Gender Dimensions of Agricultural Innovation Awareness and Adoption

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Introduction

The 3-year startup phase of the BioSight project envisions the development of "models, tools, and problem-focused analytics" to contribute to the project's larger goal of establishing stronger micro-level and spatially explicit foundations to advancing the state of bioeconomic modeling. The project aims to devote particular attention to the issue of gender, and the question of how BioSight's new models and tools can better account for the various ways the gender of resource users affects decisions about agriculture, natural resource management, and technology adoption. This paper discusses some of the conceptual issues involved in more fully accounting for gender when considering agricultural innovation adoption and presents a brief empirical analysis to illustrate the challenges of applying these insights to analytical methods.

Gender is a key consideration in agricultural development projects. The gender of participants can influence whether and to what extent they engage in projects and project activities as well as how the project affects the individual and his or her family. And whereas researchers and practitioners previously assumed (explicitly or implicitly) that households pooled resources and made collective decisions as a single unit, it is now more widely accepted that such a unitary household model of decision-making is an oversimplification of the empirical reality that men and women have differential levels of access to resources, have different preferences for how resources are used, and make different decisions on the allocation of resources (Alderman et al. 1995; Udry 1996; Fortin and Lacroix 1997).

Recognizing that a household is a complex and dynamic social entity in which different members have different needs and preferences and may engage in different activities based on their gendered and age-specific responsibilities should guide the development of extension services that are gendered and culturally specific (Jiggins, Samanta, and Olawoye 1997). The Montpelier Panel (2013) echoes this idea with its suggestion that the technologies and practices of sustainable intensification require a complementary "socio-economic intensification" that encompasses, among other things, improvements to agricultural research and extension to support the diffusion and application of these practices.

Efforts to promote and deliver the innovations necessary for sustainable intensification—and to develop analytical tools to accurately model their use—must therefore look beyond the unitary model of the household and develop more sophisticated ways of accounting for intrahousehold dynamics: allocation of resources between men and women, between old and young, and between individuals of different degrees of kinship who happen to be living together; more nuanced definitions of "household", including for example polygamous and multigenerational households; and households with multiple loci of decision-making. Agricultural development interventions, and especially those that involve the transfer of some sort of information, like extension services to farmers, must be designed carefully to account for the different ways in which men and women receive and use information and the impacts that receipt may have on individual and household welfare.

Manfre and colleagues (2013) articulate some of the specific reasons why addressing gender is important in agriculture extension. They present two main cases to support gender integration into extension programs: the business case and the development case. Under the business case, paying attention to gender will improve the efficiency of business through targeting both men and women farmers; improve the flow of goods, especially through addressing the lack of incentives for women to participate in value chains; and create new business opportunities, particularly through encouraging women to enter value chains as suppliers of key inputs. Under the development case, attention to gender will result in stronger food security and poverty reduction outcomes, as all household members can benefit from technologies and practices that increase yields and incomes; the removal of discriminatory beliefs and practices, especially with regards to female involvement in agriculture and agriculture-related careers; and an improvement in household nutrition, as women in particular strongly influence household food security.

Some existing research shows that men and women may participate differently in extension and rural advisory services. Several studies find that women are more disadvantaged than men with regards to access to extension services. For example, a World Bank and IFPRI study (2010) of Ethiopia, India, and Ghana found that women had consistently less access than men, though it varied by crop type and region. Women's access ranged from 2 percent of female-headed households in Ghana to 20 percent among women in Ethiopia, while men's access ranged from 12 percent of male-headed households in Ethiopia to 29 percent among male-headed households in India.

Overall, the evidence on women's and men's participation in extension services, and the impacts of differing rates of participation, is mixed and defies easy generalization (see Ragasa et al. 2012 for a succinct summary of a number of these studies). A number of issues can confound this sort of analysis; for example, who is identified as the farmer in a household (Doss 2002 shows that there are various ways to define farmers) may influence who is the recipient of extension services. The head of a household or the individual identified as a landowner within a household may be viewed as the primary farmer when in reality such as view often eclipses the nuances that exist amongst family members with regards to the agricultural division of labor and how involved an individual may be in agricultural activities. And when extension services are targeted based upon the division of crops as cash or food crops (often designated as "men's" and "women's" crops, respectively), the focus of extension services may be biased toward crops destined for the marketplace. Not only does this kind of focus exclude food crops that would also benefit greatly from new techniques and practices, but it also excludes women, despite research showing that women are often collaborators in the processing and marketing of cash crops as well (Manfre et al. 2013).

Data collected in early 2013 as part of the CGIAR Research Program on Climate Change Agriculture and Food Security (CCAFS) project on Increasing Women's Resilience to Confront Climate Change provide an opportunity to examine the links between gender, extension services, and awareness and adoption of agriculture and NRM technologies and practices. The project surveyed rural households in Bangladesh, Kenya, Senegal, and Uganda and queried respondents' awareness and adoption of various agricultural innovations. Furthermore, the CCAFS surveys interviewed multiple members of each household in order to capture the views and experiences of both men and women. The data therefore offer valuable insights into the ways in which men and women perceive and adopt innovations differently.

The current examination is preliminary and descriptive in nature, as opportunities for the kinds of analysis that could lead to more causal claims are limited by the cross-sectional nature of the data, the endogeneity of many potential explanatory variables, and the yet-incomplete delivery, cleaning, and preparation of this newly collected data. The focus here is on the awareness and adoption of technologies and practices and their relationship to participation in extension efforts and access to various types and sources of information. Our intention is that presenting the rationale for gendersensitive analysis of extension services, describing some methods for collecting gender-disaggregated data, and performing some basic analysis of such data will provide insights and spur discussion about how BioSight can adequately account for gender in its efforts to develop new tools.

Approach and Methods

The Survey

The survey grew out of collaboration organized by CCAFS. CCAFS asked researchers from participating centers (ILRI and IFPRI) to evaluate their ongoing portfolio in their research sites to identify gender research needs. The Gender survey represents the outcome of this endeavor. As envisioned, it attempts to answer questions about gendered and intra-households differences in vulnerability, adaptation strategies, and perception of climate risk—all areas where CCAFS interventions may lead to gender transformative outcomes.

In order to minimize the burden on respondents, the survey team chose to design the gender survey so as to combine it with the IMPACT Lite survey that CCAFS was already conducting in all of their baseline sites. These sites were chosen to represent major farming systems and agro-ecological zones in the various regions, but the purposeful selection means that the sites cannot be considered nationally or regionally representative. The IMPACT Lite survey aimed for 200 households in each site, stratified to reflect the different farm production systems that exist. Only households engaged in livestock and agricultural activities were interviewed. IMPACT Lite collected a wide range of data on household production practices, inputs, outputs, labor, and food consumption, at a plot and subplot level.

The Gender survey was designed to build upon the database already collected under IMPACT Lite. The gender survey contained 13 modules, posing questions at a household and individual level to identify land tenure and ownership; decision-making in agricultural, livestock, and household decisions; adoption and knowledge of climate-smart practices; access to and use of climate and agricultural information services; access to and use of credit; membership in groups; fuel and water use; coping strategies for dealing with shocks; perception of climate change and its potential impacts; identification of adaptation strategies; and cognitive decision-making and personal values questions.

In order to better understand gender dynamics, household bargaining, and gender-differentiated adaptation strategies and preferences, the survey asked most questions separately of multiple household members, usually the principal male and female adult decision-makers (See discussion in Doss 2013). For polygamous households, the survey teams identified additional wives and conducted the interview with them. IFPRI staff field tested and trained enumerators from each country in conducting and doing data entry for the survey. Teams conducted the survey in 6 sites, including 5 where the IMPACT lite survey had already been conducted and one where the team conducted both surveys together. The team selected these sites based on the availability of local partners to conduct the surveys, identifying teams in Senegal, Kenya (both CCAFS sites), Uganda (one CCAFS site) and Bangladesh (two CCAFS sites). The final number of respondents for each survey site are presented in Table 1.

Table 1: Numbers of Gender Survey Respondents by Survey Site

Site	Male Respondents	Female Respondents
Nyando, Kenya	198	202
Wote, Kenya	176	176
Rakai, Uganda	156	187
Kaffrine, Senegal	194	327
Satkhira, Bangladesh	214	218
Bagerhat, Bangladesh	171	183

"Climate-Smart Agriculture" and "Sustainable Intensification"

As the focus of the CCAFS project is climate change adaptation, the technologies and practices queried were those that a group of experts designated as "climate-smart". The list of climate-smart practices may not align perfectly with the list of technologies and practices BioSight considers to constitute "sustainable intensification" but the assumption is that there is enough commonality between the practices themselves and the decision processes that affect their (non)adoption so as to yield valuable insights.

Climate-smart agriculture is defined as "agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation) while enhancing the achievement of national food security and development goals" (FAO 2010, ii). Consultations with researchers and scientists working in each of the CCAFS sites produced the list of specific technologies and practices queried in the survey, which local enumerators defined in locally-understood terms and words at each training. While these practices represent current CCAFS opinion on what constitutes climate-smart agriculture, they also largely reflect current thinking on the sustainable intensification, which identifies the need to (1) increase food production through (2) high yields on existing farmland (3) with attention to environmental sustainability and (4) recognizing diverse, context specific techniques (Garrett et al. 2011). The practices included in the survey map onto the types of practices identified by Pretty et al's review of sustainable intensification in Africa (2011) including:

- crop variety improvements,
- agroforestry,
- soil and water conservation/management,
- conservation agriculture practices,
- integrated pest-management, and
- livestock and fodder innovations.

In addition to these technological innovations, the Montpelier Panel suggests that such technologies need to be introduced in the context of an enabling policy environment, highlight the role of socio-economic intensification, the process of supporting the development of institutions at the farm, community, regional and national level to support the sustainable implementation of these practices (2013).

Descriptive Analysis

As a starting point for how to incorporate gender into considerations of agricultural extension and how to ensure adoption of sustainable intensification practices, this analysis utilizes the gender-disaggregated date described above to illustrate the gender dimensions of (1) interaction with agricultural extension agents, (2) awareness of innovative technologies and practices, and (3) adoption of those same technologies and practices. Simple tabulations were completed for male and female respondents at each of 4 survey sites, Nyando and Wote (Kenya), Rakai (Uganda), and Kaffrine (Senegal).[1] For interaction with extension agents and awareness of innovations, the proportion of respondents coded as "yes" is simply reported for the male and female respondents in the sample. For adoption, we report adoption rates among those individuals who reported awareness (see Figure 1). We are therefore assuming a 2-stage sequential process by which an individual first becomes aware of an innovation (stage 1) and then decides whether or not to adopt (stage 2).

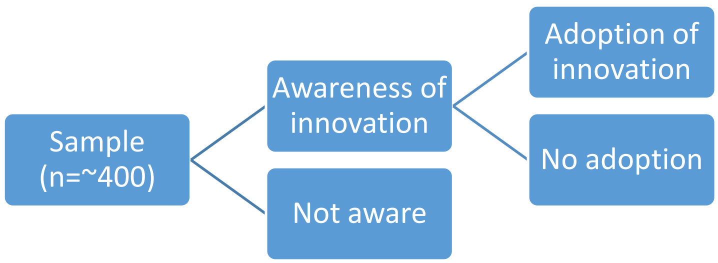

Figure 1: Assumed sequential process from awareness to adoption

Results

Interaction with Agricultural Extension Agents

Table 2 summarizes the rates at which mean and women reported having personally had contact with an agricultural extension agent within the past year. The results show a rather large range of possibilities both in terms of the level of contact with extension agents and the differences (and non-differences) between men and women. In Wote, for example, contact rates are very high for both men and women, whereas in Kaffrine contact rates are low for both genders, but women are still more than nine percentage points less likely than men to have had any contact with an agent. Rakai is something of a middle-of-the-road case in terms of contact rates, but shows the largest gender disparity between men and women.

Table 2: Proportion reporting contact with an agricultural extension agent during the past 12 months.

	Nyando (Kenya)		Wote (Kenya)		Kaffrine (Senegal)		Rakai (Uganda)	
	Men	Women	Men	Women	Men	Women	Men	Women
Contact w/ extension agent	0.566	0.683	0.966	0.938	0.106	0.012	0.641	0.390
Contact w/woman extension agent	0.429	0.579	0.210	0.205	0.005	0.000	0.045	0.027

[1] Data from the two sites in Bangladesh have not been made available at the time of this writing

We also looked at whether respondents had interacted with women extension agents. Contact with women extension officers was very rare in the Senegal and Uganda sites, but higher in both Kenya sites. In Nyando, women were 15 percentage points more likely than men to have interacted with a female extension agent.

Awareness of technologies and practices

Gender differences in rates of awareness of the full list of 20 climate-smart agricultural practices queried is presented in Table 3. These differences varied widely from practice to practice and from site to site. The greatest differential in awareness was found in Rakai, where women were 42 percentage points more likely to report awareness of no-till/minimum-tillage than men (97 percent versus 55 percent). The case where the differential was strongest in favor of men's awareness was with composting in Kaffrine, where awareness was 37 percentage points greater for men (47 percent to 10 percent). For 4 of the 20 practices, men were consistently more aware than women across all survey sites (agroforestry, water harvesting, efficient use of fertilizer, and improved feed management for livestock). The other 16 practices showed a more mixed picture, with men or women being more aware depending on the site, or one or more sight where awareness was equally balanced by gender.

Table 3: Differences in rates of awareness of agricultural technologies & practices (women minus men)

	Nyando (Kenya)	Wote (Kenya)	Kaffrine (Senegal)	Rakai (Uganda)
Agroforestry	-0.238	-0.017	-0.026	-0.002
Terraces/bunds	-0.204	0.000	-0.253	0.000
Water harvesting	-0.336	-0.006	-0.191	-0.347
Irrigation	-0.050	-0.063	-0.035	0.000
Zai/Planting pits	-0.023	0.114	-0.025	-0.031
Crop residue mulching	0.062	-0.006	-0.214	0.013
Composting	-0.236	-0.216	-0.371	0.018
Manure management	-0.003	0.080	-0.060	-0.062
Effic. use of fertilizer	-0.089	-0.244	-0.206	-0.331
Improved HYVs	0.230	-0.045	-0.381	-0.018
Improved STVs	0.067	0.000	-0.128	0.126
No/min tillage	-0.153	-0.256	-0.136	0.423
Improved grain storage	0.080	0.000	-0.025	-0.157
Improved stoves	-0.138	-0.080	0.155	0.007
Improved feed management	-0.062	-0.051	-0.159	-0.046
Destocking	-0.016	0.063	-0.092	0.067
Cover cropping	0.154	0.102	-0.104	-0.179
Tolerant livestock	0.048	0.233	-0.122	-0.052
Rangeland management	0.158	0.301	-0.111	-0.233
IPM	0.024	-0.051	-0.051	0.060

Adoption of technologies and practices

Table 4 shows differences in rates of adoption for the same 20 climate-smart agricultural practices among respondents who previously reported awareness. As with the previous results presented, it is difficult to draw general conclusions across all sites and practices. In Nyando and Kaffrine, although women were less likely to have heard of the 20 practices in the first place, women adopted the innovations at higher rates than men (for 19 of 20 practices in Nyando and 14 of 20 practices in Kaffrine).

Table 4: Differences in rates of adoption of agricultural technologies & practices (women minus men)

	Nyando (Kenya)	Wote (Kenya)	Kaffrine (Senegal)	Rakai (Uganda)
Agroforestry	0.087	-0.209	0.013	-0.026
Terraces/bunds	0.038	-0.034	0.105	-0.060
Water harvesting	0.155	-0.028	0.043	0.227
Irrigation	0.069	-0.013	-0.006	-0.075
Zai/Planting pits	0.219	-0.006	-0.200	-0.062
Crop residue mulching	0.243	-0.119	0.030	0.045
Composting	0.392	-0.029	0.059	0.115
Manure management	0.221	0.008	0.000	-0.143
Effic. use of fertilizer	0.042	-0.127	0.061	-0.156
Improved HYVs	0.046	-0.085	0.183	-0.345
Improved STVs	0.265	-0.069	0.218	-0.055
No/min tillage	0.298	0.077	0.074	-0.272
Improved grain storage	0.140	0.163	0.027	0.140
Improved stoves	0.028	-0.059	-0.032	0.046
Improved feed management	0.200	0.296	-0.052	0.498
Destocking	0.140	0.149	0.035	0.213
Cover cropping	0.121	0.360	0.198	0.114
Tolerant livestock	-0.025	-0.181	-0.200	-0.108
Rangeland management	0.447	0.077	0.023	0.037
IPM	0.190	-0.778	0.167	0.465

For improved grain storage, destocking, cover cropping, and rangeland management, reported adoption rates were consistently higher for women than for men across all four sites. The only practice for which men had consistently higher rates of adoption was changing to drought or pest-tolerant species or breeds of livestock.

Discussion

The descriptive statistics presented above do not paint a tidy picture of gender differences in contact with extension services, awareness of innovative agricultural practices, or adoption of those practices. A man's or women's likelihood of interacting with an extension agent, learning about a potentially useful technology or practice, or choosing to adopt said practice seems to be highly dependent on his or her particular set of circumstances. These findings should serve as a cautionary tale to the common (and understandable) tendency of researchers and practitioners to draw broad conclusions about gender and agricultural development based on specific evidence and experience. Perhaps the only overall lesson that can be drawn from this preliminary analysis is that accounting for gender means dealing with an empirical reality every bit as complicated, diverse, and nuanced as the natural environment. Most researchers accept that the biophysical conditions that exist in any particular location represent a unique combination of natural elements, geography, history, evolution, etc. Researchers should accept that a given set of social conditions and relationships are similarly unique and different from site to site.

The challenge and opportunity for a program like BioSight is to develop the tools, methods, and metrics that are capable of representing such social complexity in ways that are valid and consistent. This task should be approached empirically, with testable hypotheses and a commitment to continually revisiting basic assumptions.

This study has demonstrated the usefulness of collecting gender-disaggregated data to present a more complicated picture of the household than surveys that only interview a single household member are usually able to capture. As the data from this project become more available, more sophisticated statistical techniques will shed additional light on these findings and help to sort out the many variables that confound the relationships between gender, innovation awareness and adoption, and agricultural extension. Future research can use these and subsequent findings as a starting point in the development of more rigorous experimental designs. In addition, theoretical and methodological work is needed to continue to improve our understanding and representation of households so as to account for the many intrahousehold dynamics that affect decisions about investment, consumption, and resource use.

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