

LETTER • **OPEN ACCESS**

The role of climate change awareness for trust in institutions in sub-Saharan Africa

To cite this article: Peter Dirksmeier *et al* 2023 *Environ. Res. Lett.* **18** 094043

View the [article online](#) for updates and enhancements.

You may also like

- [Psychological and experiential factors affecting climate change perception: learnings from a transnational empirical study and implications for framing climate-related flood events](#)
Gala Munoz-Carrier, Dana Thomsen and Gary J Pickering
- [Measuring an artificial intelligence language model's trust in humans using machine incentives](#)
Tim Johnson and Nick Obradovich
- [The influence of political ideology on trust in science](#)
Aaron M McCright, Katherine Dentzman, Meghan Charters *et al.*

The Breath Biopsy® Guide
Fourth edition

FREE

DOWNLOAD THE FREE E-BOOK

BREATH BIOPSY

OWLSTONE MEDICAL

ENVIRONMENTAL RESEARCH
LETTERS

LETTER

The role of climate change awareness for trust in institutions in sub-Saharan Africa

OPEN ACCESS

RECEIVED

10 March 2023

REVISED

8 June 2023

ACCEPTED FOR PUBLICATION

16 August 2023

PUBLISHED

7 September 2023

Original content from this work may be used under the terms of the [Creative Commons Attribution 4.0 licence](https://creativecommons.org/licenses/by/4.0/).

Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

Peter Dirksmeier¹ , Kerstin Nolte^{1,3,*} , Lars Mewes¹ and Leonie Tuitjer² ¹ Institute of Economic and Cultural Geography, Leibniz University Hannover, Hannover, Germany² artec - Sustainability Research Center, University of Bremen, Bremen, Germany³ Johann Heinrich von Thünen-Institute, Institute of Rural Economics, Braunschweig, Germany

* Author to whom any correspondence should be addressed.

E-mail: nolte@wigeo.uni-hannover.de**Keywords:** climate change awareness, trust in partial institutions, trust in impartial institutions, sub-Saharan Africa, conflict, mitigation policiesSupplementary material for this article is available [online](#)**Abstract**

Within the context of climate change in sub-Saharan Africa, trust in institutions is an important prerequisite to implement climate change adaptation and mitigation policies. There is a lack of systematic investigation of the relationship between climate change awareness, conflicts, and trust in institutions. We address this pressing research gap based on a regression analysis with trust in institutions as dependent variables, and climate change awareness and violence as independent variables drawing on Afrobarometer individual data and aggregated data on armed conflicts. Our main findings indicate that trust in institutions in sub-Saharan Africa is influenced by both the individual climate change awareness and the violence context. First, we find a negative relationship between those who are aware of climate change and trust in institutions. Second, we observe a socio-economic divide: young, urban and educated parts of the population as well as those who feel their ethnic group is treated unfairly do not trust institutions. Third, we see a regional divide: those far from political centres are not aware of climate change, and those close to the political centres do not trust institutions.

1. Introduction

Climate change is one of the major challenges of the 21st century, but its direct consequences affect the regions of the world unequally (Beck *et al* 2018), with Sub-Saharan Africa being particularly hit. Projected temperature increases of 1.5 °C and 2.0 °C are likely to cause severe (seasonal) heat waves, droughts, and floods (Diedhiou *et al* 2018, Pelling *et al* 2018). Climate change thus directly affects farmers' livelihoods where smallholder agriculture is the main source of livelihood for many households and an important backbone of local economies (Schlenker and Lobell 2010). Moreover, there is a relationship between climate change and violent conflict (von Uexkull and Buhaug 2021). In sub-Saharan Africa, climate change-induced events such as prolonged droughts or floods may correlate with violence or the tolerance of violence (Hsiang *et al* 2013, Burke

et al 2015, Carleton and Hsiang 2016, Detges 2017, Vestby 2019).

Hence, regions heavily affected by climate change require both successful adaptation strategies and mitigation measures such as the conservation of forest resources. Such measures are vital for stabilizing livelihoods in the long term and promote peace. However, they are by no means uncontested and can lead to short term disruptions and local grievances. Hence, people must be confident that political measures taken against climate change may have negative short-term consequences for them, but positive medium and long-term benefits. It is important that society trusts the government as a reliable party to act against climate change, even if the measures taken are beyond their control (Schilke *et al* 2021).

On the African continent, like elsewhere, the implementation of mitigation and adaption policies is falling short of expectations. All African countries

(with the exception of Libya) submitted intended nationally determined contributions to prepare the Paris Agreement and most have been updated since (Nyiwul 2019, NAZCA 2021). Yet, implementation is lagging behind (Adenle *et al* 2017). In the African context, a general lack of institutional capacity is thought to prevent countries from even participating in mitigation and adaptation policies (Adenle *et al* 2017, Nyiwul 2019).

Despite the significance of climate change on human conflict, there are no systematic investigations of the relationship between climate change awareness and trust in the political system, particularly in sub-Saharan Africa. We address this research gap with a systematic empirical analysis based on data about individual climate change awareness.

2. Climate change and trust in institutions

Trust in institutions promotes a supportive attitude towards policies that address climate change (Harring 2018). Trust in the differentiated institutions of the political system is an important prerequisite for the implementation of political measures to adapt to the consequences of climate change (Marquart-Pyatt 2018, Cologna and Siegrist 2020)—while the success of these policies will only be felt decades later. It can be assumed that the acceptance of climate-friendly policies increases with the trustworthiness of politicians (Levi and Stoker 2000) and negative attitudes towards political institutions correlate with climate change denial (Huber *et al* 2021). Contexts with an affinity to conflict promote distrust in institutions (Linke 2013), and trust in institutions reduces the likelihood of conflict occurring (Wig and Tollefsen 2016).

The literature distinguishes trust in institutions into trust in partial institutions—trust in elected offices or in those bodies that make laws and rules, such as parliaments or governments—and trust in impartial institutions—trust in those bodies that monitor compliance with laws and rules, such as the police or the judiciary. These two dimensions also differ in that citizens rarely have contact with the former institutions, but much more frequently with the latter (Kulin and Sevä 2021; Rothstein and Stolle 2008).

African institutions are often perceived of as weak and being prone to corruption (Heidenheimer 2002, Birdsall 2007, Acemoglu *et al* 2016). Historically motivated work explains the weakness of institutions in sub-Saharan Africa with various influences, such as missionary activity (Nunn 2014), the slave trade (Nunn 2008, Nunn and Wantchekon 2011), or even the relative abruptness of surface forms (Nunn and Puga 2012). Lund (2006) describes a common legal pluralism, stemming from a dichotomy between formal institutions inherited from colonial rulers,

and informal institutions such as religious and traditional leaders that have also been altered by and since colonialism (Lund 2006, Meagher 2007). Traditional institutions such as pre-colonial kingdoms, ‘so-called “customary institutions”’ (Wig and Tollefsen 2016, p 33), are still important in large parts of sub-Saharan Africa (Herbst 2000). The strong role of informal institutions is often found to result in low trust in (formal) institutions (Bratton 2007, Bratton and Gyimah-Boadi 2016).

Mitigation and adaptation measures to climate change face the main obstacle of institutional fragmentation in their implementation in sub-Saharan Africa (Ford *et al* 2015, Klausbrückner *et al* 2016). Fragmentation means that a large number of institutions are involved, which leads to problems in enforcing existing laws and the coherence of different measures (Holgate 2007, Ford *et al* 2015, Klausbrückner *et al* 2016). Organising aid at the local level, on the other hand, increases trust in the political system (Vestby 2019) and accordingly promotes the feasibility of adaptation measures by local political authorities (Schilke *et al* 2021).

While we know that trust in institutions is important for implementing climate policies, we lack evidence on the relationship between climate change awareness and trust in institutions. Put differently, people across the world, including Africa, are increasingly aware of climate change (Lee *et al* 2015), however, it is unclear how this in turn affects trust in institutions which is necessary to implement adaptation measures.

The literature discusses the relationship between trust in institutions and risk perception, expecting a positive relationship between the two (Siegrist and Cvetkovich 2000, Viklund 2003), albeit often weaker than assumed (Sjöberg 2001). Trust is thus considered an important predictor of risk perception. Risk perception and climate change awareness are closely linked concepts, and empirically, climate change awareness is found to be positively related to risk perception: the more I understand climate change, the higher the perceived risks (Libarkin *et al* 2018).

Thus, our first hypothesis is: (1) People who are aware of climate change have a higher level of trust in partial and impartial institutions than people who are not aware of climate change.

Moreover, we know that conflicts are more likely in times of climate change (Hsiang *et al* 2013), and conflict in turn has a strong effect on trust in institutions (Linke 2013). Our second hypothesis thus is: (2) The assumed positive relationship between climate change awareness and trust in institutions does not hold in contexts with a high level of violent conflicts, here, people who are aware of climate change do not show greater confidence in partial and impartial institutions compared to people in non-violent contexts, due to the dominant violence effect.

3. Method

As our hypotheses suggest a relationship between individual-level dependent variables and independent variables at the individual and regional context level, we used linear multilevel models based on maximum likelihood estimations as our primary regression technique (see supplement for model specification).

We combine data from different sources. The individual data come from the Afrobarometer Round 7 (Afrobarometer 2019), which for the first time includes a module to survey attitudes towards climate change among the African population. Afrobarometer also contains trust in institutions as well as socio-demographic control variables. This new module makes it possible to analyse attitudes towards climate change in relation to trust in institutions. The Afrobarometer individual dataset for sub-Saharan Africa covers 32 states (divided into 379 regions) with a sample size of 1200 respondents per state ($n = 38\,400$). The number of regions per state included in the analysis is shown in table S1. The nation-states show a wide variance in terms of their dependence on agriculture, which is an important predictor of vulnerability due to climate change as well as conflicts arising in its wake (Schlenker and Lobell 2010, Vestby *et al* 2021) (see table S1 in supplement). At the regional level, we combine data from several sources. First, we aggregate individual data on attitudes towards violence from Afrobarometer Round 5, conducted between 2011 and 2013, at the regional level, as this was the last round in which this variable was collected. Second, we take information on attitudes towards climate change as well as on power supply via the mains from the Afrobarometer Round 7. We aggregate these variables also at the regional level. Third, we collect data on incidents of violence and non-violent conflicts from the Armed Conflict Location and Event Data Project (2021). The regional data is merged via the 'Region' variable in Afrobarometer, designating the province or region indicated by the interviewer. This also means that our analysis incorporates data which were collected in different years. Although this choice was driven by data availability constraints, we are confident that it does not significantly affect our results. This is because attitudes towards violence, which represent the oldest data, are unlikely to undergo substantial changes within a few years (Albarracin and Shavitt 2018).

All interval-scaled variables at the individual and regional level except latitude and reported fatalities (logarithm) are standardised using z-scores across all units, which ensures that zero is assigned an interpretable value (Hox 2002). Data is weighted with the multi-country weighting factor provided by Afrobarometer for interstate comparison. Individual controls are fixed as there is no theoretical reason

to assume that these indicators vary between contexts. We include random slopes (Bryan and Jenkins 2016, Schmidt-Catran and Fairbrother 2016) for the individual-level variables of climate change awareness and the perception of an intensification of droughts as well as floods, as it can be theoretically assumed that climate-sensitive attitudes also vary with regional variance.

3.1. Dependent variable

Trust in institutions is the trust that citizens place in their state and its government authorities (Putnam 1995, Levi and Stoker 2000, Harring 2013, Tam and Chan 2018). For the analysis of the influence of attitudes towards climate change given the simultaneous presence of conflicts, it is important to distinguish between trust in partial and impartial institutions (Rothstein and Stolle 2008, Kulin and Johansson Seva 2021).

To measure trust in partial institutions, we use four questions (Q43A-Q43D) which conceptualise trust in the president, the parliament/national assembly, the electoral commission, and the elected local council and are included in Afrobarometer round 7 (Afrobarometer Codebook 2020). Trust in impartial institutions is measured via three variables (Q43G-Q43I; see table S2 for exact wording) concerning expressed confidence in the police, the army, and courts of law. Response options range from 'not at all' to 'a lot' on a scale of 0–3. For each individual, we summed the respondents' answers to the respective items resulting in a score for partial institutions ranging between 0 and 12, and between 0 and 9 for impartial institutions. The question formulations are aimed at trust in the political system and less at trust in current rulers (Levi and Stoker 2000). We use confirmatory factor analysis to test whether trust in partial and impartial institutions are two separate dimensions. The results show large standardised factor loadings (>0.81) as well as acceptable coefficients suggesting both factors are two separate dimensions (RMSEA = 0.06; Bentler CFI = 0.99) (Hu and Bentler 1999). The confirmatory factor analysis even shows slightly better values for sub-Saharan Africa than Kulin and Johansson (2021) specified for Europe. We calculate trust in partial institutions as the sum of the four individual trust scores ($\alpha = 0.86$), and trust in impartial institutions as the sum of the three respective items ($\alpha = 0.80$). Both scales are z-standardised.

3.2. Explanatory independent variables

To model individual attitudes and perceptions of climate change, we rely on three items from Afrobarometer Round 7 [Questions 72a, 72b, 73a]. First, we use climate change awareness [Question 73a], where 1 stands for the awareness of climate change. Second, we take the respondents' assessments of an increase in the severity of droughts and, third, of

floods over the last ten years as individual level proxies of risk perception. We recoded these as dummies such that 1 subsumes the original categories ‘much more severe’ and ‘somewhat more severe’ and 0 summarises ‘stayed the same’, ‘somewhat less severe’ and ‘much less severe’.

Since hypothesis 2 states that the relationship between trust and climate change awareness depends on the regional level of violence as a contextual variable, we assess attitudes towards violence at the regional level from Afrobarometer Round 5 (2015). Question Q78 (see table S2 for exact wording) records attitudes towards violence and has already been successfully used in studies to determine the relationship between violence and climate change (Detges 2017). In addition, McGuirk and Burke (2020) have used Afrobarometer’s individual data on conflict to verify georeferenced conflict event data and found a high level of agreement. The variable was recoded in such a way that high values mean a high tolerance for violence to enforce political interests. The mean values of the regions were z-transformed.

Incidents of conflict and fatalities as an expression of different intensities of conflict were obtained from the Armed Conflict Location and Event Data Project (2021) at the regional level. For the low intensity events in the conflict variable, the two items of protests and strategic developments from 1/1/2017 until 31/12/2018 were added together per region, representing low intensity of conflict. Thereby, we add a variable that controls for all intensity levels of conflict on the regional level. The z-scores across all regions of the variable were used. Reported fatalities is the sum of all reported deaths due to violence per region. Reported fatalities has three extreme values for the regions of Kukawa (Nigeria), El Fasher (Sudan), and Diamare (Cameroon). In order to handle the statistical outliers, we log-transform reported fatalities. Before logarithmisation we added 0.01 to the respective values of all regions so as to not lose the zero observations (Michalopoulos and Papaioannou 2013a).

3.3. Controls

To avoid overspecification (Tam and Chan 2018), we restrict our controls to sex, age, education, locality, and feelings of unfair treatment of one’s ethnic group. While the first four represent basic socio-demographic control variables, the treatment of ethnic groups refers to the phenomenon of politicisation of ethnicity in parts of sub-Saharan Africa (Cohen 1990, Daley 2006). For multi-ethnic societies, it is always a problem when inequality runs along ethnic differentiation (Nassehi 1990). Thus, ethnic disadvantage is likely to correlate with a lack of trust in partial and impartial institutions.

At the regional level, we control for location, power supply via the mains, and attitudes towards cli-

mate change. Power supply via the mains is a proxy for distance from the political centres. Law enforcement tends to decrease the further one is from political centres in sub-Saharan Africa (Michalopoulos and Papaioannou 2013b). To construct the variable, question Q93, which ranges from 0 (no power supply via the mains) to 5 (always power supply via the mains) is aggregated at the regional level and z-standardised. Latitude controls for location on the African continent, as climatic conditions change with theoretical solar radiation. We use the centroid of the respective region according to the open source software Open Street Map (Nominatim 2021). Climate change awareness acts as a filter variable for the following questions on attitudes toward climate change (59.8% awareness in the sample). In order not to exclude too many cases from the sample, attitudes to climate change were used as controls aggregated at the regional level [Questions 71; 75; 76; see table S2 for exact wording]. The assessment of whether climate change affects one’s own country [Question 75] is surveyed on a 5-point rating scale, and recoded so that 5 stands for ‘much worse’. The question on whether climate change must be stopped [Question 76] is asked with a 4-point scale from 0 to 3, and recoded so that 3 stands for ‘Yes, by ordinary people’. The assessment of the climate conditions of ten years ago [Question 71] was surveyed on a 5-point scale, and recoded so that 5 means the assessment that today’s conditions have significantly deteriorated. The mean value of the respective region is used as the aggregate in each case and z-transformed.

Studies on the relationship between climate and violence run the risk of ‘bad control’ (Burke *et al* 2015) at the contextual level, since the classic control variables used here, such as GDP, crop production, infant mortality, or population density, are themselves climate-dependent factors (Burke *et al* 2015, Carleton and Hsiang 2016). This leads to artificial correlates that are subsequently misinterpreted. For this reason, we do not use further context control variables (see table S2 for a summary of measures used and S3 for descriptive statistics).

The large variance in the two dependent variables is striking. Trust in partial and impartial institutions is very differently distributed between the various sub-Saharan states and regions. The gender ratio is balanced in the sample and the rural population slightly predominates. The average age is 37 years. It is striking that fourteen per cent of respondents’ state that their ethnic group is treated unfairly, although the standard deviation is high, too. Sixty per cent of respondents say they have heard of climate change. For 52% the severity of droughts has increased, for 35% the severity of floods. Knowledge of climate change correlates positively with education [$r = 0.26$; $p < 0.001$ (Spearman)].

4. Results

We calculated eight multilevel linear models to test the relationship of climate change awareness and the incidence of violence on trust in partial and impartial institutions. Table 1 presents the results.

4.1. Political trust varies spatially

The intraclass correlation coefficients (ICCs) in the baseline models (Model 0a and Model 0b) indicate that both forms of trust in institutions in Africa vary very strongly spatially. Nesting people into regions explains 21% (Model 0a) and 20% (Model 0b) of overall variance.

Latitude as a proxy for geographical location on the continent is not associated with either form of trust. However, the coefficient of power supply via the mains indicates that living in more remote areas has a negative relationship with trust in partial and impartial institutions.

4.2. Individual level variables: strong role of treatment of one's own ethnic group

Across all models, both forms of trust increase with age, but decrease with education and living in urban areas. The strongest effect is achieved by the perceived unfair treatment of one's own ethnic group, which leads to a decrease in trust in partial as well as in impartial institutions. This means that if people perceive their ethnic group to be treated unfairly, this perception is associated with a decrease in trust in partial institutions by 0.273 standard deviations (Model 1a). Given the fact that the standard deviation of partial trust is 3.84, perceived unfair treatment results in a drop in trust in partial institutions by 1.05 on a scale ranging between 0 and 12 with a mean value of 6.03. This loss is even greater for trust in impartial institutions. Perceived unfair treatment of one's own ethnic group leads to a reduction in trust by about 0.66 on a scale ranging between 0 and 9 with a mean value of 5.11.

4.3. Relationship between trust, climate change awareness, and risk perception

Hypothesis 1 (H1) proposes a positive relationship between both forms of trust and climate change awareness and risk perception at the individual level. We investigated H1 in Models 2a and b and 3a and b. All three climate attitude variables at the individual level (e.g., climate change awareness, severity of droughts, and severity of floods) are negatively correlated with trust in partial institutions. The perception of climate change as a problematic phenomenon, thus, reduces political trust at the individual level suggesting a rejection of H1.

4.4. Role of violence

In hypothesis 2, we stated that the relationship between climate change awareness and trust depends

on the level of violence in regional contexts. The models 2a and 2b show that tolerance for violence and reported fatalities in the respective regions correlate negatively with both trust variables. To estimate the influence of climate change awareness, we therefore included a cross-level interaction term of CC awareness at the individual level and reported fatalities representing the level of violence at the regional level in models 2a and 2b. The interaction term remains clearly below the statistical significance threshold of .05 and has a very low coefficient. Hence, the interaction term contributes only little to the inter-person variance in trust. Consequently, in a conflict-laden context people who are aware of climate change do not show lower trust in institutions. This result supports H2.

5. Discussion

5.1. Climate change awareness results in lower political trust

Hypothesis one must be rejected. Contrary to our assumption, in sub-Saharan Africa people who are aware of climate change show less trust in institutions. Awareness of climate change and perceiving its negative consequences as a risk are negatively associated with trust in partial and impartial institutions. Further studies should investigate the reasons for this relationship. It could indicate that institutions are blamed for their inability to cope with climate change and are thereby considered partly responsible for the consequences of climate change.

Given the need for an implementation of adaptation policies, this result is important from a policy point of view. It is precisely those groups that recognise climate change as a problem that do not trust politics. This indicates the existence of reinforcing spirals (Slater 2007), as either people are unaware of climate change and thus do not see it as a problem, or those who are aware of climate change do not trust partial and impartial institutions, which leads to a rejection of those bodies who are in charge of implementing climate protection measures.

5.2. Conflicts are associated with lower levels of trust and override the effects of climate change awareness

Our regression analysis further reveals that conflicts in a region are associated with low trust in partial and impartial institutions. It is hence problematic when conflicts undermine the necessary trust in political measures to counter climate change, especially given the complex relationship between climate change and conflict (von Uexkull and Buhaug 2021). We can confirm hypothesis two: In contexts with higher levels of violence people who are aware of climate change do not show a lower level of political trust.

Table 1. Two-level regression results on political trust.

	Model (0a)	Model (0b)	Model (1a)	Model (1b)	Model (2a)	Model (2b)	Model (3a)	Model (3b)
	β (SE) Baseline (partial)	β (SE) Baseline (impartial)	β (SE) Control (partial)	β (SE) Control (impartial)	β (SE) All (partial)	β (SE) All (impartial)	β (SE) Interaction (partial)	β (SE) Interaction (impartial)
<i>Individual level</i>								
Sex (1 = female)	-0.010 (0.011)		-0.010 (0.011)	-0.038*** (0.011)	-0.021 (0.013)	-0.049*** (0.012)	-0.021 (0.013)	-0.049*** (0.012)
Age (z-score)	0.053*** (0.006)		0.053*** (0.006)	0.034*** (0.006)	0.051*** (0.006)	0.033*** (0.006)	0.051*** (0.006)	0.033*** (0.006)
Education (z-score)	-0.079*** (0.006)		-0.079*** (0.006)	-0.070*** (0.006)	-0.071*** (0.008)	-0.064*** (0.008)	-0.071*** (0.008)	-0.064*** (0.008)
Urban/rural (1 = urban)	-0.117*** (0.014)		-0.117*** (0.014)	-0.098*** (0.014)	-0.140*** (0.016)	-0.119*** (0.016)	-0.140*** (0.016)	-0.119*** (0.016)
Ethnic group treated unfairly (1 = yes)	-0.273*** (0.016)		-0.273*** (0.016)	-0.230*** (0.016)	-0.262*** (0.019)	-0.222*** (0.019)	-0.262*** (0.019)	-0.222*** (0.019)
CC Awareness (1 = yes)					-0.045* (0.022)	-0.050* (0.024)	-0.045* (0.023)	-0.055* (0.025)
Severity of droughts (1 = more severe)					-0.062** (0.023)	-0.022 (0.025)	-0.062** (0.023)	-0.022 (0.025)
Severity of floods (1 = more severe)					-0.071** (0.024)	-0.049 (0.026)	-0.071** (0.024)	-0.049 (0.026)
<i>Regional level</i>								
Latitude	0.000 (0.002)		0.000 (0.002)	0.001 (0.002)	-0.001 (0.001)	0.002 (0.002)	-0.001 (0.001)	0.002 (0.002)
Power supply via the mains (z-score)	-0.108*** (0.026)		-0.108*** (0.026)	-0.032 (0.027)	-0.141*** (0.023)	-0.063* (0.025)	-0.141*** (0.023)	-0.063* (0.025)
CC affecting country (z-score)	0.064 (0.033)		0.064 (0.033)	0.099** (0.034)	0.042 (0.030)	0.065 (0.033)	0.042 (0.030)	0.064 (0.033)
CC needs to be stopped (z-score)	-0.021 (0.027)		-0.021 (0.027)	-0.069* (0.028)	-0.013 (0.023)	-0.055* (0.025)	-0.012 (0.023)	-0.055* (0.025)

(Continued.)

Table 1. (Continued.)

Climate compared to ten years ago (z-score)	-0.074** (0.026)	-0.075** (0.027)	-0.054* (0.024)	-0.043 (0.026)	-0.054* (0.024)	-0.043 (0.026)
Tolerance for violence (z-score)			-0.043* (0.020)	-0.050* (0.022)	-0.043* (0.020)	-0.050* (0.022)
Low intensity events of conflict (z-score)			-0.038 (0.025)	0.000 (0.027)	-0.038 (0.025)	-0.000 (0.027)
Reported Fatalities (+ 0.01 ln)			-0.015* (0.007)	-0.022** (0.007)	-0.015* (0.007)	-0.021** (0.008)
<i>Cross-level interaction</i>						
CC Awareness*Reported Fatalities					0.000 (0.023)	-0.005 (0.007)
Constant	0.056* (0.025)	0.017 (0.024)	0.132*** (0.026)	0.094*** (0.026)	0.184*** (0.025)	0.140*** (0.027)
Level 2: Regions	0.216*** (0.017)	0.205*** (0.016)	0.174*** (0.015)	0.189*** (0.016)	0.071*** (0.005)	0.092*** (0.006)
Level 1: Individuals	0.797*** (0.006)	0.819*** (0.006)	0.775*** (0.007)	0.799*** (0.007)	0.766*** (0.008)	0.764*** (0.007)
-2 Log-Likelihood	91 261.649	98 063.316	73 400.929	77 929.800	55 874.180	58 548.664
n Regions	379	379	379	379	379	379
n Individual	34 530	36 758	28 063	29 464	21 255	22 245

Source: Afrobarometer Data (2015), (2019); Armed Conflict Location and Event Data Project (2021); * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; standard errors are reported in parenthesis.

5.3. The socio-economic divide

Our results also indicate, a socio-economic divide: In particular, the young, urban, and educated population in sub-Saharan Africa shows little trust in partial and impartial institutions. In addition, those that feel their ethnic group is treated unfairly lack trust in institutions. This is in line with the literature, suggesting that ethnicity affects trust in institutions (Zerfu et al 2009).

5.4. The African Climate Opinion Paradox

Our analysis shows that trust in partial and impartial institutions in sub-Saharan Africa is associated with distance from infrastructure. Iddawela et al (2021) indicate that the quality of institutions has a spatial affinity with the largest agglomerations of institutions. Michalopoulos and Papaioannou (2013a) emphasise that the geography of many sub-Saharan African countries in combination with inadequate infrastructure ensures that many national governments have only limited access to the state hinterland far from the capital (Mamdani 1996). We call this in to Wainwright et al (2019) the *African Climate Opinion Paradox*: in regions far from institutional control, trust in partial and impartial institutions is higher, but awareness of climate change is lower. Adaptation measures are unlikely to be accepted. In regions with institutional access trust in government institutions is significantly lower, which is likely to have the same effect on the implementation of carbon taxes as mistrust inhibits the introduction of future-oriented policies (Levi and Stoker 2000).

5.5. Context-sensitive approaches to implement climate change adaptation and mitigation policies

Our results indicate a need for context-sensitive approaches in implementing adaptation and mitigation policies in Africa: First, we find a negative relationship between those who are aware of climate change and trust in institutions. Second, we observe a socio-economic divide: young, urban and educated parts of the population as well as those who feel their ethnic group is treated unfairly do not trust institutions. Third, we see a regional divide: those far from infrastructure are not aware of climate change, and those close to the infrastructure do not trust institutions. Thus, national efforts to implement climate change adaptation and mitigation policies could benefit from targeted communication and education efforts and wider trust building measures (e.g. through more participatory governing processes and enhanced accountability and oversight). However, it is important to acknowledge that the regional divide is likely to exist on a continuum rather than as a distinct separation. This poses a challenge in determining the effectiveness of confidence-building measures and the point at which information campaigns on climate change would primarily be effective in the African context.

6. Conclusion

The results of the regression analysis illustrate two aspects. At the individual level, belief in climate change and its negative consequences results in lower levels of trust in partial and impartial institutions. Furthermore, trust in institutions varies spatially. Thus, the regional level is an important predictor of the variance in trust in partial institutions in sub-Saharan Africa, especially due to violence. While violent contexts per se lower trust in institutions, in contexts of violence, people who are aware of climate change do not show lower levels of trust in institutions.

To conclude, our results suggest that the introduction of climate change mitigation measures requires context-sensitive approaches in sub-Saharan Africa. Targeted programs for urban and rural regions as well as for different parts of the population are needed to address on the one hand the lack of climate change awareness, particularly in rural areas, and low levels of trust, particular among the young, urban and educated parts of the population.

Data availability statement

The data that support the findings of this study are openly available at the following URL/DOI: www.afrobarometer.org/data/merged-data/.

ORCID iDs

Peter Dirksmeier  <https://orcid.org/0000-0001-9706-004X>

Kerstin Nolte  <https://orcid.org/0000-0003-2716-7778>

Leonie Tuitjer  <https://orcid.org/0000-0001-6178-7757>

References

- Acemoglu D, Chaves I N, Osafo-Kwaako P and Robinson J A 2016 Indirect rule and state weakness in Africa: sierra Leone in comparative perspective *African Successes, Volume IV: Sustainable Growth* ed S Edwards, S Johnson and D N Weil (University of Chicago Press) pp 343–70
- Adenle A A, Manning D T and Arbiol J 2017 Mitigating climate change in Africa: barriers to financing low-carbon development *World Dev.* **100** 123–32
- Afrobarometer Data 2015 Merged data round 5 (available at: <https://afrobarometer.org/data/merged-data/>) (Accessed 24 June 2021)
- Afrobarometer Data 2019 Merged data round 7 (available at: <https://afrobarometer.org/data/merged-data/>) (Accessed 24 June 2021)
- Afrobarometer Data 2020 Round 7 codebook (available at: <https://afrobarometer.org/data/merged-data/>) (Accessed 24 June 2021)
- Albarracín D and Shavitt S 2018 Attitudes and attitude change *Ann. Rev. Psychol.* **69** 299–327
- Armed Conflict Location and Event Data Project 2021 Disaggregated data collection, analysis and crisis mapping platform (available at: <https://acleddata.com/#/dashboard>) (Accessed 23 June 2021)

- Beck H E, Zimmermann N E, McVicar T R, Vergopolan N, Berg A and Wood E F 2018 Present and future Köppen-Geiger climate classification maps at 1-km resolution *Sci. Data* **5** 180214
- Birdsall N 2007 Do no harm: aid, weak institutions and the missing middle in Africa *Dev. Policy Rev.* **25** 575–98
- Bratton M 2007 The democracy barometers (part I): formal versus informal institutions in Africa *J. Democr.* **18** 96–110
- Bratton M and Gyimah-Boadi E 2016 Do trustworthy institutions matter for development? Corruption, trust and government performance in Africa *Afrobarometer Dispatch No. 112* (available at: www.afrobarometer.org/publication/ad112-do-trustworthy-institutions-matter-development-corruption-trust-and-government/) (Accessed 27 October 2022)
- Bryan M L and Jenkins S P 2016 Multilevel modelling of country effects: a cautionary tale *Eur. Soc. Rev.* **32** 3–22
- Burke M B, Hsiang S M and Miguel E 2015 Climate and conflict *Annu. Rev. Econ.* **7** 577–617
- Carleton T A and Hsiang S M 2016 Social and economic impacts of climate *Science* **353** aad9837
- Cohen A 1990 The politics of ethnicity in African towns *The Urbanization of the Third World* ed J Gugler (Oxford University Press) pp 328–37
- Cologna V and Siegrist M 2020 The role of trust for climate change mitigation and adaptation behaviour: a meta-analysis *J. Environ. Psychol.* **69** 101428
- Daley P 2006 Ethnicity and political violence in Africa: the challenge to the Burundi state *Polit. Geogr.* **25** 657–79
- Detges A 2017 Droughts, state-citizen relations and support for political violence in Sub-Saharan Africa: a micro-level analysis *Polit. Geogr.* **61** 88–98
- Diedhiou A et al 2018 Changes in climate extremes over West and Central Africa at 1.5 °C and 2 °C global warming *Environ. Res. Lett.* **13** 065020
- Ford J D, Berrang-Ford L, Bunce A, McKay C, Irwin M and Pearce T 2015 The status of climate change adaptation in Africa and Asia *Reg. Environ. Change* **15** 801–14
- Harring N 2013 Understanding the effects of corruption and political trust on willingness to make economic sacrifices for environmental protection in a cross-national perspective *Soc. Sci. Q.* **94** 660–71
- Harring N 2018 Trust and state intervention: results from a Swedish survey on environmental policy support *Environ. Sci. Policy* **82** 1–8
- Heidenheimer A I 2002 Introduction. Part VII: endemic corruption and African underdevelopment *Political Corruption. Concepts and Contexts* ed A I Heidenheimer and M Johnston (Routledge) pp 375–8
- Herbst J 2000 *States and Power in Africa. Comparative Lessons in Authority and Control* (Princeton University Press)
- Holgate C 2007 Factors and actors in climate change mitigation: a tale of two South African cities *Local Environ.* **12** 471–84
- Hox J 2002 *Multilevel Analysis. Techniques and Applications* (Erlbaum)
- Hsiang S M, Burke M B and Miguel E 2013 Quantifying the influence of climate on human conflict *Science* **341** 1235367
- Hu L-T and Bentler P M 1999 Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives *Struct. Equ. Model.* **6** 1–55
- Huber R A, Gruessing E and Eberl J-M 2021 From populism to climate scepticism: the role of institutional trust and attitudes towards science *Environ. Polit.* **31** 1115–38
- Iddawela Y, Lee N and Rodríguez-Pose A 2021 Quality of sub-national government and regional development in Africa *J. Dev. Stud.* **57** 1282–302
- Klausbrückner C, Annegarn H, Henneman L R F and Rafaj P 2016 A policy review of synergies and trade-offs in South African climate change mitigation and air pollution control strategies *Environ. Sci. Policy* **57** 70–78
- Kulin J and Johansson Seva I 2021 Who do you trust? How trust in partial and impartial government institutions influences climate policy attitudes *Clim. Policy* **21** 33–46
- Lee T M, Markowitz E M, Howe P D, Ko C-Y and Leiserowitz A A 2015 Predictors of public climate change awareness and risk perception around the world *Nat. Clim. Change* **5** 1014–20
- Levi M and Stoker L 2000 Political trust and trustworthiness *Annu. Rev. Polit. Sci.* **3** 475–507
- Libarkin J C, Gold A U, Harris S E, McNeal K S and Bowles R P 2018 A new, valid measure of climate change understanding: associations with risk perception *Clim. Change* **150** 403–16
- Linke A M 2013 The aftermath of an election crisis: Kenyan attitudes and the influence of individual-level and locality violence *Polit. Geogr.* **37** 5–17
- Lund C 2006 Twilight institutions: an introduction *Dev. Change* **37** 673–84
- Mamdani M 1996 *Citizen and Subject. Contemporary Africa and the Legacy of Late Colonialism* (Princeton University Press)
- Marquart-Pyatt S T 2018 Trust and environmental activism across regions and countries *J. Environ. Sci. Stud.* **8** 249–63
- McGuirk E and Burke M B 2020 The economic origins of conflict in Africa *J. Polit. Econ.* **128** 3940–97
- Meagher K 2007 Introduction: special issue on ‘informal institutions and development in Africa’ *Afr. Spectr.* **42** 405–18
- Michalopoulos S and Papaioannou E 2013a Pre-colonial ethnic institutions and contemporary African development *Econometrica* **81** 113–52
- Michalopoulos S and Papaioannou E 2013b National institutions and subnational development in Africa *Q. J. Econ.* **129** 151–213
- Nassehi A 1990 Zum Funktionswandel von Ethnizität im Prozeß gesellschaftlicher Modernisierung (On the functional change of ethnicity in the process of social modernisation) *Soz. Welt.* **41** 261–82
- NAZCA 2021 *Global Climate Action NAZCA* (available at: <https://climateaction.unfccc.int/>) (Accessed 4 November 2021)
- Nominatim 2021 *Open Street Map* (available at: <https://nominatim.openstreetmap.org/ui/search.html>) (Accessed 4 November 2021)
- Nunn N 2008 The long-term effects of Africa’s slave trades *Q. J. Econ.* **123** 139–76
- Nunn N 2014 Gender and missionary influence in colonial Africa *Africa’s Development in Historical Perspective* ed E Akyeampong, R H Bates, N Nunn and J Robinson (Cambridge University Press) pp 489–512
- Nunn N and Puga D 2012 Ruggedness: the blessing of bad geography in Africa *Rev. Econ. Stat.* **94** 20–36
- Nunn N and Wantchekon L 2011 The slave trade and the origins of mistrust in Africa *Am. Econ. Rev.* **101** 3221–52
- Nyiwul L M 2019 Climate change mitigation and adaptation in Africa: strategies, synergies, and constraints *Climate Change and Global Development* ed T Sequeira and L Reis (Springer) pp 219–41
- Pelling M et al 2018 Africa’s urban adaptation transition under a 1.5° climate *Curr. Opin. Environ. Sustain.* **31** 10–15
- Putnam R D 1995 Bowling alone: America’s declining social capital *J. Democr.* **6** 65–78
- Rothstein B and Stolle D 2008 The state and social capital: an institutional theory of generalized trust *Comp. Polit. Stud.* **40** 441–59
- Schilke O, Reimann M and Cook K S 2021 Trust in social relations *Annu. Rev. Soc.* **47** 239–59
- Schlenker W and Lobell D B 2010 Robust negative impacts of climate change on African agriculture *Environ. Res. Lett.* **5** 014010
- Schmidt-Catran A W and Fairbrother M 2016 The random effects in multilevel models: getting them wrong and getting them right *Eur. Soc. Rev.* **32** 23–38
- Siegrist M and Cvetkovich G 2000 Perception of hazards: the role of social trust and knowledge *Risk Anal.* **20** 713–9
- Sjöberg L 2001 Limits of knowledge and the limited importance of trust *Risk Anal.* **21** 189–98

- Slater M D 2007 Reinforcing spirals: the mutual influence of media selectivity and media effects and their impact on individual behavior and social identity *Commun. Theory* **17** 281–303
- Tam K-P and Chan H-W 2018 Generalized trust narrows the gap between environmental concern and pro-environmental behavior: multilevel evidence *Glob. Environ. Change* **48** 182–94
- Vestby J 2019 Climate variability and individual motivations for participating in political violence *Glob. Environ. Change* **56** 114–23
- Vestby J, Buhaug H and von Uexkull N 2021 Why do some poor countries see armed conflict while others do not? A dual sector approach *World Dev.* **138** 105273
- Viklund M J 2003 Trust and risk perception in western Europe: a cross-national study *Risk Anal.* **23** 727–38
- von Uexkull N and Buhaug H 2021 Security implications of climate change: a decade of scientific progress *J. Peace Res.* **58** 3–17
- Wainwright C M, Marsham J H, Keane R J, Rowell D P, Finney D L, Black E and Allan R P 2019 'Eastern African Paradox' rainfall decline due to shorter not less intense long rains *npj Clim. Atmos. Sci.* **2** 34
- Wig T and Tollefsen A F 2016 Local institutional quality and conflict violence in Africa *Polit. Geogr.* **53** 30–42
- Zerfu D, Zikhali P and Kabenga I 2009 Does ethnicity matter for trust? Evidence from Africa *J. Afr. Econ.* **18** 153–75