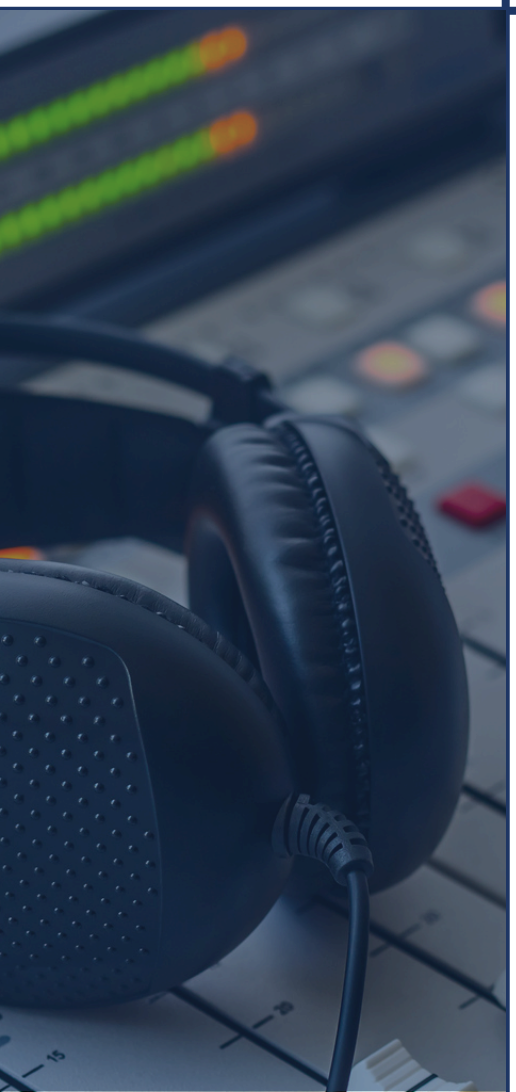
ISDC INTERNATIONAL SECURITY AND DEVELOPMENT CENTER

Impact Assessment: Evaluation of Pro-Peace Interventions to Build Trust and for Awareness-Raising and Sensitization at the Mali and Niger Border

FINAL REPORT OF FINDINGS

August 2025



Theodora Benesch

Dr Neil T.N. Ferguson

Luke Hosford

Dr. Lame Ungwang

Paulina Rebolledo Guzmán

Statement

The Peacebuilding Fund Impact Evaluation, Learning, and Dissemination (PeaceFIELD) initiative conducts impact evaluations of projects supported by the UN Secretary-General's Peacebuilding Fund (PBF), builds capacity to conduct impact evaluations on PBF-supported projects, and disseminates key evaluation findings. Launched in January 2021, the initiative is a collaboration between the International Security and Development Center (ISDC), the International Initiative for Impact Evaluation (3ie), and the Peacebuilding Support Office (PBSO). Generous support for PeaceFIELD was provided by the German Federal Foreign Office (GFFO). The views expressed in this report are of the authors and not necessarily those of PBSO, ISDC, 3ie, and GFFO. The Guatemala baseline work would not have been possible without the additional support of the association Sotz'il; the PBF Secretariat in Guatemala; as well as the joint UN agencies in Guatemala implementing this project: Food and Agriculture Organization (FAO), World Food Program (WFP) and the Office of the High Commissioner for Human Rights (OHCHR).

CRediT Statement

Theodora Benesch: Methodology; Software; Validation; Formal Analysis; Investigation; Data Curation; Visualization; Writing – Original Draft

Neil Ferguson: Conceptualization; Methodology; Formal Analysis; Investigation; Data Curation; Writing – Original Draft; Writing – Review & Editing; Supervision; Funding Acquisition

Luke Hosford: Methodology; Software; Formal Analysis; Data Curation; Visualization.

Lame Ungwang: Conceptualization; Writing – Review & Editing; Supervision

Paulina Rebolledo Guzmán: Software; Data Curation; Visualization; Writing – Review & Editing

Executive Summary

Mali and Niger have witnessed high levels of underdevelopment, political turmoil, fragility and high levels of violence for a number of years. In both countries, violence is particularly acute in the border region between them. This violence pertains, both, to extremism and violence instigated by those who believe they stand to benefit materially from it but, also, to the presence of land-based and intercommunal violence. This tense situation has been further exacerbated by a series of coups in the region, including in both Mali and Niger in recent years. It is in this context that the United Nations Secretary-General's Peacebuilding Fund (PBF) have been working. In this work, we consider the effectiveness of the "Support for Cross-Border Community Dialogue Initiatives with Security and Justice Sector Actors for Peacebuilding in Mali and Niger" project.

A key component of this project trained local community radio stations to broadcast messages and programs that, broadly, could be considered as "peace radio". These broadcasts included plays to build peace through laughter and humor; more serious news-based programming; other dramatizations (e.g. of complicated dispute settings and how they were resolved); and interviews with key stakeholders, such as local and national politicians. The overall project, including the radio component, were implemented by UNODC and UN Women in Gao and Mékana in Mali and Tillabéri and Niger, at a cost of $3.1 million, between 2019 and 2020.

According to our analyses, the PBF-supported peace radio project yielded a significant and positive impact on the geographic distribution of violence. On average, areas inside the broadcasting range (literally, grid cells of 2km by 2km created by the research team) are getting geographically further away from episodes of violence, following the broadcasts, than comparable areas just beyond the broadcasting range. In other words, the areas within the broadcasting range have become, relatively, more peaceful than similar areas outside. Using a rigorous set of statistical methodologies, these observations are attributable to the radio broadcasts.

These analyses are based on rigorous quasi-experimental research designs, using highly disaggregated geographic data and conflict event counts. This allows us to compare areas that lie just inside the limit of the broadcasting range with those that are just beyond. This approach works on the principle that, while all the areas inside the ranges are not comparable to all those outside, those within a narrow band around the limit are, likely, very similar and, consequently, should differ only in their exposure to the radio programing.

Although we cannot be sure about the overall effect of the programming on communities just outside the broadcasting range, there is a clear positive impact of this programming within the broadcasting range. This provides key first evidence that mass media interventions, such as radio broadcasts, can be effective tools, even in settings of widespread and active violence.

Background to the Research

The Peacebuilding Fund Impact Evaluation, Learning, and Dissemination (PeaceFIELD) Initiative conducts rigorous impact evaluations of projects supported by the UN Secretary-General's Peacebuilding Fund (PBF), builds capacity to understand, conduct and learn from impact evaluations on PBF-supported projects, and disseminates key evaluation findings directly to relevant stakeholders. Launched in January 2021, the initiative is a collaboration between ISDC – International Security and Development Center, the International Initiative for Impact Evaluation (3ie), and the Peacebuilding Support Office (PBSO). Generous support for PeaceFIELD is being provided by the German Federal Foreign Office (GFFO) and Global Affairs Canada (GAC). The views expressed in this report are of the authors and not necessarily those of PBSO, ISDC, 3ie, GFFO or GAC.

In recognition of key knowledge gaps and associated low-capacity for evidence-based policymaking in the peacebuilding field, the Initiative has worked closely with PBF to understand the effectiveness and mechanisms of key building blocks of PBF strategy and promising, novel, projects that could be the building blocks of future strategies.

The identification and analysis of case-study interventions that match these criteria has been a key component of PeaceFIELD. To this end, the Initiative has identified a number of viable situations for study, including: a multi-faceted livelihoods and displacement protection project in Darfur, Sudan; the creation of community registries and support and training of conflict mediators project in Polochic Valley, Guatemala; a cross-border dialogue and capacity building project for conflict prevention between local communities and security actors, working among other components through community radio stations on the Mali / Niger border; and a land rehabilitation and media project for farmers and herders at the Guinea / Sierra Leone border. In this document, we discuss results that have emerged from a “macro” level study of the Mali / Niger project in the short-term aftermath of the intervention being undertaken. In this work, we take a “helicopter” view of the situation, looking at the relationship between the intervention and key indicators pertaining to peace, analyzed at disaggregated geographic resolutions.

Table of Contents

1. INTRODUCTION AND CONTRIBUTION 5

2. BACKGROUND TO AND IDENTIFICATION OF THE PROJECT 7

Context 7
Initial Scoping and Overall Project Design 8
Radio Programming 10

3. DESIGNING THE IMPACT EVALUATION 11

Design 11
Data 12
Methods 14

4. RESULTS 15

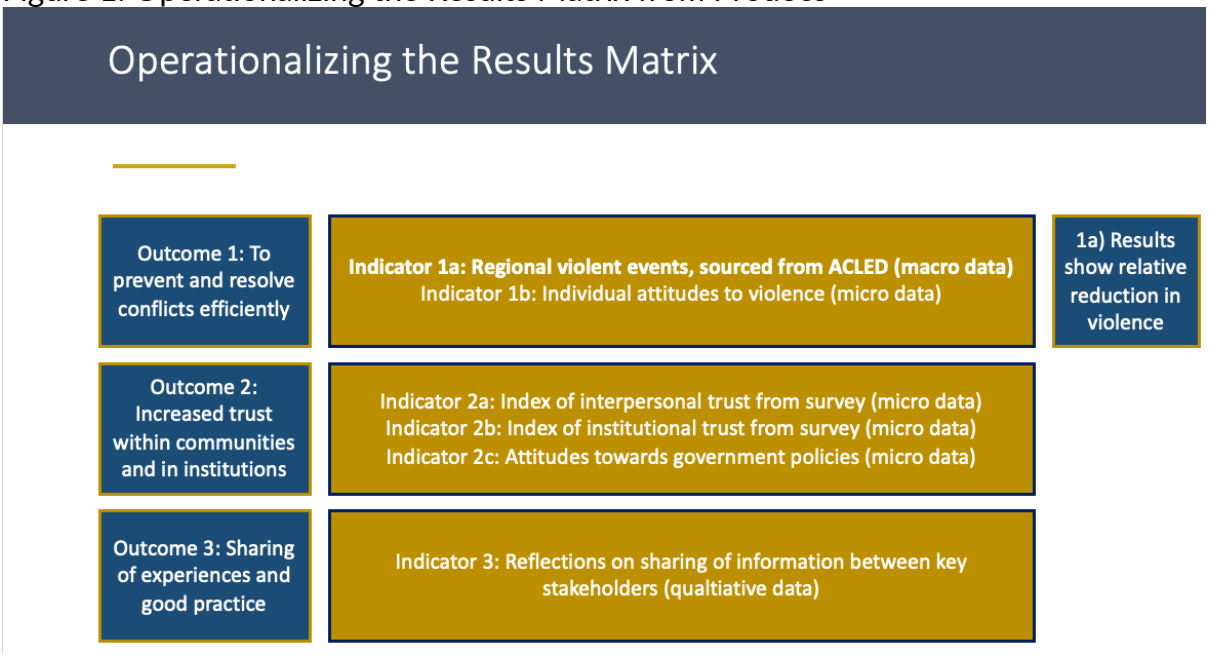
Descriptive Results 15
Main Results 19
Sub-Analysis of Economic Outcomes 20
Robustness 21

5. DISCUSSION AND CONCLUSION 21

1. Introduction and Contribution

In this report, we study the effectiveness of a project that took place on both sides of the Mali and Niger border. Specifically, this study evaluates the "Support for Cross-Border Community Dialogue Initiatives with Security and Justice Sector Actors for Peacebuilding in Mali and Niger" project (refs: 00114134 / 00114135 and IRF-299 – Mali – and IRF-300 – Niger). We focus on the effectiveness of this project in the immediate aftermath of its implementation. That is, the impacts that emerge within a year of the fulfilment of the project's deliverables. Due to the data available, this evaluation focuses on Result 1 of the project ("State and non-state conflict prevention and management mechanisms and structures… effectively prevent and resolve conflicts at the local level"), which we operationalize in terms of local violence event counts.[1] (See Figure 1).

Figure 1: Operationalizing the Results Matrix from Prodocs



The project promoted women and youth inclusive conflict prevention and management mechanisms; took a gendered, human rights-focused approach to security; and supported defense actors, created community dialogue spaces and undertook awareness-raising on a cross-border and sub-regional level. The project facilitated meetings, workshops, the establishment of peace committees and a radio broadcasting campaign via nine community radio stations in communities near to the border. Due to

[1] Results 2 and 3 – focussing respectively on the development of trust in state and defence actors and on the sharing of experiences are not considered directly in this evaluation. In the case of Result 2, data does not exist on trust at the unit of analysis of this evaluation. Result 2 will be the focus of an accompanying micro-level evaluation, which collects data from individuals living within these grid cells. Result 3 focusses on the experiences of a small number of people involved with the evaluation, which does not lend itself well to analysis through standard impact evaluation tools. Qualitative data were collected from some of these individuals and learnings on this result will be reflected elsewhere.

the analytical approach of this evaluation, which relies on statistical methodologies, focuses falls on programming in the areas within the broadcast ranges of these nine radio stations and compares the evolution of outcomes in those regions to areas just outside of the broadcasting range of these radios and that did not receive the same support. The work focuses on communities in Gao and Ménaka (Mali) and Tillabéri (Niger). Conducting the work with particular reference to these radio stations allows the definition of beneficiary communities (those just inside the broadcasting range of the supported stations) and valid reference communities (those just beyond the broadcasting range that did not receive support), which is key in supporting the quantitative approach undertaken in this evaluation. As these community radio stations typically have a short broadcasting range (on average, approximately 40km in radius) and these broadcasting ranges are known for each case, targeted areas can readily be identified, as can reference areas.

To conduct the quantitative analysis, this evaluations splits the relevant regions in Mali and Niger into 2km x 2km grid squares. We then compare outcomes of key indicators in the period before implementation (up to and including 2019) and the period after (2021), across the beneficiary and reference locations, in order to establish the impacts of the interventions. We focus on three outcome indicators of interest. These indicators are chosen both because they match the relevant components of the project's results matrix and for more practical reasons, not least that the data are available and measurable at the correct geographic resolution. As the main indicator of interest, focus falls on conflict-related events. These conflict events are mapped by year, defining the specific 2km x 2km cell in which each event took place. For cells that did not have any violent events in a given year, the distance of the center point of that cell to the nearest event is measured. In this sense, this work evaluates the relationship between the project and the geographic spread of violence in its target areas, which captures the violence reduction aspects of Result 1. A secondary focus falls on two indicators of economic activity within each cell: average land greenness per year, as observed from the Sentinel 2 satellite in each square; and average nighttime light emissions per year in each square. These measures are included to test whether or not there are knock-on effects of an improving peace and conflict environment in the local economy. While these outcomes are not, directly, related to the project's theory of change, it is plausible to expect that they capture some of the external effects of the project.

A cell is defined as being in the "treatment area" if the center point of that cell lies within the broadcasting range of a supported radio station, with data on the broadcasting range sourced from the Radio Data Centre. Reference regions are defined as regions that are just beyond the broadcast range of the supported radio stations. A geographic analysis approach is used to account for potential biases in the data. In particular, the radio stations themselves are congregated in (relatively) urbanized centers, such as regional capitals, while areas far beyond the broadcasting range are very rural, desertified, and sparsely populated. The areas towards the edge of the broadcasting range, both inside and beyond it, however, are likely to be culturally, demographically, economically and socially similar and, thus, can be more meaningfully compared to one another. This ensures that valid beneficiary (treatment) and reference

(control) areas can be defined. The analytical techniques used account for the geographic and spatial relationships within this data.

This evaluation establishes that violence has decreased in treatment areas, relative to control areas over the duration of the intervention.[2] These findings are mostly statistically significant and robust to different specifications, both to variations in the definition of the control area (Appendix A5), and to variations in the construction of the key outcome indicator (violence). We don't see expected associated impacts on land usage and nightlight emissions, but rather a clear worsening of land usage, suggesting that the geographical dispersion of violent events has not driven economic development, at least in the short term. A set of tests using data before the intervention took place are conducted to test the extent to which these results can be attributed to the intervention. The findings from these analyses are structurally different from the main analysis, adding further evidence to the effectiveness of the intervention.

These results do not strictly show a reduction in net violence in Mali or Niger but, rather, changes to where it happens. Our analyses cannot show if this is the result of displacement of violence elsewhere within the countries, or a reduction in violence overall. Related to this, this approach also only gives a bird's eye view of proceedings – it is able to show that patterns of violence are changing in response to the intervention but not, strictly, why these movements have taken place or what the individual, micro-level and behavioral foundations of these outcomes are.[3]

At the highest level, this suggests that positive outcomes are associated with the interventions in Mali and Niger. These results show that peacebuilding projects that rely on radio broadcasting can impact on patterns of violence, at least in the short-run, in actively violent situations. Given the methodological focus on radio broadcasts, such results provide more specific understanding of the performance of pro-peace messaging. As mass media is a way to reach large numbers of people, relatively cheaply, this can provide a justification for continued support and scaling up of such broadcasts, in Mali and Niger and, potentially, elsewhere. Further, it offers first evidence that such interventions can be successful in actively violent situations.

2. Background to and Identification of the Project

Context

Both Mali and Niger are characterized by high-levels of political violence and low levels of institutional capacity. Uppsala Conflict Data Program data shows approximately 7000 fatal violent events in Mali since 2015; and some 2000 in Niger in the same period (UCDP, 2022). In Niger, a series of threats are faced both in the South East of the country, from cross-border violence perpetrated by Boko Haram; and at the border with Mali, particularly in the Tillabéri region, due to extremism and "violent

[2] More correctly, the analyses show that, on average, cells in the treatment areas are getting further away from violence than those in control areas, which approximates the intensity of violence.
[3] Related qualitative and quantitative studies will focus on precisely these questions, based on data collected in May and June 2024.

entrepreneurs" (Bøås et al., 2020).[4] In Mali, a series of inter-connected conflicts have taken place across the country, stemming from violent conflict resolution norms, exacerbated by both the presence of extremist organizations and seismic political change, including two coups in recent years. A coup also took place in Niger in mid-2023, but lies outside of the focus of the work of this evaluation.

In both countries, these higher-level threats are exacerbated by climate hardships, in particular water stress and a scarcity of natural resources, as well as demographic pressures from high birth rates (Shekar et al., 2016)[5] and high levels of poverty (Zafar, 2021).[6] These pressures have increased political tensions and violence across the region (Igrarapé Institute, 2015), with inter-ethnic and farmer-herder conflicts common. This is further exacerbated by poor administration of justice in the region and by low trust – horizontally between people and groups; and vertically between citizens and elites, including state-level institutions and security forces (Ursu, 2018).

The project area includes four communes in Mali (Quatagouna, Tessit, Menaka, Anderamboukane) and three in Niger (Ayorou, Bankilare, Banibongou) is located near the border between the two countries. These areas experience a combination of these challenges, including: the presence of armed groups, including extremist groups; conflicts between farmers and herders related to transhumance routes; scarcity of natural resources and grazing areas; a lack of a human rights-based security approach by the security agents and a lack of trust in them; inaccessible justice services due to remoteness of these services but also corruption; and extreme poverty. Furthermore, conflict prevention and management mechanisms lack the inclusion of women and youth. In this context a single security-based approach would not be sufficient to build a lasting peace. Accordingly, the UN PBF-funded project focused on trust and capacity-building and the inclusion of women in conflict prevention and management, improving the capacity of a human rights and gender-based approach of the defense and security actors, awareness-raising and overall a cross-border approach. The broadcast of pro-peace, pro-trust, and awareness-raising messaging, including information on the mandate of the security actors, human and women's rights and peaceful resolution of conflicts, is expected to have contributed positively to that.

Initial Scoping and Overall Project Design

Mali was identified as a potential case-study country early in the PeaceFIELD process, due both to the nature of programming taking place there and the strategic value of peacebuilding in the country. Initial scoping by the PeaceFIELD team in the first half of 2021 revealed a cluster of interventions, taking place under the "Support for Cross-Border Community Dialogue Initiatives with Security and Justice Sector Actors for Peacebuilding in Mali in Niger" project. The project ran from January 2019 until March 2021, including an extension period due to the COVID-19 pandemic. From early 2021 until mid-2022, the PeaceFIELD team gathered information on the separate project

[4] Bøås, Morten, Abdoul Wakhab Cissé, and Laouali Mahamane. "Explaining violence in Tillabéri: Insurgent appropriation of local grievances?." *The International Spectator* 55.4 (2020): 118-132.
[5] Shekar, M., Yazbeck, A., Hasan, R., & Bakilana, A. (2016). Population and Development in the Sahel.
[6] Zafar, A. (2021). Poverty Traps in the Sahel. In *The CFA Franc Zone* (pp. 55-60). Palgrave Macmillan,

components that might meet the standard for rigorous evaluation and conducted a review of the data sources available in Mali at baseline. This approach revealed that one major component of the project was very well suited to the requirements of a rigorous quantitative impact evaluation – the broadcasting of awareness-raising and sensitization radio, implemented by UNODC and UN Women in Gao and Mékana, Mali and in Tillabéri, Niger. The project had a budget of approximately $3.1m.

The overall project focused on a number of components relating to capacity building for local armed forces and security actors in the border area of the two countries; the promotion of dialogue and inclusion in conflict prevention and management mechanisms, particularly focusing on women and youth; and the support of awareness-raising radio to increase communities' knowledge around the different mandates of the security actors active in the region and to build vertical and horizontal trust within and between communities. The project was organized around 3 outcomes: (1) More efficient conflict prevention and management that integrates women and youth; (2) Better human (especially women's) rights in the justice system, for improved local trust; and (3) Good practices and experiences shared across the border.

To test the evaluability of each component of the project, the evaluation team took a technical approach. The first consideration was the data that would be required to conduct an evaluation of each component, as well as more prosaic concerns as to whether or not it would be possible to define a suitable reference group. In the context of project components that built the capacity of local security forces, it was unclear that a control group could be established as, in principle, such improvements should benefit all individuals and areas within the locations under study. Meanwhile, despite a thorough review, no suitable individual or household level data existed in the regions where the project had taken place that could have been used in this analysis. This meant it would not be possible to analyze components of the project where the "treatment" was provided to specific individuals or groups, such as the dialogue component.

This turned attention to indicators that could be observed at disaggregated geographic units and that could be collated from secondary sources, such as conflict event counts; and remotely sensed data. The use of such indicators, however, it is necessary to assign these indicators to designated as "treatment" or "control" units. The second, that the "treatment" would be sufficiently widespread within each geographic unit to result in aggregate-level change. The component of the project that satisfied these conditions was the provision of training and materials to community radios to produce and broadcast messages that raise awareness about the roles and mandates of the different security actors (FDS, ACP), to build vertical and horizontal trust and to promote lasting peace. These projects were designed and implemented in nine community radio stations by UN Women Mali, UN Women Niger and the UNODC office for both countries. The project was implemented in Mali in: the regions of Ménaka (Circle of Anderaboukane: Commune of Anderaboukane, Circle of Ménaka: Commune of Ménaka) and Gao (Circle of Ansongo: Communes of Ouatagouna and Tessit); and in Niger: in the Tillabéry region (Department of Téra: Commune of Gorool, Department of Bankilaré: Commune of Bankilaré, and Department of Banibangou: Commune of Banibangou). For these reasons, this evaluation focuses more specifically on the radio

component of the project. However, we note that the results concerning these components cannot, and should not, be disentangled fully from the wider work conducted under the project at the more aggregate and individual levels, which provided additional to support to communities within the radio broadcast areas.

Due to the nature of the intervention, which was provided, in principle, to every individual with access to a radio living within the broadcast range of each of the "treated" community radio stations, the project reaches a significant number of individuals. Project scoping estimates suggest broadcasts could reach 300,000 individuals,[7] which provides grounds to suggest it could result in meaningful change in an aggregate indicator such as conflict event counts.

In the next phase, the evaluation defined the precise location and geography – including the broadcasting ranges – of radio stations in Mali and Niger. This work was completed with support from the Radio Data Centre. These analyses revealed that most community radio stations in Mali and Niger have a broadcasting radius of just under 40km, and thus, on average, reached a broadcasting area of just over 5000km^2 (or, approximately, 45,000km^2 in total across the nine supported stations). Such areas were deemed likely to lie within the "sweet spot" for an analysis of this sort – sufficiently large to allow significant variation of data within the treatment regions, without being so large as to pose complexities in defining reference regions that could be meaningfully compared to those within the broadcasting ranges. On this basis, we determined the potential to conduct an impact evaluation, using a discontinuity design, based on the broadcasting ranges of the stations supported in the project.

Radio Programming

The radio broadcasts were implemented from November 2019 to July 2021 in Mali and from March 2020 to December 2020 in Niger. These dates relate to the earliest and latest dates, but the exact broadcasting periods of each radio station varies. Similarly, the nature of the programming varied, both by broadcast and by broadcaster but, broadly, included: radio plays, focusing on hypothetical situations and fictional characters; interviews with local and national politicians and representatives of other institutions; and information-based news-style programming. To give an example of the structure and content of the radio program, one episode was a 30-minute show in the format of a round table that addressed the topic of social cohesion between communities, with a specific focus on jokes and humor as a method to promote lasting peace. The discussions took place with youth leaders, one religious leader and a cultural coordinator. The show's objective was to increase and build trust between individuals and communities. Another episode was a 17 minutes-long broadcast that discussed the causes and solutions to violent extremism with two retired teachers and one civil society actor. These examples adhere closely to the theory of change of the project, which was designed to boost trust, vertically and horizontally, in the areas reached by the broadcasts. The overall intensity of the programming meant that it was broadcast

[7] UN (2022): Final Evaluation of the Project "Support for Cross-Border Community Dialogue Initiatives with Security and Justice Sectors for Peacebuilding in Mali and Niger"

for several hours per day over multiple months, with broadcasts typically in the late-afternoon and early-evening, when people would be less likely to be working.

3. Designing the Impact Evaluation

This section presents the evaluation design that will be undertaken to understand the impact of the project on conflict-related indicators; the data collated to support these methodologies, the treatment of this data in order to undertake the study; and the methods used to draw inference.

Design

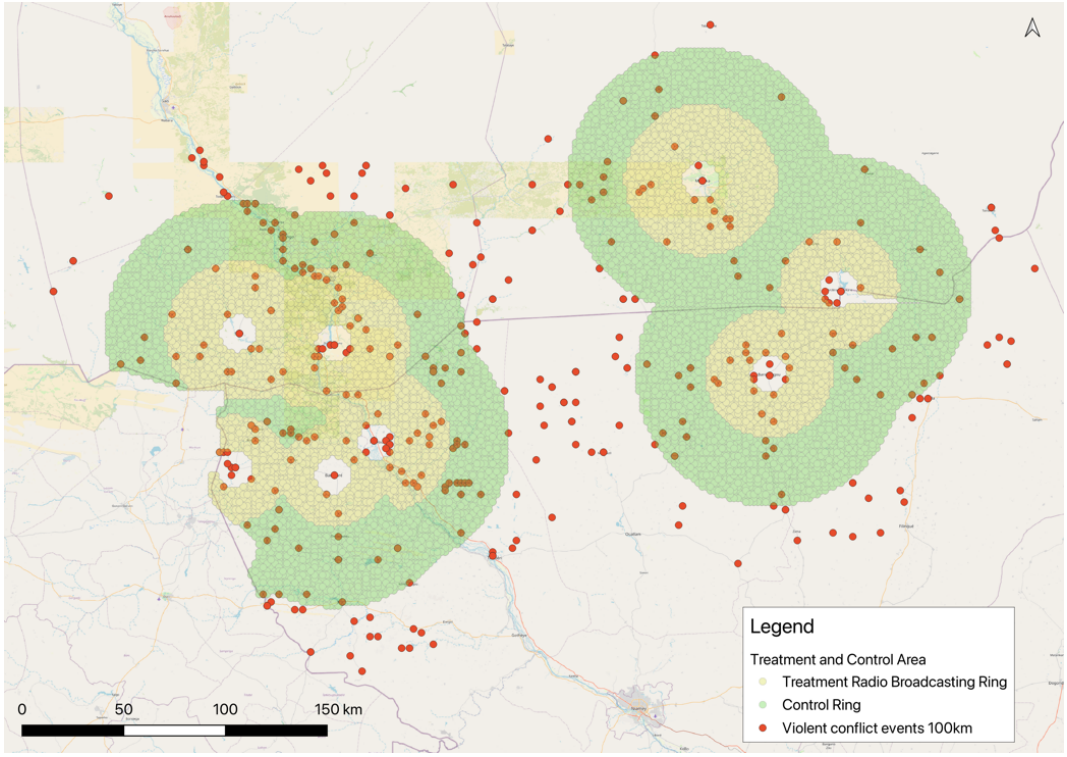
The key interest in this study is to understand whether or not the evolution of key trends differs following the implementation of the project. To do so, we split Mali and Niger into a series of 2km by 2km grid cells. This generates 402,855 cells in Mali and 370,775 cells in Niger. We then define whether or not the center point of each cell is within the broadcasting range of a supported radio station or not. If it is, we assign that square to the beneficiary group. If it is not, we give that square a non-beneficiary status. This approach defines 39,340 treatment cells. Based on available data, we construct a dataset that runs from 2015 (the first year where higher resolution satellite imagery is available) until 2021, the year after implementation was completed.

This leaves almost three-quarters of a million cells outside of the broadcasting range of any of the nine radio stations, which require some additional consideration. For the purpose of this study, we define "control" regions as areas just beyond the limit of the broadcast range. We define two versions of the control group. The first are all areas within these bandwidths, regardless of whether they receive broadcasts from other radio stations or not. The second includes only those areas that receive no radio broadcasts at all in the control group. To allow for sensitivity analyses, we use a series of different distance thresholds from the treated radio station, to ensure that our results are not – for example – the result of comparing communities at different levels of remoteness.[8]

We follow a similar approach to defining the treatment group. First, we consider all cells within the broadcast range of each radio station. To mitigate the risk that this includes the most urban and densely populated areas, we adopt two refinements. The first excludes from the analysis cells that are within 10km of the radio station; the second excludes cells within 25km of the towers. This approach works on a similar principle to geographic discontinuity, in that we expect areas just outside the range to be comparable to those just inside. See Map 1 for an overview of how the treatment and control rings look. In these graphs, the red dots denote violence events during the analysis period while the yellow area shows the treatment areas and the green area shows the control areas. We can further see that not all broadcasting ranges have the same range and that some overlap to a certain degree either with another project-related radio or with any other radio in the region.

[8] Subset ranges for the control group were 150, 100, 75, 66 and 51 km from the broadcasting tower and beyond the broadcasting range.

Map 1: Map showing definition of treatment and control areas. Unshaded areas are not included in the analysis. Yellow shading depicts treatment areas. Green shading depicts control areas. Red dots capture conflict events during the study period. Map 1 excludes treatment cells within 10km of the radio station and caps the control area as those within 66km of the radio station.



Our analyses will test whether or not key indicators evolve differently, in the aftermath of the implementation of the project, across these defined treatment and control areas. Specifically, we will seek to establish that the trends of key indicators are, broadly, the same across treatment and control areas before implementation took place, and then begin to diverge after implementation has been completed. This work looks at the very short-term aftermath of the implementation of the project.[9] This approach matches the basic "difference-in-difference" framework standard in the literature.

We will look at effects on two sets of outcomes. The first are conflict event counts, denoted by the red dots in Map 1. The second are a set of indicators of economic activity, sourced from land usage data (proxied by the green light emission of the land) and nightlight emissions data. We discuss our sourcing and treatment of the data in the next section.

Data

To divide Mali and Niger into grid cells, we ran a simple algorithm that chose the starting coordinates of the first cell in a way that maximized the number of cells in each country. As this decision was effectively random, this ensures that there is no particular

[9] We will revisit this analysis in 2025, when data are available up until 2024, to test whether or not the findings hold in the longer-term.

structure to the placements of the cells, nor the borders between them. In turn, we are confident that this specific alignment of grid squares does not influence outcomes.

We are interested in three major outcomes of interest. First, is whether or not there is an impact of the radio broadcasts on realized conflict within broadcast locations. We source the raw data on violent event counts from the ACLED project (Raleigh et al., 2012[10]; Raleigh and Dowd, 2015)[11]. Specifically, we use the geo-coded data on battle deaths to determine whether or not a violent event took place within a given cell in a given year. In 2020, for example, violence occurred within 178 cells in treatment areas. For cells where violence did not take place, we measure the distance of that cell to the nearest cell in which an event took place that year, capturing the geographic dispersal of violence for each year.[12] We assume a cell was not exposed to any violence if the nearest event is more than 25km / 50km from an event. See Table 1 for summary statistics.

As a sub-analysis to test whether a potentially improving conflict landscape is accompanied by improving economic outcomes, we gather data on land usage, which in some ways might capture economic activity or other investment in land. This indicator allows us to approximate the proportion of land that is used for crops or other production within a given cell and the proportion that lies fallow, based on the color emissions of each cell. We also source data on nightlight emissions data, arguing that this might reflect longer-term investments locally (e.g., by individuals in generators or communities in larger power generating capacity). While this also captures some aspect of economic activity, we note that it captures something distinct from land usage in at as it more likely captures longer-term investments outside of the agricultural economy.

Table 1: Descriptive Statistics

	Mean	SD	Min	Max	N
Inv. Distance Violence, 25km	0.05	0.09	0.00	1.00	89404
Inv. Distance Violence, 50km	0.05	0.09	0.00	1.00	89404
Nightlight Radiation	0.18	0.10	-0.02	1.69	89404
NDVI	0.15	0.04	-0.10	0.57	89404

Note: Table shows simple summary statistics of the main outcome variables, including the mean and standard deviation of these indicators. These indicators show that, on average, cells are 20km from the

[10] Raleigh, C., Linke, A., Hegre, H., & Carlsen, J. (2012). Armed Conflict Location and Event Dataset (ACLED) Codebook. *Center for the Study of Civil War, International Peace Research Institute, Oslo (PRIO)*.
[11] Raleigh, C., & Dowd, C. (2015). Armed conflict location and event data project (ACLED) codebook.
[12] A limitation to structuring the data in this way is that it no longer captures the intensity of violence directly. Should violence remain at the same level but become more concentrated in space, for example, the average distance of violence in a given year will increase, just as it would if there were a reduction in violence. We are agonistic on whether this is harmful for our analysis or not. On the one hand, it does not allow us to, strictly, say that the intensity of violence has changed in treatment locations relative to control locations (although we can infer this from broader trends). On the other hand, it allows us to capture variation in the spatial distribution of violence, which could include both a reduction in violence, as well as the displacement of violence to other areas. Either outcome, in some ways, could be considered positive – at least for the local communities in treatment regions. Gaining this flexibility allows us, therefore, to assess more dimensions of violence at the cost of very specific attribution in a more general sense.

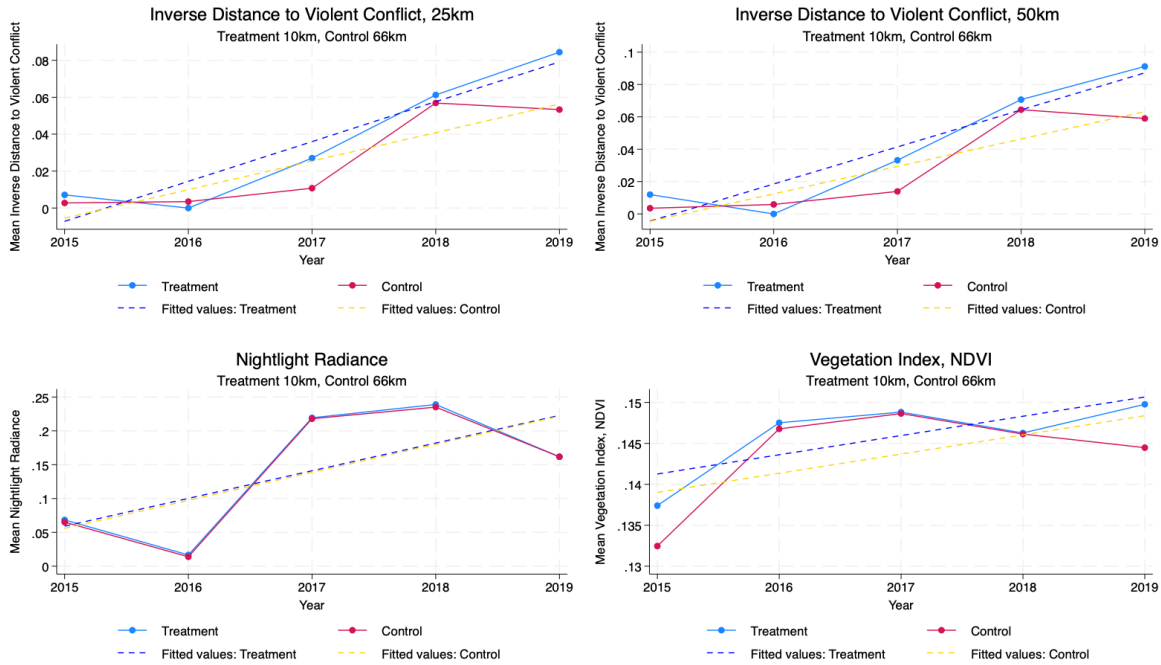
nearest cell in which a violent event took place but, also, that this data is quite highly dispersed, with a large number of cells very close to violence and others much more further away.

We subject these indicators to a series of statistical tests in order to test whether or not the interventions have resulted in meaningful improvements We focus our research on the period from 2015 (the first year where high quality data from Sentinel 2 is available and 2021 (the year after implementation was complete).

Methods

In this work, we use a spatial difference-in-differences strategy (Dube et al. 2014), which tests the extent to which an indicator evolves differently between treatment and control areas in the period after the intervention has been implemented. In our case, we compare outcomes in the year 2019 (before implementation began) and 2021 (after implementation was complete). A key requirement for the difference-in-difference based approaches is that that the outcomes of interest are evolving similarly before implementation takes place, and would continue to do so post-implementation period would implementation not take place. To establish our data exhibit parallel trends, we plot the mean of key outcome indicators by years from 2015 until 2019. Then, we inspect the trends in this data to determine whether or not these trends are parallel. Figure 2 shows these comparisons for a preferred specification, which looks at a treatment cells at least 10km from the broadcasting tower and control areas no more than 66km from the tower.

Figure 2: Assessing Parallel Trends of Key Outcome Indicators Over Time



Note: Figure 2 shows extent to which the trends in treatment and control areas are the same over time, from 2015 until 2019. Figure 2 is constructed using a treatment area composed of cells that 10km or more from the tower and within the broadcasting range. Control area composed of cells beyond the broadcasting range but within 66m of the tower. Although seemingly "random" distances, this 66km cut-off ensures that the radius of the arc of the treatment and control areas is the same.

Inspection of Figure 2 suggests that, while there is variation, year-to-year, the key trends are broadly parallel. We do not see sensitivity to the 25km and 50km distance from violence thresholds. Although these series show some divergence in the key trends in violence indicators, this is driven, broadly, by violence in control areas in 2018, which is a major outlier in the series. Without this outlier, trends would be parallel. Our findings should be understood in that context. Trends are strongly parallel for the nightlight luminosity and land usage indicator. That nightlight radiance displays parallel trends supports our underlying assumption that population dynamics just inside and outside of the broadcasting range are similar (e.g., Bennett and Smith, 2017). In the case of the 10km treatment and 66km control ring, the parallel trends give good grounds to continue with difference-in-difference based analyses.

4. Results

Descriptive Results

First, in order to understand the structure of the data, we carry out some simple summary tests. These compare the means of the key outcome indicators in various constructions of the treatment and control groups. Tables 2 – 4 show two key things. First, that there is a level difference in the spatial distribution of violence before implementation takes place (in 2019), during implementation (2020) and following implementation (2021). This shows that cells in treatment areas are, on average, closer to violent events than cells in control areas throughout the entire study period. Second, that the distance from violence in treatment areas is decreasing, relative to the distance from violence in control areas. While important, this finding could relate as much to the fact that the area of the treatment areas is smaller than that of control areas as it could to greater escalations of violence in treatment areas. In this setting, one additional violent event in a treatment area would have a larger effect, on average, in reducing the distance to violence than the same event in the control area. For this reason, we do not reflect, strongly, on these comparative findings.

By contrast, while we see some level differences in the measures of nightlight radiation and land coloration / use, similar trends do not emerge. Differences are negligible between treatment and control areas and there are no major divergences over time. As these indicators do not suffer the same complex spatial relationships as the main violence indicators, this suggests that we expect to find little indication of knock-on economic effects from the interventions.

We repeat this exercise visually in Figures 3-6, which depict the distributions of the inverse distance to violent events at both thresholds as well as the nightlight radiation and NDVI before and after the project implementation. The vertical lines depict the respective means of the indicators pre- and post-project implementation. Again, these result show cells in both treatment and control areas are, on average, closer to violence in the post-implementation period. We further see that cells in the treatment area become, relatively, further away from violence than those in the control areas. The economic outcomes trend a positive change from pre- to post-implementation phase for the nightlight radiation indicator for both the treatment and the control areas, and at no change from pre- to post-implementation phase for the NDVI indicator.

Table 2: Descriptive Statistics Pre Project Period 2019 - Treatment 10km, Control 66km

	(T) mean	sd	(C) mean	sd	(D) difference	t
Inv.Distance 25km	0.08	0.11	0.05	0.09	0.03***	(16.79)
Inv.Distance 50km	0.09	0.10	0.06	0.09	0.03***	(18.03)
Nightlight Radiation	0.16	0.01	0.16	0.02	-0.00	(-0.07)
NDVI	0.15	0.03	0.14	0.03	0.01***	(8.69)
Observations	4979		7793		12772	

Note: Table 2 shows the means of the key outcomes for the treatment (T) and control (C) areas, and a t-test of the differences between the means (D) in the last year (2019) before implementation of the intervention took place. *, ** and *** respectively show that differences in the means are significant at the 10%, 5% and 1% levels.

Table 3: Descriptive Statistics Project Period 2020 - Treatment 10km, Control 66km

	(T) mean	sd	(C) mean	sd	(D) difference	t
Inv.Distance 25km	0.11	0.13	0.07	0.11	0.04***	(17.76)
Inv.Distance 50km	0.12	0.13	0.08	0.11	0.04***	(17.84)
Nightlight Radiation	0.26	0.01	0.26	0.02	0.00*	(2.20)
NDVI	0.16	0.04	0.15	0.04	0.01***	(9.22)
Observations	4979		7793		12772	

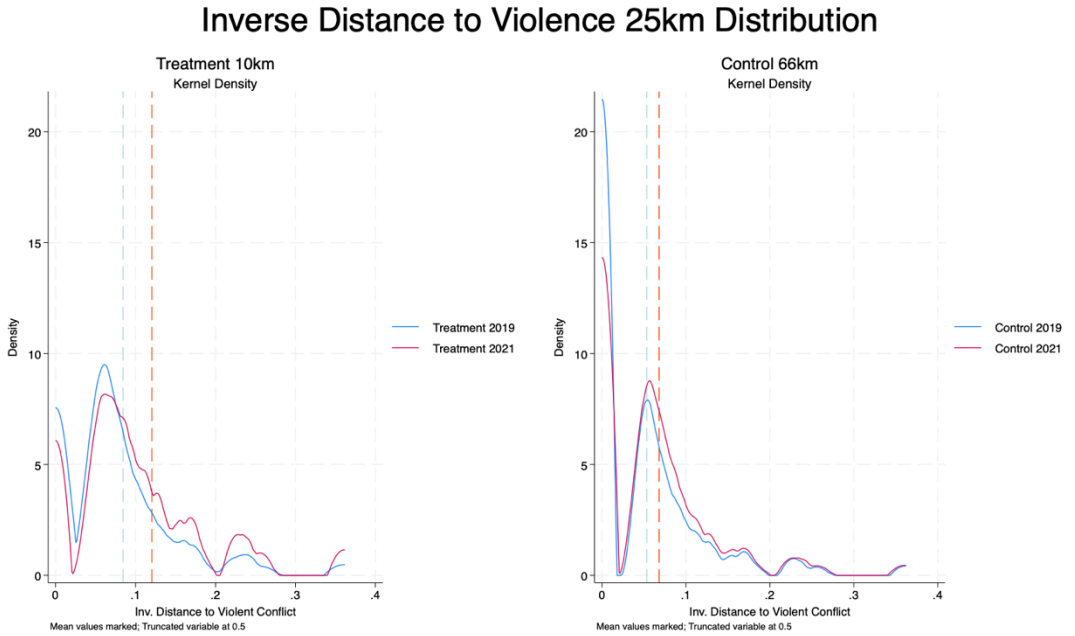
Note: Table 3 shows the means of the key outcomes for the treatment (T) and control (C) areas, and a t-test of the differences between the means (D) during the implementation of the intervention (2020). *, ** and *** respectively show that differences in the means are significant at the 10%, 5% and 1% levels.

Table 4: Descriptive Statistics Post Project Period 2021 - Treatment 10km, Control 66km

	(T) mean	sd	(C) mean	sd	(D) difference	t
Inv.Distance 25km	0.12	0.14	0.07	0.10	0.05***	(22.78)
Inv.Distance 50km	0.12	0.14	0.07	0.10	0.05***	(22.43)
Nightlight Radiation	0.30	0.01	0.29	0.02	0.00***	(10.84)
NDVI	0.16	0.04	0.16	0.04	0.00***	(3.87)
Observations	4979		7793		12772	

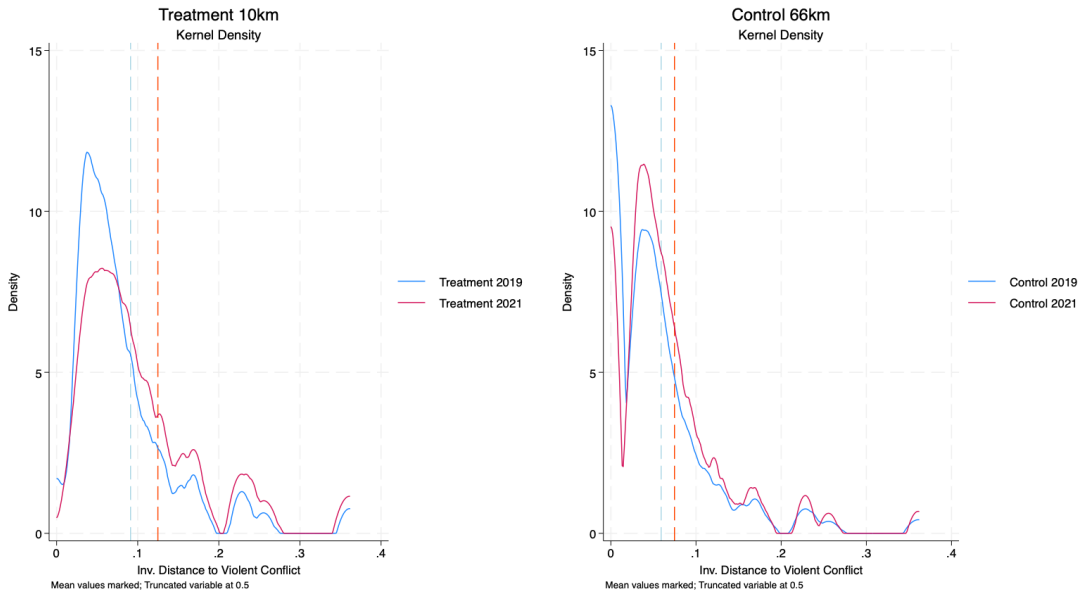
Note: Table4 shows the means of the key outcomes for the treatment (T) and control (C) areas, and a t-test of the differences between the means (D) in the first year (2021) before implementation of the intervention was completed. *, ** and *** respectively show that differences in the means are significant at the 10%, 5% and 1% levels.

Figure 3: Density for Inverse Distance to Violence, 25km, Pre- and Post-Project



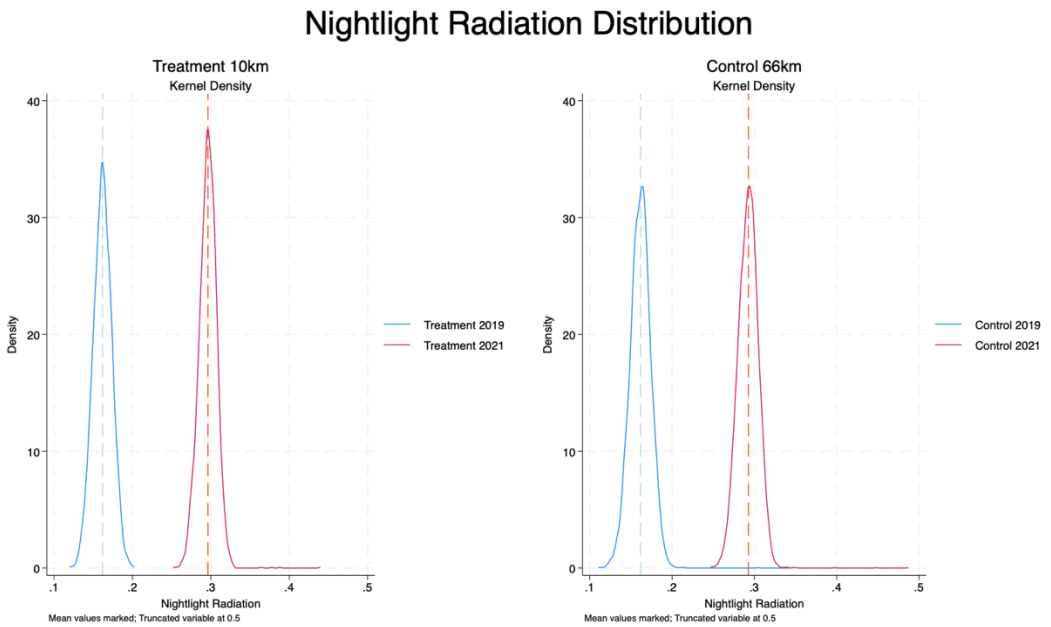
Note: Figure 3 shows a density distribution of the main violence outcome indicators (solid lines) before implementation in 2019 (blue line) and after implementation in 2021 (red line). That is, in effect, the frequency with which each potential inverse distance occurs in the data. These data show that, on average, cells are getting closer to violence over time and that this effect is more pronounced in treatment than control areas (shown by the larger gap between the dashed lines on the left-hand graph.

Figure 4: Density for Inverse Distance to Violence, 50km, Pre- and Post-Project



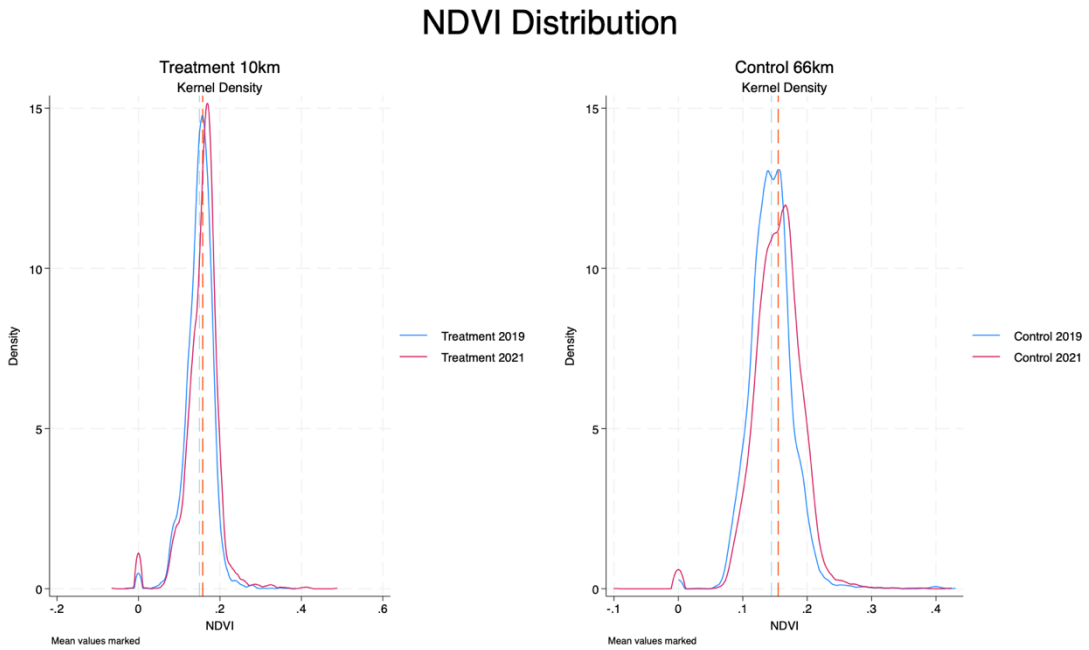
Note: Figure 4 shows a density distribution of the main violence outcome indicators (solid lines) before implementation in 2019 (blue line) and after implementation in 2021 (red line). That is, in effect, the frequency with which each potential inverse distance occurs in the data. These data show that, on average, cells are getting closer to violence over time and that this effect is more pronounced in treatment than control areas (shown by the larger gap between the dashed lines on the left-hand graph.

Figure 5: Density for Nightlight Radiation, Pre- and Post-Project



Note: Figure 5 shows a density distribution of the main nightlight radiation indicator (solid lines) before implementation in 2019 (blue line) and after implementation in 2021 (red line). That is, in effect, the frequency with which each level of nightlight radiation occurs in the data. These data show that, on average, nightlight emissions are increasing in both treatment and control areas over time. There is no clear suggestion that this gap is increasing more in either the treatment or control areas.

Figure 6: Density for NDVI, Pre- and Post-Project



Note: Figure 6 shows a density distribution of the main land usage indicator (solid lines) before implementation in 2019 (blue line) and after implementation in 2021 (red line). That is, in effect, the frequency with which level of land usage occurs in the data. These data show that, on average, land usage is not changing significantly over time.

Main Results

As noted, the summary analyses are limited and offer limited intuition, particularly for the main violence measure, which looks at the geographic dispersal of the occurrence of violent events. To overcome this, we develop a spatial difference-in-differences model, which allows us to consider the complicated spatial relationships that underpin our main measure of violence. Results for the main analysis are presented in Table 5, which looks at two slightly different constructions of the spatial violence indicator – the first, assuming a cell is unaffected by violence if the nearest event is more than 25km away; the second, assuming it unaffected if the nearest event is more than 50km away. In Table 5, we show two key outcomes. "After" captures the general trend in they key indicator over time, "Impact" the role played by the intervention, itself.

Table 5: SAC Model, Treatment 10km Control 66km: 2019 vs. 2021

	Inv. Distance to Violence 25km	Inv. Distance to Violence 50km
After	-0.030***	-0.038***
	(0.000)	(0.000)
Impact	-0.019***	-0.009***
	(0.001)	(0.001)
Number of observations	25544	25544

Note: Table 5 shows the results from the spatial difference-in-difference estimator. "Interaction Treatment # Post-Treat shows the attributable impact of the intervention. Results produced using 2019 as the "baseline" (pre-intervention year) and 2021 as the "endline" (post-intervention year). Standard errors are shown in parentheses. *, ** and *** show statistical significance at the 5%, 1% and 0.1% levels, respectively. These stars capture the certainty of the statistical relationship, with three stars indicating the greatest degree of confidence in the results.

Both models in Table 5 show that violence is decreasing in time across treatment and control regions, once the complicated spatial relationships are considered; and more importantly, that violence is reducing in treatment regions relative to control ones post implementation. This effect is highly significant in both models and offers strong suggestive evidence that the intervention has played a key, positive, role in influencing the geographic dispersal of violence.

We conduct one final test in order to assess the extent to which we can more causally attribute these findings to the intervention itself. Specifically, we repeat the analysis that produced Table 5, using two rounds of data collected before the intervention began, or was even announced. For this reason, we consider 2016 and 2017. This so-called "placebo" test allows us to test whether or not we can reproduce the same results shown in Table 5, without the intervention having taken placed. If the observed outcomes from this test are the same as those from the main analysis, this would cast doubt on the impact the intervention, itself, has had on the outcomes shown in Table 5. By contrast, if they are structurally different to those in Table 5, it more strongly allows attribution of the effects in Table 5 to the intervention. Results from this placebo test are shown in Table 6.

Table 6: SAC Model, Treatment 10km Control 66km: 2016 vs. 2017

	Inv. Distance to Violence 25km	Inv. Distance to Violence 50km
After	-0.032***	-0.007***
	(0.000)	(0.000)
Impact	-0.000	0.007***
	(0.652)	(0.000)
Number of observations	20732	20732

Note: Table 6 shows the results from the spatial difference-in-difference estimator. "Interaction Treatment # Post-Treat shows the attributable impact of the intervention. Results produced using 2016 as the "baseline" and 2017 as the "after" year. Standard errors are shown in parentheses. *, ** and *** show statistical significance at the 5%, 1% and 0.1% levels, respectively. These stars capture the certainty of the statistical relationship, with three stars indicating the greatest degree of confidence in the results.

Table 6 shows a set of results that are structurally different to Table 5, with results either insignificant (for the 25km cut-off version of violence indicator), or significant but positive (for the 50km cut-off). These results differ, substantially, in scale, sign and statistical significance, from those produced in the main analysis. In this sense, these results can be taken as further suggestive evidence that the effects shown in Table 5 are driven by the intervention, itself, rather than wider trends or other conflators.

Sub-Analysis of Economic Outcomes

There is a worsening in the intensity of land usage but an increase in nightlight radiation. We find a null effect of the radio program on nightlight radiation and a statistically significant negative effect on land usage in the treatment region (Table 7). This means that there is no systematic difference in nightlight radiation in treatment and control areas and that land usage is deteriorating in treatment areas. As the link to violence for these indicators would be indirect, we do not draw strong conclusions from the results in Table 7.

Table 7: SAC Model, Treatment 10km Control 66km: 2019 vs. 2021

	Nightlight	NDVI
After	0.127***	-0.026***
	(0.002)	(0.001)
Impact	0.000	-0.002***
	(0.000)	(0.001)
Number of observations	25544	25544

Note: Table 8 shows the results from the difference-in-difference estimator. "Interaction Treatment # Post-Treat shows the attributable impact of the intervention. Results produced using 2019 as the "baseline" (pre-intervention year) and 2021 as the "endline" (post-intervention year). Standard errors are shown in parentheses. *, ** and *** show statistical significance at the 5%, 1% and 0.1% levels, respectively.

Robustness

We reproduce the main results for different specifications of the model to ensure that our results are not driven by the selection of grid cells. Two radios broadcasted the program into 2021 and thus in principle violate the post-treatment period of our model. We run a robustness test excluding these two stations. The results do not meaningfully change (Appendix A5). We reproduce another robustness test that tests whether our findings are susceptible to changes in the definition of the control area. For this we run a model with full control rings, where we include control cells that receive other non-project radio broadcasting. We find similar outcomes with this full control ring model (Appendix A6) to our main model, lending support to the robustness of our definition as well as our findings. To further ensure that the results are not driven by a specific country, we run the model for Mali and Niger separately (see Appendix A7 and A8). Both in Mali and in Niger our SDID estimator is similar to the cross-country model, lending further support to our outcomes and to a possible positive effect of radio in different violent contexts.

5. Discussion and Conclusion

At the core of this work is a question that asks whether or not it is possible to use radio broadcasts to encourage people and places onto more peaceful trajectories, especially when provided with other components of interventions at the individual and regional level. In the context of the results produced, these results suggest that the answer – at the Mali / Niger border, at least – is "yes". Certainly, the results produced here suggest an effect that supports the theory of change of the project. Across most of our models, we find that cells in the treatment areas are, on average, relatively further away from violence compared to the areas just beyond the broadcasting ring in the post-project period, suggesting an overall reduction in the extent and geographic spread of violence within the broadcast regions. At the same time, this negative effect emerges while running a spatial Difference-in-Differences model and is not mirrored in more descriptive or graphical summaries of the development of violence in the region. These findings should, therefore, come with several considerations.

First, even though we assume no spillover from a model design point of view, our results provide reason to believe that there are positive, significant spillover effects to neighboring cells which means that on average neighboring radio broadcast decreases local distance to violence. This points, more, towards the radios changing the geographic dispersal of violence than reducing violence, overall – for example, displacing violence to communities just beyond the broadcasting range.

Second and similarly, regarding the control group rings, we note that only very specific thresholds produce near-parallel trends for the analysis, suggesting that these boundaries could, in theory at least, be random and meaningless, thus influencing the expectations we should form about trends going forward. In other words, just because these trends appear parallel does not mean that we should expect that to continue. As trends are most parallel in an area 66km beyond the broadcasting range, but also in an area 100km beyond the broadcasting range of treated radios, this suggests that

relatively small variation in the geography of violence could result in major changes in these outcomes.

Moving violence only a few kilometers could influence these trends, significantly, suggesting caution in strong interpretation of these findings in terms of reducing net levels of violence. At the same time, where we find parallel trends, we have followed theoretically valid approaches to achieving balance, effectively “cinching in” towards the geographic discontinuity. In this sense, the findings match the standard approach to defining thresholds in broader work.

Although we note limitations of the approaches presented in this document, these results open up the potential that violence has been reduced, or at least the geographic patterns altered, in the beneficiary areas of the fuller range of the project.

Appendix:

A1: Moran test results for OLS Regression Model Inv. Distance to Violence, 25km in 2019

```
Moran test for spatial dependence
         H0: Error terms are i.i.d.
         Errorlags:  Winvdist_allr_new2

         chi2(1)      =174250.99
         Prob > chi2  =   0.0000
```

A2: Moran test results for OLS Regression Model Inv. Distance to Violence, 50km in 2019

```
Moran test for spatial dependence
         H0: Error terms are i.i.d.
         Errorlags:  Winvdist_allr_new2

         chi2(1)      =161370.82
         Prob > chi2  =   0.0000
```

A3: Average impacts Nightlight Radiation Number of obs = 25,544

	Delta-Method				
	dy/dx	std. err.	z	P>|z|	[95% conf. interval]
direct					
treatment					
1	.0001769	.0002222	0.80	0.426	-.0002586 .0006123
post_treat					
1	.1269952	.0025177	50.44	0.000	.1220607 .1319297
indirect					
treatment					
1	7.16e-06	8.10e-06	0.88	0.377	-8.71e-06 .000023
post_treat					
1	.0051406	.0024824	2.07	0.038	.0002752 .0100061
total					
treatment					
1	.000184	.0002296	0.80	0.423	-.000266 .0006341
post_treat					
1	.1321359	.0001288	1025.71	0.000	.1318834 .1323883

A4: Average impacts, NDVI Number of obs = 25,544

	Delta-Method				
	dy/dx	std. err.	z	P>|z|	[95% conf. interval]
direct					
treatment					
1	-.0012466	.0003378	-3.69	0.000	-.0019086 -.0005846
post_treat					
1	-.0268181	.0011288	-23.76	0.000	-.0290304 -.0246057
indirect					
treatment					
1	.0015928	.00043	3.70	0.000	.0007501 .0024355
post_treat					
1	.034686	.0010899	31.82	0.000	.0325498 .0368222
total					
treatment					
1	.0003462	.0001414	2.45	0.014	.000069 .0006234
post_treat					
1	.0078679	.0021481	3.66	0.000	.0036576 .0120782

A5: SAC Model Treatment 10km Control 66km, Strict Model: 2019 vs. 2021

	Inv. Distance to Violence 25km	Inv. Distance to Violence 50km	Nightlight Radiation	NDVI
main				
Post-Treat	-0.033***	-0.201***	0.137***	-0.004***
	(0.001)	(0.002)	(0.003)	(0.001)
Interaction Treatment # Post-Treat	-0.001	-0.024***	0.001	-0.002
	(0.001)	(0.003)	(0.001)	(0.001)
Weighting Matrix				
Distance to Violence 25km	2.449***			
	(0.013)			
Error Term Distance to Violence 25km	11.729***			
	(0.030)			
Distance to Violence 50km		9.542***		
		(0.046)		
Error Term Distance to Violence 50km		2.541***		
		(0.019)		
Nightlight Radiation			-0.051*	
			(0.024)	
Error Term Nightlight Radiation			2.435***	
			(0.056)	
NDVI				1.396***
				(0.062)
Error Term NDVI				4.170***
				(0.093)
Sigma E				
Constant	0.060***	0.062***	0.011***	0.016***
	(0.000)	(0.000)	(0.000)	(0.000)
Number of observations	20732.000	20732.000	20732.000	20732.000

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A6: SAC Model Treatment 10km Control 66km, Full Control Rings Model: 2019 vs. 2021

	Inv. Distance to Violence 25km	Inv. Distance to Violence 50km	Nightlight Radiation	NDVI
main				
Post-Treat	-0.030***	-0.040***	0.129***	-0.031***
	(0.001)	(0.000)	(0.002)	(0.000)
Interaction Treatment # Post-Treat	-0.029***	-0.018***	-0.000	-0.004***
	(0.001)	(0.001)	(0.000)	(0.001)
Weighting Matrix				
Distance to Violence 25km	2.651***			
	(0.016)			
Error Term Distance to Violence 25km	10.978***			
	(0.064)			
Distance to Violence 50km		2.813***		
		(0.015)		
Error Term Distance to Violence 50km		12.951***		
		(0.037)		
Nightlight Radiation			0.026	
			(0.019)	
Error Term Nightlight Radiation			2.005***	
			(0.041)	
NDVI				4.297***
				(0.024)
Error Term NDVI				1.836***
				(0.038)
Sigma E				
Constant	0.063***	0.061***	0.012***	0.018***
	(0.000)	(0.000)	(0.000)	(0.000)
Number of observations	29342.000	29342.000	29342.000	29342.000

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A7: SAC Model Treatment 10km Control 66km, Mali: 2019 vs. 2021

	Inv. Distance to Violence 25km	Inv. Distance to Violence 50km	Nightlight Radiation	NDVI
main				
Post-Treat	0.004***	-0.003***	0.152***	-0.001
	(0.001)	(0.000)	(0.002)	(0.001)
Interaction Treatment # Post-Treat	-0.025***	-0.019***	0.002***	-0.002*
	(0.002)	(0.001)	(0.001)	(0.001)
Weighting Matrix				
Distance to Violence 25km	2.459***			
	(0.031)			
Error Term Distance to Violence 25km	7.737***			
	(0.062)			
Distance to Violence 50km		2.850***		
		(0.025)		
Error Term Distance to Violence 50km		9.081***		
		(0.060)		
Nightlight Radiation			-0.154***	
			(0.019)	
Error Term Nightlight Radiation			2.615***	
			(0.041)	
NDVI				1.240***
				(0.044)
Error Term NDVI				7.405***
				(0.082)
Sigma E				
Constant	0.052***	0.050***	0.009***	0.018***
	(0.000)	(0.000)	(0.000)	(0.000)
Number of observations	14200.000	14200.000	14200.000	14200.000

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A8: SAC Model Treatment 10km Control 66km, Niger: 2019 vs. 2021

	Inv. Distance to Violence 25km	Inv. Distance to Violence 50km	Nightlight Radiation	NDVI
main				
Post-Treat	-0.311***	-0.312***	0.123***	-0.021***
	(0.002)	(0.002)	(0.003)	(0.001)
Interaction Treatment # Post-Treat	-0.036***	-0.037***	0.001	-0.004***
	(0.006)	(0.006)	(0.001)	(0.001)
Weighting Matrix				
Distance to Violence 25km	7.930***			
	(0.022)			
Error Term Distance to Violence 25km	2.857***			
	(0.031)			
Distance to Violence 50km		8.141***		
		(0.021)		
Error Term Distance to Violence 50km		2.764***		
		(0.031)		
Nightlight Radiation			0.066**	
			(0.025)	
Error Term Nightlight Radiation			1.738***	
			(0.052)	
NDVI				2.669***
				(0.060)
Error Term NDVI				1.775***
				(0.088)
Sigma E				
Constant	0.069***	0.069***	0.012***	0.017***
	(0.001)	(0.001)	(0.000)	(0.000)
Number of observations	11452.000	11452.000	11452.000	11452.000

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

ISDC
INTERNATIONAL SECURITY AND DEVELOPMENT CENTER