CrossMark

Social capital dimensions in household food security interventions: implications for rural Uganda

Haroon Sseguya[1,2] · Robert E. Mazur[3] · Cornelia B. Flora[3]

Abstract We demonstrate that social capital is associated with positive food security outcomes, using survey data from 378 households in rural Uganda. We measured food security with the Household Food Insecurity Access Scale. For social capital, we measured cognitive and structural indicators, with principal components analysis used to identify key factors of the concept for logistic regression analysis. Households with bridging and linking social capital, characterized by membership in groups, access to information from external institutions, and observance of norms in groups, tended to be more food secure. Households with cognitive social capital, characterized by observance of generalized norms and mutual trust, were also more food secure than others. However, we established that social capital is, by itself, insufficient. It needs to be complemented with human capital enhancement. We recommend that development interventions which focus on strengthening community associations and networks to enhance food security should support activities which enhance cognitive social capital and human capital skills. Such activities include mutual goal setting, trust building and clear communication among actors. Education efforts for community members, both formal and non-formal, should also be supported such that they potentially strengthen social capital to improve food security in rural Uganda.

Abbreviations

FAO	Food and Agriculture Organization
FIES	Food Insecurity Experience Scale
HFIAS	Household Food Insecurity Access Scale
IFAD	International Fund for Agricultural Development
MDGs	Millennium Development Goals
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
USDA	United States Department of Agriculture
WFP	World Food Programme

✉ Haroon Sseguya
   h.sseguya@cgiar.org; hsseguya@caes.mak.ac.ug

   Robert E. Mazur
   rmazur@iastate.edu

   Cornelia B. Flora
   cflora@iastate.edu

1   International Institute of Tropical Agriculture (IITA),
    Regional Hub for East Africa, Plot 25 Mikocheni B, Mwenge
    Coca-Cola Road, Dar es Salaam, Tanzania

2   Department of Extension and Innovation Studies, College
    of Agriculture and Environmental Sciences (CAES),
    Makerere University, P.O. Box 7062, Kampala, Uganda

3   Department of Sociology, Iowa State University, Ames,
    IA 50011, USA

Introduction

As global efforts to monitor changes in hunger and food insecurity evolve from the Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs) (United Nations 2015), many people in the developing world are still food insecure. While the recent state of food insecurity (SOFI) report indicates a 10% reduction in the *proportion* of the population undernourished in sub-Saharan Africa (SSA) over the past 12 years (from 33.2% in 1992 to 23.2% in 2014) (FAO et al. 2015), the *number* of undernourished people in SSA has increased from 176 to 220 million. Further, despite increases in agricultural production in many parts of SSA, the average per

capita daily calorie and protein food availability is below the recommended values of 2500 kcal and 72 g for developing countries (Ogundari and Ito 2015). What this suggests is that simply increasing food supply does not necessarily eliminate poverty, end hunger, achieve food security and improve nutrition, as indicated in the 2014 SOFI report (FAO et al. 2014).

One of the trending discussions on food security is whether programs that promote social inclusion in agricultural productivity strategies have a beneficial impact at a local level. Research in various parts of the world demonstrates associations, both direct and indirect, between social capital and household food security. Martin et al. (2004) established that, independent of social economic status, a positive relationship between social capital and food security exists among low income households in Connecticut, USA. Carter et al. (2012) found that low social cohesion in Quebec, Canada, was a key determinant of food insecurity. Other studies indicate that participation of community members in groups in Kenya (Gallaher et al. 2013) and Ethiopia (Liverpool and Winter-Nelson 2010) enhanced access to resources (information for decision making and action, agro-inputs, markets), thereby leading to increased levels of agricultural technology adoption. This led to higher agricultural yields which, in turn, improved food security through enhanced availability of food for consumption and sale. What remains to be identified are the *dimensions* of social capital that are critical for enhancing food security outcomes.

This study addresses three questions:

1. Can projects which include social capital as an end rather than merely a means prove effective in decreasing hunger and improving nutrition?
2. Does the type of social capital that exists or is enhanced make a difference in reducing hunger?
3. How does social capital interact with other forms of household capital to increase or decrease food insecurity?

We address these questions using data from rural Uganda.

Recent analyses of Uganda data show that the country narrowly missed achieving the first MDG (SDG 1 and 2) of halving the proportion of people who suffer from poverty and hunger (Ministry of Finance, Planning and Economic Development [MFPED] 2015). However, notable variations were evident across the country. The World Food Program and Uganda Bureau of Statistics [WFP and UBOS] (2013) indicate that 48% of the Ugandan population is food insecure (food-energy deficient), with northern and eastern Uganda experiencing higher levels −59 and 54%, respectively. Further, 34% of children under 5 years of age are

stunted (Ministry of Gender, Labour and Social Development and UNICEF 2015), with rural areas having higher rates of both food insecurity and stunting. Interventions to augment food security are being implemented within the Agricultural Development Strategy and Investment Plan [ADSIP] (Ministry of Agriculture, Animal Industry and Fisheries [MAAIF] 2010), with a major focus on enhancing agricultural production and productivity, improving access to markets and adding value, creating an enabling environment, and strengthening institutions. Involvement of multiple stakeholders in the process, notably farmers, policy makers, public and private sector staff, local governments and donors, is one of the operational strategies employed by ADSIP. Thus, political capital at the national level is in place to help reduce food insecurity.

MAAIF recognizes that positive development outcomes require moving from sole consideration of conventional production factors, such as labor, land, financial capital and entrepreneurship, to include development and nurturing of stakeholders' institutions and capacities (Bukenya 2010). ADSIP have established modalities to build the capacities of institutions and to encourage them to actively participate in planning, implementation and evaluation of agricultural-related services provided by the public and private entities in the country (MAAIF 2010). The focus on institutional development of the various stakeholders by recent programs such as ADSIP, especially local community members, implies an emphasis on social capital.

In this study, we explore the degree to which social capital that links households to the larger institutional structures (bridging social capital) and to each other (bonding social capital) is associated with food security status in rural areas of Uganda. More specifically, we establish the extent to which the different dimensions and types of social capital are associated with variations in food security status. We hypothesize that bonding social capital, as indicated by households with membership and participation in local farmers' groups (each household represented by at least one individual), are more food secure than those which are not. In addition, social capital at household level, as measured by reciprocity and mutual assistance; and trust in and networks with influential individuals and local institutions (irrespective of membership in a local farmers' group as in the previous hypothesis) is expected to have a positive relationship with food security status. We also hypothesize that low human capital (education levels, frequency of sickness of household members), financial capital (wealth in the form of land and animals), and physical capital (access to markets) decrease both food security status and social capital. In the rest of this paper, we discuss conceptualization of social capital and food security, followed by a presentation of data and methods, results and discussion, ending with a conclusion.

Conceptualization and measurement of social capital

Conceptualization of social capital is still evolving without absolute agreement on its definition or measurement (Scrivens and Smith 2013). However, there is a tendency for the concept to be commonly defined in terms of groups, networks, norms, and trust that people have available for productive purposes. It is thus acknowledged that social capital is multidimensional, comprised of both structural and cognitive forms (Uphoff 2000). The cognitive form, which includes norms, values, attitudes and beliefs, predisposes people to cooperate. The structural form facilitates collective action, and includes roles, rules, procedures, precedents and social networks (Uphoff and Wijayaratna 2000). Uphoff (2000) explains how these forms are interrelated. Functioning networks (structural social capital) are based on trust which, in turn, are based on norms or values (cultural capital) that guide social actors' behavior. Thus, both structural and cognitive forms of social capital are vital for understanding the concept and its potential for mutually beneficial collective action. Social capital can either enhance or impede innovative behaviors that increase food security.

Social capital also manifests itself at various levels—micro (individual), meso (community), and macro (national or regional). Our study examines social capital at household level as the unit of analysis. On the basis of the extant multi-level and multidimensional manifestation of social capital, Flora and Flora (2013) suggested bonding, bridging and linking social capital as the core types. Bonding social capital describes the relationships among people of similar ethnicity, social status and location, and refers to social cohesion within the group and community, based on trust and shared moral values and reinforced by working together. Bridging social capital refers to relationships and networks which cross social groupings, involving coordination or collaboration with other groups, external associations, mechanisms of social support or information sharing across communities and groups (Narayan and Pritchett 1999). Linking social capital describes the ability of groups or individuals to engage with external agencies and those in positions of influence, either to draw on useful resources or to influence policies (Flora and Flora 2013). Thus, bonding social capital provides important benefits to members through close support for 'getting by' whereas bridging and linking social capital provide opportunities for 'getting ahead.' In fact, linking social capital facilitates the connections necessary for accessing resources and institutions that would otherwise be difficult to access in the community (Woolcock and Narayan 2000).

These three types of social capital co-exist in every community at different levels. They can complement each other, or they can impede community action (Njuki et al. 2008). Flora and Flora (2013) indicate that too much bonding and too little bridging social capital can restrict personal and collective initiative leading to individualism and apathy, whereas too little bridging and too little bonding social capital can leave communities vulnerable, characterized by conflict with the outside world and factionalism. Too much bridging and too little bonding social capital results in clientelism. Further, insufficient linking social capital can leave specific social groups isolated from the centers of power and influence necessary for realization of their goals. Hence, an optimum mix of bonding, bridging and linking social capital is desirable at community level. Here, we examine the mix at household level.

Measurement of social capital is a challenging and evolving activity, with most approaches proceeding by developing indicators of the key dimensions for which data are in turn collected (e.g., Narayan and Pritchett 1999; Grootaert and Narayan 2004; Dudwick et al. 2006). For instance, structural social capital may focus on existing networks (e.g., different groups, associations, local committees, informal networks) and characteristics of their membership (whether members have common characteristics, whether these networks work with others of similar or different characteristics, whether the majority seek information from outside the network, associational membership density, etc.). Measurement of cognitive social capital may consider issues of who is allowed to join the groups or networks, who is trusted most at the different levels, whether sanctions are applied to members who violate norms and whether these are effective, etc.

Many of the measurement approaches used in various empirical studies of social capital are criticized as confusing due to their failure to separate sources, forms and consequences of social capital (Onyx and Bullen 2001). For instance, trust is sometimes equated as a source of social capital (Fukuyama 1996), a form of social capital (Putnam 1993), or a collective asset resulting from social capital (Lin 1999). Some empirical studies contribute to addressing this and the multi-dimensional challenges by using factor analysis and related statistical strategies to group social capital variables into categories that relate to types or dimensions of the concept (e.g., Narayan and Cassidy 2001; Njuki et al. 2008). We focus on measuring social capital at the micro (household) level to analyze different networks that people access in terms of roles, experiences and relationships. As stated by Grootaert et al. (2004), measurement at the micro level enables assessment of people's experiences and perceptions of largely subjective issues of trust (in service providers, leaders, fellow members in groups and networks), normative reciprocity and collective action. In this study, we address the challenge of measurement by using

principal components analysis to identify the dimensions of the concept, using household as the unit of analysis.

Conceptualization and measurement of food security

Food security conceptualization has evolved considerably, with earlier accounts (before 1970) suggesting food availability at national or regional levels as a key strategy for achieving food security. Later, it was recognized that availability of food at national or regional levels does not ensure access. The work of Nobel Laureate Amartya Sen on poverty and famines (Sen 1981), drawing from an analysis of famines in Bengal (1943), Ethiopia (1973) and Bangladesh (1974), cogently brought out the need to ensure access to food by all. He argued that starvation of the poor was not a result of inadequate food supplies or availability. Rather, it was due to lack of 'entitlements' to food because of lack of means to buy, borrow or beg for it. Sen's argument was successful in guiding the international debate on food security to focus on both availability and access to food (Pinstrup-Andersen 2009). Later debates on food security (World Bank 1986; Food and Agriculture Organization [FAO] 1996) also brought out issues of stability of food supply and having food that meets nutritional requirements for a healthy and active life. To reflect these developments, the definition of food security shifted from "availability, at all times, of adequate world supplies of basic foodstuffs" in the 1970s to "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO 1996). The definition adopted in 1996 is the most recent and reflects four dimensions of the food security concept: availability, access, utilization and stability.

Approaches to measurement of food security evolved along with the concept. A number of methods, notably agricultural production surveys, intra-household food frequency interviews, and anthropometric surveys for children under age five were developed earlier (Maxwell et al. 1999). The main challenge of these measures is that they do not take into consideration all the dimensions of the food security concept as it is currently defined. Jones et al. (2013) and Maxwell et al. (2014) discuss the current common measurement approaches for food security under four categories: (i) dietary diversity and food frequency (DDFF); (ii) consumption behavior; (iii) self-assessment; and (iv) experiential measures. DDFF measures include those that capture information on 'household dietary diversity' and 'household food consumption intensity'. The focus is on identifying the different food groups consumed in a household in the recent past (e.g., last 24 h or past 3 days) and

then computing a score that reflects the food security status of each household. This approach of food security measurement has been credited with being reliable for measuring food security in contexts where food access and quality are at stake. However, Carletto et al. (2013) note that DDFF measures need more refinement and validation in terms of food item selection and grouping; portion size and intake frequency; and the selection of scoring, cutoff points, and reference periods. Furthermore, validation of indicators of dietary diversity for individual nutrient adequacy and household-level dietary diversity indicators that accurately reflect household food security is a shortcoming of DDFF measures that needs more work.

Measures relating to consumption behavior mainly use coping strategies in times of shock and stress, leading to generation of a coping strategies index (CSI) that is used to gauge the food security status of a household. Studies done by Christiaensen et al. (2000) in Mali found the CSI to be a reliable indicator of dietary inadequacy and a good predictor of food vulnerability. The main shortcoming of CSI is that it cannot be used alone since it mainly applies adequately when identifying vulnerabilities associated with food availability, access and stability with complementary measures of food security needed to get a better picture. Self-assessment measures provide a rapid and quick way of capturing food security status but have a disadvantage of "being particularly likely to capture a series of the respondent's latent characteristics, which renders problematic the comparability of this type of indicator across households and/or individuals (Carletto et al. 2013, p. 35)."

Measures of food security that probe the household's experience of food security—the household food insecurity access scale (HFIAS) and the household hunger scale (HHS)—have been heralded as having better prospects of adequately capturing information about food security at household level. This is because of their focus on universal aspects of the experience of food insecurity including food shortage and quantity and quality of diet to determine the status of a given household's access to food (Coates et al. 2007). The scales have also undergone validation in many countries, proving the utility of the scale in various locations, albeit with challenges of cross-cultural and language barriers that may lead to different interpretations. However, solutions to these challenges are being addressed as indicated by recent efforts by FAO to measure food insecurity at a global scale (FAO 2016).

Maxwell et al. (2014) note that that no single measurement approach can capture all dimensions of food security, implying that an approach should be selected based on the purpose of measurement. Because of advances made with validation of measurement of food security using experiential approaches compared with other approaches and also the focus of our study being on household food security

status arising from specific program interventions, we utilized the HFIAS approach. Jones et al. (2013) indicate that the HFIAS approach is the most appropriate for monitoring and evaluating food security interventions since it provides for characterization and location of affected households thereby providing for design of appropriate mitigation measures. We briefly discuss the process of evolution of the HFIAS approach for food security measurement in the next two paragraphs.

The first documented attempts to systematically measure food security at household level which led to development of HFIAS began in the 1960s in the United States of America (Kennedy 2002). The US Department of Agriculture (USDA) developed a household food security scale (HFSS) based on an 18-item questionnaire that measures household food security status in the preceding 12 months (Hamilton et al. 1997). The questions measured four underlying conditions or behaviors in the households: (1) anxiety about the food budget or food supply; (2) perceptions that food is inadequate in quantity and/or quality; (3) reduced food intake by adults; and (4) reduced food intake by children. The series of questions were then converted into a food security scale using a Rasch measurement model. The scale is a continuous measure ranging from 0 to 10, with cut off points within this range which signify the food security status of a given household (Smith 2001).

The HFSS then underwent minor modifications over the years and used to measure food security in the USA annually. Realizing that the scale can be potentially used in developing country contexts, USDA jointly worked with developing country scientists and institutions to adapt it to the different cultural contexts in these countries (Coates et al. 2006). Results of tests conducted in Burkina Faso, Bangladesh, Bolivia, Ghana, and the Philippines indicated that the approach to developing an experiential household food insecurity and access scale (HFIAS) can be applied successfully in different developing and developed country contexts. This is based on four underlying domains of food insecurity (access): (1) anxiety and uncertainty about household food supply, (2) insufficient food quality, (3) insufficient food intake, and (4) its physical consequences. The domains are represented by nine questions that appear to be universal across different countries and cultures (Coates et al. 2007).

To help advance the field of research beyond documenting an association between social capital and household food security, this study set out to examine (1) whether projects which include social capital as an end (rather than merely a means) decrease hunger and improve nutrition, (2) if the type of social capital makes a difference in reducing hunger, and (3) how social capital interacts with other household capitals to affect food insecurity. The theoretical literature clearly distinguishes the different characteristics, roles and potential benefits of bonding, bridging and linking social capital. Operationalizing the elements of these forms of social capital and analyzing their effect on food security can provide a valuable contribution to the existing knowledge base. Given the evolving field of research on conceptualization and measurement of food security, it is essential to use an approach that captures the underlying domains that are relevant for analysis of the experience of household food security and insecurity in rural Africa. We now detail our research data and methods.

Data and methods

Population and sample selection

We used a multi-stage sampling strategy to select the sample from six sub-counties in Kamuli district, southeastern Uganda. We purposively selected Kamuli district selected for this study because it has a high proportion of poor people (MFPED 2014) and lies in eastern region of Uganda with a proportionally high level of food insecurity, as reported by WFP and UBOS (2013). We further purposively selected three sub-counties participating in a sustainable rural livelihoods (SRL) program jointly implemented by Iowa State University (USA), Makerere University (Uganda) and Volunteer Efforts for Development Concerns–VEDCO (Uganda). These include: Butansi, Namasagali and Bugulumbya (a sub-county is an administrative unit comprised of approximately 3000 households). The SRL program was started in 2004 in Kamuli district to help address the problem of food and nutrition security (Butler and McMillan 2015). The program works with communities through farmers' groups based on the assumption that this would increase the likelihood of achieving more sustainable development rather than working with individual households (Mazur et al. 2006). Activities include farmer training in agriculture and nutrition, establishing sustainable linkages to agro-inputs and produce markets and group strengthening through training and mentoring. To provide for comparisons between participating and non-participating sub-counties, we purposively selected three other sub-counties in the district using the criterion of predominantly agricultural (crop production) communities (as distinct from pastoral/cattle grazing or fishing activities). The additional three sub-counties selected were Balawoli, Namwendwa and Kisozi.

Within each of the six sub-counties, we selected two parishes in consultation with local leaders and VEDCO field staff (a parish is an administrative unit with about 500 households). We ensured non-contiguity between parishes participating in the program and non-participants to facilitate comparisons. We assumed that members of

communities in non-participating parishes would have minimum contact with those in communities participating in the SRL program, thereby enabling valid comparisons. In cases where the participating sub-county bordered with a non-participating one, we maintained non-contiguity by selecting parishes not bordering with the participating sub-counties.

We used a purposive random sampling strategy to select 191 households from the 800 participating in the SRL program. The program worked with households which organized in farmers' groups (Butler and McMillan 2015). We additionally selected 90 households within the communities where the program was implemented that were not participating in any farmers' group. Further, we randomly selected 97 households, at least 32 from each sub-county, from the non-participating sub-counties. The final sample size was 378 and the response rate was 100%.

The SRL program office in Kamuli provided up-to-date lists of group members participating in the program, from which we used simple random sampling to select a representative proportion for each group. For non-group members, we obtained lists of all village residents from village local leaders. In consultation with both the community and group leaders, we removed names of household members who belonged to any farmers' group. The remaining names then provided a sampling frame for non-group members, from which we randomly selected the respondents. For non-SRL program sub-counties, we obtained lists of all households from village local leaders, and then conducted random selection from the sampling frame developed. Figure 1 shows the sample selection process.

Data collection

A team of four researchers was involved in collection of the data between October 2008 and March 2009. The research team successfully completed an online human subjects training certification before starting the data collection activities. We pre-tested the data collection instruments in a different sub-county in Kamuli district, with 30 respondents and made appropriate modifications based on this activity. We obtained informed consent from all individual participants included in the study.

We collected information on socio-demographic, economic and geospatial characteristics of a household, including age, education level and marital status of the household head and land ownership. Additional information was collected on group participation of household members, including level of participation, heterogeneity of the group, nature of contributions made by members, nature and level of sanctions for group members and leadership selection. Additional information was also collected on perceived levels of and reasons for group success, trust levels in the group and beyond, and group interaction with other groups in and outside the village. Information was further collected on levels of collective action, information access, trust in external institutions, mutual assistance, and everyday sociability. For each household, we collected data from individuals representing the randomly selected households in the database of SRL program beneficiaries. Where necessary, specifically in cases where respondents were not the head of household, we obtained information on the head of the household. Food security questions focused on

Fig. 1 Overview of sample selection process. *Note* all selections, except where indicated otherwise, were purposive random
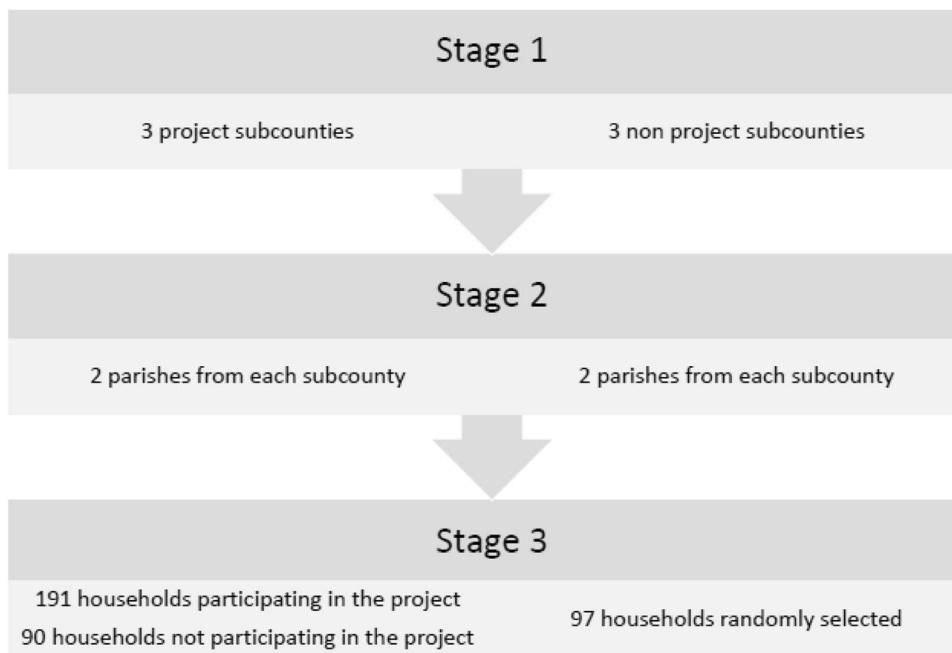
the items in the adapted Household Food Insecurity Access Scale (HFIAS), as indicated in Table 1. Selection of the study variables was guided by earlier research on social capital and development outcomes (Narayan and Pritchett 1999; Grootaert and Narayan 2004; Melgar-Quinonez et al. 2006; Coates et al. 2007).

Variables and data analysis

The dependent variable for the study is household-level food security status. We categorized households based on their responses to the HFIAS question items. We coded affirmative responses to the initial questions as 1 and negative responses as 0. For the follow-up responses on an initial negative response, we coded 'often' or 'sometimes' responses as 1 because they signify a more common status than the opposite and 'rarely' responses as 0. For each of the nine items, we coded negative responses (0) to the initial questions, as well as responses of 'rarely' to the follow-up question, as 0, even if the response to the initial question was 'yes.' We then summed up the item responses to calculate the raw food security scale score ranging between 0 and 9 points, with 0 corresponding to the most food-secure households and 9 to the most food insecure. We then generated a three-tier food security categorization based on guidelines by Bickel et al. (2000): food-secure households (0–2 points), food insecure (3–5 points), and extremely food insecure (6–9 points).

The independent variables included social, human, financial and physical capital. Since social capital is multidimensional, manifesting itself through diverse levels of trust, norms, solidarity, and networks, we used principal components analysis to establish which of its underlying indicators exhibit social capital of a given type—bonding, bridging or linking (Njuki et al. 2008), and how much of each of the types they account for. Specifically, we used principal components analysis (PCA), also ensuring that key assumptions of data reduction are met. Field (2009) recommends that PCA should meet conditions for five assumptions, which we addressed successfully.

First, Eigen values which represent the amount of variation explained by a factor should not be lower than 1 for qualifying factors. Second, communality, the proportion of common variance that a variable exhibits should be at least 0.6. Third, to avoid the tendency of most variables in a dataset having high loadings on the most important factor and small loadings on all other factors which makes interpretation difficult, orthogonal varimax rotation is recommended (Leech et al. 2005). Fourth, sample size is critical for the reliability of PCA and a Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy >0.7 is recommended. Finally, the Bartlett's test of sphericity tests the assumption that the correlation matrix is significantly different from an identity matrix, in which correlations among variables are all zero. The correlation matrix should have a significance value of <0.05, meaning that the variables are correlated highly enough to provide a reasonable basis for PCA (Leech et al. 2005).

After generating the factor scores, we conducted factor score regression for each household, representing the social capital types (bonding, bridging and linking), which were then used to develop a logistic regression model for food security and social capital. For other independent variables, we considered their respective indicators: human capital (educational level and sex of household head), financial capital (total land size owned) and physical

---

Table 1 Adapted Household Food Insecurity Access Scale (HFIAS)

During the last month…

1. Did you worry that your household would not have enough food?
   0. No (go to question 2)[a]
   1. Yes
   1a. How often did this occur? *0. Rarely 1. Sometimes 2. Often*[b]

2. Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?

3. Did you or any household member have to eat a limited variety of foods due to a lack of resources?

4. Did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?

5. Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?

6. Did you or any household member have to eat fewer meals in a day because there was not enough food?

7. Was there ever no food to eat of any kind in your household because of lack of resources to get food?

8. Did you or any household member go to sleep at night hungry because there was not enough food?

9. Did you or any household member go a whole day and night without eating anything because there was not enough food?

[a] All questions had this response format

[b] Follow-up question applied to all items

Sources: (Melgar-Quinonez et al. 2006; Coates et al. 2007)

capital (distance to major trading center and distance to water source).

Results and discussion

Principal components analysis

Principal components analysis with varimax rotation revealed three factors underlying social capital. After rotation, the first factor accounted for 40% of the variance, the second factor accounted for 21%, and the third factor accounted for 13%. Table 2 displays the factor loadings and communalities for the rotated factors. The communalities have a mean of over 0.6, the sample size was 378, the KMO measure was 0.815 and the Bartlett's test of sphericity was 0.00, all making the PCA results suitable for use in further analysis since they meet the conditions of key assumptions.

The first factor seems to indicate bridging and linking social capital and loads most strongly on variables related to participation in groups. All loadings are high, indicating the importance of participation in groups of at least one household member as a strong indicator of social capital at household level. This is in agreement with earlier studies by Putnam (1993), Narayan and Pritchett (1999), and Grootaert and Narayan (2004), whose measurement of social capital focused on participation in groups and associations. Narayan and Pritchett (1999) and Grootaert and Narayan (2004) focused exclusively on participation in groups and associations, and then developed indices which they aggregated into an overall social capital index: the density of associations and groups, their internal heterogeneity, the frequency of meeting attendance, members' effective participation in decision making, members'

contributions and community orientation of the associations or groups. Njuki et al. (2008) also used factor analysis and found bridging and linking social capital characterized by membership in groups, presence of an extension worker in the community, participation in training activities and contributions to groups as factors underlying social capital. Our study findings are largely in agreement with results of previous research whereby membership and participation in groups, group heterogeneity and access to information from external sources (NGOs) are important dimensions of linking and bridging social capital. We established that information from public extension agencies was not a dimension of linking social capital because, as established by Sseguya et al. (2012) in this part of Uganda, information from public extension agencies was unreliable.

The second and third factor loadings seem to indicate bonding social capital. The second factor reflects the importance of cognitive social capital in terms of generalized norms (trust and helpfulness) in the community whereas the third factor reflects informal interpersonal networks. The high loadings of trust at village level corroborates Saegert et al. (2001), who note that bonding social capital provides the foundation for trusting, and reciprocal relationships that catalyze solidarity, cooperation and coordination in the community. Informal networks, such as those exhibited by the third factor, reflect the potential of community members to collectively share information, care for the welfare of others and presumably work together to improve food security and other conditions.

Household food security status

Food security status varied among the three different categories of households (Table 3). Overall, more than half

Table 2 Factor loadings for the rotated factors underlying social capital

Social capital variables	Factor loadings			Communality
	Bridging and linking	Bonding (cognitive)	Bonding (structural)	
Membership in a group	0.916			0.842
Membership in more than one group	0.754			0.614
Heterogeneity index of the group(s)	0.830			0.694
Access to information from NGOs in the group	0.720			0.519
Trust in group members	0.930			0.871
Willingness of group members to help	0.917			0.849
Trust in respondent's tribe members		0.834		0.696
Trust in respondent's village members		0.915		0.845
Willingness of people who live in the village to help		0.883		0.782
No. times others in village visited respondent's home			0.868	0.768
Number of times respondent visited others			0.869	0.767

Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy = 0.815

Table 3 Food security status of households disaggregated by participation status in the livelihood improvement program in Kamuli district (n = 378)

Status of participation in the program	Food security status (%)[a]			P values for Chi square tests				
	FS	FI	EFI	Overall	1 and 2	2 and 3	1 and 3	(1 + 2) and 3
Program households (HH)	63.1	24.1	12.8					
Non-program HH (program sub-counties)	38.4	38.3	23.3					
Non-program HH (non-program sub-counties)	44.3	28.9	26.8					
Overall FS status	53.7	27.2	19.1	0.001	0.001	0.683	0.002	0.024

[a]*FS* food secure, *FI* food insecure, *EFI* extremely food insecure

(53.7%) of households were food secure, 27.2% were food insecure, and 19.1% were extremely food insecure.

Significant differences in food security status existed among all categories when disaggregated by participation in the SRL program (p ≤ 0.05). The only exception was between households not participating in the program, irrespective of whether they were located in the participating parishes or the non-participating ones (p = 0.683). This result indicates the probable importance of program interventions in rural communities focusing on enhancing food security at household level.

Relationship between food security and social capital

Before running a model to test for the relationship between social capital and food security status, we computed linear regression to test for multicollinearity among the independent variables. As suggested by Leech et al. (2005), all independent variables with a tolerance value of less than the difference between one and the adjusted R (i.e., $1-R^2$) were not included in the model. The following independent variables had tolerance values greater than $1-R^2$ $(1-0.119 = 0.881)$ and were included in the model: linking social capital, bridging social capital, bonding social capital (structural and cognitive); sex and educational level of household head, total land owned by a household, and distance of household to nearest water source and major trading center.

We then computed logistic regression to establish the relationship between food security and social capital plus other capitals (human and financial capital). Since more than 50% of the households were food secure and <20% extremely food insecure, we combined the two categories of food insecure households (food insecure and extremely food insecure) to form a binary dependent variable (food secure and food insecure households). We then generated a binary logit model (model 1, Table 4). In the analysis, food security (1) is the reference category and was compared with the category of food insecurity (0). We were also interested in establishing whether training alone is associated with food security outcomes irrespective of

social capital status of a household (model 2). In addition we also determined whether there is an interaction effect between gender and education as human capital indicators relevant for our analysis (model 3). The resulting models significantly fit the data as exhibited by the omnibus tests of significance.

The first model demonstrates that cognitive bonding social capital significantly distinguishes food secure and food insecure households (p ≤ 0.05). Bridging and linking social capital, both structural and cognitive dimensions, also significantly distinguish food secure and food insecure households (p ≤ 0.01). Respondents with cognitive bonding as well as linking and bridging social capital were more likely to be food secure. The odds of being food secure were 35% higher if a household exhibited cognitive bonding social capital, and by 45% for a household with bridging and linking social capital.

Bonding social capital is critical for bringing people with similar characteristics together to work towards a common good. This form of capital, as suggested in the literature (e.g., Titeca and Vervisch 2008) is a necessary first step to get people together. As indicated by our results, as they get together, norms of trust and reciprocity, attitudes of solidarity and beliefs about fairness and helpfulness for all members turn out to be important because they facilitate creation of a conducive environment that predisposes people to mutually beneficial collective action. Thus, cognitive social capital, especially trust, is very important, because it acts as the glue that binds members together. However, it is both the bridging and linking social capital that are credited with realization of positive outcomes associated with socio-economic outcomes, including food security via enhancing access to external individuals, networks and institutions, thereby facilitating access to development resources. However, as indicated by the results of the PCA analysis, structural and cognitive dimensions are necessary for both bridging and linking social capital, as they are for bonding social capital. Access to external groups and networks together with having clear roles, rules and procedures are not enough if there is no mutual trust and positive attitudes of mutual assistance and solidarity at the bridging

Table 4 Binary logistic regression of food security with social and other capitals in Kamuli district

Independent variables	Model 1		Model 2		Model 3	
	Coef.	Odds ratio	Coef.	Odds ratio	Coef.	Odds ratio
Linking and bridging social capital	0.37*	1.45	−1.31	0.27	−1.27	0.28
Bonding social capital (cognitive)	0.30**	1.35	0.19	1.21	0.16	1.17
Bonding social capital (structural)	0.03	1.03	0.15	1.16	0.17	1.21
Sex of the household head (reference category [RC] = male)	0.14	1.15	0.09	1.10	−0.14	0.87
Total land owned (acres)	0.02	1.02	0.02	1.02	0.02	1.02
Educational level of household head (RC = No)	0.94*	2.55	0.99*	2.70	0.90*	2.46
Distance to major trading center (km)	0.09	1.09	0.007	1.07	0.07	1.07
Distance to major water source (km)	0.37	1.45	0.42	1.53	0.41	1.51
Received training (RC = No)			1.66	5.26	1.67	5.29
link_bridg_soc _K*rcvd_train			2.26**	9.63	2.15**	8.59
bond_soc_k_cog*rcvd_train			0.16	1.17	0.19	1.19
bond.soc_k_strct*rcvd_train			−0.21	0.81	−0.25	0.78
hhsex*educ_hhd					1.12	3.07
R^2	0.092		0.116		0.119	
χ^2	30.10		38.17		39.07	
P (for omnibus tests of model coefficients)	0.0002		0.0001		0.0002	

The dependent variable is food security status (0 = food insecure; 1 = food secure)

*Significant at p = 0.01

**Significant at p = 0.05

and linking levels of social capital. Previous studies such as Glowacki-Dudka et al. (2012) and Michelini (2013) emphasize the need to have strong bridging and linking social capital of both types (cognitive and structural) because of the vitality of resources that can be potentially accessed such as markets for agro-inputs and farm produce, training and information, and credit that are necessary for realization of food security and community development.

Social capital is not always sufficient for realization of food security outcomes. Education and training are important complements to social capital as determinants of positive food security outcomes at household level. Household heads with high formal education levels were more likely to be food secure, with the odds increasing by 155% (model 1). The probable explanation is linked to the likelihood of households with better educated heads being able to access other resources necessary for food security such as income for buying food or land for food production, better than the less educated members. However, none of these two factors (income and land) is highly correlated with education level ($r_{educ+totland} = −0.008$, p = 0.882 and $r_{educ+incomesource} = 0.088$, p = 0.87), although income source is weakly correlated with educational level at p = 0.1. One possible explanation is that households with more educated heads tend to participate more in groups than less educated members, and through groups they access more resources that contribute to

better food security. Alternatively, those with lower social capital have less access to educational opportunities. Recent studies such as Smith et al. (2017) corroborate our results in part, establishing that low education status, weak social capital, low household income and unemployment are associated with food insecurity on a global scale. Like our study, theirs also used an experiential household-level measure of food security (Food Insecurity Experience Scale (FIES) of FAO). However, the study did not elaborate on what dimensions of social capital are associated with food security, which our study has attempted to do.

We also tested the possibility that household members who accessed training opportunities are more food secure irrespective of their social capital status. Our results (model 2) indicate that access to training alone does not significantly account for differences between food secure and food insecure households. Instead, as indicated in models 2 and 3, the odds of distinguishing food secure and food insecure households are at least seven times higher if a household with linking and bonding social capital also accesses training opportunities on food security. Literature on education and gender points to inequities, with female members being disadvantaged in this regard compared to males (Kabeer 2005; Atchoarena and Gasperini 2009). This, in turn, affects food security depending on who is responsible for food security and general welfare in a household. We,

therefore, tested whether the interaction between education level of household head and gender had an effect on food security status; our results were not significant.

Conclusion

Ending hunger, achieving food security, improving nutrition and promoting sustainable agriculture are essential elements in the new Sustainable Development Goals which build on the Millennium Development Goals. The key objective in this paper was to ascertain the existence and nature of the relationship between social capital and household food security status. Specifically, we sought to address three key questions: (1) can projects which include social capital as an end rather than merely a means prove effective in decreasing hunger and improving nutrition? (2) Does the type of social capital that exists or is enhanced make a difference in reducing hunger? and (3) How does social capital interact with other forms of household capital to increase or decrease food insecurity? We also examined whether low human, physical and financial asset endowments (e.g., education levels, gender of household head, land owned, and access to safe water) are associated with food security status.

Overall, our results affirm that social capital makes a meaningful contribution to decreasing hunger and improving nutrition, and that different types of social capital each have important roles in this relationship. Linking and bridging social capital are positively associated with food security. Cognitive bonding social capital also has a positive relationship with food security status. Interestingly, not all types of household and community capital exhibited significant relationships with food security. In particular, our measures of physical and financial capital were not significantly related to food security. This implies that it is important for development organizations and practitioners that work with local farmers' and other community groups and associations on food security interventions to emphasize strengthening cognitive bonding social capital. This can be realized by establishing appropriate channels and clear communication among all actors as suggested by USAID (2014). Achieving and maintaining a high level of trust among group members and with other stakeholders is also essential, as exhibited by the need to also focus on cognitive social capital at bridging and linking levels. Key trust building interventions could include inclusive approaches to establishing goals and expectations, following through on commitments made and honesty in transactions. Our key argument is that an optimal dynamic balance of bonding, bridging and linking social capital is necessary for realization of food security outcomes, as evidenced in rural Uganda. Emphasis needs to be put on strengthening the cognitive components since they are critical for sustaining achievements made.

The results also suggest that those within the community who are not part of the farmers' groups do not benefit from a 'spillover effect' of the organization. Efforts need to be constantly made to expand the inclusivity of the farmers groups, which might initially be based on kinship, religious, or clan-based relations of trust.

Human capital, reflected in the educational level of the household head, had a positive association with food security status. Low education levels are associated with low participation in groups which, in turn, are associated with food insecurity. Thus, formal education efforts should be supported, given their positive association with household food security status. Taking efforts to strengthen human capital further, integration of formal and non-formal education can help rural people acquire, build and maintain productive skills for sustainable livelihoods (Ngaka et al. 2012). This integration is also supported by our finding that training coupled with social capital at bridging and linking levels enhances the odds of having food secure households.

Future research on the important relationship between food security and various dimensions of social capital would benefit from being able to explain change over time through analysis of longitudinal data. In addition, multiple measures of various forms of social capital, livelihood resources and development program interventions would provide a more complete analysis and explanation of the achievement of household food security. Finally, we cannot infer causality from results of this study since we did not control for endogeneity of social capital. Nevertheless, the results suggest associations between social capital and food security. Future work on the relationship between social capital and food security, with endogeneity of social capital controlled for, can potentially make a significant contribution to the topic.

References

Atchoarena, D., and L. Gasperini. 2009. *Education for rural development: Towards new policy responses*. Rome: FAO and UNESCO.

Bickel, G., M. Nord, C. Price, W. Hamilton, and J. Cook. 2000. *Guide to measuring household food security*. Alexandria, VA: US Department of Agriculture.

Bukenya, C. 2010. Meeting farmer demand? An assessment of extension reform in Uganda. PhD diss. Wageningen University, The Netherlands.

M.L. Butler, and D.E. McMillan, eds. 2015. *Tapping philanthropy for development*. Boulder, CO: Kumarian Press.

Carletto, C., A. Zezza, and R. Banerjee. 2013. Towards better measurement of household food security: Harmonizing indicators and the role of household surveys. *Global Food Security*. doi:10.1016/j.gfs.2012.11.006.

Carter, A.M., L. Dubois, M.S. Tremblay, and M. Taljaard. 2012. Local social environmental factors are associated with household food insecurity in a longitudinal study of children. *BMC Public Health*. doi:10.1186/1471-2458-12-1038.

Christiaensen, J.L., R.N. Boisvert, and J. Hoddinott. 2000. *Validating operational food insecurity indicators against a dynamic benchmark: Evidence from Mali, Policy Research Working Paper # 2471*. Washington DC: The World Bank.

Coates, J., E.A. Frongillo, B.L. Rogers, P. Webb, P.E. Wilde, and R. Houser. 2006. Commonalities in the experience of household food insecurity across cultures: what are measures missing? *Journal of Nutrition* 136 (5): S1438–S1448.

Coates, J., A. Swindale, and P. Bilinsky. 2007. *Household food insecurity access scale (HFIAS) for measurement of food access: Indicator guide*. Washington, DC: Food and Nutrition Technical Assistance Project.

Dudwick, N., K. Kuehnast, V.N. Jones, and M. Woolcock. 2006. *Analyzing social capital in context: A guide to using qualitative methods and data*. Washington, DC: World Bank.

FAO. 2016. *Methods for estimating comparable rates of food insecurity experienced by adults throughout the world*. Rome: FAO.

FAO, IFAD, and WFP. 2014. *The state of food insecurity in the World 2014: Strengthening the enabling environment for food security and nutrition*. Rome: FAO.

FAO, IFAD, and WFP. 2015. *The state of food insecurity in the World 2015—Meeting the 2015 international hunger targets: Taking stock of uneven progress*. Rome: FAO.

Field, A. 2009. *Discovering statistics using SPSS*. London: Sage Publications.

Flora, B.C. and J.L. Flora. 2013. *Rural communities: Legacy and change*. Boulder, CO: Westview Press.

Food and Agriculture Organization (FAO). 1996. *Rome declaration on world food security and world food summit plan of action*. Rome: FAO.

Fukuyama, F. 1996. *Trust: The social virtues and the creation of prosperity*. London: Hamish Hamilton.

Gallaher, M.C., J.M. Kerr, M. Njenga, N.K. Karanja, and M.G.A. WinklerPrins. 2013. Urban agriculture, social capital, and food security in the Kibera slums of Nairobi, Kenya. *Agriculture and Human Values*. doi:10.1007/s10460-013-9425-y.

Glowacki-Dudka, M., J. Murray, and K.P. Isaacs. 2012. Examining social capital within a local food system. *Community Development Journal*. doi:10.1093/cdj/bss007.

Grootaert, C., and D. Narayan. 2004. Local institutions, poverty and household welfare in Bolivia. *World Development*. doi:10.1016/j.worlddev.2004.02.001.

Grootaert, C., D. Narayan, V.N. Jones, and M. Woolcock. 2004. *Measuring social capital: An integrated questionnaire*. Washington DC: The World Bank.

Hamilton, L.W., W.W. Thompson, L.F. Buron, E.A. Frongillo, C.M. Olson, and C.A. Wehler. 1997. *Household food security in the United States in 1995: Summary report of the food security measurement project*. Washington D.C.: US Department of Agriculture.

Jones, D.A, F.M. Ngure, G. Pelto, and S.L. Young. 2013. What are we assessing when we measure food security? A compendium and review of current metrics. *Advances in Nutrition*. doi:10.3945/an.113.004119.

Kabeer, N. 2005. Gender equality and women's empowerment: A critical analysis of the third millennium development goal 1. *Gender & Development*. doi:10.1080/13552070512331332273.

Kennedy, E. 2002. *Qualitative measures of food insecurity and hunger*. Rome: FAO.

Leech, L.N., K.C. Barret, and G.A. Morgan. 2005. *SPSS for intermediate statistics: Use and interpretation*. London: Lawrence Erlbaum Associates.

Lin, N. 1999. Social networks and status attainment. *Annual Review of Sociology* 25: 467–487.

Liverpool, S.O.L., and A. Winter-Nelson. 2010. Poverty status and the impact of social networks on smallholder technology adoption in rural Ethiopia. IFPRI Discussion Paper # 970. Washington DC: IFPRI.

Martin, S.K., B.L. Rogers, J.T. Cook, and H.M. Joseph. 2004. Social capital is associated with decreased risk of hunger. *Social Science and Medicine*. doi:10.1016/j.socscimed.2003.09.026.

Maxwell, D., C. Ahiadeke, C. Levin, M. Armar-Klemesu, S. Zakariah, and G.M. Lamptey. 1999. Alternative food-security indicators: Revisiting the frequency and severity of coping strategies. *Food Policy*. doi:10.1016/S0306-9192(99)00051-2.

Maxwell, D., B. Vaitla, and J. Coates. 2014. How do indicators of household food insecurity measure up? An empirical comparison from Ethiopia. *Food Policy*. doi:10.1016/j.foodpol.2014.04.003.

Mazur, E.R., H. Sseguya, D. Masinde, G. Babirye, and J. Bbemba. 2006. Facilitating farmer-to-farmer learning and innovation for enhanced food, nutrition and income security in Kamuli district, Uganda. Paper presented at the Innovation Africa Symposium, Kampala, Uganda.

Melgar-Quinonez, R.H., A.C. Zubieta, B. McNelly, A. Nteziyaremye, M.P.D. Gerardo, and C. Dunford. 2006. Household food insecurity and food expenditure in Bolivia, Burkina Faso, and the Philippines. *Journal of Nutrition* 136 (5): 1431S–1437S.

Michelini, J.J. 2013. Small farmers and social capital in development projects: Lessons from failures in Argentina's rural periphery. *Journal of Rural Studies*. doi:10.1016/j.jrurstud.2013.01.001.

Ministry of Agriculture, Animal Industry and Fisheries. 2010. *Agricultural sector development strategy and investment plan*. Kampala: MAAIF.

Ministry of Finance, Planning and Economic Development. 2014. *Poverty status report 2014: Structural change and poverty reduction in Uganda*. Kampala: MFPED.

Ministry of Finance, Planning and Economic Development. 2015. *Millennium development goals report for Uganda 2015*. Kampala: MFPED.

Ministry of Gender, Labour and Social Development and United Nations Children's Fund (UNICEF). 2015. *2015 situation analysis of children in Uganda*. Kampala: MGLSD and UNICEF.

Narayan, D., and M.F. Cassidy. 2001. A dimensional approach to measuring social capital: Development and validation of social capital inventory. *Current Sociology*. doi:10.1177/0011392101049002006.

Narayan, D., and L. Pritchett. 1999. Cents and sociability: Household income and social capital in rural Tanzania. *Economic Development and Cultural Change*. doi:10.1596/1813-9450-1796.

Ngaka, W., G. Openjuru, and R. Mazur. 2012. Exploring formal and non-formal education practices for integrated and diverse

learning environments in Uganda. *International Journal of Diversity in Organisations, Communities and Nations* 11 (6): 109–122.

Njuki, M.J., M.T. Mapila, S. Zingore, and R. Delve. 2008. The dynamics of social capital in influencing use of soil management options in the Chinyanja Triangle of southern Africa. *Ecology and Society* 13 (2): 9–25.

Ogundari, K., and S. Ito. 2015. Convergence and determinants of change in nutrient supply: Evidence from sub-Saharan African countries. *British Food Journal* 117 (12): 2880–2898.

Onyx, J., and P. Bullen. 2001. The different faces of social capital in NSW Australia. In *Social capital and participation in everyday life*, eds. P. Dekker, and E.M. Uslaner, 43–58. London: Routledge.

Pinstrup-Andersen, P. 2009. Food security: Definition and measurement. *Food Security*. doi:10.1007/s12571-008-0002.

Putnam, R. 1993. *Making democracy work: Civic traditions in modern Italy*. Princeton: Princeton University Press.

S. Saegert, P.J. Thompson, and M.R. Warren, eds. 2001. *Social capital and poor communities*. New York: Russen Sage Foundation.

Scrivens, K., and C. Smith. 2013. Four interpretations of social capital: An agenda for measurement. OECD Statistics Working Papers, 2013/06. doi:10.1787/5jzbcx010wmt-en.

Sen, A. 1981. *Poverty and famines: An essay on entitlement and deprivation*. Oxford: Clarendon Press.

Smith, V.E. 2001. Evidence for the reliability of measures and validity of measure interpretation: A Rasch measurement perspective. *Journal of Applied Measurement* 2 (3): 281–311.

Smith, D.M., M.P. Rabbit, and A. Coleman-Jensen, 2017. Who are the world's food insecure? New evidence from the Food and Agriculture Organization's Food Insecurity Experience Scale. *World Development*. doi:10.1016/j.worlddev.2017.01.006.

Sseguya, H., R. Mazur, E. Abbott, and F. Matsiko. 2012. Information and communication for rural innovation and development: Context, quality and priorities in southeast Uganda. *Journal of Agricultural Education and Extension*. doi:10.1080/1389224X.2012.638783.

Titeca, K., and T. Vervisch. 2008. The dynamics of social capital and community associations in Uganda: Linking capital and its consequences. *World Development*. doi:10.1016/j.worlddev.2007.10.021.

United Nations. 2015. *Transforming our world: The 2030 agenda for sustainable development*. New York: United Nations.

Uphoff, N. 2000. Understanding social capital: Learning from the analysis and experience of participation. In *Social capital: A multifaceted perspective*, eds. P. Dasgupta, and I. Serageldin, 215–249. Washington, DC: The World Bank.

Uphoff, N., and C.M. Wijayaratna. 2000. Demonstrated benefits from social capital: The productivity of farmer organizations in Gal Oya, Sri Lanka. *World Development*. doi:10.1016/S0305-750X(00)00063-2.

USAID. 2014. *Local systems: A framework for supporting sustained development*. Washington DC: US Agency for International Development.

Woolcock, M., and D. Narayan. 2000. Social capital: Implications for development theory, research, and policy. *World Bank Research Observer*. doi:10.1093/wbro/15.2.225.

World Bank. 1986. *Poverty and hunger: Issues and options for food security in developing countries*. Washington DC: The World Bank.

World Food Programme and Uganda Bureau of Statistics. 2013. *Uganda: comprehensive food security and vulnerability analysis*. Kampala: UBOS and WFP.

Haroon Sseguya   is a Technology Scaling Specialist at the International Institute of Tropical Agriculture. He has over fifteen years of experience working with rural development programs and teaching in sub-Saharan Africa. His primary research interests are sociology of food systems and agriculture; monitoring and evaluation; technology dissemination and communication for development.

Robert E. Mazur   is Professor of Sociology at Iowa State University. His primary research interests are decision-making strategies for rural livelihood innovation, food security and sustainability. His recent multidisciplinary research projects in Africa, USAID funded, focus on agriculture, livelihoods and health in Uganda and Rwanda; farmer decision making for improved soil fertility management in Uganda and Mozambique; and grants from the Borlaug Leadership Enhancement in Agriculture Program to mentor Ph.D. students conducting dissertation research in Africa.

Cornelia B. Flora   is Charles F. Curtiss Distinguished Professor Emeritus of Sociology at Iowa State University. In addition to teaching, she served as Chair of the Technical Committee of the Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program, Head of the Department of Sociology at Virginia Polytechnic Institute and State University, Director of the North Central Regional Center for Rural Development, and a member of the Board of Directors of Winrock International. Her primary research interests are the intersections of human communities and agro-ecosystems, and sustainable intensification in the context of climate change.