*" a teacher/WWOOF-host-expert named Sagrema told me. One day while harvesting coconuts, my host Joguta was telling me about how drastically the dates and intensity of the rainy-dry seasons have changed. "*This is why I am saying climate change is happening. It's a big deal.*"

Rising temperatures are also harming agriculture. Higher temperatures and changing rainfall reduce forest biomass. And in the Indian Ocean and Lake Victoria, higher water temperatures are reducing fish biomass.[39] In reference to crop production, Joguta told me that he and other subsistence farmers are planting crops that have a shorter time to ripen in order to avoid the risk of excessive rain, excessive dryness, or excessive heat killing them. In fact, so many farmers around the island now grow bananas (which are impervious "*to big rains that sweep other plants away"*) that the price of bananas, and the subsequent profit for farmers, has decreased

[38]Sebastian Hornum and Simon Bolwig, "The Growth of Small-Scale Irrigation in Kenya EXECUTIVE SUMMARY," 2020.
[39]Robert J. Wilson and Sévrine F. Sailley, "Large Projected Reductions in Marine Fish Biomass for Kenya and Tanzania in the Absence of Climate Mitigation," *Ocean & Coastal Management* 215, December 1, 2021.

significantly. This is one example of how adaptations to climate change in rural areas can reduce farmer income.

Unlike global problems like rising temperatures and changes in precipitation, deforestation in rural Kenya is caused by actions taken locally.[40] Poor people may not know that cutting trees often leads to more loss than gain in the long-run because of how deforestation exacerbates the effects of the climate crisis, or they know but can not afford not to.

In the Lake Victoria region in Western Kenya, deforestation has caused changes in rain patterns, as well as significant soil erosion and causal reduction in soil fertility. "Trees draw water from the ground and release water vapor through their leaves," generating rainfall.[41] Where trees have been cut down, such as on the Gwasi hills on the shores of Lake Victoria (pictured below), there is less rain, the soil becomes hotter and drier, and agricultural production in the area suffers.

(Left image) Whereas it used to be covered in a lush, green forest, the upper portion of the Gwasi Hills is now gray and black because of deforestation. What appears at first glance to be a shadow on the middle-right is in fact a huge swath of burned land. (Center and right images) A farmer shows me the dry and cracking soil of his farm, located at the base of the Gwasi Hills. When I was there in July, there had not been a significant rainstorm since late March (even though April to June is defined as the "long wet season"). Photos taken by author on a ferry in Lake Victoria and in Gwasi village, July 2021.

This is a fatally ironic cycle, as deforestation around Lake Victoria is largely caused by a desire for greater agricultural production by converting wooded areas into industrial, monoculture farms.[42] "*Bad practices all through the watershed are denuding the lake catchment.*

[40] While deforestation in Suba North Subcounty is caused by the actions of local people, there are many corporations (local, national, and international) operating in Kenya and throughout SSA that are destroying some of the most carbon dense forests in the world. Deforestation in Africa is happening four times faster than the global rate.
[41] Fred Pearce, "Rivers in the Sky: How Deforestation Is Affecting Global Water Cycles," Yale E360, July 24, 2018.
[42] The deforestation of the island was one of the most frequently visited topics during my fieldwork. While deforestation on the shores of Lake Victoria is largely caused by transitions to unsustainable, industrial farming, deforestation on the island is a different case. Based on all my conversations, the three main causes of increased

Deforestation, real estate developments, and chemical farming and tillage reduce soil fertility and cause topsoil runoff."[43] Increased topsoil runoff leads to silt piling up at the bottom of the lake, which leads to rising water levels. In 2019 and 2020, rains around Lake Victoria were unusually heavy due to climatic changes with the Indian Ocean dipole[44] and deforestation in the Congo Basin.[45] This, combined with the displacement of water caused by the topsoil runoff of the lake watershed, led to historically high water levels and floods all around the shores in 2020. On Mfangano Island, whole neighborhoods and up to 100 meters of farmland were washed away.

Images of shambas (community fishing facilities) that were swallowed by the lake. Photos taken by author on Mfangano Island and Takawiri Island, July 2021.

deforestation on Mfangano are 1. Population growth (people need wood for fences, buildings, and cooking) 2. Growth of secondary school enrollment (parents pay for school fees using firewood) and 3. The explosive growth of the Nile Perch population, an invasive fish species which needs to be smoked rather than sundried like local fish species).

[43] NT, "Agro/Permalogical Africa", August 7, 2021.

[44] The Indian Ocean dipole is a weather phenomenon caused by differences in Indian Ocean surface temperatures.

[45] Lydia Olaka, "Lake Victoria Could Burst Its Banks More Often in the Future. What Can Be Done," The Conversation, June 9, 2020.

(Right) Gotieno, smartphone in hand, pointing to a utility pole that was rendered useless by rising waters. Photo taken by author at the village of Makira beach, Mfangano Island, July 2021.

(Left) Gokomo, a WWOOF host who teaches and farms, points to where his farmlands used to extend. He lost about half an acre, i.e. half, of his fertile farmland in the last two years. Photo taken by author on Mfangano Island, July 2021.

Speaking about this recent flooding, Kenyan environmental scientist Joseph Awange says that "adopting the right engineering solutions can help ease flooding, but the public should also be aware that they play a role as well."[46] But if a mother needs to pay for school fees by selling charcoal, or if a young man needs to collect firewood to eat dinner, simply making them aware of their impact does not remove the necessity for that resource and income. In order to make the rural poor more resilient to climate change and deforestation, productivity and incomes need to be raised, and in ways that are frameworked by sustainability and ecological interconnectedness.

Even though this paper focuses heavily on crop production, learning about fishing, another one of the four agricultural sectors, was part of my research as well. Just as "*everyone farms!"* on Mfangano Island, the vast majority of households engage in fishing too. I ate fish about seven times a week, averaging out to once a day. However, fishing in the Kenyan area of Lake Victoria is becoming much more difficult. Even more so than deforestation, the dwindling success of fishing appeared to be one of the most pressing issues on people's minds. As already mentioned, rising temperatures are impairing marine species richness, species diversity, and reproduction rates. Degradation of water quality from fertilizers, pesticides, and other pollutants are also having significant impacts on fishing in Lake Victoria. A final factor is poor legal framework and enforcement concerning the acceptable maturity of the fish being caught. *"Fish levels are going down, so people use old malaria nets to catch fish. Then all the young ones get caught, and then there are none left to reproduce. Then the fish levels go down more,"* a fisherman flatly explained during an informal interview.

[46] "Lake Victoria's Rising Waters," earthobservatory.nasa.gov, June 10, 2021.

ICTs in Kenyan Agriculture

"The added variable of digital technology has changed the agricultural development equation."
Kofi Annan, 8th Secretary General of the UN

With all of these factors viewed in sum— the excitement surrounding internet access in Africa, the physical, political, and social infrastructure which has led Kenya to be a leader in ICT development, and the dire need for agricultural productivity and climate resilience to increase in the country— it becomes clear why the Digital Nyika is leading the continent in the use of ICTs in agriculture. From the Kenyan government to international development agencies to the World Bank to Microsoft, global attention from stakeholders of all kinds is being paid to digital agriculture in Kenya. According to Hamadi Boga, principal secretary of the Ministry of Agriculture, "in the African landscape, 25% of digital solutions in the agricultural sector come from Kenya".[47]

Even though the idea of using digital tools to improve agriculture is decades old, the phrase "digital agriculture" is becoming increasingly mainstreamed. Articles about digital agriculture are published weekly on Kenyan and international news sites. Scholars, development institutions, and policy makers alike are using the term to talk about the inevitable nexus between digital technology and food production. One organization that has been a big proponent of the movement in the last few years is the World Bank, creating "Digital Agriculture" country profiles, books, blogs, platforms, and hosting digital agriculture webinars and live events.

Another "buzz phrase" related to the use of ICTs in agriculture is precision agriculture. Simply put, it is a method for agricultural production which relies on data to improve decision making.[48] The term has been around since the 1990s when GPS started being employed to guide tractors. Precision agriculture really entails the same thing as digital agriculture or ICTs in agriculture; ICTs in agriculture is simply the most all-encompassing term.

In industrialized countries, all commercial farming involves precision agriculture. Some of the most advanced new technologies include robotic machinery (like drones, autonomous tractors, and fruit picking robots) and remote sensors which measure, analyze, and apply inputs automatically. In less industrialized countries like Kenya, these types of technologies are not yet available. But even when farmers have just a mobile phone, new applications can cause extraordinary improvements to productivity and sustainability. The following section provides just a few examples of what ICT use in Kenyan agriculture can entail.

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[47]World Bank, "Digital Agriculture," World Bank Live, March 23, 2021.
[48] "Precision agriculture is a management strategy that gathers, processes and analyzes temporal, spatial and individual data and combines it with other information to support management decisions according to estimated variability for improved resource use efficiency, productivity, quality, profitability and sustainability of agricultural production." (International Society of Precision Agriculture).

One of the most apparent ways that ICTs improve agriculture in Kenya is by improving decision making with agronomic advising. One government sponsored initiative is the Kenya Agricultural Observatory Platform (KAOP). The KAOP, a birth child of KALRO (Kenya Agricultural and Livestock Research Organization) and the World Bank, is an online site that provides farmers with agronomic advising and real-time weather information.[49] Digital Green is a private company that provides similar resources. Digital Green uses peer to peer community videos, a standalone internet application that aggregates data about practices that have been adopted and videos shared, mobile-based training courseware, and Farm Stack, "an open source secure platform for extracting, sharing, and governing your data".[50]

Because of how high mobile penetration is in Kenya, many organizations focus on increasing farmer knowledge specifically through SMS (which does not require an internet subscription). Two recent studies from Kenya found that sending agricultural advice to smallholder farmers via SMS can increase yields by 11.5%[51]-16%[52]. Ujuzukilimo is a Kenyan company that uses predictive analytics, cloud computing, and millions of data points to improve farmer decision making. One of their products, Soilpal, uses sensors to measure soil health and provides a report and recommendations in minutes via SMS.[53] Precision Development, a Boston-based development organization, takes advantage of Kenya's substantial mobile penetration to teach even the most remote farmer how to sustainably improve their crop production.[54] Utilizing a user-friendly (and free) two-way SMS service, data science, and behavioral economics, they provide advice tailored to each farmer's situation.[55]

Another example of how ICTs can improve climate resilience and increase productivity that I witnessed on Mfangano Island is the use of smart sensors and computer software on fish farms. By cordoning off an area of water for fish to grow, either with cages (fish farms) or with earth (fish ponds), people in fishing communities can circumvent the problems caused by climate change, overfishing, and environmental degradation. And people around the world are employing different ICTs to make aquaculture even more productive, from smart sensing to AI to drone data collection to augmented reality.[56] At the only large scale aquaculture enterprise on

[49]World Bank, "Kenya Agricultural Observatory Platform," 2021.
[50]Digital Green, "Digital Green," Digital Green, 2019.
[51] Sendhil Mullainathan and Ravindra Ramrattan, "Harnessing ICT to Increase Agricultural Production: Evidence from Kenya," September 23, 2019.
[52]Surabhi Mittal, "Role of Mobile Phone-Enabled Climate Information Services in Gender-Inclusive Agriculture," *Gender, Technology and Development* 20, no. 2 (January 2016): 200–217.
[53]Ujuzi Kilimo, "Ujuzi Kilimo," accessed December 27, 2021.
[54]"Precision Development," Precision Development, accessed December 27, 2021.
[55] Precision Development ("PD", previously Precision Agriculture Development) is not a Kenyan organization, but I included it as an example because it was an aspect of my fieldwork in that I showed the service to many of the farmers that I met. PD implemented their two-way SMS service through a government contract, so showing farmers how to use it was very straightforward.
[56]Tien Li, "7 Top Digital Farming Innovations Impacting Aquaculture," 7 top digital farming innovations impacting aquaculture | Alltech, November 27, 2020.

Mfangano Island, they utilize smart sensors that measure different variables related to the health of the fish and their environment and make adjustments based on recommendations from the analytics computer software that the data is sent to.

An interview with a fish farmer on one of the four fish farms in the waters around the island. The fish farm pictured above, which Joguta excitedly arranged for me to visit without me having to ask, is the largest and uses analytics software and smart sensors attached to the cages to enhance productivity. Many people I talked to were interested in aquaculture but lack the start-up capital. Photo taken by Joguta, July 2021.

That being said, starting an aquaculture business has long been inaccessible for small scale fishermen because of the immense initial investment needed. And in crop production, a frequently echoed sentiment by my interlocutors was that they will not buy advanced inputs, like hybridized seeds or fertilizer, if they are not certain that they will be able to afford them next year. The Agricultural Sector Transformation and Growth Strategy 2019-2029 cites flimsy access to financial services as one of the core roadblocks to agricultural transformation in Kenya. Geographic isolation and the traditional position of Kenyan smallholders in the "informal economy" has historically blocked farmers from access to in-person, on-paper banking services. But now, "fintech" has permanently changed this fact.

Fintech companies provide microfinance, holistic credit scores, financial education, reduced transfer fees, business automation, and other financial services through the use of AI, blockchain, and other digital technology. As of 2020, Kenya has at least 60 fintech companies and "is

Becoming a Global Hub of Fintech Innovation".[57] Some, like Tulaa[58], Farm Drive[59], or iFarm360[60], are made specifically for farmers. Another fintech initiative that reduces risk for small scale farmers is the availability of "crop insurance" which can be bought from seed companies through mobile internet.[61] Thanks to the democratization of banking through mobile internet, taking on more expensive projects which increase profits is now much more feasible for low-income farmers.

This paper focuses on the ways that rural Kenyan farmers use relatively new ICTs, like SMS-based and web platform-based information services (but also the internet and social media as my case study reveals), to supplement their incomes while improving their agricultural productivity and climate change resilience. However, sometimes the best way to increase climate change resilience is for new ICTs to improve upon existing networks and communication channels. One such example of this from Mfangano Island is the use of the internet, a newer ICT, to boost awareness about a community-run radio, an older ICT.

In 2012, U.S.-based NGO Organic Health Response (OHR), with support from Craig Newman (the creator of Craigslist), organized the construction of a radio station on Mfangano Island. As I will explain later on, OHR only came into existence because of the initial interaction between a farmer and an American volunteer, an interaction catalyzed by the internet. Now reaching over 150,000 monthly listeners across the country and into Tanzania and Uganda, the Ekialo Kiona Suba Youth Radio station is a huge success. Besides playing music, the station broadcasts information about sustainable agriculture and environmental protection, as well nutritional health, fishing, and HIV awareness campaigns. For context, about "half of all Africans used radio daily for their news, while about a third used television" according to a 2019 study.[62] Only 1 out of 5 Africans used the internet or social media that frequently. An additional benefit of this older ICT is that many of the programs are in Kisuba, the mother tongue of the original migrants to this region in Kenya. As Kisuba is an endangered language with less than 120,000 speakers remaining, the radio reaches people who may not otherwise get access to that information, whether because of the language barrier in internet use or network infrastructure.

Awareness of the radio station is spread, often by volunteers, through blogs and websites. While conducting research, I met someone volunteering with Ecologists Without Borders (EWB) who was on Mfangano Island because he learned about the radio through a WWOOFer's blog. He

[57]Fintech, "56 Kenya Based Fintech Companies | the Most Innovative Fintech Companies," www.fintech.coffee, accessed December 27, 2021.
[58] "Tulaa Raises $627k Seed Round for Smallholder Fintech," AFN, July 23, 2018.
[59]"FarmDrive," farmdrive.co.ke, n.d., 2019.
[60] "Ifarm360," www.ifarm360.com, accessed December 28, 2021.
[61] Asenso-Okyere, Kwadwo, and Daniel Ayalew Mekonnen. "The importance of ICTs in the provision of information for improving agricultural productivity and rural incomes in Africa." *African Human Development Report. UNDP Sponsored research Series*, 2012.
[62]Jeffrey Conroy-Krutz, "Africans Are Concerned about Ills of Social Media but Oppose Government Restrictions," The Conversation, n.d.., June 1, 2020.

wanted to see if EWB could use the radio as a platform to spread awareness about environmental protection around lake Victoria. In this situation, internet access led to the radio being built in the first place and then, years later, allowed people around the world to take interest in the environmental protection of Lake Victoria ecosystems.

As the EK Suba Youth Radio shows (as well as many recent studies from East Africa),[6364] it is vital to ensure that traditional, community based ICTs are supplemented, rather than supplanted by the implementation of internet-based services focused on improving agriculture and bettering the environment. A study from 2016 came to the same conclusion after finding that farmers in East Africa who received agronomic advising via radio were 4x more likely to implement intensified and sustainable practices compared to farmers that received advice via SMS.[65]

Another common application of digital technology for rural farmers is the provision of market information. The Kenya Agricultural Commodity Exchange (KACE) was established in 1997, making it perhaps the first Kenyan platform of its kind. “KACE collects, updates, analyses and provides reliable market intelligence… with particular attention to smallholder farmers and small scale agribusinesses.”[66] They have used SMS, interactive voice response service, an internet database, national radio, and rural radio to disseminate their information. A private enterprise that goes a step further than just providing information is M-Farm. M-Farm is “a pioneer agribusiness technology firm that”, since 2011, has offered an SMS service that enables farmers to collectively buy agricultural inputs or sell direct to market. This allows low-income farmers to “circumvent value chain middlemen and retain higher profits.”[67] Other Kenyan companies, like iProcure or Twiga, use mobile phones, crowdsourced data, and AI predictive analytics to make the delivery of inputs (seeds, fertilizers, etc…) and outputs (harvested crops, livestock, etc…) more timely and accurate, increasing profits and reducing waste.[68]

There are hundreds of other ways that Kenyans are using ICTs to better their agricultural output. I will provide one final example, which leads into my case study concerning online networking on Mfangano Island. While it is true that discussions on ICT use in Kenyan agriculture generally focus on increasing productivity with more robot-human and data-farmer interactions, there are

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[63] Heather E. Hudson, “Using Radio and Interactive ICTs to Improve Food Security among Smallholder Farmers in Sub-Saharan Africa,” *Telecommunications Policy* 41, no. 7–8 (August 2017): 670–84.
[64]Marcos Komodromos, “Interactive Radio, Social Network Sites and Development in Africa: A Literature Review Study,” *Journal of Enterprising Communities: People and Places in the Global Economy* 15, no. 2 (April 5, 2021): 282–95.
[65] Silvia Silvestri and Ganatra Dharmesh, “Going Digital in Agriculture: How Radio and SMS Can Scale-up Smallholder Participation in Legume-Based Sustainable Agricultural Intensification Practices and Technologies in Tanzania,” *International Journal of Agricultural Sustainability* 19, no. 5–6 (April 14, 2020): 1–12.
[66]Okyere, Mekonnen. "The importance of ICTs in the provision of information for improving agricultural productivity and rural incomes in Africa." 2012.
[67]“M-Farm,” M-Farm Ltd, accessed December 29, 2021.
[68]Lorenzo Casaburi, “Harnessing ICT to Increase Agricultural Production,” *Harvard University Press*, pg. 3 March 6, 2014.

still many recent studies about how enhanced person-person knowledge sharing and communal support is improving agriculture in Kenya as well. An article from the Kenya Agricultural Research Institute explains how important social media is for changing negative attitudes about farming among youth.[69] Others detail examples of social media being used in Kenya to foster collective action (buying, selling, protesting), as well as social media's ability to subvert traditional top-down agricultural extension in place of networked knowledge sharing.[7071] Instead of the increased local connectivity and local collectivism around which these articles about social media and agriculture in Kenya are centered, the type of online networking that I focused on in Suba North Subcounty was global. And through these global networks, knowledge is shared, funds are raised, and livelihoods and communities are improved.

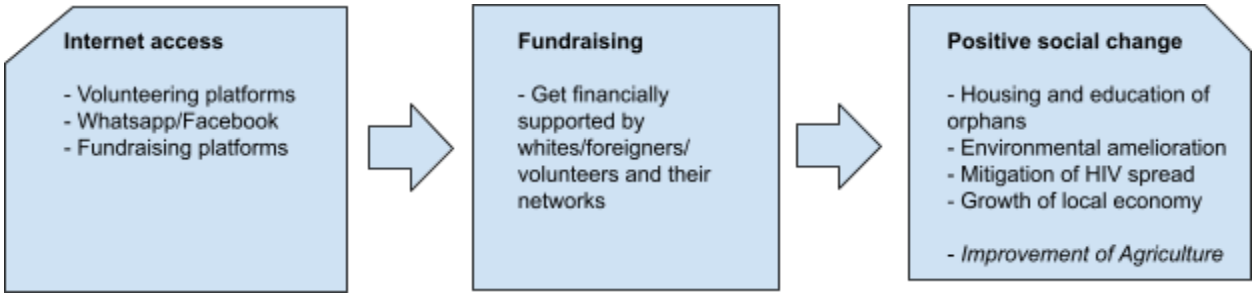
[69]K. R. G. Irungu, and J. Muia, "Information and Communication Technologies (ICTs) Attract Youth into Profitable Agriculture in Kenya," *East African Agricultural and Forestry Journal* 81, no. 1 (January 2, 2015): 24–33.
[70]Anne W. Kimani, Hillary T. Nyang'anga, and John I. Mburu, "Assessing the Status of Social Media Familiarity among Smallholder Farmers: A Case Study of Thika, Kiambu Kenya," *International Journal of Agricultural Extension* 7, no. 1 (April 25, 2019): 13–20.
[71]Thomas Kipkurgat, Michael Onyiego, "Impact of social media on agricultural extension in Kenya", International Journal of Agricultural Extension and Rural Development Studies Vol.3, No.1, (February 2016): 30-36.

Case Study: Crowdfunding, Voluntourism, and Online Networking on Mfangano Island

Introduction

All these new applications of digital technology are exciting and have extraordinary potential. But it is not just fancy, new digital technologies such as advanced weather platforms, SMS-based extension, smart sensors and their attendant software, market aggregators, and mobile credit lending being used to improve agriculture. The internet, specifically, the access to social networking that the internet provides, will likely always be the most popular application of digital technologies used by the average Kenyan. And this use of digital technologies, access to global social networks through the internet, is being employed by rural Kenyans to improve agricultural livelihoods and spur forward community development.[72]

The greatest benefit of internet access in rural areas, according to people I met in Kenya, is the power of networking which the internet provides. According to a Pew Research study, "Sub-Saharan Africans are far-and-away most likely to use the internet to stay in touch with their family and friends."[73] As Nolambo, a soccer coach/OHR employee/organic farmer said, "*The world is all about networking, getting connected*". On and around Mfangano Island, people are utilizing this digital interconnectivity in unprecedented ways. Using self-managed volunteering platforms (e.g. WWOOF, Workaway), social media (e.g. Whatsapp, Facebook), and crowdfunding platforms (e.g. GoFundMe, Airfunding), people are acquiring localized, personalized development assistance. I use the phrase "crowdfunded community development" to describe this phenomenon, which I do not believe is unique to Suba North Subcounty, Kenya. This financial assistance is used for a number of purposes, one of which is agricultural development. People in and around Mfangano Island bring in resources and capital from foreign visitors through global, online networking platforms.



[72] Community development is "a process where community members come together to take collective action and generate solutions to common problems." (UN) In the context of this study, community development mainly refers to the needs of the community (E.g. healthcare, education, housing for orphans, etc…) being addressed through the creation of Community Based Organizations (CBOs)/nonprofits.

[73] Laura Silver and Courtney Johnson, "Internet Connectivity Seen as Having Positive Impact on Life in Sub-Saharan Africa," Pew Research Center's Global Attitudes Project, October 9, 2018.

This flow chart lays out, in simplest terms, the process by which internet access is being used to affect positive social change in Suba North Subcounty (and quite possibly, many other "subcounties" around the world).

As explained in the Methodology, I decided the location of my research in Kenya based on a phenomenon that I noticed while on the web platform WWOOF. Seeing how WWOOF was so disproportionately prolific in this region in Kenya got me thinking about how the internet, and ICT more generally, is being employed by rural people in Africa to improve their lives, specifically through improved agriculture (as all the people using this platform are agriculturalists). As the first half of this paper displays, the uses for ICTs in African agriculture are ever expanding, and new ICTs are being utilized by Kenyan farmers everyday. In the following sections, I explain the use of these specific ICTs (volunteering platforms, fundraising platforms, and other social media) as they relate to the Kenyan digital agriculture scene, and I answer the original questions that directed my investigation: How and why did this phenomenon come to be?

The Diffusion of the Volunteer Hosting Innovation

It took the entire time that I lived in Kenya to piece together the full story that answers how and why there are so many farmers on this remote island making themselves available for international volunteers. I draw upon the "Diffusion of Innovation" theory popularized by Everret Rogers in 1962 to explain the proliferation of volunteering platforms on the island and in Nyanza Province more broadly. Diffusion is defined by Rogers as "the process by which an innovation is communicated through certain channels over time among the members of a social system".[74] The balance between potential reward and risk is the greatest determinant factor in the speed and uptake of an innovation. The innovation in question is the use of self-managed volunteering platforms. The channels by which it is being diffused are through word of mouth, community-based organizations (CBOs), and social media, specifically Facebook and Whatsapp. In this "Diffusion of Innovation" schema, networks are the axis upon which the wheels of social change spin. As I will demonstrate in the following section, networking with new digital technologies, as well as the old fashioned way (in-person), is vital to improving the uptake of ICTs and innovations that spur community and agricultural development.

The first person to sign up for a self-managed volunteering platform in Suba North Subcounty, and likely Kenya, was the late Modula. According to a blogpost made by one of his WWOOFers, he traveled to Norway in 1986 thanks to some people volunteering on Rusinga Island. After being recognized by the UNEP (UN Environmental Programme) in 1988 for his tree planting initiatives on Rusinga Island, a neighboring island to Mfangano, he was invited to give presentations and go to trainings on environmentalism and community development around the

[74]Everett M Rogers and United States Agency For International Development, *Diffusion of Agricultural Innovations in Eastern Nigeria : Innovation Characteristics, Motivation, and Communication Bottlenecks* East Lansing, Michigan, Michigan State University, 1967.

world. According to his son (Eodula) whom I interviewed three times, he learned about WWOOF somewhere in Scandinavia. He brought it back to western Kenya and started hosting volunteers in the 90s. (From the Odulafamily.blogspot): "The Kenyan Host Family Project, based on Rusinga Island, on Lake Victoria, was started in 1995 but became more active from 2000 onwards with the emergence of the internet in the region."[75] He helped other people sign up through the years and gradually, the idea gained traction.

Modula made environmental protection, hosting volunteers, and creating a big internet presence a family endeavor. According to Eodula, his father created "*a network of volunteers*" and "*used the network to*" bring energy saving stoves, solar panels, fencing for environmental projects, and much more to his community. The following is an excerpt from a 2009 blogpost titled "Holiday with a Difference" about voluntourists made by Vodula, son to Modula (the first Kenyan WWOOF host) and brother to Eodula (founder of Badilisha):

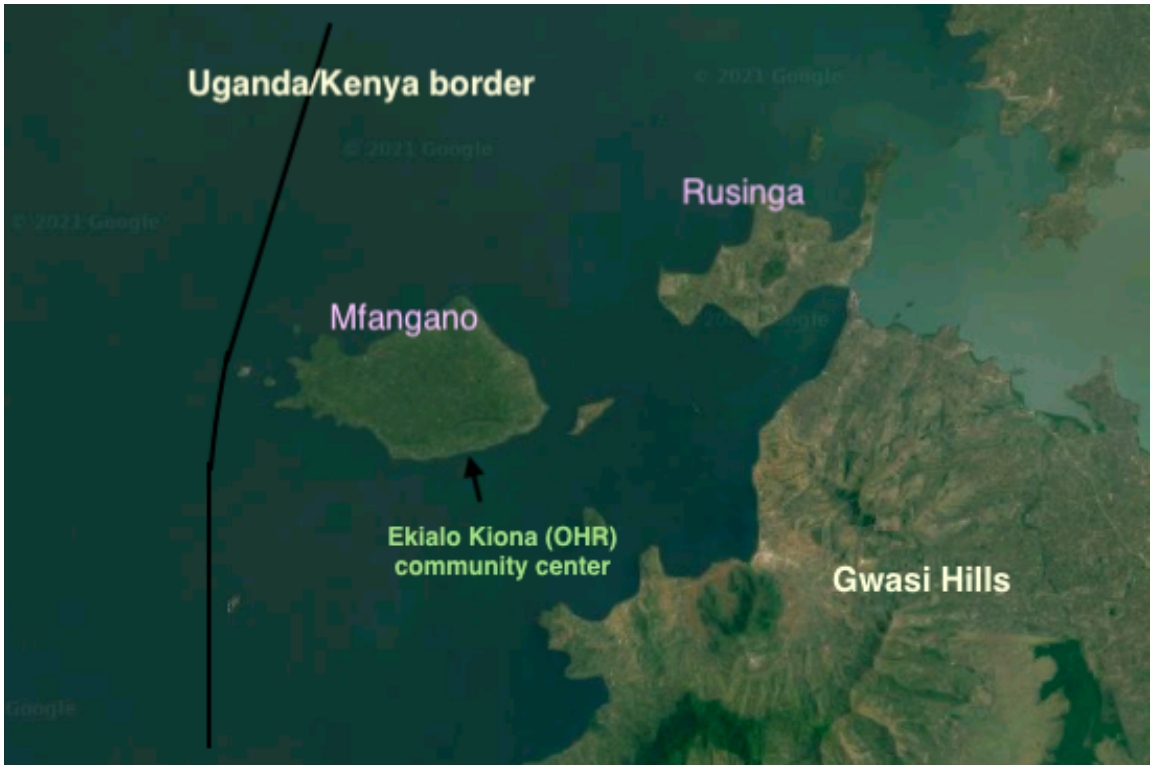
> There are also other memorable examples whereby such tourists have immensely contributed towards the development of community projects in Rusinga Island for example a tourist from France and his family back in France have supported Milimani Academy, a school for orphans and vulnerable children in the locality. One lady from USA supported to erect a permanent fence for horticultural project belonging to a local women group, and yet another one recently from Brazil assisted a host family to install a solar system to provide light and also to charge mobile phones in a rural village not yet connected to the National Grid. In February this year, a couple from Spain / Ireland by names Viviana and Neil who had come to Lake Victoria Permaculture Net work projects as volunteers donated two laptops to facilitate ICT training for the local youths and also cash to purchase school supplies, porridge ingredients and salary for three months for teachers at Milimani Academy.

Source: Odulafamily.blogspot.com

In the early 2000s, a Peace Corps volunteer on Rusinga Island began working with four young men to address the AIDS crisis in the community.[76] At that time there was only one point of internet access in the subcounty, the same one which Modula had been using for years, and the

[75] Victor Odula, "Michael and Jane Odula Host Family Project - Kenya," Odula Family, November 28, 2008.
[76] The communities in this area of Lake Victoria were some of the hardest hit by the AIDS epidemic in the world. To this day, the infection rate of HIV/AIDS on Mfangano Island is estimated to be 35%. Every community leader that I interviewed brought up the effects of the epidemic which are still extremely prevalent to this day. The catastrophic epidemic is especially relevant for the founders of orphanages (I interviewed four of the five of them on Mfangano Island), who started their foundations (all with funding from volunteers or church congregations in Spain or the USA) because of the terrible amount of orphans on the island.

Peace Corps volunteer used it to apply for grants. I was fortunate enough to be able to meet and spend several days with Eodula, Aokuku, and Dotedo, three of the four young men from Rusinga Island who worked closely with this American volunteer. Seeing how Eodula's father, Modula, and the Peace Corps volunteer were using the internet to bring in capital from around the world to address the social ills on their small island inspired them. They became passionate about utilizing the internet and voluntourists for positive social change.



Besides a few square miles south and southeast of this image, this map encapsulates the Suba North Subcounty. Image taken from google maps and edited by author.

All four of the young men in this informal cohort would go on to leverage voluntourism for community development, agricultural development, and environmentalism in Suba North Subcounty. The only one who I was not able to meet was Ragrenga. In December of 2006, Ragrenga helped his cousin who lived on the neighboring island of Mfangano sign up for WWOOF. That first WWOOF host on Mfangano Island was Joguta, my host fifteen years later. One month after signing up, Joguta got his first WWOOFer, an American doctoral student named Calmen.

Calmen evidently had a life changing experience farming with Joel and meeting people around the island, because after leaving, he applied for a Rhodes scholarship to return to Mfangano Island to do a long-term, ethnographic inquiry into the causes of the AIDs epidemic in the area.

Calmen ended up living on the island for two years. It was during that time that he, Ragrenga, and Joguta co-founded Organic Health Response (OHR) and facilitated the creation of a Kenyan-based counterpart, the Ekialo Kiona community center.

Like most international NGOs in Africa, OHR had many purposes. They provided the island with a health clinic and sought to destigmatize testing for HIV. They educated about and encouraged the adoption of organic agriculture and environmental amelioration. Disseminating information about HIV and sustainability were two of the biggest reasons for creating the EK Suba Youth radio.

OHR also brought many volunteers, mostly students and researchers associated with Calmen's university. These volunteers, combined with all the WWOOFers that Joguta was now almost constantly hosting, caught the attention of people all around the island. They asked questions, learned about WWOOF, and started signing up. Some volunteers directly signed up farmers who also wanted to host volunteers but did not have the internet literacy to do it themselves. OHR even conducted volunteer-hosting training sessions led by a farmer I interviewed, Gotieno. In this way, people on Mfangano island began using self-managed volunteering platforms to tap into global social networks.

The Story of the Internet on Mfangano Island

"I could sit there all day and through the night, connecting with organizations and people. That wifi opened us up to the world."

- Podhiambo
Founder of St. Elizabeth orphanage and school

In 2007 when Calmen came to Mfangano Island, there was no wired internet connection (cable or DSL) nor wireless internet connection (WiFi) on the island. People could only access the internet in certain areas where the signal from cellular towers on the mainland reached. People working at OHR and Ekialo Kiona recognized the power of the internet and made increasing access a priority.

In 2012, OHR collaborated with another NGO to establish a WiFi tower on the island. This boosted islanders' connection to the mobile internet and provided people who were allowed to access EK's WiFi with free, 24/7 internet access. People who I interviewed that were closely involved with EK at that time repeatedly emphasized how much of a turning point that that Wifi was. As environmentalist and WWOOF host Nolambo said in his iconically motivational and poetic way, "*That access to the internet showed us the world.*" Gotieno said something similar,

albeit in a way that unnerved me slightly because of how it echoed missionary-esque, colonial rhetoric: "*People were just in darkness. But Calmen came and showed us the light.*"

The only wifi tower on Mfangano island. It provides wireless broadband[77] connectivity to the OHR community center, three resorts, at least two internet cafes, and the public health clinic. The only other way that anyone on Mfangano island accesses the internet is using cellular data which is activated by signals delivered by cellular towers located on the mainland and neighboring Rusinga Island.

Crowdfunded Community Development

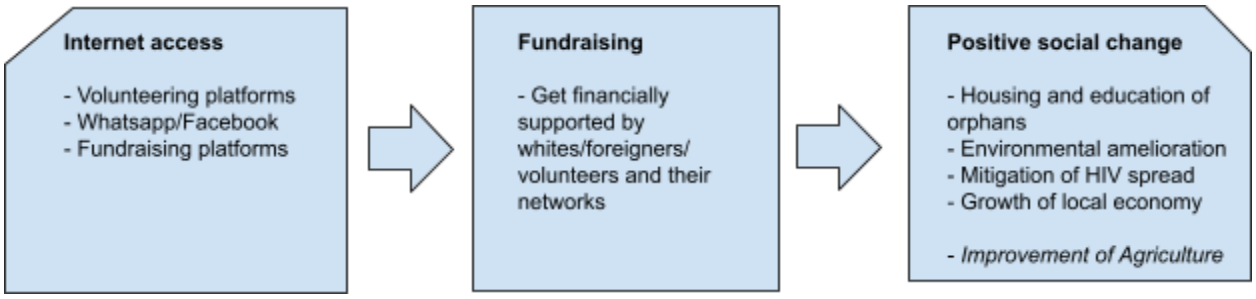
But why did people see, at least in retrospect, internet access as "*the light*"? What drove so many people to sign up for WWOOF? Recalling Everett Rogers' argument from the 1960's about diffusion of innovation theory, this innovation has diffused so successfully because farmers see no risk and great potential reward in using volunteering platforms. The number one reward that hosts cited most readily is cultural exchange and the exchange of ideas. "*Mostly I want to exchange experiences, exchange words, like I'm doing with you. It is just a matter of exchanging ideas because you came to learn. And we also— you learn from me I learn from you. We are here*

[77] Refers to high speed internet access. Broadband provides high speed internet access via multiple types of technologies including fiber optics, wireless, cable, DSL and satellite.

to learn, both of us," said Wopiyo during my very first interview. When I asked Gotieno why so many people on Mfangano are using volunteering platforms, he instantly responded: *"Exchange of knowledge. Knowledge is power. You learn from school, I learn from you. I pay no school fees!"*

But there is another reward which motivates people to engage in global networking. Most farmers did not say outright that getting donations was a motivating factor for wanting volunteers. And yet, I have been asked for some type of monetary support by 88% (23/26) of the people I interviewed. "*When you return to America you must find us some donors, some funds to send back*," one person at the community center randomly told me. Another one of my interlocutors asked me to "*Use your network. Spread my idea. Please, find me a partner,*" after talking about his hopes to start an environmental NGO. "*(I) am not good at proposal writing but on this plz am requesting you take the initiative and help us come up with one, or find us well wishers, donors, sponsors or friends who can help us develop this noble project*," was a Whatsapp message I received from Gokomo, a farmer who wants to start the island's first commercial grain store. These are just a few examples. I have been asked to write grants, become a business partner, find potential investors, give direct donations, and raise money through my "network" for a number of initiatives. Initiatives that I was asked to fundraise for include, but are not limited to, a solar water pump, a fabric store, a microfinance institution, school fees, hospital fees, a health clinic, a church, a fleet of canoes, a sunflower oil press, and an organic seed and fertilizer store.

Recall the graphic which explains crowdfunded community development and, by extension, answers one of my original questions: Why are 17.5% of all African WWOOF hosts located on one tiny, Kenyan island? Why are 40% of all African WWOOF hosts located in one Kenyan province?



Using volunteering platforms, crowdfunding sites, and other social media, rural Kenyans are connecting with people around the world and using those networks to acquire capital. This capital is then used to not only improve their livelihoods, but also to improve their communities by starting CBOs and non-profits.

Based on my fieldwork, people who are familiar with self-managed volunteering platforms are aware that 1. Most voluntourists signed up on these sites and looking for hosts in Africa have both a desire to vacation and to "help out" (voluntourism being inextricably linked with white saviorism[78]) and 2. Because of global inequality and the financial privilege that being a voluntourist necessitates, visitors have access to capital that could be shared with hosts. And if volunteers themselves do not have capital, farmers know that the visitor has a network of people with some level of financial privilege, always greater than that of the host. Essentially, 'ask the (relatively) rich foreigners to ask their relatively rich network for capital'. But to be clear, the phenomenon should not be reductionistically explained as 'Africans asking white people for money'. A more holistic way to conceptualize this phenomenon is as a method of community and agricultural development which relies on social capital and mutual aid[79], and is fundamentally opposed to traditional development aid as well as capitalist notions of self-interested growth.

One resident of Mfangano Island is especially proficient at combining volunteering and crowdfunding platforms. Using 12 different self-managed volunteering platforms and 2 websites specifically for his foundation, Sagrema has hosted around 120 volunteers since 2015. Most are from the U.S., but they come from around the world: Ethiopia, Uganda, Egypt, Zimbabwe, Brazil, China, Russia, all of Europe, and many other countries. Volunteers perform a number of different jobs in and around Kitawi village— farming, small business tutoring, women empowerment, internet connectivity— but the vast majority have one assignment in common: fundraising. Within the first 10 minutes of interviewing Sagrema, he proudly showed me 5 ongoing GoFundMes that volunteers of his had started. One of them was at $14,000.

On Rusinga Island, a neighboring island closer to the mainland, the two most influential NGOs are run solely on donations from volunteers, volunteers that they are connected with thanks to internet access and volunteering platforms. Aokuku, one of the four young men who met the Peace Corps volunteer some two decades ago, is the director of one of these two most influential NGOs. When asked where he gets his funding, he responded "*I network people with ideas and initiatives to support our community. All of this is made with funding from an informal group of people. No organization. Just many individuals*." "And how do you know these individuals?" I asked. "*Volunteers through WWOOF, volunteers through my website, friends of volunteers. It's all people I've connected to through the internet.*"

Aokuku started a different NGO before the one he currently directs. The initial capital to start and run that one was from a WWOOFer, a dentist from NYC that he met in 2004. Another one of the most influential NGOs on Rusinga, Badilisha, is also run solely on volunteer donations.

[78] White saviorism is a deeply patronizing and offensive practice where white people depict themsleves or are depicted as saving or liberating non-white people, often in ways that eliminate the agency of the non-white peoples. It is now commonly represented by a will to 'do development' via voluntourism.
[79] Mutual aid is a voluntary reciprocal exchange of resources and services for mutual benefit.

Eodula, founder of Badilisha and son of Modula (the first WWOOF host in Kenya), aptly said that "*when volunteers come to Africa, they do more than is expected of them. When they live with us, they understand our problems, and they feel compelled to give*."

As it is on Rusinga Island, the most impactful NGO on Mfangano Island (OHR) was also started because a WWOOFer (Calmen) felt compelled to go beyond just working on a farm. Overall, eleven of the twenty-six people that I interviewed have started a foundation/NGO/CBO (Community Based Organization) with capital from Westerners they met online.[80] Based on their host profiles, an additional five WWOOF hosts on Mfangano Island that I did not interview have also started organizations thanks to the beneficence of voluntourists.

During my very first interview, Wopiyo gave me his understanding of how crowdfunded community development can work (and has worked in the past, considering two people I interviewed had built entire orphanages/schools on Mfangano, with over one hundred students each, solely with funds donated by Americans who contacted them on Facebook). "*We can do messaging, we can do skyping, we can do anything with the internet. Maybe Linkedin, maybe Facebook. Maybe someone sees yours profile somewhere and they get interested in what you are doing and they reach out to you and you get connected."*

There are many agricultural resources that are acquired through crowdfunded community development which improve the livelihoods of their hosts by reducing costs or increasing productivity. Some, like solar-powered water pumps, are new technologies that greatly widen a farmers scope of what is possible on their farm. One reason why WWOOFers are desired that was brought up by multiple interlocutors is agricultural technology transfer. One of these interlocutors was Dagagwa, who used to work at a cyber cafe but quit to start a small NGO which he runs with funds from volunteers from six different volunteering platforms. He told me that he wants to farm "*organically, but in a modern way,*" reflecting a sentiment held by several of the younger farmers I met who strive to use organic practices with culturally indigenous roots and modern methods in tandem. Other agricultural resources that were donated, like organic seed balls, are simply commercialized versions of home-grown technology that has been used in East Africa for hundreds of years. This shows how the collaborative spirit of WWOOF fosters innovations that combine new technologies with old methods, preserving culture while increasing productivity.

Other examples of agricultural tools which were acquired thanks to online, global networking include fuel generators, metal hoes, irrigation lines, black netting for greenhouses, or just plain fertilizers and seeds. Examples of non-agricultural items acquired through crowdfunded community development include computers, school desks, school uniforms, a boda boda

[80] Four of these eleven were the founders of orphanages/schools who did not use WWOOF, but rather, connected with religious individuals and churches in America and Spain through facebook, whatsapp, or by being connected through missionaries in the area.

(motorcycle), soccer shoes, soccer balls, beds, medicine, a medical clinic, schools, and orphanages.

Whatsapp as Another Means of Networking-for-Development in Rural Kenya

"I want to give thanks to the 'Perma/Ecological Africa' family for the knowledge and experience, but also the support and empowerment we give eachother! Truly, a new way of coming together!

AL, August 22
Kenyan farmer/permaculturalist/groupchat member

"Can you imagine if we had an East Africa 'green' app where you can search for service providers, products, and courses? … How do we link professional support services with people who are trying to make a business, a learning hub, a center of excellence?… I know there are so many options here for youth, stay at home moms and the like to be able to support us digitally while they work from home. Through digital tools we can provide jobs by linking urban and rural professionals while growing the sustainable agriculture movement."

NT, Dec 10
Permaculturalist/groupchat member

Thanks to the internet, Kenyans are more connected with the world than ever before. And as is already abundantly clear, farmers on and around Mfangano Island are using this digital globalization to their advantage. The studies I referenced at the end of the "ICTs and Kenyan Agriculture" section argue that social media can be an incredibly useful tool for creating positive change in rural communities and on their farms. Besides self-managed volunteering sites, crowdfunding platforms, and Facebook, a fourth social media platform that acts as another means of networking-for-development in rural Kenya is Whatsapp.[81]

I have already explained how two people built two different schools with donations acquired after posting on Facebook. While it is technically owned by Facebook, Whatsapp is a different social media that is benefiting Kenyan farmers through local and global networking. On Whatsapp, the world's most prolific messaging platform, group chats hundreds strong can connect agriculturalists and environmentalists from around the world. While living on Mfangano Island, I was added to a group chat titled "Perma/Ecological East Africa". In this group chat, information is shared between hundreds of farmers, environmentalists, activists, and scientists throughout East Africa. The resources shared include webinars, contacts of organic suppliers,

[81] Social media are defined as "websites and applications that enable users to create and share content or to participate in social networking." Therefore, crowdfunding platforms and self-managed volunteering sites are technically social media.

reports, training manuals, environmental petitions, and pictures and videos of organic, sustainable practices that people throughout the region are implementing. People regularly ask for advice on issues they are running into. One person even said that they "*don't need to use google when all the answers are here in this forum!*", revealing the value farmers place on personalized advice compared to anonymous online information. In the words of another farmer, *"We are an open source platform that is sharing data and resources to grow others."*

Not only does the example of Whatsapp show the value of social media as an ICT that supplements rural farmer's knowledge, thereby increasing their agency and productivity, it also shows how influential ICTs can be in amplifying the voices of smallholder farmers. Where an individual farmer has essentially no say in policy decisions in their own country, let alone at global events like the 2021 UN Food Systems Summit, networks of farmers can make their collective wishes known. For example, the Alliance for Food Sovereignty in Africa (AFSA), which vociferously spoke out against the 2021 UN Food Systems Summit[82] on behalf of millions of smallholder farmers through Africa, relies heavily on social media to educate everyone about the food sovereignty movement, from rural farmers to international policy makers.[83]

Besides increasing awareness and online activism, social media and mobile-based communication also enhance the ability of smallholder farmers to organize and make their voices heard off the internet too. After Kenya's controversial Livestock Bill 2021 was publicized, people took to "social media" to share their outrage and organize protests. The Livestock Bill was pulled less than two weeks after its release following public outcry on the streets and on the web. And in August 2021, I witnessed the organization of protests in three East African countries via the groupchat "Perma/Ecological East Africa" after environmental activist Joannah Stutchbury was killed for her commitment to protecting forests from environmentally harmful industrial agriculture. Access to mobile internet has been critical in giving a voice and platform to millions of farmers who have previously gone unheard.[84]

[82] The 2021 UN Food Systems Summit received backlash and boycotts from stakeholders of all kinds all around the world because of accusations that the event was catering more to multinational seed and agrochemical corporations than to smallholder farmers.
[83] AFSA, "AFSA – Transitioning to Agroecology," Alliance for Food Sovereignty in Africa, 2021.
[84] Refer to *Digital Democracy, Analogue Politics,* a 2018 book authored by Nanjala Nyabola, for information on how the impressive level of digital access and online engagement in Kenya is transforming the politic sphere. As I briefly mention, increased transparency and interconnectivity is providing platforms and increasing civil agency for people all around the country, allowing the Kenyan citizenry to engage in politics in an unprecedented way.

Conclusion

Challenges

The internet, and digital agriculture in general, is not a panacea for agricultural development in Kenya, or Africa overall. There are significant barriers to increasing internet use equally, justly, and safely. There are also considerable negative externalities that I witnessed with the phenomenon of volunteering platforms on Mfangano Island. This section reviews the challenges and negative externalities that I witnessed in my case study, as well as general roadblocks in ICT use for agriculture.

The greatest negative externality that I observed with the use of volunteering platforms, crowdfunding, and online networking for agricultural development is donor dependency syndrome (DDS). DDS "is an attitude and belief that a group cannot solve their own problems without outside help."[85] Because the vast majority of enterprises created with volunteer funds are non-profits, they are unsustainable and will not lead to liberatory development. In Aokuku's words, "*At some point, we must stop relying on white people for our development. Enough with the, the Dead Aid.*[86] *Enough with the donor dependency syndrome. I mean, how many people have come to you asking for you to raise money for their projects?*" Aokuku's spot-on understanding of my situation surprised me at first, and then reminded me that just because I may be the first person to write about this phenomenon academically, many people, perhaps all people on Mfangano, are aware of the self-perpetuating cycle of dependency that this method for community development brings about.

A related negative externality, or rather, a challenge also concerning the relationship between hosts and voluntourists, is that meaningful connections between farmers and guests may be inhibited by racial and economic inequalities. Farmers believe that money and influence are potential rewards to be reaped from hosting volunteers because there is a deep rooted association between whiteness and wealth on Mfangano Island (and it is safe to say, in Africa overall). While riding on the back of my acquaintance Majengo's motorcycle through the island's bustling central marketplace, one of his friends jokingly called out to him in Luo, their mother tongue, "*Today you are rich! You are with a white man! Buy me a soda!."* "*They think white people come here and drop piles of money, bags of cash in the corner,"* Majengo explained, yelling over the wind whipping past us on the boda boda after translating what the man had said.

Another day, a different friend of Majengo told him, "*They have skin the color of money."* Similarly, after confessing to an Uber driver in Nairobi that I was pretty sure I just got overcharged for some wooden trinkets, he told me, "*They see the color of your skin and they*

[85]Phil Bartle, "The Dependency Syndrome," cec.vcn.bc.ca, June 11, 2012.
[86] Referring to Dambisa Moyo's book "Dead Aid: Why Aid Is Not Working and How There Is a Better Way for Africa".

know— this is money." Even young children have the association ingrained, and they are much more blatant than adults in admitting it. One day while walking on Mfangano's central ring road, some elementary school children started following me, jumping around, laughing and saying: "*Mzungu![87] Give me money!"*

Biddle (2020)[88], Cole (2012)[89], and other scholars who have done research and written about voluntourism have also found this association to be the case, especially while talking about East Africa (Kenya, Uganda, Tanzania) where voluntourism is particularly prevalent. And it is not just an association between whiteness and wealth, but the association between whiteness and supremacy which pervades effectively all interactions between white volunteers and hosts. After asking Gotieno about roadblocks or challenges with hosting, he nonchalantly responded, *"Other islands, they might think that they need money to host whites because whites have money. But Mfangano is a little bit civilized because we've had a lot of white people here. Here, everyone knows that anyone can host."* I would be very doubtful about whether he actually said that there is a causal relationship between interaction with white people and being civilized— had I not recorded that interview.

In a different interview, the director of a private school/orphanage stated with tired exasperation, *"Africans are beggars. You say U.S., they think money."* One night a few days before I departed, I was talking with Majengo about race and he brought up how one of his friends told him, in complete seriousness, *"White people are blessed and Black people are cursed. It is written in the bible."*

In these instances, and in many more subliminal and insidious ways, I witnessed how present white supremacy is, not just in interactions between white foreigners and Black Africans, but also in interactions between Black people, like with Majengo and his friend. In his paper on "Self-Management and Spaces of Encounter in Organic Farming Networks", Anthony Ince came to a relevant conclusion: "Encounters" through self-managed volunteering platforms can be undermined because these encounters cannot be removed from the "structural inequalities in the statist-capitalist system".[90] White supremacy is a foundational aspect of the statist-capitalist system, and it is an ever present social factor to recognize when considering the challenges to global networking and crowdfunded community development for rural farmers in Sub-Saharan Africa.

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[87] Mzungu means white person in Kiswahili. Interestingly, however, the literal translation is "someone who roams around" or "a wanderer".
[88]Pippa Biddle, *Ours to Explore : Privilege, Power, and the Paradox of Voluntourism* (Lincoln: Potomac Books, An Imprint Of The University Of Nebraska Press, 2021).
[89]Teju Cole, "The White-Savior Industrial Complex," The Atlantic, March 21, 2012.
[90]Anthony Ince, "From Middle Ground to Common Ground: Self-Management and Spaces of Encounter in Organic Farming Networks," *Annals of the Association of American Geographers* 105, no. 4 (2015): 824–40.

Taking a step back from the case study and looking at ICTs and agriculture more generally, one major challenge is people's fluency in using new technologies. The World Bank states that a "lack of extension services on the adoption of modern technology" is a main factor in the consistent loss of real agricultural value-added in Kenya since 2006.[91]

One way that the challenge of technology illiteracy should be combatted is hiring or partnering with people in every village that are well versed in internet and mobile technology who can verbally pass along information that they acquired virtually. Seed Systems Group, an NGO based in Nairobi calls these people "VBAs": Village-Based Associates. "The adoption and spread of mobile phones among farmers have dramatically increased the impact that can be achieved through private sector-led extension and VBAs, more specifically. VBAs can be facilitated to access relevant ICT applications, weather predictions, and instructive videos to accelerate the adoption of new technologies and management practices".[92] Forming concrete relationships with at least one ICT savvy individual per community ensures that rural people still benefit from increased connectivity, even where there is technology illiteracy. This emphasizes one of the key findings from my research: that in-person networks are incredibly valuable in increasing the productive application of ICTs in agriculture.

Besides internet literacy, the ability to communicate in English is another huge barrier preventing rural Kenyan agriculturalists from taking advantage of the volunteering sites and their attendant networks and funds. "*Some people are very good at writing, talking up their farm*," is what Nolambo said one hot day as we sat on the dry ground in the shade of one of his mango trees. He was complaining about the way that hosts on Mfangano Island must compete with each other for volunteers and the factors that determine success or failure. He and others who are extremely intelligent, interpersonally skilled, and experienced agriculturalists will forever be looked over in favor of the host who can write better in English.

People who aspire to host volunteers but are not confident in their English may end up relying on visitors to supplement this lack. Recall Gokomo, the host who messaged me after our interview saying, "*(I) am not good at proposal writing but on this plz am requesting you take the initiative*". He has a marvelous idea for a commercial grain store and intimately understands the processes by which other people have kickstarted their projects, but because of his low-level of English writing skills, he is not confident enough to apply for grants or start fundraisers himself.

Besides asking volunteers to do the fundraising and grant writing for them, another way that farmers circumnavigate internet and English illiteracy is getting their accounts created by other volunteers. After weeks of daily trips saddled up close on his motorcycle, I became friendly with

[91] World Bank, "Kenya Economic Update: Transforming Agricultural Productivity to Achieve Food Security for All," World Bank, 2019.
[92] Seed Systems Group, "Seed for the Transformation of Food Systems in Left-behind Countries of Africa: The Role of Seed Systems in Averting Pandemic-Induced Food Crises," 2021.

Wopiyo, a middle-aged man who worked part-time as a boda-boda driver and part time at the OHR community center. One day, Wopiyo saw me on my computer on the veranda of the community center, left, and came back with his own laptop (which had been bought years prior by volunteer fundraising through the center). He sheepishly asked me if I could create a WWOOF account for him, which I proceeded to do with gusto by asking him what he wanted to say and then supplementing it with my grammar and vocabulary. Another farmer, Gotieno, was the chairman of the "volunteer hosting team" for OHR and told me that previous volunteers had also made this task of signing people up for volunteering sites one of their regular activities. "*My (WWOOF) profile was created by a very nice American named Graham.*" Graham also created the website for Gotieno's foundation, a youth empowerment program that is using fundraising from volunteers' networks to construct fish ponds for unemployed youth in his village. By relying on in-person networks, the problems with internet and English illiteracy can be circumvented.

That being said, language skills cannot be avoided altogether. In two of my interviews I needed a translator, and while it certainly would not have been impossible to live with them, communication before coming and upon arriving would have been a huge barrier to that which hosts seek most: exchange of culture, knowledge, and ideas. Thus, while low literacy can be managed through peers and tools like google translate, achieving social change and agricultural development in SSA via internet-based global networks often requires proficiency in a European language.[93]

Another roadblock related to digital literacy is that people do not have the time, energy, or know-how to use all these new ICTs to improve their agriculture. According to a 2017 Pew Research study, "Sub-Saharan Africans are far and away most likely to use the internet for" social and entertainment purposes, I.e. staying in touch with family and friends.[94] Out of the twenty-six people I interviewed, nearly every respondent said that communicating with friends and family was their most common use of the internet and is the best part of having mobile data and WiFi on the Island. Whatsapp, Facebook, and email are by far the most common applications on and around Mfangano Island. During an interview that lasted all afternoon, Aokuku critiqued my idealism surrounding the power of internet access to revolutionize agriculture: "*Young people don't go on their phones to learn about farming. They use phones to flirt and watch porn.*" Two people in their early twenties who were listening in on our conversation shrugged and gave affirmative nods. ICTs for agricultural development are useless if people do not have the will to find and use them.

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[93] That proficiency in a European language is often required to bring in volunteers to rural SSA may not always be the case. With the ever-increasing volume of interaction between China and SSA, knowledge of Mandarin is becoming more relevant to accessing development aid, whether institutional or crowdsourced as described here.

[94] Laura Silver and Courtney Johnson, "Internet Connectivity Seen as Having Positive Impact on Life in Sub-Saharan Africa," Pew Research Center's Global Attitudes Project, October 9, 2018.

There is also the problem of generational divisions, wherein young people do not much like farming and old people are less likely to start using new technologies. One afternoon while sitting on the veranda of the community center, I was asking Modembo, an older employee of OHR and a farmer, if he goes to the internet to learn about farming. He said that using "*the internet and books and manuals are for commercial farmers*", and that people "*around here*" do not need them. Modembo believing that subsistence farmers don't need to utilize technological solutions is representative of a larger roadblock concerning generational divides in digital uptake.

Physical infrastructure is another obvious barrier for people who wish to use the internet or mobile phone to improve their agriculture. Broadband only reaches 30% of Kenya, compared to an average of 70% in Europe.[95] Kenya has been slowly improving their physical ICT infrastructure, as in 2013 when Kenya began implementing their national broadband strategy and in 2018 when the government started another initiative to "lay fiber optic cable from major towns to rural areas".[96] Furthermore, Kenya outlined ICT development as one of the four main drivers of economic growth and prosperity in their national plan, "Kenya Vision 2030". However, it is not just internet lines and terrestrial cables needed. In order for increased market information to be any good, goods need to be able to be delivered, which requires roadbuilding. And smartphones need to stay charged, which requires consistent electricity. There was one public generator powering all electricity on Mfangano Island, and a small thunderstorm blew out power for half a week. Almost all digital tools are useless without electricity.

One final challenge that I observed, and that is observable in the implementation of ICTs in Kenyan agriculture more broadly, is a gender divide. Several studies from Kenya found that on average, women work more, own less land, and have less access to education, finances, agricultural extension, and employment. Kenyan men are 20% more likely to own a smartphone than women.[97] In one study across ten cities, women were 50% less likely to be online than men.[98] And in my own research there was a great gender divide as well. Out of the 26 people I interviewed, only 4 were women, an abysmal 15%. I would have strongly preferred a 50/50 split, and some factors that limited gender inclusivity in my fieldwork were the immense gender disparity concerning WWOOF hosts on the island, gender disparity concerning computer ownership and use, and most significant were gendered cultural norms that limited who I regularly interacted with and was easily permitted to meet with. If the fact that women simply deserve to be treated equally is not convincing enough, it is empirically proven that female empowerment and inclusion are some of the greatest pathways to increasing agricultural productivity and general economic growth. Gender equality must be mainstreamed, i.e., the

[95]Stastia, "Countries with High Broadband Penetration 2017," Statista, accessed December 29, 2021.
[96]Stastia, "Countries with High Broadband Penetration 2017," Statista, accessed December 29, 2021.
[97]Knowledge for Policy, "Kenya Digital Agriculture Profile | Knowledge for Policy," knowledge4policy.ec.europa.eu, July 9, 2021.
[98]"Digital Gender Scorecard for ICT's in Kenya | the International Association of Women in Radio & Television," Iawrt.org, 2011.

digital gender divide must be considered in every policy and initiative as agriculture in Kenya grows increasingly digital.

Review

Providing smallholder farmers with phones, internet access, and other digital tools will not create an agricultural utopia. It will not solve all problems related to inefficiency and environmental change in the Kenyan, African, or global landscape. But, it does have the potential for enormous, even revolutionary change. As this paper demonstrates, wherever internet access spreads, increased local and global interconnectivity leads to new innovations which improve people's lives in a myriad of ways, one of which is through the improvement of agriculture.

There are significant challenges and negative externalities which limit the efficacy and scalability of online networking for the purpose of agricultural development in rural regions of the Global South. Some, like illiteracy, can be overcome fairly easily. Others, like sexism and white supremacy, will take generations to deconstruct.

ICTs are transforming all aspects of global agricultural production and supply chains. One way this is happening in Kenya, the Digital Nyika, is the use of volunteering platforms, crowdfunding platforms, and other social media by rural farming communities to acquire capital which is then used for agricultural and community development. Accessing global social networks through the internet can be especially transformative for island populations who have been traditionally locked out of both public and private investment because of their geographic isolation and exclusive participation in informal economies. In light of the many challenges that the Kenyan agricultural sectors are dealing with (declining average farm size, declining agricultural extension[99], declining public expenditure, and limited access to markets and market information, as well as the effects of the climate crisis, declining general productivity, and new laws which harm farmers in the informal sector), international investment is exceedingly important for small scale farmers in Kenya. What I observed and documented on Mfangano Island shows how access to the internet has opened up new pathways for international capital to reach farms in Africa's most rural peripheries.

With the power of the internet, subsistence farmers are connecting with people around the world— some passionate about sustainable agriculture, some interested in community development, or others just excited about cultural exchange— who come to Western Kenya and more often than not, help in some way to improve the lives of their hosts. Farmers who are using the same organic practices that their ancestors have been using for hundreds, if not thousands of years, are now adding in new tools and practices that they are learning from Willing Workers On

[99] *Agricultural extension* is the application of scientific research and new knowledge to agricultural practices through farmer education

Organic Farms,[100] and incorporating new technologies donated by these international volunteers who, after existing so intimately within the community, feel compelled to participate in crowdfunded community development. Farming is one of humankind's oldest endeavors, and digital technology is one of its newest. The nexus of the two marks a revolutionary advancement in agricultural development for the rural poor around the world, not just because profits can be increased and supply chains enhanced, but because digital technology has connected humans in an extraordinary and unprecedented way.

[100] WWOOF used to stand for this before changing to its current name (World Wide Opportunities on Organic Farms).

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