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Agriculture in Shifting Climates: The Configuration and Ripeness of Problem Understandings in Uganda and Senegal

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ABSTRACT

The international community has advocated the adoption of climate-smart agriculture (CSA) as lower-income countries deal with the negative consequences of climate change. Scaling up such policies, practices, and programs successfully will require support from a variety of local stakeholders. Such support requires alignment between CSA solutions and the problem understandings of stakeholders. However, problem understandings can differ across individuals, stakeholder groups, and geographic areas. Consequently, we examine understandings of climate problems and socioeconomic and infrastructure problems related to agriculture among different stakeholder groups in Uganda and Senegal. We operationalized and measured these problem understandings following the detailed guidance of the political will and public will approach for analyzing social change. Semistructured interviews elicited stakeholder-generated lists of problems for each group. Limited quantification of problem understandings and their relative importance or "ripeness" demonstrates how contexts might shape opportunities for CSA.

KEY WORDS: climate change, developing countries, environment, governance

气候转变背景下的农业：乌干达和塞内加尔在问题理解上的布局和成熟度

国际社会已提倡低收入国家采取气候智能型农业（*climate-smart agriculture, CSA*）应对气候变化带来的消极结果。为成功扩大此类政策、实践和相关计划，需要一系列本地利益相关者的支

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持。这样的支持要求将*CSA*解决措施和利益相关者对气候问题的理解联系起来。然而，不同的个人、利益相关者群体和地理位置都可能对问题的理解不尽相同。因此，本文检验了乌干达和塞内加尔地区不同利益相关者群体对与农业相关的气候问题、经济社会问题、基础设施问题的看法。本文依照政治意愿和公众意愿方法（用于分析社会变化）的仔细指导，对问题理解（*problem understanding*）进行了操作化和衡量。半结构化面试得出了每组利益相关者群体列出的问题。对问题理解的有限量化（*limited quantification*），加上相关重要性/"成熟度"（*ripeness*），共同证明了情境如何能影响 *CSA* 机会。

关键词：气候变化, 发展中国家, 环境, 治理

La Agricultura En Climas Cambiantes: La Configuración y Madurez Del Entendimiento De Los Problemas En Uganda y Senegal

La comunidad internacional ha apoyado la adopción de la agricultura "climate-smart" (CSA) ya que los países de bajos ingresos están lidiando con las consecuencias negativas del cambio climático. Incrementar estas política, prácticas y programas exitosamente requerirá apoyo de una variedad de partes interesadas. Este apoyo requiere un alineamiento entre las soluciones de la CSA y el entendimiento de problemas de las partes interesadas. Sin embargo, el entendimiento de los problemas puede ser distinto en diferentes individuos, grupos de interesados y áreas geográficas. Consecuentemente, examinamos el entendimiento de problemas del clima en temas socioeconómicos e infraestructurales, relacionados a la agricultura, en diferentes grupos de interesados en Uganda y Senegal. Pusimos en práctica y medimos estas formas de entender el problema con la ayuda de la dirección que nos da la aproximación de la voluntad política y pública para analizar el cambio político. Las entrevistas semi estructuradas fomentaron la creación de listas generadas por las partes interesadas para cada grupo. La cuantificación limitada de las formas de entender el problema y su importancia o "madurez" relativa demuestra cómo los contextos pueden formar oportunidades para la CSA.

Palabras clave: cambio climático, países en vías de desarrollo, medio ambiente, gobernanza

Introduction

Climate change is already affecting agriculture in significant ways, including variability in precipitation and seasons in our study countries of Uganda and Senegal (Boko et al., 2007; Hepwerth & Goulden, 2008; Senegalese National Agency for Civil Aviation and Meteorology, 2013). This variability makes agriculture much more difficult, which in turn has serious implications for nutrition, food security, and poverty in many low-income countries. From the perspective of experts, deliberate and proactive adaptation to climate change is an urgent priority (FAO, 2016).

Climate-smart agriculture (CSA) has emerged as an umbrella term for policies, practices, and programs designed to deal with such climate-driven agricultural difficulties (FAO, 2013). CSA is an interesting example of a global effort (mostly aimed at low-income countries) with fairly flexible implementation at the country and local levels. However, regardless of the technical and scientific markers of the problems and the logical design of solutions, scaling up the implementation of CSA will require social change.

While supportive policies will be important, success will ultimately hinge on the willingness of local populations to adopt new practices and social structures and to endure new risks. Whether local populations are willing to undergo such significant changes depends on a variety of factors (e.g., see Feder & Umali, 1993;

Rogers, 2003; Stoneman & Battisti, 2010), and some exploration of how populations will react to CSA innovations has already begun (e.g., Bonilla-Findji, Zougmore, Henry, Shreeg, & Jarvis, 2016). We focus on the role of problem understandings in the successful long-term adoption of innovations.

Scholars and practitioners of participatory communication (Odugbemi & Jacobson, 2008), participatory action research (McIntyre, 2007), community-based participatory research (Hacker, 2013), and behavioral economics (Karlan & Appel, 2012) have observed that the effectiveness of social change depends on buy-in and active participation. Such buy-in requires recognizing the preferences and beliefs of local populations. These basic ideas are also important to branches of democratic theory with labels as varied as "civic engagement," "citizen participation," "deliberative democracy," "democratic governance," and "participatory governance," despite divergence in their details. Further, evidence that community and empowerment (i.e., increasing local knowledge, confidence, and self-efficacy) are crucial to success has emerged in large program reviews like the one recently completed for the U.S. government's Feed the Future initiative (USAID, 2016).

A key part of producing buy-in on the part of key stakeholders is their belief that the proposed changes will address an important problem (Denhardt & Denhardt, 2015; Foster-Fishman, Nowell, & Yang, 2007). Gathering information about local problem understandings is often a crucial first step in participatory action research approaches that involve local people as co-creators of knowledge (Reason & Bradbury, 2006). Historically, ignoring such local views has been the source of many foreign aid failures (Easterly, 2006). Problem understandings can vary across individuals, groups, geographies, and so forth. A solution aimed at a problem that is nonexistent or unimportant in the eyes of the local population is unlikely to be successful.

Participatory approaches, which assert that policies work better when policy participants are also policy advocates and implementers, are becoming better accepted in the public policy and administration communities. The traditional view of stages in the policy process tended to be a top-down conceptualization in which elites set the agenda and then legitimated their policy choices to the people (see Brewer & deLeon, 1983). Newer, more flexible approaches have recognized that publics supportive of specific policies can vary in composition. The shared understanding of problems helps to create a social system, which is a key component of such a "public" (e.g., Raile, Raile, Salmon, & Post, 2014).

In line with such ideas, our primary empirical research question is: how do different stakeholders understand climate and socioeconomic problems related to agriculture in Uganda and Senegal? A secondary question focuses on how these problem understandings might present opportunities and obstacles for policy entrepreneurs advocating CSA solutions. We used certain components of the political will and public will (PPW) approach for analyzing policy making and other social change efforts (Post, Raile, & Raile, 2010; Raile, Raile, & Post, 2017; Raile et al., 2014) in investigating these questions. The PPW approach is ideally suited to this task based on its clear operationalization of problem understandings and corresponding specification of targets for assessment. We used semistructured interviews to gather information about problem understandings from stakeholders. We then coded, counted, and diagrammed problem understandings for different key stakeholder groups within basic issue categorizations for each country. In the

following sections, we examine theory and background, cover the data and methods, detail the findings, supply analysis and comparison, and discuss the implications and extensions of this research.

Theory and Background

This section begins with consideration of the literature on problems, followed by a brief overview of problem understandings within the PPW approach. This discussion leads directly into the presentation of new tools for diagramming problem understandings. The final subsections provide background information about CSA and the two case study countries of Uganda and Senegal.

Problems

Problems are a central concept in the study of policy making and other forms of social change. The public policy-making literature frequently employs terms like "policy problem," "public problem," and "social problem," all generally referring to problems that affect social groups or require collective action. Problems have also featured prominently in textbooks and other major academic works dealing with the public policy-making process, policy analysis, or governance (e.g., Anderson, 2003; Bardach & Patashnik, 2015; Baumgartner & Jones, 2015; Brewer & deLeon, 1983; Eyestone, 1978; Sabatier & Weible, 2014). Researchers have used different terms to describe the process through which situations or conditions come to be seen as problems. Some talk in more objective ways about problem "identification," while others talk about more subjective processes of problem "definition" or "social construction" (Anderson, 2003; Jones, 1977; Mintrom & Norman, 2009; Peters, 2005; Spector & Kitsuse, 2000; Stone, 2012).

While defining problems is a significant exercise on its own, it is also a part of broader elite activities of agenda setting (Baumgartner & Jones, 1993; Entman, 1993; Kingdon, 2003; Rochefort & Cobb, 1994) and issue framing (Borah, 2011; Chong & Druckman, 2007). *Agenda setting* involves getting issues onto the short list of problems that a community must address. Researchers broadly recognize that *issue frames* specify the domain boundaries for an issue (e.g., this is a security issue) and consequently emphasize certain considerations and exclude others (Crow & Lawlor, 2016; Druckman, 2004; Edelman, 2001; Entman, 1993; Nelson, 2004; Stone, 2012). Policy entrepreneurs or claims-makers (Mintrom & Norman, 2009; Spector & Kitsuse, 2000) are elites who attempt to shift problem perceptions through issue categorization and through linking problems and solutions within an issue frame. Our research requires a systematic way to examine the problem definitions that stakeholders possess (i.e., problem understandings). The PPW approach provides the necessary tools.

Political Will and Public Will Approach

The PPW approach supplies a systematic framework for analyzing political and public support for public policies and other social change initiatives (see Post et al.,

2010; Raile et al., 2014, 2017). Conceptual definitions of "political will" and "public will" are the core of the approach, accompanied by operationalizations, targets for assessment, and ideas about measurement for each component. We focus on public will here, as our stakeholder samples fall within this realm. The definitional components of public will are:

> "1. Social system;
> 2. Shared recognition of a particular problem;
> 3. Resolve to address the situation;
> 4. In a particular way; and
> 5. Through sustained collective action." (Raile et al., 2014)

The PPW approach emphasizes the importance of stakeholders sharing common problem and solution understandings in order to achieve social change (Raile et al., 2017). Intention to do something about a problem means little if members of a social collective do not see the problem or solution similarly.

The PPW approach integrates theoretical insights from prominent approaches like multiple streams (Kingdon, 2003), punctuated equilibrium theory (Baumgartner & Jones, 1993), and Stone's (2012) exposition on ideas and the construction of policy arguments. The PPW approach builds on these precursors by focusing more explicitly on the *mechanics* of problem and solution understandings. How might we carefully define such understandings? What, exactly, does it mean for problem and solution understandings to align? How can we go about assessing and measuring these understandings and their alignment? How can existing knowledge about persuasion strategies be used to facilitate this alignment? The PPW approach answers these questions through careful explication of concepts, aiming for systematic and scientific description while relying on established theories for assertions about causality. Further, the PPW approach differs in its call for direct examination of the distribution of problem and solution understandings within and across social groupings. In short, the use of the PPW approach in this project is essential to analyzing problem understandings in a consistent and in-depth way. Other approaches provide essential theoretical underpinnings but do not delve as far into the details of problem and solution understandings.

According to the PPW approach, a "social system" is identified in part by its shared understanding of a particular problem (Raile et al., 2014). Consequently, a researcher can look for *potential* publics by first identifying problem understandings among important stakeholders. These stakeholders might not meet the other component requirements for a "public" as specified above, but shared problem understanding is a crucial starting point for the composition of a public that could effectively push for social change. The PPW approach proposes operationalizing "shared recognition of a particular problem" as: (1) recognition that a condition must be addressed and (2) convergence in terminology surrounding the problem (Post et al., 2010; Raile et al., 2014). The approach involves investigating whether stakeholders are using a similar frame and terminology for the problem, as well as whether stakeholders share a view that something must be done (Raile et al., 2014). According to the authors, evidence for the latter may come from attitudes and beliefs and the volume of such expressions. In line with this approach, we devise a method for measuring the importance of problems as a function of the

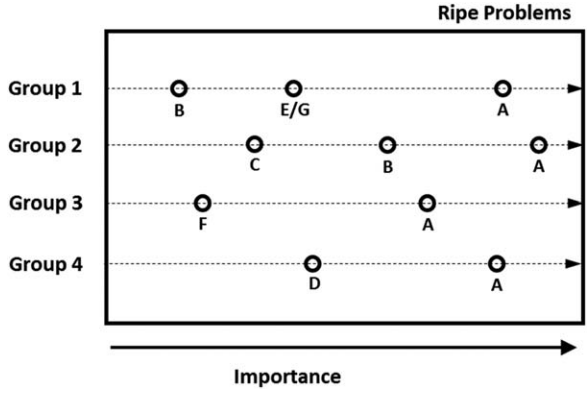

Figure 1. Sample problem diagram for climate-agriculture category

volume of concern and convergence in terminology within stakeholder groups. Problems viewed as more important by stakeholders are "ripe" in that the stakeholders are readier to see these problems addressed.

The rectangle in Figure 1 represents the climate-agriculture category for all four stakeholder groups (i.e., Groups 1–4) in a hypothetical exercise. Each of the small circles labeled with one or more letters (e.g., A, B, C) in Figure 1 is a particular problem (e.g., "A" is crop diseases and pests) within the category. A problem can appear in multiple categories simultaneously and can appear in different categories for different stakeholder groups. The horizontal dimension in Figure 1 indicates problem importance. The right-hand area of the rectangle is a region of ripeness that can accommodate relatively few problems. Researchers might operationalize importance in a number of ways, including salience or relevance to stakeholders, the perceived urgency or need to find a solution, the breadth of recognition of the problem within the stakeholder group or public, or the perceived magnitude or severity of the problem. Inclusion of a problem in a particular category (i.e., climate-agriculture) suggests that language surrounding the problem is pretty well aligned within a stakeholder group, though not necessarily across stakeholder groups. In other words, members of a stakeholder group are using language and symbols more or less uniformly (i.e., convergence in understanding) and also likely share beliefs about the problem and its causes.

Figure 1 is an example snapshot of problem understandings, but this configuration can change over time. Though issue categorization is often the first part of the problem definition process (Peters, 2005), problems can shift from one issue category to another (e.g., the hypothetical movement of B to the socioeconomic and infrastructure-agriculture category for Group 1). The movement of a problem into a new issue category can establish a different solution as reasonable or appropriate (Stone, 2012) or can make the same solution more desirable. For example, the problem of failing family farms might call for government protectionism when categorized as an issue of traditional values but might call for job retraining programs when categorized as an economic modernization issue or a free trade issue. As another example, some people will view a carbon tax as a more reasonable solution for climate change when the problem is categorized as a public health or national security issue than when categorized as an

environmental or energy issue. Our project is looking for problem understandings that might fit well with CSA solutions.

Climate-Smart Agriculture

The first use of the term "climate-smart agriculture" is generally attributed to a 2010 document prepared by the Food and Agriculture Organization (FAO) of the United Nations (UN). The international community recognizes three common elements of CSA: "(1) sustainably increasing agricultural productivity and incomes; (2) adapting and building resilience to climate change; and (3) reducing and/or removing greenhouse gas emissions, where appropriate" (FAO, 2013). CSA is an integrated or systems approach to the management of crops, livestock, forests, and fisheries that calls for adapting policies, practices, and technologies to local conditions (FAO, 2013). CSA advocates have differentiated CSA from concepts like "conservation" or "sustainable" agriculture. In essence, conservation agriculture is a set of practices that can contribute to the broader goals of CSA, but not all CSA activities are conservation agriculture practices (Shreeg, 2015). The same applies to sustainable agriculture practices. The CSA approach calls for agricultural "intensification," or greater production per unit of inputs, as a means of simultaneously increasing agricultural productivity and reducing greenhouse gas emissions.

CSA encompasses a range of potential solutions to a variety of problems (Steenwerth et al., 2014). Common CSA programs involve seeds that are more resilient to perturbations or more efficient water delivery systems. The U.S. Government's Feed the Future (FtF) initiative, which operates primarily in the sub-Saharan region, treats CSA as a topic that cuts across programs. FtF projects in Uganda involve education, research, and training activities to improve climate change adaptation, as well as work with policy advancement. Though drip irrigation projects are popular in Senegal, FtF has also implemented projects on nutrition and sustainable fisheries. The Research Program on Climate Change, Agriculture, and Food Security (CCAFS) sponsors climate-smart villages in both Uganda and Senegal (see Sanogo et al., 2016). CCAFS has also assisted with national adaptation planning in Uganda and has sponsored a climate information initiative that utilizes radio transmissions in Senegal. Another project in Uganda sponsored by the UN Development Program, FAO, and the Common Market for Eastern & Southern Africa (COMESA) aimed to increase productivity through sustainable soil and water management. In Senegal, the World Bank Group is implementing a project on female leadership, sustainable energy, and climate resilience. These are just a few of the many projects recently implemented in these countries and throughout Africa.

Case Study Countries

We analyze understandings of agriculture-related problems in the two countries of Uganda and Senegal. A USAID requirement that the work be done in two Feed the Future countries in sub-Saharan Africa set a parameter for case selection. The general importance of agriculture and the broad shape of challenges in the areas of

poverty, nutrition, and climate change are similar throughout sub-Saharan Africa. These similarities ensured that the types of information we were eliciting would be relevant to stakeholders. On the other hand, given that our research question emphasizes variance in specific problem understandings, our case selection aimed for variance in geographic location, colonial heritage, and governance situation. Differences between the two countries would provide analytical leverage. Our case selection was neither a "most similar systems" nor a "most different systems" design (see Przeworski & Teune, 1970), as both designs are based on isolating causal relationships between independent and dependent variables. Our study is more concerned with accurate description of problem understandings. Rather than being central, the comparative component supplements the primary analysis in this study.

Uganda has experienced large fluctuations between democratic attempts and authoritarian governments since gaining independence from Britain in 1962. Though formally labeled a multiparty presidential republic, the same individual has occupied the presidency and controlled the government for 30 years. Evaluators of democracy label Uganda as marginally autocratic or "not free," though the press receives a grade of "partly free" (Center for Systemic Peace, 2010b; Freedom House, 2017b). This Eastern African country ranks near the bottom globally in human development (including income, education, and life span) and state stability (Fund for Peace, 2017; United Nations Development Program, 2017b).[1]

Examining poverty and agriculture numbers more closely, about one-third of Uganda's population was at or below the World Bank's poverty line of $1.90 per day in 2012 (World Bank, 2017b). Uganda also remains largely agrarian, with the vast majority of Ugandans living in rural areas and working in agriculture, though most farms are small (United Nations Development Program, 2017b; World Bank, 2017d).[2] The Government of Uganda has invested relatively little in agriculture in recent years; investment has often been about 3% of the national budget (Nabwiiso, 2015). The Uganda Ministry of Agriculture, Animal Industry and Fisheries (2010) cites many challenges facing the agricultural sector, including: low levels of productivity across sectors, declining soil fertility, uncertain land rights leading to underinvestment, inadequate infrastructure to support value-added processing, and difficulties meeting increasingly high international standards for food safety and quality.

Climate change is a particularly serious threat for Africa and for the food security of its peoples (see Africa Rice Center, 2011; Tirado, Hunnes, Cohen, & Lartey, 2015). A study of Uganda's vulnerability to climate change points to rapidly increasing temperatures, greater frequency of intense rain events (with corresponding flooding), and greater frequency or severity of heat waves and droughts (Hepwerth & Goulden, 2008). These changes are all directly consequential for agriculture in Uganda.

The second case study country, Senegal, is a former French colony in Western Africa. Since independence in 1960, Senegal generally has experienced a stepwise move toward democracy. Senegal's presidential republic is now one of the most democratic regimes in sub-Saharan Africa, though press freedom is somewhat problematic (Center for Systemic Peace, 2010a; Freedom House, 2017a).[3] Senegal ranks roughly even with Uganda in human development, due primarily to the low

current mean years of schooling (United Nations Development Program, 2017a).[4] On the other hand, Senegal is considerably more stable than Uganda despite ongoing reasons for concern (Fund for Peace, 2017).[5]

Detailed numbers for Senegal reveal 38.0% of the population at or below the World Bank's poverty line, with 56.3% of the population in rural areas and 46.1% of employment in agriculture (United Nations Development Program, 2017a; World Bank, 2017a, 2017c).[6] The government of Senegal has devoted more than 10% of its national budget to investment in the agricultural sector in recent years (Republic of Senegal Ministry of Agriculture, 2013). This investment is in line with the pledge made by African governments in 2003 as part of the African Union's *Maputo Declaration on Agriculture and Food Security*—a pledge a number of African countries have not met. In terms of nutrition, moderate but chronic malnutrition with deficiencies of micronutrients and protein are common (Feed the Future, 2011), contributing to relatively high child and maternal mortality rates.

Increasing agricultural production in Senegal is a challenge. Senegal is mostly in the Sahel, so the agricultural sector is subject to erratic rainfall and drought. Very little of the land under cultivation is irrigated, and soils are poor and have been subject to degradation in areas (Mbow, Mertz, Diouf, Rasmussen, & Reenberg, 2008; Ndiaye, 2007). Major problems in the agricultural sector have included inadequate access to capital, low levels of technical knowledge, problems with seed stock, limited diversification in production, and gender inequalities (World Bank, 2013). Agriculture contributes only about 17.5% of added value to gross domestic product (World Bank, 2017e), which illustrates the prevalence of subsistence farming.

Experts see Senegalese agriculture as quite vulnerable to climate change, especially given the rain-fed nature of nearly all operations (Msangi, 2014). Temperatures are expected to rise. Though rainfall is hard to predict, the central region and sylvo-pastoral zones are likely to be most impacted by climatic variability; further, flooding frequency has increased since 2000 (Climate risk, 2013). Flooding has become a rather severe problem in places, both as a result of heavy rainfall and sea level rise. The rising temperatures, flooding, and other climatic changes are significant concerns for agricultural producers (Bonilla-Findji, et al., 2016; USAID, 2016).

Data and Methods

Case studies of Uganda and Senegal constitute the basic research design, with semi-structured interviews serving as the primary method of data collection. Surveys are ill suited as a method in this study because they limit responses to options generated by the researchers. The first task within the research design, and the initial task within the PPW approach (Raile et al., 2017), is identification of relevant stakeholders. Due to resource limitations, we could not talk with a comprehensive list of stakeholders from the entirety of both countries. Consequently, we attempted instead to talk with individuals in the major stakeholder categories most relevant to answering our research question. Consistent with guidance on stakeholder analysis practices (see Schmeer, 2000), our working group identified stakeholder categories and individuals based on a review of documents and the input of local experts. We were

looking for local people who could become part of publics, namely those who could contribute to social systems that would be supportive of CSA solutions. We first identified general stakeholder categories that fit this criterion and then individuals within these categories. We excluded donors from consideration at this stage due to their primarily external status and the fact that they typically function more like policy entrepreneurs than as members of publics built from the bottom up.

As a result of this process, we identified four stakeholder categories as important: (1) employees of national and local government entities working in the areas of agriculture, livestock, agribusiness, water, the environment, meteorology, nutrition, and agricultural extension; (2) researchers working in the above areas (even if also government employees); (3) agricultural producer groups and producers; and (4) nongovernmental organizations (NGOs) working in the areas of agriculture, the environment, and relevant private sector issues. Categorization of interviewees was mutually exclusive, meaning that each interviewee was assigned to only one group. Our sampling approach was a purposive one that aimed to maximize variation in key characteristics (see Bryman, 2016) given resource constraints. Though we sampled solid cross-sections in the first two groups (government and researchers), our coverage of the latter two groups (producers and NGOs) was less inclusive, which has implications for our findings.

The questions in the semistructured interview protocol derived from the conceptual definitions and from the operationalizations and targets for assessment in the PPW approach (Post et al., 2010; Raile et al., 2014). Most relevant to the present study were questions in the protocol aimed at gathering information about stakeholder understandings of problems. The major problem categories (i.e., the frames)—climate, social, economic, and nutrition problems related to agriculture—in the protocol resulted from a review of documents and potential linkages to CSA. However, the wording of the questions within these categories was open ended to allow for an inductive, organic process of stakeholder identification of problems as suggested by the PPW approach. The questions about problems appeared at the very beginning of the protocol to ensure that views of problems would not be shaped by discussion of other topics.[7] Again, the PPW approach operationalizes shared problem understandings based on the use of similar frames and terminology, as well as a view that something must be done. The use of the word "problems" in the questions implied that something must be done. The problem-related questions themselves were:

1. What do you think are major climate problems related to agriculture in your country, if any, either now or in the future?
2. What do you think are the major nutrition problems in your country?
3. What do you think are the major economic problems related to agriculture in your country?
4. What do you think are the major social problems related to agriculture in your country?

We conducted interviews within each of the four stakeholder groups in both countries. We conducted a total of 27 semistructured interviews over the course of 5 days in July 2015 (involving 51 people total) in Uganda. Meetings took place in the capital of Kampala and in the two districts of Namutumba and Bukedea. Similarly, we

conducted 21 semistructured interviews over the course of 5 days in September 2015 (involving 46 people total) in Senegal. These meetings took place in the capital of Dakar and various locations throughout the Senegal River Valley. In both cases, group interviews were limited almost exclusively to the producer and NGO categories. Conversely, the government employee and researcher categories tended to involve one and sometimes two interviewees per meeting. The typical interview lasted just under one hour. One or two researchers attended each meeting in Uganda, depending on schedules. In Senegal, two researchers attended each interview, along with a local interpreter and sometimes a facilitator. We took field notes and typically made audio recordings during the interviews. Interviewees received an informed consent statement and were given an opportunity to decline the recording of the interview, and a very small number of interviewees did decline. Names of interviewees were not directly linked to the field notes or audio recordings.

Given the desire for interviewees themselves to identify problems within the broad categories, basically any discussion of problems was relevant. The early placement of these questions in the protocol ensured that interviewees had enough time to provide their responses comprehensively. We prompted for additional information when necessary to identify the problems accurately.

We uploaded transcripts of audio recordings and typewritten field notes into qualitative data analysis software. The software allowed for coding text into nodes and subnodes and producing matrices of data.[8] The major coding nodes (climate, socioeconomic and infrastructure, and nutrition problems) basically mirrored the interview protocol categories in a deductive coding approach (Miles, Huberman, & Saldaña, 2014). We developed the subnodes (i.e., specific problems) within each major node using a collaborative, inductive, and descriptive process (Miles et al., 2014). In other words, the empirical responses from the interviewees served as the basis for constructing the subnodes, and we refined and recoded these subnodes in multiple rounds with multiple coders. We allowed for simultaneous coding of text into multiple different nodes or subnodes. The inductive coding of the interviewees' language allowed for assessment of the terminology used by interviewees, in line with the PPW operationalization of problem understandings. We coded the Uganda transcripts first and followed a parallel process for Senegal.

Findings

This section discusses the plotting of problem scores within categories for the two countries. Frequency distributions are one of the potential outputs of the coding process described in the previous section. Table 1 displays frequencies as they relate to the "climate-agriculture" and "socioeconomic & infrastructure-agriculture" categories for each country.[9] These frequency distributions represent one potential measure of importance (i.e., the horizontal dimension in the space in Figure 1). The number immediately following each stakeholder group in Table 1 is the number of interviews conducted within that group. The numbers after each particular problem are the total number of mentions and then the total number of interviews in which the problem was mentioned.

We calculated a score for each problem using the formula of:

$$\left(\frac{Number\ of\ interviews\ in\ which\ problem\ was\ mentioned}{Number\ of\ interviews\ conducted}\right)\times \left(\frac{Total\ number\ of\ mentions}{Number\ of\ interviews\ conducted}\right)$$

These numbers are all specific to a stakeholder group and country. The first result is the proportion of interviews mentioning the problem, which gives a sense of the breadth of concern. The second result is the number of mentions per interview conducted, which gives a sense of the intensity of concern. Multiplying these two quotients together essentially weights breadth of concern by intensity of concern. This formula tends to reward breadth of concern over one interviewee mentioning a problem multiple times. Problems appear in each cell in order from highest to lowest score.[10]

Table 1. Problems by Country, Category, and Stakeholder Group

UGANDA	SENEGAL
Climate-Agriculture	***Climate-Agriculture***
Government (9): inadequate rainfall (9/6); extreme weather events (8/6); precipitation & seasonal variability (8/5); habitat loss (7/3); soil degradation (3/3); crop diseases and pests (3/2)	**Government (6)**: inadequate rainfall (9/4); sea water intrusion & salinization (6/3); precipitation & seasonal variability (5/3); deforestation (3/2); increasing temperatures (3/2); crop diseases & pests (5/1); erosion (3/1)
Researchers (11): precipitation & seasonal variability (8/5); inadequate rainfall (4/3); extreme weather events (2/1)	**Researchers (6)**: precipitation & seasonal variability (8/3); loss of biodiversity (6/2); inadequate rainfall (3/3); sea water intrusion & salinization (2/2); increasing temperatures (2/1)
Producer groups (2): extreme weather events (6/2); inadequate rainfall (4/2); precipitation & seasonal variability (4/2); crop diseases and pests (3/2)	**Producers (4)**: precipitation & seasonal variability (5/2)
NGOs (5): inadequate rainfall (4/3); precipitation & seasonal variability (2/2); habitat loss (3/1)	**NGOs (5)**: Inadequate rainfall (6/3); precipitation & seasonal variability (3/2); deforestation (4/1); low crop yields (2/2); sea water intrusion & salinization (2/1)
Socioeconomic & Infrastructure-Agriculture	***Socioeconomic & Infrastructure-Agriculture***
Government (9): food/crop storage (8/3); poverty (8/3); inadequate farm size (4/3); gender-related issues (3/3); seed quality (2/2); mechanization (2/1); need for cooperatives (2/1); reckless behavior (2/1); unproductive agriculture (2/1)	**Government (6)**: urban migration (6/3); input problems (3/3); low investment (4/2); high food prices (2/2); traditional methods (2/2); access to water (2/1); food/crop storage (2/1)
Researchers (11): food/crop storage (15/6); inadequate farm size (10/6); seed quality (10/6); other inputs (8/7); output markets (10/5); middle men (8/4); need for cooperatives (4/3); transportation (4/3); population growth (2/2); gender-related issues (2/1); poverty (2/1)	**Researchers (6)**: insufficient irrigation (3/3); traditional methods (3/2); access to water (2/2); not rice self-sufficient (2/2); gender-related issues (2/1)
Producer groups (2): food/crop storage (11/2); output markets (6/2); middle men (5/1); need for cooperatives (4/1); poverty (2/2); other inputs (3/1); seed quality (3/1); unproductive agriculture (2/1)	**Producers (4)**: mechanization (2/1)
NGOs (5): gender-related issues (8/2); food/crop storage (2/2); other inputs (2/2); output markets (2/2); poverty (2/2); inadequate farm size (2/1); seed quality (2/1)	**NGOs (5)**: low investment (3/3); access to water (3/2); health/healthcare (2/2); not rice self-sufficient (2/2); poverty (2/2); food/crop storage (3/1); international competition/export problems (2/1)

Notes: The two categories shown here are (1) climate-agriculture and (2) socioeconomic & infrastructure-agriculture. The four stakeholder groups for each categorization are government, researchers, producers, and NGOs. Numbers immediately following each stakeholder group are the number of interviews. Within each stakeholder cell, problems are listed in terms of importance score from high to low. The first figure after each problem is the number of coded in the data, and the second figure is the number of persons or groups who mentioned the problem. For example, 5/3 would indicate 5 mentions by 3 persons/groups. Only problems that received multiple mentions are shown in the table due to space limitations.

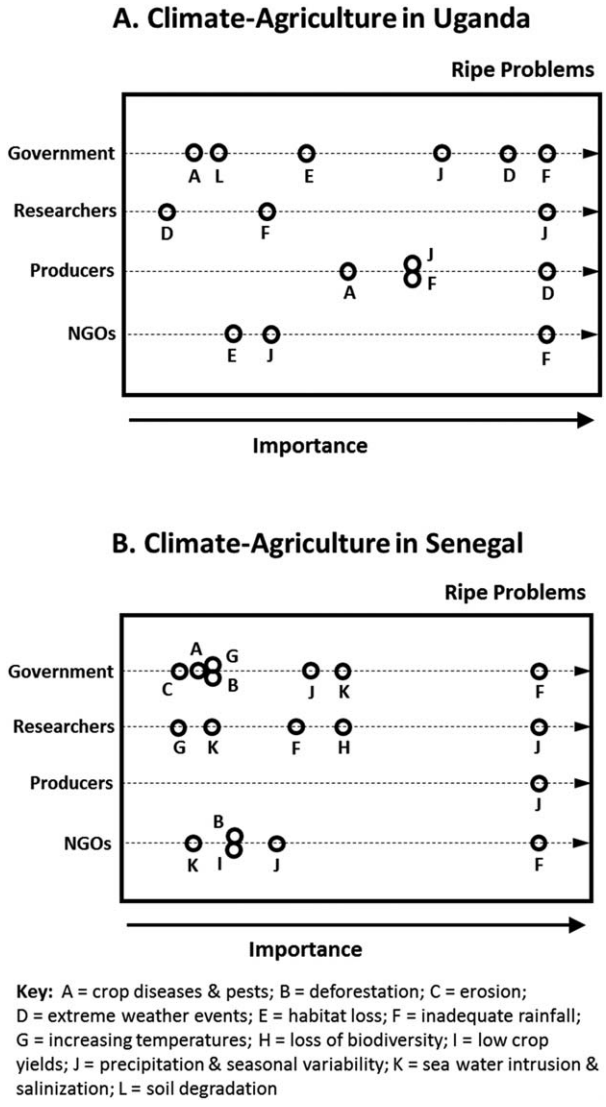

Figure 2. Problem understandings and climate-agriculture category

Figure 2 plots particular problems in the climate-agriculture category as described by the interviewees for both Uganda (2A) and Senegal (2B). The highest score attained by a single stakeholder group within a particular category is placed at the right-hand edge of the figure. The figure then scales the scores proportionally within each stakeholder group. In Figure 2B, for example, the highest score for the government group (F) is 1.000 and the second highest (K) is 0.500. Consequently, the latter is halfway across the figure from left to right. While this approach does not ensure strict equivalence across stakeholder groups or countries, it does indicate which problems are more or less ripe within a stakeholder group.[11] Further, the approach shows relationships among problems within a particular stakeholder group and shows which problems are at least on the radar of most or all groups.

Looking first at Figure 2A for Uganda and the climate-agriculture category, the most prominent problems align rather well across the four stakeholder groups. The three most prominent are extreme weather events (D), inadequate rainfall (F), and precipitation and seasonal variability (J). However, the ordering and magnitude differ a bit from one stakeholder group to another. These problems relate to one another in logical ways. Rainfall can be inadequate during certain periods even if overall rainfall does not change due to concentrated bursts of rain in extreme weather events. Conversely, droughts are extreme weather events that involve inadequate rainfall. Such extreme events contribute to variability in precipitation. The changing of seasons, particularly with regard to the onset of rainy periods, is another significant problem. Researchers are especially worried about this problem (see Figure 2A). Although these three problems are distinguishable, coding some or all together would also be a defensible decision. These problems also align well with the scientific studies and projections mentioned earlier. Such alignment with scientific models is not altogether surprising given that some of the interviewees are scientists working in climate-related areas. However, the other groups express these same concerns, and one might not find such uniformity in a place like the United States in which climate change is very politicized and polarizing. Other problems receiving some attention in Uganda are crop diseases and pests (A) and habitat loss (E), both with direct connections to climate change and consequences for agriculture.

Figure 2B displays the corresponding findings for Senegal in the climate-agriculture category. The same pattern roughly holds, with inadequate rainfall (F) and precipitation and seasonal variability (J) emerging in prominent places. Extreme weather events (D) are a less common problem in the case of the Senegalese interviewees. The interviewees as a whole also mention a greater variety of problems in this category, though most problems cluster in the area of lesser importance. Other problems of some prominence in Senegal are deforestation (B), increasing temperatures (G), loss of biodiversity (H), and sea water intrusion and salinization (K). Here, too, the patterns make sense, and the problems hold together well. Increasing temperatures are the core element of climate change, and the last two are clearly consequences of climate change. Concern about increasing temperatures may be more acute in Senegal due to the level of heat already. Loss of biodiversity includes certain crops that can no longer be grown in traditional areas. Rising sea levels are pushing salt water up rivers and into aquifers, thereby endangering water supplies and soils used in agriculture.

Figure 3 similarly plots socioeconomic and infrastructure problems related to agriculture. Beginning with Figure 3A for Uganda, most striking is food and crop storage (B), which is the first problem in three stakeholder groups. This problem includes both postharvest storage of crops and food storage for families, as the two are often indistinguishable, particularly given the scope of subsistence farming in the country. The lack of crop storage also affects the ability of farmers to store crops long enough to sell surpluses at market. Gender-related issues (C) are the foremost problem for NGOs, and poverty (S), a cross-cutting problem, is tied in the first position for government employees. Inadequate farm size (F) and inadequate markets for selling crops (Q) also show up in intermediate positions across multiple groups. Small farm sizes make anything beyond subsistence farming difficult (due in part to the infeasibility of mechanization), and inability to sell crop surpluses at markets

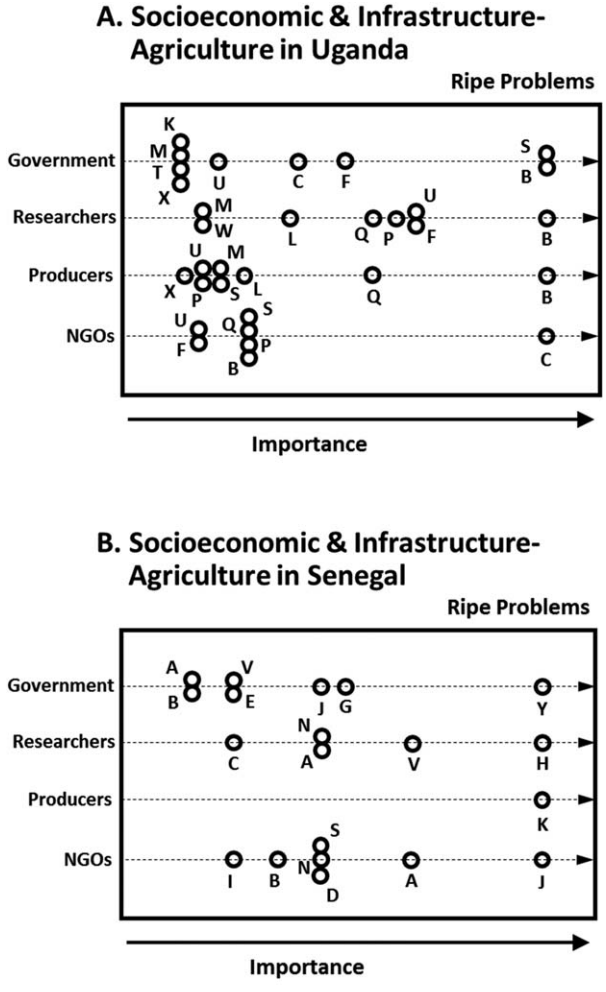

Figure 3. Problem understandings and socioeconomic & infrastructure-agriculture category

further damages incomes. The sheer number of problems mentioned and the consequent extreme clustering are noteworthy in this figure. By any objective metrics, Uganda does have many major socioeconomic and infrastructure problems, and the interviewees are aware of them. In terms of development priorities, these may all be pressing problems but addressing all simultaneously is not feasible.

Figure 3B completes the exercise for Senegal in the socioeconomic and infrastructure-agriculture category, with the most conspicuous finding being the general lack of agreement across stakeholder groups. Government employees see urban migration (Y) as most important. Most pressing for researchers is insufficient irrigation

(H) and for NGOs is low investment (J). The urban migration concerns are tied to the lack of agricultural labor available in rural areas. Insufficient irrigation applies in part to the government's plan for rice self-sufficiency (discussed below). Low investment applies both to government investment in agriculture and to the availability of credit for smallholder farmers. The producer group spent very little time discussing these types of problems; they talked much more about climate and about their operations and irrigation schemes. However, mechanization (K) does arise as a problem, particularly as related to the difficulties of buying and maintaining irrigation machinery. Access to water (A), for multiple uses, is the only problem that appears across at least three stakeholder groups. The use of traditional farming methods (V), which is viewed as a drag on productivity growth, appears for two groups and more prominently for researchers.

Analysis and Comparison

What do our findings mean for the general feasibility of CSA solutions in the two case study countries? In Uganda, understanding of the nature of climate-driven agricultural problems is rather uniform both within and across stakeholders groups. Furthermore, this understanding fits with the direct, stated aims of CSA. However, the scope and number of socioeconomic and infrastructure problems that affect agriculture in Uganda (see Figure 3A) mean that competition for potential agenda space is considerable. Additionally, from the perspective of producers, maintaining only subsistence farming (rather than intensifying production as suggested by CSA approaches) makes sense when farm sizes are small, storage of surplus crops is difficult, and getting surplus crops to market is a challenge. Though not yet mentioned, very real concerns among stakeholders about adulterated seed, fertilizer, and other inputs are also drags on any kind of innovation, including the adoption of new seed varieties that are more drought tolerant. This competition for potential agenda space brings us to the standard foreign aid and development question of whether dealing with many problems at once (e.g., Sachs, 2005) or using small, focused, local interventions (e.g., Easterly, 2006; Karlan & Appel, 2012) is the better approach. The government of Uganda currently is taking something of a third path that fits with traditional ideas about modernization: investment in general infrastructure in the hopes that benefits will spread to other sectors like agriculture (Lucía Coronel, 2015).

Policy entrepreneurs should have relatively straightforward opportunities to link problems to CSA solutions in Uganda. Understandings of problems like extreme weather events, inadequate rainfall, and precipitation and seasonal variability pose direct opportunities. However, beyond the number and scope of competing problems, communication and informational difficulties are also obstacles for policy entrepreneurs and innovators who wish to spread CSA knowledge. Among such problems mentioned by stakeholders are the need for cooperatives, the lack of market information, and agricultural extension service difficulties. As a consequence of these communication obstacles, policy entrepreneurs may need to work on disseminating information and innovations directly.

While the communication challenges in Uganda are not entirely unique, they are a meaningful context when thinking about opportunities to link problem understandings to CSA solutions. Our findings for the NGO and producer groups are

contingent on the particular interviewee identities given the sample sizes relative to the larger populations. Therefore, the samples are another important context. A survey in the rural Sahel several years ago found that villagers were much more likely to name other economic, political, and social factors as major challenges for daily life than to name climate change (Mertz, Mbow, Reenberg, & Diouf, 2009). Additionally, a survey in central Senegal found that farmers incompletely understood the causes and consequences of climate change (Tschakert, 2007). In contrast, some producers in our samples had previous experience with CSA, which likely influenced their responses. Their geographic locations and particular crops grown are other important contexts. Our sample of NGOs included organizations focused on the environment, agriculture, women, and business interests. Not surprisingly, the problems they identified tended to run along those lines. A different or broader sample might supply additional information about obstacles and opportunities.

In the case of Senegal, precipitation and seasonal variability and inadequate rainfall are also problems that lend themselves well to the major objectives of CSA. Certain problems mentioned less prominently, like higher temperatures, sea level rise, and a loss of biodiversity, are good potential fits, as well. The general lack of agreement about socioeconomic and infrastructure problems among stakeholders may cut in two directions by either opening the agenda to CSA solutions or generating enough noise to complicate the agenda-setting process. However, a number of the socioeconomic and infrastructure problems are related to the importance of water, which provides a potential focus. Interviewees also provide information about government priorities and agenda competition. More specifically, interviewees in all four stakeholder groups repeatedly mention the goal of food self-sufficiency, especially rice self-sufficiency, as a primary agricultural priority for the government of Senegal. Like general investment in infrastructure in Uganda, attention paid to rice self-sufficiency has opportunity costs for certain CSA programs mentioned previously.

Policy entrepreneurs in Senegal also have relatively straightforward opportunities for promoting CSA innovations. CSA policies and programs that can fit neatly with both climate-driven agricultural problems and water problems seem particularly good given the lack of cohesiveness around socioeconomic and infrastructure problems otherwise. Policy entrepreneurs also need to take into account the government's major priorities, like food self-sufficiency, which do seem responsive to democratic demands.

Some of the findings for Senegal are also context specific. Again, the more limited samples for producer and NGO stakeholder groups means that some concerns emerged rather than others and that broader examination might reveal additional opportunities and obstacles. For example, our geographic focus on the Senegal River Valley likely produced a greater emphasis on obstacles to achieving the goal of rice self-sufficiency due to the extent of rice growing there. Additionally, sea water intrusion and the corresponding spoilage of aquifers are much bigger problems in some parts of Senegal (e.g., the Saloum River Valley) than in others. Again, the subject-matter emphases of the NGOs with which we spoke—environmental, agricultural, and women's groups—likely influenced the types of responses we collected.

To be more direct in comparing the two countries, the similarities are rooted in poverty and increasing climate variability. The types of problems discussed by stakeholders in both countries often flow logically from these challenges, resulting

in overlap in problem understandings. However, the configurations of competing problems differ. A greater variety of socioeconomic and infrastructure problems emerge in Uganda, though one sees greater uniformity among the most important of these problems in Uganda than in Senegal. The centrality of water in Senegal also stands out given the dryness of much of the country and the problem of salinization that comes from having rivers that flow to the ocean. Further, the state of communication systems and diffusion infrastructure in Uganda creates implementation challenges that are lesser for Senegal. The use of community radio in Senegal and the existence of other established means of disseminating information are advantages in dealing with many of these problems.

Governance differences are also meaningful. The basic priorities of the governments—building general infrastructure in Uganda and working toward food self-sufficiency in Senegal—are driven in part by the different political institutions. The level of democratization in Senegal suggests a degree of responsiveness to constituencies that can cut in opposing directions. The country may have advantages in government responsiveness to the demands of publics and in longer-range planning efforts due to greater stability. However, CSA is potentially subject to other forms of competition in a more democratic setting. Priorities that are viewed as more urgent by publics and that are important for electoral purposes, like rice self-sufficiency, could stifle the implementation of broader CSA initiatives.

Conclusion

According to experts, agricultural producers in many low-income countries must adapt proactively and rapidly to climate change. The international community has promoted the adoption of CSA policies, practices, and programs to deal with this challenge. However, generating the support necessary for successful, widespread adoption of such innovations typically requires a shared understanding of problems as a first step (Post et al., 2010; Raile et al., 2014, 2017). Using operationalizations from the PPW approach for analyzing policy making and social change as a guide, we have examined stakeholder understandings of climate problems and socioeconomic and infrastructure problems related to agriculture in Uganda and Senegal. Other than the study of public opinion gathered by large surveys, the public policy and administration literature has largely ignored such local problem understandings as a precursor to setting agendas, passing policies, and implementing those policies successfully. Gathering local views via interview is labor intensive and inconvenient, but we believe it is a crucial step in identifying potential publics supportive of a particular policy program.

This study contributes to our knowledge about problem understandings generally and as they apply more specifically to climate-driven problems and the feasibility of CSA. Our application of certain elements of the PPW approach stems from recognition that problem understandings are central to policy making and other social change efforts and that such efforts tend to benefit considerably from local buy-in and participation. The PPW approach offers clear operationalizations and targets for assessment when examining such problem understandings, with an emphasis on the ways stakeholders themselves view problems rather than the way external experts might see them. The tools we have developed here, while certainly open to

adaptation, are designed to be user friendly for a range of scholars and practitioners. The idea of problem ripeness, based on convergence of issue terminology and on importance as measured through the breadth and intensity of concern, gives practitioners a new tool to assess stakeholder readiness for innovations and policy solutions.

Some might wonder about the usefulness and application of the scores produced from our semistructured interviews. First, our procedures allowed us to gauge how local stakeholders view climate-related agriculture problems. Many change-oriented programs have not engaged in this crucial step. As a result, we have likely identified some problems not anticipated by experts, donors, and program implementers. Second, this process shows variety among problem understandings, as well as their relative intensities. This constitutes further evidence that change efforts cannot make assumptions about problem understandings or their uniformity. Third, this process also demonstrates competition among problem understandings. Knowing that certain problems are "ripe" for being addressed among some stakeholders but not others provides crucial information about obstacles and opportunities. Finally, our work improves on methods for assessing local problem understandings. This method could stand on its own in a local setting with a population or a representative sample. Additionally, our findings could be used in constructing well-informed surveys on this topic, which is a common and appropriate use of data produced by semistructured interviews (Bryman, 2016). Despite the purposive nature of our samples, our groups of interviewees in the government employee and researcher groups in both countries captured good parts of the relevant populations in a way that intentionally maximized variety. As a result, we feel comfortable with the representativeness of these findings. As noted earlier, the NGO and producer groups were considerably less representative, meaning the findings are more context specific.

The identification of obstacles and opportunities for policy entrepreneurs is yet another use of the problem understanding scores. In the PPW approach (Raile et al., 2014), policy entrepreneurs can solidify social systems, in part by categorizing and advocating for certain problem understandings with an audience. They also link these problem understandings to potential solutions. In general, we find that understandings of certain problems across stakeholder groups do create opportunities for CSA solutions. However, such problem understandings are context specific and face considerable agenda competition. Policy entrepreneurs might use our findings to determine which types of CSA solutions are best suited to particular stakeholder groups or geographic areas. Ultimately, a policy entrepreneur's goal would be to use these findings to identify emerging social systems that might be supportive of particular CSA solutions and to facilitate the solidification of these social systems around specific problem-solution combinations.

We see productive opportunities for extending this research, especially given the study's constraints. First, as we have noted, this study was subject to geographic and sampling limitations. Our findings with regard to the producer and NGO stakeholder groups are likely specific to the localities and subject-matter emphases for the interviewees in these groups. Surveys would be an option for getting a broader cross-section of views and for better understanding such contingencies. Surveys might also produce enough information to make more robust comparisons across stakeholder groups. Second, this was an initial attempt at measuring problem understandings in line with the PPW approach, so the process could be subject

to improvement. Such refinements might include alternative measures or new numerical or graphical applications. Finally, we have already initiated work that extends and expands on some of the findings in this study. Such work includes further investigation of the infrastructure and communication obstacles to the adoption of CSA in Uganda. Another extension involves a closer look at problem-solution linkages and agenda crowding as they apply to CSA in a larger cross-section of geographic areas in Senegal. We hope these extensions can add in meaningful ways to our understanding of the potential adoption of CSA innovations.

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Notes

1 Uganda is 163rd of 188 countries ranked by the United Nation's Human Development Index, with universally low numbers. Similarly, the Fund for Peace's Fragile States Index for 2016 ranks Uganda as the 23rd most fragile state of 178, with problematic numbers across the board.
2 World Bank data show 34.6% of Ugandans living at or below $1.90 per day in 2012, adjusted for purchasing power parity, and 83.9% of Ugandans living in rural areas in 2015. The UN's HDI data show 71.9% of all Ugandan employment in agriculture.
3 Aside from a move toward autocracy in the 1960s, the Polity IV Project shows Senegal advancing in steps toward democracy, with a rather large jump in 2000 due to the election of an opposition presidential candidate. The 2010 Polity IV score for Senegal was 7, and the Freedom Rating from Freedom House was 2, with a corresponding characterization of "free." Freedom House's most recent press freedom score for Senegal is 49, which carries a "partly free" designation.
4 Senegal is 162nd of 188 countries in the HDI. Current mean years of schooling are 2.8 years.
5 Senegal is the 59th most fragile country of 178 in the Fragile State Index in 2016. Demographic pressures, refugees and internally displaced persons, and public services are areas of concern.
6 The United Nations' agricultural employment figure differs significantly from the CIA World Factbook's 2007 figure of 77.5% of the labor force being engaged in agricultural employment (though this is a slightly different indicator).
7 Subsequent topics in the semistructured interview protocol included potential CSA solutions, sources of political support, information flows, crucial stakeholders, and other challenges or obstacles for CSA. Additionally, the protocols included some separate questions about the adoption of innovations for interviewees aligned with producer associations.
8 The software used was NVivo11 Plus. We used transcriptions of audio files for Uganda but typewritten field notes for Senegal. After transcribing a sample of the audio files for Senegal, we determined that such transcription added little to the coding and data analysis due to the time consumed by language interpretation in the interviews.
9 We do not present the nutrition category due to space limitations. The coders made every effort to keep a problem within the category assigned by interviewees. This was often clear based on the timing or language of interviewee responses. However, sometimes coders needed to make value judgments. In such cases, coders worked collaboratively to assign a problem to the most logical category.
10 For logistical reasons, some of these interviews were group interviews with multiple individuals and tended to last longer. For example, both producer interviews in Uganda were group interviews. Given such differences, we did not standardize across groups. In other words, a score of 1.500 in one stakeholder group was not treated the same as a score of 1.500 in another stakeholder group.
11 Scores may be comparable across issue areas for a single stakeholder group in a country given similarities in methodological approach.

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