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Juliette Alenda-Demoutiez

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## Climate change literacy in Africa: the main role of experiences

Juliette Alenda-Demoutiez 

Department of Economics, Radboud University, Nijmegen, The Netherlands

### ABSTRACT

Climate change, one of the major challenges of our time, requires international responses. This paper focuses on understanding what shapes climate change literacy in Africa, i.e. the understanding and knowledge about all the elements of climate change: its causes, its consequences and its solutions. The methodology is based on the seventh round of the Afrobarometer surveys, which for the first time included questions about climate change. The results show in particular the central role of direct experience of the connected understanding between the different aspects of literacy and the complexity of the impact of identity and trust in institutions. All these elements should be key to motivate governments in responding to climate change challenges.

### KEYWORDS

Literacy; climate; Africa; Afrobarometer; perception; policy

### Introduction

Climate change, one of the major challenges of our time, requires international responses. The growing visibility of climate change in the media or in actual climatic events around the world has raised awareness of climate change everywhere. A survey conducted in 2020 among European and American countries showed that an overwhelming proportion of respondents are aware that the climate is changing [1]. Considering of course variations among countries, in Africa, a majority of citizens are also aware about climate change, as 58% of the respondents in the round 7 of Afrobarometer surveys declared they were familiar with the concept [2]. This awareness is the first step towards the development of knowledge about climate change. In order to achieve SDG 13 and to answer to the urgency of the situation, climate change literacy is a vital element to draw strategies, conduct policies and change behaviours [3]. Increasing climate change literacy is a key to motivate populations and governments to engage in the fight against climate change. Bewket [4] or Ullah et al. [5] noted the importance of experiencing and understanding the impacts of climate change and the relation to adequate adaptation strategies.

In Southern Africa, it has been shown that smallholder farmers are coping based on their own perception of climate variability [6]. Drawing on Johnston [7] and Selormey et al. [2], the current paper defines climate change literacy as the knowledge or ability to understand climate change in its cause, impacts and solutions. It is a path to follow from step to step. Starting from awareness, it is then about understanding the human role in

**CONTACT** Juliette Alenda-Demoutiez  [juliette.alenda-demoutiez@ru.nl](mailto:juliette.alenda-demoutiez@ru.nl)  Department of Economics, Radboud University, Heyendaalseweg 141, Nijmegen 6525, The Netherlands

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causing climate change, the negative consequences, and, from here, the perceived efficacy of acting against it. Literacy is thus about a complete view of the matter, going from developing knowledge to giving individuals a sense of necessity to act.

What factors shape this literacy among African citizens? Africa is experiencing a paradox in the face of climate change. It is the continent that contributes the least to greenhouse gas emissions, but it is also the one that is experiencing the hardest consequences in the short and medium term. Moreover, agricultural production remains the main source of income for rural communities, and this is highly influenced by climate change. The vulnerabilities of African populations are at the same time climatic, political, economic and social. More and more studies examine awareness, knowledge and perception of African citizens and the strategies adopted in consequences [8]. There is a need for synthesis, as cross-country analysis is missing. In Africa as elsewhere, policymakers need to include people at the grassroots level in the decision-making process of programmes designed to minimise the effects of climate change on human development [9]. As a particular focus in the literature has been the role of international organisations in shaping climate discourses and interventions in development, understanding the perception of the grassroots levels is even more important [10].

Using the seventh round of the Afrobarometer survey, the first one to give a larger picture of climate change understanding on the continent, this paper aims to understand the factors shaping the literacy of climate change in Africa. The following sections draw on existing studies to establish what could be the main determinants of this literacy. The statistical analysis is realised based on different groups of factors, as experience, socio-cultural and socioeconomic possible explanators shaping climate change literacy. In particular, the focus is on the central role of direct experience, of the connected understanding between climate change causes, consequences and solutions, and the contrasted results in terms of identity and trust in institutions. Finally, these results are discussed in the light of African policies.

## The path to climate change literacy

The literature in social sciences first engaged with the topic of the direct impact of climate change, then on mitigation, before exploring adaptation and perception, beginning with western countries [11]. The development of behavioural economics also accompanied this movement. Africa's perceptions of climate change are as varied as its climate [2]. The public has been found to use a multidimensional and complex set of assessments in their perception and interpretation of the dangerousness of climate change, with psychological, social, moral, institutional, and cultural dimensions [12]. Three main groups of factors that may impact climate change literacy (thus understanding climate change in its cause, consequences and solutions) emerged from the literature review. As the present study is one of the first exploring this effect at a large scale in Africa, the direction between the possible predictors and an increased literacy of climate change are not clear. Thus, there is a need for such a cross-country analysis.

The first group of possible explanators to go from awareness to literacy is information. This information may be accessed by two means: direct information, when people actually experience the consequences of climate change, and indirect information, when people hear about it from the news. Based on four projects in African countries,

Steynor and Pasquani [13] showed the importance of psychological proximity and the resulting differences in the perception of risk arising from climate change. This proximity may be defined by the geography, when climatic events occur closely around individuals, or by social networks, when such events impact people around us, implying an emotional perspective. In the last Afrobarometer round, 49% of respondent declared that the climate conditions for agricultural production have become worse over the past 10 years [2]. The personal experience of extreme weather events emerges as an important determinant of this psychological distance. Therefore, personal experience could have an important influence on climate change's literacy [14]. Different micro-studies among farmers in Africa have shown the connection between experiencing change, conversing about it with other farmers, and analysing the consequences of climate change as negative [15,16]. The understanding of the impact of climate change through experience is also connected to different action strategies in return [17], indicating this supposed connection between the different levels of literacy. On the side of indirect information, the amount of information about climate change available for the public has increased significantly [18]. Education and information about climate change may thus play a role in increasing the literacy among citizens [19,20]. Different researches have shown the varied impacts of learning about climate change through personal experience and through statistical description of possible outcomes and likelihood, leading to very different perceptions and actions [21]. In Ghana, Teye et al. [22] showed the impact of owning a radio on the perception of climate change.

The second group of factors is related to norms and values among citizens. In western countries, cultural norms and values are important drivers of perception and knowledge of climate change, as well as ideological polarisation [21]. Cultural norms and values affect the ways individuals experience climatic events, interpret how climate change will manifest, and what are the risks that climate change will carry [23]. Culture, in the anthropological sense, refers to a set of values, beliefs, practices and techniques supporting a certain representation of the world. Therefore, the values resulting from this culture are strong. They shape reality and are sustainable. Individuals are socially situated, i.e. they are influenced by norms, by their belonging to a particular group and by their environment, in a radically uncertain world, which makes it impossible to grasp all the possibilities and situations.

Social relationships are important for transferring knowledge, for cooperation towards environmental sustainability, for formulating public policies, through social networks [24]. Based on a multi-ethnic assessment in Benin, Sanchez et al. [25] showed that ethnicity plays a role in this perception. They explained that several ethnic groups reported differently the effects they observed resulting from climate change. They also used different adaptation strategies according to their own perception derived from these observations. The role of trust is again important here [18], as it has been shown that institutional trust is an important factor explaining diverse interpretations of risks, and of the support (or opposition) to certain policy choices. Consequently, the role of identity, culture and trust in different institutions may be important factors explaining diverse understandings of climate change; these effects being potentially even stronger in Africa [25–27].

The final group is about socio-economic factors, as shown by diverse studies, but the literature reveals cross-country nuances [28–30]. In western countries again, many works show the influence of socio-demographic aspects, especially gender and age, and the

understanding of risks related to climate change is higher among females and younger people [13]. In Africa, e.g. Ghana, gender roles also seem to play an important role, in terms of perception of climate change and on the adaptive strategies adopted by men and women [31,32]. But contrasted studies exist [33]. The role of education is more nuanced. Some studies show that people with higher socio-economic status and education may have more confidence in the future and the possibilities to cope with climate change [34], when other studies show the opposite [35]. Different aspects, as education, geographical situation, gender, age or the status of the household, may impact interpretation of climate change and thus climate change literacy. Education in particular has been shown to play an important role in the comprehension and necessity to undertake adaptation strategies among African farmers [15].

## Methodology

The methodology consists of several nominal logistic regressions,<sup>1</sup> based on the Afrobarometer surveys [36]. The data from the seventh round have been published in 2019, and incorporate, for the first time, specific questions about climate change. This round results from 45,823 interviews in 34 countries between September 2016 and September 2018<sup>2</sup> (more details in appendix 1). Two first considerations were taken into account: Zimbabwe is eliminated from the data, as questions about climate change were not asked; and, focusing on climate change literacy, the survey selected individuals who answered 'yes' to the question 'have you heard about climate change', thus who have already passed the first step of awareness. Descriptive statistics are available in appendix 2.<sup>3</sup>

### *Three dependent variables to cover climate change literacy*

Three questions in particular are relevant to understand the perception of climate change, leading to three distinctives models. [Table 1](#) shows the questions used.

Q74 is transformed into a dichotomous variable on the causes of climate change, considering on one side that human causes are important and on the other that they are not. Q75 is reworked into a nominal variable with three possibilities: 'it is making life better', 'it is the same', 'It is making life worse'. For this specific variable, Kenya had to be excluded as this question has not been asked in this country. Q76 is compressed in a scale with three categories: 'No', 'Yes, but ordinary citizen cannot do anything', 'Yes, and citizen should participate'. It was intended to gauge the understanding of respondents about their own behaviours too. These three dependent variables thus cover the definition of literacy established in the introduction. It is about the knowledge of the causes of climate change (Q74), its consequences (Q75) and its solutions (Q76). For the third model, about the perceived efficacy to act, Q74 and Q75 are included as possible predictors. As stated earlier in the paper, literacy is considered as a path: if individuals display literacy about the causes and consequences of climate change, they may also understand the role everyone can have in acting against climate change and thus the perceived efficacy of action.

The choice of nominal logistic regressions is made for consistency reasons, as dependent variables are nominal/very small scale. An ordinal regression was not correct as these scales were not respecting proportional odds, and the distance between each scale is

**Table 1.** Questions used to build the dependent variables.

Question	Possible answers
Q74: People have different ideas about what causes climate change. What about you, which of the following do you think is the main cause of climate change, or haven't you heard enough to say?	<ul style="list-style-type: none"> <li>● Human Activity, like burning fuel and other activities that pollute the atmosphere</li> <li>● Natural processes</li> <li>● Both human activity and natural processes</li> <li>● None of these</li> <li>● Don't know/Haven't heard enough</li> </ul>
Q75: Do you think climate change is making life in [country] better or worse, or haven't you heard enough to say?	<ul style="list-style-type: none"> <li>● Much better</li> <li>● Somewhat better</li> <li>● Neither/no change/about the same</li> <li>● Somewhat worse</li> <li>● Much worse</li> <li>● Don't know/Haven't heard enough</li> </ul>
Q76: Do you think that climate change needs to be stopped? [If yes] How much do you think that ordinary Ghanaians can do to stop climate change?	<ul style="list-style-type: none"> <li>● No, climate change doesn't need to be stopped</li> <li>● Yes</li> <li>● Ordinary Ghanaians can do nothing at all</li> <li>● Ordinary Ghanaians can do a little bit</li> <li>● Ordinary Ghanaians can do a lot</li> <li>● Don't know</li> </ul>

Source: Afrobarometer, round 7, 2016–218.

indeed not the same: the difference of perception is important between considering that life will be worse or better, or that ordinary citizens should be involved or not in the fight against climate change. Nominal ordinal regressions would lead to a better understanding of these differences, as the literature in climate change perceptions generally shows [29].

### *Independent variables*

Four variables are proxy for respondents' experience and information on climate change. Three of them account for direct experience: one is about respondent's opinion on the evolution of agricultural conditions in the past ten years; the other two consider experiences of more or less droughts or flooding over time that are not only related to agricultural conditions. This way, the survey may cover not only the entire population, and not only African citizens working in this specific sector. The frequency of media exposure, in order to understand indirect experience, is a scale computed from five variables in the survey,<sup>4</sup> including radio, television, newspaper, social media and internet.

To study norms and values, firstly, the study reviews the variables used to gauge the identity of respondents and their place in their own communities. Religion is proxied by the religion of respondents themselves, by the importance this religion occupies in their life and their preference between religious or civil law for their country and by their active participation (or not) to a religious group. Combining these three variables helps to understand the impact of the religion on their knowledge of climate change, as the importance that religion is taking in their life and the shared identity with other members of this religion. For the religion itself, dummies were created for Christians and Muslims, as, according to the same Afrobarometer survey, they are the two largely dominant religions on the continent. Since the participation in community is not always religious, two variables are included to measure the role played by respondents in different

communities and the resulting shared identity, whether an active member of a community-based group, or participating actively in community-based activities. Finally, there is a variable measuring the ethnic identity.

The second part of this group of factors was about trust and the relation with institutions. Considering formal and informal institutions, the research includes data to measure trust in traditional institutions (using a variable combining trust in traditional and religious leaders) and trust in legal institutions (combining trust in the President, the Parliament and the local government). As in different countries, relationships between citizens and politics may also play a role. Thus, to complement the relation between citizens and political institutions, there are variables about the relation with a political party; political discussions with friends or family; and the active participation in political activities.

The last group, about socio-economic and demographic factors, includes first the localisation of the respondents, the African region where they live, as the changes in weather are far from being homogenous on the continent. The difference between rural and urban areas may also be important in this perspective, especially in the observation of certain climatic events. There is a variable indicating if respondents have lived outside their country for a period of time, also considering that they may have been confronted by other visions of climate change and cultures. As in other literature, age, gender, form of the household and indications on the socio-economic status are present.

## **Results: direct experience, geography, education and contrasted institutional effects**

Descriptive statistics already indicate some positive insights about climate change literacy (Appendix 2). A majority of respondents present knowledge about the human causation of climate change, the fact that life will be worsened with climate change in their country and the perceived efficacy to act in general. In [Table 2](#), the results of the three models are displayed.

The role of experience and information is confirmed. Observing a change in agricultural conditions or in the severity of floods and droughts in general is increasing the understanding of the human causation of climate change, as well as media exposure. What is interesting to note is the fact that observing better agricultural conditions is actually decreasing the odds of understanding this human causation. Having experienced both worse and better conditions also increases the odds in estimating that climate will change life in the country, for the worse or the better, compared to no change at all. The odds are 4 times greater to think that the situation will get worse if you experience worse agricultural conditions already, when the odds are almost 4 times higher also in the opposite direction. Outside of agriculture, experiencing climatic events as droughts and floods contributes to thinking that the situation will evolve in the future. Even with small variations, the less severe people think droughts are, the less they think that the future will also evolve. But, observing that flooding got less severe in the past ten years increases the odds of thinking there will be changes in the future, in the two directions. Interestingly, the more you are exposed to the media, the less you are actually thinking that the situation will change, also in both directions. The experience coming from observing agricultural conditions is finally directly linked to the perceived efficacy of

Table 2. Perceptions of climate change.

	Model 1: human causation in climate change		Model 2a: better situation in the future (compared to the same)		Model 2b: worse situation in the future (compared to the same)		Model 3a: yes, we must fight, but ordinary people cannot do much (compared to no need to fight)		Model 3b: everybody must fight (compared to no need to fight)	
	Odds ratio	S.E.	Odds ratio	S.E.	Odds ratio	S.E.	Odds ratio	S.E.	Odds ratio	S.E.
<i>Experience and information</i>										
worseagriconditions	1.17**	0.05	1.53***	0.09	4.18***	0.07	1.46***	0.07	1.24***	0.06
betteragriconditions	0.79***	0.06	3.75***	0.09	1.91***	0.08	0.81**	0.08	0.77***	0.07
Q72a. Severity of droughts	0.91***	0.01	0.99	0.03	0.80***	0.03	1	0.02	0.96*	0.02
Q72b. Severity of flooding	0.97*	0.01	1.06*	0.03	1.06*	0.02	1.02	0.02	1.02	0.02
mediaexp	1.17***	0.02	0.87***	0.04	0.89***	0.03	1.01	0.03	1.08**	0.03
Q75 mediate. Climate change: affecting country causecc							1.42***	0.02	1.60***	0.02
							1.57***	0.06	4.45***	0.05
<i>Norms and values</i>										
membrelgroup	0.92	0.04	1.14	0.08	0.97	0.07	0.86*	0.06	0.96	0.05
religiouslaw	0.79***	0.04	1.15	0.08	1	0.07	0.91	0.06	0.79***	0.05
christian	1.05	0.06	1.21	0.11	1.23*	0.1	0.9	0.09	0.98	0.08
muslim	0.93	0.07	1.08	0.13	1.13	0.12	1.11	0.1	1.28**	0.09
membcomgroup	0.99	0.05	1.38***	0.09	1.28**	0.09	0.86*	0.07	0.89*	0.06
participationcommunity	1.10***	0.02	0.97	0.03	1.07*	0.03	1.07**	0.03	1.06**	0.02
ethnicidentity	0.94	0.04	0.94	0.07	1.01	0.06	0.91	0.06	0.95	0.05
trusttradi	1.04	0.02	0.91*	0.04	0.97	0.04	1.15***	0.03	1.14***	0.03
institutionaltrust	0.86***	0.02	1.19***	0.04	1.02	0.04	0.86***	0.03	0.95	0.03
Q88a. Close to political party	0.84***	0.04	1.27***	0.08	1.08	0.07	1.12*	0.06	1.06	0.05
discusspol	1.09*	0.04	1.11	0.08	1.15*	0.07	1.12	0.06	1.13*	0.05
participationpolitics	0.94*	0.03	1.21***	0.06	0.91	0.05	0.93	0.05	0.98	0.04
<i>Sociodemographics</i>										
EA (ref. WA)	2.98***	0.09	1.29	0.27	4.56***	0.25	1.32*	0.13	1.57***	0.12
CA	1.44***	0.07	0.74**	0.12	0.63***	0.1	0.68***	0.1	0.83*	0.08
NA	2.32***	0.14	0.71	0.18	0.36***	0.16	5.50***	0.2	2.03***	0.2
SA	1.11*	0.05	0.76**	0.09	0.71***	0.08	0.74***	0.07	0.86*	0.06
rural	0.94	0.04	0.99	0.08	0.93	0.07	1.28***	0.06	1.08	0.05
Q67. Lived outside country	0.93	0.04	1.12	0.08	1.06	0.07	0.96	0.06	0.96	0.05
Q1. Age	1	0	0.99***	0	1	0	1	0	1	0
male	1.21***	0.04	0.87	0.08	1.06	0.07	1.01	0.06	0.99	0.05
Q4b. Your present living conditions	0.96*	0.02	0.98	0.03	0.89***	0.03	0.96*	0.02	0.94**	0.02
student	1.40***	0.07	1.17	0.11	1.12	0.1	1.05	0.1	1.01	0.08

(Continued)





Table 2. (Continued).

	Model 1: human causation in climate change		Model 2a: better situation in the future (compared to the same)		Model 2b: worse situation in the future (compared to the same)		Model 3a: yes, we must fight, but ordinary people cannot do much (compared to no need to fight)		Model 3b: everybody must fight (compared to no need to fight)	
	Odds ratio	S.E.	Odds ratio	S.E.	Odds ratio	S.E.	Odds ratio	S.E.	Odds ratio	SE
agriculture	1.15**	0.05	1.19	0.11	1.21	0.1	1.09	0.07	1.24**	0.07
midlevel	1.30***	0.08	1.14	0.13	1.38**	0.11	1.14	0.11	1.32**	0.09
informschool	1.03	0.09	1.55	0.23	1.55*	0.22	0.78	0.14	0.99	0.13
primaryschool	1.11	0.07	1	0.14	1.27	0.13	0.85	0.1	1	0.09
highschool	1.32***	0.07	0.98	0.14	1.26	0.13	0.63***	0.1	0.99	0.09
postsecondary	2.09***	0.09	0.74	0.17	1.32	0.15	0.65***	0.13	1.08	0.11
headhouse	0.99	0.05	1	0.09	0.82**	0.08	0.95	0.07	0.94	0.06
N	14813 (33 countries)		14748 (32 countries)		14244 (33 countries)		14244 (33 countries)			
Pseudo R <sup>2</sup>	0.11		0.24		0.24		0.24			

Dummies are always in reference to the first level. \*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ . See appendix 3 for Likelihood ratio tests.

acting in model 3. When experiencing worse conditions, the odds in thinking that there is a need to fight against climate change increase, slightly more in considering that ordinary people cannot do anything. On the contrary, experience of better agricultural conditions decreases these odds. The frequency of media exposure increases somewhat the odds in stating that we must fight, and that citizens have a part to play. Finally, the connection between the different levels of literacy is significant. Understanding the human causation and the fact that life in the country will change increase the odds for stating that climate change must be stopped, the odds being even higher for stating that everyone has to fight, including ordinary citizens.

Norms and values variables present interesting and highly contrasted results. People having informal political talks with friends and family, and people participating in communities, present increasing odds in understanding human causes as important in explaining climate change. On the contrary, people believing in the dominance of religious law present decreasing odds. The interesting part is that all variables related to politics, institutional trust, participation through actions, and closeness to a political party decreased these odds. Again, for the second model, to be a member of a community group presents contrasted results: it increased the odds for understanding the situation will change, for the worst as for the best. Trust in institutions is actually increasing the odds in thinking that the situation will get better (as to being close to a political party), when trust in traditional leaders decreases them. Discussing politics informally with friends and family increases the odds in establishing that the situation will get worse; thus, sharing experiences and opinions is playing a role, even with a smaller significance level. Finally, on the perceived efficacy to act, the odds of understanding that we need to fight climate change as a whole are decreasing with the importance people put on religious law, but increase actually when people are Muslims. Contrasted results occur again in community: being a member of a community-based group decreases the odds, but participating in community increases them. The trust in traditional leaders increases the odds in thinking the fight is needed, with or without citizens, when trust in institutions decreases them. But, to be close to a political party or to discuss politics with friends and family increases the odds in perceiving the efficacy of acting, without citizens for the first variable, with them for the second one.

Finally, for socio-demographic aspects, there appears to be some strong significance in the positive relationship between living in East, Central or North Africa compared to West Africa, and being a male compared to being a female, with the understanding of the human causation. Status and education are also confirmed: being a student, working in agriculture, working in mid or up-level jobs and being higher educated all increase the odds of placing human causes as the principal reason of climate change. In the second model, living in East Africa compared to West Africa largely increases the odds in forecasting a worst life. The present living conditions decrease the odds for understanding that life will become worse compared to no change. The results on the variables about education are not conclusive; significance levels are almost at 0.05. The only hint comes from the greater odds for a worse life with at least informal school compared to no schooling. Finally, occupying a mid/up-level job increases the odds for anticipating the situation will get worse, but being the head of the house indicates the opposite direction. On the perceived efficacy to act in the third model, North Africa presents the highest variations compared to the reference, West Africa. In East Africa, the odds in answering

that there is a need to act against climate change also increase, but they decrease for Central Africa and South Africa, in comparison to the reference. Living in rural areas is significant in thinking that fighting climate change is important, but ordinary people cannot do much. The present living conditions lead to a decrease in thinking that climate change must be stopped. But, to be more precise, to have a mid/up-level job increases the odds in answering that everybody must fight, as for people working in the agricultural sector.

### **Discussion: a central role for direct experiences**

The first important message is that direct experience seems to play a larger role in explaining the differences in climate change literacy. As hundreds of millions of people in Africa depend on rainfall to grow their food, direct experience was indeed conceived as an important factor. This confirms studies done both in Africa and elsewhere. Learning about climate change from personal experience is a widely shared process in Africa, and this experience is a precondition for action, as Kosmowski et al. [37] showed in West Africa or Jiri and Mafongoya [6] in Southern Africa, where most adaptation strategies are based on the perceptions of the variability of rain by smallholder farmers. In Kenya, farmers' experience and the length of this experience appear to be the main explanation of their perceptions of climate change and the type of adaptation strategies [38]. Akerlof et al. [23] established that personal experience of global warming matters also in western countries, being connected to how individuals envision the future.

There are two important drawbacks to this relationship between direct experience and literacy about climate change. The first is that it may be more related to a conception of the negative consequences mainly at a local level, and may thus miss the enormous scale of the global situation. Weber [21] describes this as the local warming effect. There is thus a discrepancy between how the general public and the climate scientists describe climate change. This implies that those who do not directly experience it are less concerned and present decreased levels of literacy, as they are more distant in space and time [39].

The second drawback is that depending on the type of experiences they actually face, individuals may develop a different understanding of the consequences of climate change in the future and the perceived efficacy of action, thus presenting varied levels of literacy. As displayed in the results, when experiencing better agricultural conditions, individuals tend to be more optimistic about the future and do not see the need to act against climate change. The impacts of climate change on the continent are not consistent; they may vary in intensity and types. This may also explain the differences observed in the results regarding the region where respondents live. Respondents in East Africa, a region highly affected by climate change [40,41], present largely higher odds in anticipating a negative future and in considering that there is a need for action. So, it is essential to complement direct experience with education and information, to avoid the risk of wrong perceptions and low literacy levels. As Kosmowski et al. [37] showed, the awareness of farmers in semi-arid zones of Africa is all the more acute as climate change occurs in a relatively short time and is of high amplitude, as in central Senegal and parts of Niger. One can therefore imagine that a more gradual change will be more difficult to detect. It will also be complex in some countries where the vulnerability may differ among societies that are closed geographically, as in Ethiopia [42]. In addition, the literature has shown contrasted

results in terms of consistency of farmer's observations. Sharma and Shrestha [43] or Becken et al. [44] found that observations of climate vulnerability were accurate in the populations they studied. But, in South Africa, Rapholo and Diko Makia [33] found that a part of the farmers targeted by their study held wrong observations in comparison to meteorological data.

These issues matter in terms of national policy, even more as many adaptation programmes across the continent are conducted as short-term responses to current changes and take place in most cases at the individual/household/community levels, lacking support from governments [45,46].

A second important message is the connection between different levels of literacy. When respondents understand the human causation of climate change and anticipate a worse future, the perception of the efficacy of action increases. The literacy about causes, consequences and finally the solutions is complementary in Africa. It is also clear that fatalism is not so much present in Africa, unlike some other parts of the world, where literacy about the causes and consequences of climate change may actually discourage action [47]. In a study conducted in the UK, O'Neill and Nicholson-Cole found that 'climate change images can evoke powerful feelings of issue salience, but these do not necessarily make participants feel able to do anything about it; in fact, it may do the reverse [48, p. 373].' It is not, however, always the case. In a more recent study conducted in the EU and US, Eichhorn et al. [1] show that generally, when respondents feel personally responsible, they also consider that taking action is fundamental.

Feelings may thus impact the way literacy works from understanding causes and consequences to the perceived efficacy of action. It is important to understand how to improve the levels of literacy in Africa. According to Selormey et al. [2], considering the two first levels of literacy, causes and consequences on climate, 28% of African citizens can be considered as climate change literate. Thus, again, personal experience will not be sufficient to raise these numbers; it must be complemented by education and communication, the latter already playing a role in shaping literacy as indicated in the results. Some programmes exist in this perspective, like the one from CARE Ethiopia, combining local knowledge and scientific data in order to improve the understanding of the implications of climate change [49]. This also confirms some results in the literature, as in Ado et al. [50], explaining the importance of media outreach, including above all local languages. In terms of policy-making, such understanding should be complemented by a better understanding of the constraints people actually face to adapt that may impact the level of the perceived efficacy of action, as inequalities are important in this perspective [51,52].

The most contrasting results came from the role occupied by respondents in their communities and the trust in different institutions. Actively participating in a community and trusting traditional leaders seems to lead to a more important understanding of the causes, consequences and solutions. On the contrary, factors related to politics and trust in formal institutions seem to produce less understanding, which is a unique feature compared to other parts of the world [53]. The diversity of institutions and social groups in Africa is thus another important message: trust and participation in different groups and institutions lead to different levels of literacy. Accordingly, communication must take place with an understanding of the context, if it is to be effective in aiming to secure real change. Based on a multi-ethnic assessment in Benin, Sanchez et al.

[25] showed that several ethnic groups reported differently the effects they observed resulting from climate change. They also used different adaptation strategies based on their perception derived from these observations. In some parts of Benin, although the peasant community is unanimous on the continuing climate change, the understanding of the causes takes various forms, often linked to local norms and beliefs: lack of respect for rituals and social norms, lack of respect for deities, occult practices of cloud neutralisation and deforestation [54]. There is thus a connection between trust in formal institutions and climate change literacy. Formal and informal institutions need to be persuaded to support the growing climate change literacy. In Niger, for example, natural resources are managed in a joint approach, combining the role of public authorities and traditional institutions [55]. Trust in institutions may also explain the very contrasting results. In Ghana, for example, trust in traditional chiefdoms is still very important in dealing with everyday life matters and in establishing customary laws [56]. These findings are even more important as local institutions are fundamental in facilitating adaptation strategies, and are generally separated or rarely supported, by formal institutions and channels of aid [6].

Socio-economic conditions do not seem to play an important role for developing climate change literacy; but they may indicate some leads to act and channels of the needed communication and education in complementing direct experiences. Occupying mid/up-level jobs leads to a more pessimistic vision of the future and to a stronger belief that there is a need to act against climate change. Significantly in the first model (as in the second one when taking the OLS regression into consideration), males seem more aware of the human cause of climate change and the negative consequences. This contrasts with the relation we may find in western countries as stated in the literature review, but is in line with other studies conducted in Africa [33,57]. The fact that gender roles differ in the two parts of the world may have an impact on this result, e.g. because women are largely less educated than men in Africa. Living conditions may be related to a stronger confidence in the future, as some studies show. Lower risk perceptions may be explained by the fact that people in positions of power feel more distant from the effects of climate change, and may have more capacity to adapt than people with less power [58].

## Conclusion

The perception of climate change varies throughout Africa. The current paper offers a cross-country analysis, which may indicate some more generalised patterns. The results mainly show the central role of personal experience and of the need to consider literacy as a whole. They also show some important particularities on the continent compared to other parts of the world, in the very contrasted trust in formal institutions. This exploratory study highlights important elements that should be key to motivate governments in responding to climate change challenges. Climate change in Africa aggravates poverty. Development programmes must include climate change and find ways to mitigate its effects.

This study is, of course, not without limitations. Working with nominal dependent variables is helpful to understand the direction of the relationships between the different factors and the different aspects of literacy, but it is not so helpful in comparing the

weight of these relationships. The current analysis is focused on literacy. It does not consider the question of people in Africa who may never have heard about climate change.

Not everyone has the same capacity to mitigate the effects of climate change or to adapt to climate change. Public authorities and traditional institutions may need to work together with great flexibility if Africa is to mitigate effects and adapt to a changed reality. Climate change literacy must lead to actual communication.

## Notes

1. In robustness checks, the consistency of these results was evaluated with ordinal logistic regressions (appendix 4).
2. These 34 countries are home to almost 80% of the continent's population. The data are weighted to ensure nationally representative samples, and each country is weighted equally.
3. Appendix 5 includes correlation matrixes for each model. As the correlation was important between the dummies Muslim and Christian, a test has been done without it. As the results do not change significantly, it has been conserved in the present tests.
4. Variables with a Cronbach's alpha equal or superior to 0.7 were kept for scales creation.

## Availability of data and material

Afrobarometer offers a wide range of data on Africa for free use. The institution is funded from public sources, and the offered data are a public resource. The dataset underlying this article is available at <https://www.afrobarometer.org/data/merged-round-7-data-34-countries-2019>.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## ORCID

Juliette Alenda-Demoutiez  <http://orcid.org/0000-0001-7123-2704>

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