Eric D. Raile*, Linda M. Young, Julian Kirinya, Jackline Bonabana-Wabbi and Amber N. W. Raile

Building Public Will for Climate-Smart Agriculture in Uganda: Prescriptions for Industry and Policy

https://doi.org/10.1515/jafio-2021-0012
Received February 8, 2021; accepted February 10, 2021

Abstract: The global policy community has largely converged on climate-smart agriculture as a solution to various problems driven by climate change, but mass adoption of the crucial innovations presents challenges – particularly in the developing world. Widespread, meaningful, and rapid adoption of climate-smart agriculture will require an appropriate enabling environment. This study uses the political will and public will approach to identify the obstacles and opportunities for upscaling of climate-smart agriculture innovations. In 2015 and 2018, two rounds of semi-structured stakeholder and expert interviews conducted by researchers in Uganda identified four relevant obstacle categories: agricultural extension; communication infrastructure; basic and agricultural infrastructure; and other incentives and disincentives. These categories are related to the five definitional components of public will to reveal pathways for enabling social change. Importantly, both infrastructure and appropriate incentives are necessary for diffusion and then continued use of climate-smart agriculture innovations, often in interrelated ways. The study concludes with a detailed discussion of the implications for industry, government, and donors.

Keywords: climate-smart agriculture, public will, adoption of innovations, infrastructure, enabling environment

JEL Codes: L1 (Market Structure, Firm Strategy, and Market Performance), O1 (Economic Development), Q1 (Agriculture)

***Corresponding author: Eric D. Raile**, Department of Political Science, Montana State University, PO Box 172240, Bozeman, MT 59717, USA, E-mail: eric.raile@montana.edu. https://orcid.org/0000-0002-4860-2081
Linda M. Young, Department of Political Science, Montana State University, PO Box 172240, Bozeman, MT 59717, USA, E-mail: lmyoung@montana.edu
Julian Kirinya and Jackline Bonabana-Wabbi, Department of Agribusiness & Natural Resource Economics, Makerere University, PO Box 7062, Kampala, Uganda, E-mail: jbonabana@caes.mak.ac.ug (J. Bonabana-Wabbi)
Amber N. W. Raile, Jake Jabs College of Business & Entrepreneurship, Montana State University, PO Box 173040, Bozeman, MT 59717, USA, E-mail: amber.raile@montana.edu

1 Introduction

The global policy community has largely converged on climate-smart agriculture (CSA) as a solution to a variety of problems driven by climate change, particularly in the areas of low agricultural productivity, nutritional deficits, and poverty. As an approach, CSA sustainably increases agricultural productivity and incomes but also adapts and builds resilience to climate change while aiming to reduce greenhouse gas emissions (Food and Agriculture Organization of the United Nations [FAO] 2013). The planting of drought-tolerant seeds, the use of drip irrigation, and the use of shade trees in integrated agriculture are examples of CSA techniques, which are diverse. The adoption of CSA is critical to support countries already suffering from serious climate-driven stresses to agriculture, such as the present case study country of Uganda (Caffrey et al. 2013; International Center for Tropical Agriculture and Bureau for Food Security of the United States Agency for International Development [CIAT/BFS/USAID] 2017). Delays in acting are likely to produce further nutritional deficits, starvation, and environmental degradation.

Despite general agreement that implementing CSA is crucial to helping the developing world cope with climate change (see Lipper et al. 2014), upscaling the crucial innovations is likely to be difficult. By "upscaling" we primarily mean the expanded adoption of practices horizontally across producers and geographies, though upscaling can also happen vertically through changes to institutions and policies (Sulaiman, Chuluunbataar, and Vishnu 2018, 3). While entities including industry, government, and donors might contribute to providing an appropriate enabling environment for such upscaling, identifying obstacles to the widespread adoption of innovations is a precursor to prescribing action on the part of such entities. Consequently, this study applies the analytical framework of the political will and public will (PPW) approach (Post, Raile, and Raile 2010; Raile, Raile, and Post 2018; Raile et al. 2014) as a lens for helping to answer the initial research question: *What are the obstacles to building public support for adoption of CSA innovations in Uganda?* Hopefully, the findings of this research can serve as a precursor to overcoming such obstacles in Uganda and perhaps in other developing countries, as well.

Uganda was selected as a case study country for a few key reasons. First, Uganda is one of the focal countries of the U.S. government's Feed the Future (FtF) program. Like many other Sub-Saharan African countries, Uganda has experienced extensive chronic poverty and nutrition problems, and the primary goal of FtF is to "sustainably reduce global hunger, malnutrition, and poverty" (United States Government 2016, 8). Second, Uganda is a country in which agriculture remains very important, with widespread smallholder farming and a significant diversity of crops. Finally, Uganda has been fairly transparent with its many different development plans (see James 2010; Hickey 2013), thus allowing for assessment of the elements of these plans. One such plan, the *Uganda Climate Smart Agriculture Country Program 2015–2025* (Ministry of Agriculture, Animal Industry, and Fisheries and Ministry of Water and Environment [MAAIF/MWE] 2015), even lays out the country's strategic priorities in agriculture given the changing climate.

The research design was qualitative and utilized two rounds of semi-structured interviews with in-country stakeholders and experts to identify obstacles to the economic and social feasibility of upscaling CSA in Uganda. The questions in the interview instrument were derived from the structure of the PPW approach, which permitted both inclusion of traditional economic factors and expansion beyond them to examine social factors using a systems approach. This procedure revealed four basic categories of obstacles related to public will: agricultural extension; communication infrastructure; basic and agricultural infrastructure; and other incentives and disincentives. Overall, upscaling CSA in Uganda will require infrastructure interconnected with appropriate incentive structures. While progress in addressing the obstacles is ongoing, considerable work remains before large-scale CSA adoption will be feasible in Uganda. Moreover, as this analysis will reveal, the obstacles identified through the PPW lens serve as opportunities for industry, government, and donors.

2 Public Will and Innovations

The PPW approach to analysis and action is a framework for addressing social issues that require large-scale change. The approach focuses on understanding the roles of political actors and publics in making such changes (Raile, Raile, and Post 2018). The PPW approach is based on conceptual definitions of political will and public will. Political will become meaningful for social change when "a sufficient set of decision makers with a common understanding of a particular problem on the formal agenda is committed to supporting a commonly perceived, potentially effective policy solution" (Post, Raile, and Raile 2010: 659). Public will similarly becomes meaningful when "a social system has a shared recognition of a particular problem and resolves to address the situation in a particular way through sustained collective action" (Raile et al. 2014: 105). The framework disaggregates the definition of public will into five definitional components: (1) a social system; (2) shared recognition of a particular problem; (3) resolve to address the situation; (4) in a particular way (i.e., a shared solution); and (5) sustained collective action (Raile et al. 2014). The social system, which is the first component of public will, is "a set of interrelated units that are engaged in joint problem solving to achieve a common goal" (Rogers 2003: 23). System thinking is important to the PPW approach, which recognizes dynamism and interactions in complex situations (Greenwood 2015).

Both political will and public will are typically necessary for broad and meaningful social change within this systems approach, as they react to one another dynamically (Raile et al. 2014). Governments can block innovation, be indifferent, or create an enabling environment in response to public pressures. Publics, in turn, can choose to promote, embrace, defy, or ignore government policies (Post, Raile, and Raile 2010). However, the primary focus of the current study is on public will, specifically examining how communication and other processes affect the feasibility of widespread CSA adoption. Individual producer-level decisions (i.e., the domain of traditional agricultural economics) certainly matter, but they are not the whole story. Applying the PPW approach can help with understanding what is necessary to shift aggregate public preferences. More specifically, a coherent social system must recognize a particular problem and converge on a problem definition, resolve to address the situation based on shared beliefs about the capability of the social system to effect change, converge on a solution across key stakeholders, and commit to sustained collective action to enact the solution (Raile et al. 2014, 2018).

3 Methods

In this qualitative case study, information was primarily collected through semi-structured interviews given the PPW approach's focus on local views of problems and solutions. Interviews were superior to a survey in this case to allow local stakeholders and experts to generate the ideas

themselves. Resource constraints were another important consideration.

The first step of the purposive sampling procedure was to consult with local researchers and experts to identify key stakeholder categories. The researchers then relied on local experts and formal documents to identify relevant individuals for interviews within these basic stakeholder categories (Schmeer 2000). Most of these identified individuals would serve as key informants for the information-gathering activities. Table 1 provides a breakdown of the stakeholder/expert categories, topics, samples, and protocols for two rounds of interviews. While the resulting responses may not be demographically representative of stakeholder group views in the country as a whole, they are rooted in local views and are well informed in nature. We conducted two group interviews in the first round with 26 total producers. Though not everyone spoke in these group interviews, overall these 26 individuals represented a little over half of the total sample of 51 individuals for the first round.

Following transcription of the audio files, analysis of the first-round interviews proceeded using qualitative data analysis software (NVivo 11 Plus). The coders generated nodes deductively based on the PPW-related structure of the interview instrument (e.g., information flows, views of problems and solutions), while descriptive subnodes emerged inductively in an iterative process involving multiple coders (Miles, Huberman, and Saldaña 2014). The coders first met to establish the deductive node structure and then met again after coding initial samples to identify and resolve differences in coding of the nodes and subnodes. The inductively generated subnodes provided guidance for the relevant categories discussed in the Results section below, as well as for development of the second-round interview instrument.

The purpose of the second round of interviews was to update information and assess any changes related to topics identified through the first-round coding. Consequently, as noted in Table 1, the second-round question topics differed from those covered in the first round. Since second-round interviewees needed to be capable of speaking authoritatively about developments related to infrastructure and agricultural innovations, interviewers focused on experts rather than on stakeholders for this round. Though the second-round interviews were also transcribed, the researchers did not use the same sort of formal coding process for this updating information since the categories were already clearly established.

4 Results

This section systematically discusses four basic obstacle categories that emerged as a result of aggregating thematically across subnodes in the coding process: (1) agricultural extension; (2) communication infrastructure; (3) basic and agricultural infrastructure; and (4) other incentives and disincentives. Table 2 lists these four obstacle categories and

Table 1: Interview procedures and protocols by round.

	First Round (2015)	Second Round (2018)
Stakeholder/Expert categories	– Government employees – Researchers – Agricultural producers – Nongovernmental organizations	– Government employees – Researchers – Agricultural producer associations – Private sector representatives
Topics	– Views of problems and solutions – Information flows for agricultural innovations, including agricultural extension service – Successful and unsuccessful adoption of agricultural innovations	– Infrastructure as part of government development plans – Importance of building infrastructure – Factors helping and hindering infrastructure development – Recent changes to agricultural extension service – Agricultural innovation cases
Sample	– 27 interviews with 51 individuals in Kampala, Namatumba, and Bukedea	– 10 interviews with individuals in Kampala
Protocol	– More open ended – Field notes – Audio recordings (with consent) – Transcription – Deductive and inductive coding – About 1 h each	– Less open ended – Field notes – Audio recordings (with consent) – Transcription – 20–30 min each

Table 2: Obstacles for upscaling CSA in Uganda related to public will definitional components.

Relevant obstacle categories	Public will definitional components
Agricultural extension	#1: Social system
	#2: Shared recognition of a particular problem
	#4: In a particular way (i.e., shared solution)
Communication infrastructure (e.g., radio and phone technology and infrastructure)	#1: Social system
	#2: Shared recognition of a particular problem
	#4: In a particular way (i.e., shared solution)
Basic infrastructure (e.g., transportation, electricity) and agricultural infrastructure (e.g., agricultural product markets, food storage, quality of inputs)	#1: Social system
	#3: Resolve to address the situation
	#5: Through sustained collective action
Other incentives and disincentives (e.g., plot sizes, non-farm income, risk aversion)	#3: Resolve to address the situation
	#5: Through sustained collective action

relates each back to the definitional components of public will. The final subsection below summarizes the relationship between the obstacle categories and definitional components, using Figure 1 as a guide.

4.1 Agricultural Extension

The agricultural extension service is a crucial component in relaying information and spreading innovations to producers in most countries. Consequently, agricultural extension was a central topic of conversation during the first-round interviews (69 mentions across 18 interviews). In the PPW approach, communication is centrally important to three different elements of public will. Building a coherent social system (definitional element #1) typically depends on the members having reliable means of communication. Further, the development of shared understandings of problems (#2) and of solutions (#4) also depends on communicative efforts. In sum, generating similar views of problems and solutions in a systematic way within a social group is a communicative process, and agricultural extension is typically a key part of this process.

The story of agricultural extension in Uganda is complicated. The agricultural extension service has undergone major transformations during the last two decades. Prior to 2001, the extension model in Uganda was a "traditional top-down, government-led extension service, based on the Training and Visit model" (Rwamigisa et al. 2017: 91). Extension employees worked with and within local governments. However, over time international donors and other key stakeholders began pushing for an extension service that would be more in line with the Washington Consensus on government and economic reform. Donors thought that a privatized extension service would be more responsive and would promote modernization (Rwamigisa et al. 2017). A first-round interviewee described the proposed system as being driven by client (i.e., farmer) demand, with more efficient services provided by the private sector. Farmer groups would determine priorities and oversee contracting processes in this model, in what might also be characterized as a public-private partnership (Okoboi, Kuteesa, and Barungi 2013). Donors and the national government would partially subsidize the system, while farmer groups would also contribute to paying the costs of service delivery. Government extension employees would find new employment with private-sector service providers. The National Agricultural Advisory Services (NAADS), the traditional extension organization that would continue to exist in a more limited capacity, was to work with the National Agricultural Research Organization (NARO) to channel research demand. With the NAADS Act of 2001, the national parliament reformed the system with such outcomes in mind.

Despite general agreement that farmer involvement in setting priorities was a good idea, the reforms did not work as anticipated. One first-round interviewee believed that Uganda lacked the infrastructure necessary for privatization or even semi-privatization to be effective – a common problem in low-income countries more generally. The first reason offered for the problems was that the private sector was not robust enough to deliver services, and expansion of private-sector service providers was slow. Further, private-sector capacity differed greatly from one area to another, meaning that service availability was uneven. Second, extension workers were unable to move seamlessly into the private sector, which resulted in a loss of institutional knowledge. Third, many smallholder farmers – even if they could have banded together effectively to request services – did not know what to request.

Fourth, farmers also lacked the capacity to supervise the delivery of services due to limited technical knowledge and weak organization. The existing producer associations tended to be active mostly at the time of input delivery, which limited the promotion of technology innovations.

At the time of the first round of interviews in 2015, the system had begun reverting back toward a more traditional model. As described elsewhere, the reform program had been "suspended twice, drastically re-moulded, and finally turned on its head, to re-emerge as a government extension service once again" (Kjaer and Joughin 2012, 319). The first-round interviews revealed that President Museveni had recently directed changes to the system. The army was involved in distributing inputs such as seeds. The army's involvement was in large part a response to the previous distribution of fraudulent and adulterated inputs (like seeds and fertilizers), yet the army did not have the expertise necessary to solve this particular problem.

Second-round interviewees discussed more recent changes as the system continued its reversion toward a government-led model. One interviewee estimated that the process was 70% complete. The establishment of the Directorate of Agricultural Extension returned the agricultural extension function to the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). NAADS is once more involved in managing the distribution of inputs and in assuring the quality of inputs that are provided for free to farmers. Evidence suggests that the free provision of inputs is effective in stimulating demand in the Ugandan case (Matsumoto 2014). Extension service providers are also operating at the local level. All of this (perhaps aside from the free provision of inputs) represents movement back toward a more traditional model of agricultural extension.

However, second-round interviewees also pointed to ongoing problems with the agricultural extension service. For instance, the ratio of extension employees to farmers is low, and the government expenditure on the free distribution of seeds has left no money for the free distribution of agricultural chemicals. Further, the enormity and pace of changes in the agricultural extension service have made relying on the extension service for information difficult for farmers. Additionally, farmers are more likely to seek information for profitable crops like passionfruit as the country transitions toward commercial agriculture. Overall, one second-round interviewee noted that in the current model producers access information about agricultural innovations through multiple channels: the extension system and local governments, other government agencies, non-governmental extension providers, and the private sector.

4.2 Communication Infrastructure

As with agricultural extension, communication infrastructure can aid in building a social system (definitional element #1 for public will) and in developing shared understandings of problems (#2) and solutions (#4). Multiple first-round interviewees discussed the potential importance of radio in building widespread support for CSA, though with mixed reviews of its effectiveness to date. On the positive side, producers had access to weather forecasts translated into 22 different languages. Further, one interviewee mentioned the government's use of radio to communicate to producers about banana bacterial wilt in western Uganda, noting that "it is a major tool." On the negative side, some interviewees pointed to logistical and timing difficulties. One expert noted that only 10% of local subsistence farmers operating in rural areas had access to radios. Rural areas also lacked access to electricity and batteries; further, the timing of broadcasts was a significant limitation, with one interviewee noting that the government "can decide to pass the information over the radio once or twice in a season." The second-round interviewees explained additional complications, including unreliable meteorological information being broadcast and the ineffectiveness of radio broadcasts in convincing farmers to adopt new seeds – a process that works much better with local demonstrations and farmer-to-farmer transmission. Overall, radio has some potential in Uganda but is being used more effectively in other countries such as Senegal (Raile et al. 2018).

The other element of information and communications technology (ICT) that emerged relatively frequently in the first-round interviews was mobile phone technology. As with radio, logistical limitations reduce the potential effectiveness of mobile phone technology, especially limitations of cost and accessibility. Though mobile phone technology tends to be much cheaper in low-income countries, the degree of poverty among smallholder agricultural producers remains an obstacle. Moreover, phone-based internet remains unavailable or too costly for many people, and charging batteries can be problematic.

However, interviewees often pointed to an upward trajectory with the use of mobile phone technology for spreading agricultural information. Second-round interviewees indicated that access is improving. Statistics on ICT in Uganda corroborate the interviewee perspectives. Mobile-cellular subscriptions in Uganda increased from 12.83 million in 2010 to 24.95 million in 2017, while internet users as a percentage of the population rose from 12.5% in 2010 to 21.9% in 2016 (International Telecommunications

Union [ITU] 2019). Perhaps even more importantly, farmers have found ways to work around access limitations. The technology necessary for spreading basic messages is simple. Producers have taken to using platforms like WhatsApp to share information with one another (Kawuma 2016). Further, not all farmers need to have access to mobile phone technology if they are willing to pool their resources or to share information. Much of the information transfer, therefore, is direct farmer-to-farmer communication or occurs within the framework of clubs, innovation platforms, or cooperatives. Overall, mobile phones can be an efficient and effective means for the government and others to distribute information to producers. For example, one first-round interviewee mentioned a meteorological program that used mobile phone technology and reduced crop damage by about 50%. However, such information transfer must then also rely on diffusion through local networks.

4.3 Basic and Agricultural Infrastructure

The next category of obstacles for building public will for CSA in Uganda encompasses basic and agricultural infrastructure. As shown in Table 2, such infrastructure is important for the creation of social systems (definitional component #1) as well as for the resolve to address the situation (#3) and to sustain collective action in support of the chosen solution (#5). As we discuss below, basic infrastructure is more relevant to the formation of social systems than is agriculture-specific infrastructure, but both are crucial to the incentive structure for farmers. These incentives, in turn, affect the resolve of farmers to adopt solutions and to persist with promoting them collectively. The potential adoption and promotion of innovations is contingent on knowing that the innovations will reliably lead to positive outcomes.

Basic infrastructure showed up in the first-round interviews in a number of ways, with the predominant forms of infrastructure being roadways and electricity. The deficit of well-constructed and well-maintained roadways in Uganda presents multiple problems. In terms of creating social systems, the lack of transportation (including vehicles) inhibits travel for individuals who might want to discuss agricultural problems and solutions – particularly in the deep rural areas where many smallholder farmers operate. As noted above, the lack of electricity also complicates communication using technology such as radios and mobile phones.

However, first-round interviewees noted the centrality of basic infrastructure in government development plans (e.g., see State House of Uganda 2019). Formal government documents, such as *Uganda Vision 2040* (Government of Uganda 2007), have laid out the importance of developing basic infrastructure. Further, formal statistics support claims that progress is being made beyond communication infrastructure improvements. One such example is the increase in rural residents with access to electricity, with rates rising from 8.9 to 18.0% between 2010 and 2016 (United Nations Development Program [UNDP] 2019). Such statistics also indicate an increase in paved roadways of about 1000 km from 2015 to 2018 (Central Intelligence Agency 2019).

Second-round interviewees provided additional details about basic infrastructure improvements via mechanisms such as the National Backbone Infrastructure Project. They pointed to the willingness of donors such as the World Bank and European Union to provide loans for basic infrastructure projects. They also mentioned the Chinese government's provision of grants, noting the requirement that Chinese workers build the roads. China's involvement in infrastructure development in Uganda and in Africa more widely has attracted some controversy (see Bräutigam 2018; Kaplinsky et al. 2015; Namubiru 2018). The interviewees further highlighted significant increases in Ugandan government spending on infrastructure resources such as water, roads, and energy. The government ultimately aims to increase private-sector profitability (including agricultural profitability) with these improvements, as increased infrastructure will reduce transportation and other export-associated costs.

Based on the first-round interviews, relevant agricultural infrastructure included infrastructure for distributing high-quality inputs (e.g., seed, fertilizer, herbicide); storing agricultural products; transporting agricultural products to market (i.e., roads, vehicles, etc.); and selling agricultural products. In the interview transcripts, agricultural infrastructure overlapped with basic infrastructure to an extent. Roadways and vehicles figured prominently in these discussions, given their centrality to the distribution of high-quality inputs and the transportation of agricultural products to markets. First-round interviewees also mentioned the high unit cost of transportation for smallholder farmers.

Unreliable access to high-quality inputs provides disincentives for farmers to adopt CSA innovations. First-round interviewees spoke frequently and broadly about input problems (10 interviews mentioned seeds alone), including distribution of counterfeit inputs as well as supply-chain problems and costs associated with fertilizers and herbicides. Counterfeit inputs are a particularly pernicious problem, as they tend to increase risk aversion and

the subsequent unwillingness of farmers to adopt innovations. Based on the second-round interviews, problems persist for input distribution. Seed companies have limited capacity and little incentive to improve based on a lack of accountability. The free distribution of inputs also raises questions about the system's sustainability. However, NAADS's management of the seed distribution system provides some hope.

The inability to store agricultural products also creates disincentives for adopting and promoting CSA innovations. Nine different first-round interviews talked about shortcomings in food storage as a problem that disincentivizes the production of surpluses and the planting of new crops prone to faster spoilage. In illustrating the surplus problem, one interviewee noted that farmers are "forced to sell at whatever prices they can get, and [those prices] are low." However, the second-round interviews suggested improvement in this area in recent years. The private sector has invested in storage, processing facilities, and warehouses in response to government grain policy. Reduced tariffs have also helped with access to refrigerated trucks for milk transport. Further, the recent fall in maize prices has renewed interest in increasing both public- and private-sector investment in food reserves and storage systems.

Markets (mentioned in 10 different interviews) were yet another subcategory of agricultural infrastructure that were seen as falling short in the first-round interviews, thus disincentivizing the production of surpluses or of new, potentially marketable crops. Lack of access to markets was one central concern, joined by the lack of accurate price signals. Markets did not price according to quality, and farmers lacked mechanisms for learning about prices. As one interviewee summarized the marketing problem, "The domestic markets are so disorganized that you find either excess of supply or excess demand in one area or another area." The second-round interviews noted a continued need to move food surpluses to other geographic areas both domestically and continent-wide via more effective markets. However, the interviews also mentioned marketing improvements via international donor programs like village stores and TradeMark East Africa.

4.4 Other Incentives and Disincentives

We used the label of "other incentives and disincentives" for a final category of obstacles that emerged across the first-round interviews. This category is associated with two of the public will components as shown in Table 2: a resolve to address the situation (definitional component #3) and sustaining collective action in support of the chosen solution (#5). To reiterate, in line with more traditional economic theory, producers need appropriate incentives to adopt innovations. They are also unlikely to push collectively for innovations without clear incentives.

This category included three basic themes: small plot sizes, potential for non-farm income, and risk aversion. In the first round of interviews, small plot sizes turned up as a frequent disincentive (mentioned in 11 interviews) for adopting CSA innovations. More specifically, smallholder farmers did not have enough land to think beyond subsistence agriculture, and land inheritance traditions and gender norms exacerbated the problem (Acosta et al. 2015). Interviewees also mentioned potential income from non-farm employment as a disincentive for innovating in the agricultural sector, though such income can also allow for procuring better knowledge and technologies. Such non-farm employment is particularly attractive for young people. Finally, interviewees in both rounds emphasized risk aversion among agricultural communities and its implications for adopting innovations. For example, interviewees noted the need among farmers to see an assured market before adopting new crops.

4.5 Summarizing the Obstacles

Figure 1 illustrates the relationship between the obstacle categories and the definitional components of public will. The first row shows the five definitional components of public will (rearranged into a slightly different order for illustrative purposes). The second row shows the ideal configuration of elements that would indicate strong public will for the adoption of CSA in Uganda. The bottom row demonstrates the current situation in Uganda based on the two rounds of interviews. The area between the current situation and the ideal configuration in Figure 1 shows what is necessary to bridge the gap. This area encapsulates the findings from the interviews.

A strong social system is the first definitional component of public will. The current social system in Uganda is fragmented and inconsistent. As shown in Figure 1, the creation of the sort of extensive and cohesive social system that could facilitate mass change would require additional agricultural extension work, communication infrastructure (e.g., mobile phones, radios), and basic infrastructure (e.g., transportation). Basic and communication infrastructure are essential for the types of communicative exchanges that would allow for quick dissemination of information. Similarly, an effective agricultural extension

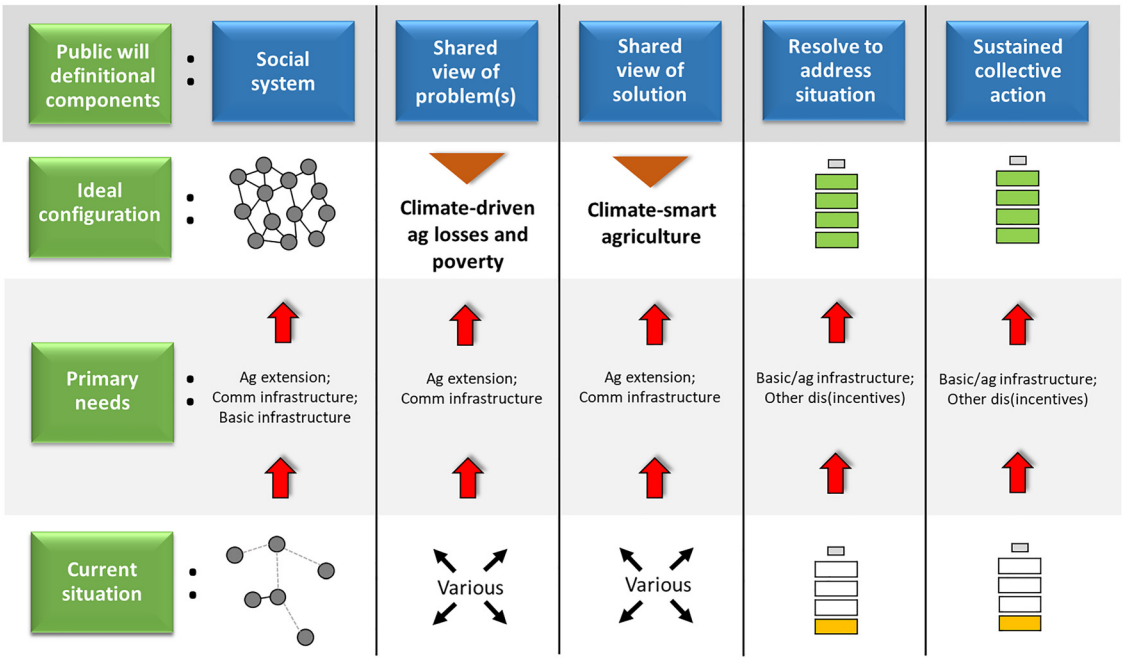

Figure 1: Obstacles to public will for CSA in Uganda.

service is a key mechanism for consolidating and disseminating crucial information.

The next requirements in creating public will for CSA are shared views of the problem(s) and solution. In the ideal configuration, the extensive and cohesive social system would share a relatively narrow view of climate-driven agricultural losses and poverty as the problems and would view CSA as the associated solution. However, the current situation is one in which interviewees identify a variety of major problems. Not surprisingly, interviewees also envision a wide variety of solutions to these problems, as well (Raile et al. 2018). Further development of agricultural extension and communication infrastructure are crucial in fostering shared views of problems and solutions. This is not to say that stakeholder and expert views of problems are wrong, since other identified problems are of course legitimate and significant. Rather, upscaling CSA broadly and quickly enough would require that these problems be identified as particularly severe and deserving of top priority status.

The final definitional components are a resolve to address the situation and the willingness to engage in sustained collective action. In the ideal configuration, these components would be powerful. However, the current situation is one in which these components are relatively weak, in part due to lack of a clear solution. Bridging the gap will depend on having the appropriate incentive structures in place. Building such incentive structures partly hinges on improved basic infrastructure (e.g., transportation, electricity) and agricultural infrastructure (e.g., markets, storage). Without such infrastructure, producers cannot reliably project the proposed benefits of CSA and are unlikely to put forth the level of commitment necessary. Other incentive structures must overcome risk aversion and promote willingness to engage in manual farm labor.

In sum, then, a systems orientation toward the situation in Uganda and other developing nations suggests a two-pronged approach. The type of strong public will necessary for the rapid and widespread adoption of CSA is unlikely to emerge without *both* appropriate infrastructure to facilitate the spread of CSA innovations *and* appropriate incentive structures for the adoption and continued use of these innovations. In fact, the two are heavily intertwined throughout the analysis. While these challenges are significant, having a clearer picture of necessary conditions might represent an exciting precursor to social change.

5 Discussion

This study uses a novel approach in examining the economic and social viability of CSA practices and the consequent likelihood of upscaling these practices. The PPW lens applied here incorporates but also goes beyond traditional economic approaches in a more systems-

oriented manner. Individual-level incentives are certainly part of the story, though the current incentive structure falls well short of persuading individual producers to adopt CSA innovations *en masse*. More traditional economic approaches would ask whether the benefits of adopting these CSA innovations outweigh the costs for individual producers. Making these information-based calculations, producers would then adopt innovations that generate net benefits. However, such an approach assumes an information-rich environment, a requirement that is clearly not met in the case of Uganda. Smallholder farmers, who compose a large portion of the agricultural sector, do not have nearly enough information about CSA innovations nor about the prospective costs and benefits of adopting these innovations to engage in utility-maximizing behavior. Further, while more limited CSA decisions, such as the adoption of a new seed variety, seem to fit fairly well with standard microeconomic thinking, true adoption of CSA principles requires something closer to lifestyle change.

Given the pressures of climate change, such alterations need to happen quickly and broadly. Mass behavioral transformations in adapting to climate change will require recognition of socioeconomic factors (Notenbaert et al. 2016); collaboration and information sharing among stakeholders (Clar, Prutsch, and Steurer 2013; Schut et al. 2016), including across weak ties (Thuo et al. 2014); and various other forms of collective action (Ombogoh et al. 2018). Ideally, the collective action would put pressure on policymakers to create conditions that would further enable the spread of CSA (Ampaire et al. 2015).

The linkage between public will and political will is specifically attenuated in Uganda by the power of the president. However, some presidential policies focused on infrastructure are likely to be helpful despite not being targeted toward the upscaling of CSA in particular. The ability to serve multiple objectives simultaneously through the building of basic infrastructure could ease concerns about policy tradeoffs, though convincing decision makers that CSA should be a top priority in a developing country with many competing needs can be difficult. Additionally, public pressure may influence the bureaucracy, while the president seems inclined to allow programs with external financial support as long as they do not interfere with his primary objectives. Other researchers have pointed to the importance of "science-policy engagement" as especially important in producing policy change in the CSA space (see Dinesh et al. 2018), so that is another potential consideration.

Ultimately, the characteristics of the situation suggest the need for a social movement, and the PPW lens offers an approach for generating such a movement. In this case, we began by considering categories of obstacles as they relate to the definitional components of public will. First, the historical lack of an effective agricultural extension system inhibits the formation of local social systems with cohesive views about climate-driven agricultural problems and about various forms of CSA that could solve these problems. The agricultural extension system is important for adaptive capacity (Tiyo, Orach-Mezaq, and Edroma 2015), as extension agents serve as potential change agents in a complex informational environment (Blythe et al. 2017). Second, deficiencies in communication infrastructure (e.g., radios and mobile phones) similarly hamper the formation of social systems with cohesive views. Both of these communication factors limit the social viability of CSA more broadly. Third, deficiencies in basic and agricultural infrastructure are problematic in multiple ways. Underdeveloped transportation and electrical systems hinder the emergence of social systems and provide disincentives for adopting CSA innovations. Problems with agricultural infrastructure (in areas such as inputs, food storage, and marketing) similarly supply disincentives for adoption and for collective calls for the spread of CSA. Finally, producers face other disincentives for adoption and collective dissemination of CSA. Such disincentives emerge in the form of limited plot sizes, potential sources of non-farm income, and general risk aversion in smallholder agricultural production.

However, the analysis of our semi-structured interviews offers some reasons for optimism. The agricultural extension service is in the process of reverting back toward a more proven model that is successful in countries throughout the world. This transition (with appropriate resources, staffing, monitoring, and accountability) holds promise for limiting agricultural input problems and for improving the dissemination of information about CSA to producers. Further, the Ugandan government has prioritized the development of basic infrastructure such as roads and communication technologies. Interviewees often mentioned the relatively high government prioritization of agriculture-specific infrastructure, as well. Of course, turning such prioritization into realities is contingent on resources and the actual completion of projects (Rumney 2016). Finally, potentially successful programs are targeting food storage deficiencies and the marketing of agricultural products.

The identification of obstacles within the PPW approach reveals opportunities for action. Such identification allows for targeted funding on the part of the government (crucial given resource limitations), as well as targeted requests for funding and assistance from donors,

multilateral organizations, and international nongovernmental organizations. This identification also provides useful information about enabling conditions for the creation of many local "publics" or social systems that might coalesce into a social movement. The lack of well-organized producer associations throughout the country (see Latynskiy and Berger 2016) does not fit cleanly into the obstacle categories but clearly links to multiple categories. Producer associations are ready-made social systems capable of converging on shared understanding of climate-driven agricultural problems and the CSA solutions to these problems. Further, producer associations can serve as liaisons to agricultural extension and can disseminate information throughout their membership. Multiple interviewees indicated in both rounds that learning and adoption of innovations often happens through producer associations and through peer interactions at the local level based on relationships of trust (Kasirye 2013). Producer association leaders are key stakeholders, and partnering with such "opinion leaders" (Rogers 2003) within communities is crucial for CSA adoption (Beckford 2009). Producer associations also serve as a mechanism for overcoming signal and information problems and risk aversion, all of which serve as disincentives to innovation adoption. Certainly, the creation and strengthening of producer associations would benefit from assistance (Adong, Mwaura, and Okoboi 2013). High-level government officials have made calls for strengthening producer associations, and the Uganda Cooperative Alliance is also active in this arena.

This study is subject to certain limitations. The PPW approach is context specific, and the methods used were relatively labor intensive. However, despite this context specificity, the basic obstacles and opportunities identified for the social and economic viability of CSA in Uganda are likely generalizable to other contexts. These problems are not entirely unique to Uganda (though the specifics of the agricultural extension service might be). Additionally, this research only involved two areas of the country outside the capital. The concerns of individuals and producer associations might vary in significant ways from one region to another. This geographic issue raises further limitations of sampling. Despite making considerable efforts to ensure a sample of interviewees that reflected major stakeholder groups and knowledgeable individuals, the sample might not be wholly representative. Given the goal of identifying obstacles, any non-representativeness likely only reduced the comprehensiveness of the identified set of obstacles. For example, other researchers have pointed to the importance of gender in innovation adoption in Uganda (Fisher and Carr 2015; Murage et al. 2015; Tiyo, Orach-Mezaq, and Edroma 2015). Beyond sampling concerns, the scope of the project also leaves the door open for other levels of analysis. Specifically, future research should examine decision making at the household level as it relates to the adoption of CSA, and more should be done to explore relationships among markets, information, and infrastructure. Finally, this is not a comparative study of the cost-effectiveness or feasibility of different policies and programs. Nor is it a study of the tradeoffs among different policy alternatives. Instead, the goal here was assessing the requirements for producing a mass movement in favor of CSA, thereby also illuminating potential roles in creating an appropriate enabling environment.

Abundant opportunities exist for industry, government, and donors to contribute to such an enabling environment. This discussion has already indicated the usefulness of policies that support the building of infrastructure in various forms – transportation, electricity, communication, crop storage, markets, etc. The building out of such infrastructure also represents an opportunity for industry, and we have seen industry starting to fill some of these gaps (e.g., crop storage). Further, this discussion has noted the importance of improving the efficacy of agricultural extension services and of producer associations. At least one of the experts we consulted with still believes that the private sector is capable of contributing in meaningful ways to agricultural extension in Uganda, and the latest structure does not appear to rule out such contributions entirely. Opportunities for industry are also evident in the need for better organization and information structures. While many CSA innovations may be beneficial, producers often lack the information and incentives necessary to adopt these innovations. Entrepreneurs might facilitate smaller reorganizations within the sector that would allow a social movement around CSA to flourish. In the end, the obstacles and opportunities identified here do not seem to be entirely unique to CSA, which suggests these findings may generalize to the adoption of agricultural innovations more broadly.

Acknowledgments: The authors would like to thank the editors and reviewers for their work. The authors are also grateful to the research participants and acknowledge assistance from Lena Wooldridge and Elisa Cherry related to the larger project.

Research funding: The United States Agency for International Development and the United States Department of Agriculture provided funding support for this research. The project also benefited from funding provided to Montana INBRE and the HELPS Lab at Montana

State University-Bozeman by the National Institute of General Medical Sciences of the National Institutes of Health.

References

Acosta, M., E. Ampaire, W. Okolo, and J. Twyman. 2015. *Gender and Climate Change in Uganda: Effects of Policy and Institutional Frameworks*. Montpellier, France: CGIAR. https://hdl.handle.net/10568/67156.

Adong, A., F. F. Mwaura, and G. Okoboi. 2013. "What Factors Determine Membership to Farmer Groups in Uganda? Evidence from the Uganda Census of Agriculture 2008/9." *Journal of Sustainable Development* 6 (4): 37–55.

Ampaire, E. L., P. Happy, P. van Asten, and M. Radeny. 2015. *The Role of Policy in Facilitating Climate-Smart Agriculture in Uganda*. Montpellier, France: CGIAR. https://cgspace.cgiar.org/handle/10568/65143.

Beckford, C. L. 2009. "Sustainable Agriculture and Innovation Adoption in a Tropical Small-Scale Food Production System: The Case of Yam Minisetts in Jamaica." *Sustainability* 1 (1): 81–96.

Blythe, J., R. Sulu, D. Harohau, R. Weeks, A.-M. Schwarz, D. Mills, and M. Phillips. 2017. "Social Dynamics Shaping the Diffusion of Sustainable Aquaculture Innovations in the Solomon Islands." *Sustainability* 9 (1): 150–73.

Bräutigam, D. 2018. *U.S. Politicians Get China in Africa All Wrong, April 12*, Online ed. Washington, DC, USA: Washington Post.

Caffrey, P., T. Finan, S. Trzaska, D. Miller, R. Laker-Ojok, and S. Huston. 2013. *Uganda Climate Change Vulnerability Assessment Report*. Washington, DC: United States Agency for International Development. https://www.climatelinks.org/resources/uganda-climate-change-vulnerability-assessment-report.

Central Intelligence Agency. 2019. *World Factbook*. 2019. Also available at https://www.cia.gov/the-world-factbook/.

Clar, C., A. Prutsch, and R. Steurer. 2013. "Barriers and Guidelines for Public Policies on Climate Change Adaptation: A Missed Opportunity for Scientific Knowledge-Brokerage." *Natural Resources Forum* 371 (1): 1–18.

Dinesh, D., R. B. Zougmore, J. Vervoort, E. Totin, P. K. Thornton, D. Solomon, P. B. Shirsath, V. O. Pede, I. Lopez Noriega, P. Läderach, K. Jana, D. Hegger, E. H. Girvetz, A. E. Friis, P. Peter, J. Driessen, and B. M. Campbell. 2018. "Facilitating Change for Climate-Smart Agriculture through Science-Policy Engagement." *Sustainability* 10: 2616.

Fisher, M., and E. R. Carr. 2015. "The Influence of Gendered Roles and Responsibilities on the Adoption of Technologies that Mitigate Drought Risk: The Case of Drought-Tolerant Maize Seed in Eastern Uganda." *Global Environmental Change* 35: 82–92.

Food and Agriculture Organization of the United Nations (FAO) 2013. *Climate-Smart Agriculture Sourcebook*. Rome: FAO.

Government of Uganda. 2007. *Uganda Vision 2040*. Kampala: Government of Uganda. http://www.npa.go.ug/uganda-vision-2040/.

Greenwood, D. J. 2015. "An Analysis of the Theory/Concept Entries in the *SAGE Encyclopedia of Action Research*: What We Can Learn about Action Research in General from an Encyclopedia." *Action Research* 13: 198–213.

Hickey, S. 2013. "Beyond the Poverty Agenda? Insights from the New Politics of Development in Uganda." *World Development* 43: 194–206.

International Center for Tropical Agriculture, and Bureau for Food Security of the United States Agency of International Development (CIAT/BFS/USAID). 2017. *Climate-Smart Agriculture in Uganda*. Washington, DC: CIAT/BFS/USAID. https://hdl.handle.net/10568/89440.

International Telecommunications Union (ITU). 2019. *Statistics*. Geneva, Switzerland: ITU website. https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx.

James, P. A. S. 2010. "Using Farmers' Preferences to Assess Development Policy: A Case Study of Uganda." *Development Policy Review* 28 (3): 359–78.

Kaplinsky, R., A. Agyei-Holmes, R. Atta-Ankomah, D. Botchie, M. Farooki, and J. Wasswa-Mugambwa. 2015. *Infrastructure Development within the Context of Africa's Cooperation with New and Emerging Development Partners*. New York: NEPAD and United Nations Office of Special Adviser on Africa. https://www.un.org/en/africa/osaa/pdf/pubs/2015infrastructureanddev.pdf.

Kasirye, I. 2013. *Constraints to Agricultural Technology Adoption in Uganda: Evidence from the 2005/06–2009/10 Uganda National Panel Survey*. Kampala: Economic Policy Research Center, Makerere University. http://makir.mak.ac.ug/bitstream/handle/10570/4000/series102.pdf.

Kawuma, B. 2016. *Whatsapp Pig Farmers! Uganda's Innovation Platform Connecting and Sharing on Smartphones*. Montpelliar, France: CGIAR. https://livestockfish.cgiar.org/2016/04/14/whatsapp-uganda/.

Kjaer, A. M., and J. Joughin. 2012. "The Reversal of Agricultural Reform in Uganda: Ownership and Values." *Policy and Society* 31: 319–30.

Latynskiy, E., and T. Berger. 2016. "Networks of Rural Producer Organizations in Uganda: What Can be Done to Make Them Work Better?" *World Development* 78: 572–86.

Lipper, L., P. Thornton, B. M. Campbell, B. Tobias, B. Ademola, B. Martin, P. Caron, A. Cattaneo, D. Garrity, K. Henry, H. Ryan, L. Jackson, A. Jarvis, F. Kossam, W. Mann, N. McCarthy, A. Meybeck, N. Henry, T. Remington, P. T. Sen, R. Sessa, S. Reynolds, T. Austin, and E. F. Torquebiau. 2014. "Climate-Smart Agriculture for Food Security." *Nature Climate Change* 4: 1068–72.

Matsumoto, T. 2014. "Disseminating New Farming Practices Among Small Scale Farmers: An Experimental Intervention in Uganda." *Journal of the Japanese and International Economies* 33: 43–74.

Miles, M. B., A. Michael Huberman, and J. Saldaña. 2014. *Qualitative Data Analysis: A Methods Sourcebook*. 3rd ed. Los Angeles, CA: Sage.

Ministry of Agriculture, Animal Industry, and Fisheries Ministry of Water and Environment. (MAAIF/MWE). 2015. *Uganda Climate-Smart Agriculture Programme 2015–2025*. Kampala, Uganda: MAAIF/MWE. https://hdl.handle.net/10568/76225.

Murage, A. W., C. A. O. Midega, J. O. Pittchar, J. A. Pickett, and Z. R. Khan. 2015. "Determinants of Adoption of Climate-Smart Push-Pull Technology for Enhanced Food Security through Integrated Pest Management in Eastern Africa." *Food Security* 7: 709–24.

Namubiru, L. 2018. *Chinese Contractors Are Going to Keep Dominating Road Construction in Uganda*, Quartz Africa, July 13. https://qz.

com/africa/1326618/china-is-building-expensive-roads-in-uganda/.

Notenbaert, A., C. Pfeifer, S. Silvestri, and M. Herrero. 2016. "Targeting, Out-Scaling and Prioritising Climate-Smart Interventions in Agricultural Systems: Lessons from Applying a Generic Framework to the Livestock Sector in Sub-Saharan Africa." *Agricultural Systems* 151: 153–62.

Okoboi, G., A. Kuteesa, and M. Barungi. 2013. *The Impact of the National Agricultural Advisory Services Program on Household Production and Welfare in Uganda*. Washington, DC: Africa Growth Initiative at Brookings. https://www.brookings.edu/wp-content/uploads/2016/06/03_agricultural_advisory_services_uganda.pdf.

Ombogoh, D. B., T. Joseph, S. McMullin, J. Muriuki, and J. Mowo. 2018. "Enhancing Adaptation to Climate Variability in the East African Highlands: A Case for Fostering Collective Action Among Smallholder Farmers in Kenya and Uganda." *Climate & Development* 10: 61–72.

Post, L. A., A. N. W. Raile, and E. D. Raile. 2010. "Defining Political Will." *Politics & Policy* 38 (4): 653–76.

Raile, A. N. W., E. D. Raile, and L. A. Post. 2018. "Analysis and Action: The Political Will and Public Will Approach." *Action Research* 37 (3): 867–99.

Raile, E. D., A. N. W. Raile, C. T. Salmon, and L. A. Post. 2014. "Defining Public Will." *Politics & Policy* 42 (1): 103–30.

Raile, E. D., L. M. Young, J. Bonabana-Wabbi, J. Kirinya, S. Mbaye, L. Wooldridge, A. N. W. Raile, and L. A. Post. 2018. "Agriculture in Shifting Climates: The Configuration and Ripeness of Problem Understandings in Uganda and Senegal." *The Review of Policy Research* 35 (2): 302–25.

Rogers, E. M. 2003. *Diffusion of Innovations*. 5th ed. New York: Free Press.

Rumney, E. 2016. *Uganda Urged to Improve Infrastructure Delivery to Boost Economy, June 7*. Online. London, UK: Public Finance Focus.

Rwamigisa, P. B., K. Paul, F. B. Matsiko, M. N. Mangheni, and R. Birner. 2017. "When the Solution Became a Problem: Strategies in the Reform of Agricultural Extension in Uganda." In *Agronomy for Development: The Politics of Knowledge in Agricultural Research*, edited by J. Sumberg, 91–103. New York: Routledge.

Schmeer, K. 2000. *Stakeholder Analysis Guidelines*. Geneva: World Health Organization. https://www.who.int/workforcealliance/knowledge/toolkit/33.pdf?ua51.

Schut, M., P. van Asten, C. Okafor, C. Hicintuka, S. Mapatano, N. L. Nabahungu, D. Kagabo, M. Perez, N. Emmanuel, P. M. Donstop-Nguezet, M. Sartas, and B. Vanlauwe. 2016. "Sustainable Intensification of Agricultural Systems in the Central African Highlands: The Need for Institutional Innovation." *Agricultural Systems* 145: 165–76.

State House of Uganda 2019. *National Priorities: Infrastructure Development in Roads, Railways and Energy*. Kampala: State House of Uganda. http://www.statehouse.go.ug/national-priorities/infrastructure-development-roads-railways-and-energy.

Sulaiman, R. V., D. Chuluunbaatar, and V. Sreeram. 2018. *Upscaling Climate Smart Agriculture: Lessons for Extension and Advisory Services*. Rome: FAO.

Thuo, M., A. A. Bell, B. E. Bravo-Ureta, M. A. Lachaud, D. K. Okello, E. N. Okoko, N. L. Kidula, C. M. Deom, and N. Puppula. 2014. "Effects of Social Network Factors on Information Acquisition and Adoption of Improved Groundnut Varieties: The Case of Uganda and Kenya." *Agriculture and Human Values* 31 (3): 339–53.

Tiyo, C. E., F. L. Orach-Meza, and E. L. Edroma. 2015. "Understanding Small-Scale Farmers' Perception and Adaptation Strategies to Climate Change Impacts: Evidence from Two Agro-Ecological Zones Bordering National Parks of Uganda." *Journal of Agricultural Science* 7 (10): 253–70.

United Nations Development Program (UNDP). 2019. *Country Profiles: Uganda*. New York: UNDP. http://hdr.undp.org/en/countries/profiles/UGA.

United States Government. 2016. *U.S. Government Global Food Security Strategy: FY 2017–2021*. Washington, DC: United States Government. https://www.usaid.gov/sites/default/files/documents/1867/USG-Global-Food-Security-Strategy-2016.pdf.