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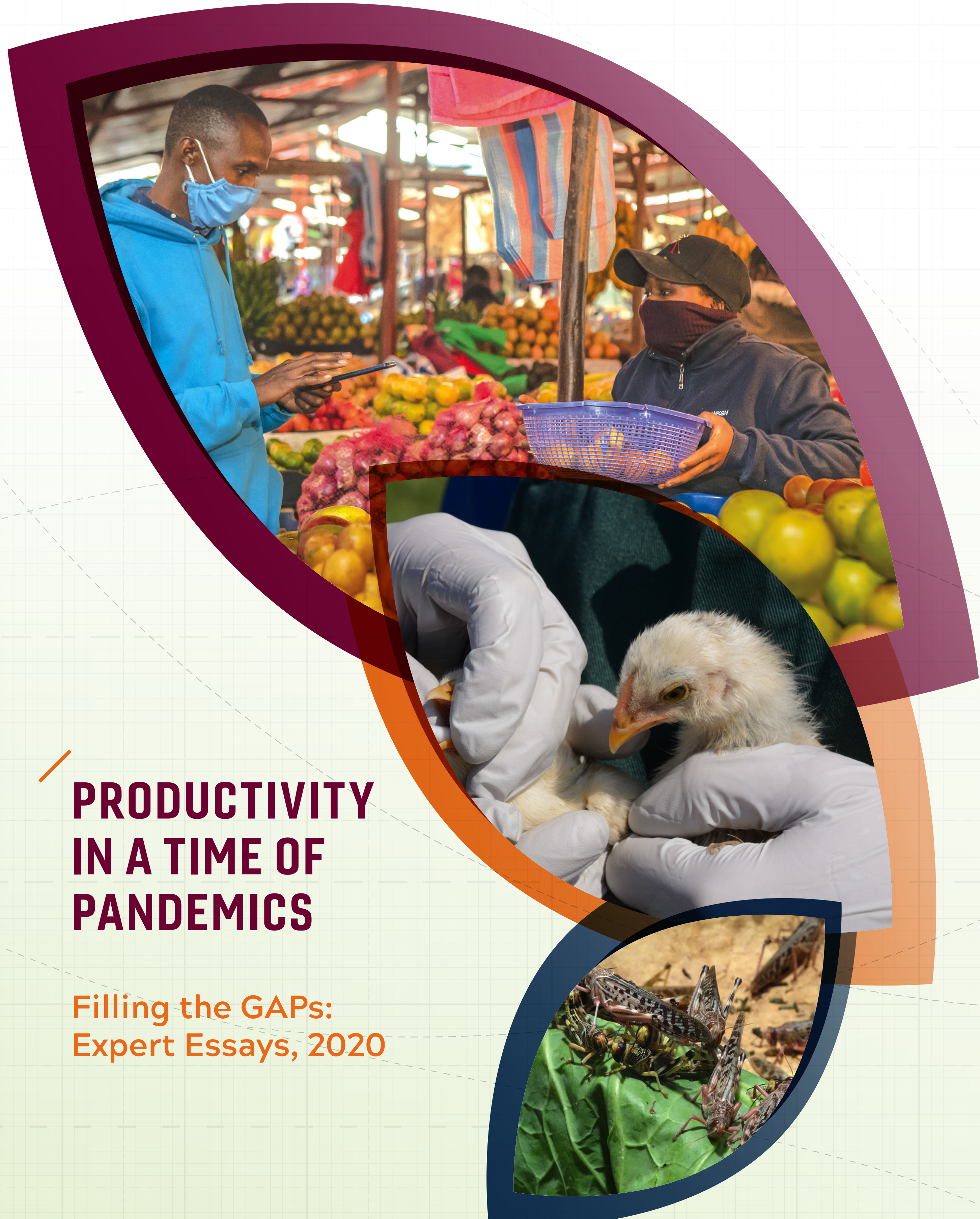

PRODUCTIVITY IN A TIME OF PANDEMICS

Filling the GAPs: Expert Essays, 2020

The Global Agricultural Productivity Report® (GAP Report®) is central to the mission of CALS Global in the Virginia Tech College of Agriculture and Life Sciences (CALS): to build partnerships, drive thought leadership, and create opportunities for students and faculty to serve globally.

In addition to producing this annual update on global progress toward doubling agricultural output through productivity growth by 2050, the GAP Initiative coordinates opportunities for collaboration and learning between its partners, the university, and stakeholders around the world.

Direction and input for the GAP Report and related activities are provided by the Virginia Tech Internal Advisory Group and the GAP Initiative Leadership Council. Members are acknowledged on the back cover.

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The GAP Report brings together expertise from the private sector, NGOs, conservation and nutrition organizations, universities, and global research institutions. **Supporting Partners** provide financial support for the GAP Report and activities. They offer important perspectives on critical issues facing agricultural systems in the US and around the world. **Consultative Partners** contribute their knowledge of productive, sustainable food and agricultural systems, including the role of agricultural R&D and extension, natural resource conservation, human nutrition, international development, gender equity, and the needs of small-scale farmers.

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Agricultural productivity is best expressed as Total Factor Productivity-TFP. TFP is a measure of efficiency in agriculture – the efficiency with which agricultural inputs such as labor, fertilizers and seeds are converted into outputs of crops and livestock. According to the the Global Agricultural Productivity Index (GAP Index), global TFP must increase by 1.73 percent annually to meet global goals for adequate food, feed, fiber, and biofuel for 10 billion people by 2050. When we fall short of this target growth rate, as we have each year since the GAP Index was developed in 2010, this creates a "productivity gap". The productivity gap is worsening in the world's poorest countries, where TFP growth now averages only 0.58 percent annually. The productivity gap threatens food security and often forces farmers to cultivate marginal lands, which can also threaten biodiversity. How do we close the productivity gap and get back on track to achieving global food security? This year, the GAP Report editors invited scholars and experts to submit essays based upon their research about strategies for closing the productivity gap and increasing agricultural sustainability and resilience.

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TECHNOLOGY ADOPTION FOR IMPROVING AGRICULTURAL PRODUCTIVITY IN SUB-SAHARAN AFRICA

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ABSTRACT

Agricultural productivity in sub-Saharan Africa (SSA) continues to lag behind the rest of the world. Here, we briefly review the status of adoption of technologies that have potential to boost productivity – irrigation, mechanization, genetically-improved crops, and digital technologies. No more than 5-6 percent of SSA cropland is irrigated, despite the continent's vast reserves of renewable and non-renewable water. Increasing irrigation may hold the greatest promise for increasing agricultural productivity and production in SSA. Recent trends suggest that small-scale "farmer-led" irrigation is on the rise in SSA. The lack of farm mechanization continues to challenge many SSA farmers. Recent innovations, including equipment-sharing schemes, are beginning to make a difference. Nevertheless, mechanization costs are still a barrier to most SSA farmers. The large majority of SSA farmers do not use improved seeds created through conventional breeding, hybridization, genetic modification, or gene editing – and thus are not able to take advantage of improvements in crop stress tolerance, adaptability, and other traits. Several African countries have or soon will revise standards to allow genetically-modified crops, a promising trend. Science-based policies and effective seed systems, both formal and informal, can give farmers to improved seeds. The number and use of agricultural digital applications in SSA is increasing rapidly, along with availability of internet and mobile devices. These hold promise for improving farmer information about weather, markets, pests, and more. There is no one solution to increasing agricultural productivity in SSA; this will require improved access to multiple inputs, supportive government policies, and well-functioning supply and value chains.

INTRODUCTION

After years of improvement, hunger is again on the rise in sub-Saharan Africa (SSA). Both the prevalence of undernourishment and number of undernourished individuals have increased since 2014. Now, twenty percent of individuals in SSA are undernourished, 347 million are moderately food-insecure, and 59 million children suffer from stunted growth.[1] In some regions, hunger and nutrition indicators are worse due to shocks such as drought, conflict, and pest infestations. In Eastern Africa, for example, 31 percent of individuals are undernourished.[2] The 2020 shocks of the desert locust invasion of East Africa and the economic and food security shocks due to COVID-19 may make an already serious situation dire. Furthermore, the United Nations projects that the population of SSA will double to 2.1 billion by 2050.[3] For a continent that currently struggles to feed and nourish its population, it is imperative that agricultural production be increased.

Increases in agricultural production can arise through bringing new land into production, increasing application of key inputs such as fertilizer and crop protection products, expanding irrigation into new lands, and increasing total factor productivity (TFP) – the efficiency with which agricultural inputs are converted to outputs. In this brief essay, we will focus on how the adoption of appropriate agricultural technology – including irrigation, mechanization, genetically-improved crops, and digital technologies – will be crucial to create a food and nutrition-secure future for the people of SSA.

IRRIGATION

Expanding irrigation may hold the key for increasing agricultural production for the 38 percent of sub-Saharan Africa's population that live in arid and semi-arid regions.[4] Currently, no more than 5-6 percent of Africa's cropland is irrigated, and this value has increased only slightly during recent years.[5] This is despite the enormous potential to expand irrigation in Africa. With appropriate technology, it is estimated that an additional 96 million hectares in SSA can be irrigated by smallholders, potentially benefitting up to 369 million people.[6] Such expansion would account for more than half of the currently cultivated land in SSA.[7] According to a recent World Bank report, SSA has 1.4 billion cubic meters of renewable shallow groundwater, and non-renewable groundwater resources are estimated at 660,000 cubic kilometers.[8] Because of ease of access, almost all farmer-led irrigation relies on renewable surface and groundwater sources.

Recent evidence suggests that irrigation in SSA may be more widely practiced than has been estimated, with smallholder farmers leading the way by utilizing a multitude of water sources such as shallow groundwater, streams, small impoundments, rainwater harvesting, and more. Farmer-led irrigation is driven by and for smallholder farmers.[9] As much as 4.1 million hectares may be irrigated in Ethiopia through "farmer-led irrigation", far higher than official statistics.[10] More than 80 percent of irrigation in most SSA countries is small-scale farmer-led irrigation.[11] Creating supportive policies and an enabling environment to encourage irrigation expansion by smallholders could result in dramatic increases in agricultural production and productivity, and increased resilience to climate change.

Extending irrigation can increase agricultural production and TFP by allowing crops to take advantage of increased additions of other inputs. Worldwide, 40 percent of agricultural production comes from the 20 percent of land that is irrigated.[12] Expanding irrigation in SSA can increase TFP and reduce the pressure to cultivate more land, which threatens biodiversity.[13] However, there are many serious constraints to expanding farmer-led irrigation in SSA, including uncertain land tenure, poor infrastructure to support irrigation, inadequate farmer knowledge and lack of extension/advisory support, and limited awareness about irrigation technology.[14] Investment in strengthening capacity of farmers and advisory services, increased availability of credit, improved infrastructure, more research and development, and supportive policies will be needed to overcome these obstacles.[15] Women farmers often do not have equal access to water or irrigation technology compared to men; it will be crucial for gender equity that this is borne in mind in irrigation development.[16,17]

Irrigation alone will not ensure food security for SSA. The higher yield potential with irrigation will not be realized unless farmers have access to other technologies, including genetically improved crops, fertilizers, crop protection products, and appropriate mechanization.[18]

MECHANIZATION

Sub-Saharan Africa has the least mechanized agricultural systems in the world. According to a 2019 report by the African Agricultural Technology Foundation (AATF), African farmers have only one-tenth the amount of mechanized tools per farm area than farmers in other developing regions, and access has grown at slower rates.[19] This is understandable for an industry dominated by smallholder farming. However, several recent programs throughout SSA have shown that mechanization is a powerful and feasible tool for productivity growth for smallholder farmers.

Data from Uganda suggests that, despite the considerable barriers to acquiring the technology, access to tractors improves agricultural productivity for small-scale farmers much more than other inputs such as fertilizer.[20,21] As yields in sub-Saharan Africa continue to hover around 56 percent of the international average, bringing the power of mechanization to smallholders is increasingly being considered as a powerful tool to sustainably increase productivity.[22]

The Cassava Mechanization and Agro-processing Project (CAMAP), founded in 2012 by AATF, has expanded access to mechanization for smallholder farmers in Africa. The project allows farmers to buy into a collective revolving fund so that they each can afford the maintenance and mobilization of machines including tractors and trucks that increase productivity for cultivation and processing of crops.[23] By 2018, CAMAP had brought mechanization services to more than 6,000 operations in Zambia, Nigeria, and Uganda, and the project also formed a company called Agridrive Limited which is dedicated to expanding availability of mechanization services for farmers in Nigeria and Kenya.[24]

CAMAP is one of several projects and companies that have been started by Africans in recent years to deliver financial and logistical access to productivity enhancing mechanical technologies for smallholders.[25] Internationally, major agri-business companies such as John Deere have also started projects to bring increased access to tractors to farmers in SSA. John Deere partners with the African company Hello Tractor to make 10,000 new tractors available to smallholders in Nigeria and Kenya. Farmers can affordably hire tractors for short term use, allowing them to make use of the productivity-enhancing technology without needing the significant capital investment of buying the machines outright.[26] However, there remain considerable challenges for wide access to mechanical tools for smallholders in Africa, and continued efforts from both public and private interests will be necessary if mechanization is to continue playing a role in closing the agricultural productivity gap between Africa and the rest of the world.

GENETICALLY-IMPROVED CROPS

Improved and genetically modified seeds represent some of the most widely used and broadly accepted technologies that have been proven to enhance yields and productivity for farmers of all scales. Genetic improvement may arise through conventional selection and breeding, biotechnology (GMOs), and recently by gene editing through CRISPR and similar technologies. The first Green Revolution proved more than fifty years ago the great potential of improved plant genetics for increasing agricultural production; by the year 2000, improved crop varieties introduced beginning in the 1960s had been planted on about 80 percent of cereal area in South and East Asia, resulting in a tripling of yields during the same period.[27] However, despite overwhelming evidence that improved crop genetics can improve productivity for smallholders in Africa, these technologies have yet to be widely adopted on the continent.[28]

In 2018, the World Bank reported that Ugandan agricultural output grew by only 2percent per annum during the past five years; this number was outpaced by population growth.[29] Malnutrition is widespread, with 29 percent of children below the age of 5 stunted. Meanwhile, only 30 percent of crops planted in Uganda are genetically improved.[30,31] And Uganda is not alone. Use of genetically improved maize in many African countries represents just 20-30 percent of total acreage; and this fraction is much lower for most other local staple crops.[32]

As the demands of increased population and the challenges of climate change mount, biotechnologies represent proven productivity enhancing solutions that various actors in Africa are beginning to turn to. One reason for the slow adoption of new seed technologies in SSA is the reliance on traditional seed systems, by which farmers pass on seeds to one another that never enter into a formal channel. Efforts are being made to incorporate partnerships between farmers and the public and private sectors to develop formal seed systems by which farmers can have access to a wider and more reliable range of seeds.[33] However, even as new seed systems develop across SSA, the adoption of GMO technologies faces serious opposition from a number of sources.

The continued widespread use of nontariff trade barriers on GMO crop imports to the European Union has been a central issue to blocking genetic crop technologies in Africa, as African farmers are forced to refrain from using genetically-modified seeds in order to access the vast markets in Europe.[34] Major influence is also wielded by developed countries that have tied development aid packages to anti-GMO policies, and from international activist non-governmental organizations such as Greenpeace and Via Campesina that spread anti-GMO sentiment and often disinformation about the technologies.[35,36] A 2016 study estimated that under the current restrictive regime of anti-GMO policies, low- and middle-income countries globally could be forgoing as much as US $1.5 trillion in economic benefits through 2050.[37]

In 2019, Nigeria became one of the first African nations to approve the commercial use of GMO technology in a food crop; and similar actions are under development in Ghana, Kenya, Tanzania, Ethiopia, Mozambique, Uganda, and Malawi.[38] Projects such as the African Center for Crop Improvement (ACCI) which, through support from the Rockefeller Foundation and the Alliance for a Green Revolution in Africa (AGRA), have educated and trained more than 100 plant breeders from throughout Africa at a PhD level.[39] ACCI is a project launched by Africans to expand the availability and use of improved seed technologies that can be tailored to local needs.

Throughout much of Asia, availability of genetically-improved seeds has played a critical role in increasing agricultural productivity. In SSA, supportive government policies, including science-based regulations governing genetic technologies, are necessary so that farmers can access improved seeds. Recent trends are encouraging, with several SSA countries allowing or considering sales of genetically-modified seeds. Private-sector solutions will be needed to ensure availability and affordability of improved seeds for farmers.

DIGITAL TECHNOLOGIES

In 2018 the number of SIM connections in sub-Saharan Africa reached 747 million, representing a 74 percent penetration rate, and it is projected that by 2025 that number will reach 1.04 billion.[40] The role that digitalization can play in fostering economic development in developing countries is documented in numerous studies; and digital technologies have recently reached the agricultural sector in SSA.[41]

According to the Technical Centre for Agricultural and Rural Cooperation (CTA), various digital technologies for agriculture have registered more than 33 million smallholder farmers across Africa, (representing up to “13 [percent] of all SSA smallholders and pastoralists… depending on assumptions used to calculate penetration.”).[42] The report found that there are at least 390 distinct digital agricultural tools, or ‘solutions’ currently active in Africa, 60 percent of which were launched in the last three years.[43]

These ‘solutions’ include mobile-accessible apps and tools that increase access to updated market price data, financial services, weather forecasts, pest outbreaks, and more. Weather is increasingly erratic, however many farmers in Africa can only rely on outdated weather stations and traditional knowledge about weather.[44] New tools can now bring accurate and modern forecasting directly to smallholders via SMS or other messaging services in local languages for just a few US $ cents a day.[45] Other evidence shows that digital tools already rolled out in Kenya have succeeded in significantly facilitating much needed extension services, and that smallholder farmers who gained digital access to market information systems experienced higher labor and land productivity, among other benefits.[46]

One successful example is Twiga Foods, a company started in 2014 to connect small farmers in Kenya with small and medium sized vendors in cities.[47] By using blockchain technology and cutting out the need for intermediary wholesale markets, Twiga has been able to offer higher prices and a guaranteed market to more than 17,000 producers in Kenya as of 2019.[48]

To date, technologies like these have been concentrated in East Africa and nearly two-thirds of farmers using digital tools are in East African nations such as Kenya.[49] However, CTA reports that digital tools for agriculture are present in at least 43 out of 49 sub-Saharan African countries and their prevalence increases each year. Increasing the access to internet and mobile devices, and increasing digital literacy will be critical to expanding engagement with these productivity-enhancing tools.[50] Despite the potential benefits of the use of digital technologies in agriculture, their use could exacerbate existing gender disparities. At least 40-50 percent of smallholder farmers in SSA are women, but women represent only 25 percent of registered users of digital agricultural solutions. Increasing women's access to digital technologies must be considered of paramount importance for increasing agricultural productivity.

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BUILDING INCLUSIVE AND EMPOWERING AGRIFOOD SYSTEMS FOR RESILIENCE

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ABSTRACT

Agricultural communities face a range of shocks from animal disease and crop pest outbreaks to natural disasters, political conflicts, and health crises such as COVID-19. Women are often particularly vulnerable to such shocks given constraints they face in terms of access to information, household decision-making power, control over assets and resources, time burdens, and more. Enabling agricultural producers to recover from shocks and mitigate the risks of future threats requires technologies, practices, and policies that ensure women's participation and access to benefits but also their empowerment to make strategic life choices. Necessary steps toward more inclusive agrifood systems include 1) increasing women's decision-making power and control over resources and assets within households and communities, 2) raising women's voices in key processes such as market negotiations, research, and political processes, and 3) including and considering women's needs and preferences in the design of programs and institutions. By building more inclusive and empowering agricultural production systems, communities can better withstand crises and bounce back stronger, with benefits not only for women but for all of society.

INTRODUCTION

Agricultural communities face a range of shocks from animal disease and crop pest outbreaks to natural disasters, political conflicts, and health crises such as COVID-19. Women are often particularly vulnerable to such shocks given constraints they face that prevent them from engaging in agrifood systems on terms that are equitable and fair. However, women are also important agents of change and play key roles in helping their households and communities respond to shocks.

In many countries, women have less schooling than men, control fewer resources, have less decision-making power over household income, and face time constraints because of their triple burden of productive, domestic, and community responsibilities.[1] These gender differences shape men's and women's experiences of shocks and their abilities to respond. In Kenya, for example, gender disparities in access to information and awareness of climate-smart agricultural practices contribute to women's lower adoption rates of these practices.[2] Research also indicates that men and women perceive risks differently and therefore may prefer different coping mechanisms: women's concerns with health-related risks may make savings instruments more appealing while men's priorities related to agricultural production could be better addressed with index-based or other insurance mechanisms.[3] Gender also intersects with other spheres of vulnerability and identity – including ethnicity, age, and poverty – to further impact how women engage in agrifood systems and their resilience to shocks and stressors. For instance, evidence from Nigeria suggests that youth face specific constraints in agriculture such as lack of capital, experience, and social networks to cope with climate shocks and other challenges, and young women in particular have less access to information and irrigation and are less likely to benefit from cooperative memberships.[4]

Enabling agricultural producers to recover from shocks and mitigate the risks of future threats requires technologies, practices, and policies that not only enable women to participate and benefit equally but also empower women, or expand their ability to make strategic life choices where they were previously denied that ability.[5] The reach-benefit-empower framework[6] – developed to distinguish between agricultural development project approaches that reach women as participants, those that benefit women, and those that contribute to empowering women – can be a useful lens to explore how agrifood systems can be transformed to be more inclusive and gender-equitable. Reaching women as participants does not ensure that they will benefit from a project, and if they do accrue benefits such as increased income or better nutrition, that does not ensure that they will be empowered to control that income or choose foods for their households.[7] Measuring the effect of a program's ability to reach, benefit, or empower women will require indicators specific to each approach, such as tracking the number of women who participated in an agricultural project to measure reach, assessing women's nutritional outcomes to measure benefit, and examining dimensions of decision-making power or control over resources to measure empowerment.[8]

Ensuring that women's contributions to agrifood systems are recognized – by their families, communities, policymakers, and society more broadly – and that women can make strategic choices about their involvement in those systems has benefits for all of society, including helping communities better withstand crises and bounce back stronger. Women's empowerment can improve agricultural productivity, household food security and dietary quality, and maternal and child nutrition.[9,10,11,12] Given the vital role that women play in agrifood systems for themselves and their families, it is imperative that they can engage equitably and that constraints on their empowerment be addressed through changes to policy, programming, and norms.

CREATING INCLUSIVE AND EMPOWERING AGRIFOOD SYSTEMS FOR WOMEN

Creating an inclusive and empowering agrifood system for women requires action in several key areas:

Increase women's decision-making power and control over resources and assets

Increasing women's decision-making power and control over assets within their households and communities is a key step toward inclusive agrifood systems. A recent systematic review finds that women's access to assets like credit, land, training, and transportation is limited, which reduces their choices and influences their ability to engage in more lucrative, larger scale activities.[13] In some areas, men have moved out of agriculture or migrated away from rural areas, leading to a "feminization" of agriculture. This can present opportunities for women to gain greater decision-making power and higher earnings in key parts of agrifood systems, but it can also increase women's workload and financial burdens.[14,15,16]

One way that women's control over assets and decision-making power in agrifood systems can be supported is by enhancing their negotiating power vis-à-vis market actors through fair contracting or payment schemes. In Uganda, the Farm and Family Balance project is working with the country's largest sugarcane processing company to increase women's involvement in sugarcane marketing and management activities by encouraging the transfer or registration of a contract the parcel of land on which the sugarcane is grown from husbands to their wives. The contract entitles the wife to receive inputs on credit, cash advances, and the final payment associated with the block. Initial findings indicate that overall acceptance of the intervention was high (70 percent), suggesting that simple encouragement can effectively nudge men to include their wives in household commercial activities.[17]

Raise women's voices in key processes

In addition to ensuring that women's engagement in activities throughout the agrifood system is equitable and fair, it is critical that women's voices be heard in key processes related to agrifood systems, such as research and political engagement. Agricultural research for development is an essential pathway for agrifood system transformation, contributing to improved management practices, production, processing, transportation, and more. Women's priorities and preferences – such as for food crops with certain nutritional or taste qualities or that do not require excessive labor – must be part of the research process. In Kenya, GROOTS – a national movement of grassroots women-led community-based organizations – is working with the agricultural extension system to provide input on the types of climate-smart technologies preferred by the members.[18] Recognizing women's needs and priorities in the early stages of research is an important step toward ensuring that women benefit from the results, particularly for technologies and practices that will enable communities to build resilience to future shocks.

Political mobilization is also a central avenue through which women's voices can influence the policies that shape the agrifood system. By voting or by becoming policymakers themselves, voicing support or dissent for key policies, and participating in other civic processes, women can affect the way agrifood systems operate. Evidence from India shows that women who belong to women's self-help groups are more politically engaged and make use of a greater number of public entitlement schemes that can help strengthen their and their households' livelihoods, food security, nutrition, and health.[19]

Enhance institutional support for women

Ensuring that institutions are supportive of women is another critical factor for inclusive agrifood systems. For example, formal laws and informal systems governing property rights impact women's abilities to invest in their land or businesses, access credit, and diversify their livelihoods. There is strong evidence that women's land rights affect the extent to which they make decisions about household consumption, human capital investment, and transferring resources to the next generation, though further research is needed to investigate these links more directly.[20]

Financial institutions also hold great potential for empowering women and helping them build resilience, but when financial systems are not designed with women's needs and preferences in mind, they risk exacerbating gender wealth gaps. A partnership between CARE International, PostBank, and local partners in Uganda is seeking to address these challenges by introducing a mobile banking product specifically designed for women's priorities (such as saving for school fees or healthcare), providing financial counseling sessions, and integrating a research component to better understand factors affecting uptake of the program and users' experiences.[21]

Access to timely information is another critical factor to ensure women's equitable inclusion in agrifood systems. Women's access to information can be facilitated or inhibited by technologies, programs, or institutions. For instance, mobile phones can facilitate access to banking and government programs. They can also connect producers with information such as extension services or real-time updates on market prices and weather – information that is increasingly important in the context of climate change.[22] Yet women own and use mobile phones at lower rates than men, and thus may have less access than men to services and information provided via mobile phones.

Ensuring that girls and women have equal access to educational and training opportunities and institutions is also essential for their inclusion and empowerment in agrifood systems.[23] Closing the gender gap in basic education can help the next generation of women break out of poverty and make informed and strategic choices about their livelihoods, the food they and their families consume, and the types of policies they demand from political leaders.

TAKING ACTION AND MOVING FORWARD

As agricultural households and communities face a range of threats and challenges, it is critical to ensure that the technologies, practices, and policies intended to enhance their resilience open opportunities for women without exacerbating existing gender gaps or putting additional burdens on them, such as increased labor or time demands. Evidence also suggests that approaches to empowering women must include working with men, both to prevent backlash against women's gains (such as gender-based violence or other retaliation) and to make sure that newly transformed gender norms are sustained.[24] By building more inclusive and empowering agricultural production systems, communities can better withstand crises and bounce back stronger, with benefits not only for women but for all of society.

For more information on the International Food Policy Research Institute's work on gender, visit https://www.ifpri.org/topic/gender.

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FLORIDA AGRICULTURE FACES THE ECONOMIC IMPACT OF COVID-19

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ABSTRACT

In this essay we review the impacts of COVID-19-related market interruptions on the Florida agriculture industry. Through interviews with academic and industry leaders in the agriculture sector we explore unique perspectives on the direct impacts to the Florida agricultural sector in 2020, and consider the work that needs to be done to ensure greater efficiencies, develop alternative markets, and promote safety and flexibility in the labor market. Further, we evaluate the impact of timing on produce sales and planting forecasting under conditions of uncertain demand. For more than eight decades, Farm Foundation has provided an objective, non-partisan home for open and healthy conversations and debate among food and agriculture leaders. Perspectives gained are the keystones of generating innovative options to address evolving issues like agricultural productivity in a time of pandemic.

INTRODUCTION

As the COVID-19 crisis unfolded in the United States, all sectors of the economy were affected with the agricultural supply chain at the forefront of the narrative. While the situation varied across the country, the story in Florida provides an interesting look into the resilience of the American farmer and the changing landscape of the U.S. agricultural supply chain.

While we do not yet know the full economic impact of the crisis on Florida agriculture, pre-crisis, agriculture in Florida represents a US $160 billion per year industry and is one of the three main economic drivers of Florida's economy.[1] In Florida, the timing of the initial shut down of the food service industry and panic buying leading up to shelter-in-place orders hit right at the peak of the south Florida growing season. Between late October and May, south Florida alone supplies about 150 million people in the eastern United States with fruits and vegetables, according to Mike Joyner, President of the Florida Fruit and Vegetable Association. At the beginning of March, Joyner says, "we were really at the peak of our season in Florida. It was looking to be a very good year. Yields were up, prices were up, and the quality was in a good place. Then it was like it completely stopped."

That rapid stop led to an immediate economic impact that continues to this day. As of just April 15, 2020, the Florida Department of Agriculture and Consumer Services (FDACS) estimated initial crop losses of US $522.5 million,[2] compounded by hundreds of millions of dollars of losses in related industries like the cut flower market, according to Dr. Martha Roberts, Farm Foundation Fellow and former long-term Deputy Commissioner with Florida Dept of Agriculture and now food and agriculture policy consultant.

	Total Annual Sales Revenues (5 year average, $millions)	% Annual Revenue March to Mid-May	Output at risk ($millions)	% loss from survey (average with 90% confidence interval)	Estimated Losses ($ Millions)
Field Crops	$720.36	10%	$72.04	-22% [-30%,-15%]	$15.85 [$10.81,$21.61]
Horticultural Crops	$1,935.52	44%	$846.79	-46% [-54%,-39%]	$389.52 [$330.25,$457.27]
Vegetable, Melon, Potatoes	$1,421.97	40%	$568.79	-24% [-38%,-12%]	$136.51 [$68.25,$216.14]
Fruits and Nuts	$1,593.90	40%	$637.56	-32% [-39%,-24%]	$204.02 [$153.01,$248.65]
Livestock and Aquaculture	$1,455.65	21%	$303.26	-40% [-46%,-34%]	$121.30 [$103.11,$139.50]
Animal Products (Milk, Honey, Eggs)	$653.69	21%	$136.19	-20% [-32%,-8%]	$27.24 [$10.89,$43.58]
Sum Total	$7,781.09		$2,564.62		$894.44 [$676.33,1,126.75]

Figure 1: Losses of Sales March to mid-May 2020, US $
Source: University of Florida-IFAS.[3]

In March and April, the rapidly shifting demand left some producers unsure what the rest of the season would hold. David Hill, Farm Foundation Fellow and President of Southern Hill Farms, one of Florida's largest blueberry suppliers, reports that, "For about five to seven days, demand went through the roof." Walmart, one of Southern Hill's buyers, had indicated that demand for blueberries was up 200 percent. "We were thinking, wow, maybe this isn't going to be so bad. Then all of a sudden like a light switch went off in the middle of the week, all the orders stopped, and the big chains started giving orders back that they had." Panic buying, Hill says, moved away from fresh produce and into frozen and canned goods.

While some producers were able to shift or stop production, this isn't possible with many crops. "With us, if we decide to stop harvesting because we're afraid we won't be able to sell the berries, if we leave them on the bush, that bush is done for the year," says Hill. Alternatively, "we can pick them and throw them on a ground, but at a US $1.20 a pound, you can't do that very long. It hit us different than the other crops – at least they had the option to bypass some of their crops, or try and save the second half of their crop." Those losses continue on top of several years' worth of declining prices, but with significant losses during 2020 (Figure 2).

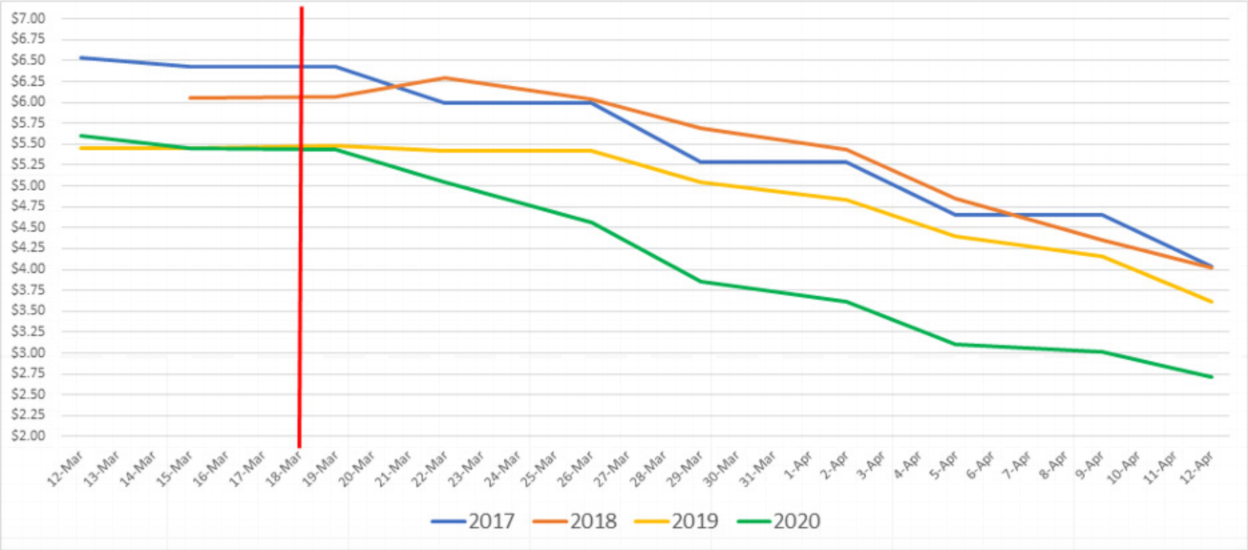

Figure 2: Blueberry Prices per Pound, US $
Source: Southern Hill Farms. Blueberry prices per pound.

The impact on the food service industry was particularly challenging for Florida producers: especially the tomato market. Because of the sudden and severe drop in demand in this sector, early losses in the tomato market alone are estimated to be well over US $133 million.[4] Similar losses are reported in other specialty crop markets within Florida, including estimates of 50-100 percent loss in commodities like lettuce, green beans, cucumbers and more.[5]

Supply and demand shocks were also occurring within the retail markets, leaving some producers with nowhere to place their products. Joyner noted that some retailers cancelled orders not simply because of shifting demand, but because of a lack of storage space.

Critical for understanding the Florida market in particular is the pre-harvest cost of production. These high costs make investment recovery impossible if producers are unable to harvest. Beyond this, fruit and vegetable growers do not receive government subsidies and crop insurance is often not an option. Returning to the tomato market, the FFVA estimates that pre-harvest costs for tomatoes are US $10,000 per acre. High costs for other crops are no different.

The Coronavirus Food Assistance Program aims to provide some remedy to U.S. agriculture, and for Florida producers, the program is in many cases producers' first experience with agricultural subsidies. However, the losses that farmers are facing go well beyond what government relief could provide. Both Joyner and Roberts cited examples of farmers with losses in the millions of dollars. "I know a first-generation farmer who has a seven-figure loan and lost US $500,000," Joyner said, "and that was one of the lowest ones I heard. Most folks lost millions." As producers looked to apply for CFAP, many initially found that they did not qualify, either because their crops weren't initially included, or because their commodities' price drops didn't seem to meet the qualifications. This changed, however, in early July 2020 when the USDA announced that many additional specialty crop commodities would be eligible for the program, and that CARES Act funding for seven eligible commodities, including blueberries, would be expanded. Even still, the government relief will not replace the hundreds of millions of dollars of market losses. One major concern for producers was that the government relief was focused on downward turns in commodity prices, but not necessarily the changes in sales revenues. A University of Florida IFAS Extension survey of over 700 respondents showed major losses in sales revenues across all commodity groups from March to mid-May 2020, due not only to price changes but also major demand shifts (Figure 3).

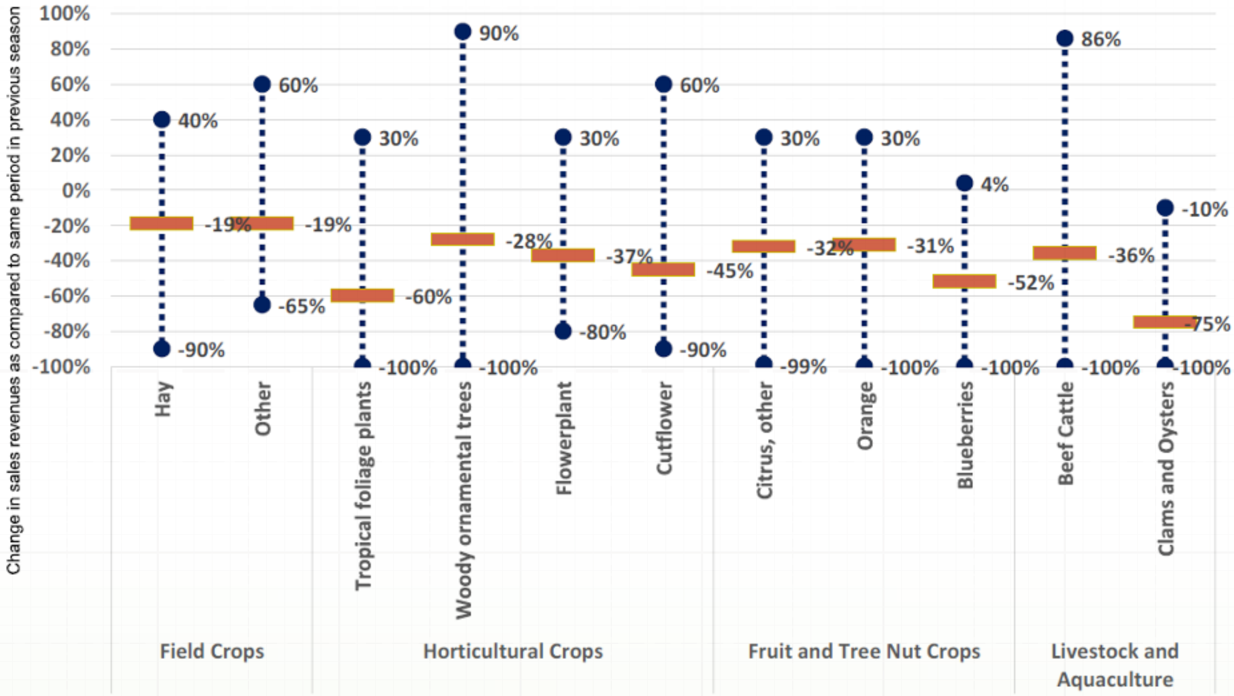

Figure 3: Changes in Sales Revenue by Commodity Group
Source: University of Florida-IFAS.[6]

R.C. Hatton donated 100,500 servings of sweet corn, 50,000 servings of green beans, and 40,000 pounds of cabbage.

Photo credit: Florida Fruit and Vegetable Association

Despite the major economic loss, the bright spots in the crisis are the generosity and quick thinking of producers, the public's greater awareness and appreciation of farmers, and the resilience of the American farmer. As of mid-July, Joyner notes that the restaurant side is seemingly coming back, although with many restaurants shuttering their doors, some growers are still scrambling to place their products. Roberts notes that the crisis revealed that transportation seemed to not have been as much of an issue as previously thought, but that vulnerabilities in the entire food supply chain emerged because of the lack of storage capacity for perishable foods.

The sudden loss of food service markets, in addition to cancellations and changes to retail market orders, led to supply surpluses in perishable fresh produce. Joyner cited the example of a grower who had picked and packed strawberries waiting in the cooler to be shipped to a retailer when the retailer suddenly cancelled the approximately US $500,000 contract. With nowhere else to turn, the producer then shipped 9 semi-truck loads of strawberries to Feeding Tampa Bay in a two-week period. After those two weeks, remaining product from this supplier had to be turned away due to a lack of cooler space.

The necessity of food, and the crisis effect on American consumers led many to begin buying directly from farmers either more often or for the first time. The U-Pick operation at Southern Hill Farms quickly pivoted to a drive through pick up operation. "It didn't cover our loss," Hill said, "but it was way better than we thought it would be. It gave people something to do. People wanted to see the farm, meet the farmer. So that part – the drive-through business – will probably become part of our spring business from now on."

Southern Hill Farms converted their U-Pick operation into a drive-through.

Photo credit: Farm Foundation

As the crisis continues, the importance of the agricultural supply chain has demonstrated the resilience of the American farmer. As Roberts put it, "You've got the politics of the situation, the economics, and you've got the unbelievable pressure of increased international trade that's just exacerbating the whole damage. But God bless the American farmer, particularly the Florida farmer. They are so resilient; they will try to come up with additional options. As to what is permanent versus what is of a year or two consequence, I don't think we know right now. Thank goodness for the faith of the Florida farmer and farmers around the country have – they're out there planting, getting new customers." Even still, "There's been an unbelievable, undocumented amount of pain."

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OPEN ACCESS TO GENETIC SEQUENCE DATA MAXIMIZES VALUE TO SCIENTISTS, FARMERS, AND SOCIETY

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ABSTRACT

Over the last 20 years, genome sequencing has become increasingly faster and affordable, with genome sequences of thousands of species – plants, animals, insects, bacteria, viruses – now curated in multiple, open access databases available to all scientists worldwide with internet access. The open access database system, as it stands today, offers fair and equitable sharing of GSD, promotes sustainable use of biodiversity, while also contributing to conservation of biological diversity. Yet this free and unencumbered access to GSD may now be threatened by policy-makers looking to regulate and monetize GSD in the hopes of creating more "fair and equitable sharing of benefits from the use of genetic resources". Unencumbered, open access to GSD contributes directly to improved breeding programs, more vibrant seed systems, greater agricultural productivity, and greater resilience of crops and farmers in the face of changing environmental conditions. We ask that policy makers and politicians move with great care and caution when considering regulation and monetization of GSD, beyond what currently exists for international sharing and partnering of GSD. Public research and emerging economies have the most to lose if GSD is further controlled, especially if the global scientific community is not consulted.

INTRODUCTION

Combinations of the mononucleotides cytosine (C), guanine (G), adenine (A), and thymine (T) are the building blocks of life, lining up in unique orders, or sequences, thereby forming the genome, or genetic sequence data (GSD), specific to each organism. Over the last 20 years, genome sequencing has become increasingly faster and affordable, with genome sequences of thousands of species – plants, animals, insects, bacteria, viruses – now curated in multiple, open access databases available to all scientists worldwide with internet access. For example, just three of these plant-focused databases, Legume Information System, SoyBase, and Maize GDB, serve 2,300 to over 5,200 users each month, accessed from nearly every country. (Figure 1). In a paper recently published in the journal Global Food Security, a group of international authors explain the value of GSD, and why the current system of open access to GSD is critical to discovery, innovation, and more sustainable global agriculture and food systems.[1]

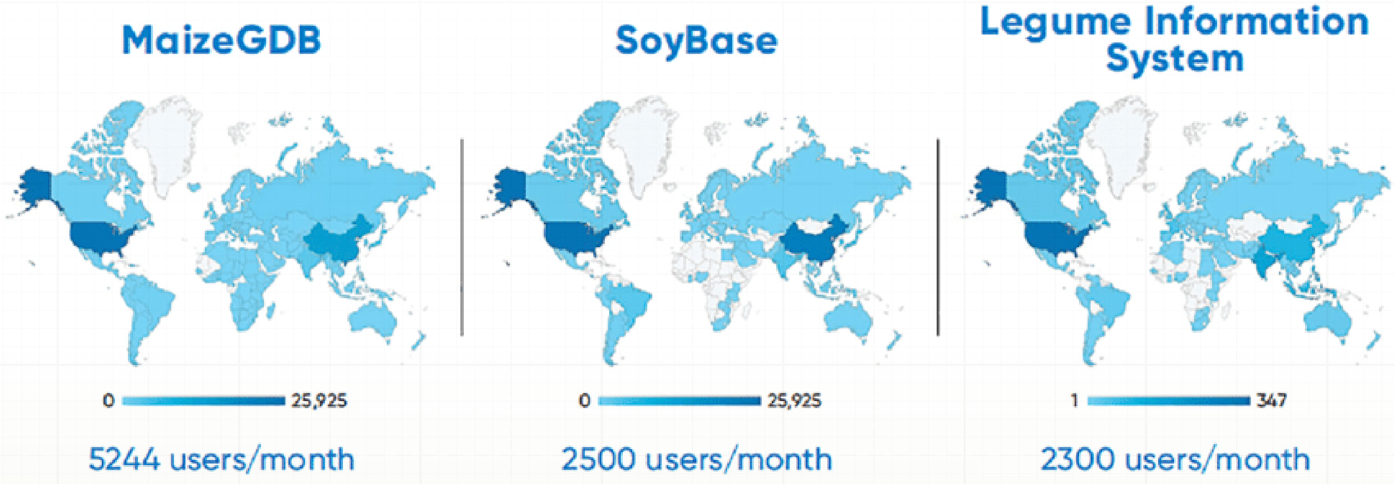

Figure 1: Users by country and by month of select crop genomics databases.
Figure compliments of Carson Andorf and Lisa Hartman, USDA/ARS.

Genomic sequence data, and broad, open, and unencumbered access to it, allows scientists all over the world the freedom to leverage the vast genetic diversity of crop varieties and their wild and weedy relatives, to enable a more thorough, precise, and rapid breeding process. The combination of GSD and new breeding technologies under development will continue to create opportunities for achieving greater food security, a balanced diet and more climate-resilient crops. The open access database system, as it stands today, offers fair and equitable sharing of GSD, promotes sustainable use of biodiversity, while also contributing to conservation of biological diversity – the three objectives of the Conventions on Biodiversity (CBD).[2]

Yet this free and unencumbered access to GSD may now be threatened by policy-makers looking to regulate and monetize GSD in the hopes of creating more "fair and equitable sharing of benefits from the use of genetic resources."[3,4,5] Negotiations under the CBD, Nagoya Protocol, and International Treaty have reached a stalemate and policy makers may use GSD as a bargaining chip or compromise. In so doing, they may further threaten achieving the objectives of the CBD and limit the value of GSD.

Funded by governments and philanthropic donor agencies, the open access databases have grown in size and sophistication. Curators, most often in public research and academia, have developed training tools and easy-to-use search applications to make the sequence data widely available. Scientists from both the public and private sectors have been the contributors of sequence data. The value of GSD, resides not in the raw nucleotide sequences provided in the databases, but in the evaluation, interpretation, and application of these data to generate information which is then applied to develop improved crops, vibrant seed systems, and greater food security. Developing this value requires creativity, resources, ingenuity, and importantly, collaboration amongst scientists. Value is created when more productive and resilient varieties of crops are integrated into a breeding pipeline and subsequently delivered to farmers. More rapid delivery of improved crops and cropping systems is one of our best opportunities to mitigate and adapt to climate change and help farmers become more resilient in the face of ever-changing cropping environments.

The value created through a paid access and benefit sharing scheme for GSD, however well-meaning, would pale in comparison to the monetary and non-monetary value created when GSD is unencumbered by regulation and broadly available for innovation and discovery.

EXAMPLES OF VALUE

Numerous examples exist of how GSD is being utilized in crops important to Africa and Asia and serve to reinforce our points made above. Cassava, with 60 percent of global production occurring in Sub-Saharan Africa (SSA), is threatened by viral and bacterial disease and has numerous "anti-quality" traits, storage and nutritional problems.[6,7,8] The availability of sequence data for this crop combined with other plant breeding innovations has resulted in improved starch quality, higher levels of vitamin A in the roots, iron and zinc biofortification, and brown streak disease resistance.[9,10,11,12] Work continues on other diseases and to improve storage of cassava roots.

Sorghum is likewise an important food security crop, feeding around half a billion people in SSA and Asia alone. Sorghum has amongst the largest libraries of GSD available of any African indigenous crop.[13,14,15,16,17,18,19] These data have been used to evaluate numerous agronomic and quality traits, including grain size, heat tolerance, starch content, nitrogen use efficiency, and anthracnose resistance.[20,21,22,23,24,25,26]

Pearl millet, like sorghum, is indigenous to Africa and a resilient crop in the face of high heat and drought conditions. The reference genome of pearl millet was published with 38,579 genes and made available to plant scientists anywhere.[27] The information extracted from this database has been used to establish marker assisted breeding. Marker-trait associations have been linked to root traits, plant height, yield, grain quality, tolerance to water deficit and heat, and resistance to an ever-changing disease and insect pest spectrum.[28]

A final example is provided by how GSD could transform breeding efforts in Ethiopia's national crop, *Eragrostis tef.* When considering area under cultivation, the number of farmers growing tef, and its importance to the diet, tef is far and away the most important crop in Ethiopia.[29] Yet it lags behind most other cereals in Ethiopia in terms of productivity and yield and has numerous constraining agronomic characteristics.[30,31,32] Until very recently, a draft or completely sequenced genome (GSD) was unavailable for tef, and tef improvement programs had to rely on direct phenotypic selection and conventional breeding, which is slow and cumbersome. The valuable genetic diversity of tef has therefore remained relatively hidden and unknown, and while helpful, the sequenced variety *"Dabbi"* is one of hundreds of farmer-used varieties sown in Ethiopia.[33] The availability of openly accessible GSD on greater numbers of farmer-preferred tef varieties would revolutionize tef improvement by allowing application of molecular breeding and advanced plant breeding approaches for achieving enhanced yield potential and beneficial agronomic characteristics. Ultimately, millions of farmers would achieve greater productivity and sustainability, over 100 million Ethiopians would have a more reliable and lower cost supply of tef, and pressure on land resources would be reduced.

VISION FOR THE FUTURE

Unencumbered, open access to GSD contributes directly to improved breeding programs, more vibrant seed systems, greater agricultural productivity, and greater resilience of crops and farmers in the face of changing environmental conditions.

We ask that policy makers and politicians move with great care and caution when considering regulation and monetization of GSD, beyond what currently exists for international sharing and partnering of GSD. Public research and emerging economies have the most to lose if GSD is further controlled, especially if the global scientific community is not consulted. Administrative, financial, and legal barriers will quickly weigh down research organizations making determinations as to GSD value, point of origin, accessibility and with whom negotiations for access must be conducted. Many of these tasks would take time and be difficult, if not impossible. It is imperative to find ways to help scientists innovate while lowering legal and financial barriers to innovation, which will contribute to the most productive path forward to equitable use of genetic resources and GSD.

While we have focused this discussion on plants and agriculture, human health and public safety is also directly impacted by open access to GSD. In the early days of the current coronavirus pandemic, scientists quickly and easily submitted and accessed viral GSD to multiple open access databases, with freedom to operate and limited legal implications.[34] This access allowed scientists to rapidly gain a better understanding of the virus, develop diagnostic tests, and envision a path on how best to develop vaccines and other preventive measures.

Maintaining open access and the use of GSD will serve to enable research collaborations, maximize returns on investments and ensure creation of value to scientists, farmers, and society. This also allows for greater scientific collaboration, enabling and strengthening a global network of scientists. Crops like tef, sorghum, cassava, and pearl millet will become more productive in regions where food security is most at risk. The opportunity exists to create a new era of discovery and investment with GSD.

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MARKETS FOR NUTRITIOUS FOODS – WHAT ROLE FOR THE AGRICULTURAL SECTOR IN MARKET-BASED APPROACHES TO NUTRITION IN MOZAMBIQUE?

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ABSTRACT

Given that, globally, more than 2 billion people suffer from deficiencies in micronutrients that are essential for human health, there is a need to identify ways to scale the distribution and demand for nutrient-rich foods, particularly among low-income populations. The potential for agricultural productivity to contribute to nutritional outcomes has long since been acknowledged. In recent years, the recognition of individuals as net food consumers has led to an increased focus on the biofortification of staple crops, a shift in agriculture-nutrition policies, and promotion of food safety. The agricultural sector also plays a key role in the availability and affordability of naturally nutrient-rich foods that play an essential role in high-equality diets. However, the potential the agricultural sector to support the success of market-based approaches to nutrition, particularly in the promotion of a variety of naturally nutrient-rich foods, has been largely unexplored. Using data collected from four urban markets in the northern Mozambican city of Nampula, this essay examines the nature of weekly consumer food purchases and the ways the agricultural sector might support increased demand for a variety of naturally nutritious foods. It concludes with exploring the potential synergies between innovation in agricultural productivity and agri-food value chains and market-based approaches to nutrition. Research at this intersection will be especially important in the face of threats to food security resulting from crises such as the COVID-19 pandemic, to ensure that consumers reliant on markets have access to the foods that are essential for reducing micronutrient deficiencies.

INTRODUCTION

In the past, addressing food security in low- and middle-income countries (LMICs) was tantamount to addressing agricultural productivity. We now know that, prior to the COVID-19 pandemic, gains in crop yields (such as the well-known Green Revolution) have contributed to significant reductions in undernutrition; however, reductions in deficiencies of micronutrients essential for human health and nutrition continue to lag. This form of malnutrition, known as hidden hunger since such deficiencies are not always apparent, is addressed through improving not just the quantity of food consumed but also the quality.[1] Identifying ways to increase the consumption of nutritious foods to improve diet quality has proved challenging. It has been further complicated by the ongoing pandemic and other threats to livelihoods and agricultural production. Since an increasing number of low-income households rely less on their own production and more on markets for food, there is a possibility that food markets could contribute to increases in the purchase and consumption of a variety of nutrient-rich foods. Results from a study I recently conducted in Mozambique reveals synergies between agricultural productivity and market-based approaches to nutrition, especially in the sale of naturally nutrient-rich foods. To date, this intersection has not been widely explored.

Market-based approaches to nutrition specifically refer to the way that the private sector can intervene within food systems to increase the availability, affordability, accessibility, and affordability of nutritious foods. There is evidence that food products fortified with essential micronutrients can be successfully marketed to low-income consumers, particularly if, alongside the nutritional benefit, there are other characteristics that the consumer values (i.e., brand name, convenience, desirability).[2] However, there is much less known about how to market foods that are naturally nutritious (i.e., fruits, vegetables, eggs, dairy) to low-income consumers. Retailers of these foods have faced challenges in differentiating their offerings among the available substitutes in the market. Naturally nutritious foods, though, comprise an important part of a varied diet which, according to nutrition experts, is the gold standard for improving nutrition.[3] The agricultural sector, particularly innovations in productivity and development of agri-food value chains, have an essential role to play in driving the purchases of these foods from the market.

Market data collected from 600 consumers in two-time periods in four markets in the northern Mozambican city of Nampula show that a significant portion of the food baskets purchased by low-income consumers are in fact naturally nutritious. Figure 1 shows the average amount consumers spent on each of five food groups. I use the food groups developed by the Food and Agriculture Organization for Mozambique which defines the groups according to the food's role in the body – (1) Builders – protein-rich foods that build muscles and bones (e.g., meat, eggs, dairy, beans), (2) Protectors – nutrient-rich foods that protect the body from illness and disease (e.g., fruits, vegetables), (3) Energy – calorie-rich foods that provide energy to work and play (e.g., rice, cassava, orange fleshed sweet potato), (4) Brain Energy – foods rich in fats that assist in brain development and function (e.g., oil in limited amounts, avocado, coconut), and (5) Other – foods that are commonly consumed but have low nutritional value (e.g., salt, sugar).[4]

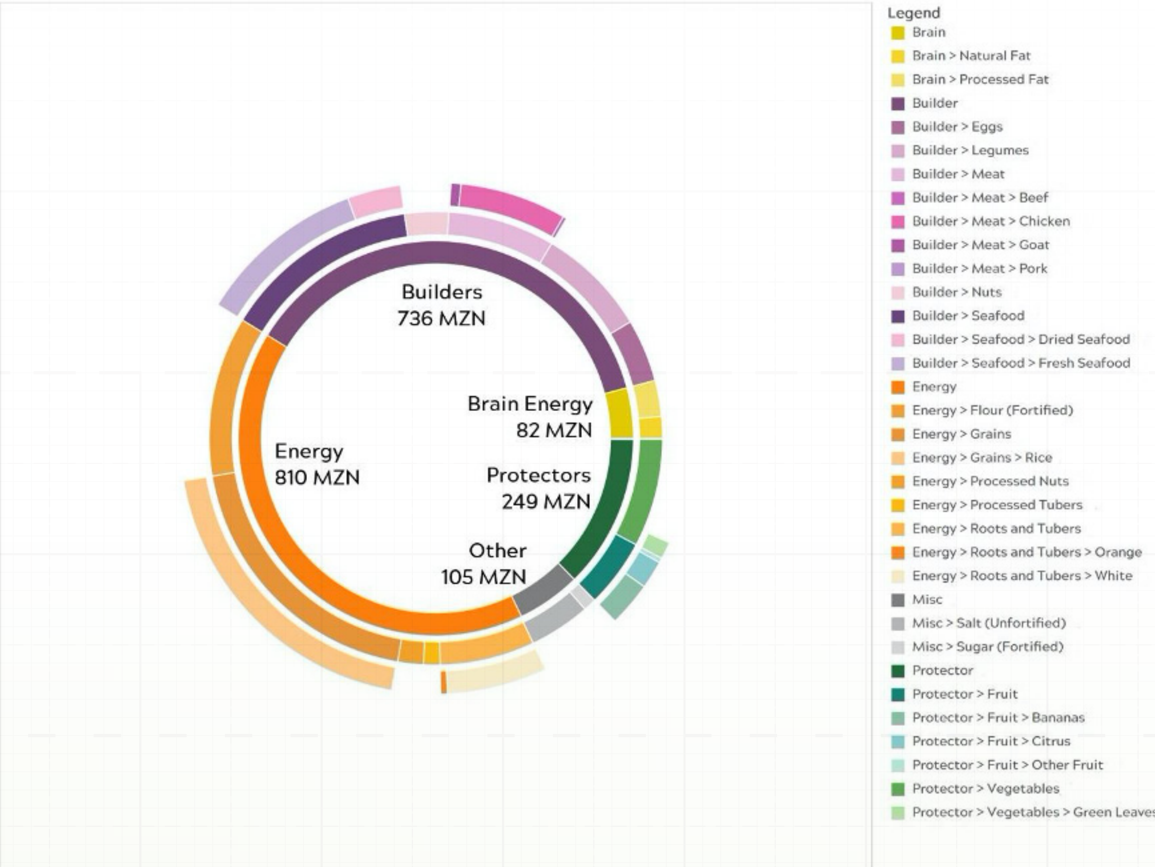

Figure 1: 7-Day Household Food Expenditure, Nampula, Mozambique
Note 1: 1 Mozambican Metical (MZN) = USD $0.014

As expected in a low-income context, Energy foods comprise between one-third and one-half of the food basket. Calorie-rich but nutrient-deficient foods such as white rice or white potatoes make up the majority of the foods purchased in this category; however, consumers also spend approximately 226 MZN per week on fortified maize flour. Roots and tubers that are high in vitamin A content (i.e., yams, orange fleshed sweet potato) have been widely promoted in Mozambique in the last several years;[5] however, results from this market survey show that these foods only comprise a small part of the food basket. Somewhat unexpectedly, Builder foods comprise just over one-third of the amount spent on the weekly food basket. The main proteins purchased by consumers include seafood, legumes, and meat (mainly chicken). Protector foods comprise only a small part of the basket in terms of expenditure, the majority of which are vegetables. Green leafy vegetables, rich in micronutrients that the population are deficient in (i.e., iron, vitamin A), represent only a small portion of the vegetables purchased. Among Brain Energy foods, oil is the most commonly purchased, which is considered less ideal compared to foods naturally rich in fatty acids such as avocado and coconut.

There are a variety of factors that may influence the purchase of nutritious foods. Household production, prices, taste and preferences, food quality and safety, to name only a few. Understanding how the price of the food affects the amount purchased is a first step to understanding the patterns of demand within the market. Figure 2 shows the number of times a food was purchased over a 7-day period (x-axis) among 301 consumers at the beginning of the month[6], the average price per 100g (MZN) of the food (y-axis), with the size of the bubble representing the amount of the food purchased (in grams).

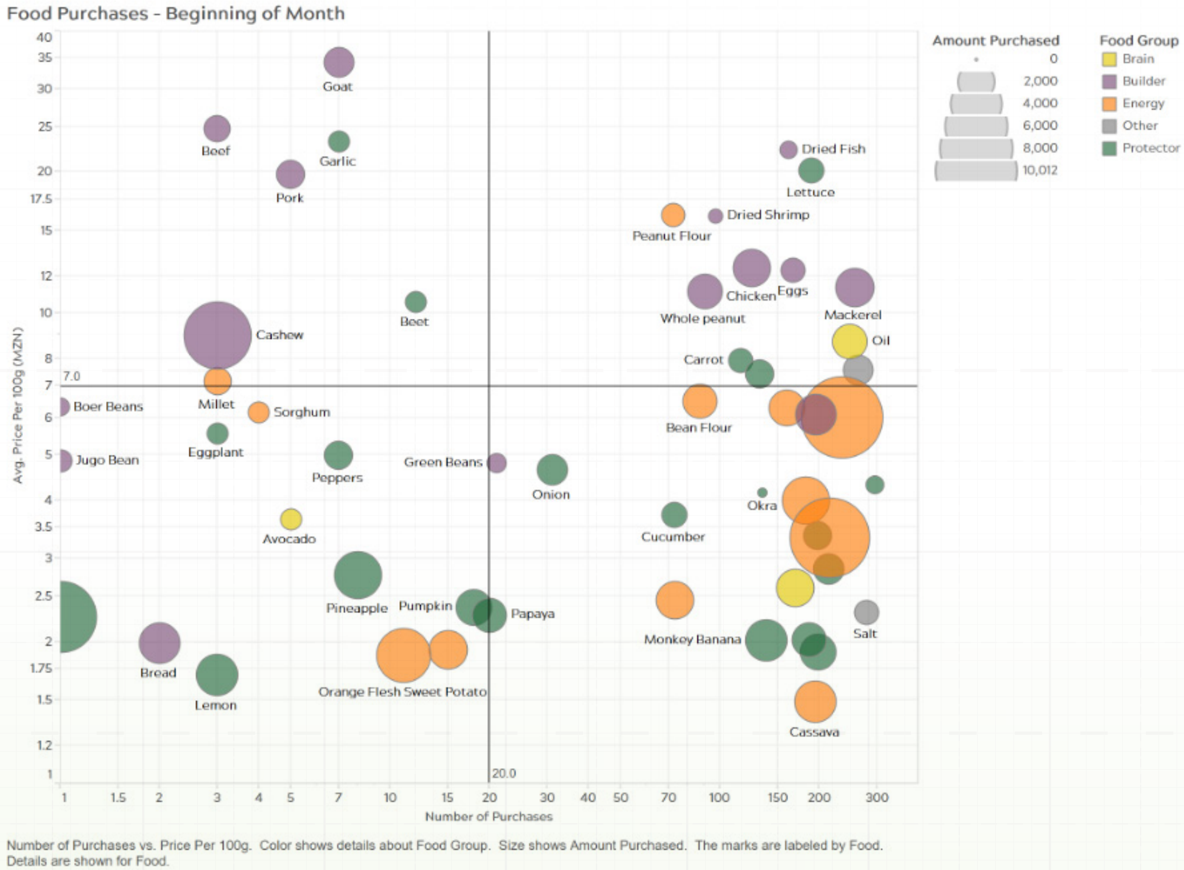

Figure 2: Food purchases

The top left quadrant primarily consists of foods that are not commonly part of the Mozambican diet, with the exception of cashews. Increasing the purchase of these foods (especially of beef, goat, and pork) would likely require a reduction in price as well as education on the importance of these foods in good health and nutrition. Foods in the top right quadrant on the other hand are relatively expensive but purchased by the majority of consumers in the study. Reducing the price of these foods, while also maintaining or increasing quality, would likely have a positive effect on the quantity purchased. Foods in the bottom left quadrant are relatively inexpensive but are not widely consumed. In this quadrant we see foods that are very nutritious (with the exception of white bread). Millet and sorghum for example have excellent nutrient profiles but are less popular than their nutrient-deficient alternative, rice. Similarly, highly nutritious foods in the bottom right quadrant (i.e., onions, papaya, okra, tomatoes) are more frequently purchased but in smaller quantities. This in part reflects that Energy foods comprise the main portion of the meal; however, from my experience wandering through the Mozambican markets, talking with consumers, and conducting a community-based nutrition intervention in Nampula, these small and/or infrequent purchases are due to low awareness of the nutritional importance, perceived expense, and poor quality or accessibility of these foods.[7]

There is a growing consensus that complementary public and civil sector interventions to raise the awareness on nutritional importance of naturally nutritious foods. But what role can the agricultural sector play in supporting the success of market-based approaches in reducing the prevalence of hidden hunger in LMICs?

1) Increase the affordability, availability, accessibility, and acceptability of a variety of nutritious foods, especially those that are naturally nutrient-rich

Expanding the scope of agricultural productivity beyond cash or staple food crops to other foods rich in micronutrients will contribute to the increased availability, affordability, acceptability, and accessibility of a variety of these foods. Figure 2 in particularly highlights a variety of foods that could be supported by the agricultural sector, especially produce. Until now, efforts to address food security have somewhat overlooked Protector foods; however, they are an essential part of a high-quality diet.

2) Channel high quality nutritious foods into business models that provide offerings valued by the consumer

In market contexts where the producer does not directly interface with the consumer, finding ways for the retailer to market their foods to low-income consumers will be essential for driving demand for foods that can reduce hidden hunger. Channeling nutritious foods into business models that are able to meet the other demands of the consumer (i.e., convenience, brand name, taste) could help to drive demand for naturally nutritious foods.

As threats to food security continue to arise, strong connections between the production of nutritious foods and the outlets where consumers access these foods are increasingly important as many of the world's poor rely on markets for food. Part of the BUY2THRIVE (www.buy2thrive.com) approach to food and nutrition security seeks to understand how to more effectively engage the agricultural sector in market-based approaches to nutrition. Innovation in agricultural productivity and agri-food value chains have an essential role to play, but until now, have primarily only been addressed in so far as to help businesses operating in the space of market-based approaches to nutrition to become more profitable. Yet, research and initiatives aimed at this intersection have the potential to contribute to significant reductions in hidden hunger among low-income households in LMICs.

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[6] Salaries are typically paid at the beginning of the month. Please see the online version of this article to explore how purchases change between the beginning and end of the month.

[7] Interested readers on the findings of the entire study can be found in my recently published dissertation: Buying to Thrive - Exploring the Potential for Market-based Approaches to Contribute to Increases in Diet Diversity in Mozambique.

EXTENSION AND ADVISORY SERVICES: SUPPORTING COMMUNITIES BEFORE, DURING, AND AFTER CRISES

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ABSTRACT

Extension and Advisory Services (EAS) providers are important partners for communities to prepare for, respond to, and recover from shocks such as natural disasters and human, plant, and animal disease and pest outbreaks. EAS providers work long-term in communities to equip people with knowledge, skills, and technical resources to improve their livelihoods. EAS are provided by various actors including governments, nongovernmental organizations, private sector entities, higher education institutions, and other organizations. EAS often serve in bridging roles connecting resources from numerous actors operating in communities and are valuable conduits of information during shocks.

EAS are seen as key partners in helping communities rebuild and strengthen food systems after the initial shock, given their long-term work horizons. There are numerous examples of EAS responding to crises around the world, such as HIV/AIDS, Ebola, Avian Influenza, malaria, and, more recently during the current COVID-19 pandemic. During COVID-19, EAS have undertaken an unprecedented shift to virtual and distanced programming as daily life has been disrupted through restrictions on movement and gatherings. EAS agents have been challenged to modify program delivery and remain effective in serving their clientele while navigating this new landscape. In this essay we explore examples of EAS supporting communities before, during, and after crises, and discuss implications for future EAS work, including considerations of lessons learned during the COVID-19 pandemic response.

INTRODUCTION

Extension and Advisory Services (EAS) play an important role in equipping people and communities with knowledge and technical resources to improve their lives and livelihoods. EAS empower people, promote economic growth, foster beneficial communication, require and promote collaboration, and work to reduce poverty.[1] As such, EAS are well-positioned to help communities experiencing a crisis as they have supported responses to many crises in the past, such as natural disasters and epidemics like HIV/AIDS, Ebola, Avian Influenza, malaria, and, more recently during the COVID-19 pandemic.[2]

EAS are key partners in preparing communities for shocks such as human, animal, or plant disease or pest outbreaks; in response as these shocks unfold; and in recovery, building resilience in communities and food systems after crises. The challenging and ambitious nature of EAS efforts requires long-term commitment by EAS providers to the people and communities they serve, and EAS often remain after the initial shock or disaster.[3,4] In this essay we explore examples of EAS supporting communities before, during, and after crises, and discuss implications for future EAS work.

PREPARATION

EAS prepare communities for negative events as they serve as a bridge between information sources and the stakeholders with which they engage. While no one uniform EAS model exists, it is this bridging role that has enabled EAS to offer value in communities by providing clientele with the information, skills, and strategies to enhance their economic and social futures. As fundamentally relational institutions, EAS often serve as connectors and communication conduits between the many actors operating in communities.

Rural advisory services, also called extension, are all the different activities that provide the information and services needed and demanded by farmers and other actors in rural settings to assist them in developing their own technical, organisational, and management skills and practices so as to improve their livelihoods and wellbeing. Ian Christoplos, 2010[5]

The Cooperative Extension System (CES) in the United States is a partnership between the United States Department of Agriculture, the Land-Grant University System, and state and local governments. This partnership connects resources in higher education to communities and builds on long-term relationships county-level Extension personnel create in their localities.[6] This tripartite government-led model is relatively unique in the US; however, other actors also provide services. Globally as well, EAS are provided by nongovernmental organizations, governments, private sector entities, through higher education institutions, and other means.[7]

A central principle of the US CES is the value of cooperation not only in terms of financial investment shared by federal, state, and local governments, but also organizational and programmatic cooperation within and across state Extension systems. For example, the Extension Disaster Education Network (EDEN) was formed following the 1993 Missouri and Mississippi river floods in the central United States. The network allows states in the midst of crisis to access resources and expertise they might otherwise not have access to in the moment. EDEN helps communities prepare for shocks through education, training, and research to better equip communities before crises arise.[8]

RESPONSE

In times of crisis, EAS use their long-standing relationships in communities to assess immediate needs and relay relevant information to others involved in the response. EAS can educate communities about the current outbreak and advise on immediate precautions, complete rapid assessments of damage or incidence and communicate that to relevant agencies, and identify and address market and supply chain disruptions in collaboration with others. EAS undertake these activities while being sensitive to social issues such as the disproportionate impact on vulnerable populations such as women and children. Given their access to field-level data and trusted relationships, EAS are often relied upon by governments to provide objective information used in informing government response.[9]

The COVID-19 pandemic disrupted economic and social systems across the planet. The pandemic is unique in how quickly the governmental response around the world forced changes in all aspects of society through limiting in-person activities. Food and economic systems, education, and healthcare, to name a few, were changed virtually overnight as governments sought to limit transmission. EAS were immediately forced to change how they functioned as organizations, including how they continued to provide services to clientele.

The US CES quickly adapted to offering programming virtually, served as a connector and resource aggregator for clientele, and worked with local and state partners to provide services and resources for vulnerable populations. Specifically, eXtension [impact.extension.org], a platform for sharing resources with CES professionals, aggregated information from the World Health Organization and the US Centers for Disease Control and Prevention, guidance on the impact of COVID-19-related legislation, as well as materials provided by CES and universities from throughout the United States. Topics of benefit to the general public and information sharing how the various systems responded to the pandemic from an organizational perspective were included.[10]

The Ministry of Agriculture and Rural Affairs in China created a cloud-based extension information portal used for digital engagement and access to experts by farmers and dissemination of relevant market- and production- related guidance. While much has been made of new communication solutions and the switch to virtual programming, in countries throughout Africa, existing media channels such as farm radio continue to serve as important conduits to reach communities with current, relevant information during disasters, including the COVID-19 pandemic.[11]

RECOVERY

Previous shocks have offered examples of how EAS is valued for helping communities recover and build resilience for future events. Extension agents play an important role in understanding the impacts of pandemics. In Sierra Leone, extension agents and farmers reported that the Ebola outbreak led to losses in productivity and reduced output, which affected food availability, reduced incomes, and affected household financial security.[12] During the Ebola outbreak in Liberia, food insecurity increased as buying habits, food production efforts, and marketing channels were disrupted by government restrictions and fear-induced changes in habits. The corresponding impacts on food systems and food availability compounded existing problems in the country. Following the crisis, investment in agricultural extension was requested to enhance food security.[13] The World Bank viewed EAS as a complement to improved seed and access to technology, as key to increasing food security through improving farmer livelihoods, and invested in programs to support farmers through these channels in Sierra Leone, Liberia and Guinea.[14]

ADDITIONAL CONSIDERATIONS

The role of technology and the unprecedented switch to virtual engagement in all aspects of life during the COVID-19 pandemic warrants further discussion. In Virginia, CES virtual events such as blueberry field days and volunteer development trainings drew far larger participation than the same events had in previous years when delivered in person. The ability of EAS to switch course rapidly depends on agents' willingness and ability to adapt to new methods of service provision, including use of technology platforms, and extension professionals report greater comfort in adopting methods shared by their peers.[15] The impact of changes to extension program delivery methods and platforms, the effects of those changes on organizational response, and longer term effects on organizational functioning will require further evaluation to better inform future responses.

Shocks affect economies and communities differently, and therefore the response of EAS will have different impacts on recovery. Further, the relative strength of each EAS will affect its ability to respond effectively. Extension systems can be affected in the short run through direct impacts and disruptions for extension professionals, through diversion or deployment in response to crises, and these disruptions affect the clientele who normally would benefit from their expertise. Long term, extension systems can be threatened by lack of investment to rebuild systems. This disinvestment can spill over and affect related organizations and providers.[16]

EAS provide critical resources to people and communities. Continued investment in EAS will be required to ensure they are resourced and available to continue important work and respond in extraordinary situations. EAS should continue to evaluate the quality and impact of programming and explore ways technology can further their reach and support improved livelihoods.

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