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Really effective (for 15% of the men): Lessons in understanding and addressing user needs in climate services from Mali

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1. Introduction

Climate services have long been held up as development tools with tremendous potential to reduce risk and vulnerability, and build resilience, for agrarian communities in the Global South (Dessai et al., 2009; Fröde et al., 2013; Pervin et al., 2013; USAID Global Climate Change Office, 2014). The ongoing development and refinement of climate service-based tools, such as weather based index insurance, provides opportunities to stabilize and protect people's livelihoods by establishing new forms of safety nets, strengthening existing safety nets, and supporting the general improvement of risk management mechanisms (Carter et al., 2014; Hess and Syroka, 2005; Jensen et al., 2015; Mburu et al., 2015). For example, climate advisories and information offer opportunities to inform farmer management of climate related risk (Boyd et al., 2013; Carr et al., 2015c; Hansen, 2012; Hellmuth et al., 2011; Ingram et al., 2002), such as by supporting farmer decisions with regard to intensifying production, investing in new technologies, or taking measures to protect their households and livelihoods in the case of adverse predictions (Carr et al., 2015a,c; Hansen, 2012).

The climate services community was initially dominated by a focus on delivering climate information, especially information focused on identifying and/or predicting weather and climate shocks and stresses to which particular users were exposed (for discussion, see Carr and Owusu-Daaku, 2016; Hansen et al., 2009; Millner and Washington, 2011; Roncoli, 2006; Shankar et al., 2011). Such challenges are broadly related to agroecological context (Akponikpè et al., 2010; Carr et al., 2015c; Ingram et al., 2002; Leclerc et al., 2013; Patt et al., 2005; Phillips et al., 2002; Roncoli et al., 2009; Silvestri et al., 2012) and the livelihoods of the intended users (Akponikpè et al., 2010; Bone et al., 2011; Carr et al., 2015a,c; Green and Raygorodetsky, 2010; Roncoli et al., 2001, 2002, 2009, 2011). The place- and activity-specific impacts of most weather and climate shocks and stressors has resulted in a contemporary climate services literature which recognizes that users' vulnerability to weather- and climate-related stress is not only a function of their exposure, but also their sensitivity and adaptive capacity.

As climate services have ever more closely examined the intended users of these services, it has become increasingly clear that within agroecological zones, communities, or even households, various social cleavages can shape the weather- and climate-related vulnerabilities individuals face, and therefore the particular type of climate information they need, or if they need new or additional information at all. This growing literature has drawn out the ways in which gender (Carr et al., 2016; Carr and Owusu-Daaku, 2016; Ingram et al., 2002; Patt et al., 2005; Roncoli et al., 2001; Tschakert, 2007; Tschakert et al., 2010; Ziervogel, 2004), age (Akponikpè et al., 2010; Carr et al., 2015b; Carr and Owusu-Daaku, 2016; Ingram et al., 2002; Roncoli et al., 2001; Tschakert, 2007; Waiswa et al., 2007), wealth (Akponikpè et al., 2010; Carr et al., 2015c; Roncoli et al., 2001; Tschakert et al., 2010), religion (Orlove et al., 2010; Roncoli et al., 2009, 2011), ethnicity (Carr et al., 2015c; Roncoli et al., 2009), education (Akponikpè et al., 2010; Waiswa et al., 2007), and even the identities that emerge at the intersection of two or more of these cleavages (Carr et al., 2015a,b; Carr and Owusu-Daaku, 2016; Orlove et al.,

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2010; Peterson et al., 2010; Roncoli et al., 2009, 2011; Ziervogel et al., 2006) produce different roles and responsibilities that result in different exposures, sensitivities, and adaptive capacities within populations, communities, and even households. This literature makes it clear that effective climate services are those directed at particular users, to address their particular vulnerabilities.

We interpret this body of critical, empirically-informed work on climate services as a powerful call for more serious attention to the *social* science of climate services for development. If we are to design and implement climate services that truly help users address their weather- and climate-related vulnerabilities, we must understand who our users are in all of their diversity, what challenges these different users face, whether or not weather and climate information can address any of these challenges, and what information best addresses these challenges for different members of the same user population. Simply put, it is possible to design climate services that, in the context of a specific stressor for a specific group of people, work brilliantly, but when applied to a wider group of users for new purposes, fail dramatically. Our work assessing Mali's *l'Agence Nationale de la Météorologie's* (Mali Meteo) Agrometeorological Advisory Program serves to illustrate this important lesson, one which can inform the design and scaling-up of climate services for development, as well as the monitoring and evaluation of such services, going forward.

We begin with a review of the history and function of the Agrometeorological Advisory Program. We then turn to the results of our efforts to assess the use and efficacy of this program for farmers in southern Mali. Our assessment found very low, highly gendered rates of advisory use. On the surface, these results appear deeply disheartening for those who view climate services as an important tool for adaptation, vulnerability reduction, and resilience building. However, our findings are not necessarily indicators of either a failed project or the limitations of climate services for development, as those using the advisories followed their advice very closely. Instead, this contradiction presents an interesting question: why, if this climate service is so useful to some farmers, it is not used by more? As we demonstrate through ethnographic analysis, when these results are placed back into the context of the stated goals that informed the program's design in the early 1980s, the low, highly gendered rates of use reflect a project well-designed to address a particular problem (food insecurity linked to drought) through a particular solution (boosting yields of staple grains through better farming decisions). It is only when this program is abstracted from that specific context, and applied more broadly to questions of agricultural development, climate change adaptation, and resilience building, that these results became indicators of failure. Thus, this example of climate services for development is an extraordinarily clear example of the need to design climate services for specific goals, and when monitoring and evaluating a climate service to carefully assess which goals, and *whose* goals, that service is meeting.

2. Mali Meteo's Agrometeorological Advisory Program: background

The Agrometeorological Advisory Program was the brainchild of two Malian scientists, Kaliba Konaré and Mama Konaté. In the late 1970s, they began to ask how weather and climate information might address the repeated instances of food insecurity that were stressing the country. Like many at the time, they linked food insecurity in Sudanian and Sahelian West Africa to persistent droughts that began in the late 1960s. Konaré and Konaté drafted a concept note for a pilot climate service program that would assess farmer needs for weather and climate information, provide needed information, and assess the efficacy of that information in meeting those needs and ultimately addressing Malian food insecurity. The project was eventually taken up at the start of another dry episode in the early 1980s (Moussa and Traore, 2014).

Initially, advisories were developed and implemented through the *Equipe de Travail Pluridisciplianire* (ETP). Members of the ETP were drawn from the various extension services of the *Office de la Haute Vallée du Niger* (OHVN), the *Compagnie Malienne du Développement des Textiles* (CMDT), *Office du Riz Segou* (ORS), *Office du Riz Mopti* (ORM), and the Direction Régional de l'Agriculture (DRA). While the members of the ETP represented their respective organizations in the process of developing advisories, they were also expected to bring specialized expertise in their area of intervention/interest to the team. This dual role created a relatively non-hierarchical collaborative structure in the ETP that would be carried through later iterations of the program as it took on more organizations and interests.

While this incipient program had many sub-goals, at the broadest level it was designed as an emergency effort to boost yields of key staple grains and thus reduce the levels of food insecurity in Mali. An initial assessment of the Agrometeorological Advisory Program (Moussa and Traore, 2014) identified three distinct phases in the project's development. In the first, experimental phase (from 1982 to 1986), the project worked with 16 volunteer farmers in the Koulikoro Region. In these pilots, farmers focused on the cultivation of a single grain (either millet or sorghum, depending on local agroecological conditions) for which advisories were provided. The ETP funneled technical advice through institutional representatives from across the directorates and offices of the Malian government (for a full list and discussion, see Moussa and Traore, 2014: 14), organized into the *Groupe de Travail Pluridisciplinaire* (GTP), who in turn produced weather and climate bulletins for dissemination to farmers. These bulletins were used in the pilot project to inform farmer decisions such as variety selection, planting times, and the timing of inputs. Results from these pilot efforts suggested that in the more southern parts of Koulikoro, the information from the bulletins resulted in yield increases between 25% and 30%. In the northern parts of the region, they recorded increases of 40%–60%. These numbers suggested tremendous value in climate and weather information for farmers, and farmer demand for this information in participating and nearby communities further fueled the transition of this pilot program into a demonstration and extension phase (from 1986 to 1990) aimed at augmenting production of the

key staple grains millet, sorghum, maize, peanuts, and the cash crop cotton. By 1990, demand for the project had grown such that it transitioned into a scaling-up phase to reach farmers across southern Mali (which continued until the end of funding from Swiss Cooperation in 2005). In 1993, the ETP merged with the GTP to form the *Groupe de Travail Pluridisciplinaire d'Assistance Agrométéorologique* (GTPA). This new organization took on responsibility for the production and dissemination of advisory bulletins to farmers via radio, television, and extension.

The advisories provided by the program have evolved over time. Advisories were (and still are) issued three times a month, approximately every 10 days, from the beginning of May through the end of October. Initially, the advisories included ten-day bulletins with summary information on hydrological, meteorological, agricultural, and pest conditions for the five, targeted crops. They also included three-, seven-, and 10-day weather forecasts. These products remain part of the advisories, but over time the GTPA added several other products, including water requirement estimates for the different grains and cotton; crop water balances at the end of each 10-day period; a climatological crop calendar and sowing dates; information about the timing and duration of dry and wet spells; market information about prices for crops; and the state of forage for animals.

Advisories are broadcast via radio and television, and therefore generally available across Mali. However, the spatial resolution of the advisories is quite coarse, reflecting the fact that until very recently the quality of data on the spatial distribution of seasonal precipitation was equally coarse. Lacking precise data for the precipitation associated with specific communities, the program ground-truths its advisories by providing communities with a rain gauge that can be used to assess local conditions. In each community, a farmer observer has been trained to read the rain gauge twice daily and record any precipitation. This data serves two purposes. First, it allows the farmer observer to interpret advisories, which generally tie advice on variety selection and the timing of planting to the amount of precipitation received in the previous ten-day period. Thus, if an advisory tells farmers in Koulikoro to plant 120-day cycle varieties of millet right away if they have received 10 mm of rain the previous 10 days, farmers in a particular village in that region can go to the farmer observer and ask how much rain has fallen to interpret the advisory for their own use. Second, the data collected by the farmer observers is returned to Mali Meteo, who intend to use it to improve the institutional understanding of the country's climatology and inform the production of more accurate future advisories.

This brief history of the Agrometeorological Advisory Program serves not only to orient the reader to this program, but also to highlight the fact that it was designed by Malians to address a very specific problem, food insecurity that was perceived to be tied to food production deficits in the country brought on by severe drought conditions. Further, it was designed to address this problem by providing information that would augment the production of key staple foods (and a key cash crop), thus addressing food insecurity by boosting food availability.[1] It was not intended to serve as a development tool, let alone a tool to address the needs of agrarian populations in a changing climate.

3. The contemporary use and impact of the Agrometeorological Advisory Program

In 2011, the USAID-funded Climate Change Resilient Development (CCRD) project was tasked with supporting most of the costs an assessment of the Agrometeorological Advisory Program. In its work on climate services, USAID had seen significant interest in the replication of the program in other countries, especially in the wake of Mali Meteo presentations that attributed 25% to 60% yield increases to the program. Before supporting the scaling up of the program across the Sahel, CCRD funded an independent assessment of the program to 1) independently verify the claims of impact attributed to the program and 2) to understand exactly how it worked such that it could be transported to new countries and contexts. One of the authors (Carr) coordinated the initial assessment effort, which focused on gathering an institutional history of the program and its workings (an effort led by staff of the CGIAR's Climate Change and Food Security Theme and Mali's Institut d'Economie Rural in Mali), establishing the scientific basis and quality of the advisories (led by a team from the International Research Institute for Climate and Society), and determining the levels and types of advisory use among farmers (led by Carr, and eventually the Humanitarian Response and Development Lab [HURDL]). This initial effort led to an extensive report covering all three areas (Carr, 2014a). In 2014, a team from HURDL designed and implemented a follow-up assessment of farmer use of the advisories to explain the observed patterns of use in the initial assessment. In this paper, we focus on the findings about farmer use of the advisories.

3.1. Assessment methods

The findings described below were drawn from data gathered through focus groups, structured interviews, semi-structured interviews, and participant observation. The initial effort to specify the farmer use of advisories in 2012 relied on structured interviews and focus groups, stratifying sampled communities by gender and seniority. This initial stratification was drawn from the literature on agrarian livelihoods among the Bambara (e.g. Becker, 1990; Akeredolu et al., 2007; Grigsby,

[1] Contemporary discussions of food insecurity, drawing on lessons learned in the Sahel and other African famines, recognize that food availability is but one aspect of food security, and that the role of access to food is often more important in shaping food outcomes than absolute availability (for discussion, see Brown et al., 2015; Carr, 2006; Davis et al., 2001; Kotzé, 2003; Maxwell, 1996a,b; Maxwell and Smith, 1992). To be fair to the designers of this program, it is worth noting that at the time the project was designed and piloted, a focus on food production was generally understood to be good practice in addressing food insecurity.

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1996), the Senoufo (e.g. Förster, 1998; Skinner, 1959), and Mandinka (e.g. Assé and Lassoie, 2011) ethnicities that dominate the communities in which the project is operating in southern Mali. We selected 36 communities for investigation, a sample that included eleven villages participating in the program (drawn from a limited list of participating communities held by Mali Meteo), fifteen communities that had never participated, and seven that had once participated but were no longer participating in the program (Fig. 1).[2] For various reasons, ranging from damage to the rain gauge to the death of the farmer observer, residents of this third group of villages no longer have access to advisories that might inform their agricultural decisions. However, their initial and often extended exposure to the advisories might have shaped agricultural decisionmaking (for discussion, see Carr, 2014a). Therefore, the presence of this third group of villages, only discovered after the start of fieldwork, provided an opportunity to disaggregate seasonal decisions from long-term behavioral changes associated with the program.

These communities were distributed across the four FEWS-NET livelihoods zones in southern Mali (Dixon and Holt, 2010)[3] (Fig. 2): ML 09: West and central rainfed millet/sorghum, ML 10: Sorghum, millet, and cotton, ML 11: South maize, cotton, and fruits, and ML 12: South west maize, sorghum, and fruits. Two Malian field teams, each comprised of a lead investigator from Mali's Institut d'Economie Rural (IER) and four junior investigators (two men and two women) conducted the fieldwork. In each village, the teams conducted four focus groups, one each for senior men, junior men, senior women, and junior women (typical group size was five individuals). These focus groups concentrated on establishing the vulnerability context for the community, and the livelihoods activities in which different members of the community participated. After completing the focus groups, the team then conducted a series of individual structured interviews focused on detailed livelihoods activities, especially agricultural activities and decisions, and the use of the advisories, with five to six representatives from each of these four identity groups. To gain a measure of reliability via triangulation of data sources, interviewees included a mix of members of the focus group and other community members not previously engaged by the team to check the consistency of responses. The analysis included data from 132 focus groups and 660 interviews.[4]

Explaining the patterns of farmer use of advisories seen in the 2012 data (discussed below) required a deep understanding the livelihoods decision-making of the residents of each of the four livelihoods zones in southern Mali. To structure this phase of inquiry, we employed the Livelihoods as Intimate Government (LIG) approach (Carr, 2013, 2014b). LIG approaches livelihoods not merely as efforts to make a living, but building on previous work in the study of livelihoods (e.g. Bebbington, 1999), as efforts to organize and make sense out of the world. LIG structures the interrogation of livelihoods decision-making around three key arenas. The first is the *discourses of livelihoods* at play in the context under investigation, which are best understood as the ways in which people speak about and act upon the world around them when engaged in efforts to make a living. The second is the *mobilization of identity*, where particular livelihoods roles and responsibilities are linked to particular identity categories. This connection occurs through everyday organized ways of engaging in particular livelihoods activities in a manner that both ensures order in the livelihoods activities within a particular productive unit and renders natural the roles and responsibilities of individuals within that organization. The third arena of decision making is *tools of coercion*, the means by which members of a community or other social unit enforce conformity with the expectations encompassed in the discourses of livelihoods and mobilization of identity (for extended discussion of the theoretical basis for LIG, see Carr, 2013; for more on these arenas of decision-making and their use in practice, see Carr, 2014b).

We selected four villages, one from each livelihoods zone, whose patterns of livelihood activities and crop cultivation most closely represented the other villages in that livelihoods zone (Fig. 3). In May, June, and July 2014, four teams of one or two members each conducted eight weeks of semi-structured interviews and participant observation in these villages. Interviews were not audio recorded in the field, and so data analysis focused on French (from three teams) and English (one team) field notes. Field notes recorded in French were translated into English, either by translators paid by HURDL or by the HURDL staff who took the original field notes. The English documents were imported into MAXQDA, a qualitative analysis support software, and coded according to the LIG framework, under the broad headings of vulnerability context, discourses of livelihoods, identity, and tools of coercion. Each of these broad areas contained many sub-codes to represent specific types of answers. For example, under vulnerability context, references to inadequate access to farming equipment in the interviews were coded separately from references to lack of equipment, as those with inadequate access were generally trying to increase existing agricultural production to allow for larger marketable surpluses while those lacking access were concerned with cultivating enough food to meet their subsistence needs.

Analysis followed the LIG approach, starting with the identities of the residents, using the codes to draw out the roles and responsibilities associated with different identities. We then analyzed the discourses of livelihoods associated with different activities reported by members of each community. This allowed us to understand how local framings of these activities mobilized perceptions of who a particular activity was good or bad for, and why. Finally, we identified the tools of coercion that, in each community, served to enforce the expectations of different individuals created by this weaving of livelihoods discourses and the roles and responsibilities they mobilized. We addressed issues of rigor and validity in our interpretations

[2] Two of the sampled villages did not cluster, in terms of livelihoods activities and agricultural practices, with those in any other zone, and were therefore excluded from analysis. In one other village, there was significant disagreement about the status of their participation in the advisory programme. This village was also removed from the sample.

[3] The research team independently confirmed the value of using these livelihoods zones for stratification, finding that the villages investigated, when clustered by crops grown and livelihoods activities emphasized, fell into roughly the same groupings as seen in the livelihoods zone analysis (for discussion, see Carr, 2014a, pp.164–168).

[4] This is a subset of the 144 focus groups and 720 interviews the team conducted in the course of fieldwork because those associated with the three problematic villages were excluded from this analysis.

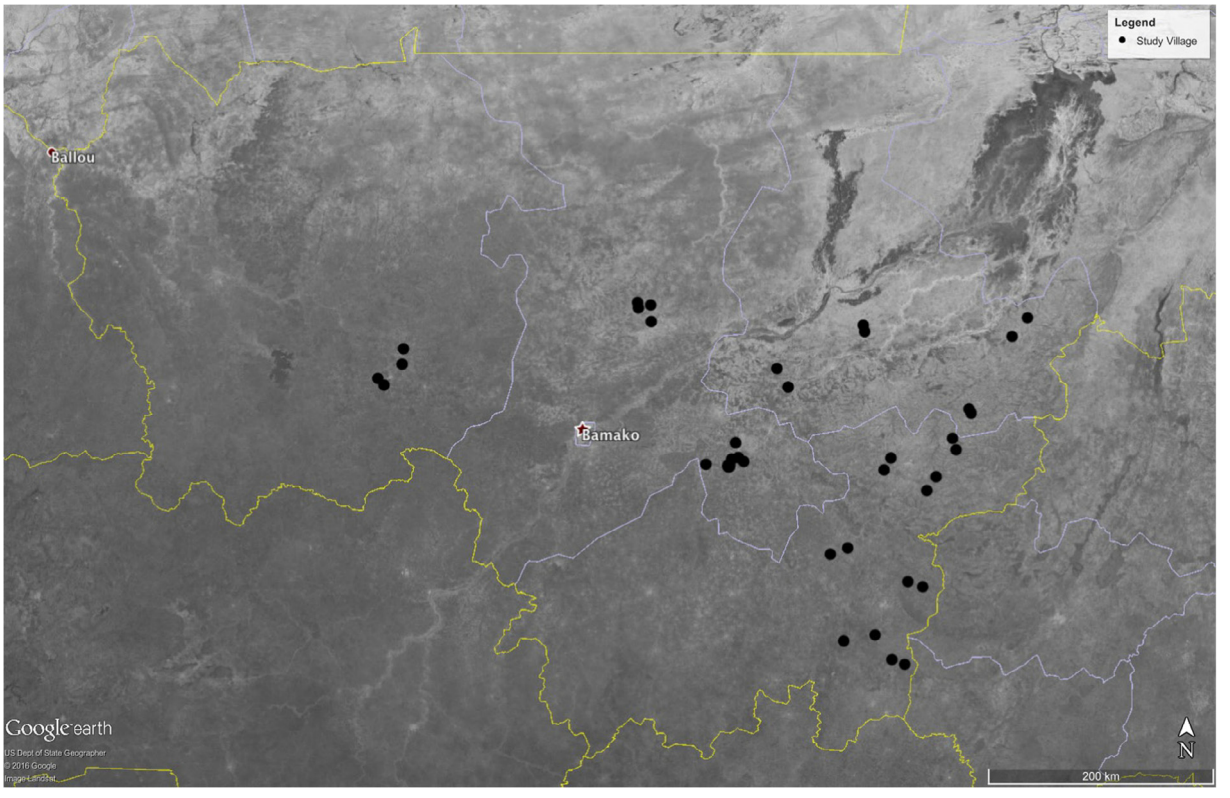

Fig. 1. Locator map of the villages in southern Mali sampled in the initial 2012 assessment of the Agrometeorological Advisory Program.

by cross-checking claims with those of other informants, with ethnographic observations, with data from the preliminary report, and with external sources of information, such as weather and climate records. The result is a robust interpretation of the different roles, responsibilities, and decisions of different residents of rural southern Mali that allow us to understand the source of current patterns of advisory use, and point us toward productive interventions that might reach new users or inform different decisions.

3.2. Assessment findings

Both assessments found varied patterns of use among residents of the villages participating in the program (residents of villages that either never or formerly participated could not, by definition, be using the advisories). First, the overall rates of advisory use are very low across livelihoods zones in southern Mali, from a high of just over 24% (Zone ML12: South west maize, sorghum, and fruits) to a low of 8% (Zone ML09: West and central rainfed millet/sorghum). Second, rates of use decrease when one moves from parts of southern Mali with the largest amount, and most predictable annual rainfall, to those areas further north with less total precipitation and less predictable precipitation (Fig. 4). Counterintuitively, this program appears least used by those farming in marginal environments where biophysical factors like limited and variable annual precipitation or weak soils limit production, and who we might therefore assume are in the greatest need of advisories. Third, women rarely engage with the advisories, no matter what livelihood zone they might live in (Table 1).

The fourth finding, in the context of the first three, presented a contradiction. Though rates of advisory use were very low across southern Mali, there was clear evidence, in all four clusters, for the use of advisories in variety selection. Among those using advisories, variety selection was consistent with the use of local rain gauges to calibrate the advice in the advisories to local conditions. For the most important grains in each zone (as defined by the farmers in that zone) variety selection among those using the advisories conformed to the advisory recommendations to a greater degree than seen among farmers in the same village who where not using advisories, and to a much greater degree than those in villages without access to advisories at all (for discussion and detailed data on patterns of selection, see Carr, 2014a: 56–163).

Therefore, those using advisories follow them closely to make important decisions. But even within a single village, not everyone is using the advisories. This presents a contradiction: if the advisories are delivering useful information, why isn't everyone using them? Why does this appear to be a very successful program, but only for a relatively small percentage of the men in southern Mali?

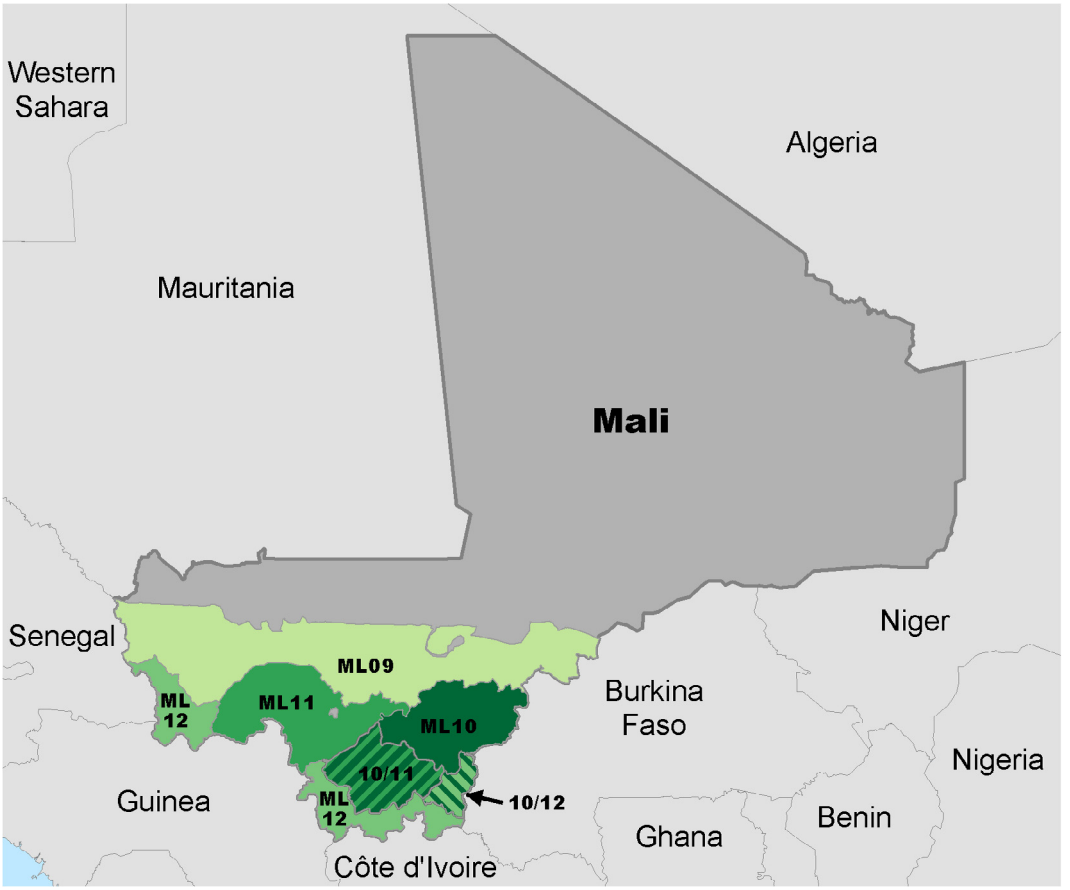

Fig. 2. Livelihoods Zones in Southern Mali. While the underlying framing of these zones is drawn from Dixon and Holt (2010), both changes in zone boundaries and the blending of zones were produced by the empirical data gathered in the assessment of the Agrometeorological Advisory Program. Map produced by Christopher J. Witt, Department of Geography, University of South Carolina.

3.3. Explaining the findings

The data gathered for the assessment of Mali Meteo's Agrometeorological Advisory Program, especially that data gathered through qualitative, ethnographic means in 2014, allows us to interpret these patterns and explain these paradoxical findings. First, the qualitative data echoes the literature on agricultural decision-making among the dominant ethnic groups in each livelihoods zone, especially how identities at the intersection of gender and seniority are associated with different roles and responsibilities. The Bambara (who are the dominant ethnicity in Zone ML09: West and central rainfed millet/sorghum, and present in Zone ML10: Sorghum, millet, and cotton, Zone ML12: South west maize, sorghum, and fruits, and the eastern parts of the Zone ML11: South maize, cotton, and fruits), Senoufo (who dominate Zone ML10: Sorghum, millet, and cotton, and Zone ML12: South west maize, sorghum, and fruits, and are found in parts of eastern ML11: South maize, cotton, and fruits), and Mandinka (who live in much of the western part of southern Mali, especially in the western part of Zone ML11: South maize, cotton, and fruits) organize society and agricultural production in broadly similar ways (for discussion, see Akeredolu et al., 2007; Assé and Lassoie, 2011; Becker, 1990, 2000; Förster, 1998; Grigsby, 2002, 2004; Skinner, 1959). In all cases, households of a man, his wives, and his children are organized into patrilineal extended family groups headed by the most senior man. The most senior male member of a lineage or family allocates land to a communal "concession" farmed by all members of the extended family (common among the Bambara and Mandinka, but less common among the Senoufo) and then to the male heads of household in that lineage (seen across all three groups), who then allocate this land to cultivation of different crops and different household producers, with the cultivation of staple grains for household consumption receiving the highest priority (though in cotton-producing areas, this cash crop is often of equal or higher priority than staple grains). Concessions generally have communal farm equipment and granaries, though at times households within a concession might have their own granaries.

Across southern Mali, women's production is seen as secondary to men's role as subsistence providers, and therefore women generally cannot own land. Women's insecure land tenure serves as a disincentive for planting long-term tree crops or undertaking other improvements to the land. Therefore, among most sedentary agriculturalists in southern Mali, senior

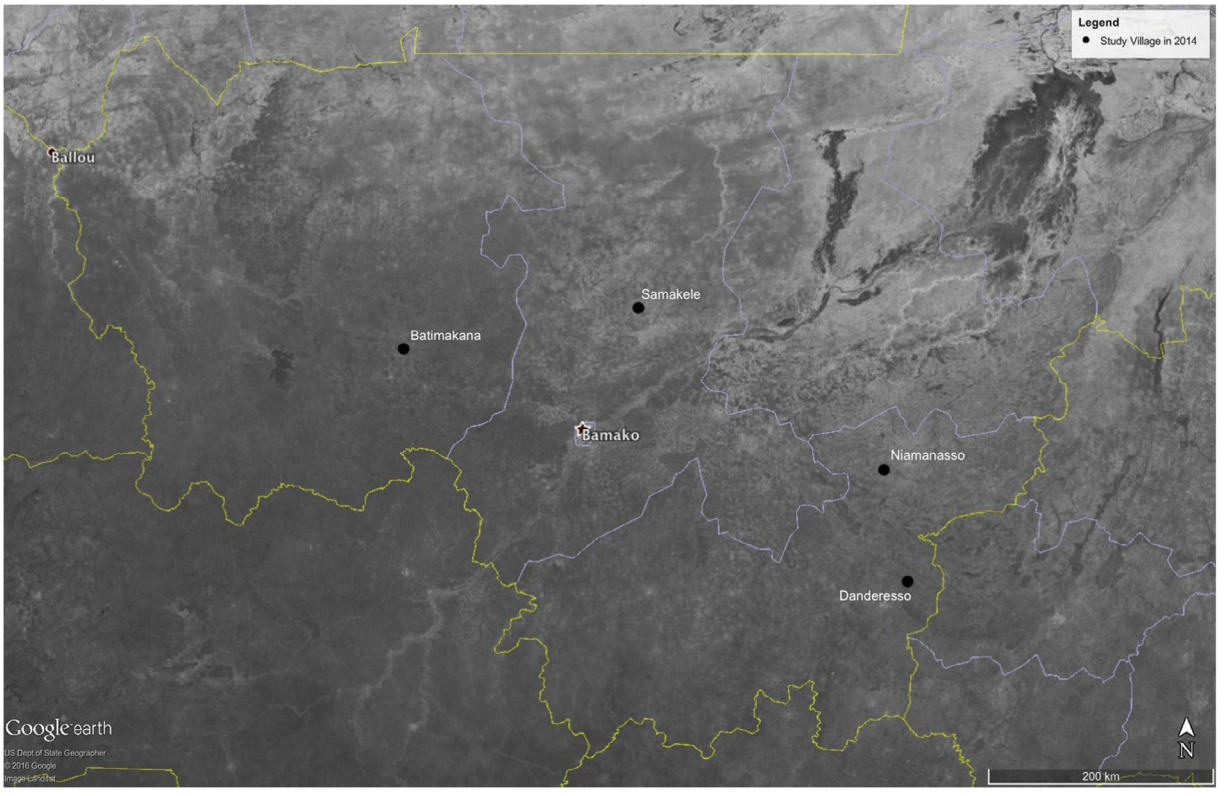

Fig. 3. Locator map of the four villages in southern Mali selected for detailed analysis in the 2014 assessment.

men will have the greatest ability to act upon advisories, with junior men reliant on their approval because of their need to go through senior men to access land and often animal traction and agricultural equipment. Women have little opportunity to make independent decisions about rain-fed agriculture, and may cultivate particular cycle lengths to address social challenges, like threats to their land tenure, rather than climatic challenges. The only clear exception to this is among the Malinké, where gender relations in agriculture are a bit different from those seen among the Bambara or Senoufo. In smaller Malinké households (i.e. a husband and wife), men treat women as joint partners in agriculture in what Assé and Lassoie (2011, p.255) call "gender inclusive decision-making". However, larger polygamous households practice "gender exclusive decision-making" (Assé and Lassoie, 2011, p.255) where women are explicitly excluded from communal household agricultural decisions. Thus, as they mature and their households gain assets, men will marry again and, as a result, their first wives will gradually lose decision-making authority in agriculture, bringing the overall structure of Malinké agricultural decision-making into close alignment with that of Bambara or Senoufo agriculture.

These roles and responsibilities, however, do not fully explain the observed patterns of advisory use across southern Mali. Such explanation requires understanding the uneven distribution of agricultural assets in these communities. In our 2014 ethnographic investigation of livelihoods decision-making, we found that one of the strongest predictors of advisory use was ownership of draught animals and plows (Table 2). Without these assets, farmers cannot act on advisories in a timely manner, as they must wait until other households with these assets complete their farming tasks and are willing to lend or rent them out.

Identity and asset ownership converge to explain the patterns of use. In most settings in southern Mali, senior men are the ones with the authority to make decisions about agricultural strategy. Further, these men have the greatest responsibility for the cultivation of staple grains, and they are the most likely to own the equipment and animals needed to respond to advisories in a timely manner, because the accumulation of such assets often requires time and the appropriation of the labor of more junior members of the family group. Thus, senior men with equipment are the most likely to be using advisories. Junior men can, at times, own enough animals and equipment to follow the advisories, but generally do so only if the senior men in their families approve. In settings where agricultural production is organized by concessions and households (Zone ML09: West and central rainfed millet/sorghum, and to a more limited extent ML10: Sorghum, millet, and cotton and ML12: South west maize, sorghum, and fruits zones), junior men must first work on concession land controlled by senior men, before turning to work on their own farms. As a result, even if they own draught animals and agricultural equipment, their personal field preparation and planting is delayed, sometimes to the degree that there are few, if any, decisions (the timing of inputs, the selection of variety by cycle length) remaining that the advisories can productively inform. For example, if agri-

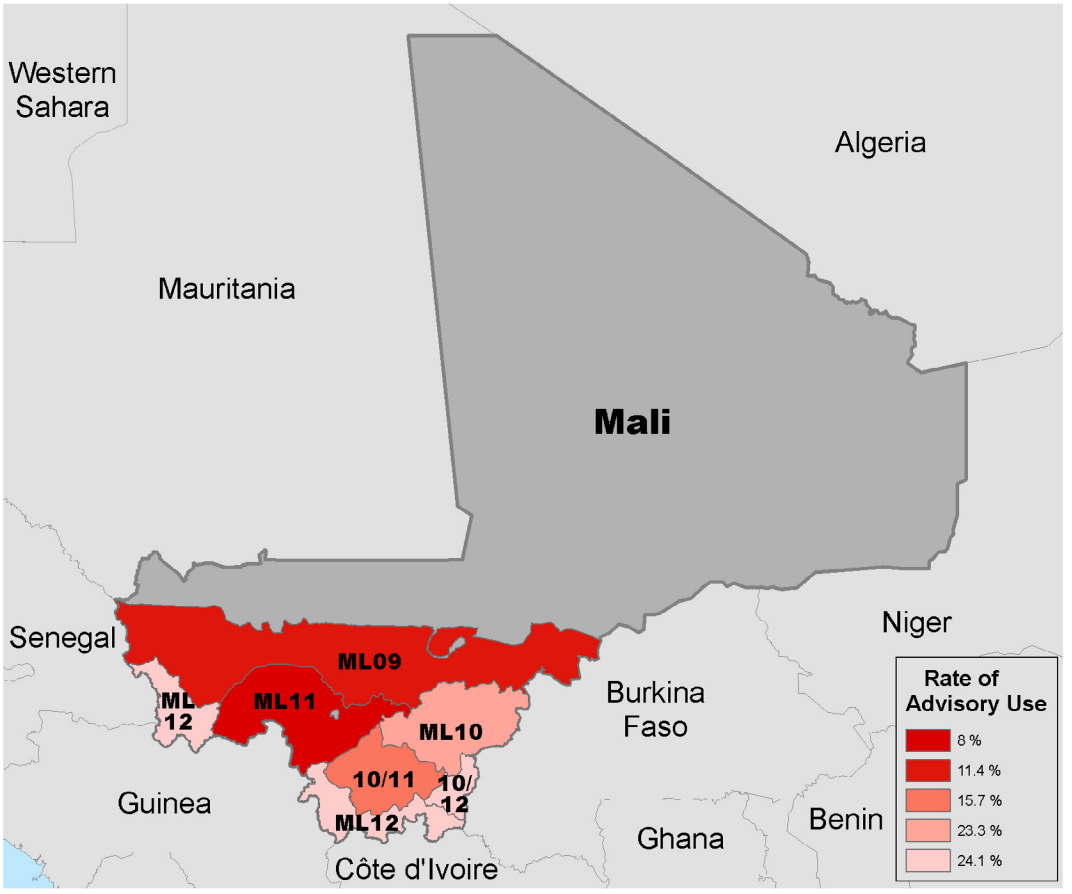

Fig. 4. Map of the rates of advisory use by zone, illustrating the declining overall use of advisories in northern and western parts of southern Mali. Map produced by Christopher J. Witt, Department of Geography, University of South Carolina.

cultural activities are significantly delayed, the limited remaining season may dictate the selection of short-cycle varieties to generate any harvest at all. This is particularly true in families where senior men lack draught animals and equipment. In such families, concession production is delayed by the wait for these agricultural assets, producing further delays that trickle down through the family group to the individual household production of these junior men.

The situation of women also varies by seniority, but less obviously. Across southern Mali, women are expected to be obedient to both their husbands and other senior men, and to help with concession or household agricultural activities before undertaking any of their own work. Generally speaking, senior women have more of a leadership role in the domestic activities of the household and concession (where appropriate). Among the Bambara and Senoufo, their authority does not extend to livelihoods activities outside the house or compound. Generally speaking, women in these groups do not make rain-fed agricultural decisions such as crop/variety selection and the timing of agricultural activities. Such decisions rest with the men in their families. Only when they have met their responsibilities to the concession are senior women free to cultivate their own fields. This results in extremely delayed start of production, often to the degree that the remaining cultivation season is so short as to preclude the need for cycle-length decisions. However, among the Malinké, this situation is reversed. Junior women in monogamous Malinké households may share agricultural decision-making with their husbands, extending their authority and role to agriculture and key livelihoods decisions. Thus, a junior woman in monogamous Malinké household will likely have greater decision-making authority with regard to rain-fed agriculture than a senior woman in a Bambara or Senoufo household, or even a senior woman in a polygamous Malinké household. However, households comprised of junior adults generally have little equipment, animal traction, or autonomous agricultural decision-making authority, so they still cannot act upon the advisories. This explains why junior women in the South maize, cotton, and fruits zone do not report higher rates of advisory use than those in other zones.

In ML10: Sorghum, millet, and cotton zone, ML11: South maize, cotton, and fruits zone, and ML12: South west maize, sorghum, and fruits zone, the patterns of use reflect the livelihoods roles and responsibilities of different identities framed at the intersection of gender and seniority, as refracted through access to agricultural assets. In zone ML09: West and central rainfed millet/sorghum, however, these two factors cannot explain the extremely low rates of advisory use, relative to rates

Table 1
Rates of advisory use by gender and seniority, in both the 2012 and 2014 assessments. The 2012 rates report on a set of villages (except for Zone ML 09, where only one village in the sample was still participating in the program), while the 2014 rates reflect findings in a single representative village in each zone.

	Zone ML 09: 2012	Zone ML 09: Samakele 2014
Senior men	80.00%	14.7%
Senior women	0.00%	0.0%
Junior men	60.00%	0.0%
Junior women	0.00%	0.0%

	Zone ML 10: 2012	Zone ML 10: Niamanasso 2014
Senior men	16.25%	38.5%
Senior women	0.00%	14.3%
Junior men	14.41%	30.0%
Junior women	6.25%	0.0%

	Zone ML 11: 2012	Zone ML 11: Batimakana 2014
Senior men	9.52%	17.6%
Senior women	17.78%	0.0%
Junior men	17.28%	11.1%
Junior women	9.78%	0.0%

	Zone ML 12: 2012	Zone ML 12: Danderesso 2014
Senior men	13.89%	50.0%
Senior women	0.00%	0.0%
Junior men	12.35%	37.5%
Junior women	0.00%	11.1%

of use in other, more southerly, zones in Mali. In this zone, the values associated with different livelihoods activities changes the importance of advisories. Unlike patterns in other zones, in the ML09 the wealthiest individuals focus their livelihoods more and more on animal husbandry as they accumulate assets. Thus, those with the greatest livelihoods resources, who are those most able to use advisories, are disengaging from agriculture as a primary livelihoods activity as their asset situation improves. This means that agricultural production is more central to the livelihoods of those with limited resources, and therefore limited capacity to respond to the advisories.

It is critical to note that these patterns of association between identities and particular livelihoods roles and responsibilities were deeply embedded in the social structures of all four zones. They were reproduced day after day, and season after season, such that they became "social facts" that shape individuals' understandings of possible actions in and thoughts about the world (Gidwani, 2001, p.79). Thus, the act of making decisions about what to plant and when mobilized particular identity categories, specifically at the intersection of gender and seniority, which legitimized some individuals' ability to make decisions for others in their family or household. The perpetuation of these structures of decision-making based upon identity made the roles and responsibilities associated with particular identities appear natural. This became clear as the analysis of livelihoods decision-making in each zone turned to tools of coercion.

In all four zones, interviewees were asked about the sanctions that might be levied against them if they were to transgress the expectations of the community around appropriate livelihoods activities, the appropriate conduct of those activities, and the appropriate behaviors associated with different identities. In all parts of southern Mali, interviewees reported an escalating set of sanctions that generally started with verbal reprimand before proceeding to physical acts of violence (i.e. domestic violence) and finally expulsion from the family and/or the community. While these sanctions presented significant incentives to conform to expectations, what was perhaps most interesting was the fact that in all zones, several respondents across genders and seniority status reported that either no person had ever actually transgressed to any great degree or they had never *considered* transgressing expectations. This is remarkable, as the clear differences in agricultural outcomes across these identities, and the evidence we collected in all four zones, suggested that junior men and women of both junior and senior status were aware that the existing structure of authority and decision-making disadvantaged them, and that they were not necessarily happy with their place in this structure. For example, the first challenge named by one junior woman in Danderesso (Interview 44) was that she "has to wait on her husband for his animals and plow." After an interview with a senior woman in Niamanasso, an interviewer reported "She is always late having her field plowed because she has to wait for her husband to grant the authorization for his draught animals farming equipment to plow her field. She sows right after her

Table 2
Rates of advisory use by access to livelihoods assets, especially animal traction, equipment like plows, and the ownership of other domesticated animals.

Samakele/Zone ML09

	Overall Percentage Using advisories
High Access to Livelihoods Resources	13.3%
Limited Access to Livelihoods Resources	16.7%
Inadequate Access to Livelihoods Resources	0.0%

Niamanasso/Zone ML10

	Overall Percentage Using advisories
High Access to Livelihoods Resources	41.7%
Limited Access to Livelihoods Resources	30.0%
Inadequate Access to Livelihoods Resources	9.5%

Batimakana/Zone ML11

	Overall Percentage Using advisories
High Access to Livelihoods Resources	19.2%
Limited Access to Livelihoods Resources	2.7%
Inadequate Access to Livelihoods Resources	7.1%

Danderesso/Zone ML12

	Overall Percentage Using advisories
High Access to Livelihoods Resources	50.0%
Inadequate Access to Livelihoods Resources	10.5%

field is plowed, but she is most of the time late because she has to work every day in her husband's fields except on Fridays" (Interview #03). In both cases, these women are tying their agricultural (and livelihoods) challenges to a structure that privileges men's farming and crops. At the same time, the fact that transgressions against this existing structure of decision-making are very rare (only one or two members of each village sample reported such transgressions) is evidence that such transgression generally stands outside the realm of possibility defined by the social facts of identity and livelihoods discourses across southern Mali, and therefore that changes to these structures which might enable broader advisory use will be very challenging and slow.

4. Discussion

The patterns of advisory use in southern Mali, and their underlying roots in livelihoods decision-making, speak to the challenge of designing effective climate services. We might interpret the very low rates of advisory use, and their highly-gendered character, as failings of the advisory program to deliver broad-based benefits to agrarian communities in southern Mali. However, such a conclusion presumes that this was the goal of the program. As the historical review of this program demonstrates, the Agrometeorological Advisory Program was never designed to deliver such benefits. Instead, it was designed as a narrowly-focused emergency response to acute food insecurity. The Malian diagnosis of the causes of this food insecurity focused on very low rates of precipitation as the cause of this problem, and identified increased food availability as the solution. Framed around this challenge, this understanding of its causes, and the proposed solution, the Agrometeorological Program is not representative of failure, but of a very well-designed program that leveraged on-the-ground livelihoods decision-making structures in an effort to increase food security.

Consider the structure of agricultural decision-making outline above: in all cases, those responsible for the cultivation of the vast majority of Mali's staple grains (and, as it turns out, cotton as well) are men. Among these men, only the most senior men have the ability to make their own agricultural decisions on a consistent basis, and they tend to make the agricultural decisions for the rest of their extended families as well. Thus, the advisories were never intended to speak to agricultural production in southern Mali broadly. They were intended to inform the decisions of senior men cultivating staple grains, as this was the fastest way in which to change agricultural decisions and behaviors around these grains, boost yields, and improve food availability in Mali. That rates of use would decline in more northerly parts of the country was not a problem for the program, as these areas were not producing as much grain as those more southern areas with more total and more

predictable rainfall. Finally, the relatively low rates of advisory use across southern Mali, even among senior men, reflects a question of agricultural asset availability, a problem that the advisory program could not address and therefore had to operate within.

In short, as originally conceived, the Agrometeorological Advisory Program was never intended to be a broad-based, long term means of building resilience to a variable and changing climate (especially as climate change had not risen to the surface of development discussions in the early 1980s). It was an instrumental tool by which Mali could meet a specific challenge quickly, and in this light it was very well designed.

At the same time, the program has now been in existence for more than 30 years, and while it has added new information to the advisories over time, the basic structure and assumptions of the program have not changed. Today it is seen as a development tool, one that should be building the resilience of rural populations to climate variability and change, an issue now at the forefront of agrarian development in Sudanian and Sahelian West Africa. In this light, the low rates of use, and the highly gendered patterns of use, are failures to deliver broad-based benefits to rural Malians. This is an unfair criticism of the program, as it presumes that something designed to achieve a very specific goal via specific means at a particular time should also achieve other goals via those means over a much longer timespan. Such an expectation rests upon the same logic that once informed supply-side climate services design, where there was a presumption that weather and climate information were inherently useful and therefore would bring benefits if they were simply delivered to potential users. What this paper, and the larger assessment of the Agrometeorological Advisory Program on which it reports, demonstrates is that effective climate services clearly target the challenges posed by particular weather and climate stresses, identify what those challenges are *among* the presumed users, and deliver information to those uers that is seen as salient, legitimate, and credible (Cash et al., 2003). Information that is provided to a particular set of users to address a particular stressor cannot be presumed to have wider benefits, either in terms of users or in terms of the challenges that information might address. Indeed, the uncritical application of an existing climate service, such as the Agrometeorological Advisory Program, to a new challenge (for example, building resilience to climate variability and change) can exacerbate some of the factors that produce deficits in resilience in the very populations the service is meant to address. It is very clear that the Agrometeorological Advisory Program, for all of its effectiveness in addressing the needs and interests of senior men with draught animals and agricultural equipment like plows, concentrates its benefits among these men, and makes their families and households even more dependent on their decision-making. This reduces the likelihood that junior men or women of any seniority might find ways to innovatively meet their own needs, or otherwise transform agricultural decision-making to better meet the realities of a changing Sudanian and Sahelian environment. Dependence on a single decision-maker, with a particular set of social, economic, and environmental interests, is not likely to serve as a path to resilience in this context, and it certainly does nothing to address other development goals such as gender empowerment and the health, nutrition, education, and fertility benefits that have been associated with increased women's empowerment.

5. Conclusion

The case of Mali's Agrometeorological Advisory Program reinforces much of what we now see as clear parts of the climate services literature: that climate services designed from a supply-side perspective run significant risks of delivering information that nobody wants, needs, or can act on. However, this case also presents several significant new lessons from practice for climate services for development that extend and complement this literature, suggesting new lines of inquiry for the field of climate services.

1. The goal of the climate service greatly shapes its design, delivery, and the nature of its impact. The Agrometeorological Advisory Program was designed as a humanitarian assistance effort, where the designers understood the compromises they were making (effectively empowering the powerful and rich in rural Mali at the expense of others) to achieve a short-term goal (boosting staple grain yields and revenues from cotton production). The problematic character of the program emerged when this critical, conscious tradeoff was lost to history, and the project was uncritically converted to a development program that was assumed to have broad-based benefits.
2. While a well-designed climate service might achieve its stated goals, we cannot assume benefits beyond that stated design, either in terms of goals or the beneficiaries it might reach. This is an extension and nuancing of thinking in climate services that has moved us away from a supply-driven model of climate services to a focus on demand-driven services.
3. If climate services are to have immediate impact on the lives and livelihoods of users in agrarian contexts, they must be designed in a manner sensitive to existing decision-making logics of those users. Such design requires a nuanced understanding of livelihoods decision-making that engages not just the material outcomes of livelihoods (i.e. a climate service aimed at increasing incomes from the production of a particular crop), but also the various sociocultural aspects of livelihoods that greatly shape what is seen as an acceptable activity, an acceptable means of conducting that activity, and for whom the activity is a part of their roles and responsibilities. The success of the Agrometeorological Advisory Program came from its ability to leverage a deep understanding of agricultural decision-making in rural Mali to deliver needed information to the people most able to translate it into needed increases in grain yield quickly. Those outcomes of the project that might today lead us to see it as a failure are the result of a mismatch between the stated (new) goals of

the project (broad-based agricultural development and resilience-building) and the ability of the intervention to effect such development among those without the authority to make decisions informed by the advisories, or who lacked the assets to use the advisories.

4. Therefore, while climate services can provide critical information that might inform livelihoods decisions in a manner that build incomes, food security, and resilience (to name a few potential benefits), climate services alone are rarely sufficient to bring about these results. As the case of the Agrometeorological Advisory Program shows, even useful information cannot overcome barriers like the absence of farming equipment or animal traction that enables the use of that information. Therefore, we must start connecting climate service interventions with those in other sectoral areas (and emerging cross-sectoral areas, like resilience and adaptation) to align both in a way that maximizes the impacts of each.
5. None of this is to say that climate services are devoid of transformative potential. Discourses of livelihoods mobilize various aspects of identity to produce regular patterns of activity and livelihoods outcomes in any community, activities and outcomes that are policed in various ways by the members of that community. However, all communities have transgressors: those who in some way or other defy expectations of their identity, of what is seen as an acceptable livelihoods activity, or of what is seen as an acceptable means of conducting that activity. While much of the discussion around tools of coercion suggests that such individuals should not be found during fieldwork (because they would have been disciplined into compliance or expelled from the family, household, and community), we found one or two transgressors in every community in which we worked. These individuals are critical for thinking about how changes in the use of climate services might come about, or how changes in livelihoods that enable the productive use of climate services for new or enlarged populations might happen, because they have figured out how to push back against the structures of governance that shape their lives and livelihoods in a manner that gives them space to try new or different things without incurring unacceptable levels of sanction or pressure from the community. We have much to learn from these individuals.

While the field of climate services for development has matured greatly in recent years, the empirical basis for many of the claims about climate services and their efficacy remains thin. A final lesson from this case for the field, then, is that we need more deep assessments of existing, working programs such as that described in this case, from which to learn about what works, for whom it works, and why.

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