

Climate information services and behavioral change: The case of Senegal

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The Sahel Research Group, of the University of Florida's Center for African Studies, is a collaborative effort to understand the political, social, economic, and cultural dynamics of the countries which comprise the West African Sahel. It focuses primarily on the six Francophone countries of the region—Senegal, Mauritania, Mali, Burkina Faso, Niger, and Chad—but also on developments in neighboring countries, to the north and south, whose dynamics frequently intersect with those of the Sahel. The Sahel Research Group brings together faculty and graduate students from various disciplines at the University of Florida, in collaboration with colleagues from the region.

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Working Paper Series for Development, Security and Climate Change in the Sahel: Exchange Program between UF, Sciences Po and UCAD

The Sahel is an expansive region on the southern edge of the Saharan Desert characterized by intense environmental change, political and economic instability, and rapid population growth – all of which contribute to various security challenges in the region. Despite this complex confluence of issues, development initiatives have often failed to employ a systems approach, which would be well suited to tackle interaction and feedback between sectors, scales, and states.

The aim of the project, which has involved faculty and graduate students from the University of Florida, Sciences Po (Paris) and Université Cheikh Anta Diop (Senegal), is to shed light on the interplay between these different challenges and to generate development-based interventions and solutions aimed at alleviating social, environmental, economic and political insecurity.

Project participants met three times during the 2014-15 academic year, once in each location (UF, Sciences Po, and UCAD). Periodic virtual conferences were scheduled throughout the year to facilitate long-distance collaboration. The culmination of the project was the organization of a panel at the third International Conference on Sustainable Development Practice, held at Columbia University, New York (September 23-24, 2015), where the results from the project were presented. Some of this output has been reviewed for this Working Paper Series.

The PI for this project was Dr. Renata Serra (UF and affiliate to the Sahel Research Group). The project was funded by the Cultural Services of the French Embassy in the US, the UF Sahel Research Center, and the UF Center for African Studies.



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Abstract:

This paper reviews preliminary evidence from two villages in the Kaffrine region of Senegal, which has witnessed a substantial effort to provide quality coverage of climate information services to facilitate the uptake of climate smart agricultural practices. Data indicate that while most respondents receive radio messages about weather and climate predictions, only a small minority utilizes those messages in decision making about adoption of climate smart practices. A framework for interpreting these data is proposed, which focuses on the role of psychological factors in constraining behavior change, as distinct from other factors, such as financial, technological, and social. We argue that ideology, social norms, and mental frames all affect the way information is processed and risk is appreciated; and a pessimistic outlook on future prospects and associated psychological factors may prevent individuals from undertaking seemingly “SMART” decisions, because they present difficult trade-offs between immediate and long-term gains - or even between individual interests and collective welfare. While much attention has focused on improving coverage of CISs, we should equally invest resources and efforts in tackling the complex domain of individual and collective perception of information, and consequent behavioral change – through innovative approaches to social learning and social marketing.

Key Terms: Climate information services; climate smart agriculture; information processing and decision-making under uncertainty; behavioral change; Senegal.

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1. Introduction

Climate predictions for the African Sahel indicate rising temperatures, increases in average rainfall, higher frequency of extreme events, and greater evapotranspiration (IPCC, 2014). These types of changes have specific implications on food production systems, population mobility, and health wherever they occur. In a region already considered as one of the most vulnerable in the world due to its fragile environmental basis, high fertility rates, and undiversified economic sectors, it is likely such impacts will have lasting effects on future development trajectories (OECD 2014).

Adaptation to climate change represents a key response in Sahelian countries. It is conditional on the availability of information on what to adapt to and how to adapt and the availability of resources necessary to implement the adaptation measures (Füssell and Klein, 2006). The provision of data and information on both weather conditions over the short term and climate events over the longer-term is referred to as climate information services (CIS).

Investing in effective CIS has become an important priority in development, and is viewed as the prePcondition for establishing successful adaptation efforts, even more so in the areas in the world most likely to experience the severe effects of climate change, such as the Sahel. However, these efforts face multiple challenges in terms of both reaching intended beneficiaries with relevant and meaningful messages and in making sure that the targeted individuals and communities are willing and able to act upon that information by implementing sustainable practices.

The present paper discusses some of these challenges by reviewing evidence from a pioneering initiative launched in 2011 in Senegal by the CGIAR program on Climate Change, Agriculture and Food Security (CCAFS) in collaboration with the National Civil Aviation and Meteorology Agency of Senegal (ANACIM) to improve the use of climate information services among farmers in rural Senegal. The project, piloted in the Kaffrine region, has been scaled nationally through partnership with the *Union des Radios Associatives et Communautaires* du Senegal (URAC), an association of community based radio stations spread throughout the country (CCAFS 2015). This is an innovative and successful project in many respects, thanks to the strong leadership manifested by the ANACIM, the institutional format (collaboration between ANACIM, local radios, and extension agents) to reach out communities in a vast rural area, and the efforts spent in making messages relevant in the local context, through training of local radio broadcasters and facilitation of dialogue between scientists and extension workers (Lo and Dieng, 2015).

The paper presents a closer analysis of some data collected by CCAFS in the project area, consisting of both a quantitative survey from 2014 and qualitative interviews with a variety of local actors conducted during summers 2014 and 2015. We show that, despite the wide coverage of CIS, especially through radio messages, only a minority of the people surveyed indicate these services as instrumental in their decisions to adopt climate smart agricultural (CSA) practices; furthermore, the rate of CSA adoption remains pretty low, despite CIS. While these findings may be consistent with an explanation based on inaccurate or poorly delivered CIS, we argue this is not the whole story. Even when CIS messages are correct and effectively conveyed, they may fail to positively affect individual behavior due to key constraints affecting people's reception of information and choices in the presence of uncertainty. These challenges are not only of technical, financial or social nature – and thus go beyond the known problems of identifying costPeffective ways of transmitting messages to vast regions, adequately training extension agents, and inducing whole communities to

pay attention to the messages – but also involve dealing with the messier nature of human psychology and decision making in uncertain situations.

The paper thus contributes to the literature on climate information services and adaptation practices by incorporating findings from recent studies in experimental and behavioral economics, which demonstrate that individuals are not always rational in the way standard theories would have them to be, and they instead absorb and filter information, and perceive and react to risks, in non-predictable ways. This is due to not only differences in culture and context, but also differences in individual traits, such as personal risk aversion, literacy, and past experiences. We conclude by emphasizing the need to incorporate more specific considerations of behavioral and psychological factors when devising the provision of CIS, so to enhance the effectiveness of current interventions.

2. The Senegal case study

The case of Senegal is an appropriate choice for examining the role of climate information services in adaptation practices. The country has laid out a medium-term plan with the goal to become an emerging economy by 2050 (*Plan Senegal Emergent*). Senegal has pioneered a number of initiatives in the context of climate change and sustainable development, including leading work on the equitable distribution of climate information services among poor and disenfranchised farmers and the significant role of gender in effective climate science. The project launched in 2011 by the CGIAR's research program on Climate Change, Agriculture, and Food Security (CCAFS), in partnership with the National Civil Aviation and Meteorology Agency of Senegal (ANACIM), represents one such effort to improve the provision and use of climate information services among farmers in rural Senegal. The project, piloted in the Kaffrine region, has been scaled nationally through partnership with the Union des Radios Associatives et Communautaires (URAC), an association of community based radio stations spread throughout the country (CCAFS 2015).

Baseline data from 2011 indicated that farmers used traditional knowledge rather than seasonal forecasts to plan for appropriate adaptations to climate and weather events (Kristjanson et al., 2011; CCAFS Baseline Indicators for Kaffrine, 2015). This evidence supported efforts on the ground aimed to pursue greater integration of sources of knowledge. Indeed, multi-disciplinary teams of farmers, extension agents, climatologists, NGO representatives, and the media met to discuss farmer perceptions and needs with regards to climate information. In this venue, facilitators described how traditional forecasting, as described by farmers, could be and was in fact represented by some of the technical weather forecasts, demonstrating important complementarity and possibilities for integration of both types of information sources, thus diminishing skepticism among farmers about technical forecasts (Ndiaye et al., 2013; Jay, 2014; Lo and Dieng, 2015).

As part of the broader CCAFS research initiatives, UF researchers returned to Kaffrine from May through July 2014 to collect both quantitative and qualitative data to examine the relationship between climate information services and the use of climate smart agricultural (CSA) practices. Specifically, the research sought to identify what access farmers had to climate information services and what climate smart agricultural practices had been adopted by farmers in two communities in Kaffrine. Another aspect to investigate was if there were any relevant gender differences. Researchers at the University of Florida have been working with CCAFS since 2012 to understand how gender intersects and affects climate information services, in its content, distribution, and utilization for change at the

household level (McOmber et al. 2013; McKune and McOmber 2013; Devereux and McKune 2014; Ryley and McKune 2014; Poulsen et al. 2015; McKune et al 2016).

Survey data utilized here come from two communities: Kahi and Malem Thierign, both located in the semi-arid Kaffrine region of Senegal (see Figure 1). Previous research showed that Kaffrine is especially prone to climate disaster, and has experienced increasing floods and other extreme weather-related events in recent years (Tall et al. 2014). The main livelihood in Kaffrine is rainfed agriculture (peanuts, millet, and maize). Wolof is the major ethnic and language group found in Kaffrine (and is the ethnic identity of all of the survey respondents), although the town of Malem Thierign also receives many Fulani pastoral and semi-pastoral herders.

In addition, responses to qualitative interviews conducted during two different visits, in 2014 and 2015 (see Poulsen et al. 2015), were also taken into account, as well as a series of reports from CCAFS project (McOmber et al. 2013; Tall et al. 2014; Lo and Dieng, 2015).

Figure 1. Location of the Kaffrine region, Senegal



Though both communities have moderate rates of food insecurity, Kahi had not received any CCAFS climate information, while the village of Malem Thierign had been a site of multiple research projects, including ongoing CCAFS work since 2010, and various research projects conducted by World Vision. Previous research has highlighted gender-specific vulnerabilities to climate-related shocks, endogenous adaptation strategies, and coping mechanisms (Tall et al. 2014). CCAFS-related interventions in the site include the provision of climate information services.

A total of 49 surveys were administered to women and men across 34 households, including 15 intra-household couples where both male and female heads of house were surveyed (see Table 1).

Table 1. Samples size in the two villages sites, Kaffrine, Senegal

Village	Kahi (No interv)	Malem Thierign (ongoing interv)
Men (n=22)	10	12
Women (n=27)	14	13
Total (n=49)	24	25

Source: UF/CCFAS data, Kaffrine, Senegal

Nearly all respondents reported receiving climate information (including the “control site” of Kahi) (McKune et al. 2016), thus eliminating access to climate information as a primary concern in these communities. However, only 8% of respondents reported changing crop varieties.

2.1 Sources of climate information

The leading sources of climate information by village are reported in Table 2 (where figures denote percentages, and each respondent could mention more than one source):

Table 2. Sources of climate information reported among household in Kaffrine, Senegal by community (percentages, n=49)

	Kahi	Malem Thierign	All
Source_ Trad	9.1	8	8.5
Source_ Radio	90.9	92	91.5
Source_ TV	27.3	4	14.9
Source_ Phone	4.5	16	10.6
Source_ Pamphlet	0	0	0
Source_ ExtOffice	0	0	0
Source_ Schools	0	0	0
Source_ Neighbors	40.9	24	31.9
Source_ Family	4.5	8	6.4
Source_ Leaders	9.1	16	12.8
Source_ OwnExp	0	0	0
Source_ Groups	0	0	0
Source_ Barazas	0	0	0

Source: UF/CCFAS data, Kaffrine, Senegal

The predominant source of climate information in both villages is the radio, followed by ‘neighbors’. The major differences in source of information between communities are that: in Kahi there is a more widespread use of TV (reported among 27% of respondents compared to 4% in Malem Thierign) whereas cell phones are relatively more important in Malem Thierign (16% compared to 4.5% in Kahi); and in Kahi there is a greater reliance on neighbors (41% vs. 24%), but a lower reliance on family (4.5% vs. 8%) and community leaders (9% vs. 16%) than in Malem Thierign.

Table 3 reveals the leading sources of climate information by gender of the respondent. Men and women comparably report radio as the most important source of climate information. The major differences, instead, are not only men’s greater use of TV and phones than women (which could be expected), but also their higher reliance on more traditional sources of information, including traditional sources of information, family, and community leaders. By contrast, women report a greater reliance on neighbors.

These data suggest some interesting points. First, the main channel through which individuals hear about climate and weather forecasts is the radio. The advantage of the latter is its ubiquity, since most people in rural Senegal are likely to listen to the radio on a daily basis and to perceive it as nonintrusive. ANACIM has pioneered novel approaches to make radio messages relevant to farmers – for instance by facilitating backstage meetings between scientists and farmers, so that the former may become aware of how information needs to incorporate local knowledge and understanding; and by facilitating meeting between farmers and radio conductors, so that the latter may be able to transmit

appropriate messages to the right audience (Tall et al. 2014). The survey responses confirm the claim made by the CCFAS team that CIS has attained wide coverage in Kaffrine, reaching potentially two millions people (Lo and Dieng, 2015).

Table 3. Sources of climate information reported among household in Kaffrine, Senegal by gender (percentages, n=49)

	Men	Women	All
Source_ Trad	13.6	4	8.5
Source_ Radio	90.9	92	91.5
Source_ TV	18.2	12	14.9
Source_ Phone	18.2	4	10.6
Source_ Pamphlet	0	0	0
Source_ ExtOffice	0	0	0
Source_ Schools	0	0	0
Source_ Neighbors	27.3	36	31.9
Source_ Family	9.1	4	6.4
Source_ Leaders	18.2	8	12.8
Source_ OwnExp	0	0	0
Source_ Groups	0	0	0
Source_ Barazas	0	0	

Source: UF/CCFAS data, Kaffrine, Senegal

At the same time, selected inPdepth interviews conducted in the field also suggest there are challenges in translating this level of “potential use” into “real use” of information. Some respondents stated the information is not always useful or accurate enough; others stated that since their time is very limited, they preferred to listen to other and more entertaining programs than weather forecasts on radio and TV (McKune et al. 2016). When asked how climate information services could be made more useful to farmers, respondents offered a variety of suggestions such as: make information more relevant to their agricultural activities (52%), increase the frequency with which climate information is shared (45%), make the presentation of the information more clear (40%), make the informationPsharing method more accessible (23%), among other suggestions (McKune et al. 2016).

Thus radio is a wellPknown channel of information and communication, yet it has some limits: radio messages are not personalized (as those that would be provided through interP personal interaction) and cannot take advantage of visual images, which are often powerful tool in effective communication. Furthermore, there are important gender differences, as evidenced in Table 3.

If rural women/men are to be appropriately reached, it is necessary to understand how information circulates among their respective social networks. If women are not individual consumers of information, but they are more likely than men to access it, and possibly process it and discuss it, collectively, then information campaigns and extension services that reach out to groups, rather than to individuals, are more likely to be effective for this particular group. Extension and sensitization campaigns that regularly reach out to communities and enable participants to revise their expectations and strategies appear to be very promising, even if requiring a higher cost than radio programs.

On the other hand, traditional knowledge seems to be more important to men than to women – this also needs to be factored in, so that information can be rendered more gender-sensitive.

Finally, another important challenge from a gender perspective is that if/when women are not the main agricultural decision-makers, they are not too interested in weather and climate information (Poulsen et al. 2015). This means that, unless CIS is relevant to women to start with, any innovative way of bringing information to them is being lost.

Therefore, even if ANACIM has put in effort to make seasonal forecasts as relevant as possible to its intended audience, the messages (content or format) may still not appear as significant for farmers’ daily experiences as those that are transmitted through interpersonal encounters with family and neighbors; and they do not sufficiently differentiate between genders’ preferences. This would suggest the need for interventions to pay greater attention to the mental frames and psychological attitudes of the different groups on the receiving end of the message – a topic that is discussed later in Section 3.

2.2 Adoption of CSA practices

Table 4 gives some evidence on the extent to which the implementation of CSA practices are linked to the CIS received. Over half (57%) of the respondents stated they implemented any of the CSA practices as a consequence of the climate information received (50% of the sample in Kahi and 64% in Malem). The practices most frequently reported include (in order of frequency mentioned): manure management, intercropping, crop rotation, and improved storage. In both villages, more men than women in the sample stated that climate information led to changes in practices on their farms. There are no major differences in the frequencies with which men and women mention their use of practices, except that rotational grazing is used more by women than men in Kahi.

Table 4. Implementation of CSA practices

		Kahi (pre-intervention)		Malem Thierign (ongoing intervention)		Total
		Men (n=10)	Women (n=14)	Men (n=12)	Women (n=13)	49
Climate info has led to changes on farms (%)		70% (n=7)	36% (n=5)	75% (n=9)	54% (n=7)	57%
CSA Practice Used (% of those who made to changes)	Manure Management	100%	93%	100%	100%	
	Intercropping	90%	100%	92%	92%	
	Crop Rotation	90%	100%	83%	100%	
	Improved storage	80%	86%	92%	69%	
	Conservation tillage			50%	62%	
	Residue Management	50%	64%			
	Rotational Grazing	25%	100%			
	Improved breeds of cattle	25%	33%			

Source: UF/CCFAS data, Kaffrine, Senegal

When respondents were asked what was the main source of information that induced them to adopt the mentioned CSA practices, a surprising pattern emerges. Most of the information relevant to the adoption of practices came from family, traditional knowledge, personal experience, social networks and community leaders (Table 5). Neither radio messages nor extension services were ever mentioned, despite they were listed in the questionnaire as possible responses. Thus, evidence from Tables 4 and 5 does not appear to support the claim that CSA practices emerge as the result of climate information provision.

Table 5. Sources of knowledge about CSA practices

	Kahi, Senegal (pre-intervention)		Malem Thierign, Senegal (ongoing intervention)	
	Men	Women	Men	Women
Manure Management	50% traditional knowledge, 30% family, 20% community groups	64% family, 21% traditional knowledge, 7% community groups	58% family, 25% community groups, 8% traditional knowledge, 8% barazas	61% family, 23% traditional knowledge, 8% neighbors, 8% community groups
Intercropping	30% family, 30% personal experience, 30% traditional knowledge	64% family, 29% traditional knowledge	50% family, 17% traditional knowledge, 17% personal experience, 8% neighbors	77% family, 8% neighbors, 8% personal experience
Crop Rotation	50% traditional knowledge, 20% family, 10% personal experience, 10% community groups	57% traditional knowledge, 43% family	42% family, 25% personal experience, 17% traditional knowledge	69% family, 23% traditional knowledge, 8% neighbors
Improved storage	40% family, 40% personal experience	42% family, 21% traditional knowledge, 7% neighbors, 7% local leaders, 7% personal experience	33% personal experience, 25% family, 8% traditional knowledge, 8% neighbors, 8% community groups	31% family, 15% personal experience, 8% neighbors, 8% local leaders, 8% barazas
Conservation Tillage			25% family, 8% neighbors, 8% personal experience, 8% community groups	46% family, 8% traditional knowledge, 8% neighbors
Residue Management	30% traditional knowledge, 30% family, 20% personal experience, 10% community groups	42% family, 21% traditional knowledge, 7% personal experience, 7% community groups		
Rotational Grazing	10% barazas	7% barazas, 7% family		

Source: UF/CCFAS data, Kaffrine, Senegal

Overall, two main findings emerge from this preliminary analysis from the two villages. First, although more than 90% of respondents receive climate seasonal forecasts through radio and other means, only half put in practice adaptation measures to minimize farm losses from drought and other extreme weather events. Furthermore, the source of CSAP related information is to be located mostly in traditional knowledge, family and neighbors – and only to a very minor extent in radio campaigns and extension services.

3. Cognitive processes and behavioral changes

The ANACIM agency in Senegal is highly praised for their effort in providing meaningful and effective climate information services. Evidence from farmers' responses reviewed in the previous section, as well as from similar studies in the Kaffrine region, suggests that CIS reach out to many people, and the messages are positively valued by recipients. Why is it then that the implementation of CSA is so limited on the ground – and even those who put them in practice appear to be informed more by traditional channels of knowledge and less by CIS messaging? The present section tries to address these questions by examining the role of uncertainty in decision making and evidence from studies of behavior under risk.

An explicit focus on uncertainty¹ is particularly useful to understanding the limits to climate messaging and implementation of climate adaptation (Jones and Preston, 2011; Dow et al., 2013b). Climate changes and weather events are intrinsically uncertain, so perfect predictions are impossible. What climate and weather modeling and projections attempt to achieve is to reduce the degree of uncertainty of future events and produce predictions for outcomes and associated probabilities that are as close as possible to the underlying values.

The investment in climate information services is based on the premise that the production of reliable science based information about uncertain events can help end users make more informed decisions, that is, decisions that are most likely to generate their desired outcome (e.g., higher crop production) given the predictions. For instance, correct and timely CIS are considered essential for food producers in the Sahel – including farmers, fishers and livestock holders – in order to strategically plan activities as to minimize climate change impact and maximize production.

At their basic core, CIS share a common premise, that there exists a defined and linear relationship between predictions of uncertain events and decisions taken by actors (Figure 2). The depicted model also implies a number of assumptions about the objectivity of science based knowledge; the possibility of clearly conveying that information, and the rationality of actors who receive the information.

The sense of urgency attached to the need to act now in the face of the threats from climate change (IPCC 2014) can possibly account for the high expectations placed on climate information provisioning. Once the scientific community finally agreed that climate change was real and was already affecting many aspects of life, especially in high risk areas such as the African Sahel (Parry et al. 2007; UNEP 2011; Diffenbaugh and Giorgi 2012; and IPCC 2014), much of the policy efforts was then oriented towards reinforcing the climate messaging and assisting individuals and communities in these high risk areas to adapt. It has been natural to presume that, if that information is appropriately conveyed, rational

¹ The terms risk and uncertainty both imply lack of knowledge about a given outcome but there is a main difference: in situations with risk, one knows the probability distribution of outcomes, while with uncertainty one does not know the possible outcomes nor their probability distribution.

agents would then respond by changing behavior in ways that adapt livelihood practices and mitigate the impact of these events. Adaptation policy assessments aim thus to turn non-adaptive farmers into 'smart' ones (Füssell and Klein, 2006), for instance, encouraging them to adopt drought-resistant crops and seeds and to develop locally appropriate irrigation solutions; or livestock holders to alter herding corridors, diversify income sources, and utilize new drought-hardy species of livestock.

Figure 2. Linear Relationship often assumed to be representative of the generation and transmission of information



If behavioral change consistent with scientific knowledge does not take place, it is mostly assumed that this is because scientific information is not appropriately delivered to end-users and information services are inadequate (the third node in Figure 2). In the case of developing countries, this is often attributed to lack of resources and biased policy priorities at national or local level, which lead to underinvestment in public goods' provision, such as climate information services. It is to address this gap that experts and development partners have intensified their calls for the need to reinforce extension services in rural Africa, and scale up knowledge and information campaigns that sensitize the public about climate change.

Recent research has shown that these assumptions may be too simplistic. To be clear, investment in climate information services is an essential public good, and represents a key policy priority. There is indeed an underinvestment in information provision in many countries, especially those in the African Sahel, and at all levels (not only regarding climate change), suggesting that the returns from scaling up information campaigns and extension services are probably very high. However, this by itself will not suffice.

There are substantial limits to adaptation, which include not only biophysical and technological factors, but also cognitive, behavioral, social and cultural factors (IPCC, 2014). Social and cultural factors, including political affiliation (Hamilton, 2011; McCright and Dunlap, 2011) and educational attainment (McCright and Dunlap, 2011), can influence the degree of confidence that individuals place on different information sources, as well as the distribution of vulnerability and adaptive capacity among different individuals and groups. Social and cultural factors combine with psychological traits in affecting people's values, worldviews, and cultural norms and behaviors (O'Brien, 2009; Moser and Ekstrom, 2010; O'Brien and Wolf, 2010; Hartzell-Nichols, 2011), in turn influencing their perceptions of risk as well as evaluation of adaptation options. Several studies from Africa explicitly explore the influence of some of these elements in driving awareness, uptake, and use of adaptation technologies for agriculture (Nhemachena and Hassan, 2007; Hassan and Nhemachena, 2008; Deressa et al., 2009, 2011).

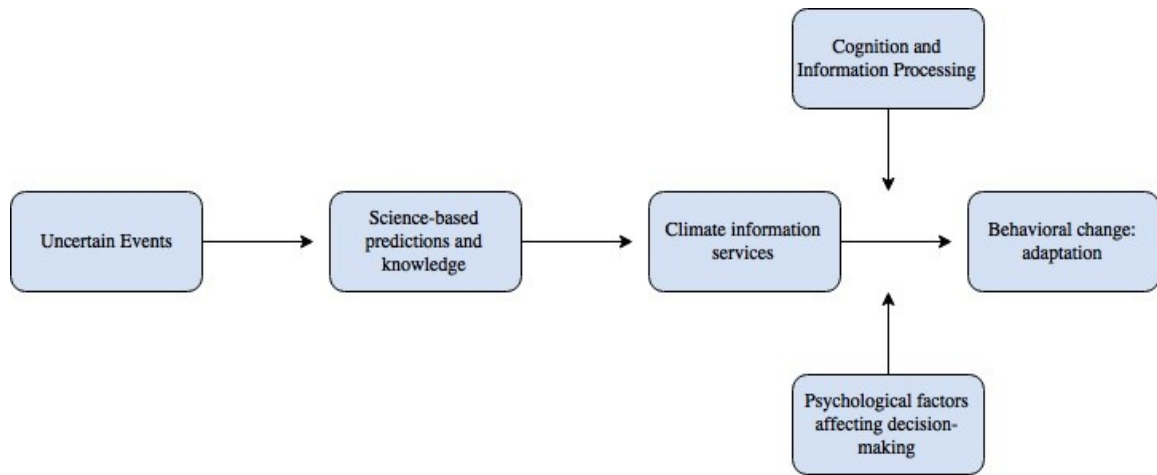
This evidence suggests that addressing knowledge deficits may not necessarily lead to adaptive responses. Indeed, recent models of adaptation to climate change have recognized some of these complexities. Second-generation vulnerability assessments thus "acknowledge that it is not the mere availability of adaptation options but the capacity of

people to actually implement these options that determines their vulnerability to climate change” (Füssell and Klein, 2006: 319) and that adaptive capacity includes both climatic and nonPclimatic factors. “Improved” adaptation policy assessments recognize that effective implementation of adaptation strategies require interventions beyond the provision of scientific information and data collection, to include facilitation through awareness raising and capacity building (Füssell and Klein,2006).

Psychological factors are known to play a large role in shaping individuals’ perceptions of risks, including climate change (Leiserowitz, 2004; 2006; Norgaard, 2009). In 2011, the American Psychological Association devoted an entire issue of its leading journal to address the psychological dimensions of climate change, and analyze the links between climate mitigation and adaptation, on the one hand, and cognitive, affective and motivational responses and processes on the other hand.²

When it comes to the applied policy debate, however, there seems to be insufficient discussion about the influence of psychological factors, as distinct from social and cultural ones, in affecting behavioral change. Interventions on the ground thus may lack the resources to try and activate the link between information and behavioral change, and investigate more closely the challenges to behavioral uptake that come from mental and emotional factors. By incorporating insights from behavioral and experimental studies, we propose a more expanded model for use in policyPmaking than the one in Figure 2, which recognizes the role of psychological factors, at least at two levels (see Figure 3).

Figure 3. The role of psychological factors in the relationship between information and behavior change



The first pertains to cognitive processes, that is, with **how people receive and process the information**. Field experiments and other empirical psychological methods have demonstrated that the average individual is far more irrational than what previous models had assumed; and filters information in ways that dramatically depart from the predictions based on the *homo economics* model (Mullainathan and Thaler 2001; Cardenas and Carpenter 2008). Behavioral studies have shown that as humans, we are subject to emotions when making decisions, even while using rational tools, so that the way a piece of information is “framed” influence the way it is received and acted upon (World Bank, 2015).

² See Swim et al (2011) for the introductory article to the special issue of the American Psychologist.

Individuals are also affected by what people in their social networks believe and do. If some information appears to require actions that are contrary to one's group interests or to favor the interests of a group that is perceived to be inimical, then people filter the information in ways that only reinforce their initial hypotheses. In other words, more information does not necessarily lead to a change in behavior. This speaks to the force of ideology and of cognitive illusions, which are implicit and often unconscious assumptions that individuals make about complex realities around them (World Bank, 2015).

Among the reasons why people may not fully process a given piece of information available to them is the coexistence of multiple sources of knowledge. Besides 'scientific knowledge', other sources of knowledge exist which individuals and communities utilize in order to make sense of the complex world around them. In the context of climate change, the most relevant is probably locally owned knowledge or what is called often "indigenous knowledge". This comes through many channels and conduits (traditional leaders, oral traditions, folk tales, diviners, etc.) and involves several bodies of knowledge, including spiritual and religious. It plays an important role in the way individuals and communities see and interpret the environment around them. It has also been proven that ignoring this kind of knowledge is counterproductive; while integrating this into the process of climate information service may lead to better incorporation of relevant information into actual decision making and practices.

The second and important level at which psychological factors can exercise their influence is on **how people act upon the information received** (Fig. 3). Behavioral change is known to suffer from inertia at all levels, even when the information about the need to change and adapt has been apparently absorbed and understood. This is true in many domains, including public health, where individuals are expected to make choices that are beneficial to them and their communities. In the domain of climate adaptation strategies, inertia has been noted at the level of the environment, implying that increases in temperatures are likely to occur even after sustainable practices are put in place; and of technology and infrastructure, which are costly and slow to replace. Inertia is also at the level of individuals and communities, and is due to technological, institutional and financial constraints that prevent actors from responding quickly to the flow of new information (World Bank, 2015, Ch. 9). Examples include lack of access to credit or family labor (due to migration for instance), which may make some desired adaptations strategies too costly to implement.

However, there is another type of inertia, which has received less attention in the CIS domain, which derives from psychological factors creating hurdles that inhibit behavioral change. Evidence from studies in many developing countries show that when people are poor and have been afflicted by many episodes of hardship and failures, they may feel overly pessimistic about their future options. In turn, this leads them to underestimate their options to save and invest, and not see the point of it – in the language of economics, they tend to heavily discount potential distant benefits and instead give more weight to small but immediate rewards (Banerjee and Duflo, 2011, Ch. 6). There is no reason to suppose these concerns do not affect other types of behavior, such as those in the realm of adaptation strategies. If so, the obstacles to adoption may appear at times more psychological than technological or even financial. This does not make these instances easier to tackle, however, since these constraints are no less real to people, whose life circumstances have imbued them with a sense of hopelessness about their future options, and led them to believe that adopting a short-term horizon may serve them better overall.

Overlooking mental frames and emotions as minor issues may be very consequential. It is tempting to believe that psychological factors are due to stickiness, which time can help to

dissipate, and that people are just used to their ways of life and acting. It is really more than that. People who are poor and have experienced institutions that have failed them in the past may need a good dose of extra incentives to convince them to implement actions that, though beneficial in the long term, do not appear feasible nor attractive in the short term.

While scant empirical evidence exists on how psychological factors may affect climate adaptation initiatives, they appear to resonate with what Tschaket (2007) noted in her study in central Senegal, which she identified as “generic vulnerability”, manifested in “...weakened disposition of its people, stressed by sickness, scant income-generating sources, and the utterly poor conditions of their village infrastructure” (p. 393). The author notes that: “Compared to this pervasive manifestation of social vulnerability, climate extremes appear to be a minor hazard” (p.393), which can be interpreted as evidence of how mental attitudes due to overall difficult life conditions may reduce people’s appreciation of climate risks, diminishing the incentive to act. In these circumstances, it appears obvious that only focusing on refining the climate information messaging is destined to have limited impact. Not surprisingly, the author goes on to suggest that livelihood enhancement initiatives that directly reflect people’s views and tackle identified conditions of their risks and responses may be both more urgent and more effective than narrow solutions targeted at adapting to specific climate events.

In the Kaffrine context studied in this paper, individuals who receive the information from the ANACIM services process it together with other sources of information, and filter it in ways that make sense to them, in their current mindset and mental frame. This can explain the apparent puzzling evidence that, while respondents state in qualitative interviews that the climate messages are relevant and interesting, at the same time they rely for all practical purposes on other information sources. Traditional sources of knowledge and neighbors are characterized by a language, format and content that better fit people’s values and shared social norms.

The Kaffrine case study suggests that information that is at odds with known mental models, and that cannot be shared within social networks, is more difficult to act upon, because there are no examples in the community, nor ways to derive lessons easily. There are no major differences by gender in this respect. Both men and women seem to relate better to locally grounded and socially shared channels than to radio and extension services.

4. Concluding reflections and policy implications

Conveying climate information to farmers and livestock holders and ensuring that climate information is translated into sustainable practices is fraught by challenges operating at different scales and impinging several development domains at once (livelihood, health, social relationship, etc). This paper reviews preliminary evidence from Kaffrine region of Senegal, which has witnessed a substantial effort to provide quality coverage of CIS to the whole region. The data analysis indicates that while most respondents receive radio messages about weather and climate predictions, only a tiny minority relies on those messages in their decisions to adopt climate smart practices.

By incorporating insights from behavioral and experimental studies, the paper proposes a framework that emphasizes the role of mental frames and emotions in accounting for how people process the information and act upon that information to make choices. Our paper identifies two ways in which psychological factors may constrain the adoption of CSA practices.

First, it is possible that information delivered is not appropriately framed (people respond differently according to how information is presented and whether it appears to conflict with existing values and social norms), or that it is too detailed and complex, or alternatively too vague for people to consider it seriously. If this is the case, delivering more of the same information may not bring about the desired change. Taking into account people's cognitive processes and thus understanding how people in a given context are likely to receive and process that information is absolutely essential for CIS to be effective. This set of problems thus leads to our first policy recommendation, which is to **pay attention to the design of CIS, to make them more relevant to people's mental frames, and more in line with their ideology and social norms.** For instance, if the radio is to remain the main channel for climate communication in Senegal, it is imperative to increase the appeal and demand for programming that innovatively and effectively conveys the information. A possibility would be to adopt a format of a radio drama program, which portrays scenes from rural life and where recognized actors feature farmers and livestock holders interacting and discussing of their own problems as in real life.

Second, there may be complicating factors at the level of decision making and action implementation. Even when people have a good understanding of risks involved in a certain climate scenarios and a theoretical understanding of desirable actions, they may not be able to put them in place. This is due not only to technical difficulties and financial costs and risks, but also to the possible psychological consequences (including fear of social disapproval). Our second recommendation is thus to **make it easy for individuals to implement desired set of actions not only by reducing the technical costs of implementation and lowering the financial risks, but also by enhancing the psychological and social acceptability of certain practices and by aligning them with existing social norms.** This might be accomplished through a social marketing campaign that focused on normalizing language around climate change, adaptation, and resilience. Priming the population so that they are ready to receive the messages is as important as making sure the messages are available.

The findings that individuals and groups do not always make rational choices, which has been common assumption in much of economics and mainstream development thinking, clearly complicates the relationship between information source and behavioral change and leads to the more complex diagram in Figure 3.

While much attention has focused on improving the quantity and quality of CIS, one should equally invest resources and efforts in tackling the complex domain of individual and collective perception of information, and consequent behavioral change. Interventions could build on the experiences of social marketing in the field of public health (Kotler and Zaltman, 1971; Serrat, 2010), or use the idea of institutional nudges proposed by Banerjee and Duflo (2010) in the realm of broader development interventions. Ultimately, behavioral change needs to be primed and accommodated by innovative features that encourage users to adopt certain practices, normalize the message around them and make them more appealing.

REFERENCES

- Banerjee, Abhijit and Sendhil Mullainathan. 2010. "The Shape of Temptation: Implications for the Economic Lives of the Poor." NBER Working Papers 15973.
- Banerjee, A. and Duflo, E., 2011. *Poor economics: A radical rethinking of the way to fight global poverty*. PublicAffairs.
- Cardenas, JC and J Carpenter. 2008. "Behavioural Development Economics: Lessons from field labs in the Developing World" *Journal of Development Studies*, 44 (3): 311P338.
- CCAFS. 2015. The impact of Climate Information Services in Senegal. CCAFS Outcome Study No. 3. Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).
- Deressa, T.T., R.M. Hassan, C. Ringler, T. Alemu, and M. Yesuf, 2009. "Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia." *Global Environmental Change*, 19(2), 248P 255.
- Deressa, T.T., R.M. Hassan, and C. Ringler, 2011. "Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia." *Journal of Agricultural Science*, 149, 23P31.
- Devereux, T. and McKune, S. 2014. "Gender, power and climate information in Nyando, Kenya". *Climate Change, Agriculture, and Food Security*. CGIAR. 1 Aug 2014. Web.
- Dow, K., F. Berkhout, B.L. Preston, R.J.T. Klein, G. Midgley, and R. Shaw, 2013b. "Limits to adaptation" *Nature Climate Change*, 3, 305P307.
- Diffenbaugh, N.S. and F. Giorgi, 2012. "Climate change hotspots in the CMIP5 global climate model ensemble" *Climatic Change*, 114(3P4), 813P822.
- Füssell, H.M. and Klein, R. J. T. 2002. "Vulnerability and Adaptation Assessments to Climate Change: An Evolution of Conceptual Thinking", in UNDP Expert Group Meeting "Integrating Disaster Reduction and Adaptation to Climate Change", Havana, Cuba.
- Füssell, H.M. and R.J.T. Klein (2006) "Climate change vulnerability assessment: An evolution of conceptual thinking" *Climate Change*, 75: 301P329.
- Hamilton, L.C., 2011. "Education, politics and opinions about climate change evidence for interaction effects." *Climatic Change*, 104(2), 231P242.
- HartzellPNichols, L., 2011. "Responsibility for meeting the costs of adaptation." *Wiley Interdisciplinary Reviews: Climate Change*, 2(5), 687P700.
- Hassan, R. and C. Nhemachena, 2008. "Determinants of African farmers' strategies for adapting to climate change: multinomial choice analysis." *African Journal of Agricultural and Resource Economics*, 2(1), 83P104.
- IPCC (Intergovernmental Panel on Climate Change). 2014. Climate change 2014: Impacts, adaptation, and vulnerability. Contribution of Working Group II to the Fifth

- Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press.
- Jay. A. 2014. How can we turn climate information into action? Copenhagen: CCAFS. Available at: <http://bit.ly/10340u9>
- Jones, R.N. and Preston, B.L., 2011. Adaptation and risk management. *Wiley Interdisciplinary Reviews: Climate Change*, 2(2), pp.296P308.
- Kotler, P. and Zaltman, P. 1971. "Social Marketing: An Approach to Planned Social Change" *Journal of Marketing*. Vol. 35, No. 3 pp. 3P12.
- Kristjanson P, Garlick C, Ochieng S, Förch W, Thornton PK. 2011. Global Summary of Baseline Household Survey Results. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen: Denmark.
- Leiserowitz, Anthony A. 2004. "Day after Tomorrow: Study of Climate Change Risk Perception." *Environment: Science and Policy for Sustainable Development* 46 (9): 22–39.
- Leiserowitz, Anthony A. 2006. "Climate Change Risk Perception and Policy Preferences: The Role of Affect, Imagery, and Values." *Climatic Change* 77: 45–72.
- Lo HM and Dieng M. 2015. Impact assessment of communicating seasonal climate forecasts in Kaffrine, Diourbel, Louga, Thies and Fatick (niakhar) regions in Senegal. CCAFS.
- McCright, A. M. and R.E. Dunlap, 2011. "The politicization of climate change and polarization in the American public's views of global warming, 2001–2010." *The Sociological Quarterly*, 52(2), 155P194.
- McKune, S. and McOmber, C. 2013. "Is gender being considered within climate services?" *Climate Change, Agriculture, and Food Security*. CGIAR. 24th April 2013. Web. 29 April 2013.
- McKune, S., Poulsen, L., Devereux, T., Russo, S., Faas, S., McOmber, and C. Ryley, T. 2016. "Reaching the end goal: Do interventions to improve climate information services lead to greater food security?" *Climate Risk Management, Forthcoming*.
- McOmber, C., Panikowski, A., McKune, S., Bartels, W., Russo, S. 2013. Investigating Climate Information Services through a Gendered Lens. CCAFS Working Paper no. 42. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark.
- Moser, S.C. and J.A. Ekstrom, 2010. "A framework to diagnose barriers to climate change adaptation." *Proceedings of the National Academy of Sciences of the United States of America*, 107(51), 22026P22031.
- Mullainathan, S. and Thaler, R. 2001. "Behavioral Economics." *International Encyclopedia of Social Sciences*. Pergamon Press (1st ed.): 1094P1100.
- Ndiaye O, Moussa A, Seck M, Zougmore R and Hansen J. 2013. Communicating seasonal forecasts to farmers in Kaffrine, Senegal for better agricultural management. In: Hunger – Nutrition – Climate Justice 2013. A New Dialogue: Putting People at the Heart of Global Development.

- Ndiaye, O., Zougmore, R., Hansen, J., Diongue, A., Seck, E.M. 2012. Using probabilistic seasonal forecasting to improve farmers' decision in Kaffrine, Senegal. *Risk Management: Current Issues and Challenges*, 497P504, 21. doi: 10.5772/2568.
- Nhemachena, C. and R. Hassan, 2007. "Micro-Level Analysis of Farmers' Adaptation to Climate Change in Southern Africa." IFPRI Discussion Paper No. 00714. International Food Policy Research Institute, Washington, DC, USA.
- Norgaard, Kari Marie. 2009. "Cognitive and Behavioral Challenges in Responding to Climate Change." Policy Research Working Paper 4940, World Bank, Washington, DC.
- O'Brien, K., 2009: Do values subjectively define the limits to climate change adaptation? In: *Adapting to Climate Change: Thresholds, Values, Governance*. [Adger, N.W., I. Lorenzoni, and K. O'Brien (eds.)]. Cambridge University Press, Cambridge, UK, pp. 164P180.
- O'Brien, K.L. and J. Wolf, 2010: A values-based approach to vulnerability and adaptation to climate change. *Wiley Interdisciplinary Reviews: Climate Change*, 1(2), 232P242.
- OECD (2014). *An Atlas of the Sahara-Sahel: Geography, Economics and Security*, West African Studies, OECD Publishing, Paris.
- Parry, M.L., O. F. Canziani, J. P. Palutikof, P. J. van der Linden, and C.E.Hanson, IPCC Fourth Assessment Report: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, U.K.: Cambridge Univ., 2007.
- Poulsen E, M. Sakho, S. McKune, S. Russo and O. Ndiaye. 2015. Exploring synergies between health and climate services: Assessing the feasibility of providing climate information to women farmers through health posts in Kaffrine, Senegal. CCAFS Working Paper no. 131. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).
- Ryley, T. and McKune S. 2014. "Climate change and social networks in Senegal's peanut basin". *Climate Change, Agriculture, and Food Security*. CGIAR. 2 Oct 2014. Web.
- Serrat, Olivier. 2010. *Future of Social Marketing*. Asian Development Bank. <http://hdl.handle.net/11540/566>. License: CC BY 3.0 IGO.
- Swim, Janet K.; Stern, Paul C.; Doherty, Thomas J.; Clayton, Susan; Reser, Joseph P.; Weber, Elke U.; Gifford, Robert; Howard, George S. 2011. "Psychology's contributions to understanding and addressing global climate change". *American Psychologist*, 66(4): 241P250.
- Tall, A., P. Kristjanson, M. Chaudhury, S. McKune and R. Zougmore, 2014. Who gets the Information? Gender, power and equity considerations in the design of climate services for farmers. CCAFS Working Paper No. 89. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark.
- Tschakert, P. (2007) "Views from the vulnerable: understanding climatic and other stressors in the Sahel" *Global Environmental Change*, 17 (3P4): 381P396.

United Nations Environment Program, *Livelihood Security: Climate Change, Migration and Conflict in the Sahel*, Nairobi, Kenya, 2011.

World Bank (2015) *World Development Report: Mind, Society and Behavior*, Washington DC: The World Bank.