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Cyclones and violence against civilians: Evidence from the Cabo Delgado insurgency

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Abstract
Do natural shocks increase insurgent rates of civilian victimization? We consider one case of a natural shock that directly affected an ongoing rebellion, Mozambique's Cabo Delgado insurgency, where in recent years an insurgency with few societal ties and an extremist, pro-Islamic State ideology has engaged in multiple attacks on civilians. Our assessment employs both time series analysis and qualitative evaluations. Our focus is on the effects of cyclones—a climatic event whose rates are predicted to intensify over the coming decades—on this insurgency's use of violence against civilians. In contrast to several past studies of natural shocks in conflict zones and strategic violence against civilians, our findings suggest that in contexts of insurgencies that do not have a strong local support base and where the group purports an extremist transnational ideology, natural shocks may lead to more violence against civilians.

Keywords
conflict, disaster, human security, violence, climate change

Introduction

How do cyclones impact the risk of insurgent-perpetrated violence against civilians?[1] In this study we leverage an exogenous weather shock to set up a "natural experiment" of an

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unanticipated weather-induced intervention in the context of insurgent violence. Our analysis focuses on an ongoing conflict in Mozambique's Cabo Delgado region, where religious-extremist rebels have been staging a low intensity insurgency (Oxford Analytica, 2020). Between March and April 2019, Cabo Delgado experienced two consecutive major storms, Cyclones Idai, and Kenneth. Cyclone Idai struck first and was initially described by the United Nations (UN) as "one of the worst weather-related disasters ever to hit the southern hemisphere" (Faleg, 2019, p. 2), whereas Kenneth was reported to be the most powerful cyclone on record to hit the region (Maclean, 2019). Natural disasters often include endogenous processes, where the severity of their impact is shaped by local state capacity and conflict dynamics (Gaillard et al., 2008; Yannitell Reinhardt & Lutmar, 2022). However, the cyclones themselves constitute random weather *shocks*, meaning that changes in insurgency patterns in the storms'*immediate* aftermath reflect their independent impact(s), once additional confounds are considered.

Our mixed-methods assessment of the cyclones' impact on the behaviors of Cabo Delgado's insurgents suggests that violence increased in the year following the shock. Quantitatively, the rates of insurgent attacks on civilians were an average of 0.8 to 0.9 incidents per week higher after the two cyclones compared with before. These findings are surprising considering that studies of insurgent violence against civilians that emphasize its long-term strategic logic would expect the opposite effect. Weather shocks—and natural shocks generally—harm military capacity by forcing governments to divert resources to handle the impacts of the disaster (Ide et al., 2020; Koehnlein & Koren, 2022). This opens doors for rebel groups to illustrate their viability as a service and governance provider while reducing their rates of violence, thereby gaining civilian support. Such trends have indeed occurred in post-shock contexts in the Philippines and Indonesia (Beardsley & McQuinn, 2009; Walch, 2014, 2018). By contrast, our findings are more in line with research that emphasizes disasters can create opportunities for violence (Beardsley & McQuinn, 2009; Wood & Kathman, 2014).

Importantly, in leveraging past research on ideology, bargaining, and natural resources (e.g., Wood, 2014; Wood & Kathman, 2014) alongside qualitative evidence from Cabo Delgado, we can suggest explanations for *why* the insurgents in Cabo Delgado behave in a seemingly self-defeating way and—broadly—*when* environmental shocks can increase civilian risk. In our theoretical section, we outline several potential explanations for this behavior, building on past research on social (dis)embeddeness (Mampilly & Stewart, 2021; Moore, 2019), ideological extremism (Sarwari, 2021; Thaler, 2012), and signaling (Farrell, 2020). Our qualitative assessment provides some evidence in support of these explanations within Cabo Delgado's insurgency. Considering that climate change-induced extreme events are increasing, and in illustrating how environmental shocks affected insurgent violence in Cabo Delgado, our study has implications for researchers working on understanding and explaining political violence and its causes in disaster contexts, and for policymakers seeking to address such disruptions.

Cyclones and insurgent violence: Theoretical linkages

Natural shocks and insurgency

Extant research has broadly considered how natural shocks shape conflict and political instability patterns (e.g., Beardsley & McQuinn, 2009; Gaillard et al., 2008; Raleigh &

Kniveton, 2012; Salehyan & Hendrix, 2014; Theisen et al., 2012; Walch, 2014, 2018). More recent studies emphasize the context-dependent nature of these effects, nesting a natural shock's impacts within the broader socioeconomic and political factors of where they take place. For example, Ide et al. (2020, p. 102063) show that "climate-related disasters increase the risk of armed conflict onset…[but] the link is highly context-dependent and we find that countries with large populations, political exclusion of ethnic groups, and a low level of human development are particularly vulnerable." Similarly, von Uexkull et al. (2016, p. 12395) argue that:

> it is clear that drought explains a small share of the observed variation in conflict involvement, implying that the substantive effect is modest compared with central drivers of conflict, such as ethnopolitical exclusion, temporal and spatial proximity to violence, and various country-specific risk factors.

Numerous studies find that natural shocks have a contextual impact, and that they are sometimes even associated with a positive (peaceful) outcome (e.g., Brzoska, 2018; Eastin & Zech, 2022; Ide, 2023; Kikuta, 2019; Kim, 2021; Slettebak, 2019).

With respect to violence against civilians, past research highlighted that violence patterns are often shaped by the strategic incentives of violent actors (Kalyvas, 2006; Valentino et al., 2004). Several scholars specifically explore the potential influences of climate shocks. Berrebi and Ostwald (2011), for instance, find that terrorist attacks in Thailand and Sri Lanka increased following the tsunami that hit the region in 2011. Bagozzi et al. (2017) find that insurgent attacks against civilians rose in locations and years that experienced drought, a finding subsequently confirmed in Africa (Rezaeedaryakenari et al., 2020). However, this extant research has rarely examined the exact *motivations* for these behaviors or tried to identify organizational-specific risk traits. Several of these studies (e.g., Berrebi & Ostwald, 2011) also use country-level data, which prevents them from assessing exactly *where and how* the storms' impacts affected violence. We address this issue using a mixed method assessment and empirical focus on weekly level time series variation in violence against civilians.

In line with research that highlights the importance of climate shocks in creating windows of opportunity for civilian victimization linked to temporarily weakened/shifted state capacity (e.g., Beardsley & McQuinn, 2009; Koehnlein & Koren, 2022), we emphasize the context-dependence linking natural shocks and their potential impacts on violence. In this regard, one possible pathway relates to the impacts of the cyclones on the state's local administrative and bureaucratic capacities, specifically its ability to address both the implications of the event and the insurgency (including providing protection to vulnerable civilians). This notion builds on the definition of administrative capacity developed by Hendrix (2010, p. 274), who stresses that this perspective "shifts the focus from the state's ability to put boots and arms in the field to its ability to collect and manage information." Weak states often struggle to obtain information and to regulate political and socio-economic activity within their boundaries, providing an opportunity for rebel groups and non-state actors to use this to their advantage (Herbst, 2000). Strong states, in contrast, have more developed administrative apparatuses and often more supporting resources, which allows them to collect information, maintain (or reintroduce) local administrative operations, and effectively identify potential threats.

In these regards, researchers suggest that natural shocks can impact the administrative capacity of weak states in a variety of ways. For example, in diverting resources to combat a cyclone's fallout, governments may need to reduce or stop providing other services (e.g., Brzoska, 2018; Salehyan & Hendrix, 2014). Weak states also tend to divert funds away from natural disaster preparedness and mitigation, ultimately compounding the shocks' adverse impacts (McLean & Whang, 2021). With respect to cyclones, massive flooding and destruction of transportation networks can further undermine the government's ability to actively access disaster-affected regions, reducing its physical presence locally. Already facing constraints on resource allocations even before the storm strikes, the expense of limited resources for disaster mitigation and relief further strains the regime. International agencies and organizations can provide aid to address humanitarian implications, but their impact on improving administrative capacity and the ability to protect civilians from insurgent predation varies (Koehnlein & Koren, 2022).

Under these circumstances, an *opportunity* opens for insurgents to exploit this governance vacuum, further exacerbating the government's administrative and military capacities. When a storm inundates villages and fields, destroying infrastructure, and posing a sudden economic strain, governments' abilities to administer and control disaster-affected areas and—importantly—to protect civilians are constrained (e.g., Ide, 2021; Ide et al., 2020; Koehnlein & Koren, 2022). This is especially pertinent if the government's presence in the region was already tenuous and limited to specific areas, such as for oil or gas extraction sites or mining facilities, and if many civilians are forced to live in temporary camps due to the disaster. In such contexts, insurgents can take advantage of the increased vulnerability of civilians (Rezaeedaryakenari et al., 2020).

It is crucial to emphasize that these dynamics will not necessarily persist indefinitely—as the government is able to address the impacts of the disaster and eventually reintroduce control, violence could also decline over time.[2] This is important in that our theory, assessment, and discussion are ambiguous as to the ability of the government to reestablish control—and corresponding rates of violence—in perpetuity. Another caveat relates to the possibility that climate-induced shocks to administrative governance could induce pacifying effects in at least some contexts (Beardsley & McQuinn, 2009; Kikuta, 2019; Kreutz, 2012; Walch, 2014). Accordingly, in line with research on opportunistic violence (e.g., Wood, 2014), our theory and empirical assessments of a natural shock's impact pertain primarily to its short-term effects (approximately 1 year after the storms' landfall, in the analysis below) and their impact on a group's propensity to engage in *violence*. Thus, we outline two scope conditions in our next subsection that link cyclones to higher risk to civilians from insurgent attacks, before proceeding to test the broader implications of our theory in the empirical section. Specifically, we build on relevant research to identify two risk factors that could impact a group's propensity to increase violence given the post-cyclones opportunity: social disembeddedness and ideological signaling.

Pathways to civilian victimization

The first scope condition we emphasize is the degree to which the group is socially embedded within the local population. "Anchored" groups, namely groups that have a high degree of social embeddedness (Sarbahi, 2014), enjoy more popular support. Historically, groups such as New People's Army and Free Aceh Movement could be considered as socially embedded, considering their appeal to and dependence on the local population (Beardsley & McQuinn, 2009; Walch, 2014). In contrast, non-anchored—or "floating"—groups have a low degree of social embeddedness (Sarbahi, 2014). As such groups rely on little-to-no support from the population, their incentives for engaging in predatory behaviors to obtain resources such as money and food rises (Koren & Bagozzi, 2017; Mkandawire, 2002; Wood, 2014). While winning the hearts and minds of a local population is often hard, non-anchored groups face particularly high barriers due to their lack of social embeddedness and the need to support themselves (Wood, 2014). Moreover, aware of this issue, insurgents might not even seek to win the hearts and minds of civilians at all. In these circumstances, the alternative to gaining a population's support via peaceful means is to use violence to obtain compliance (Mkandawire, 2002; Wood, 2010).

For instance, Moore (2019) shows that foreign insurgents who are not socially embedded raise the risk of civilian victimization. The reason is that "[s]ocial embeddedness thus eases access to critical information and blurs the distinction between rebel and civilian" (Moore, 2019, p. 281), so "[g]roups that employ socially disembedded outsiders may face unique hurdles relative to those that rely on cadres of fighters who are networked into local communities" (Moore, 2019, p. 283). Similarly, Mampilly and Stewart (2021) develop a typology of rebel power-sharing, integration, and inclusion of civilians using the examples of the Rwanda Patriotic Front and the Islamic State (IS). Within this framework, the lack of social embeddedness is one reason for why insurgents will not engage in any power-sharing (favoring martial law instead) or choose to use partial subjugation. Focusing on military capacities broadly, Wood (2014, p. 476) shows that "[i]ncentives for victimization are instead largely shaped by the group's potential to mobilize support among the population and its reliance on this support for its survival."

Extending the logic of social (dis)embeddedness and windows of opportunity, we draw linkages with climate shocks. We posit that following such shocks, socially disembedded groups will find it less useful to increase civilian inclusion and provide governance services compared with embedded groups. Instead, they will prefer to leverage the increased vulnerability of civilians to engage in violence, for instance, to loot or extort civilians and aid providers (Wood, 2010, 2014) or kill more civilians to impose regime costs. This contrasts to using this opportunity to increase their relative power by undermining the influence of government.

A second, and related, scope condition pertains to the rebel group's ideology and strategic goals. Some groups have ideologies that are more likely to produce violence. For instance, Sarwari (2021) shows that religious insurgents are much more likely to encourage sexual violence as a means of subjugation, whereas Marxist-Leninist groups are less likely to do so. Sanín and Wood (2014) argue that ideology conditions violence as a means of socialization or in reducing normative commitments to restrain from using violence. Some groups may also operate locally and draw on local recruits but have national or global ambitions. Such groups will purport ideologies that are often extremist, transitional, or religious (e.g., establishing an international caliphate), and which—as a result—are unlikely to appeal to the local populations (Boukhars, 2020; Mkandawire, 2002). They may therefore attack civilians to signal *alignment*, especially if they do not directly receive support from the transitional actors that originated the ideology (Farrell, 2020; Hoffman & McCormick, 2004) or to not seek to settle with the government (Wood & Kathman, 2014).

This pathway is especially relevant when collaborating and coordinating attacks across distinct and remote world regions. An effective option for insurgents that share the same ideology is to physically harm civilians—often brutally—to signal their commitment to the shared ideology to other umbrella organizations and groups (Hoffman & McCormick, 2004). This is especially true for groups such as IS and Al Qaeda, which serve as such ideological "umbrellas" for other global organizations that operate in distinct and isolated world areas (Rosenblatt et al., 2019). For instance, a 2016 statement by the IS's spokesperson that "civilians were fair game" resulted with a wave of violence spanning the globe, from Orlando USA, through Magnaville, France and Istanbul, Turkey, to north Lebanon, Baghdad, Iraq, and Dhaka, Bangladesh (Rosenblatt et al., 2019, p. 39). These attacks were all carried out by individuals who wanted to signal their commitment not only to their target governments, but also and primarily to IS's leadership, given that they otherwise had no direct contact with the group before referencing its call as the reason for their attack. While Rosenblatt et al. (2019, p. 41) do not find a clear link between propaganda and the level of violence, they also conclude that "[a]ttacks do not need to follow leadership statements every time in order to fulfill their intention of signaling a commitment." To signal alignment, it is sufficient that violence is perpetrated against the same targets identified by the umbrella organization, and that the attack is attributed at least partly to the influence of this umbrella organization. Indeed, insurgents that signal ideological alignment will also often publicize videos of attacks or of their leaders discussing the group's ideology (and alignment with others) on social media or other media outlets.

Why should the signaling logic lead to more violence on the count of susceptible groups following a natural shock? First, considering the opportunity aspect of our argument emphasizes decline in government presence, increasing violence rates following a natural shock can be more easily interpreted as a demonstration of strength to potential umbrella organizations, highlighting the group's violence and the government's lack of power to stop it. Another possibility could be related to media coverage. Following a disaster, national and international media outlets are more likely to be present in affected regions in the interest of reporting about the situation, providing susceptible groups with a larger stage for their violence to be reported (Hoffman & McCormick, 2004).

Building on Seawright and Gerring's (2008)"most likely" case approach, we are interested in the microanalysis of one specific case that meets our scope conditions rather than a cross-comparative evaluation, where the key difference over time is the natural shock. This means that both the social disemebeddeness and ideological signaling features are effectively held constant in our quantitative analysis of this case. For this reason, we leverage qualitative evidence to assess their viability below. The logic behind this design is summarized as follows. Previous research highlights the importance of social embeddedness, ideology, and resource constraints as factors that condition civilian victimization (e.g., Hoffman & McCormick, 2004; Moore, 2019; Wood, 2014). Previous research also highlights the importance of climate shocks in creating windows of opportunity for civilian victimization linked to costly violence (e.g., Bagozzi et al., 2017; Rezaeedaryakenari et al., 2020) and temporarily weakened state capacity (Ide et al., 2020; Koehnlein & Koren, 2022). Accordingly, we treat the Cabo Delgado insurgency as a most-likely case where civilian victimization ramps up in the aftermath of a disaster and test the impact of natural shocks in this context.

Background on Cabo Delgado's insurgency[3]

The Cabo Delgado region of Northern Mozambique has experienced a domestic Islamist insurgency since 2015. While this insurgency currently exhibits ties to international groups, the domestic conditions—including unequal distribution of revenue from natural resources and marginalization of many people in the region by the government—are often identified as central causes (Matfess, 2019, p. 2; Mukwakwa, 2020). The insurgents primarily refer to themselves as Ansar al-Sunna or Ahlu Sunnah Wa-Jama (ASWJ), but the "population on the ground" refer to them as "Al-Shabaab," a term the "insurgents eventually re-appropriated" (Morier-Genoud, 2020, p. 398). By most accounts, ASWJ was established in Cabo Delgado around 2015 by Islamist extremists (West, 2018, p. 5).

Over the 2015 to 2017 period, the group became increasingly violent, eventually calling for Sharia's implementation, advancing anti-state rhetoric, and creating hidden training camps for government opposition, with membership estimates ranging from 350 to 1,500 (Faleg, 2019; Morier-Genoud, 2018; Mukwakwa, 2020) and funding obtained via smuggling and illicit trade in contraband goods (Faleg, 2019; Morier-Genoud, 2018; Mukwakwa, 2020; West, 2018). In this early period of the insurgency, the imposition of Sharia Law was the "initial goal" of ASWJ, and they attempted to enforce it by "withdrawing from society and the state whose schooling, health system and laws it rejected" (Morier-Genoud, 2018, p. 2). On the part of the government, nothing was done until October 5th, 2017, which corresponds to an attack marking the starting point of ASWJ's active campaign against the state (Matsinhe & Valoi, 2019, p. 17). This October 2017 attack targeted police forces and not civilians, despite one civilian death (Matsinhe & Valoi, 2019 of; Morier-Genoud, 2018), which potentially suggests that civilians were not initial targets the insurgency.

Background on Cyclones Idai and Kenneth

Cyclone Idai began as a tropical disturbance on March 3rd, 2019. It ultimately made landfall as a category 2 storm on March 14th in Mozambique. It was described by the UN as "one of the worst weather-related disasters ever to hit the southern hemisphere" (Faleg, 2019, p. 2). After Idai's landfall, electricity was unavailable across the region, leading to internal displacements (Gerken, 2019, p. 10). The cost of the rescue efforts was estimated at $282 million (OCHA, 2020), while the Cyclone and subsequent flooding were responsible for the destruction of more than 100,000 residences and millions of dollars in damage to buildings, infrastructure, and agriculture (UN News, 2019). 600,000 residents were left in need of food, water, and other supplies (Yuhas, 2019). One year after Cyclone Idai made landfall in Mozambique, roughly 2.5 million people remained in need of humanitarian assistance due to the Cyclone's effects (UNICEF, 2020).

Cyclone Kenneth hit Mozambique on April 25th, 2019, 6 weeks after Idai. It was considered the strongest cyclone on record at the time (UNICEF, 2020) and was ultimately designated category 4 just prior to landfall. Immediately prior to Cyclone Kenneth's landfall, relief directors worried that "existing relief resources for Idai are not sufficient as things stand" and that Cyclone Kenneth would make relief delivery "very difficult, if not impossible" (Hope, 2019, p. 1). Damage to infrastructure was a similar cause for concern among aid workers, who questioned whether they would be able to effectively distribute emergency rations (de Greef, 2019).

Quantitative analysis

To quantify insurgent violence against civilians for our Cabo Delgado case, we employ data from the Armed Conflict Location and Event Dataset (ACLED; Raleigh et al., 2010). ACLED is widely used in similar microanalyses of political violence (e.g., De Juan et al., 2019; Haer & RezaeeDaryakenari, 2022; Koren & Bagozzi, 2017; Kreutz, 2012) including studies of Mozambique's insurgency (ACLED, 2020). As political event data, ACLED allows us to recover discrete daily events of violence against civilians as perpetrated by armed non-state actors. For our measure of insurgent violence against civilians, hereafter referred to as *Insurgent Violence*, we subset the ACLED data to such events arising only within Mozambique's Cabo Delgado province for March 1st, 2018 through April 30th, 2020. This time window ensures over a full year of data coverage prior to the onset of Cyclone Idai and slightly over 1 year of data coverage after the landfall of Cyclone Kenneth. Extending the data beyond April 30th, 2020, poses inferential problems for our analysis given the subsequent spread of COVID-19 in Mozambique. For our ACLED data, our dependent variable then retains only violent events arising from Cabo Delgado's insurgents[4] and targeting civilians.

The above data formatting steps identify 295 individual instances of insurgent violence against civilians in Cabo Delgado from March 1st, 2018 to April 30th, 2020. We next aggregate these data to a single time series of weekly event counts of *Insurgent Violence* against civilians for Cabo Delgado. This choice of weekly aggregation conforms with the primary level of temporal aggregation presented within ACLED's own microanalysis of political violence in Mozambique (ACLED, 2020) as well as with several broader micro analyses of subnational political violence (e.g., Bhatia et al., 2019; Osorio, 2015). We demonstrate the robustness of our analysis to an alternate, monthly, temporal aggregation further below. Our Supplemental Appendix presents summary statistics for all variables used in our analysis.

For our independent *Cyclone* variable, recall that Cyclone Idai made landfall in Mozambique on March 14th, 2019; whereas Cyclone Kenneth hit Mozambique 6 weeks after Cyclone Idai on April 25th, 2019. We accordingly coded *Cyclone* as 0 for every week prior to March 14th, 2019, and as 1 thereafter (i.e., until April 30th, 2020). This coding designates the effect of *Cyclone* to persist for roughly 1 year after the landfall of Cyclone Kenneth, which is consistent with a broad array of accounts from aid agencies indicating that the damage, aftermath, and social disruptions of these dual Cyclones in Mozambique has persisted for at least a full calendar year after their landfall (OCHA, 2020; Reliefweb, 2020; UN, 2020). This coding also effectively allows us to treat the joint effects of Cyclones Idai and Kenneth as an external shock in the context of insurgent violence in Cabo Delgado.

To initially visualize the relationship between (a) Cyclones Idai and Kenneth and (b) *Insurgent Violence* against civilians, we collapse *Insurgent Violence* to the monthly level for our period of interest and plot the corresponding monthly event counts in *Insurgent Violence* for Mozambique's Cabo Delgado region in Figure 1. We then add to this plot vertical lines corresponding to the month of landfall of Cyclone Idai and Cyclone Kenneth. This Figure demonstrates that Cabo Delgado's insurgency exhibited a low level of civilian targeting in the 12 months prior to Cyclone Idai's onset, with monthly event counts ranging from 0 to 13, an average number of events of 5.5, and no discernable upward or downward trend. However, beginning with Cyclone Idai's landfall, we then see a brief decline in violence in the immediate month following the cyclones' landfalls followed by a substantial increase in monthly instances of civilian targeting thereafter. For the period from March 2019 onward, Cabo Delgado's insurgents exhibit a monthly average of 16.14 attacks—nearly three times the rate of events observed for the pre-cyclone period in Figure 1.

We provide several additional illustrations in the Supplemental Appendix for descriptive purposes. For example, Supplemental Figure A.1 plots each cyclone's track while Supplemental Figure A.2 plots the location and frequencies of violence by insurgents before and after the cyclones. In support of our contentions, this descriptive evidence shows not

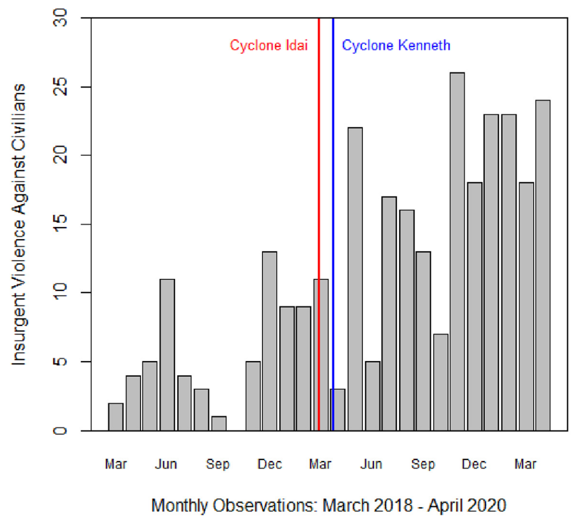

Figure 1. Temporal variation in monthly insurgent violence in Cabo Delgado for the period covering 1-year prior-to, and 1-year following, Cyclones Idai and Kenneth.

only intensification in violence following the two cyclones; but also that this intensification was the greatest in locations in the direct trajectory of the cyclones (especially Kenneth), which were also the most severely affected. Altogether, this preliminary evidence suggests an increase in insurgent violence against civilians in Cabo Delgado starting with the landfall of Cyclone Idai and persisting 1 year after Cyclone Kenneth's landfall.

Modeling approach

We use time series analysis to better assess the effects of *Cyclone* on *Insurgent Violence*. In this context, our focus is a single series of weekly (t) event count data on *Insurgent Violence* against civilians (y_t) for the period March 1st, 2018 to April 30th, 2020. Although—as mentioned above—the insurgency began in 2015, we decided to focus on this period as it covers the year before and year after the two cyclones, providing an effective assessment of the storms' immediate effects. This time series corresponds to 114 total weeks (T).[5] For our quantitative analyses, our contention is that a structural break in *Insurgent Violence* occurred in conjunction with Cyclones Idai and Kenneth. Supplemental Figure A.3 in the Supplemental Appendix presents our full weekly time series and its autocorrelation function (ACF), whereas Supplemental Figures A.4 and A.5 present comparable quantities for our (a) pre-Cyclone and (b) post-Cyclone sub-periods. Supplemental Figure A.3 suggests that our full time series does not exhibit seasonality but does exhibit a degree of non-stationarity given some persistence in the ACF following a large single spike in the first lag. However, after splitting our series by *Cyclone*, we find no evidence of non-stationarity in Supplemental Figures A.4 and A.5. This is consistent with our contention that any non-stationarity in our series is driven by a structural break due to Cyclones Kenneth and Idai. We hence seek to test for this potential explicitly via our *Cyclone* indicator, as opposed to modeling away any nonstationarity via first differencing or a nonstationary model.

Given the above reasoning, we employ a linear Poisson autoregressive [PAR(p)] model (Brandt & Williams, 2001) for dynamic event counts, y_t, in our primary analyses. The PAR(p) models y_t as a function of k exogenous covariates (x_t hereafter) and has been previously used in analyses of policy interventions in the context of neighborhood thefts, presidential vetoes, and terrorist hostage-taking dynamics (Brandt & Sandler, 2009; Brandt & Williams, 2001). In addition to ensuring that we can properly account for any dependent, autoregressive processes in our event count time series data, the PAR(p) model importantly allows us to estimate both the immediate and long-term effects of *Cyclone* on our dynamic counts of insurgent violence against civilians. As such, the PAR(p) model provides an ideal and effective way of evaluating *Cyclone*'s impacts. We also present several alternative modeling approaches in the robustness section.

As detailed in Brandt and Sandler (2009, pp. 764–765), the PAR(p) model is based upon an extended Kalman filter for count processes, whereby one can capture an event time series' autoregressive process via a series of three equations. The first equation is a measurement equation of y_t, and is defined as $\Pr(y_t|m_t) = (m_t^{y_t}\exp(-m_t))/y_t!$, where m_t is the mean Poisson process at time t. The second equation is a transition equation for the (latent) mean number of events' autoregressive evolution, defined as $m_t = \sum_{i=1}^{p} \rho_i y_{t-i} + \left(1 - \sum_{i=1}^{p} \rho_i\right)\exp(x_t\beta)$, where ρ_i is the autoregressive lagged count parameter, ρ is the number of autoregressive lags employed, and β is a $k \times 1$ vector of regression coefficients for x_t. The third equation captures the initial conditions of the probability density for the autoregressive process in each t via $\Pr(m_t|y_{t-1}, \ldots, y_{t-p}) = \Gamma(\sigma_{t-1}m_{t-1}, \sigma_{t-1})$ with a Γ-distributed mean and scale parameter σ_t. Drawing on these equations, Brandt and Williams (2001) show that the PAR(p) model's predictive count distribution is negative binomial (NB), ensuring that the model accounts for overdispersion via serial correlation in y_t.

For this model, model selection criteria such as Akaike information criteria (AIC) can be used to select the lag structure for the exogenous covariates included in x_t. For a given exogenous covariate, x, and lag structure, the impact (i.e., instantaneous) and long-run multipliers of a one-unit change in that covariate can be calculated via the following two equations, which we present for a one period lag structure (i.e., t^t and $t-1$) for ease of exposition:

$$\text{Impact Multiplier}: \left(1 - \sum_{i=1}^{p} \rho_i\right)\exp(\gamma z_t + \beta_1 x_t + \beta_2 x_{t-1})\beta_1, \tag{1}$$

$$\text{Long} - \text{Run Multiplier}: \exp(\gamma z_t + \beta_1 x_t + \beta_2 x_{t-1})\beta_2, \tag{2}$$

where z_t are the remaining exogenous covariates with coefficients γ_i, and where β_1 and β_2 denote the coefficient estimates for x_t and x_{t-1}, respectively (Brandt & Sandler, 2009).

We estimate four PAR(p) specifications below. For these specifications, we follow Brandt and Sandler (2009) in first identifying an optimal lag length for our PAR(p) models by estimating a series of baseline PAR(p) models with successively higher ρ's. Here we begin with $p = 1$ and consider up to $p = 6$.[6] We select the most parsimonious PAR(p) model that exhibits statistically significant lag coefficients across all ρ's considered, in this case selecting a PAR(2) model for all primary PAR(p) specifications. We then incrementally add-in our key independent variable—*Cyclone*—and a series of relevant controls. Consistent with Brandt and Sandler (2009, p. 766), we use AICs to select lag structures for each exogenous covariate (including *Cyclone*) by considering lags of up to two periods (and every combination thereof).

We include several control variables along with their appropriate (AIC-selected) lags. To rule out the potential that *Cyclone* is simply increasing violence against civilians from all actors in Cabo Delgado, we use ACLED to derive a control for weekly event counts of government violence against civilians in Cabo Delgado (*Gov.→Civ. Violence*). To ensure that we are identifying an effect of *Cyclone* on strategies of insurgent violence towards civilians, we again use ACLED to derive and include a weekly event count control for insurgent violence against government actors in Cabo Delgado (*Insurg.→Gov. Violence*). To rule out the potential that *Cyclone* may produce heightened government counterinsurgency efforts in Cabo Delgado,[7] we include and control for an ACLED-derived weekly count of government violence against insurgents in Cabo Delgado (*Gov.→Insurg. Violence*). To account for the possibility that insurgent violence in proximate regions is driving any observed effect, we control for a(n ACLED) count of *Ext. Insurg. Violence* (against government and civilian targets) in all areas of Mozambique outside of Cabo Delgado.[8] Finally, in October 2019, a Russian paramilitary group collaborated with the Mozambican military to launch counterinsurgency operations in Cabo Delgado, resulting in the capture of several insurgents and the subsequent killing of seven Russian mercenaries in retaliation (Mukwakwa, 2020, p. 7; Sauer, 2019). To ensure that the arrival of Russian mercenaries is not driving our findings, we include a binary control that is coded 1 from October 2019 onward.

Results

Our results appear in Table 1. Our independent variable, *Cyclone*, is positive and statistically significant at either the $p < .05$ (Model 3–4) or $p < .01$ (Models 1–2) levels across all four model specifications. In support of our contentions, this implies that Cabo Delgado's *Cyclone* period is associated with an increased frequency of weekly *Insurgent Violence* against civilians. Put simply, quantitative evidence strongly suggests that the two cyclones have pushed Cabo Delgado's insurgents to intensify their attacks against civilians in the region.

We next consider our estimates for ρ_1 and ρ_2. In each specification, these estimates are consistently positive and are statistically significant in the case of ρ_1. This implies that *Insurgent Violence* against civilians within Cabo Delgado is positively correlated over t—and thus that such violence exhibits positive temporal dependence. Turning to our controls, *Gov.→Insurg. Violence*, *Insurg.→Gov. Violence*, and *Russian Support* each generally exhibit reliable and positive associations with *Insurgent Violence* against civilians. By contrast, *Gov.→Civ. Violence* and *Ext. Insurg. Violence* each exhibit unreliable effects in Table 1.

To evaluate the net effects of *Cyclone*, we calculate its multiplier effects as defined in Equations 1-2. For each model specification, Table 2 reports *Cyclone*'s multiplier effects while holding all other covariates to their means. In keeping with Brandt and Sandler (2009), this Table reports uncertainty estimates for these multiplier effects based upon Monte Carlo-estimated 68% confidence regions (i.e., roughly one standard deviation above and below a mean estimated effect). Given that the sample average for our weekly *Insurgent Violence* event counts is only 2.5, the effects of a 0-to-1 change in *Cyclone* are consistently positive and substantively sizable. The instantaneous effect of *Cyclone* (i.e., in period $t + 1$) implies 0.78-to-0.98 additional weekly *Insurgent Violence* attacks against civilians, on average. The

Table 1. PAR(p) models of weekly insurgent violence against civilians in Cabo Delgado.

Variables	Model 1	Model 2	Model 3	Model 4
Cyclone	.568*** (.182)	.512*** (.197)	.502** (.204)	.495** (.235)
Gov.→Insurg. Violence	.180 (.127)	.255** (.116)	.254** (.129)	.233* (.137)
Gov.→Insurg. Violence t−1	−.598** (.303)	−.485* (.251)	−.471* (.257)	−.608** (.247)
Insurg.→Gov. Violence	.	.030 (.142)	−.006 (.154)	−.090 (.170)
Insurg.→Gov. Violence t−1	.	.266** (.129)	.287** (.134)	.327** (.134)
Insurg.→Gov. Violence t−2	.	−.238 (.213)	−.345 (.286)	−.455 (.296)
Gov.→Civ. Violence	.	.	−.146 (.292)	−.416 (.313)
Gov.→Civ. Violence t−1	.	.	.336 (.230)	.274 (.244)
Ext. Insurg. Violence	.	.	.	−.015 (.057)
Ext. Insurg. Violence t−1	.	.	.	.058 (.051)
Ext. Insurg. Violence t−2	.	.	.	−.102 (.068)
Russian Support	.	.	.	.586* (.334)
ρ_1	.291*** (.082)	.265*** (.085)	.278*** (.083)	.256*** (.093)
ρ_2	.081 (.106)	.075 (.099)	.083 (.101)	.78 (.101)
Intercept	.790*** (.173)	.749*** (.173)	.757*** (.178)	.694*** (.179)
Log Likelihood	−219.063	−216.308	−215.244	−210.672
AIC	448.126	448.617	450.489	449.344
$\chi^2_{df=p}$, H_0: Poisson Model (*p*-value)	15.144 (.001)	11.095 (.004)	12.547 (.002)	8.879 (.011)
d.f.	107	103	101	97

Standard errors in parentheses. ρ_i denotes the autoregressive lag coefficient at lag *i*. Weekly data for 03/2018 to 04/2020.

Note. AIC = Akaike information criteria.

$^*p < .1$. $^{**}p < .05$. $^{***}p < .01$.

total long-run impact of *Cyclone* in turn implies 1.2-to-1.5 additional weekly instances of *Insurgent Violence* against civilians. Hence, in support of our theoretical arguments, *Cyclone* notably increases *Insurgent Violence* against civilians in both the short and long term.

Finally, we consider the χ^2 tests in Table 1. The null hypothesis of each χ^2 test is that a given PAR(2) model's autoregressive process is more properly specified as jointly zero—and that our time series data are thus better modeled via a standard Poisson model rather than a PAR(p) model. As Table 1 indicates, we can reject this null hypothesis at the $p < .01$ level for each specification. This implies that the PAR(p) model is preferable to a standard Poisson model in each instance, and that our time series of *Insurgent Violence* against civilians in Cabo Delgado exhibits a dependent, autoregressive process.

Robustness assessments

Our Supplemental Appendix evaluates the sensitivity of the above results. Supplemental Table A.2 re-estimates our models after re-coding *Cyclone* to begin with the landfall of Cyclone Kenneth rather than Idai. All results remain highly robust to this alternate temporal coding. Supplemental Table A.3 returns to our main *Cyclone* measure but now separately controls for the immediate month following both cyclones' landfalls given the brief decline in violence during that period observed in Figure 1. We find that this latter control is negative but not statistically significant, whereas our coefficient estimate for *Cyclone* remains positive and statistically significant across all models. Supplemental Tables A.4 and A.5

Table 2. PAR(p) impact and long-run multipliers for 0 → 1 change in Cyclone.

Effect type	Cyclone, Model 1	Cyclone, Model 2	Cyclone, Model 3	Cyclone, Model 4
Impact	0.851 (0.510↔1.407)	0.983 (0.574↔1.512)	0.956 (0.510↔1.589)	0.781 (0.375↔ 1.438)
Total	1.399 (0.887↔2.163)	1.502 (0.929↔2.230)	1.546 (0.858↔2.451)	1.201 (0.617↔2.081)

Note. 68% confidence regions in parentheses.

evaluate the sensitivity of our findings to our choice of ρ. Here, we estimate a comparable series of PAR(1) and PAR(3) models and find that our main conclusions likewise hold under these alternative lag structures. Next, we assess the sensitivity of our *Cyclone* findings to the Cabo Delgado insurgency's increasing alignment with the IS over time. Aside from an instance of the IS claiming credit for an attack by Cabo Delgado's insurgents in 2017 (Weiss, 2019), evidence suggests that the latter insurgents' international interaction with the IS began to arise in 2018, during a deadly May 27th attack by Cabo Delgado insurgents in Macomia, Cabo Delgado that was celebrated on pro-IS channels on the Telegram messenger service (BBC, 2018). We hence code a new binary variable (*IS Support*), set equal to 1 for the period in our time series beginning on May 27th, and 0 prior to that point. We add this control to each of our primary (i.e., Table 1) model specifications within Supplemental Table A.6. We find that our estimated effects for *Cyclone* remain significant and actually grow in magnitude after controlling for *IS Support*, though model fit statistics continue to favor our Table 1 specifications over those in Supplemental Table A.6. We then present a series of standard Poisson and NB models for each of our Table 1 specifications in Supplemental Tables A.7 and A.8. We find herein that the violence-inducing effects of *Cyclone* remain positive and statistically significant in all instances.

Next, we return to our primary PAR(2) models and re-estimate these models for monthly—rather than weekly—data. Although this significantly reduces our *N*, Supplemental Table A.9 indicates that the effect of *Cyclone* remains positive and statistically significant in all model specifications considered. Following this, we report baseline versions of all main and robustness models reported thus far. Per Supplemental Table A.10, our findings are generally robust to this sparser approach. We then implement a placebo test by considering the effects of our primary *Cyclone* variable on violence against civilians at the hands of al-Shabaab in Somalia, for a comparably sized and located region (Middle Juba and Lower Juba) within the same weekly time-series and time window as outlined above. We selected this case and region for our placebo test as it represents one of the most geographically and ideologically proximate Islamist insurgencies in Africa that was nevertheless unaffected by Cyclones Kenneth and Idai. Hence, if our time-window-based *Cyclone* variable is indeed affecting Cabo Delgado's insurgency due to its cyclone-specific effects—and not due to some spurious temporal process associated with Sub-Saharan Africa, reporting patterns, or transnational Islamist insurgency—we would expect a positive finding for *Cyclone* in Cabo Delgado but not in the context of Middle and Lower Juba. Per Supplemental Table A.11, the effect of *Cyclone* is not statistically significant for Somalia—confirming our expectations.

We next adopt a different tack entirely in estimating the number and locations of changepoints within our weekly *Insurgent Violence* data directly, rather than making assumptions regarding PAR(p) process timing. To do so, we use Blackwell's (2018) Bayesian changepoint

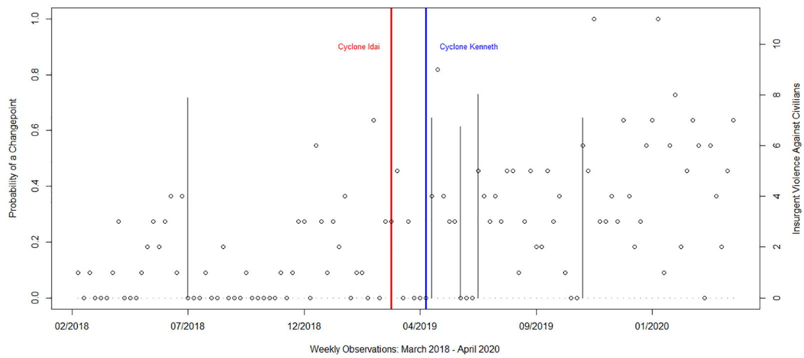

Figure 2. Changepoint probabilities greater than .50 for insurgent violence.

model for overdispersed count data.[9] This model utilizes our *Insurgent Violence* variable (but does not include *Cyclone*) to recover both the number of underlying changepoints in this weekly series and their locations. Accordingly, this analysis allows us to better evaluate whether the specific timing of shifts in insurgent tactics align with our cyclone events, as opposed to following broader upward trends in violence over our entire analysis window. In estimating this model using Markov Chain Monte Carlo (MCMC) with 100,000 iterations, thinning of 100, and a burn-in of 5,000 iterations, we recovered the posterior changepoint probabilities for each weekly time point in our series. Following Blackwell (2018, p. 237), we then plot all changepoints with a probability greater than .5 in Figure 2. This Figure also includes markers for Cyclones Kenneth and Idai and points for our weekly counts of *Insurgent Violence*.

Figure 2 supports our theoretical contentions. It identifies five changepoints with a posterior probability greater than .5. Three of these five changepoints imply that finer grained structural breaks in our time series occurred very shortly after the landfall of Cyclone Kenneth. Whereas the first two of these changepoints could be argued to reflect the initial volatility in insurgent violence immediately following the Cyclones' landfalls, the third of these changepoints more definitively denotes an increase in violence that persists for the remainder of the series. This is consistent with contentions that Cyclones Idai and Kenneth ultimately produced a tactical increase in insurgent violence against civilians which—when viewed alongside the evidence for *Cyclone* above—implies that these Cyclones contributed to shifts in civilian targeting among Cabo Delgado's insurgents. The two remaining changepoints identified in Figure 2 are also informative. The first occurs in June to July 2018 when *Insurgent Violence* exhibits a sharp decline—suggesting that, if anything, violence against civilians may have been in a low intensity phase in Cabo Delgado leading up to Cyclones Idai and Kenneth. The final changepoint then occurs in late fall 2019. The added uptick in *Insurgent Violence* captured here is consistent with the Russian mercenary-backed counterinsurgency operations in Cabo Delgado that began in October 2019.

Assessing the Scope Conditions

We now turn to evaluate whether our claimed scope conditions are present in this context using qualitative process tracing.[10] Prior to the landfalls of Cyclones Idai and Kenneth, the insurgents' tactics remained consistent over time. Some authoritative accounts emphasized that prior to the cyclones, the insurgency was more so targeting military and police forces than civilians (Morier-Genoud, 2018, p. 1). However, in line with our quantitative findings, these behaviors shifted after the cyclones, involving not only an increase in the killings of civilians by shootings, but also the increased usage of decapitations, often alongside arsons of people, buildings, and vehicles. For example, Kenneth hit Cabo Delgado on April 25th, 2019, and in May 2019, journalists reported that insurgents "attacked Ntapuala and Banga Velha villages in the Macomia district where they killed a teacher [...] and burned three other people" in what was considered the first attack since Cyclone Kenneth's landfall (AFP, 2019b). In the ensuing weeks, insurgents killed "nearly two dozen villagers" and torched hundreds of homes in Nacate, Ntapuala, and Banga-Vieja villages—all of which are in Cabo Delgado (Nhamirre, 2019). According to media reports at the time, this was their "deadliest attack since they launched" the insurgency in October 2017 (AFP, 2019a).

Turning to examine the first scope condition discussed earlier—that of dismebeddedness—evidence supports the notion that the Cabo Delgado insurgents are indeed a disembedded group, which has implications for their post-cyclone behaviors. As we described above, after the cyclones, Cabo Delgado's insurgency employed increasingly violent methods against civilians, whose support would otherwise be crucial, which included beheadings, arson, and setting villagers on fire. Additionally, although civil society and NGOs—and the government—came together to support the victims of the cyclones, there is no evidence that the same was true for the insurgents, as there were zero (recorded) attempts to peacefully try and spread the group's ideology in tandem with any aid provision, or even to endorse aid provision in an effort to draw attention to the insurgency's viability as an effective political-ideological alternative to the state, as happened, for example, in the Philippines and Indonesia (Beardsley & McQuinn, 2009; Walch, 2018). The insurgency likewise took an oppositional role towards the provision of post-storm aid in the region, as illustrated by aid workers' concerns that their efforts to help victims were being impeded by insurgent activity, in addition to them being physically attacked by insurgents (CoM, 2019). The behaviors in turn made it increasingly challenging for families to recover from Cyclone Kenneth, forcing victims of Cyclone Kenneth and recent armed violence to "rebuild their lives twice" (ICRC, 2019). Overall, then, the insurgency's patterns of behavior, specifically the intensification of its random attacks and its efforts to prevent aid distribution, are in line with the behaviors of disembedded groups as defined in the theory section.

With respect to the role of violence as a means of ideological signaling, we again find that qualitative evidence supports this scope condition. In 2017, details of Cabo Delgado's insurgency were relatively sparse in international media, and most reports included in international sources were originally published in local media outlets in Portuguese. Evidence of the insurgency's international following began to arise in 2018, during which "pro-IS channels on Telegram cheered a deadly 27 May attack in Macomia" (BBC, 2018). Following the cyclones, insurgents were then seen hoisting the IS "black flag" over defence force barracks that they had attacked in Mocimboa da Praia (All Africa, 2020).[11] In addition, one widely circulated WhatsApp video during this latter period featured a Cabo Delgado insurgent speak "frequently about Islam, and his desire for an 'Islamic government, not a government of unbelievers'" (BBC, 2020). This was the first instance in which the insurgents "spoke to the public" in what was described as a "clear gain of confidence," given that the faces in the video were unmasked (BBC, 2020). In line with our theoretical argument, then, these varied instances suggest that the logic whereby violence is used to signal to ideologically similar groups—alongside Cabo Delgado's insurgents' increasingly public commitments to an extreme form of Islamic governance—is one viable explanation for why the insurgents in Cabo Delgado increased their rates of violence following Cyclone Kenneth.

Conclusion

Our findings add insights as to when climate shocks are likely to lead to more violence against civilians by insurgent groups, while also extending previous findings in these regards to cyclones as opposed to droughts and earthquakes. Cyclones and hurricanes represent one of the costliest extreme weather events globally and are projected to increase in intensity in the coming years due to climate change (Holland & Bruyère, 2014). Our findings thus offer an important example of how greater weather variability over the long term can increase the risk of violence against civilians. In this study, they thereby directly inform climate-conflict nexus debates (e.g., Von Uexkull & Buhaug, 2021; Yannitell Reinhardt & Lutmar, 2022).

Our theory and findings also suggest that group characteristics may impact insurgents' preferences to perpetrate violence. Socially embedded secessionist groups seek to increase their local appeal to civilians by using a natural shock as a focal point to make peaceful political gains toward regional autonomy (Beardsley & McQuinn, 2009; Walch, 2014). Such strategies may be less appealing to extremist disembedded groups such as Boko Haram or Cabo Delgado's insurgents, which espouse violent and alienating ideologies. Sri Lanka's LTTE, which was not as heavily dependent on a particular population segment, was also much less receptive to cooperation efforts with local and international organizations in the wake of a major tsunami (Beardsley & McQuinn, 2009). Especially if insurgents seek to demonstrate their alignment with other groups with which they have little active cooperation otherwise, our results suggest they will use violence to gain influence, maximizing short-term gains over long-term viability. Nevertheless, future research should test the claimed effects of these group characteristics in other insurgent contexts to fully evaluate their relative contributions to disaster-induced insurgent violence.

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Data availability

Replication data for this article can be found at Bagozzi et al. (2023).

Supplemental material

Supplemental material for this article is available online.

Notes

1. We use the terms "rebels" and "insurgents" interchangeably.
2. This need not always be the case—if insurgents establish effective military or governance control over these regions, the government may face challenges in reestablishing control (e.g., Loyle et al. 2022).
3. A more detailed background discussion is provided in the Supplemental Appendix.
4. We use ACLED's designations for armed nonstate actors to retain insurgents. For our sample, roughly 95% of retained insurgent actors have a more specific actor code of "Islamist Militia (Mozambique)," with the remainder being "Unidentified Armed Group (Mozambique)."
5. However, note that our statistical models omit several of these initial weekly observations, depending on the lag structures and data used within any given specification.
6. That is, from ρ_1 to $(\rho_1, \rho_2, \rho_3, \rho_4, \rho_5, \rho_6)$.
7. Which in turn can influence rates of insurgent violence against civilians (Wood 2010).
8. We obtain comparable results for our primary independent variable when we instead control for *Ext. Insurg. Violence* (against civilian targets) in all areas of Mozambique outside of Cabo Delgado.
9. In the Supplemental Appendix we show that findings are comparable when using a changepoint model for non-overdispersed count data.
10. We provide further detail, and outline our approach to identifying and selecting credible news stories, in the Supplemental Appendix.
11. Yet while Cabo Delgado's insurgents raised the IS flag and likely communicated with IS, there has been no indication of an outright IS take-over, making it "difficult to sustain an argument for an 'external invasion' or even an 'import' that led to the insurgency" (Morier-Genoud 2020, p. 406).

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