Socio-Environmental Assessment of Gender Equality, Pastoralism, Agriculture and Climate Information in Rural Communities of Northern Tanzania

Sofie Sandstrom[1,*], Alexandre Strapasson[23]

[1] University of Helsinki, Finland

[2] Belfer Center for Science and International Affairs, Harvard University, United States

[3] Centre for Environmental Policy, Imperial College London, United Kingdom

* Corresponding author: sofie.sandstrom@gmail.com

Abstract

Investment in climate services in support of climate change adaptation has increased, especially in Sub-Saharan Africa. As this is a relatively new field of practice, little research is available to inform the design of these interventions. The aim of this research is to contribute to building knowledge around this theme. Given the gender dynamics inherent in decision making on livelihoods in Sub-Saharan Africa, we focus on differences in the use of climate services between men and women. We use quantitative and qualitative methods to critically discuss and review the barriers that exist for the use of climate information in making livelihoods related decisions. The results indicate that a link exists between households accessing productive assets and taking action on the basis of climate information, and revealed a large gender inequality across all the assessed variables. What emerged clearly is the need for interventions to be based on needs assessments to ensure that services provided are usable**.**

Keywords: Climate services, gender coefficient, pastoralism, subsistence agriculture, Tanzania

Introduction

Climate services are provided to improve the capacity of agricultural households to adapt to climate change and variability in Sub-Saharan Africa (Tall *et al.*, 2014a; Coulibaly *et al.*, 2015). However, there is little academic work available on climate services, and even less on the gender dimensions of these services. Further research is needed to understand the complexity involved in climate informed agricultural decision making. This article aims to contribute to the debate around how to improve uptake of climate services for decisions informing agricultural activities by applying qualitative and quantitative methods to explore differences in utilizing climate information between various groups, including women and men. It also investigates potential gender inequalities for accessing climate information and agricultural assets (small and large livestock, farm equipment and inputs such as fertilizers, seeds and pesticides).

The geographical areas of focus are Kiteto and Longido districts, located in Manyara and Arusha regions in Northern Tanzania (see map in Figure 1). These semi-arid districts with a majority of pastoralist populations are the target districts for a multi-agency climate service programme, the

Global Framework for Climate Services (GFCS) Adaptation Programme in Africa. The GFCS Adaptation Programme in Africa[1] was a three-year programme implemented in Malawi and Tanzania from 2014 to 2016, aiming at improving climate services for agriculture, health and disaster risk reduction. Key activities implemented included the downscaling of climate products such as the seasonal forecast to the district level and disseminating this to farmers through trained intermediaries, radio and sms.

Figure 1 Map of Regions in Tanzania
Source: Tanzania Meteorological Agency (2017)

As part of this programme a quantitative baseline study was conducted in 2014 by the World Agroforestry Centre (ICRAF) under the leadership of the Consultative Group for International Agricultural Research (CGIAR) research programme on Climate Change, Agriculture and Food Security (CCAFS) (Coulibaly *et al.*, 2015). The survey looked at the current use and need for climate services among households and found that less than 50% acknowledged receiving climate information, with no significant differences observed between men and women. However, large differences were observed in the level of control men and women have of agricultural resources. Only 11% of women reported to own the farmland, while around 9% reported having control over seeds. About 4% women participate in agricultural trainings and as less than 10% of surveyed women have access to pesticides compared with over 80% of men (Coulibaly *et al.*, 2015).

[1] See more about GFCS at: http://www.wmo.int/gfcs/Norway_2

These previous studies provide a conducive context for further exploring whether these significant gender differences in control over productive assets have any impact on the ability to utilize climate information received. Thus, this paper builds on these previous studies, applying a gender equality analysis and using both quantitative and qualitative methods to critically discuss and review the barriers that exist for the effective uptake of climate information and use of climate services for making livelihoods related decisions. The aim of this paper is to contribute to building a theory around this topic. Through using statistical methods, we aim to identify areas where more research is needed and offer lessons that may be potentially useful for other regions and contexts.

Gender, climate and pastoralism

Substantial research has been conducted on gender, subsistence agriculture and pastoralist decision making to date. However, there is limited peer-reviewed research on the use of climate services in general and particularly on gender differences in the access and use of climate information, and even less for critical rural areas of developing nations in Africa. This brief review of existing literature aims to provide a context for our research and is focused on three main themes: gender and pastoralism, , use of weather and climate services and climate services in Longido and Kiteto.

Gender and pastoralism

There is a relatively large body of research available on gender and pastoralism. This literature review focused on studies on the role of gender in the decision making process in pastoralist households, especially in relation to livestock and rangeland management. Substantial research is available on the decision making process in pastoralist communities, especially in relation to livestock and rangeland management. For instance, Oba (2012) provides a detailed description on the process followed by three pastoralist communities in decisions related to rangeland usage, the Orma in Kenya, the Afar in Ethiopia and the Karamojong in Uganda. What each pastoralist community has in common is a set of institutions that govern access to the different communal land areas, using a complex system of indigenous knowledge capturing a range of factors to inform their decisions, including rainfall and soil type. These systems efficiently integrate social and environmental factors to maximize the utility of the land. Nelson (2012) describes how in Maasai communities the land is communal and divided into certain areas, the most important division being land that is being used for grazing during the wet season and land used in the dry season. Much of the land used by pastoralists falls into the legal category of "general land" controlled by central government (Sendalo, 2009), and pastoralists therefore fear that the government might decide to use the land for alternative purposes at any time. This represents a major uncertainty in the future of these traditional communities of smallholders.

The clear roles assigned to men and women in the Maasai community are documented in a number of studies (Oba 2012; Nelson, 2012). In the seminal work "Rethinking Pastoralism in Africa", Hodgson (2000) outlines the four "myths" of the patriarchal pastoralist in Africa as reflecting a view whereby pastoralist societies are patriarchal in the economic, political and social and cultural spheres. Barrow and Mogaka (2007) note that the situation of women and men in pastoral communities is not static, as incidences of drought have led to transformation in the socio-cultural and socio-economic organisation of pastoral societies.

The multiple role that livestock plays in the pastoral economy has been well documented, for instance by Bailey *et al.* (1999), with livestock providing goods and services and also functioning as wealth storage. Sendalo (2009) describes the roles and responsibilities in pastoral communities in Tanzania in relation to livestock management, with young boys are in charge of herding, while women are responsible for livestock health and milk production. Decisions around the sale of livestock have evolved during past decades as pastoralist societies have become more monetized as described in Buhl and Homewood's (2000) study on livestock and milk sale among the Fulani. It is often stated that men decide on when to sell livestock, although Bailey et al. (1999) suggest that the decisions to sell is a result of negotiations that take place between husbands and wives. As Hodgson (2000) points out the fact that women and men in pastoralist societies have different roles and responsibilities does not necessarily imply a relationship of inferiority. In general, the multiple and even overlapping rights and responsibilities of various household members in relation to livestock are not well known and tend to vary across communities.

Critical research has pointed out that the focus of both researchers and practitioners on women's roles related to livestock reflect a view on what constitutes an asset that was introduced by the colonial administration, and has been perpetuated since by various development interventions (Hodgson, 2000). Both research and development interventions tend to focus on livestock management, and overlook the importance of milk production and sale and the collection of plants, both of which are essential for the survival of the household (Hodgson, 2000). A typical example of this is the paper by Goldman and Riosmena (2013) on adaptive capacities among Maasai in Northern Tanzania, where adaptive capacity is equated with the ability to maintain livestock herds. Research has shown that, whereas development interventions tend to focus on the economic value of livestock as an asset, for the pastoral household economy the income from livestock products is often more important that the income from the sale of livestock itself (Bailey et al., 1999). Hodgson (2000, p. 11) summarizes the situation as follows "Monetization and commoditization of their livestock economies during the colonial and postcolonial periods transformed cattle, in particular, from a shared good in which men and women held overlapping rights and responsibilities into a commodity, bought, sold and owned by men". This implies that the lack of control over key productive assets among pastoralist women that many development interventions are trying to address is in fact a problem constructed to a certain extent by the development community itself. However, research has also found that female headed pastoralist households tend to be less able to diversify their livelihoods than male headed households.

Use of weather and climate services

A number of studies have been conducted on the use of weather and climate services among rural communities in Sub-Saharan Africa (Tall *et al.*, 2014a; Vogel & O'Brien, 2001; Hansen, 2012). Given the widespread practice of rainfed crop production, the connection between the weather and agriculture is a given one. As African meteorological agencies are generally underfunded and therefore not sufficiently equipped to provide quality services, the use of formal weather information across the continent is limited.

According to Vogel and O'Brien (2001), there are two general approaches used to assess the use of weather forecasts: prescriptive approaches, which assume that users of the information behave

in a manner that is optimal according to some normative theory of decision making; and descriptive approaches, which focus on the actual behaviour of users and their actual information processing and decision making procedures. The majority of studies reviewed follow a prescriptive approach, assuming that there is a course of action that is appropriate to take following receipt of the climate information.

Prescriptive approaches tend to advocate for climate information to be provided in a gender sensitive manner (Lwando, 2013). In contrast, in a descriptive approach, governments should ensure a good dissemination of seasonal forecasts, regardless how famers would use such information (Tomson, 2001). One can therefore note a key difference between the way the prescriptive and descriptive approaches perceive the role of the government versus the role of individual farmers, whereby the prescriptive approaches advocate a significant role of government agencies in supporting farmer decision making through extension services.

The prescriptive studies have identified multiple bottlenecks that prevent forecasts from supporting farmers in managing climate risk (O'Brien *et al.*, 2000; Tall, 2014b; Hansen, 2012). The main ones are are: (i) the scientific language in which climate information is disseminated, and often the language itself (Hansen, 2012); (ii) the lack of trust among users in the climate information and forecasts (Patt, 2002); (iii) inadequate dissemination mechanisms of climate information from the producers to the users, including feedback mechanisms (Roncoli *et al.*, 2001; de Jalon *et al*., 2015); (iv) the limited financial capacity of communities to trigger preparedness actions once forecasted information is received; (v) the differences in geographic scale between the forecast, which are usually made at the national level, and the farmers who make very local decisions (Patt, 2002); and finally (vi) limited inputs available to farmers, such as fertilizers, pesticides, seeds, irrigation or availability of land (Vogel and O'Brien, 2001). Vogel and O´Brien (2006) refer to an accumulating body of evidence showing that the use of forecasts among small-scale farmers is constrained by the limited production alternatives available to them. In the context of climate service provision, it is essential to bear in mind that information alone is not sufficient to enable necessary action to be taken. Contradictory findings have been reached by for instance Phillips (2001), who in a study on the use of forecasts among communal farmers in Zimbabwe found that lack of access to assets do not appear to hinder use of forecasts but that access to information is likely to be influenced by wealth.

The overall impact is that little of the information reaches users, and that a majority of farmers and pastoralists rely on indigenous knowledge and personal experience. The World Bank report "Increasing Agricultural Production and Resilience Through Improved Agro-meteorological Services" (World Bank, 2015) highlights the role of cultural barriers as farmers tend to rely on indigenous knowledge and be cautious about adopting new farming practices on the basis of external information. This is why projects that have combined formal scientific knowledge with indigenous information have proven very successful (Ndiaye *et al.*, 2013).

The majority of studies on climate services have focused on crop producers (Tall *et al.*, 2014a; Blench, 2001). Much less research is available on how pastoralists use weather and climate information. Some research available indicate that rainfall as a factor in pastoral decision making cannot be separated from the socio-economic context in which pastoralists exist suggesting a complex decision making process that is not well researched (Bailey *et al.*, 1999). Several

research efforts have gone into detail on the complexity of the decision making strategies employed by farming households and understanding the role of climate information in this context (Nelson and Finan, 2000; Roncoli *et al.*, 2000 and 2001). In practice, users of climate information deal with several other uncertainties in their environment, and therefore how they use this information is not always clear or predictable (Sivakumar & Hansen, 2007).

There are few studies available on the gender impact of improved climate service delivery, and most of the studies on the use of climate forecasts are gender blind, see for instance Mpandeli *et al.* (2013). Studies that do consider both gender and climate services, such as Tall *et al.* (2014b), usually reflect a prescriptive approach, based on the assumption that women need climate services and that the provision of these would lead to a change in the participation of women in decision making processes. Research and climate service interventions tend to treat women as a homogenous group, which overlooks the fact that in pastoralist societies the roles, responsibilities, rights and duties of women change over their life cycle (Hodgson, 2000). This means that both the ability and need to access climate information varies for women depending on their age and status within the community.

Climate Services in Longido and Kiteto

Tanzania has a bimodal rainy season with one season lasting from March to May and the second one from October to November. The climate of the dry lands is characterised by scarce and unreliable rainfall (FAO, 2013). In the survey carried out by Coulibaly *et al.* (2015), almost 40% of the respondents in Longido identified drought as the biggest threat to their agricultural productivity. Similar results have been found by other surveys conducted among pastoralist communities in Tanzania, such as Gustafson *et al.* (2015), Hampton *et al.* (2015), Enfors *et al.* (2008), and Below *et al.* (2013), who found that the respondents stated that their local climate was becoming warmer and drier, and the rainfall pattern was changing.

Extreme precipitation changes over Eastern and Southern Africa, such as droughts and heavy rainfall, have been experienced more frequently during the last 30-60 years (Niang *et al.*, 2014). Regional and global climate models for future projections generally agree that temperatures in the region will increase under all emission scenarios, but there is no consensus on the impact of climate change on rainfall variability in East Africa (Niang *et al.*, 2014).

Available studies on the global and regional impact of climate change on agriculture do also not provide a conclusive picture. Models suggest that up $2 – 3^{o}C$ warming in the tropics may be tolerated by crops, especially if precipitation increases, but for livestock there is a lack of models relating climate to animal physiology limits. As outlined by Salinger et al. (2005), climate affects livestock in four ways: through the impact of changes on availability and price of feed grain, through impacts on livestock pastures and forage crops, through the direct effects of weather and extreme events on animal health, growth and reproduction and through changes in the distribution of livestock diseases.

Historical rainfall data for Longido and Kiteto reveal no significant trend but rather a pattern of considerable variation. For Longido, the data available is from Arusha and Tinga Tinga stations, whereas for Kiteto district the data is from the station in Dodoma. The Tinga Tinga observations show that 14 of 24 years received below average rainfall (58%) and for Arusha station the same

was observed in 33 of the 53 years (62%) for which there are observations. For Dodoma, the station with the longest observational record of 79 years below average rainfall was observed in 38 years, which is just under half of the years.

Climate information is disseminated through two main streams: directly to users at the household level through media, mobile phone's Short Message Service (SMS) and the website of the Tanzania Meteorological Agency (TMA), and through government channels (Daly *et al.*, 2015). In the government system, the information flows from TMA through the sector ministries, and onward to the district level officials who disseminate this to the ward, village and county level mainly through written letters. Officials at these local levels of administration disseminate the information to households and communities depending on the type of information, sometimes using traditional governance structures (Daly *et al.*, 2015). The steps involved in the dissemination through the government channels are so numerous that delays are significant. For climate information issued on a short-term basis, such as the monthly agro-meteorological bulletins, the delay is enough to make the information useless.

Methodology

The methodology comprises contextual analysis, semi-structured key informant interviews, four focus group discussions and statistical analysis of secondary data. Key informant interviews were held with a total of eight respondents to complement the literature review. The focus of these interviews was to identify steps taken to address gender dynamics in the provision of climate information and any preliminary gender impacts observed, acknowledging the anecdotal nature of this information. Key informants were selected by the authors on the basis of posts held in organizations implementing climate service projects, including CCAFS, Care International, University of Reading, the Food and Agricultural Organization (FAO) and the World Food Programme (WFP). There was also an opportunity to participate in loco in two focus group discussions with farmers who had benefited from a climate service intervention in Longido district in April 2016 to discuss uptake of the information received.

Secondary survey data collected in 2014 (Coulibaly *et al.*, 2015) was used in this paper both to provide the context as well as to conduct a regression analysis to answer the research question on whether there is a relationship between women and men utilizing climate information and key productive assets The secondary data used was collected by ICRAF through structured household questionnaires in sampled villages. A stratified random sampling design including village experiments (to receive the program) and controls (to serve as comparison) was used for the individual household data collection process. Data were collected in 17 villages (9 experimental and 8 control) and on 340 individual households (25% female headed) using trained teams of enumerators (Coulibaly *et al.*, 2015). There are a number of limitations and benefits with using secondary data, including the ability to produce new analysis of existing data (St Martin *et al.*, 2010). Given the somewhat limited analysis that was done on the data collected (see Coulibaly et al., 2015) this paper was able to further explore the data and provide new analysis and generate additional information.

For Kiteto, which is a mainly agricultural district the key productive assets chosen to conduct the tests were seeds, tools, pesticides and fertilizer. For Longido, where the majority of people are pastoralists the assets chosen for the test were fodder, grazing, small and large livestock. The

survey was also used to further explore potential discrepancies in terms of gender equality in the assessed agricultural regions. To this end, we suggest that the differences between access to assets and information for women (A_w) may be proportional to those for men (A_m), times a hypothetical gender coefficient (g). This coefficient quantitatively reflects the level of inequality for a specific parameter or group of parameters in the case of multiple subjects, which can be geometrically represented as polygons using radar charts, for instance, as described in Equation 1, here termed "equation of gender proportionality".

$$\mathbf{A_w = g\ A_m} \qquad \text{(Eq. 1)}$$

Where:

g < 1 meaning a higher concentration of male for the assessed variable

g = 1 meaning a gender balance between men and women for the assessed variable

g > 1 meaning a higher concentration of female for the assessed variable

For more complex analysis involving dimensions of health, empowerment and labour market, UNDP (2016) suggests the utilization of a Gender Inequality Index (GII), and therefore this proposed equation should be seen as part of a much broader context. It is not dedicated to explain other external issues that may affect the results, such as violence, cultural and historical aspects, or to assess a larger number of gender identities that not only men and women. Instead, it provides a simple approach for assessing the available database for the selected districts of Northern Tanzania, which may also be applicable as a reference for other studies elsewhere. We did not include R squared values from the tests in our findings because they were all very low.

Results and discussion

Current use of climate services

The key informant interviews conducted revealed that few climate service interventions were based on needs assessments. Most agencies referred to a need for climate services that had emerged from ongoing discussions with partners and there was a tendency to view the need as self-evident. Surveys conducted at the household level have generated varied results. Coulibaly *et al.* (2015) found that the most common climate information received by farmers and pastoralists in Longido and Kiteto are forecast of an extreme event and forecast of the onset of the rainfall, which is received by less than half of the population, with that less than 10% of surveyed households reporting receiving the seasonal forecast and daily weather forecasts (Coulibaly *et al.*, 2015). Other surveys have indicated that the daily forecast is the most accessed climate service at the local level in these districts (Daly *et al*., 2015). Possible causes for these differences include sampling methodology and differences in socioeconomic profiles of communities. The overall picture that emerges from an analysis of survey results is that access to climate services is highly varied, and generally very low.

In the focus group discussions conducted in April 2016 with two groups of ten people, each consisting of five men and five women, all respondents stated that they now received seasonal forecasts for the first time. Because these were now specific to their district, the farmers were able to use them in making cropping related decisions. The information was interpreted for them

by the agricultural extension worker, and accompanied by agricultural advisories. Households tend to see the formal climate information as something that should be "certain" due to the fact that it has been provided by the government, which easily creates mistrust when forecasts do not materialize exactly as predicted (Daly *et al.*, 2015). This was confirmed in the focus group discussions in April 2016 where the farmers expressed very limited understanding of the probabilistic nature of forecasts. They indicated that they followed the advice of the extension agent, based on the forecast. Credibility is further challenged by the fact that the forecasts are produced at such large scale, with many products being provided for countrywide coverage, which means that users often do not see how the forecasts correspond to the actual weather conditions experienced in their particular location (Daly *et al.*, 2015; Coulibaly *et al.*, 2015). Language was identified as being a key challenge in accessing the information. Most formal information is provided in Kiswahili, rather than in the vernacular language (Maa), and the translation of some of the meteorological terms from English to Kiswahili also offers some risks for potential misinterpretations (Daly *et al*., 2015).

There are differences to be noted in how various livelihood groups use climate information and the livelihood profile of Kiteto districts differs significantly from that of Longido. According to the survey (Coulibaly *et al.*, 2015), over 80% of rural households interviewed in Kiteto identifying as crop farmers (60%) and agro-pastoralists (33%) involved in both crop production and livestock keeping and 53% of households in Longido identifying as pastoralists, and 32% as agro-pastoralists. For pastoralists the relevance of climate information depends on the type of decision that is being taken and surveys have found little use of formal climate information in decision making related to livestock keeping among pastoralists in Longido. Daily forecasts and severe alerts can be used to inform decisions related to livestock mobility, such as moving livestock to higher grounds to avoid flooding. For the seasonal forecast pastoralists could use this information to plan their herd composition and grazing movement for the season. However, there is little evidence of such use of climate information being common among pastoralists. For example, 65% of the surveyed pastoralists made their grazing decisions on the basis of indigenous knowledge, with experience of others being the second most important influence in their decision making process (Coulibaly *et al*., 2015; Daly *et al.*, 2015). What was interesting to observe in the focus group discussions held in April 2016 was a tendency for individuals to express amusement when asked about the use of indigenous knowledge, indicating that the topic was not to be discussed seriously with outsiders.

In addition to barriers at the household level there are bureaucratic and financial barriers that limit the possibility of expanding the provision of climate services for farmers. Financial constrains facing most African National Meteorological and Hydrological Service (NMHSs) mean these agencies have limited staff available both for production of climate information and the dissemination of this to stakeholders at all levels (World Bank, 2015). Moreover, the observational network is lacking in Tanzania as in most African countries, which means there are technical limitations to the downscaling of climate and weather products to make them more relevant to the users (Daly *et al.*, 2015). There is a lack of formal cooperation between the NMHSs and relevant line Ministries, such as the Ministry of Agriculture. Even when such formal cooperation is in place, the number of institutional steps required for a climate product to reach end users at the household and district level are often so many that it causes severe delays. In Tanzania, district level authorities reported receiving information such as the seasonal forecast

up to a month after it has been issued by the Tanzania Meteorological Agency (TMA), and there are also reports of districts getting misdirected information, i.e. information for another district altogether. (Daly *et al*., 2015). The issue is due to the fact that no formal links exist between TMA at the national level and district level authorities (Daly *et al*., 2015).

Some of the delays in dissemination of information within the sectors from the national to the district level are also caused by staff issues within the other government departments. Experience from projects implemented by agencies interviewed highlight the important of creating an enabling environment around the provision of climate services, and experience showed that the interventions worked best when integrated into a larger scale community based adaptation programme that included provision of inputs. Also, in Kenya, the experience of devolution of core governance responsibilities to the county level has created an enabling environment for continuous dialogue between stakeholders at the county level.

Gender differences in the access to agricultural assets and climate services

The use and access of climate services are generally lower in Longido than in Kiteto. Use of climate information in Longido was very low across all variables collected in the survey. The variable used for the tests was use of the onset of the rains as that had generated the most complete data. As can be seen in the below graphs (Figures 2 and 3) most respondents answered "not applicable", indicating that they either do not access or use climate information on the onset of rains. This reflects the different livelihood and agricultural profiles of these districts. No women in Longido reported receiving the seasonal forecast, but 25% of men did. There are significant differences in how women and men access assets needed to act on climate information. For instance, 94% of men in Longido have mobile phones but only 71% of women do (Coulibaly *et al*., 2015). This lack of access to mobile phones was confirmed by the key informant interviews as a main barrier for women accessing and utilizing climate information.

Overall, access to the main agricultural assets and climate information were substantially more favourable to men than women. In Kiteto, for example, as shown in Figure 2, women had lower access than men to all of the agricultural inputs for which tests were run (seeds, tools, fertilizers and pesticides). Women also had lower access than men to climate information, with only 10% of women accessing such information compared to 22% of men. Even though there were variations between districts in Kiteto, there was not a single case in the data where women would have been found to have equal or more access to any input than men.

For Longido, as shown in Figure 3, the results for women were so low, mostly zero, that is not even possible to correlate them with the values for male. However, all values for women are also inside the large polygon dominated by men, as also occurred for Kiteto, but in different magnitude and using some different variables. Thus, the results show the main assessed variables presented in these figures are apparently interconnected, and that although a substantial difference between men and women is noted, no significant differences in gender were observed on how they tend to respond once increasing access to climate information or agricultural inputs.

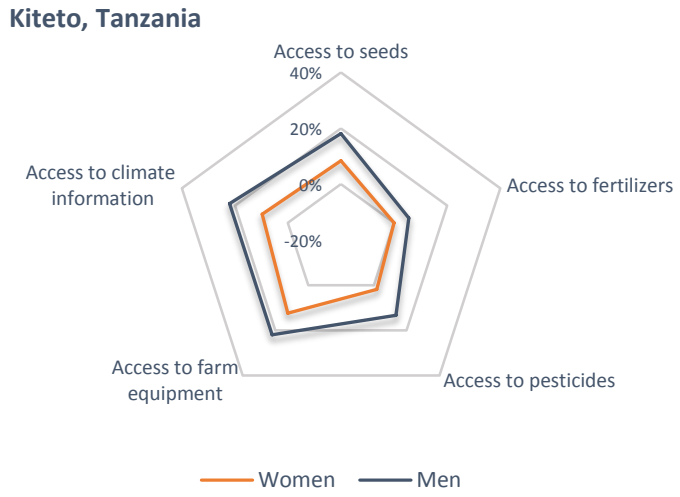

Figure 2: Access to agricultural assets and climate information in Kiteto, Tanzania
Source: Prepared by the authors, using data from independent survey (Coulibaly *et al*., 2015)

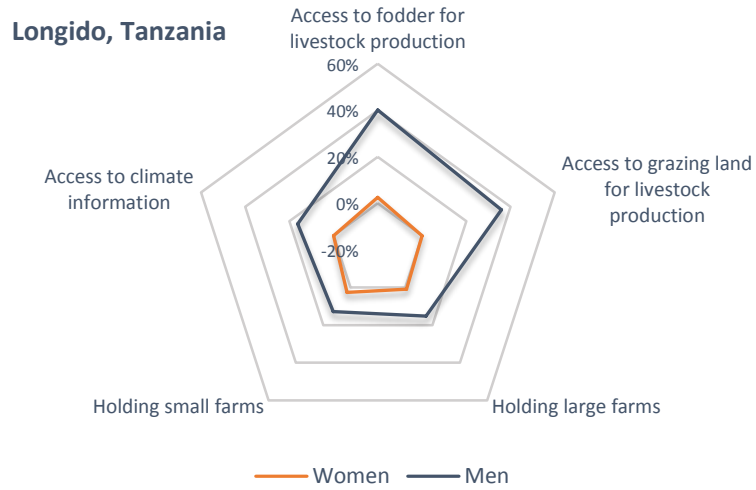

Figure 3: Access to agricultural assets and climate information in Longido, Tanzania
Source: Prepared by the authors, using data from independent survey (Coulibaly *et al*., 2015)

Therefore, in both figures above, it is possible to apply Equation 1, in order to find a certain proportionality in expanding the different vertices of the polygons, i.e. the access to agricultural assets and climate information. In the case of Kiteto, excluding variables with null values, the average value obtained for the coefficient *g* was equal to 0.40 (polygon) in a range between 0.14 and 0.57 for the assessed variables individually. As for Londigo, also excluding variables with null values, the average value obtained for *g* was equals to 0.11 (polygon), with a variation between 0.06 and 0.20 for the assessed variables individually. Therefore, in both cases there is a clear male prevalence in the access to agricultural inputs and climate services, which is even

worse for Longido than Kiteto.

On the other hand, in terms of climate services, the key informant interviews conducted during this research revealed that relatively limited data had been collected on the gender differences in use and access of climate services. Therefore, these analyses should be seen as an approximation, based on the available date, rather than a deterministic result. Most agencies used experience from other projects as a basis for designing climate services. When projects have been able to engage directly with women and get a sense of what their need of climate services are, some differences have emerged. For instance, in one location women were only allowed to manage the land once the men had concluded their activities, which meant that women need information on dry spells particularly late in the rainy season, which is something that the climate scientists could easily provide, but may not be aware that anyone needed.

Two essential themes emerged from the key informant interviews. Firstly, the more members of the household access information the more likely it is to be used by the household. This implies that even though women might not be the final decision making authority in a household on a specific livelihood related issue, such as when to plant, ensuring women have information strengthens their role in the "bargaining" process within the households and leads to the household being more likely to act on the information. Secondly, experience from other agricultural interventions has revealed that women tend to keep certain livelihood sources private from the men in order to protect these from being controlled by men and keep a source of private income. This means that there is a significant likelihood that surveys that aim to capture livelihood related information, such as the survey that generated the data used for this research, do not accurately reflect the livelihood situation of the women interviewed as it would be very likely that women have withheld information during the interviews. Without in depth qualitative research it is not possible to prove if this is the case. However, when analysing the findings and when making recommendations for policy and practise change based on the findings this is worth bearing in mind.

Statistical analysis on the links between gender, use of assets and use of climate information

Statistical tests were run on selected variables to identify whether a relationship was to be observed from the data between women's and men's use of climate information and their use of key productive assets and inputs. For Kiteto, which is a primarily agricultural district the variables selected were use of fertilizers, pesticides, seeds and farm equipment. Of the respondents, 38.5% answered that both women and men use climate information, 22.5% said that men use it, 9.6% said that women use it and 29.4% did not answer the question. Generally, there was a relatively low use of assets, for both men and women, where for instance for use of pesticide 69% and for use of fertilizer 83% provided no answer (Coulibaly et al, 2014).

A regression analysis was conducted to test for correlation between use of key productive assets in Kiteto and use of climate information and differences among men and women. The data was first grouped in terms of percentage of respondents in each village within Kiteto that responded that either men or women utilized the productive asset in question and climate information (see tables 1 and 2 below). There was no clear trend as can be observed in our analyses, as the values were dispersed widely. The R-squared values were low for all of the assets, indicating no significant relationship, but given the generally low access to climate information between men

and women low R-squared values were expected. The R values were generally the same for men and women, indicating that for both sexes the use of climate information increased with the use of farm equipment. For pesticides and fertilizers there were such low rates of utilization for women that a difference can be observed. This result indicates that further research could be conducted on this to improve the accuracy of these results.

Table 1: Summary of Longido data used for tests

			Access to fodder for livestock production	Access to grazing land for livestock production	Holding large farms	Holding small farms	Access to climate information
Longido	Kamwanga	Women	0 %	0 %	0 %	0 %	0 %
		Men	74 %	63 %	5 %	5 %	11 %
	Kiserian	Women	0 %	0 %	0 %	5 %	0 %
		Men	5 %	14 %	24 %	14 %	10 %
	Lang'atabash	Women	11 %	0 %	5 %	11 %	0 %
		Men	0 %	11 %	26 %	21 %	11 %
	Longido	Women	0 %	0 %	0 %	0 %	0 %
		Men	58 %	47 %	11 %	11 %	37 %
	Olkedu Luongishu	Women	5 %	0 %	0 %	0 %	0 %
		Men	60 %	50 %	10 %	10 %	0 %
	Sinya	Women	0 %	0 %	0 %	0 %	0 %
		Men	45 %	30 %	15 %	15 %	30 %
	Average	Women	3 %	0 %	1 %	3 %	0 %
		Men	40 %	36 %	15 %	13 %	16 %
	g value		0,06	0,00	0,06	0,20	0,00
	g value average		0,11				

Source: Prepared by the authors, using data from independent survey (Coulibaly *et al*., 2015)

Table 2: Summary of Kiteto data used for tests

			Access to seeds	Access to fertilizers	Access to pesticides	Access to farm equipment	Access to climate information
Kiteto	Olpopongi	women	26 %	0 %	0 %	32 %	37 %
		Men	42 %	21 %	21 %	32 %	21 %
	Orkine	women	10 %	0 %	0 %	19 %	10 %
		Men	0 %	0 %	0 %	14 %	19 %
	Sunya	women	5 %	0 %	5 %	0 %	0 %
		Men	19 %	10 %	0 %	33 %	10 %

Katikati	women	10 %	0 %	5 %	25 %	0 %
	Men	25 %	0 %	20 %	25 %	30 %
Makame	women	0 %	0 %	0 %	0 %	10 %
	Men	20 %	15 %	15 %	30 %	10 %
Mesera	Women	0 %	0 %	0 %	5 %	0 %
	Men	10 %	0 %	15 %	15 %	20 %
Mwanya	Women	10 %	0 %	5 %	10 %	20 %
	Men	20 %	5 %	15 %	30 %	15 %
Ndaleta	Women	10 %	0 %	0 %	15 %	15 %
	Men	5 %	0 %	5 %	0 %	30 %
Ndedo	Women	5 %	0 %	0 %	10 %	5 %
	Men	10 %	5 %	35 %	15 %	35 %
Nhati	Women	5 %	0 %	0 %	10 %	5 %
	Men	20 %	0 %	5 %	20 %	25 %
Olgira	Women	11 %	0 %	6 %	11 %	6 %
	Men	28 %	6 %	17 %	28 %	28 %
Average	Women	8 %	0 %	2 %	12 %	10 %
	Men	18 %	6 %	13 %	22 %	22 %
g value		0,46	0,00	0,14	0,57	0,44
g value average		0,40				

Source: Prepared by the authors, using data from independent survey (Coulibaly *et al*., 2015)

Use of climate information was higher in Longido than in Kiteto, with 69% of respondents reporting that both men and women use the information (Coulibaly *et al.*, 2015. As half the population is pastoralist, the assets selected for Longido were use of grazing land, fodder, large livestock and small livestock. The responses for women were marginal for all of the variables in Longido, with men and both being provided as the answers for the majority of all the assets. Because the response rates for women were so low, the groups selected for the regression analysis were “men” and “both”.

The regression analysis for Longido revealed similar results to Kiteto in that the data results were disbursed widely across the graph. The two variables where the results were more closely aligned with the model line were for small and large livestock. For these variables the R-squared values were also very high for “Both” indicating that the households in which both men and women utilize livestock tend to also use climate information. In the households were only men utilized livestock the usage of climate information was much lower. For grazing and fodder the R-squared values for “both” were higher than just for men, indicating that households in which both men and women utilize grazing and fodder would also be more likely to utilize climate information, but the difference was not as large as compared with the livestock variables.

The main finding from the regression analysis is that there is a clear difference between men and women utilizing productive assets and inputs, with all the graphs for Kiteto showing much higher rates of utilization among men. For Longido, the rates of utilization for women were non-existent, with the “both” answer being the most common. Qualitative research would need to be

conducted to explore the power dynamics within households to establish what "both" utilizing a certain asset actually means for women and men.

What emerges from the regression analysis is that the link between utilization of productive assets and climate information is generally clearer for assets and inputs that are more commonly used. Further data would be needed to run statistical tests more consistently. From our analysis and aware of the several uncertainties involved, no difference for men and women were observed, indicating that the importance of having access to and utilizing inputs and assets as a precondition to being able to use climate information is as important for men as it is for women, at least based on the available data to date.

Conclusion

The picture that emerged of climate services from the research conducted as part of this paper is one of a field of both practice and research that is very new, and where key gaps exist in knowledge that need to be addressed in order for climate service interventions to be effective.

The regression analysis did indicate a link between men and women utilizing key productive assets and being able to use climate information. For the pastoralist households in Longido and Kiteto this link was clearest for small and large livestock whereby households who utilized these assets also had higher rates of utilization of climate information. For the agricultural households in Kiteto households where men and women utilized farm equipment and seeds were also more likely to utilize climate information. The regression analysis did not indicate any significant gender differences in the link between utilization of productive assets and climate information.

The analysis of the data prior to conducting the statistical tests revealed such low use of climate information that it could be questioned whether the data was sufficient for the statistical tests. Therefore, rather than concluding that the results of the tests mean that no such links exists, it would appear that more research is needed, especially studies that involve data collection at the household level with a wide geographic coverage. Further research should focus on areas of intensified agricultural production where the use of climate information is more likely to be widespread. The question whether such low levels of use of climate information means that any additional information provided is likely to be useful is one for practitioners to address.

What is striking when analyzing the data for Longido is the very low access to grazing rights, with only 3 of the 119 households reporting access to grazing rights, yet 63 of the households identified pastoralism as their primary livelihood. This can be due to errors in the implementation of the survey and even how the question was posed, but could also indicate a disconnect between the self-perception and the economic reality for households in the district. For Kiteto the picture is much more consistent with the majority of households surveyed identifying as farmers and most of these having access to crop land.

In addition, what emerged strongly from the literature review and the key informant interviews carried out as part of this research is that in order for surveys to capture gender differences in use of climate information in pastoralist communities, they would need carefully designed variables on what constitutes productive assets, including variables such as milk production and plant collection, which are controlled by women. Survey design and data collection would need to take

into account the complexity of gender relations to ensure that productive assets that constitute the "shadow economy" controlled by women are adequately captured without jeopardizing the control women have over these assets.

The central finding from this research is that there is an urgent need for more information on the use of climate services, the impact such services can have on livelihoods, and the gender dynamics involved. What emerged clearly from the key informant interviews was that practitioners involved in designing and implementing climate service interventions base their decisions on a prescriptive approach based on a set of assumptions, the main one being that climate services will have positive livelihood impacts for both men and women. Few agencies base interventions on rigorous needs assessments, which would generate data that would allow for activities to be tailored to the specific context of the intended beneficiaries.

The findings from this research generate a number of recommendations for practice, policy, and research. For practitioners, given the increase in investment in climate services in Sub Saharan Africa and elsewhere, it would be imperative that methodologies for gender sensitive needs assessments are developed and rolled out at scale. Without adequate information on which productive assets are critical for a household to have in order to be able to fully utilize climate information investments risk targeting households and communities that are not best placed to act on climate information, and as such miss opportunities for significant impact in terms of improving livelihoods. In addition, in order for climate service investments to be sustainable and achieve impact, especially at scale, it is important that en enabling environment is created, including by policy changes that allow for an effective and functional extension service and functional markets for agricultural produce. As highlighted earlier a number of research gaps exist related to barriers to acting on climate information that should be explored to inform practice and policy development. The main gap is the need to look more in depth at the decision making process at the household level related to livelihoods and production, in an attempt to identify the factors that would enable households to adjust their production choices in response to climate information.

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