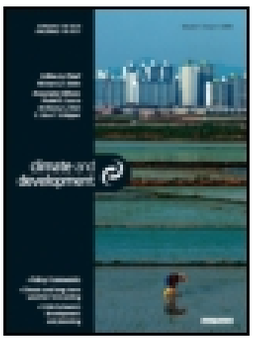

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RESEARCH ARTICLE

Understanding gender dimensions of agriculture and climate change in smallholder farming communities

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In Uganda, Ghana and Bangladesh, participatory tools were used for a socio-economic and gender analysis of three topics: climate-smart agriculture (CSA), climate analogue approaches, and climate and weather forecasting. Policy and programme-relevant results were obtained. Smallholders are changing agricultural practices due to observations of climatic and environmental change. Women appear to be less adaptive because of financial or resource constraints, because of male domination in receiving information and extension services and because available adaptation strategies tend to create higher labour loads for women. The climate analogue approach (identifying places resembling your future climate so as to identify potential adaptations) is a promising tool for increasing farmer-to-farmer learning, where a high degree of climatic variability means that analogue villages that have successfully adopted new CSA practices exist nearby. Institutional issues related to forecast production limit their credibility and salience, particularly in terms of women's ability to access and understand them. The participatory tools used in this study provided some insights into women's adaptive capacity in the villages studied, but not to the depth necessary to address women's specific vulnerabilities in CSA programmes. Further research is necessary to move the discourse related to gender and climate change beyond the conceptualization of women as a homogenously vulnerable group in CSA programmes.

Keywords: gender; participation; climate change; agriculture; smallholders

1. Introduction and background

Although the effects of climate change are expected to vary geographically, poor and vulnerable smallholder farmers in the global south already experience and can expect increases in the unpredictability of weather patterns, more extreme weather events (including increased drought and flood risk), increases in mean temperature and rising sea levels (IPCC, 2013; Vermeulen, Aggarwala, et al., 2012; Vermeulen, Campbell, & Ingram, 2012). If they do not adapt in the face of system-wide heat and water stresses that will negatively impact plants, livestock and people, they will be dealing with reduced production prospects (Challinor et al., 2014). The natural resource base on which these farmers depend will be altered, traditional socio-economic safety nets will be stressed and the potential for future agricultural development will be affected (Beddington et al., 2012; FAO, 2010, 2012; Thornton, Ericksen, Herrero, & Challinor, 2014).

Rural women in particular are reported to be at high risk of negative impacts from climate change (Goh, 2012; Kakota, Nyariki, Mkwambisi, & Kogi-Makau, 2011; Nellemann, Verma, & Hislop, 2011). This is because their household responsibilities such as childcare and the collection of firewood and water can make women particularly climate-sensitive, because they are taking on more agricultural work as men migrate for labour, because they have less access to agricultural resources such as land, extension services and inputs with which to adapt to variability and change, and because gendered social norms and roles can inhibit women's adaptive capacity (Doss, 2011; FAO, 2011; Kakota et al., 2011; Nelson & Stathers, 2009; Peterman, Behrman, & Quisumbing, 2010; Wright & Chandani, 2014).

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On the other hand, the increasing role that rural women are playing in smallholder agriculture provides an important opportunity to positively impact food production and security in a changing climate (Carvajal-Escobar, Quintero-Angel, & Garcıa-Vargas, 2008). It has been estimated that if rural women had the same access to agricultural resources as men, yields could increase by 20–30% and the total number of hungry people around the world reduced by 12–17% (FAO, 2011). Thus, focusing information, resources, technologies and practices for climate-smart agriculture (CSA) on women is an important strategy for catalysing adoption.

Socio-economic and gender analysis is an important step for gender-appropriate targeting of CSA. It can be used to understand the socially differentiated roles, responsibilities, priorities and resources of producers at the community and household levels, providing the kind of information needed for policy and programme development that addresses the types of inequalities that prevent women's access and control of resources (FAO, 2001, 2003; Kristjanson et al., 2014; Meinzen-Dick et al., 2012; Quisumbing & Pandolfelli, 2010). When considering the influence of gender on the ability of individuals and communities to adapt to the effects of a changing climate on their agricultural development, and to mitigate the causes of climate change,

> Gender roles and relations are of key importance, disadvantaged persons and groups are a priority in development initiatives, and participation is essential for sustainable development and climate change adaptation. (FAO, 2012, p. 12)

However traditional, (typically) quantitative approaches to gender analysis may not be sufficient for elucidating the norms and roles that underlie gender dynamics in specific sociocultural contexts, or identifying entry points for transforming gender norms and thereby enabling a community's adaptation to climate change (Nelson & Stathers, 2009). They may, in fact, be promoting the predominant framing in much of the climate change discourse of women as a homogenously vulnerable yet nature-protecting group (Arora-Jonsson, 2011). This oversimplification is hindering progress towards the deeper understanding of gender dynamics that members of the climate change research community need (Carr, 2008; Okali, 2011; Wong, 2009).

Participatory approaches are being used by development practitioners and researchers alike to understand perceptions about climate change, and communities' adaptation priorities and needs (CARE, 2014; Peterson et al., 2010). Adapting these approaches to the exploration of gender dynamics in the context of climate change may be the most appropriate way to improve the level of understanding in the climate change research community (Lilja, Ashby, & Sperling, 2001).

The aim of this study was to develop an approach to deepening the understanding of gender in terms of the major topics of the global research programme on Climate Change, Agriculture and Food Security (CCAFS). The objective was to develop and test participatory tools for investigating the gender dimensions of agriculture and climate change. In this paper, we describe the topics explored, the tools used and the results obtained. We analyse the tools in terms of ease and consistency of implementation, and the strengths of the pilot test results in terms of generating useful information for practitioners and others seeking more gender equitable agricultural development strategies and solutions.

2. Methods

The methods in this study were derived from research conducted by Lambrou and Nelson (2010). It was conducted in the context of a large, multi-year research programme on CCAFS with multiple research themes led by experts in the fields of CSA, climate information systems and mitigation (ccafs.cgiar.org). So as to focus the study on themes relevant to the programme, priority gender and climate change topics were identified by CCAFS research leaders from each theme. The topics were:

- *Engaging in climate-smart agricultural practices* that sustainably increase productivity and resilience (adaptation), reduce or remove greenhouse gases (mitigation) and enhance achievement of food security and development goals
- *Sharing adaptation strategies in climate analogue villages* that share similar climates across space and/or time
- *Accessing and using climate information*, including daily and seasonal forecasts

The study was implemented in Uganda, Ghana and Bangladesh, corresponding to three target CCAFS regions: East Africa, West Africa and South Asia (Förch et al., 2013). Long-term (10–20 years) research sites in each region were purposively established in 2010 so as to allow for exploration of a diversity of socio-economic, ecological and production systems, and solutions to climate change effects on agriculture and food security in these systems. For this study, one village was purposively selected from each site (from 20 villages), based on the following criteria: village leaders were able to provide information related to CCAFS work, the village contained more than 50 households and ease of access. Although ideally all 20 villages would have been included in the study, resources for this pilot phase were limited and it was important to avoid research fatigue in the sites.

A gender-balanced team of researchers with expertise in participatory rural appraisal implemented the study in

each country. A guide for investigating the gender dimensions of climate change in agriculture and food security sectors was developed (FAO, 2012), and the teams were brought together for a joint training. The guide standardizes sample selection, ensures consistency in fieldwork, creates uniformity in reporting and aids in cross-site comparison of results.

Selection of focus group participants was based on random sampling using a list of all households in the village. Invitations that indicated the gender of the participant were issued to 15 households either orally or in writing. The target size for focus group discussions was 15–20 individuals, and it was assumed that some invitees would not respond while in other cases residents of the village that had not been invited would show interest and join a group. No household participated in more than one focus group. In the case where there were an appreciable number of households not actively farming in the village, the list was filtered first to remove those households before the remaining were used for random selection. In some cases, other people joined the focus group, usually village elders or decision-makers.

Raw data from each focus group were recorded by the research teams using standardized forms provided in the study guide for each topic. The teams provided the study organizers with these forms, along with images of any diagrams or charts and a report with analysis, observations, conclusions and recommendations. The forms were divided by sex to capture nuanced gendered understanding of potential climate change adaptation methods. The study organizers analysed information separately for men and women by theme in each research site. Then, the study organizers conducted a comparative analysis across sites to reach the conclusions of the study.

2.1. *Engaging in climate-smart agricultural practices*

This section of the study focused on understanding the drivers for practising CSA, organizations that promote it and institutions that support it. To investigate existing practices, two focus groups were formed in each site, one female (average number of participants = 15) and one male (13). Venn diagrams were used indicate external organizations intervening in the village and their institutional relationships. A new tool called 'changing farming practices' was used to facilitate a discussion on changes in the last 10 years, and to identify the top three to five (FAO, 2012). These key changes were discussed in detail, including drivers of change, decision-making related to change, implementation, rates and types of participation, constraints to participation, types and distribution of benefits, organizations involved in introducing or supporting change, and the impact of change on overall wellbeing, income and food security. Key informant interviews with development workers were held to capture more information on the above issues.

2.2. *Sharing adaptation strategies in climate analogue villages*

To investigate mobility as a barrier to farmers making visits to climate analogue villages, two focus groups were formed in each site, one female (20) and one male (14). First, the concept of climate analogues, defined as villages with similar climates across space and/or time, was explained (Ramírez-Villegas et al., 2011). The approach can be used to enable adaptation by helping farmers better visualize and understand what their agricultural future might look like and what kinds of changes and options they need to consider. The objective of this part of the study was to evaluate the extent to which farmers could visit an analogue site and learn about adaptation strategies. Participants were asked to describe what they thought would be key characteristics of analogue sites from their perspectives (i.e. climate/environmental changes that they were starting to face). Key characteristics identified were drier climates in Ghana and Uganda, and higher soil salinity in Bangladesh. Then they were asked to identify villages they perceived to currently have those characteristics, and review some of the challenges that would come up in a potential visit. Next, village resource maps and guiding questions were used to explore perceptions regarding mobility, identify factors that may influence that mobility and ascertain if farmers might exchange any information pertaining to agriculture.

2.3. *Accessing and using climate information*

To investigate access to and use of daily weather and seasonal climate forecasts, four focus groups were formed in each site, one each for adult females (14), adult males (13), female youth (8) and male youth (16). Seasonal calendars were used to understand farming activities in relation to weather information. Daily and seasonal forecasts provided by national meteorological services were shared and discussed.

3. Results

3.1. *Uganda*

Kyengeza Village, Rakai District suffers from declining natural resource quality and quantity (Kyazze & Kristjanson, 2011; Wortmann & Eledu, 1999). Rakai is especially vulnerable to flood events (Onyango et al., 2012). HIV/AIDS seriously impacts food security in the area (Hunter, Bulirwa, & Kisseka, 1993; Taylor et al., 2011). Subsistence agriculture is the dominant economic activity. Crops include bananas, beans, potatoes, cassava, maize, sorghum, finger millet, fruits and vegetables. Coffee is

the main cash crop. Livestock include cattle, goats, pigs and poultry (Roncoli, Orlove, Kabugo, & Waiswa, 2010; Ruecker, Park, Ssali, & Pender, 2003).

3.1.1. *Engaging in climate-smart agricultural practices*

Farmers reported experiencing changes in rainfall duration and intensity, more erratic rainfall patterns and more prolonged droughts. As a result, they say it is increasingly difficult to plan and make agricultural decisions. They associate the emergence of new crop diseases and pests with climate change. Other reported drivers of changing agricultural practices in the village were lower incomes, less household food availability, less access to resources for improved agricultural production and, on the positive side, more opportunities for training. Men said they are more motivated by income opportunities to change their practices, while women said they are more driven by the desire for increased food availability. Both said that men are more likely to have access to resources, especially cash, that enables them to take up new agricultural practices that make them less vulnerable to the observed changes in weather patterns mentioned above.

Farmers reported several types of adaptation strategies being pursued in order to cope with perceived changes in climate patterns. Men and women report adopting new crop management practices equally. The most frequent change reported was intercropping, followed by dry planting before the rains have started, earlier planting, adopting drought-resistant varieties and making adjustments in the timing of weeding and harvesting. Less frequently, farmers said they had begun rotating crops, and integrating crops, livestock and trees. Only a few farmers reported using improved seeds.

With respect to adoption of soil and water conservation practices and/or soil fertility enhancement practices, important gender differences were identified. Activities such as the construction of trenches for water management and mulching, usually in banana and coffee fields, were more likely to be practised by men than women. This was attributed by the respondents to women's lack of access to labour and cash for needed inputs. Micro-irrigation and water harvesting are rarely employed, and are almost exclusively used by men, reportedly because they are costly and labour intensive. Soil fertility enhancement with livestock manure and inorganic fertilizers is rarely practised, but when it is, it is almost exclusively practised by men, again reportedly due to the costs involved. Men have also been adopting zero grazing practices, and younger men are the ones that have adopted small-scale irrigation practices for high value and labour-intensive crops such as tomatoes. Women, and not men, reported using mechanical traps for pest control.

A diversity of organizations support the improvement of agriculture in Kyengeza, including state and local government extension and advisory services, and local and national NGOs. All of these organizations are promoting tree planting, especially in coffee and banana fields, and soil and water conservation techniques, especially terracing in banana fields. Some organizations are providing free seeds and other inputs. These organizations target farmer groups, but have no specific policies regarding social-differentiation and gender sensitivity.

3.1.2. *Sharing adaptation strategies in climate analogue villages*

Mobility for farmers in Kyengeza usually involves travel to surrounding villages (up to three kilometres) for household needs such as purchasing essential commodities, selling produce at markets and buying improved seeds. Men are twice as likely to travel outside of Kyengeza for marketing than women, and are usually responsible for purchasing improved seeds. Travel for improving agricultural production most often involves visiting neighbours to observe production practices, and to attend development trainings. Examples given of new ideas from other villages being adopted by farmers in Kyengeza include improving tomato production, mulching bananas, construction of water trenches, planting trees and using inorganic fertilizers.

Age and sex appear to play important roles in determining mobility, with young men most likely to travel. However, new market information services may be influencing this trend. Mobile phone owners, most frequently young men, travel less because they are able to access information about market opportunities and prices electronically.

Factors limiting women's mobility included lack of funds to pay for transportation, poor infrastructure, security, health, household responsibilities and lack of permission from their spouses. Male respondents indicated that they would be more willing to grant women permission to travel to meetings if the women received an official letter of invitation. Farmers most frequently travel by bicycle, whereas both men and women reported that women could not ride bicycles and if they wanted to travel outside their village they must have the cash to cover the bus fare.

In discussion about other places facing similar climates and farming challenges, both men and women indicated an awareness of innovators in neighbouring villages. They indicated that in one instance, their neighbours were well organized in production and marketing associations that facilitate the adoption of improved agricultural practices. They also were aware that another neighbouring village, despite receiving good rainfall, was worse off than they were because of poorer soils.

3.1.3. *Accessing and using climate information*

Farmers reported regularly receiving weather information as SMS (short text messages) on their mobile phones,

and credited the 'prime minister's office' as the source. Despite this high level of exposure to and perceived legitimacy of the information, few farmers of any sex or age appeared to find it salient or credible. They did not understand the international weather symbols most often used in print media for daily forecasts, and found seasonal forecasts difficult to understand. Few said they had ever received a seasonal forecast. Women did not seem able to understand the seasonal forecast presented during the study or its implications for agricultural decision-making, while the men were able to do so. However, they perceived that both daily and seasonal forecasts broadcasted on the radio were unreliable as they related to a large geographic area and not their village specifically. Both men and women reported getting and using weather and climate information and knowledge from trusted elders within their family. So although they report a desire to receive information on why the environment is changing, very few are actively seeking out and using weather and climate information. They also want to receive reliable information on when to plant, the expected intensity and distribution of rainfall events, and adaptation and mitigation options and strategies.

The majority of men prefer to hear weather and climate information on the radio. Women prefer to receive this type of information, in order of importance, via megaphones, letters, village leaders, farmers groups, school children, religious and social gatherings, and print media. Both sexes feel this type of information can only be useful when it is issued in the local language and is more location-specific.

3.2. *Ghana*

The Upper West Region, particularly Lawra and Jirapa Districts where Doggoh Village is located, is especially vulnerable to increasing temperatures and unpredictable rainfall patterns (Pinto, Demirag, Haruna, Koo, & Asamoah, 2012). Poultry, sheep, goats and pigs are raised, and the main crops are maize, sorghum, millet, rice, groundnuts, cowpea, Bambara nut and soybeans (Naab & Koranteng, 2012). Most farmers rotate intercrops, while some farmers relay grains and legumes and a few farmers practise mono-cropping.

3.2.1. *Engaging in climate-smart agricultural practices*

Farmers in Doggoh highlighted three main drivers of changing agricultural practices in the village: changing rainfall patterns, declining soil fertility (attributed mainly to tree cutting and burning) and labour shortages due to urban migration. Men reported adopting a wider variety of agricultural changes than did the women, including introducing new crop varieties, new tree crops such as mango, cashew, citrus and papaya, and new livestock species, including pigs and rabbits. They also said they had begun using more inorganic fertilizers and other agrochemicals, along with changing the shape of their hoes and beginning to use ploughs and tractors to cultivate in straight lines.

Women reported having introduced new vegetable crops such as moringa, spinach and cabbage, starting to make compost and planting in rows across slopes to better capture and retain rainwater. They pointed out that, other than planting in rows, these new practices have increased their already heavy workloads. They mentioned that the newer crop varieties are more susceptible to diseases and pests, and are more perishable. Both sexes said that these new agricultural methods have been introduced by government agencies that provide extension services and training.

The sex-disaggregated focus groups elicited an interesting difference in points of view about adoption of new agricultural techniques. Men said that women are the primary decision-makers regarding new crop varieties because they are responsible for the family's food supply. Women said that men are the primary decision-makers for staple food crops because they seek to maximize profits. It seems that men are the first to adopt new practices taught by extension service staff, and women learn about them from their husbands. Some women have been agents of change by learning from NGOs about improved varieties, fertilizers and other agrochemicals, and composting. They have also obtained new vegetable varieties from friends and neighbours.

Currently there are no programmes to introduce CSA practices in Doggoh. However, farmers are attempting to adapt to observed changes. Men indicated they were planting fruit trees such as mango, and plants such as moringa and aloe vera. They also reported switching to improved crop varieties, adopting intercropping and crop rotations, making compost, using manure and occasionally inorganic fertilizers, stopping burning, incorporating crop residues, leaving fields fallow and cultivating in low lands.

With respect to new practices, women reported planting vegetables in dry season gardens for consumption and sale, and expressed an interest in starting tree nurseries. The women also pointed out that because they cannot own land, they have little incentive to adopt new methods, particularly making investments that pay off in the longer run.

Both genders are interested in learning about no-till techniques, managing crop residues, and accessing more drought-tolerant varieties of crops. Multiple organizations have been involved in introducing changes, including the national extension services, NGOs and local organizations. Other services supporting the adoption of new agricultural and livelihood strategies by farmers are savings and loan programmes, literacy programmes, and education and health services. Interestingly, it sometimes took considerable probing (and inquiring specifically about new crops or trees in the landscape, for example) to elicit information

on new agricultural practices; perhaps a characteristic of communities that have always had to deal with highly variable weather.

3.2.2. *Sharing adaptation strategies in climate analogue villages*

Travel involves moving most often to neighbouring villages. Men in Doggoh are more mobile than women, travelling up to five times the distance. They travel for trade and multiple social reasons. In contrast, women travel in connection with the family livelihood. They travel to sell their products such as firewood, charcoal, shea butter, 'pito' (a local alcoholic beverage) and vegetables, but also for social reasons. Women travel more frequently during the dry season, when they have less work on the farm and because most of their income-generating products are made during that season. Travel is mostly by foot or by bicycle. Therefore, women tend to be limited in mobility because they do not have a bicycle or they do not have money to pay for transport. They are also constrained by their home responsibilities, particularly childcare.

Although they do not travel primarily for learning about different agricultural practices, farmers from Doggoh reported making observations when they travel. Men are now practising the use of animal traction they observed in Burkina Faso, tilling and planting on flat seed beds, planting fruit and cashew trees, planting grafted mangoes, cultivating early maturing crops, stopping burning and producing improved livestock breeds. Women have observed and are now practising planting in rows, making ridges, ploughing across slopes and forming microcredit groups.

Farmers from Doggoh have opportunities to learn from their neighbours. Nearby villages are climatically similar, but there are differences in soils. Slightly more distant villages, particularly those to the north in Burkina Faso, are hotter and drier with a predominance of bare land, and men have observed that the climate of Doggoh is becoming more like them. Ideas for slowing or preventing this change include planting trees, stopping burning, using climate-adapted varieties, using compost and producing more livestock.

3.2.3. *Accessing and using climate information*

Farmers in Doggoh reported occasionally receiving daily rainfall and temperature forecasts from the radio, and find the information to be highly credible and salient. Men have more access to this information, as they are usually the owners of radios in a household. If they receive weather information, men tend to disseminate it within the household and to friends. Women feel that socio-economic similarities between households in the village ensure that useful information does get disseminated, even if women are not direct recipients. Weather forecasts were reported by men to be useful for planning farming activities such as choices regarding varieties and cropping area, and for household protection such as securing roofs before storms. Women, on the other hand, tend to use this information for planning household chores such as firewood and water collection, milling, cooking and washing.

Farmers in Doggoh have a high level of trust in both traditional indicators of climate and weather, and weather information received over the radio from the Ghana Meteorological Services. However, because weather forecasts are not frequently disseminated, traditional indicators are more often used. Farmers do not have access to seasonal forecasts. However, when they were provided a forecast by the research team they understood it and expressed strong interest in receiving seasonal forecast information, because of the trust they have in the weather information they already receive. Men said that information about the likely timing of the onset and end of rains, rainfall quantity and drought periods would help them choose between crop varieties. Thus, they would use seasonal information in the same way they use daily weather information. Women preferred to have seasonal forecasts to plan farming activities and property management.

Given their experience and limited access to resources, both men and women said they preferred to receive weather and climate information from the radio and in their local dialect, through church announcements and from extension agents. Other methods of dissemination, such as television, mobile phones and newspapers, were seen as not useful due to limited ownership of TVs and cell phones and language issues. Women did say that they would like to receive the information from television, if they could have access to the technology because the medium would allow them to both hear and see the forecasts.

3.3. *Bangladesh*

The Southwest region of Bangladesh, where Chandipur Village is located, has a flat terrain with many rivers. Climatic trends in the district since the 1950s have included increasing annual minimum and maximum temperatures, increasing annual rainfall and decreasing pre-monsoon rainfall (Rimi, Rahman, & Abedin, 2009).

Soil salinization related to sea level rise is an important problem in the region. Salinization is the major cause of outmigration. More than half of households are engaged in farming, with nearly half also earning income off-farm through business, labour and trade (Wright, Kristjanson, & Bhatta, 2012). High yielding varieties of paddy rice were introduced in the 1970s. By the 1990s, yields plateaued due to sharp declines in soil organic matter content. Traditional practice had been to burn crop residues and apply farm manure to supplement organic matter. However, the availability of manure has been reduced due to declines in cattle and the increasing use of manure

as a fuel source. Extension services now encourage farmers to leave crop residues on the fields.

Farmers produce cereals, fruits, vegetables and livestock, including small stock, poultry, fish and shrimp. Bangladeshi women have very limited property rights, resulting in the marginalization of women in terms of agricultural decision-making and receipt of agricultural extension. Although both genders in the household are engaged in farming, the government defines a farmer as 'one who owns land'. National policy directs extension services to 'farmers', thereby reaching only men.

3.3.1. *Engaging in climate-smart agricultural practices*

Men and women in Chandipur cite erratic and decreased rainfall, increasing salinity, increasing cyclones and tidal surges, and colder and foggier weather during the winter period as the most common climate-related reasons for changes they are making to farming practices. Switching to shrimp farming, as well as salinization, is reported as the primary drivers of people leaving agriculture altogether. However, residents of Chandipur report being less inclined to shrimp farming and more inclined to continue with rice farming because of salinity issues and decreasing income from the practice. Freshwater shortages, siltation, salinization, climate variability, natural disasters, pests, irrigation problems and the costs of inputs for agriculture and aquaculture were cited as the most important limits to livelihoods. Women manage collective resources such as water at the community level to ensure their availability, particularly during times of scarcity.

Men are in charge of on-the-ground agricultural activities and marketing, while women take responsibility for post-harvest work. Women are responsible for livestock production, while men market the products and manage the proceeds. Despite their lack of access to extension services, women as well as men in Chandipur reported taking up some new agricultural practices that can be considered 'climate smart'. Most are commonly used nationwide, such as high-yielding rice and the conservation of crop residues, and were not introduced specifically because of climate change. Farmers are concerned about continued declines in soil quality. Women said they continue to use manure on their vegetable gardens.

Other adaptive practices include planting wood and fruit trees in public areas such as along roads and pond banks – by both genders – in addition to the traditional practice of planting them in the homestead. This is encouraged by the government. Women reported that they plant fruit trees to meet emergency cash needs and save for their daughters' marriages, while the men said they plant trees to earn income. Women also reported that local governments have the right to take possession of trees planted in public areas, and that this happens more often to trees planted by women than men. Local NGOs support the establishment of tree nurseries managed by women. They have also been training women in vermiculture and composting, and in improved vegetable gardening. Now NGOs are encouraging vegetable production in hanging pots where salinity limits production. Men are practising row cropping with irrigation and agrochemical inputs for paddy rice and commercial vegetables.

3.3.2. *Sharing adaptation strategies in climate analogue villages*

Men are reported to be more mobile than women, who generally are limited to travelling within two kilometres. Travel is usually not undertaken by either sex for the sake of learning about different agricultural techniques, although both men and women notice interesting practices while they are travelling for other purposes. Women tend to travel for social reasons, and to market their products and make purchases. They report accessing useful information regarding agricultural inputs and production, new income-generating activities and NGO-related interventions and credit schemes. They also seek new information about coping at times of peak food insecurity, when men tend to leave the village for work. Men travel to find work. They report accessing useful information about land preparation, cultivation and crop varieties.

Both genders travel by walking, or using vans and buses, and travel is generally difficult during the monsoon. Thus, the poor and women are limited by transport costs. Women are also limited by social norms that prohibit them from entering crowded buses. When asked to identify an area where the current climate may be analogous to what Chandipur can expect in the future, farmers identified Munshigang sub-district 15 kilometres away. But they chose this analogue area because of the severity of salinization that is already occurring there, not because of observable climatic factors. However, both genders were hesitant to consider farmer-to-farmer visits to Munshigang, because of what they consider to be poor practices related to shrimp farming that are contributing to soil salinization.

3.3.3. *Accessing and using climate information*

Farmers indicated trust in indigenous knowledge regarding weather and climate, which is provided by elders of both genders. Weather information is readily accessed by both men and women via radio broadcasts, and is considered reliable. The information is disseminated to women from poor households without radio at public meeting places. Men also access this information from television. Women use weather information to make decisions about mobility, while men use it for agricultural decision-making. Community members do not have access to seasonal climate forecasts. Thus, the research team decided not to present one.

Because they find the weather information reliable, informants said they would like to have information about seasonal rainfall amounts and salinity levels.

4. Discussion

4.1. *Case studies*

This study highlights similarities and differences between study sites (Table 1), with implications for future research and the design of CSA programmes. Farmers in all three sites are changing agricultural practices, often at least in part because of changes they have observed in weather, climate or environment. However, financial and food security incentives for change appear to be as important as those related to climate. Changes were most frequently introduced by extension services to men and NGOs to women. This gender difference, particularly strong in both Ghana and Bangladesh, is likely due to public extension services conceptualizing the 'farmer' as male while NGOs have identified female farmers' information needs as an otherwise unfilled gap. Many of the changes can contribute to farmers becoming more 'climate smart' in terms of helping better manage and conserve soil and water resources.

Women are adopting changes less frequently than men, citing financial and resource limitations. New tasks that are more labour intensive, such as composting and vermiculture, seem to fall on women, an issue also cited by women as a disincentive to changing agricultural practices. It thus appears that changes in agricultural practices are occurring mainly within existing gender roles, rather than the introduction of new CSA practices leading to challenges of existing gender roles. This highlights the need for further research, such as understanding household and village labour roles in terms of existing and potential new CSA technologies and practices, and modifying them so as to make them more attractive to women in terms of impacts on labour loads. Further research is needed to elucidate the context-specific gender dynamics of labour allocation for potential CSA practices beyond simply considering sex differentiation, by taking into consideration a variety of social drivers.

The study has shown that there is potential for spreading knowledge of adaptation strategies via the use of a climate analogue approach, particularly at the local level, with some caveats. Originally, climate analogues were conceptualized only in terms of physical/environmental characteristics. Clearly, the social and cultural context matters a lot to people. If this is also incorporated in the choice of climate analogue sites, they will be more willing to learn from what others are doing. For example, in Bangladesh, community members had reservations regarding the value of a learning-oriented farmer-to-farmer visit due to perceived harmful production practices in the climate analogue village being considered. In future work, it will be important to examine in more depth how different and changing social and cultural contexts in climate analogue locations affect peoples' and communities' capacities to adapt. Rather than simply identifying communities to visit that have physical and environmental similarities to the future expected for the target village, the concept of positive deviance can be used to identify innovative farmers' testing adaptation options within a potential analogue community (Biggs, 2008).

Farmers in these very diverse sites generally move using public transport or by walking. However, women have greatly restricted mobility because of social norms and cost. This has implications for those wishing to make a climate analogue approach more equitable. If climate analogue locations are to be chosen (for either personal site-to-site visits or videos), then sociocultural concerns will have to be taken into account. Innovative communication-based approaches could potentially add a lot of value (e.g. showing videos or other visualizations in places where women and men gather instead of physically moving people around). Further research is needed to identify incentives for increasing the mobility of women in a variety of contexts.

Indigenous knowledge is the most available and considered the most reliable source of weather and climate information in all three sites. This is consistent with findings from other studies, and indicates that indigenous forecasters are an entry point for the joint production and distribution of seasonal climate forecasts (Orlove, Roncoli, Kabugo, & Majugu, 2009; Roncoli, Ingram, & Kirshen, 2002; Ziervogel & Opere, 2010). Interestingly, elders of both genders produce and disseminate this information in the three study communities. However, the extent to which indigenous knowledge is more accurate or not compared to scientific forecasts is yet to be tested in a systematic manner in these sites.

The sites differed in terms of access to and perceived reliability of weather and climate information. Radio is the most frequent means of access. Women in Uganda prefer other methods, such as gatherings and megaphones, because of their limited access to radio. Women in Bangladesh wanted more access via television, as they felt it would improve their understanding because of the combined visual and auditory presentation of information.

We were unable to explore perceptions of seasonal weather forecasts, as they are only occasionally available in the Uganda site, and not at all in Ghana and Bangladesh. When given a seasonal forecast, both men and women were able to understand it in Ghana. Farmers had difficulty in understanding it in Uganda, especially women. This is consistent with other studies that found seasonal forecasts as presented by meteorological services difficult for farmers to understand without facilitation (Roncoli, Ingram, Jost, & Kirshen, 2003). Suggestions to improve the credibility

Table 1. Comparison of study sites in three countries.

	Uganda	Ghana	Bangladesh
CSA			
Primary means of livelihood	Integrated crop/livestock subsistence agriculture	Integrated crop/livestock subsistence agriculture	Integrated crop/livestock subsistence agriculture, higher rate of off-farm income
Managers of agricultural income	Men	Men	Men
Managers of household food security	Women	Women	Women
Main climate characteristic	Marked dry season with frequent droughts	Marked dry season with frequent droughts	High temperatures, humidity, soil salinity
Drivers of changing agricultural practices	Recent observations of weather, climate and environment	Recent observations of weather, climate and environment	Observations of weather, climate and environment since 1970s
Organizations introducing agricultural changes	Government and NGOs	Government and NGOs	Government and NGOs
Climate analogues			
Potential to use climate analogue tool	High	High	Low
Weather and climate forecasts			
Most available source of weather information	Indigenous knowledge	Indigenous knowledge	Indigenous knowledge
Availability of scientific weather forecasts	Frequent	Infrequent	Frequent
Perceived reliability of scientific weather forecasts	Low	High	High
Availability of seasonal climate forecasts	Occasional	Never	Never
Understanding of seasonal climate forecasts	Poor, especially women	Readily by men and women	Not tested
Control of access to technology in the household	Men	Men	Men

and salience of seasonal forecasts have included downscaling, use of local languages, inclusion of recommendations on how the information can be used, facilitating access to the resources and inputs that farmers need in order to take advantage of agro-meteorological information, and the use of participatory approaches to dissemination at the local level (Cash, Borck, & Patt, 2006; Hansen, Baethgen, Osgood, Ceccato, & Ngugi, 2007; Patt, Suarez, & Gwata, 2005; Roncoli et al., 2008).

Women's access to information appears to be limited by their lack of technology ownership. In general, men control technology within the household. In addition, the limited rights of women in terms of land access and ownership poses a serious challenge in terms of women's incentives for practising CSA. In Bangladesh, this issue is amplified by women not receiving extension services.

4.2. *The research guide*

The participatory tools used in this study proved to have advantages and disadvantages in terms of the topics investigated. Separating respondents into male and female focus groups appears to have given greater freedom to women to voice their ideas and opinions. However, this was not tested further in mixed gender focus groups. Furthermore, the approach may have contributed to the general tendency in this study's results to treat the concept of 'gender' as simply the difference between men and women as single, homogenous groups.

The visualization tools, such as maps and calendars, helped respondents to systematically consider the research topics, and helped scientists keep information organized and ensure that contributions were not lost in the course of the discussion. The 'changing farming practices' tool could be improved by adding changes in agricultural practices on a timeline to facilitate discussion and learning.

Overall, the study did not succeed in producing a critical analysis of gender relations and inequalities, key to better understanding responses to and outcomes of climate change. For example, differences in women's and men's roles might be complementary and supportive of joint coping in some contexts, or perhaps driven by a lack of choice and the influence of gender-based constraints in others.[1]

Participatory methods rely on teams of practitioners skilled in animating and facilitating focus group discussions. Success depends on practitioners having a thorough understanding of the study context and themes. There is, however, often a trade-off between flexibility and consistency in multisite studies. The trade-off may be reduced by including time for field practice in trainings so that team members can observe one another and agree on standard practices. In the end, it may not be possible to fully standardize participatory studies when the sites have very different sociocultural profiles.

5. Conclusions

A main challenge for the climate change research community is to move beyond the current simplistic understanding of smallholder women as a homogenous group that is inherently nature-protecting, but unable to adapt to climate change because of their overwhelming vulnerability (Arora-Jonsson, 2011). The use of participatory approaches in climate change adaptation research has been identified as a way to elucidate beliefs and norms that contribute to gender dynamics (CARE, 2014; Lilja et al., 2001; Peterson et al., 2010).

The tools used in this study provided some insights into women's adaptive capacity to deal with climate change in the villages studied in terms of their mobility, access to information and CSA labour roles. However, they did not provide the depth of understanding regarding exposure, sensitivity and adaptive capacity necessary to address women's specific vulnerabilities in CSA programmes. Nor did they elucidate the beliefs and norms contributing to gender dynamics and vulnerability. More work is necessary to move the discourse beyond the conceptualization of women as a homogenous group in CSA programmes. Revision of the tools to address these weaknesses is recommended. In particular, it is recommended that the tools be improved so that they can capture a variety of voices by splitting participants into more socially differentiated groups, and also that they allow for the probing of the norms, rules and beliefs related to gender and climate change within social groups.

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