

How resilient are farming households, communities, men and women to a changing climate in Africa?

Working Paper No. 80

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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RESEARCH PROGRAM ON
Climate Change,
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Abstract

Social, economic and institutional factors and driving forces enhance or hinder the adaptation capacity of agricultural and pastoral households and communities. The effectiveness of the resulting adaptation strategies influences the nature and extent of the impact of multiple stresses and shocks, including climate change's, at the local-level. Using a 9-country dataset from sub-Saharan Africa, and integrating quantitative household-level analyses with qualitative work, we show evidence that adaptation is connected to population growth, dependence on cash to cover essential needs, and limited sources of employment other than exploitation of natural resources and sale of crop produce and animals. In some countries, government policies like privatization of community forests, rangelands and riparian areas, the settlement of pastoralists, and the provision of subsidies for food or agricultural inputs reduce adaptation capacity. Policies take away the traditional decision-making and collective action powers that communities had to regulate the use and sustainable management of natural resources. Gender relations also affect agricultural practices and adaptation. The women farmers in our sample control less land than men, the land they control is often of poorer quality, and their tenure is insecure. Women, more than men, are dependent on internal village groups, as opposed to organizations operating at regional or national levels. Hence, women have less access to extension and input services, and are less likely than men to use improved seeds, fertilizers, and pesticides. The adaptive capacity of individuals and communities depends on their differential access to resources, economic assets and social capital, which are mediated by their socially defined rights and responsibilities. Highlights include:

- Vulnerability and adaptation to climate change depend on opportunities governed by the varied and complex interplay of social relations, institutions, organizations, and policies.
- Climate is one of many influences that affect the producers' coping and adaptation strategies.
- Women and men incorporate a wide range of technology and production management adjustments.
- The producers' most frequently cited reasons for adjustments include decrease in productivity, fluctuation in prices, market opportunities, and frequency of drought.

Keywords

Climate, Agriculture, Adaptation, Surveys, Gender

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Introduction

Climate change combines with political, economic, social, cultural and institutional conditions that “explain differential exposure to hazards, differential impacts, and, most importantly, differential capacities to recuperate from past impacts and/or to cope and adapt to future threats” (Eakin and Luers, 2006: 370). Such conditions include disparities in distribution and access to productive resources, social control over choices and opportunities, and historical forms of social domination and marginalization (Adger, 1999; Comfort et al., 1999; Leichenko and O’Brien, 2002; Liverman, 1990; O’Brien and Leichenko, 2001; Parry and Carter, 1998; Pelling, 1999). They also include policy-driven market liberalization and changes in natural resource use, globalization, the spread of infectious diseases, and conflicts. Given that such combinations facilitate or hinder livelihood strategies and economic and social opportunities, vulnerability and resilience to climate change should be studied within the broader context of vulnerability to other stressors (Eakin, 2005; Leichenko and O’Brien, 2002; O’Brien et al., 2004).

Vulnerability affects individuals, groups, social classes, as well as regions (Bohle et al., 1994). The who, where, and when of vulnerability are determined by the combination of human and physical conditions that shape the allocation of assets in society (Pelling and Uitto, 2001) according to the rights and opportunities that individuals and social groups are entitled to (Sen, 1981). These entitlements often vary according to gender, ethnicity, religion, class and age conditions (Cutter, 1995; Denton, 2002; Enarson, 2000; Wisner, 1998). They encompass resources and assets, including labor power, technology, education and information, as well as people’s decision-making power and adaptive capacity (Adger and Kelly, 1999; Bohle et al., 1994; Cutter, 1995; Downing et al., 1996; Hewitt, 1997; Sen, 1981,1990). Yet vulnerability is not a static condition. On the contrary, it can be described as a dynamic “space” bounded by historical and socially constructed sociopolitical and economic processes and structures where entitlements are negotiated. In all these senses, vulnerability to climate change is a problem of society, not for society (Hewitt, 1997).

In this article we examine the social, economic and political conditions that define the adaptation limits of a selected number of households and communities in Eastern and Western Africa. For that, we draw on a unique qualitative and quantitative dataset on household- and community-level perspectives. An analysis of the dataset allows us to appreciate the extent to which those human groups are exposed to, and able to cope with, and recover from multiple stresses and shocks. We consider their vulnerability

(and resilience) from a multi-layered and multidimensional perspective of “concentric” social spaces (household, community, region) akin to a set of Russian dolls. Each one of the outer layers hinders or empowers the capabilities of people within the inner layers to define and use successful livelihood strategies. By probing those spaces it becomes clear that adaptation to shocks (and the ability to seize opportunities) depends on a systemic interaction of gender relations, economies in flux, transformations in natural resource management, and alterations in policy and institutional contexts. We argue that climate change is only one more dimension in this system, albeit a very important one, and that climate change will have differential impacts on vulnerable social groups and spaces.

Methods and data

We draw on information from a household quantitative survey and a series of rapid qualitative village focus group studies implemented from late 2010 to early 2011 in nine countries in East Africa (Ethiopia, Kenya, Tanzania and Uganda) (Kristjanson et al., 2012) and West Africa (Burkina Faso, Ghana, Mali, Niger, Senegal). The household survey and village studies are components of the baseline definition activities of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) (Vermeulen et al., 2011). The baseline studies were designed to provide one source of evidence for behavioral change to which CCAFS may have contributed, through time at different scales, which in turn contribute to higher-level development outcomes (Förch et al., 2014). The surveys included standard indicators to ensure comparability across a wide range of locations and farming systems, hence it was not as in-depth as is possible in location-specific household surveys. The indicators covered household economy and livelihood security, access to resources and assets, and risk management, mitigation and adaptation practices. The survey included information on the kinds of changes in farming- and/or animal husbandry practices (adaptations) that households have been making, and their reasons for doing so. These include those related to land, labor and other resource-related challenges, in addition to people’s perceptions of the changing climate.

One common survey questionnaire was implemented in 11 sites (six in East Africa and five in West Africa) in 9 countries (4 in East Africa and 5 in West Africa). Within each site, the sampling frame used was a square block of land measuring approximately 10 km by 10 km in East Africa and 30 km by 30 km in West Africa (the larger sampling frames to compensate for lower population densities). The sites

were chosen in consultation with NARES, NGOs, government agents and farmers' organizations. The selected areas cover a range of key biophysical and agro-ecological conditions and agricultural production systems, and a gradient of anticipated temperature and precipitation changes. They also contain established agricultural research partners, and a network of regional partners to facilitate scaling up. In addition, many of the sites have long-term socioeconomic and weather data, and information on mitigation and/or carbon sequestration potential. The chosen sampling frames were mapped, and all villages within were numbered. Seven villages within the sampling frame, and in turn 20 households within each village were randomly selected. The household survey was implemented in those households. In total, 77 villages (seven villages per site) and 1,540 households (11 sites x 140 households per site) were included, which resulted in 1,530 viable survey responses.

Qualitative village level focus group-based data were collected to supplement the survey data. The village studies were conducted in one out of the seven villages at each site where the household survey was implemented. The studies lasted three days per village, and included different sets of around 15 men and 15 women participants, one set for each day, who were randomly chosen on the basis of the household listings prepared for the household survey. To the extent feasible, the participant groups included individuals of different age levels as well. The village studies sought to ascertain qualitative information on indicators of natural resource use, organizational arrangements, as well as on information networks for weather and agricultural information. Below we present analysis that uses both the qualitative and quantitative information obtained from the household survey and the village studies. A detailed description of the sites, the sampling frame, the tools and the household and village study reports can be found at: ccafs.cgiar.org/resources/baseline-surveys

Twenty percent of the survey respondents were from female-headed households (Table 1). According to FAO data, 26% of the households in sub-Saharan Africa are female-headed (30% in Eastern Africa and 19% in Western Africa). Sub-Saharan Africa concentrates the highest- and the lowest prevalence of female-headed households in developing regions (respectively, Swaziland and Burkina Faso) (FAO, 2011:118-119).

Results from the household survey were analyzed using logistic regression for each variable, adjusting for whether the household was headed by females or males (a dummy variable with male-headed=1, female-headed=0), whether the household was in East or West Africa (a dummy variable with East Africa=1, West Africa=0), and

the interaction between these variables. We compared East and West Africa rather than adjusting for each country of origin because we had relatively few respondents from female-headed households in some countries.

Table 1: Number of male- and female-headed households surveyed in each site

Site name, Country	Lat/Long	Agro-ecological zone	Male	Female
Yatenga, Burkina Faso	13.828, -2.113	Sahelian agroecological zone (650 mm). Agrosilvipastoral small-scale systems.	131	7
Borana, Ethiopia	4.957, 38.567	Agropastoral/pastoral, pockets of rainfed farming; semiarid lowlands of southern Ethiopia.	101	39
Lawra-Jirapa, Ghana	10.735, -2.624	Mixed crop-livestock smallholder systems. Guinea Savannah, 950-1100 mm.	129	9
Nyando, Kenya	-0.269, 35.068	Primarily mixed rainfed crop livestock farming system. Humid to sub-humid climate.	87	50
Makueni, Kenya	-1.809, 37.724	Largely agropastoral with a mix of crops. Semi-arid climate.	93	46
Segou, Mali	13.509, -5.613	Cereal and groundnut production. Sudano Sahelian savannah (680 mm).	139	2
Kollo, Niger	13.654, 2.826	Millet fallow or millet cowpea cropping systems and agro-pastoral systems. Sahel, 300-500 mm of annual rainfall.	135	5
Kaffrine, Senegal	14.242, -15.407	Pearl millet and groundnut cropping systems. Transition zone from the Sahel towards Sudan Savannah (500-800 mm).	134	4
Usambara, Tanzania	-4.790, 38.417	Mixed crop livestock, quite intensive farming systems in higher elevation and agro-pastoral systems in lower elevation.	109	31
Albertine Rift, Uganda	1.535, 31.546	Steep rainfall gradient from highland agroforestry, mid hill coffee/tea, small-scale mixed farming/commercial to dryland small-scale agriculture /agro-pastoralism.	109	31
Kagera Basin, Uganda	-0.621, 31.484	Steep rainfall gradient from high along Lake Victoria (>1400 mm) to low in Western Rakai and Isingiro (< 1000 mm)	112	27
Total			1,279	251

Results from the study

Livelihoods, natural resources and land use in the sites

The sample population encompasses smallholder farmers who use mainly family labor and low levels of technology, and consume most of their output directly. In a few sites it also includes pastoralists or agropastoralists who depend largely on the sale of livestock and livestock products to buy staple foods and other necessities. In general, the households purchase few inputs, sell a small proportion of their output, derive their main source of income from their farm but participate in off-farm and/or nonfarm employment whenever possible. Their farms are often held under traditional or informal tenure, and are in marginal or risk-prone environments. Both agriculturalists and pastoralists engage in hunting/gathering of wild resources to meet food requirements as well as energy, clothing, health, and cash income needs.

Food security varies within and across sites. Many of the households struggle to feed their families, from any source, for one or more months of the year, and depend on government aid to get through these hunger months. In Nyando, Kenya and Usambara, Tanzania the hunger period lasts up to 6 months of the year. In Makueni, Kenya it is reported to last up to 10 months, and people depend on food relief and remittances from male family members, most of whom out-migrate to cities.

People fetch water from boreholes or rivers that often are muddy during the rainy season, in some cases salty to the point of being unsuitable for vegetable production, or dry up for a couple of months. Only the Nyando site in Kenya has clean, piped water but water provision is not regular as the pipes break and water pumps that feed them do not run constantly due to power shortages. In the Kagera Basin site, Uganda focus group participants indicated that getting water involves long hours and distances for young girls, situations that are often linked with rape, pregnancies and the spread of HIV/AIDS.

Children in all the East African sites have access to several primary and secondary schools near the villages, even if the schools are in poor conditions. The government runs most of the schools but there are also Catholic schools and Madrasas. In contrast, children in the West African sites do not have easy access to schools. The only exception is the Ghana site, where there is a large school in good condition.

Drivers of change in the sites

Focus group participants identified human population growth, commercialization of the economy, and national government policies as critical determinants of changes in the state and use of natural resources in their communities. In all sites participants reported that human population growth has encouraged encroachment on forests, clearing of trees and bush burning, in order to meet the increasing demand for cropland and forest resources (fuelwood, charcoal and timber). Population growth has also led to land fragmentation and overexploitation of the area under production, soil fertility depletion, and soil erosion. In the Uganda and Ghana sites, it has resulted in increased numbers of livestock and the taking over of grazing lands for cultivation. As a result, there is not enough pasture for all and few areas of the tall grass used for thatch harvesting remain. In sites close to waterways, population pressure has increased the demand for and depletion of fish resources. The need for more land for cultivation has resulted in cultivation of wetlands on the lakeshores and the streams flowing into it. It has also led to unrestricted cutting of trees in the riparian corridor, siltation, and the cultivation of the riverbanks.

All these land use/land cover transformations were reported to be at the expense of wildlife. Due to deforestation, wildlife (e.g. leopards in Kenya, buffaloes in Albertine Rift, Uganda, monkeys in Makueni, Kenya) has disappeared. In Albertine Rift, Uganda, the wetland habitat for chimps, Colobus monkeys and mudfish was being destroyed with deforestation. In Kagera Basin, Uganda, the hills, which are now bare, were forested in the past and provided forest products such as honey, timber, wildlife, and herbs. Currently there are very few forested areas and no wildlife.

Focus group respondents in Burkina Faso, Ghana, Senegal, Kenya (Nyando), and Uganda (Albertine Rift) indicated that the use of natural resources was changing due to “commercialization” of the local economy, i.e. participation in local markets for goods and services. Households are no longer able to meet their needs exclusively from what they produce on their farms, or what they harvest from communal areas. They need cash to buy food, clothing, pay school fees, and to purchase agricultural implements and seed. There are, however, few sources of employment available to earn cash. Participants in Kenya stated that: “Today people must do farming as a business.” Besides producing cash crops (e.g. coffee, cotton) households engage in self-employment opportunities based on the exploitation of natural resources, including the sale of fruits and medicinal leaves; wood, thatch and reeds for roofing; and timber for making furniture. People also make bricks, brew local beer, and wash

cars in wetlands or riverine areas. Households in Burkina Faso, Ghana and particularly Kenya (Makeuni), depend heavily on remittances from relatives who have moved elsewhere in the country in search of employment. Kenya (Nyando) participants expressed that people carve off the edges of the forest and cut live wood that is then sold or used for social needs. In Senegal people harvest sand and laterite in their village, even if that creates deep gullies and destroys the roads.

Participants in all six East Africa sites identified national government policies as critical change factors of natural resources use. For participants in the Ethiopia site, until 20 years ago, most people were mobile pastoralists who depended almost exclusively on livestock products for their livelihood security. In order to address a series of drought events that resulted in famine, the government decided to actively discourage itinerant migration, and encourage people to settle in selected areas. This policy led to a transformation of the basis of the economy from livestock- to crop production, and from mobile pastoralism to village proliferation. Government policy to permanently settle pastoralists, lack of agricultural extension services related to cultivation, human population growth and drought are perceived as the most important drivers of land-use change in this area.

For participants in Kenya (Nyando), Tanzania and Uganda (Albertine Rift and Kagera Basin), national policies have affected land use in subtler but equally deleterious ways. In Nyando, Kenya there is no longer public land on which to plant community forests. Even riverbanks are considered private land. In Tanzania, the government removed restrictions on the use of the river and the riparian area, which created open access without regulation of use of the river and surrounding area. For Uganda (Albertine Rift) site participants, the government's policy of leasing forest to individuals (*de facto* privatization) has contributed to deforestation because of poor control. Those who lease land have obtained plots surrounding the forests. Hence, in the last seven years sugarcane farming has significantly encroached on forests, and laborers work in plantations operated by people from outside the area.

Today, many trucks transport charcoal and lumber out of the area daily as far as Kampala. The Uganda (Kagera Basin) site participants also perceived that the natural resources deterioration in their area is related to the current inability of communities to enforce measures to manage those resources due to government policies. For instance, the government has taken away the management of the lake and its resources from traditional leaders, and *de facto* has assigned it to big land leasers from outside the area. The government does not control privatized natural resources, and does not

allow the community to do it, either.

Gender-based access to resources and ability to withstand shocks

There is a clear gender-based division of labor in agriculture and natural resource use among the village study participants, although there are still overlaps in what men and women do. In most sites, the male participants grow cereals (millet, sorghum, maize), legumes (cowpeas, groundnuts, beans), sesame, Bambara nuts and, to a lesser extent, roots and tubers (cassava and potato) and horticultural crops (onions, tomatoes, cucumbers, cabbage, lettuce, melons, sorrel and okra). In some cases they also produce cash crops (coffee and cotton). Men fish and collect timber from the trees remaining in the fields or from woodlots.

For their part, women in most sites grow vegetable crops (onions, tomatoes, marrows, sorrel and okra). In Ghana, Mali and Senegal women reported growing cereals (millet, maize), groundnuts, beans, and sesame. In Burkina Faso and Ghana, women stated being in charge of livestock production (including dairy cattle, sheep, goats and chicken) and harvesting fresh and dry fodder for animals. Women are generally responsible for the livestock that ranges freely in fields between farmlands or woodlots, and in communal and private lands.

In all sites, women are responsible for collecting firewood and forest products other than timber and wood. Those products encompass food security staples like Baobab and Sisyphus tree leaves, honey, mushrooms, and wild fruits like Néré and Shea tree nuts, from which “dawa dawa” and Shea butter are made. Yet women are not the only ones who harvest natural resources. About the same proportion of men and women reported harvesting and selling fuelwood, wild fruits and fish, and slightly more men than women are selling charcoal and honey.

Women tend fields and natural resources located near their homes, while men’s fields and areas of influence are further away. In Tanzania, for instance, men have access to forests that are a three-hour walk away from the community. In two sites (Ethiopia and Tanzania) participants reported that men and women have their own, separate water pans, with different water quality and quantity. These arrangements barely hide prevalent gender hierarchies. In the Ghana site, men’s crop fields are located adjacent to the main, permanent river, while women’s crop fields are near a seasonal river.

Participants in all sites reported that both men and women have access to individual fields and communal ones, but only men own and inherit land. Women cultivate land given to them by their husbands (inherited, not purchased private land) or by the community (communal land). In the Mali site women have stopped cultivating communal land, and they only farm individual pieces of land allocated to them by their husbands. It was not made clear how unmarried female-headed households obtained access to land, in this case. As participants in the Burkina Faso focus groups emphasized, women more than men lack land and have no access to improved technology or equipment, no access to manure or labor, no means to buy chemical fertilizer, and few training opportunities. In general terms, therefore, based on the focus group discussions, women have less access than men to productive resources and opportunities. An analysis of the household-level survey data supports that finding, albeit with some caveats (Table 2).

Table 2. Differences in access to livelihood resources between households headed by males and females, by region

Variable	West Africa		East Africa	
	Logit regression	P level	Logit regression	P level
At least a secondary education.	-0.54	P=0.32	-1.07	P=0.332
Had less land	0.694	P=0.136	1.461	P=0.122
Land is less productive	-0.271	P=0.491	-0.668	P=0.405
Women do most of the agricultural work.	1.0	P=0.01**	1.05	P=0.219
Household size more than 6.	-1.10	P=0.006***	-1.41	P=0.088
Insufficient labor when needed	0.728	P=0.157	1.176	P=0.259
Unable to hire labor because it is too expensive	1.56	P=0.006***	2.935	P=0.011***
More than 2 crops produced on own farm sold for cash	-0.85	P=0.04**	-1.13	P=0.172
Produce harvested from own farm, sold for cash during the last 12 months	0.35	P=0.38	1.554	P=0.064
Access to any cash sources (employment, remittances, payments, etc.) during the last 12 months	-0.94	P=0.04**	-1.85	P=0.048**
At least one source of cash	-0.94	P=0.04**	-1.8399	P=0.049**
Had access to credit	-0.116	P=0.83	0.347	P=0.762
Five or more hunger months	2.0	P<0.001**	0.003	P=0.984

We found that in our sample there were no statistically significant differences between male- and female-headed households in either West Africa or East Africa with respect to education levels, credit use, sale of produce harvested on-farm, the

perception that their cropland was declining in productivity or area, or that there was insufficient labor at critical times.

The differences between male- and female-headed households in both East and West African sites were primarily related to access to cash, or the ability to use cash to obtain goods or services, highlighting the importance of shifts seen over the last 10 years towards commoditization and more reliance on markets and cash, rather than a subsistence- and barter-oriented economy. In all sites, female-headed households are less likely than male-headed households to have access to at least one cash source, including employment, remittances and payments, and more likely to have problems with hiring labor due to labor costs. Female-headed households in the West Africa sites are less likely to have two or more crops produced on their own farm that they sell for cash than male-headed households. As research for other parts of Africa has shown, shortages of cash to hire labor, to sponsor communal labor parties or to purchase inputs may critically reduce the ability of female-headed households to intensify production (Pender and Gebremedhin, 2006), gain access to laborsaving technology such as oxen (Von Braun and Webb, 1989), or access capital to repay credit (Chipande, 1987).

There were more significant differences between male and female-headed households in West Africa than in East Africa, and the differences between those households in the West Africa sites were more pronounced than in the East Africa sites. In West Africa, female-headed households tended to be smaller, and had more women doing the work. Significantly, female-headed households in that region were more food insecure than male-headed households. They tended to experience five or more hunger months more frequently than male-headed households. Poverty is the unfortunate norm for most households. There are poor women and men in the villages, and both have limited adaptive capacity. Nonetheless, female-headed households tend to have fewer assets than male-headed households, even if the evidence in our sample is not conclusive. As stated above, access to cash is less common in all female-headed households sampled, but their having less land is not statistically significant. Further, the smaller size of female-headed households is statistically valid only for West Africa. These findings contrast with clearer patterns of more restricted female access to, and ownership of land, and smaller size of landholdings in Africa and elsewhere (Croppenstedt et al. 2013; Doss 2001).

Gender-based access to social support institutions, government and NGOs

As shown in the previous section, the key constraints to, as well as opportunities for women's livelihood strategies (and adaptive capacity) are linked to the assets women possess and their levels of access to income and common property resources. We found that they are also related to the extent to which they interact with and benefit from social support institutions, government and NGOs. This confirms conclusions of Barbier, 2000; Bardham, 2006; Davies and Hossain, 1997; Quisumbing and Pandolfelli, 2010; and Robinson and Berkes, 2011.

Male and female focus group participants were asked separately to identify the organizations that they considered important to the community, and those they interacted with. The organizations were placed in three categories: those working only within the community/village, those working within the locality/district, and those working beyond the locality/district. Women reported working mostly with groups that operate within the community, while men are better connected with groups that operate beyond the locality (Table 3). This is consistent with research indicating that men and women commonly depend on different kinds of social relations or networks: men tend to rely more on formal relationships, while women rely more on informal relations, often forming stronger kinship and friendship relations than men (Agarwal, 2000; Molyneux, 2002; More, 1990; Riddell et al., 2001).

Table 3. Number of all organizations and community level organizations identified as providing critical support to villages in the focus group sites

Country site	Male-identified organizations		Female-identified organizations	
	All (no.)	Community-level %	All (no.)	Community-level %
Burkina	21	43	17	59
Ethiopia	12	17	11	36
Ghana	13	23	12	67
Kenya	13	31	16	50
Mali	14	43	8	87
Niger	11	9	15	40
Senegal	13	15	21	80
Tanzania	17	18	18	67
Uganda-Hoima	14	29	20	60
Uganda-Rakai	25	20	16	75

Women partake of mutual insurance, risk-sharing networks at the village level that are primarily based on relatives and friends, but also community members in general. They depend on everyday forms of flexible, reciprocal collaboration in activities such as collecting water, fetching fuel wood, and child rearing, which is consistent with

observations from elsewhere (Agarwal, 2000; Cleaver, 1998). In some cases women help each other in farm work in exchange for labor, cash or produce (Burkina, Mali). They also rely on task-specific groups that sing in church and celebrate weddings, assist during funeral services by providing flour, sugar and money to the family of the deceased, and look after widows and orphans (Tanzania, Kenya, Makeuni). They participate in groups where the members grow, in communal lands, products such as watermelons, maize, tomatoes, kales, groundnuts, cowpeas, and sesame (Burkina, Ghana, Kenya, Mali, Senegal). In most cases women share the harvest among each other but also frequently they manage a mutual fund that is boosted with the sale of part of the harvest. In Kagera Basin, Uganda women in a group contribute money to buy seeds for one another in a rotating system. This arrangement allows them to maintain and increase the collective seed pool, while adding some cash to the households.

Community organizations are not necessarily isolated from the external world. In some cases, they channel into the community resources such as micro-lending funds, medicines and school supplies that they obtain from organizations that operate in the locality or beyond. In the Burkina Faso village there is an active local chapter of the national NGO AKAFEM/BF (the Koom Association for the Self-Promotion of Women of Burkina Faso) that sponsors literacy classes, credit and cowpea seed for women. Community-level women's groups in Ghana, Kenya, Mali, Senegal and Uganda make available to members loans with funds provided by external microfinance institutions. The external funds may be combined with funds that women in the group save as a requisite for being part of the group. Women use such funds to cover school fees, educational supplies, school canteen, or to pay for labor in their farms.

Importantly, the panorama of organizations operating within the community is complex. In the same way as adaptations to climate change (Fankhauser et al., 1999; Smit et al., 2000), women's local networks can be ad-hoc, autonomous or planned. Some of the community organizations are very small and informal, whereas others are large and formal even if they are not necessarily registered with, or taken into account by the state. The focus groups identified several formal women's indigenous groups that have over 30 members. One organization in Burkina Faso includes more than 100 women members. In addition to groups organized by women, the discussions in Senegal, Tanzania, and Albertine Rift, Uganda reveal community organizations that are formally sponsored by local Muslim and Catholic religious groups. In the Senegal site, the Mosque supported the construction of horticultural sites for women and the

accompanying infrastructure (wells, power pumps and fence). The Mosque also sponsored the digging of trenches for pipes to take water from the women's site to the men's site where water is salty.

In all the focus group villages, formally registered organizations that work within and beyond the locality, rather than within the village, provide support primarily to men. These organizations include government agencies from sundry ministries, local or international NGOs, church associations, and/or research centers with national or international affiliation. Depending on the country where the villages are located, this support may include technical advice and subsidized tools, seed, fertilizers, improved livestock breeds and water pumps; seedlings for reforestation; postharvest storage of food purchased from the farmers and distribution in times of famine; cash incentives for communal work; school facilities, teachers, supplies, uniforms, and beds for children who stay in boarding schools; vaccination, provision of mosquito nets and supplemental feeding for children; tap water and boreholes; and building houses for widows and destitute children.

The external organizations ostensibly also support women's groups in all the sample villages but their support to women is limited and generally mediated by village men. In Ghana and Mali, government agencies distribute, respectively, fertilizers and seed only to men. In Tanzania, the Ministry of Health distributes ivermectin tablets to men to control river blindness (*onchocerciasis*), even if women are the ones that manage the medicine. When training or agricultural inputs are made available for women, women do not necessarily participate or benefit from them. Women's physical mobility is typically more restricted than men's due to their substantial production and reproduction obligations, or the need to be allowed to participate by men in their households. In all the sampled villages, there are relatively few opportunities for women to improve their agricultural or livestock production. The organizations external to the village are more likely to provide training and distribution of goods for women health or children education activities. Examples of health-related activities include birth attendants' training, women's access to hospitals during labor, HIV prevention, children vaccinations, provision of nutrition supplements for children, and household hygiene.

In the villages sampled, therefore, it does not hold that gender division of labor and power relations necessarily limit women's participation in formal organizations (*pace* Molyneux 2002, for instance). It all depends on how one defines "formal organizations," especially given that women have their own formal community

organizations. The situation, however, is quite different regarding formal organizations that work within and beyond the locality. In the entire sample of villages, men are the interlocutors with those external organizations, and thus assume the role of gatekeepers for women. It is not surprising that in some sites women tend to have very little information about organizations working beyond their village. In fact, they even had a hard time identifying external organizations that operated in the village.

Adapting to agricultural risks and opportunities, incl. weather-induced ones

In the household survey we asked respondents which specific changes they had made with respect to crops, crop varieties, livestock, soil, water, tree and/or land management practices during the last decade. Table 4 shows the percentage of respondents that mentioned taking up adjustments to existing and/or new agricultural crop farming practices. Not all changes reported are included here, and innovations reported by fewer than 15% of households in any site are left blank.

The respondents reported a wide range of technology and crop management adjustments to agricultural practices. The technological changes include adopting new crop varieties or crops (higher yield, shorter cycle, drought tolerance, pest resistance, and disease resistance), and using commercial inputs (seed, fertilizer, pesticides, herbicides). The crop management adjustments include soil management (contour farming and agroforestry), changing planting dates (land preparation and seeding), and modifying the plots' area (expansion or contraction). There were no reported changes in cropping systems.

Table 4. Crop technology and management adjustments during the last decade, by country (% of respondents)

Adjustment	BF	Eth	Gh	Ke	Ke2	Ma	Ni	Se	Tz	U-h	U-r	All
Technology												
Introduced a new crop variety	73	25	94	58	97	54	64	83	81	75	87	72
Planted higher yield variety	43	14	81	80	81	28	51	78	76	70	84	62
Planted shorter cycle variety	65	20	83	63	97	42	53	75	77	41	61	62
Introduced a new crop	30	19	56	44	74	40	41	84	84	66	58	54
Earlier land preparation	67	37	28	83	51	3	75	78	91	35	33	53
Purchased pesticides or herbicides	37	7	64	23	84	13	41	54	66	31	60	44
Use purchased improved seed	53	3	23	64	96	18	31	18	70	30	48	41

Used inorganic fertilizer	73	0	55	20	6	33	66	73	81	17	20	40
Planted drought-tolerant variety	20	17	18	78	94	12	8	2	79	39	58	39
Used pesticides or herbicides	35	1	63	11	73	1	29	59	48	14	38	34
Planted pre-treated or improved seed	56	1	50	44	77	3	7	11	64	21	27	33
Planted pest-resistant variety	2	4	20	33	62	0	1	4	67	31	48	25
Planted disease-resistant variety	5	1	19	26	50	0	3	0	74	37	51	24
Tested a new crop	11	11	5	7	52	5	24	7	15	26	32	18
Crop management												
Adopted soil management	81	8	95	26	99	26	37	92	81	32	47	57
Adopted agroforestry	46	100	49	61	77	31	13	35	59	46	81	54
Expanded crop area	57	46	49	46	68	45	56	77	46	34	61	53
Planted earlier	21	33	27	84	70	1	19	51	84	49	40	44
Reduced crop area	30	7	78	27	64	29	28	69	36	23	62	41
Planted later	22	16	99	22	78	0	49	4	74	26	16	37

We found only a few statistically significant differences between male- and female-headed households in either West Africa or East Africa in terms of changes in agricultural practices. First, compared to male-headed households, female-headed households in East Africa were less likely to plant pretreated/improved seeds (1.944, $P=0.018$), while those in West Africa tended to expand area less often (-1.00, $P=0.02$). Second, in both East Africa and West Africa sites female-headed households were less likely to plant disease-resistant varieties (WA 1.2, $P=0.03$; EA 2.822, $P=0.014$), and tended to have reduced the area under production more frequently (WA 1.24, $P=0.01$; EA 2.41, $P=0.008$) than male-headed households. Thus, female farmers may be more constrained than male farmers in accessing and using improved seed varieties.

Table 5 shows the percentage of respondents who indicated having made adjustments to existing and/or new livestock keeping practices within the last decade. The spectrum of these changes was focused around fewer options than in the case of crop management. The most commonly reported livestock modifications were related to herd species mix and herd size, and to fodder management.

Table 5. Livestock technology adjustments during the last decade, by country (% of respondents)

Adjustment	BF	Eth	Gh	Ke	Ke2	Ma	Ni	Se	Tz	Ug-H	Ug-R	All
Change in herd composition	32	3	99	16	97	100	1	83	74	26	95	52
Reduce herd size	35	2	75	52	60	35	56	67	20	42	45	44
Stopped keeping one type of	14	3	65	27	41	11	46	29	29	16	60	31

animal												
Fodder storage	74	33	33	11	47	23	31	68	12	0	1	30
Cut and carry												
fodder	31	28	65	18	25	12	25	23	65	1	12	28
New farm												
animals/ breeds	14	8	48	36	22	86	9	37	51	30	37	27
Increase in herd												
size	49	6	23	39	31	23	4	48	31	18	21	26
New breed												
introduced	23	5	20	15	13	38	4	10	46	9	17	18
Growing fodder	9	1	12	14	12	3	4	20	50	1	10	13
Fencing	38	0	7	16	11	9	1	17	1	2	9	10
Stall keeping	1	0	25	1	4	1	1	3	36	2	9	8
Improved												
pastures	4	3	1	5	25	3	3	8	19	0	4	7
New farm												
Animals tested	10	1	0	5	5	0	0	0	6	5	7	4

Once survey respondents identified the changes in crop- or livestock keeping practices that they had made, they were asked about what motivated them to make those changes. No statistically significant differences were found in the expressed reasons for changing farming or livestock management practices, whether by sex of survey respondents, or by region.

As shown in Table 6, the motivators for technological and crop management changes seem to be highly site- and time specific. The most frequently cited explanations for technological and crop management changes are responses to variations in crop productivity, soil fertility, pest pressure, prices, market opportunities, and rainfall volumes and onset time. Yet these changes are not distributed consistently. Some farmers reported better yields, better prices and new produce markets, while others mentioned encountering land being less productive, soil fertility problems and pest pressure. All the reported perceived changes in weather were related to rainfall volumes or timing. More erratic rainfall and more frequent droughts were the most commonly mentioned reasons, but some farmers reported more overall rainfall. Some respondents pointed to later starts of the rains, others to earlier starts.

Table 6. Reasons for crop technology and management adjustments, by country (% of respondents)

Reasons	BF	Eth	Gh	Ke	Ke2	Ma	Ni	Se	Tz	Ug-H	Ug-R	All
Better yields	68	40	100	85	99	100	54	75	86	42	98	75
Land less productive	92	11	100	53	99	100	88	51	74	31	98	71
Better price	43	19	100	45	99	100	9	63	79	49	95	60
More erratic rainfall	79	11	99	19	98	100	64	16	64	19	95	57
New opportunity to sell (markets)	32	3	99	16	97	100	1	83	74	26	95	52

Less land	43	17	96	42	97	100	24	23	71	9	96	51
More frequent droughts	56	7	99	56	99	100	14	1	61	12	96	49
Sufficient labor	56	1	99	41	99	0	19	9	57	11	93	46
More resistance to pests	32	1	90	37	97	0	9	2	71	31	96	43
New pests	33	1	98	23	98	100	4	1	46	31	96	42
Insufficient labor	37	2	67	42	97	100	39	25	4	14	96	41
Able to hire labor	25	1	99	36	99	0	13	19	14	16	94	39
Government/project told farmers	54	1	91	7	98	100	5	9	56	15	96	39
Government/project showed farmers	55	0	94	4	96	100	4	3	55	9	94	37
Unable to hire labor (too expensive)	26	1	78	15	97	100	48	6	25	14	96	37
More land	16	1	93	4	96	0	7	3	34	9	94	33
More overall rainfall	5	4	50	23	96	100	4	2	34	13	96	32
Land more productive	1	1	29	10	97	0	2	1	34	17	96	31
Later start of rains	34	1	72	32	84	12	28	1	56	6	19	31
Earlier start of rains	11	0	93	64	92	0	4	0	66	6	63	30
Unable to hire labor (not available)	13	1	60	2	96	100	2	6	1	6	94	25
Policy changes	32	0	57	0	95	0	0	0	4	3	92	25

The most frequently cited reasons for adjustments to livestock keeping are related to adaptations in prices, productivity, pathogen and pest pressure, market opportunities, and frequency of drought (Table 7). These changes are not distributed consistently across the situations. It is possible that at one place and/or time there was more drought or more frequent flooding mentioned as a reason.

Table 7. Reasons for livestock technology adjustments, by country (% of respondents)

Reasons	BF	Eth	Gh	Ke	Ke2	Ma	Ni	Se	Tz	Ug-H	Ug-R	All
Better price	67	30	95	48	97	100	19	16	60	27	96	56
More productive	68	12	95	66	97	100	4	17	54	17	94	52
New diseases	33	4	98	55	96	100	4	56	36	16	96	51
New opportunity to sell	46	13	99	17	97	100	16	35	45	18	96	47
More frequent droughts	47	18	98	44	96	100	6	4	24	1	93	40
More resistant to pests	32	1	6	21	96	100	0	23	52	6	93	37
Government told producers	42	0	92	25	96	0	0	0	34	4	95	33
Government showed producers	42	0	95	20	96	0	0	0	39	4	93	33
Able to hire labor	18	0	92	7	96	0	1	4	14	6	92	28
Insufficient labor	4	0	90	12	96	0	1	7	5	4	90	26
More frequent floods	8	0	0	15	96	0	0	6	0	0	78	23
More salinization	12	0	0	0	96	0	0	0	0	0	17	14

Discussion and conclusions

In all the communities studied, households are responding concurrently to multiple interrelating stressors and opportunities. These include crop or livestock productivity, pathogen and pest pressure, prices of agricultural inputs or outputs, labor supply, and weather (rainfall volumes, rainfall onset time, extreme events) that may affect individual producers differentially, as part of year to year variations. Climate is only one of many factors affecting the producers' coping and adaptation strategies.

The adaptation capacity of households and communities in our sample will likely differ enormously from one context to another. Their adaptive capacity depends on differential access to resources and economic assets, which are mediated by their socially defined rights and responsibilities. It is influenced by their ability to participate in formal and informal institutional coping mechanisms within and outside the villages. It is also connected to longer term and broad institutional changes that affect all producers, including population growth, dependence on cash to cover essential needs, and dearth of sources of employment other than exploitation of natural resources and sale of crop produce and animals. Finally, in some countries government policies are fostering the privatization of community forests, rangelands and riparian areas, the settlement of pastoralists, subsidies for food or agricultural inputs, while taking away the traditional decision-making powers that communities had to regulate the use and sustainable management of forests, wildlife, riparian areas, and communal land through collective action.

The terms under which the communities operate and adapt to changes are being defined to a large extent by organizations and institutions that are superimposed on the villages' own internal organizations. Communities adapt to but do not influence the agendas and priorities defined by outside organizations for the provision of technical assistance, inputs, emergency food, credit or any other development goods and services.

The women farmers in our samples control less land than men, the land they control is often of poorer quality, and their tenure is insecure. Women are less likely than men to use modern inputs such as improved seeds, fertilizers, pest control measures and tools. Finally, women have less education, less access to extension services, and less available free time, which make it more difficult to gain access to and use some of the other resources, such as land, credit and fertilizer. These findings confirm evidence

from other similar studies (Quisumbing and Pandolfelli, 2010; Friis-Hansen et al., 2012, Kristjanson et al., 2013).

Male community leaders and individuals in the sampled villages are in a more favorable position and adept at dealing with and benefiting from government agencies, NGOs, even private enterprises than women are. Men get from those institutions technical assistance, subsidized tools, seed, fertilizers, improved livestock breeds, water pumps, seedlings, and cash incentives for communal work. Men play an important role as mediators with those organizations, and often speak to them on behalf of women. One could interpret this male mediation role as an expedient and harmless intra-household division of labor if it is assumed that males and females share all resources within the household, and that helping men necessarily translates into helping the households (i.e. men and women). However, households have multiple and even conflicting objectives depending on their members, and there is no basis to assume that individual choices are taken with the goals of the household as a whole in mind (Jones, 1986; Goldstein and Udry, 1998).

Women, more than men, are dependent on internal village groups, as opposed to organizations operating at regional or national levels. Relying on internal village groups is not necessarily disadvantageous for women. In fact, it allows them to tap into a vibrant, varied and nimble network of mutual insurance, risk-sharing village organizations. These include informal mutual help groups and formal associations, organized around secular and religious goals. The formal and informal women village-level groups excel in solidarity and local initiative, and women successfully depend on such social relations to cope with, manage or adapt to stress in their daily lives. Through those networks women gain access to food, labor and cash that facilitate their productive and reproductive responsibilities, while some women gain recognition, as well, as leaders within the villages.

Women's village groups are not necessarily isolated from the external world. Some of them routinely channel external resources to the community, which include microcredit funds, school supplies, vaccines and nutrition supplements for children, training for women in HIV prevention, and birth attendants' training. External organizations that focus on the provision of microfinance lending, public health, reproductive health, and education services explicitly and consistently target women groups. This almost shockingly contrasts with the approach of government and NGO agencies that focus on agriculture, livestock, forestry and the management of soil, water and other natural resources. These groups primarily, if not exclusively, target

men and their needs.

The real challenge for women, therefore, is not accessing outside institutions in general but specifically overcoming tremendous anti-women biases by public and private agencies that foster agriculture and livestock production.

Female-headed households are more insecure than male-headed households in terms of availability of production resources and dependency on irregular income inflows from produce sale, employment or remittances. Their insecurity, however, extends to other realms. Following Bourdieu's conceptualization, the above mentioned anti-women biases make female-headed households insecure in terms of social capital (i.e. participation in networks) that allows people to gain direct access to economic resources, and cultural capital that people gain through contacts with experts or individuals of importance (i.e. the embodied cultural capital) or links to institutions that bestow valued credentials (i.e. institutionalized cultural capital) (Portes 1998). This combination makes female-headed households highly vulnerable to food insecurity, and also less able to adapt their farming practices to economic and climatic risks.

Few studies combine quantitative household-level analyses with qualitative work that delves into the 'why' as well as the 'what'. Even fewer examine gender issues in relation to agricultural practices. This study does both, although intra-household research is needed to get more fully at additional critical questions relating to access to and control over resources within the household. Gender norms will play a big role in shaping how well households will be able to adapt to change, including a changing climate. But these norms do change, sometimes very quickly. Sharing the findings and issues raised here with these communities is one way of spurring more widespread dialogue within and across communities and with local and national policymakers.

In an ideal world, sharing this information with governments, development agencies, agribusiness and NGOs working on enhancing farm families' resilience to climate change should contribute to more inclusive approaches and initiatives. In the next few decades, the people living in the sites examined in this study will likely experience even more variable and less predictable weather, and more extreme climate events such as floods and droughts, and more and more pressure on scarce water resources. Policies and strategies aimed at overcoming the tremendous anti-women biases still held widely by public and private agencies that foster agricultural development will

be needed in order for both men and women to be able to deal with their changing environments. These include giving women the right to own land, enhanced and equitable access to weather and climate information, improved and equitable access to agricultural credit, enhanced equitable access to improved seeds and other inputs, strengthening traditional institutional arrangements surrounding the sustainable use and management of forests, wildlife, communal land and water through collective action. Indeed, global food security is unlikely to be achieved in the face of climate change without increased attention to, and investment in, the millions of small-scale farmers – men and women – that produce food.

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