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Understanding Women's Needs for Weather and Climate Information in Agrarian Settings: The Case of Ngetou Maleck, Senegal

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ABSTRACT

While climate services have the potential to reduce precipitation- and temperature-related risks to agrarian livelihoods, such outcomes are possible only when they deliver information that is salient, legitimate, and credible to end users. This is particularly true of climate services intended to address the needs of women in agrarian contexts. The design of such gender-sensitive services is hampered by oversimplified framings of women as a group in both the adaptation and climate services literatures. This paper demonstrates that even at the village level, women have different climate and weather information needs, and differing abilities to act on that information. Therefore, starting with preconceived connections between identities and vulnerability is likely to result in overgeneralizations that hinder the ability to address the climate-related development and adaptation needs of the most vulnerable. Instead, as is demonstrated in this paper, the design and implementation of effective gender-sensitive climate services must start with the relevant social differences that shape people's livelihoods decisions and outcomes, including but not limited to gender.

1. Introduction

For those whose livelihoods revolve around rain-fed agriculture, climate services have the potential to reduce precipitation- and temperature-related risks to agricultural production, boost agricultural yields by enabling appropriate crop and variety selections, and build resilience in rural populations by enhancing the food and income base of their livelihoods (Hansen et al. 2007; Klopper Vogel and Landman 2006). To further the achievement of these and other development goals, climate services must deliver information that is salient, legitimate, and credible to those for whom these services are designed (Carr and Owusu-Daaku 2016; Carr et al. 2015b; Hansen 2002; Peterson et al. 2010; Roncoli et al. 2009; Waiswa et al. 2007; Tall et al. 2014; Rasmussen et al. 2014; Ziervogel et al. 2005). Further, we must understand whether and how new information is of value to these users. Information that is not actionable, that does not speak to farmer needs, or that lacks credibility relative to other sources of weather and climate information does not add value to their decision-making, and may even result in confusion around decision-making that reduces the efficacy of existing livelihoods strategies. In short, weather and climate information is not inherently valuable to those in rural agrarian contexts, but must be tailored to the specific needs of the users if it is to have a productive impact on their lives and livelihoods (see, e.g., Carr and Owusu-Daaku 2016; Carr et al. 2015a,b; Vogel and O'Brien 2006; Hansen 2002; Hu et al. 2006; Luseno et al. 2003; Millner and

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Washington 2011; Roncoli et al. 2002, 2009; Shankar et al. 2011).

Further, it is increasingly clear that weather and climate information has different value for different users. Of particular interest to the climate services community, and the adaptation and disaster risk reduction (DRR) communities more broadly, are women, whose needs and activities historically have been underconsidered in agrarian development projects. However, the consideration of women's needs for weather and climate information must walk a careful path, as the literature on gender and adaptation in rural contexts is littered with oversimplified framings of women as a group that often miss the different needs, vulnerabilities, and opportunities *among* women in a particular place [for discussion, see Carr and Thompson (2014)]. To fully understand women's needs, we must first understand that women are not themselves a unitary category of user in a particular place. Instead, the experience of being a woman is greatly shaped by the intersection of gender with other identity categories, such as seniority or ethnicity, and can shift in the context of different activities (see, e.g., Warner and Kydd 1997; Arora-Jonsson 2011; Carr 2008; Harris 2006; Tschakert 2012; Tschakert and Machado 2012; Nelson and Stathers 2009; Onta and Resurreccion 2011; Ahmed and Fajber 2009; Nielsen and Reenberg 2010; Carr 2011). Therefore, we should expect to find different levels of exposure, sensitivity, and adaptive capacity among women in the same community or even household. As has been noted in the literature (e.g., Rasmussen et al. 2014; Vogel and O'Brien 2006), while those who produce climate services often assume that their information is useful to users, they rarely understand users' decision-making processes and contexts. As a result climate services may not be actionable in the manner envisioned by the producers [see also Msangi et al. (2006) for a critique of much ex ante work on the identification of weather and climate information needs].

In this paper, we employ the Livelihoods as Intimate Government (LIG) approach (Carr 2013, 2014b) to explore the different decision-making contexts among women in Ngetou Maleck, a village in Senegal's Kaffrine region. This allows for an ex ante identification of their weather and climate information needs that speaks to Vogel and O'Brien's (2006) call for the understanding of user needs for climate services in the context of user livelihoods [see also Luseno et al. (2003)]. Such an approach produces different, and we argue more valuable, framings of the potential impact of climate information than other contemporary efforts, such as those ex ante approaches reviewed by Thornton (2006). Using LIG, we demonstrate a means of meaningfully identifying the different climate services needs in a given user population. This approach parses users by assemblages of vulnerability: collections of perceived shocks and stresses and their relative importance as reported by individuals. Following LIG, we then identify those aspects of identity associated with these assemblages, focusing specifically on how the roles and responsibilities of particular identities come to be associated with specific livelihoods activities and decision-making, resulting in particular climate and weather information needs. Employing this approach we show that even at the village level, potential users have different climate and weather information needs, and differing abilities to act on that information. Focusing specifically on women, we elucidate not only the needs and barriers to use that cross all women, but also those that are specific to women's age and access to livelihoods assets (a proxy for wealth in this context). Therefore, it is not possible to meaningfully talk about ''women's needs'' in this village, or a set of climate services that might address women's needs in this village or the larger region to which it belongs. To address the development and adaptation needs of the most vulnerable, we must start with the relevant social differences that shape people's livelihoods decisions and outcomes, including but not limited to gender (Carr 2008; Carr and Thompson 2014). As Carr (2008, p. 911) observes in the context of agricultural development, it is only through investigation into the role of social difference (considered broadly) in the production of vulnerabilities to climate variability and change that we are most likely to accurately identify if women have specific information needs, and what those needs are.

We begin with a review of the literature on climate services for development concerned with identifying the needs of potential end users of services. We demonstrate that this literature, like the larger gender and adaptation literature focused on agrarian settings, tends to treat women as a unified category, if women are considered at all. We then turn to our study site, identifying groups of people sharing assemblages of vulnerability. Following LIG, we identify those aspects of women's roles and responsibilities associated with their livelihoods activities and decision-making, exploring the ways in which identity, discourses of livelihoods, and the threat of social sanction serve to create a realm of possible actions within which women (and indeed all residents of the village) make livelihoods decisions. Finally, we use this understanding of women's livelihoods decision-making to identify both the climate and weather information needs shared by women in this village, and those specific

to women of different seniorities and access to livelihoods assets.

2. Gender and climate services

The literature on climate services recognizes that gender is one of several social factors that shapes access to and use of climate information (Hansen et al. 2011). However, only a very limited literature directly addresses issues of gender in climate services. This literature acknowledges the importance of gender to the design and use of climate services in various ways. First, it notes that men and women receive forecasts, and express needs for information, through different behaviors and venues shaped by culturally mediated expectations (Perez et al. 2015; Roncoli et al. 2009, 2011; Roncoli 2006; Archer 2003; Carr 2014a; Carr and Owusu-Daaku 2016). For example, Roncoli and her colleagues (Roncoli et al. 2011) considered the various social and cultural factors that influenced farmer engagement with seasonal forecasts in Burkina Faso. They noted that discussions of such forecasts were heavily influenced by gendered social expectations. For example, where women found themselves in meetings with men, they sat at the outskirts of the meeting site or in a different room entirely (Roncoli et al. 2011, p. 129). In a similar vein, Archer (2003) notes that in South Africa's Limpopo province, women's labor expectations can create time and attention constraints that prevent them from listening to the radio and receiving forecast information.

Second, the literature recognizes that women and men often play different livelihoods roles, and therefore have different information needs (Roncoli et al. 2001; Carr and Owusu-Daaku 2016; Carr et al. 2015b; Roncoli et al. 2002; Orlove et al. 2010; Archer 2003). For example, Carr and his colleagues (Carr 2014a; Carr et al. 2015b; Carr and Owusu-Daaku 2016), drawing on both a broad ethnographic literature (e.g., Becker 2000; Grigsby 1996; Akeredolu et al. 2007; Grigsby 2002, 2004; Becker 1990; Skinner 1959; Förster 1998; Assé and Lassoie 2011) and extensive field data, note that in southern Mali senior men have the principal responsibility for the cultivation of rain-fed staple grains, while women have the most control over hand-irrigated garden crops. Further, women have little decision-making authority over rain-fed cereals. As a result, women have little interest in or ability to act on forecasts aimed at the needs of rain-fed cereal farmers.

Third, the different activities associated with men and women give rise to different awareness of climate and environment issues, which in turn can result in the use of different sources of local information about weather and climate conditions (e.g., Archer 2003). For example, Roncoli and her colleagues (Roncoli et al. 2002, p. 416) note that, among the Mossi inhabitants of Bonam village in Burkina Faso,

> [c]ollecting water and firewood expands the boundaries of [women's] observations to the uncultivated bush. Women note fluctuations in water levels in ponds and wells and in the production of wild fruit that they collect to cook or sell in the market. They also observe insect behavior at water sources and in rubbish heaps. For instance, bugvaré are black insects of the Orthoptera sp. that dig concave nests in rubbish heaps outside compounds. After the first rains, larvae emerge, filling the nests with dirt. A good season is expected if bugvaré fill their nests to the brim with dirt, which symbolizes a full granary.

The existing gender and climate services literature therefore raises the issue of women's particular constraints, needs, and sources of information. However, this discussion is largely limited to essentialist construction of gendered identity, where ''women'' in a particular place or of a particular ethnicity are treated as an undifferentiated group (Carr and Owusu-Daaku 2016). This is in part due to the relative paucity of gender discussion in the literature; what literature there is has to work simply to put the issue of gendered needs for and interest in climate services on the table. To the credit of some researchers, there are hints of much more complex understandings of gender and identity in this literature. For example, Roncoli and her coauthors (Roncoli et al. 2011), in their discussion of gendered engagements with seasonal forecasts mentioned above, clearly recognize that gender is both a relational category, and one that takes meaning from its intersection with other categories. For example, they note that men's participation in discussions about seasonal forecasts was also impacted by cultural norms, such as when senior men refrained from speaking in meetings that involved their daughters-in-law, because they were not allowed to approach or directly address these women (Roncoli et al. 2011, p.129). Here, it is not just men, but *senior* men who experience this constraint, suggesting that the identity associated with this constraint is not simply ''man,'' but instead the intersection of the expectations associated with being a man and those associated with being ''senior'' [see also the discussions of gender and seniority in climate services in Carr et al. (2015b), Carr (2014a), and Carr and Owusu-Daaku (2016)].

In the study below, we explicitly move beyond the identification of ''women's'' climate information needs to identify the different needs for climate information, and the different capacities to act on that information, that emerge among women in Ngetou Maleck. In so

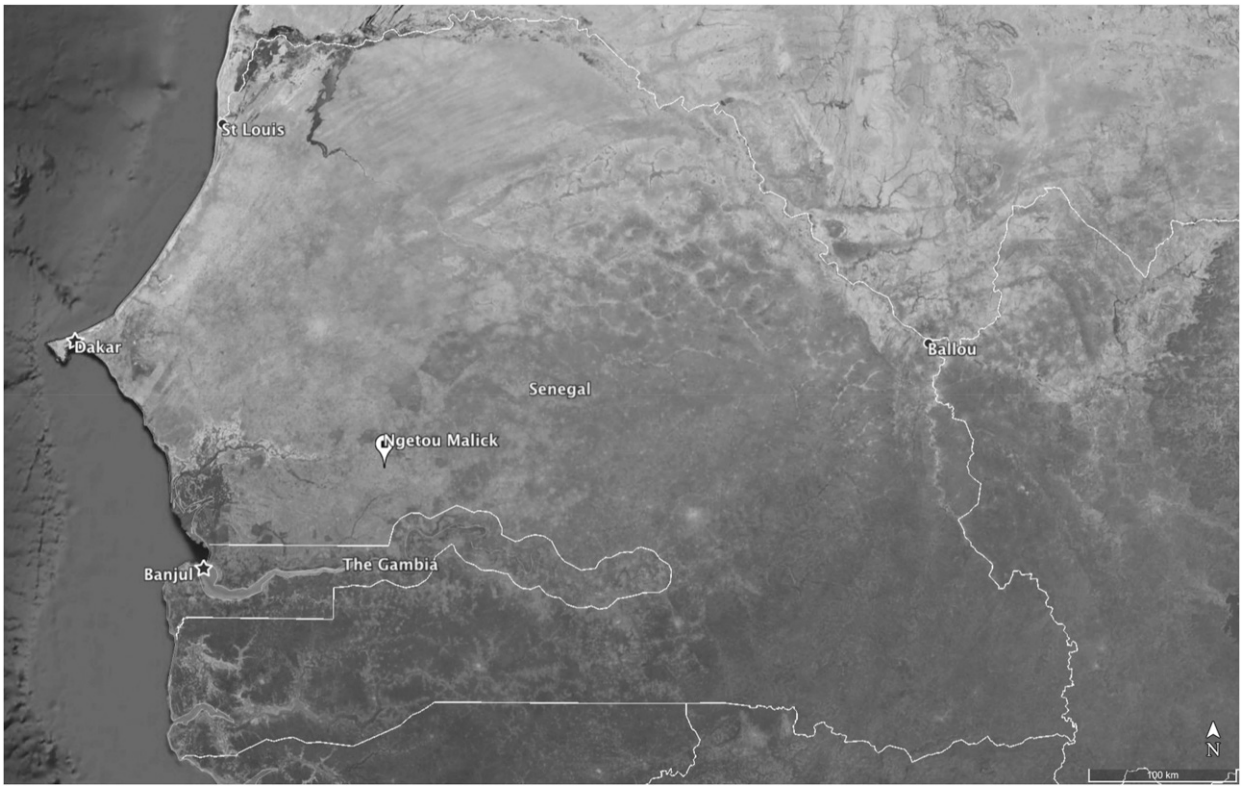

FIG. 1. Locator map for Ngetou Maleck.

doing, we bring the discussion of gender and climate services into alignment with emerging literature on gender and adaptation which moves beyond the treatment of gender, or other identity categories, in an essentialist manner [see Carr and Thompson (2014) for an overview]. Instead of treating all women in Ngetou Maleck as belonging to a single essential category, our analysis below explores how the particular livelihoods activities of women are shaped by the *intersection* of gender with other social categories, notably seniority, and their *situation* vis a vis particular livelihoods activities and access to livelihoods resources. This, in turn, produces different vulnerabilities to climate variability and change among women, different information needs to address those vulnerabilities, and different capacities to use that information. A richer understanding of women's vulnerabilities and climate information needs is critical to the design and implementation of meaningful, effective climate services for development.

3. Research context

The village of Ngetou Maleck is located 7 km southwest of the regional capital of Kaffrine, in the Maleme Hodar department (Fig. 1). In 2013, the Kaffrine region was home to an estimated 566 992 residents, nearly evenly divided between men (49.8%) and women (50.2%); 84.9% of Kaffrine's population lived in rural areas,[1] with the overall nearly equal split between men and women in rural and urban settings. The region around Ngetou Maleck receives 500–800 mm of rain annually, with nearly all falling between the beginning of July and end of October. Like many parts of Sudanian/Sahelian West Africa, Kaffrine saw a steep decline in annual precipitation in the late 1960s through the early 1980s, before a recovery to a ''new normal'' approximately 25% below pre-1960 averages (Fig. 2). This precipitation is critical to the agricultural livelihoods of those in this region, where the rain-fed cultivation of peanuts and millet dominates the economy. Other significant crops include sorghum and sesame, with gardened crops such as watermelon and cash crops such as cotton comprising a relatively small portion of cultivation. Ngetou Maleck is a small village in this region, comprising at least 1470 residents. This residential count is almost certainly low, as it is

[1] Data accessed through the Data Portal of Senegal, http://donnees.ansd.sn/, on 11 Oct 2015.

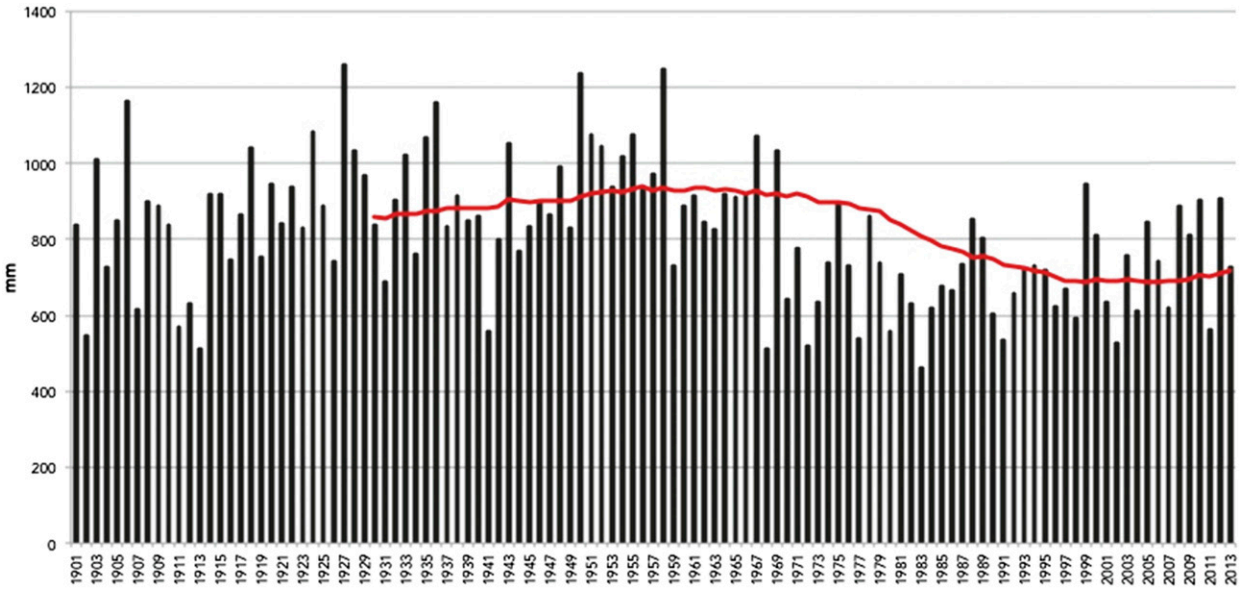

FIG. 2. Annual precipitation in Kaffrine, 1901–2013. Data source: World Climate Research Program, Global Climate Observing System, Global Precipitation Climatology Centre FDP version7 2p5 prcp. (Accessed 4 Nov 2015, from http://iridl.ldeo.columbia.edu/SOURCES/.WCRP/.GCOS/.GPCC/.FDP/.version7/.2p5/.prcp/Y/%2814.24N%29VALUES/X/%2815.00W%29VALUES/T+exch/2+ncoltable.html.]

based on the number of people who pay taxes for seeds at the village level. In the course of fieldwork, we found that residents of this and other villages in the region pay a tax to the village chief to become eligible for a seed subvention from the government. Some residents see the tax-for-seeds program as corrupt, and do not participate, thus ensuring the official population figure is an undercount.

4. Methods

To explore the livelihoods decision-making of the residents of Ngetou Maleck, and of Kaffrine more broadly, the team from the Humanitarian Response and Development Lab (HURDL) employed the LIG approach. This approach differs from previous livelihoods approaches in that it views livelihoods not merely as activities undertaken to make a living in a particular place, but as wider efforts to order ''the world and one's place in it that reconcile particular social roles and livelihoods outcomes with individual self-interest, broadly conceived'' (Carr 2014b, p. 112). Under LIG, this reconciliation proceeds through the alignment of three spheres of everyday life. *Discourses of livelihoods* speak to how those in a particular population understand their vulnerability context and how to manage it to achieve various goals such as income, social status, and happiness. These discourses, while often aimed at the procurement of material needs, speak not only to what people should do and how they should do it, but also *who* should do it. This last point results in the *mobilization of identity*, where the roles and responsibilities associated with different subject positions within communities or households are used as explanations for ''appropriate'' livelihoods roles and decisions in a manner that brings forth the self-interest of the individual. For example, such a mobilization might proceed from a discourse of livelihoods under which men have to focus on the cultivation of staple cereals because a good man is one who feeds his family for the entire year. Such a mobilization identifies men as those who grow staple grains, and encourages men to engage in this cultivation so they can be seen as ''good'' and therefore worthy of the status that designation brings within the community or household. This alignment of discourses of livelihoods and identity is policed through *tools of coercion*, the locally legitimate institutions and practices through which some in a community can act to alter the choices or behaviors of others, for example through sanctions that individuals face should they fail to conform to these roles and activities. These three spheres of everyday life come together through everyday practices, linking particular roles, responsibilities, behaviors, and identities into what Gidwani (2001, p. 79) calls ''social facts'' that define what members of that population see as possible action and thought. Under LIG, this field of acceptable action and thought serves to explain observed

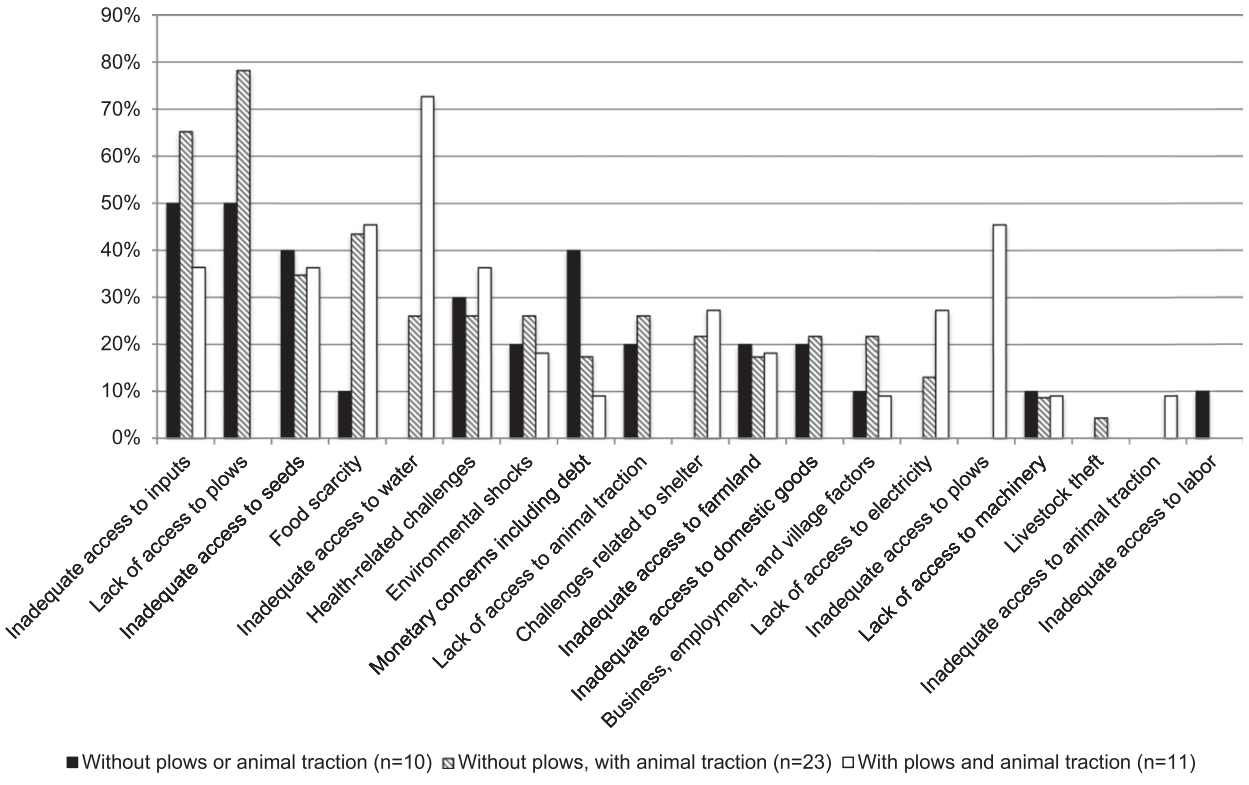

FIG. 3. The different assemblages of vulnerability reported by residents of Ngetou Maleck, grouped by access to livelihoods resources.

livelihoods decisions and behaviors [for extended discussions of the LIG approach, see Carr (2013) and Carr (2014b)].

LIG is both a conceptual framework and a methodology for studying livelihoods decision-making. Following Carr (2014b), the field team began work with a basic literature review that established the vulnerability context of Kaffrine, the shocks and stresses experienced by the residents of the area, as well as any issues of seasonality that might exacerbate or ameliorate them. The field team followed up on and refined this desk study through two weeks of preliminary scoping fieldwork in two villages in rural parts of the region. Fieldwork in Ngetou Maleck built on this preliminary understanding of the vulnerability context, using semistructured interviews to explore the vulnerabilities of 43 residents. Critically, however, this phase of the fieldwork did not specifically ask farmers to discuss their weather- and climate-related vulnerabilities. To do so would have biased the data, suggesting to the interviewees that the field team was most interested in weather and climate stressors. This, in turn, would likely have led at least some interviewees to emphasize such stresses, even when they were in reality not that important relative to other stressors. Instead, this phase of research served to tell us just how important weather- and climate-related stressors were to the farmers from their perspective.

After conducting this first phase of fieldwork, the team divided the community into three groups based on their shared assemblages of vulnerability (Fig. 3). These assemblages, the collections of perceived shocks and stresses and their relative importance as reported by individuals, took shape around the relative access of individuals to heavy agricultural tools such as plows and animal traction. Those without either tools or traction made up 22.7% of the sample; 54.5% of the sample reported owning animals but not farming equipment. Those with both comprised 20.5% of the sample. Compared with other ethnographic studies of agriculture among the Wolof in Senegal (e.g., Venema 1978), those in Ngetou Maleck appear to have less access to animals and/or equipment than in many surrounding areas.

Initial investigation found, however, that access to animals and equipment did not produce lower reported rates of food insecurity, as might be expected. As Fig. 3 illustrates, those *without* equipment and animals reported the lowest rates of concern for food scarcity, while the other two groups reported much higher rates of concern. The groups with access to animals, or access to equipment

and animals, despite displaying similar levels of concern for food security, had divergent concerns with regard to access to farming equipment and access to adequate water. These differences suggested that the members of each group had different experiences of the vulnerability context of Ngetou Maleck. The apparent disconnect between access to animal traction and equipment and perceived levels of food insecurity served as a contradiction that shaped inquiry into livelihoods decision-making in the village [for discussion of the role of contradictions as a point of interpretive entry in LIG, see Carr (2013) and Carr (2014b)].

Among the Wolof, who make up the majority of the population of Ngetou Maleck, there are significant differences in roles and responsibilities associated with different identities. The ethnographic literature on the Wolof suggests that gender and seniority shape the decisions made by different members of the community (see, e.g., Venema 1978; Venema and van Eijk 2004; Perry 2005). With this in mind, the team reinterviewed members of each group and extended the sample, purposively sampling within each livelihoods resource access group to capture a range of gender and seniority intersections (i.e., junior vs senior women) to better understand the intragroup differences in activities, assemblages of vulnerability, and decision-making authority that might shape the use of advisories. It was only in these interviews, at their conclusion, that the interviewer explicitly referenced weather- and climate-related stresses, and even then only if the interviewee had not yet discussed such issues. As in the first phase of study, the follow-up interviews were semistructured. The questions incorporated into these interviews evolved as answers to initial questions led to new lines of inquiry. This phase of fieldwork achieved a reasonable degree of saturation, where no new answers or questions were emerging from interviews, for the topics under investigation [for discussion of the grounded theory that underpins LIG, see Glaser and Strauss (1967)]. The field team used participant observation to cross-check their interview data, living in Ngetou Maleck and observing the activities of residents with regard to livelihoods decision-making, particularly the use of information to inform agricultural decisions.

The field team recorded field notes from the interviews and participant observation in French. The lead member of the field team (Kalala) translated these notes into English to facilitate the wider participation of team members in data analysis. The translated notes were imported into MAXQDA, a qualitative analysis support software. The team used MAXQDA to code the notes according to the LIG framework, using the broad headings of vulnerability context, discourses of livelihoods, identity, and tools of coercion to structure a complex set of subcodes that represented specific issues in Ngetou Maleck. HURDL staff used these codes to retrieve data used to generate the results presented below, as well as retrieve supporting passages and quotes from field notes that allowed for the meaningful interpretation of trends in the data.

5. Women and vulnerability in Ngetou Maleck

Even a cursory consideration of gendered perceptions of the shocks and stresses impacting human well-being in the community (Fig. 4) demonstrates that women and men, as aggregated groups, experience different assemblages of vulnerability. While women and men share similar rates of concern for access to heavy farming tools such as plows, fertilizer, seeds, and food security, men report much higher rates of concern for environmental shocks, water cost and access, access to land, and access to electricity. Women have higher rates of concern for access to domestic goods and healthcare. These suggest different roles and responsibilities attached to gender in this community.

Further, when we disaggregate the women of Ngetou Maleck by their seniority and access to livelihoods resources (the determining factors shaping their assemblages of vulnerability), we see differentiated assemblages of vulnerability *among* women (Fig. 5).[2]

Of particular interest is the fact that junior women with animals but without equipment have much higher rates of concern for food security than senior women in the same asset situation. To understand what produces these patterns of differentiation, including the persistence of the apparent contradiction where those in the village with the least access to equipment and animals, and the least authority over livelihoods decisions, are the least concerned with food security, we must connect these patterns to the livelihoods and livelihoods decisions of women in this village. To accomplish this, we turn to women's roles and responsibilities in Ngetou Maleck.

6. Women's roles and responsibilities in Ngetou Maleck

Men and women are associated with different roles and responsibilities within Ngetou Maleck. Further,

[2] There was one junior woman in the group with access to animals and equipment. Her vulnerabilities were not gathered by the field team, and they would be of limited utility as it is impossible to distinguish her idiosyncratic perceptions from those of any larger group of women in the same situation.

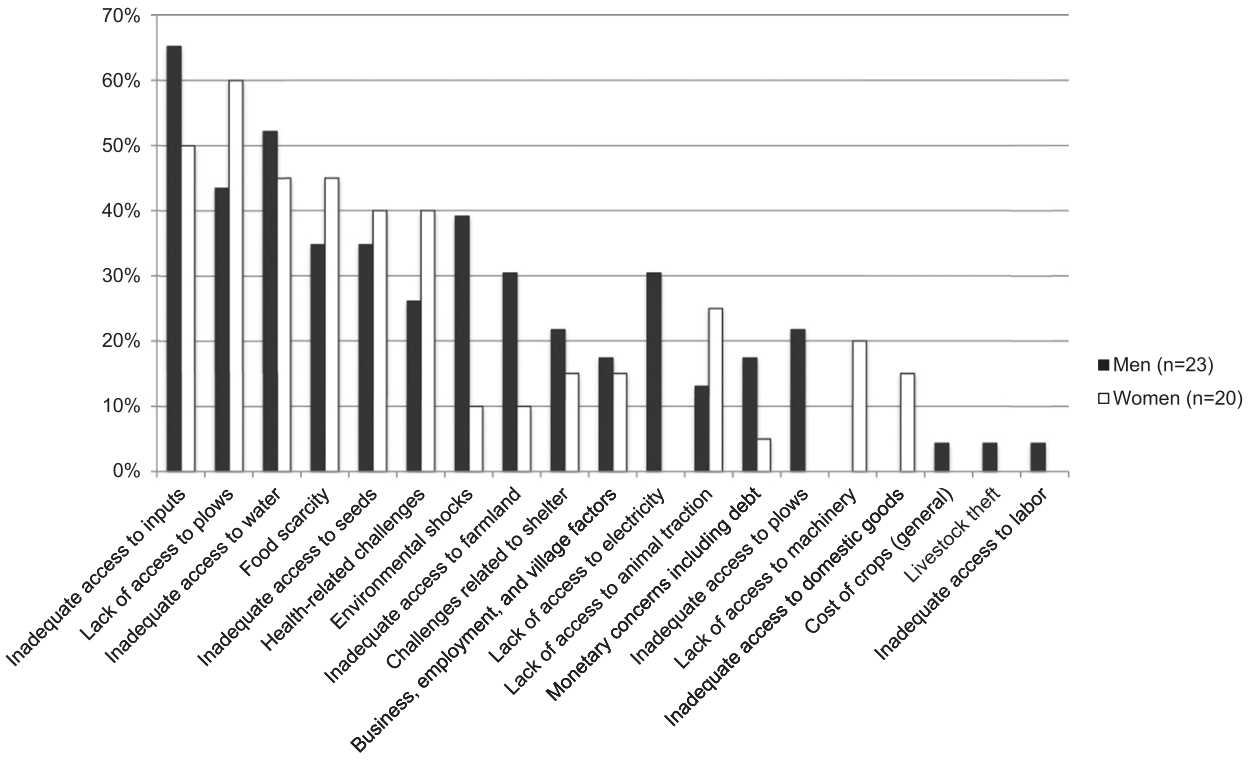

FIG. 4. The assemblages of vulnerability reported by men and women in Ngetou Maleck.

these roles and responsibilities are complicated by the seniority of the individual in question. In this context, seniority is a social marker that is loosely tied to age, but also includes wealth, intrafamily status, intrahousehold status, and the number of children one has. In the course of our fieldwork, we asked individuals to self-identify by seniority. The responses were broadly consistent, with the transition from junior to senior generally falling somewhere around the age of 40, depending on the other factors listed above.

While this article focuses on the use of weather and climate information by women in this community, we recognize that gender is a relational category. Therefore, to understand women's roles and responsibilities, it is critical to briefly review the roles and responsibilities associated with men in this community. Among the Wolof, men who head households are expected to provide food for their dependents. This is a central responsibility of men, for as Perry (2005, p. 211) notes, the term for dependents, *surgë*, translates to "one who is filled up." Whether junior or senior, men are expected to live up to this expectation via the cultivation of millet and maize (interviews 36, 37, and 40). Because the provision of millet and maize is seen as an integral part of a man's responsibility to provide for his family, women are discouraged from growing these crops under normal circumstances (interviews 4, 5). This responsibility also justifies men's control over the family's land, the granaries in which family grain is stored, and most agricultural equipment (Perry 2005). However, male heads of household must allow married women and the unmarried men in their households the ability to earn money for expenses, and to build up the resources that will allow unmarried men to marry and eventually head their own households.

Wolof women are expected to respect and show deference to men, especially their husbands (Venema and van Eijk 2004; Venema 1978). Their principal responsibilities lie in the management of the household, including childcare and other domestic activities (Venema 1978; Perry 2005). At the same time, women are expected to have money of their own, take care of themselves and their children, and purchase domestic goods (Venema and van Eijk 2004). This is not uniformly true—in wealthy households, the husband may give his wife money for housekeeping (Venema and van Eijk 2004). In Ngetou Maleck, women often must pursue farming and other livelihoods to earn money because their husbands do not provide enough income to purchase all necessary groceries (interview 20).

Although all women in Ngetou Maleck are expected to farm, women's production is generally seen as less

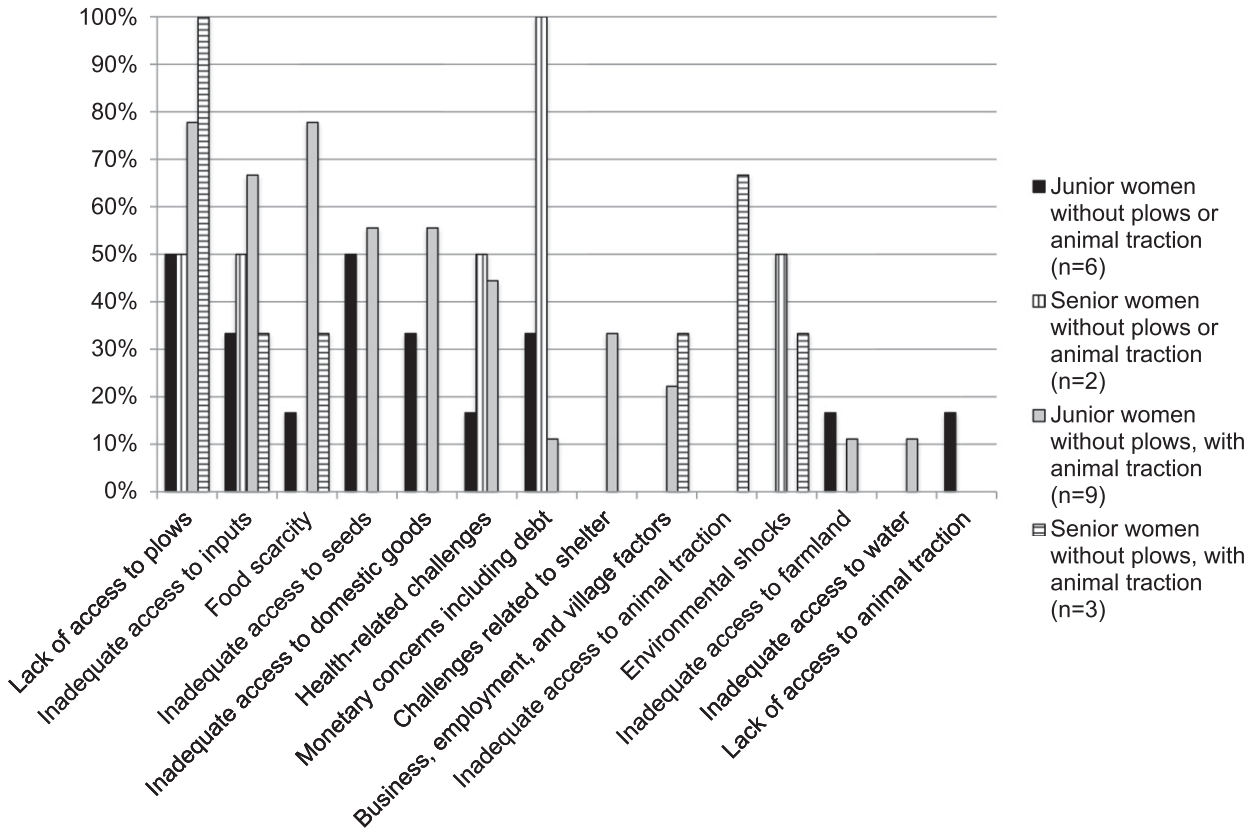

FIG. 5. The assemblages of vulnerability reported by women of different seniority statuses, grouped by access to livelihoods resources.

important than that of men. Women's production relies on limited usufruct rights to land controlled by their household, which they obtain starting around the age of 13. In cases where the husband fails to provide land for his wife or in the case of a widowed woman, it is common for brothers or other extended family members to step in and provide land for them (interview 10). Widows who have sons, especially older sons, will gain access to land, traction, and equipment through their sons. A widow without sons is very vulnerable, and a newly widowed woman is often married to one of her brothers-in-law who will then have responsibility for her well-being, including her access to land. Land tenure for all but the wealthiest women is therefore unstable, as the women do not have direct control over the land that they cultivate each year.

Women's access to land is closely tied to their ability to access seeds, especially peanut seeds. The first season after they marry, women receive peanut seeds from their husbands as a form of startup capital. From that point forward, women are responsible for maintaining or increasing their stock of seeds. Instead of granting them access to land outright, men often choose to rent fields for their wives to use, allowing for season-to-season changes in field size depending on how much seed the women are able to acquire (interview 28). Men also give their wives portions of the same plot of land, which allows them to adjust the size of each wife's plot within the overall women's plot for the household on a season-to-season basis (interview 15).

In polygamous households, wives plant hibiscus as a demarcation of each woman's particular plot within the larger field (interviews 15, 25). Women are also expected to grow cowpeas as they flavor sauces and provide nutrition for family meals (interviews 1, 17). Women are not encouraged to grow maize and millet. If the woman in question is either widowed and must provide for family, or if the woman was not able to procure more expensive peanut seeds for the upcoming rainy season (as millet seeds are very cheap and often seen as a last resort), then she is permitted to cultivate millet (interviews 7, 10, 39). Because maize cultivation requires accessing seeds through tax payments at the village level, and because these seeds come with fertilizers, women's access to maize is restricted even for widows or those dealing with temporary stresses.

Women are expected to give leftover peanut straw to their husband (who either use it as animal fodder or sell it) as a sign of respect if he has helped them plow their

fields. Additionally, women typically give their husbands their peanuts, who will then sell them at the market as they are seen as better negotiators (interview 28) and because some women feel that lifting and weighing peanut bags at market is labor-intensive and best done by men. Because the men sell the peanuts, women often grant the men a portion of the profits (interview 5). This money is, however, ultimately the woman's property, and she can refuse to grant the men any of it if she so chooses (interview 25). Women guard against having their profits skimmed by their husbands by listening to the radio, which announces market prices for peanuts and other crops during that particular season (interview 28). There is also a great deal of conversation among women about market prices for peanuts in Ngetou Maleck.

Beyond the many behavioral expectations that women must meet, a ''good'' woman in Ngetou Maleck regularly engages in a rage of domestic chores for the household. These include taking care of her husband's property and animals when he is not present or is otherwise in need of assistance, cooking for the household, and cleaning and washing clothes. The first wife in a Wolof household, if deemed a ''good wife,'' may become the focal point of domestic decision-making, with authority over the domestic labor of other wives in the household (Venema 1978). In Ngetou Maleck, the most junior woman in each household is expected to complete the largest portion of the domestic duties of all the wives. Senior women gain freedom from most domestic duties when their sons marry and bring wives into the family, as a newly married wife will take over all her mother-in-law's household workload. During fieldwork, the team heard from one senior woman who was encouraging her 18-year-old son to get married so that she could get some rest and devote her time to less labor-intensive activities.

As a result of this age hierarchy in the domestic sphere, junior women cannot dedicate significant time to agricultural pursuits or the pursuit of any secondary livelihoods (interviews 4, 25, 29). Because junior women take up many domestic tasks, senior women can devote more time to agricultural pursuits and other secondary livelihoods to earn more income for themselves and their families.

Although women's plowing and planting decisions are controlled by their husbands, women commonly maintain control over their own crop selection, regardless of their status as junior or senior, because they are responsible for acquiring their own seed (interviews 2, 28). However, given all of the demands placed on women and their production, it is not surprising that both Venema (1978) and the HURDL team in Ngetou Maleck observed that sowing and weeding dates came much later in the season on women's plots than men's plots. This delay limits women's production, as they must rush to plant a limited number of crops, usually on the shortest maturation cycle available, to ensure at least some harvestable crops by the end of the season.

For the purposes of designing, monitoring, and evaluating climate services for women in Kaffrine, we are concerned with the ways in which these broad identity characteristics are translated into specific livelihoods roles and responsibilities. This translation shapes who makes what livelihoods decisions, which in turn defines the information needs of different women in the region.

7. Discourses of livelihoods in Ngetou Maleck

Overall, women do not engage in many different livelihoods activities in Ngetou Maleck, a situation mirrored in the larger literature on Wolof livelihoods in this part of Senegal (e.g., Perry 2005; Venema and van Eijk 2004; Venema 1978). The livelihoods activities associated with junior and senior women in the three vulnerability assemblage groups in Ngetou Maleck are illustrated in Fig. 6. All women interviewed reported agriculture as their primary livelihood, generally because agriculture is the activity that both provides food and brings in the most income. In nearly all cases, the other four livelihoods activities women reported (business, gardening, agricultural labor, and animal husbandry) were secondary to agriculture.

While Fig. 6 suggests that access to animals appears to have very little impact on the livelihoods activities of women,[3] it also shows that seniority does play such a role. Overall, senior women participate in business at 8 times and in gardening at more than 3 times the rate of junior women, and exclusively control animal husbandry. That seniority would play a greater role in the shape of women's livelihoods activities than access to draft animals and equipment makes sense, as on the whole women have constrained access to livelihoods resources relative to men. Even if they live in a household with animals and equipment, even senior women will access both only after men finish their field preparation and they complete their domestic tasks.

[3] While access to equipment appears to have a large impact on livelihoods activities, there was only one woman in this situation. It is therefore impossible to gauge if her case is representative of the experiences and activities of other women in the same situation.

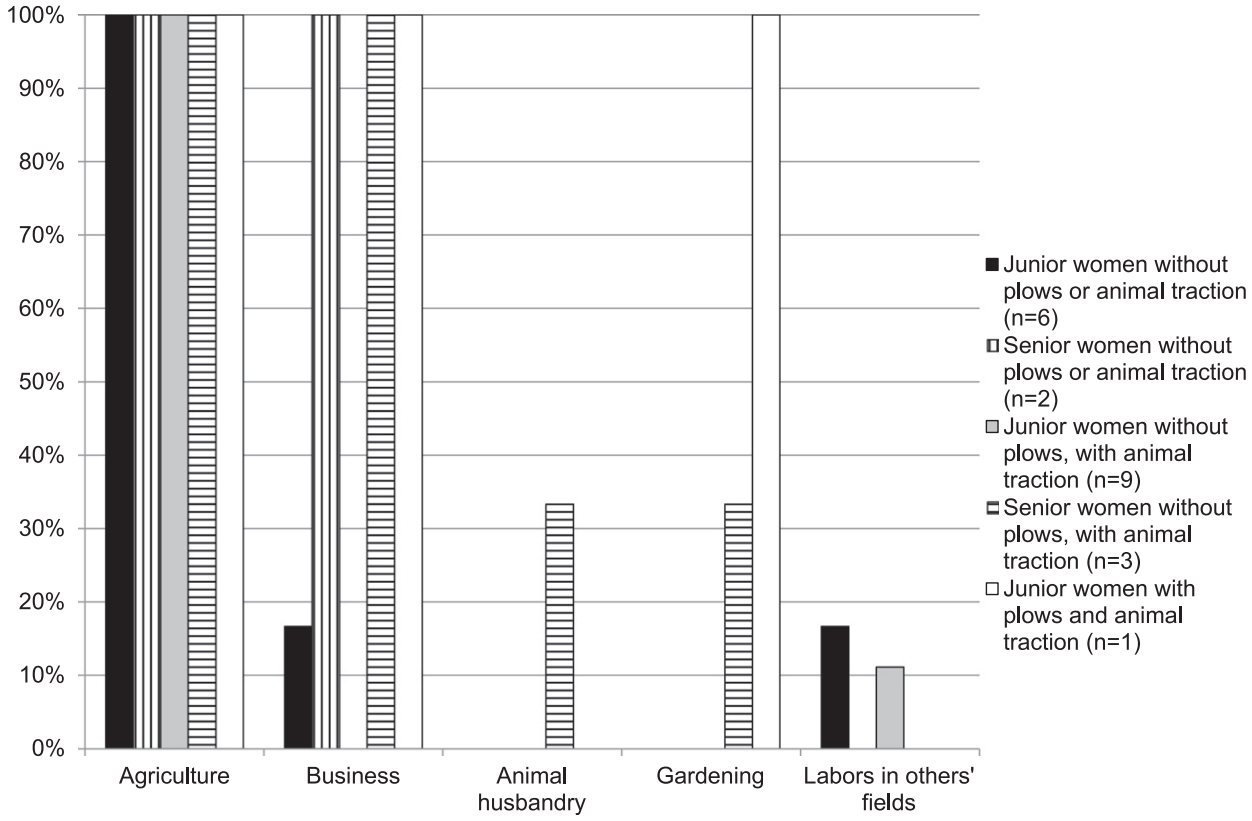

FIG. 6. Livelihoods activities reported by women in Ngetou Maleck, grouped by seniority and access to livelihood resources.

Overall, women have low rates of animal ownership, with goats and poultry the most commonly owned animals (Fig. 7). It is difficult to discern the extent to which access to animals and equipment shape animal ownership, as women without access to either did not report any animal ownership, and only a single woman reported having access to both animals and equipment. Again seniority appears to shape animal ownership to a

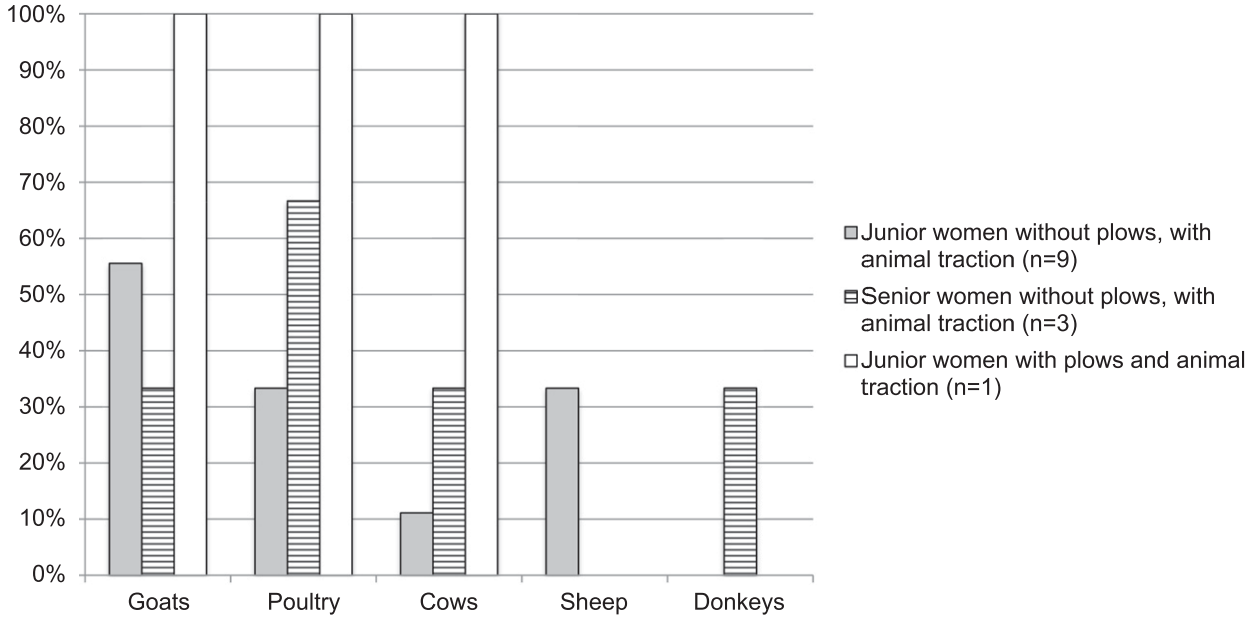

FIG. 7. Women's reported animal ownership in Ngetou Maleck, by asset ownership and seniority.

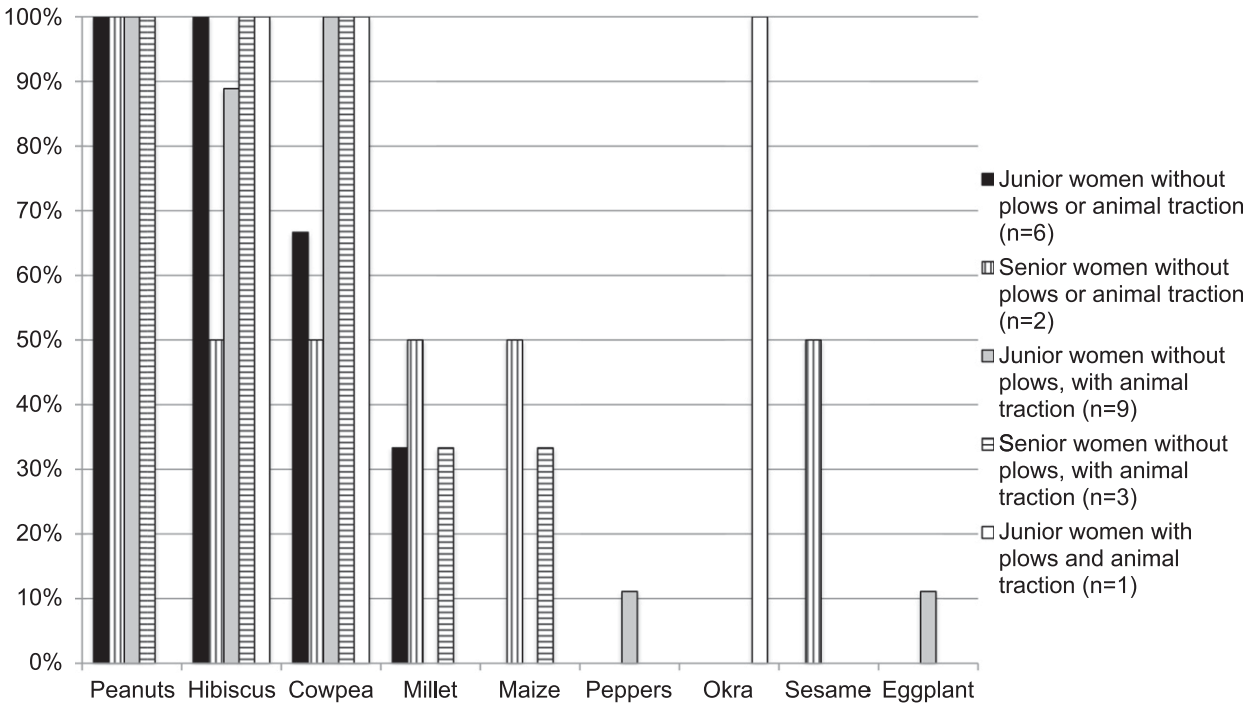

FIG. 8. Women's reported crop selections in Ngetou Maleck, grouped by seniority and access to livelihood resources.

degree. Senior women dominate poultry ownership, while junior women dominate goat ownership. Senior women exclusively own donkeys (but this was only a single woman, making this ownership unusual overall), while junior women owned sheep exclusively. Very few women of any seniority owned their own cows. The animals owned by this group largely serve as precautionary savings to mitigate risk, as sacrifices for ceremonies (e.g., sheep, goats), or to produce food stuffs for subsistence purposes in the household (e.g., chickens for eggs, cows for milk, goats for meat). Sheep are highly utilized as sacrifices in a Muslim ceremony called Tabaski.

Overall, women focus heavily on the cultivation of peanuts, hibiscus, and cowpeas (Fig. 8). Seniority and asset ownership have relatively little effect on the rates of cultivation for these crops, although senior women cultivate millet and maize at higher rates than junior women, regardless of asset ownership. This pattern is explained both by identity and mortality, as these crops are cultivated nearly entirely by widows who must raise the food for their households, and can do so by calling on the land and agricultural assets of their sons or brothers-in-law.

Cycle length is the single most important seed characteristic shaping women's variety selections (although it is not the only characteristic that women mentioned, as taste and texture also play into selection). Women identified constrained planting times as harmful to overall crop yields. At the same time, they often planted short-cycle seed varieties to provide a quick infusion of income during the lean period right before the harvest, colloquially referred to as the hungry season (interview 15). In this regard, women's variety selection is a response to both agroecological and economic factors that push for short cycles. However, women have a limited ability to act upon this logic. Only a few women reported access to short-cycle seeds that might allow them to make different selections depending on planting date and market conditions (interview 3). Two junior women mentioned that they would plant short-cycle peanuts if they had the means, however they only had access to long-cycle varieties and therefore had no alternative (interviews 15, 20).

The data in Fig. 9 were gathered by asking women to place their use of a crop on an ordinal scale, where 1 represented eating all of a crop, 2 was eating more than selling, 3 was eating and selling the crop in equal quantities, 4 was selling more than eating, and 5 was selling all of the crop. The values for each crop were averaged by cohort to determine the interpreted value. This figure demonstrates that in Ngetou Maleck, the overall structure of women's agricultural production centers on the market sale of peanuts and occasional gardened crops, with all other crop cultivation oriented toward subsistence. Most staple grains are grown for

	Junior woman without plows or animal traction	Senior woman without plows or animal traction	Junior woman without plows, with animal traction	Senior woman without plows, with animal traction
Peanuts	Sell more than eat	Sell more than eat	Sell more than eat	Sell more than eat
Hibiscus	Eat all	Eat and sell equally	Eat all	Eat all
Cowpea	Eat all	Eat more than sell	Eat all	Eat all
Millet	Sell more than eat	Eat all		Eat all
Maize		Eat all		Eat all
Eggplant			Sell more than eat	
Pepper			Sell more than eat	

FIG. 9. Reported crop uses for those without access to equipment or animal traction, and those without access to equipment only.

consumption, with almost no expectation of a marketable surplus. Junior and senior women are able to sell the majority of their peanut crops both because they rarely have to fulfill the role as primary provider for the family and because they are expected to purchase their own seeds, for which they need income. However, their highly constrained production, both in terms of space and the duration of the remaining season when they cultivate, limits their other grain production to subsistence alone, as they are unable to generate marketable surpluses. The senior women fit into broad expectations of their identities and the cultivation of rain-fed staple grain in that those who grow maize and millet do so for subsistence, and are allowed to do so because they are widows and therefore the main providers for their households (interviews 2 and 38). The junior women in this group who grow millet do so largely for sale. This is socially acceptable because, as discussed above, they either cannot afford to procure other seeds (interview 10) or because they do not have access to peanut seeds for other reasons (interview 39), and therefore must dedicate at least some of their production to earning capital for the next season's peanut crop.

Junior and senior women also cultivate hibiscus and cowpea primarily as cooking ingredients. Outside of its direct culinary use, one junior woman mentioned that cowpea is often intercropped with peanuts, ostensibly to save space and assist in crop rotation season over season (interview 15). As discussed above, women in Ngetou Maleck used hibiscus to mark the edges of their field subdivisions (interview 15). White hibiscus is generally entirely eaten after it has served its use as a field marker. Red hibiscus, another variety that is also grown in Ngetou Maleck, is always sold rather than eaten. The only senior woman in this group who chooses to grow hibiscus grows both variants, selling all of the red hibiscus and consuming all of the white hibiscus (interview 8).

In summary, in Ngetou Maleck, women's livelihoods are centered on agriculture, although senior women also show a very high rate of engagement with small business activities. However, with very few exceptions, all non-agricultural livelihoods activities associated with women are secondary to agriculture, and either depend upon agricultural profits for their raw material or startup capital or contribute income that is reinvested in agriculture or the household. Women's agricultural production is largely oriented toward subsistence production, with little difference in strategy visible between junior and senior women, or across different levels of access to livelihoods resources. Whatever their differences in crop selection by seniority, women engage in the cultivation of crops for the same reasons. Further, as women of all seniorities are constrained in their independent agricultural decision-making, and are generally expected to work on their husbands' farms before their own, all women's autonomous cultivation begins relatively late in the season, when their degrees of freedom with regard to agricultural strategy and seasonal precipitation are largely gone.

8. Tools of coercion in Ngetou Maleck

The roles and responsibilities attached to identities shaped at the intersection of gender and seniority align with participation in livelihoods activities to form a coherent framing of livelihoods in Ngetou Maleck. For example, as mentioned briefly above, senior men grow staple grains to meet their responsibility to feed their families and dependents, thus making both their social role and their participation in this particular activity

appear natural. Women are responsible for the management of the household while showing deference to their husbands. Therefore, they focus on supporting their husband's production and their domestic role before engaging in agriculture or other livelihoods activities. The fact they sell peanuts at a high rate is consistent with their role only in that they are expected to maintain or grow their stock of peanut seed each year, thereby providing food and income for the household at no additional cost to the husband. Thus, women's agricultural role as secondary, limited producers appears natural, even when marked by an apparent contradiction like the high rate of marketing for women's peanuts.

While the intersection of identity and livelihoods provides a coherent logic for the current state of roles, responsibilities, and livelihoods outcomes in this community, such logic is not enough to produce the high degree of conformity to expectations observed during fieldwork. For example, women's agriculture production, and therefore their economic autonomy, is limited by their responsibilities in the domestic sphere and the related construction of their agricultural activities as of secondary importance. Women are aware of this limitation on their livelihoods, and it is unlikely that all of them are happy about it. Yet nearly all women conformed with patterns of livelihoods activity, crop selection, and gendered domestic tasks that create and reinforce their social position(s) and livelihoods outcomes. To ensure women, and indeed all members of the community, conform to expectations, there exist numerous implicit and explicit means through which roles and responsibilities within Ngetou Maleck are enforced.

As discussed above, in Ngetou Maleck individuals are expected to obey and respect the most senior man in their household. This obedience extends to livelihoods decisions, such as the timing of plowing and planting (interviews 7, 8, 20), livestock decisions (interviews 4, 5, 8), and numerous other facets of daily life in the village. Women who do not obey their husbands are subject to a bevy of possible sanctions. The most minor of these sanctions are related to social status. For example, a disobedient woman will be critiqued by others in the village (interviews 18, 25, 26, 28, 34). Her husband or others in the village will also resort to treating her like a child (interviews 13, 41, 42), will lose respect for her (interviews 4, 8, 16, 19, 24), and will talk down to her (interviews 4, 6, 7, 15). Accruing enough of these minor sanctions can lead to more acute sanctions. For example, such women may no longer be delegated household responsibilities (interview 16). While this initially may sound like a light punishment, this means that these women will no longer serve any productive purpose to their family. Women who suffer this sanction leave their gender roles unfulfilled and lose social status in the village. ''Bad women'' also are also subject to marriage-related sanction, in that their husbands will not ask permission to marry another wife (interview 17). Normally, men ask their wives for permission to marry another wife to ensure that the wives will get along, so not engaging in that process has the potential to create great strife within the household. In some cases, a woman's views may no longer be considered in the village (interviews 1, 2). More serious social consequences include absolute isolation from peers, nobody wanting to work with them or assist them when they are in need, and exclusion from information about important issues in the village. There is one clear difference in the sanctions leveled at junior and senior women. One man mentioned that nobody wishes to marry a bad woman (interview 17). Given that junior women rely greatly on their husband's support in developing their own agricultural livelihoods and providing for their households, and lack senior women's (and even many widows') ability to call on grown sons or brothers-in-law for access to land and agricultural assets, this is a very serious sanction.

9. Different vulnerabilities, different goals: Opportunities for advisories in Ngetou Maleck and beyond

Using LIG as a framing approach, we now can discuss women's perceptions of the shocks and stresses they have to negotiate in their everyday lives, and observed livelihoods decisions and outcomes, such that we can see the potential value of climate services for their different livelihoods. Various convergences of identity, livelihoods, and tools of coercion shape the different perceptions of shocks and stresses seen among women in each group, and the differences among women across the groups. Explaining these perceptions allows us to identify how climate services might inform existing livelihoods decisions for different women in this community such that a wide range of their vulnerabilities are addressed.

The rigor and validity of the interpretations below emerges from the triangulation of data and interpretation enabled by LIG. While the samples for each subgroup of women discussed in this paper are small, the understandings of the roles and responsibilities associated with women, the discourses of livelihoods, and the tools of coercion in Ngetou Maleck that frame this interpretation emerged across the 53 interviews and associated participant observation conducted in this village. The framework through which these small samples are interpreted below reflects the convergence

of what, given our understandings of livelihoods decision-making in this village drawn from these interviews, we would expect women of a particular seniority to be doing and the observed actions of these women. Therefore, our interpretations are not drawn from the actions of a few women. Instead, the actions of these women are interpreted through a much larger, more robust lens.

Returning to the assemblages of vulnerability in Fig. 5 above, women without heavy farming tools such as plows and animals are the most stressed of those in Ngetou Maleck. They generally lack the resources needed to provide stable livelihoods or reliably negotiate shocks and stressors. Junior women in this group are as likely to report monetary stressors as they are agricultural ones. Because they are more often busy with fulfilling domestic duties than are senior women, junior women without access to tools or traction have less time to dedicate to nonfarm livelihoods that provide income over which they have control. This issue is manifest in their low rates of animal ownership. Without productive animals, these junior women lack a source of secondary income and savings that would otherwise enable them to augment their yearly seed supply. With unstable access to seed, they are particularly vulnerable to reductions in their field sizes, further constraining their incomes.

Senior women without heavy farming tools and animals, freed from many of these household responsibilities, are able to spend more time focusing on agricultural pursuits and other secondary livelihoods. Because these women have time for other livelihoods, issues that constrain such activities are felt more acutely. Therefore, they report monetary and livelihoods asset access concerns at a higher rate than their junior counterparts.

It is challenging to identify weather and climate information that informs agricultural practice in a manner that can be acted upon by women without heavy farming tools and draft animals in this community. They have little use for seasonal onset data, as their cultivation begins long after the start of the season. Advisories regarding the length of the season, and the likely amount and timing of precipitation across the season, have only marginal utility for these women. While they are responsible for purchasing their own peanut seeds, they report challenges accessing different variety lengths, and the delayed start to their agricultural seasons may limit any variety selection decisions. Here, the needs of junior and senior women diverge slightly. Because they have fewer domestic responsibilities, senior women can cultivate sooner than junior women and therefore have marginally greater opportunity to make variety selections that can address cycle length. This suggests that climate information will have a slightly greater impact on the decisions of senior women relative to junior women in this group.

Because of the centrality of peanut cultivation to these women's livelihoods activities, providing information about seed prices and availability, as well as market prices for peanuts and millet, could enable women to make market decisions that improve their incomes, such as purchasing the maximum amount of seeds appropriate for the season. Such information, coupled with advisories on the duration of the season and the amount and timing of rainfall across the season, would further senior women's use of the advisories, and potentially allow junior women a greater chance to start using advisories in at least a limited manner. It is also important to note that these women do own a few small animals, and therefore forecasts of extreme heat events, or likely protracted heat stress, might allow them to protect their limited personal livelihoods assets.

For women with access to traction animals, but not to equipment, access to heavy farming tools and fertilizer are the most highly reported stressors. Junior women in this group are most preoccupied with stressors related to agricultural production and food availability, reporting these stressors at greater rates than senior women. These junior women only participate in agricultural livelihoods, and have access to seeds for a limited number of crops. With peanuts as their only source of income, these women's entire livelihoods contribution, whether food or income, hinges on agricultural production. Senior women are also agriculturally focused, but own animals and participate in nonfarm employment (NFE). In short, their livelihoods are more diversified, relieving some of the pressure on their agricultural activities.

Women with access to animals but not equipment suffer from many of the challenges that limit the decisions of their counterparts who lack both equipment and animals. Their cultivation is also delayed by the community focus on men's cultivation and their domestic responsibilities. Therefore, data about the onset of seasonal rain are also of little use to the women in this group. However, these women have greater livelihoods assets from which to draw, improving their access to seeds and inputs. They also have greater incomes, which allows for livelihoods like gardening. Therefore, advisories on the length of the season and the amount and distribution of precipitation across that season are somewhat more actionable for these women. These women, on the whole, would benefit from coupling weather and climate advisories with seed price and

availability information as well as market price advisories. Senior women in this group who reported gardening might also benefit from groundwater advisories. Junior women in this group currently do not garden, and may not be able to until such time as the distribution of domestic labor, which eats away at their time for agricultural activities, is shifted to allow them more time for farming.

Further, these women, like those without access to animals and equipment, might benefit from heat forecasts that allowed them to take steps to protect their poultry and other particularly heat-sensitive animals. In these groups assessments of the current state of forage and its future conditions could help those women who own goats, sheep, and cows plan their activities, including their agricultural decisions about what to plant and at what cycle length, to ensure their animals obtain adequate food.

10. Conclusions

While climate services for development have significant potential as tools for addressing the vulnerabilities of agrarian populations around the world, this potential is unevenly distributed through these populations. Different groups within these populations experience different exposures and sensitivities, and have varying capacity to adapt to shocks and stressors. When we explore these groups, we find that they are comprised of individuals marked by shared identities that shape their roles and responsibilities, and thus their livelihoods activities and decisions. Initial efforts to understand gendered uses of and needs for climate services emerged from efforts to understand and address this phenomenon in the context of climate service project design and implementation. However, as the literature argues, and we have demonstrated here, relying on gender as the means of identifying and addressing different climate information needs in a given population is likely to be too coarse a means of disaggregating a population to effectively identify such needs and explain their sources.

As we have demonstrated through the case of Ngetou Maleck, if climate services are to address the widest possible set of needs in a given population, they must move beyond identity-specific a priori framings of vulnerability to the impacts of climate variability and change. Instead, starting at the project design stage, projects must identify the different vulnerability groups within a target user population, understand the aspects of identity around which they cohere, and explore the nexus of identity, livelihoods, and coercion that frames why these groups experience particular assemblages of vulnerability and why they address these vulnerabilities through particular decisions and actions. By understanding this logic of decision-making, designers of climate services can understand how different forms of information fit into existing decisions, and how they might enable plausible future decisions for many groups, not just a dominant group in the target population.

In this article, we have demonstrated a means by which climate services programs might conduct such an investigation. In so doing, we have shown both where there are clearly gendered needs for climate services (i.e., where the need is broadly shared by all members of a particular gender) and where other aspects of identity intersect with gender to produce distinct needs *among* women. Further, we have demonstrated that focusing only on the former would address some women's needs, but do so in an uneven manner that benefits some women more than others. In short, we have shown that to identify and address the widest range of women's needs for weather and climate information, we must start *not* by focusing on women, but by focusing on groups that share assemblages of vulnerability. Such an approach allows us to understand the role of gender in the production of vulnerability, and the extent to which it should be a focus when we are trying to address the needs of the most vulnerable in an era of increasing climate variability and change.

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