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Oldenburg Discussion Papers in Economics

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V – 449-25

March 2025

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More Than Money: The Critical Role of Management in Educational Aid Effectiveness in Africa *

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March 19, 2025

Abstract

The effectiveness of educational aid in Africa is a pressing issue, with little consensus on whether the management quality of aid has significant contribution toward achieving inclusive, equitable, and quality education on the continent by 2030. Despite substantial inflows of educational aid from both bilateral and multilateral sources, Africa continues to report the world's highest illiteracy rates, indicating potential inefficiencies in educational aid management. This paper investigates whether the impact of World Bank–funded educational projects across Africa on literacy rates depends on the quality of project management. The findings reveal that educational projects managed in a highly satisfactory manner significantly reduce illiteracy, regardless of the quantity of aid or volume of aid disbursement. Meanwhile, projects managed in a sub-satisfactory manner show no progress at all. These findings highlight that effective management is far more critical to success than the amount of aid provided and suggest that reforming management practices could drastically enhance the impact of educational aid. By prioritizing high-quality management practices, policymakers and international organizations could improve the effects of educational aid, offering a targeted strategy to drive Africa's educational progress.

Keywords: aid effectiveness, management quality, illiteracy, DHS, World Bank, Africa

JEL Classification Numbers: F35, O12, O55, I2, I21

*I would like to sincerely thank Jürgen Bitzer, Erkan Gören, Bernhard C. Dannemann, and seminar participants at the Carl von Ossietzky Universität Oldenburg, 2024, for helpful comments and suggestions. All remaining errors are my own. **I have no known conflict of interest to disclose**.

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1 Introduction

Worldwide, there is a "learning crisis" (Stacy et al., 2023; UNICEF, 2024) driven by factors such as low investments in education, economic hardship, conflicts, and climatic conditions (e.g., flooding and drought) that hinder educational development. The crisis is particularly acute in Africa. Despite efforts to achieve universal primary education and quality education for all under United Nations Millennium Development Goal 2 (MDG 2) and Sustainable Development Goal 4 (SDG 4)[1], high levels of educational exclusion persist in Africa (UNESCO, 2024a). In Sub-Saharan Africa, for example, around 60% of youths aged 15 to 17 are not in school, and roughly 48 million young people in this age group lack basic reading and writing skills (UNESCO, 2024a). Moreover, about 89% of 10-year-old children in Eastern and Southern Africa cannot read a simple text (World Bank, 2024). Orphans, children from rural areas, and people with disabilities are among the disadvantaged groups that experience educational exclusion (Lewin, 2020; Riddell & Niño-Zarazúa, 2016).

The World Bank has sought to address these challenges and accelerate the realization of SDG 4 by providing substantial financial aid for education in Africa. As of 2023, the World Bank's educational aid in Eastern and Southern Africa alone amounted to about $6.33 billion across 35 projects (World Bank, 2024)[2]. Although we expect these financial commitments to improve educational outcomes significantly, evidence suggests that project performance is often impeded by management challenges. This shows the importance of understanding how the quality of project management affects the success of educational aid and, by extension, the effectiveness of these projects in reducing illiteracy.

One strand of the literature on aid effectiveness and educational outcomes has focused on the relationship between educational aid and improvements in achievement metrics such as completion rates, revealing significant but varying impacts (Birchler & Michaelowa, 2016; d'Aiglepierre & Wagner, 2013; Dreher et al., 2008; Michaelowa & Weber, 2008; Michaelowa, 2004; Miningou, 2019). In a paper closely related to the present one, Yogo (2017) found that foreign aid positively influenced primary school completion rates in 35 Sub-Saharan African countries, but that the effect was relatively small. Their conclusion was that aid levels should be doubled to achieve universal primary education. Thierry and Emmanuel (2022) extended this analysis by assessing the role of financial development in increasing enrollment at all educational levels through structural economic factors (a country's financial system [3]) such as accessibility and efficiency,

[1]MDG 2 is aimed to achieve universal primary education; SDG 4 is dedicated to ensuring inclusive and equitable education and promoting lifelong learning opportunities for all.

[2]From 1995 to 2014, the number of aid projects in Africa was about 1,970 out of 5,684 geocoded projects (5,881 total projects) in 6,591 out of 61,243 project locations worldwide (AidData, 2017).

[3]Thierry and Emmanuel (2022) use nine indices: overall financial development, financial institutions, financial institution depth, financial institution access, financial institution efficiency, financial markets, financial market depth, financial market

and argued for strengthened domestic financial systems to ensure inclusive educational progress. Musah et al. (2024), in contrast, found that although investments in primary and tertiary education do improve some aspects of educational quality, secondary education continues to face challenges despite increased funding.

The aforementioned studies rely on country-level data, which obscures critical within-country variation by failing to control for unobserved heterogeneity (factors such as historical relations that might affect foreign aid allocation in a given geographical area) across countries. The present paper addresses this problem by employing a sub-national focus, analyzing geocoded data across multiple recipient countries to generalize findings more broadly. The empirical design enables identification of local variation, which is particularly relevant in Africa, where diverse communities face distinct educational challenges that affect long-run educational development. The focus in this paper—in contrast to Thierry and Emmanuel's emphasis on financial systems or Yogo's focus on aid allocation for primary education—is on the management quality of World Bank– funded projects as a determinant of illiteracy outcomes.

Another paper focusing on the sub-national level, but with a much narrower geographic scope than the present one, is that of Helskog (2024), who investigated the localized effects of development aid on primary school dropout rates in conflict-affected areas of Rwanda. Using a linear probability model to analyze over 63,000 individuals within $10km$ of aid projects, the author found that development aid reduces the probability of dropout in genocide-affected areas by 20%, particularly in low-income households. While their study provides valuable insights, it also has limitations: It does not consider the quality of project management, which could significantly influence aid project effectiveness. It further raises questions about the generalization of findings to other contexts beyond Rwanda, given the country's unique post-genocide history. Moreover, it has difficulty isolating the specific impact of educational aid since only 12 of the 199 projects studied directly targeted education. To address this, Helskog takes a broad approach, showing how forms of non-educational aid, such as health and agriculture initiatives, indirectly benefit education by improving household incomes and helping families keep their children in school. While this sheds light on the far-reaching effects of development aid, it also shows the need for further research focusing on how targeted educational aid and effective management can make a difference. The present paper seeks to answer this question by not only examining conflict-affected areas but also looking closely at managerial aspects of aid allocation and the specific contributions of the targeted educational aid in reducing the illiteracy rate in a given spatial unit.

A second strand of research analyses the determinants of World Bank project management performance, focusing on country-level factors such as GDP growth, political stability, and institutional quality (Ashton

access, and financial market efficiency to proxy for financial development in a given country.

et al., 2022; Briggs, 2019; Chauvet et al., 2010; Denizer et al., 2013; Dreher et al., 2013; Guillaumont & Chauvet, 2001; Guillaumont & Laajaj, 2006), as well as project-specific characteristics such as the assignment and supervision of task team leaders (TTL) (Heinzel & Liese, 2021; Honig et al., 2022; Kilby, 2000; Limodio, 2021) as critical for overall aid success. However, this research largely overlooks how management performance directly influences specific intended outcomes such as reductions in illiteracy rates.

No study to date, to the author's knowledge, has combined these two strands of literature by investigating how the quality and efficiency of management in World Bank–funded educational projects translates into educational outcomes at the sub-national level. The present paper makes the unique contribution of analyzing the impact of project management quality—measured by World Bank project ratings—on illiteracy rates at the sub-national level in Africa. It examines distinctions between projects rated highly satisfactory (HS), moderately satisfactory (MS), and less satisfactory (LS) to provide nuanced insights into the differential effects of project management on educational development. Furthermore, it applies spatial buffers to match World Bank–funded educational projects with educational information. This offers a more precise understanding of how management quality influences educational outcomes in specific areas by uncovering granular patterns of aid effectiveness. Additionally, it investigates how the management quality of one project affects that of other projects in the same spatial unit, addressing the question of whether an HS project can improve the impact of an LS educational project in the same cluster. This approach fills critical gaps in the literature by linking the management quality of diverse project clusters to sub-national educational outcomes, offering a novel perspective on optimizing aid strategies for educational improvement in Africa.

In this paper, I match the sub-national geocoded data on World Bank project management quality (proxied by project ratings) produced by the Internal Evaluation Group (IEG) from AidData (AidData, 2017) with geocoded data on education from the Demographic and Health Surveys (DHS) Program (ICF, 2024a) in 33 African countries. Using data from 1992 to 2020 and a 50 km buffer as baseline results, my results show that educational projects with HS management significantly reduce illiteracy rates, while the opposite holds for MS and LS projects. Probing further reveals management quality dependencies. Areas with HS projects show consistently reduced illiteracy, whereas areas with MS and LS projects show increased illiteracy. This suggests that ineffectively managed educational aid can actually worsen educational outcomes in a given spatial unit. Results also show that in both urban and rural areas, HS projects consistently reduce illiteracy, with greater impacts in urban areas. In urban areas, MS projects worsen outcomes when implemented alone but improve outcomes when paired with HS projects, whereas in rural areas, the positive impact of paring MS with HS projects is not observed. LS projects, on the other hand, consistently exacerbate illiteracy, even when paired with MS or HS projects. Robustness checks based on different buffer sizes show that the choice of distance around the DHS program location does not drive the results. These results suggest that to maximize impact, policies must prioritize scaling HS projects and fostering effective project combinations. Rural areas need strategic investments in management capacity and tailored project designs to address persistent challenges.

The structure of the paper is as follows: In Section 2, I describe the data and key variables used for the analysis. Section 3 focuses on the empirical and econometric framework. Section 4 presents the empirical results, Section 5 discusses the robustness checks, Section 6 discusses the paper's findings, and Section 7 concludes.

2 Data

In this analysis, I combine georeferenced aid data from AidData (AidData, 2017), which reports on World Bank aid projects in each recipient country in a given year. It spans the period 1995 to 2014. The educational data are obtained from the DHS survey program (ICF, 2024b), which covers a large number of years, 1992 to 2020. The analyses presented here span that entire period, encompassing approximately 57,340 clusters with little or no completed educational aid projects prior to the survey date. Further details on the construction of dependent and explanatory variables are presented in the following subsections 2.1, 2.2, 2.3.

2.1 Dependent Variable

The "share of illiteracy" is the dependent variable based on geocoded data from DHS (ICF, 2024a) for 33 countries between 1992 and 2020 (see Appendix Tables A.8 for countries and surveys included). The DHS data are nationally representative and include demographic, educational, and geographic information for households and individuals. Educational information includes and is not limited to years and level of completed education and current schooling status. Combining this information, I calculate the proportion of individuals aged 6 to 24 years without formal or completed primary education. The illiteracy rate in a cluster is expressed mathematically as:

$$illiteracy_{dct} = \frac{\sum S_{idct}}{\sum N_{idct}} \tag{1}$$

where: $illiteracy_{dct}$ indicates the percentage share of people in the 6 to 24 age group within cluster d in country c at time t who have no formal or completed primary education. $\sum S_{idct}$ is the total number of individuals with no formal education or no completed primary schooling in that age group.

Table 1: Descriptive Statistics

Statistics	Obs.	Mean	St. Dev.	Min	Max
	Dependent variable				
Share of illiteracy (6-24 years)	58,182	24.408	24.895	0	100
	Completed aid projects – indicator				
Dummy: highly satisfactory edu.	58,182	0.175	0.380	0	1
Dummy: moderately satisfactory edu.	58,182	0.252	0.434	0	1
Dummy: less satisfactory edu.	58,182	0.057	0.232	0	1
	Completed aid projects – counts				
Total completed aid	58,182	9.175	15.604	0	123
Total completed edu. aid	58,182	1.673	3.933	0	46
Highly satisfactory, completed edu.	58,182	0.512	1.914	0	23
Moderately satisfactory, completed edu.	58,182	0.559	1.379	0	18
Less satisfactory, completed edu.	58,182	0.088	0.499	0	9
	Completed aid projects – log of disbursement				
ln(Value edu.)	21,038	15.775	1.501	11.593	19.845
ln(Highly satisfactory)	10,204	15.946	0.975	13.045	18.673
ln(Moderately satisfactory)	14,651	15.355	1.500	11.593	19.841
ln(Less satisfactory)	3,318	14.315	1.537	12.109	18.269
	Geographic and weather controls				
Num. conflicts 5 years prior	58,182	4.711	18.824	0	573
Population per 100,000	58,182	21.293	32.300	0	244.025
Mean nighttime light	58,182	7.713	8.674	2.259	59.537
Mean precipitation	58,182	89.529	57.391	0.009	289.387
Mean temperature	58,182	23.847	3.659	10.115	31.030
Mean drought	58,182	−0.287	0.714	−2.456	2.743
	DHS Variables				
Average age	58,182	22.996	3.744	12.500	62.233
Average household size	58,182	6.669	2.536	1.154	44.607
Share of children	58,182	0.446	0.101	0	0.875

Notes: This table summarizes statistics for the regression variables. The descriptive statistics for the logged disbursement variables are calculated using only non-zero values, as including 0.01 would result in negative values. Consequently, statistics for logged disbursements are provided exclusively for clusters with positive recorded entries to avoid this issue. All disbursements are reported in U.S. dollars. The raster data on population for certain years and clusters (notably in the Democratic Republic of Congo, Egypt, and Tanzania) indicate zero population values, even though DHS respondents are present. These clusters are in remote regions and additionally, due to the spatial displacement of DHS geolocations by approximately 0–10km where satellite-based population data fail to accurately capture the presence of inhabitants (see Section 5 for robustness checks by buffer sizes).

$\sum N_{idct}$ is the total number of individuals in that age group in a given cluster. The proportion is a measure of the illiteracy rate among individuals aged 6 to 24 within a specific demographic cluster [4]. I construct the dependent variable by integrating various self-reported education-related questions, such as educational attainment, schooling status, and other educational variables. For example, in the DHS

[4]The use of enrollment measures as a proxy for educational outcomes has been challenged in the literature, which generally recommends that the outcome variable include educational quality indicators, such as test scores, rather than just enrollment to reveal the true impact (Bennell, 2002). Clemens et al. (2008), for instance, report that higher enrollment rates are associated with declining educational quality in some countries due to factors such as higher student–teacher ratios, increased failure and repetition rates, and lower test scores. However, since disaggregated test score data or other indicators for measuring quality education for a larger sample are unavailable, I use enrollment rates as a proxy for illiteracy in my analysis.

data, some individuals report completing ten years of education but lack entries for schooling status or educational level achieved, and vice versa. Relying solely on one variable, such as educational level, would exclude certain individuals from the sample. To address this, I infer educational levels using other related educational variables where possible (see Appendix, Table A.7). Descriptive statistics are reported in Table 1.

2.2 Main Explanatory Variable: IEG Rating

The World Bank's development projects follow a structured process starting with preparation and moving through implementation to the post-completion evaluation stage. A project is evaluated by the Independent Evaluation Group (IEG) according to a set of criteria (including relevance, efficiency, and effectiveness) and a number of project characteristics. These include whether the World Bank's funding was well designed, how the project was supervised, implementation experience, and the recipient government's initial readiness to implement the project. The overall outcome receives a score from 1 to 6, with 1 denoting highly unsatisfactory and 6 highly satisfactory outcomes (for full detailed discussion on IEG ratings, see Bedasso, 2024; Chauvet et al., 2010; Ika et al., 2012).

The dataset comprises 5,684 World Bank projects approved between 1995 and 2014, valued at over $630 billion in commitments and $389 billion in disbursements. My study examines 1,970 geocoded World Bank projects in Africa. The dataset includes project details such as start and end date, sector, and geolocation. In cases where IEG ratings were unavailable, project rating data were matched with project specifics from IEG (2024) for the most recent ratings. The analysis is focused on completed educational projects that have been formally approved and evaluated and have IEG ratings. Fig. 1 illustrates the spatial distribution of DHS survey locations and World Bank aid projects in Africa for only the sampled countries in the analyses. Most World Bank projects are located in East, Central, and West Africa, for which DHS data are available. I define a project as belonging to the educational sector if any of its sub-sector categories (unspecified: education, basic education, secondary education, or post-secondary education) correspond to education.

2.3 Covariates

In compiling the final dataset, I augmented the education and aid data with additional demographic, socioeconomic, and geographic information specific to the cluster location. The selection of these variables was guided by previous research on sub-national aid project analysis (Bitzer & Gören, 2024; Briggs, 2018a, 2018b; Dreher et al., 2008; Nunnenkamp et al., 2016). Following established methodologies in the literature, I systematically considered factors that could influence the relationship between education and

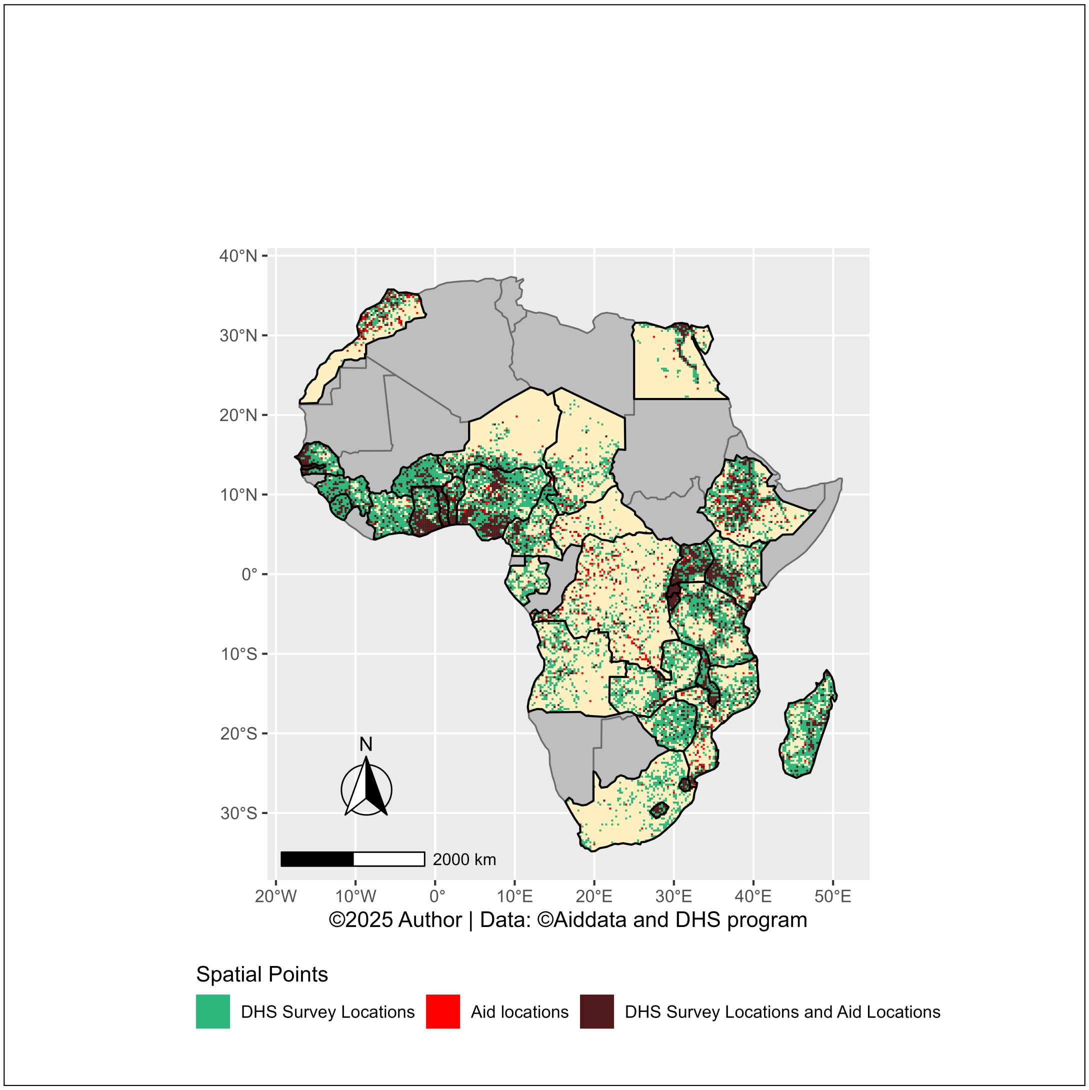

Figure 1: DHS and World Bank Aid Projects Locations in Africa

Notes: The graph displays World Bank projects approved in Africa from 1995 to 2014 (red dots). The green dots show the locations of households surveyed by the DHS program between 1992 and 2020. Brown dots indicate where both aid projects and DHS data are available.

aid effectiveness while excluding variables that might introduce confounding effects. Due to Africa's lack of disaggregated GDP estimates, I used nighttime light images as a proxy for economic development and remoteness. These images have been shown to correlate with official GDP growth data (Doll et al., 2000; Elvidge et al., 1997; Ghosh et al., 2009; Henderson et al., 2012). Utilizing the methodology proposed in the nighttime light literature, I calculated the mean of nighttime light using zonal statistics within each buffer zone. The visible, stable light data were obtained from NASA's Earth Observation Group. They spanned the period 1992 to 2014, with additional recent data from 2015 to 2021 incorporated based on

Bitzer and Gören (2024) [5]. I assumed that aid management is more effective or visible in less remote areas, leading the World Bank to be more likely to allocate aid to regions with higher nighttime light intensity and to be more reluctant to allocate aid to more remote areas.

Furthermore, I included population figures (in hundred thousands) sourced from the Socioeconomic Data and Applications Center (CIESIN, 2018) to mitigate the potential bias stemming from aid targeting densely populated areas (Öhler et al., 2019) and to explore the relationship between population density, educational infrastructure, and aid allocation. Notably, regions with limited educational infrastructure have been found to attract more educational aid from the World Bank (Dollar & Levin, 2006; Song et al., 2020). Next, I include the number of organized conflicts 5 years prior to the survey date from the UCDP Georeferenced Event Dataset (GED), global version 23.1 (Davies et al., 2023; Sundberg & Melander, 2013) in the buffer to proxy for political instability and institutional quality. I assume that conflicts at the location of World Bank projects will delay project approval and execution, will intensify local violence (Blattman & Miguel, 2010; Collier & Hoeffler, 2006; Findley et al., 2023; Maren, 2009; Trisko Darden, 2020; Zürcher, 2019) and may attract more aid when the conflict is over and its effects are more visible (Child, 2014; Wood & Molfino, 2016).

The analyses consider the effect of weather-related variables on household income. Many African regions rely heavily on agriculture as a source of livelihood, making climate variables a significant factor in agricultural productivity (Zamand & Hyder, 2016). Rainfall scarcity or extreme drought due to high temperatures can lead to crop failures, resulting in decreased household incomes. Climate-related economic shocks can cause families to prioritize immediate survival over education, reducing literacy rates as children are compelled to work to support their families instead of attending school (Cockburn & Dostie, 2007; Mahmud & Riley, 2021; Marchetta et al., 2018). Once children drop out of school, it becomes increasingly difficult for them to return (Asare et al., 2023). To isolate this effect, I control for climate variables such as mean precipitation, temperature, and drought. I also control for demographic variables such as average household size, average age, and the share of children (i.e., sons or daughters of the household head) within the cluster as additional factors that correlate with educational outcomes.

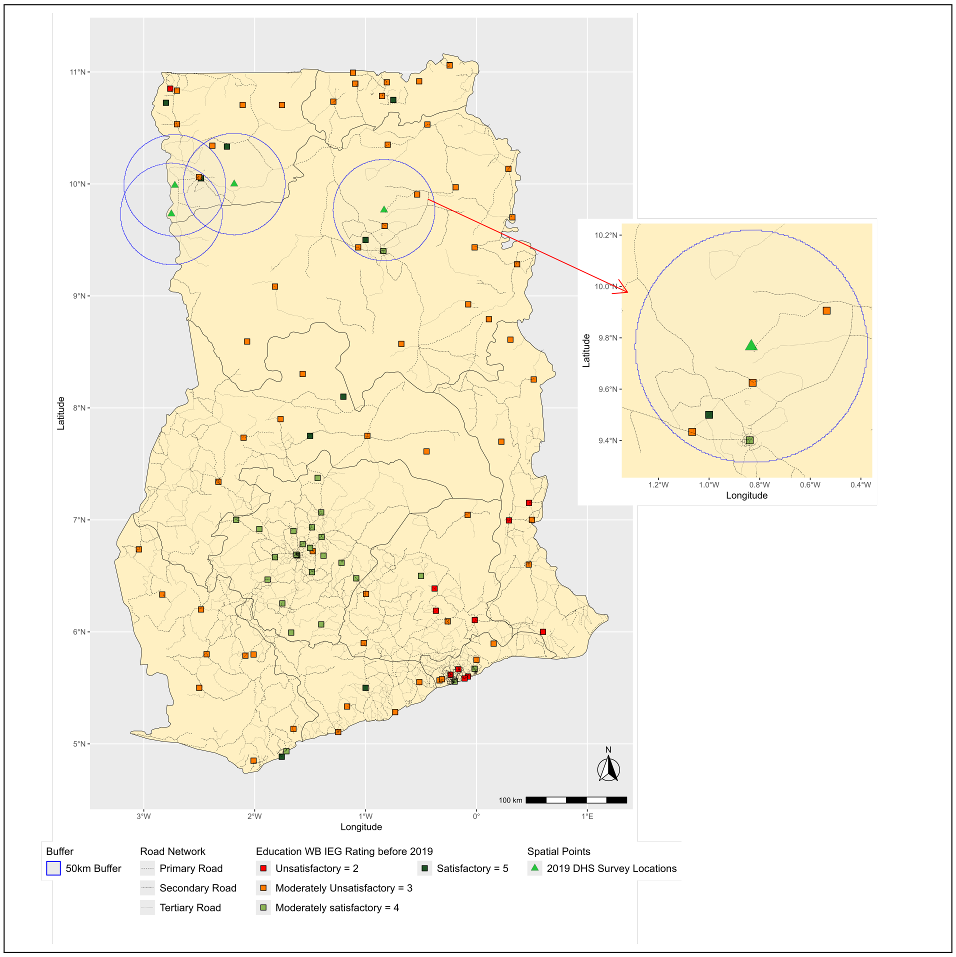

Figure 2: Spatial matching approach

Notes: The figure uses Ghana to illustrate the spatial matching approach of World Bank IEG project ratings and DHS locations. A 50 km buffer is drawn around the DHS cluster. The triangles are a subset of the 2019 DHS cluster located in the northern part of Ghana. The squares are overall IEG scores associated with each completed aid project. As shown on the map, Ghana like other countries in my sample does not obtain the two extreme rating scores: 1 (highly unsatisfactory) and 6 (highly satisfactory).

3 Empirical Strategy

3.1 Spatial Matching

I explore the geographic proximity of clusters in the World Bank educational project areas by taking my analysis from the individual level to a more aggregate geographic area (cluster units). I create a $50km$ buffer, corresponding to an area of about $7,854\ km^2$. The buffers are convenient spatial units that allow me to match projects to nearby clusters with educational information. Spatial buffers provide a

[5] These are calibrated data designed to ensure comparability across different satellites. For detailed explanations of the calibration process, see Bitzer and Gören (2024) and Hsu et al. (2015)

more targeted and precise analysis than administrative regions, making them valuable spatial units for the analysis[6]. The choice of buffer size is important in the estimation as DHS locations do not represent the exact location of the clusters due to geographical displacement of about $0 - 10km$ (DHS, 2024), to avoid identification of individuals. For instance, a larger buffer size increases the noise by likely counting clusters far from aid projects as beneficiaries of aid, which might not be the case. To circumvent this concern, I provide estimates with different buffer sizes in Section 5. The sample consists of African countries for which DHS survey waves are available. The first wave corresponds to a period with little or no World Bank educational aid activities. It is also worth noting that I examined completed educational aid projects before the cluster was surveyed.

Fig. 2 illustrates the spatial matching approach of aid projects and DHS cluster locations. If an educational aid project was completed before the surveyed date of the DHS cluster, I consider it as treated. I measure aid to education using three approaches: First, an indicator equals one if a cluster has a completed educational aid project. Second, I count the number of completed educational projects. Third, the total value of disbursements[7] within each cluster is calculated. The disbursement is reported only for the main project. However, these projects often consist of multiple sub-projects across different locations. Therefore, I evenly split the total disbursement among sub-projects under the main project (Briggs, 2018b). All three aid measurement levels must exist before the DHS cluster survey date. I repeat the three steps for the World Bank IEG project rating associated with the project as a proxy for management quality. The overall IEG rating is on a scale from 1 to 6. Therefore, a dummy, a count, and the disbursement value of each specific scale in the buffer are calculated.

Finally, I made 3-point scales to simplify the analysis by combining ratings 1 and 2 as LS projects, 3 and 4 as MS projects, and 5 and 6 as HS projects. The reason is that none of the educational projects completed prior to the cluster survey was rated 6 (highly satisfactory), and only a few clusters were rated

[6] Previous studies in aid have used grid cell analysis to study economic growth/poverty (Bitzer & Gören, 2024; Briggs, 2018b) or conflicts (Wood & Sullivan, 2015). Although a grid cell is an appropriate spatial unit, I am more interested in a more localized effect, where the impact of aid on the illiteracy rate is the primary concern. Grid cells are noisy and broad in area (i.e., often covering larger uniform regions), with no emphasis on areas surrounding an actual DHS cluster (the focus of this analysis). As a result, such a spatial method may include an area that does not contain the outcome variable itself, which may reduce the accuracy of the results.

[7] The aid data on disbursements have limitations, as there are instances where disbursements were not reported for certain years or specific projects. I do not use aid commitments because these are not necessarily the exact amount disbursed and often overstate the actual aid flow. The summary statistics in Appendix table A.1 shows that, on average, approximately \$72 million was disbursed to projects approved during our study period, with approximately \$6.8 million in the educational sector. LS projects on average have the lowest disbursements, amounting to approximately \$380,000, whereas MS projects on average have the highest disbursements.

1 (highly unsatisfactory). Using Ghana as an illustration in Figure 2 (left), there are four MS (three with an IEG rating of 3 [moderately unsatisfactory], and one with an IEG rating of 4 [moderately satisfactory]) and one HS (IEG rating of 5, satisfactory) projects before the survey date of the cluster. Additionally, for each cluster represented by the triangle in Figure 2, I compute the shares and averages for some household characteristics (e.g., average age, average household size) and the outcome variable illiteracy (i.e., the share of individuals between the ages of 6 and 24 years with no formal or completed primary education).

3.2 Identification Strategy

I employ fixed-effects (FE) estimation to investigate whether World Bank management quality (proxied by project rating) has an effect on reducing the illiteracy rate. First, I estimate generic aid impact on illiteracy using Equation (2) and employing the three measurements for World Bank educational aid: an indicator of whether educational aid had ever been completed, a count of the number of completed educational aid projects, and finally, the total disbursement. Second, I explore management quality using Equation (3). The estimated equations take the following form:

$$Illiteracy_{dct} = \beta_1^m Aid_{dct}^m + \mathbf{X}'_{dct} + \delta \mathbf{Z}'_{dct} + \phi \mathbf{G}'_d + \lambda_g + \lambda_t + \varepsilon_{dct} \tag{2}$$

$$Illiteracy_{dct} = \alpha_1 HS_{dct} + \alpha_2 MS_{dct} + \alpha_3 LS_{dct} + \theta \mathbf{X}'_{dct} + \delta \mathbf{Z}'_{dct} + \phi \mathbf{G}'_d + \lambda_g + \lambda_t + \varepsilon_{dct} \tag{3}$$

$$\begin{aligned} Illiteracy_{dct} = {} & \alpha_1 HS_{dct} + \alpha_2 MS_{dct} + \alpha_3 LS_{dct} \\ & + \alpha_4 (HS_{dct} \times MS_{dct}) + \alpha_5 (HS_{dct} \times LS_{dct}) + \alpha_6 (MS_{dct} \times LS_{dct}) \\ & + \theta \mathbf{X}'_{dct} + \delta \mathbf{Z}'_{dct} + \phi \mathbf{G}'_d + \lambda_g + \lambda_t + \varepsilon_{dct} \end{aligned} \tag{4}$$

where: *Illiteracy* denotes the share of individuals between 6 and 24 years of age with no education in cluster d in country c at time t, as discussed in Section 2 Equation 1. *Aid* in Equation (2) captures the impact of World Bank aid on illiteracy across the different aid measurements $m = \{dummy,\ counts,\ ln(disbursement)\}$. Equation (3) examines each level of project management quality on illiteracy, and Equation (4) explores interaction effects between management quality[8]. Where: HS = highly satisfactory (scores 5 and 6); MS = moderately satisfactory (scores 4 and 3) and LS = less

[8] For Equation (3) and (4) disbursement of each level of project management quality is log transformed.

satisfactory projects (scores 1 and 2). In Equation (2), β_1^m represents the effect of educational aid on illiteracy for each level of project measurement quality. On the other hand, α_1 to α_6 in Equation (4) captures the marginal impact of project management quality on the illiteracy rate. The marginal effect of a management quality level can be expressed as follows:

$$\frac{\partial Illiteracy_{dct}}{\partial HS_{dct}} = \alpha_1 + \alpha_4 MS_{dct} + \alpha_5 LS_{dct} \quad (5)$$

$$\frac{\partial Illiteracy_{dct}}{\partial MS_{dct}} = \alpha_2 + \alpha_4 HS_{dct} + \alpha_6 LS_{dct} \quad (6)$$

$$\frac{\partial Illiteracy_{dct}}{\partial LS_{dct}} = \alpha_3 + \alpha_5 HS_{dct} + \alpha_6 MS_{dct} \quad (7)$$

In the parsimonious specification in Equation (3), the effect of the main management quality level on illiteracy is straightforward and reflects its unique influence. However, when interaction terms are included, the interpretation changes significantly. In such cases, the impact of management quality depends on the levels of the interacted variables, which can lead to coefficients of the interacted variables having the opposite signs from the specifications without interaction terms. That is, the effect is no longer isolated but contingent on the interplay between variables. The vector $\mathbf{X}'$ socioeconomic controls (e.g., number of conflicts, population in hundred thousands and mean nighttime light). The vector $\mathbf{Z}'$ is climatic controls (mean temperature, precipitation, and drought), and $\mathbf{G}'$ is a set of DHS cluster demographics (average age, average household size, and share of children). λ_g[9] and λ_t are administration level 2 and year FE, respectively.

Administration level 2 and year FE control for unobserved variations that are constant over time and vary across clusters. This includes differences in humanitarian needs or other pertinent conditions (historical and cultural relations) that influence the allocation of aid from the World Bank and other bilateral sources. This ensures that I am always comparing within a given cluster at a single point in time. Finally, ε is an idiosyncratic error term. Unless otherwise stated, standard errors are clustered at DHS cluster level d throughout all regressions.

4 Main Results

The baseline results are divided into three sections based on the measurement of educational aid, namely: indicator, count, and disbursement measures. Each of the reported sections is further structured into

[9] I replace countries with no global administrative area level 2 (gadm) with level 0 to avoid them being dropped out of the analysis. Excluding them also does not alter the significance or sign of the coefficients. Results are available upon request.

three columns for all regression tables. Column (1) of Tables 2, 4, 6 provides estimates for Equation (2) examining the generic impact of completed World Bank educational aid projects on illiteracy. Column (2) focuses on World Bank project management quality using Equation (3) by estimating a parsimonious model without the interaction terms to investigate the influence of management quality on illiteracy. Finally, Column (3) uses Equation (4) to explore the interaction effects between management quality levels to ascertain whether illiteracy rates in one area are influenced by the management quality of other educational projects in the same vicinity. In addition, to aid interpretation, the dependent variable, the share of illiteracy (proportion of individuals aged 6 to 24 who lack formal education), was scaled by a factor of 100 to express it as a percentage points. Consequently, the coefficients of the explanatory variables reflect the change in the illiteracy share in percentage points. Standard errors are clustered at the DHS cluster level. For simplicity, coefficients for climate variables and DHS demographics are controlled but not reported.

Indicator for Educational Aid: Table 2 investigates the impact of completed educational aid projects on illiteracy rates, employing an indicator for the presence of educational aid before the cluster survey date. In Column (1), the analysis reveals a positive and statistically significant coefficient at the 1% level. This indicates that, all else being equal, starting a new educational project in a specific cluster and year is associated with an increase in illiteracy by approximately 1.75 percentage points. This result is unexpected, as educational aid is typically aimed at improving literacy rather than increasing illiteracy. One potential explanation is that some projects may have been poorly implemented or unsuccessful, resulting in little to no improvement in literacy rates. This raises concerns about whether World Bank educational aid is effectively achieving its goal of reducing illiteracy. A limitation of this specification is the use of a broad indicator for educational aid presence, which may overlook important factors such as the role of management quality in shaping project outcomes. Incorporating measures of management quality, such as overall performance ratings from the IEG, could provide valuable insights into these puzzling findings. These considerations are addressed in subsequent models to better understand the underlying factors driving these results.

The analysis further reveals that conflicts, which are significant at 1%, play a significant role in increasing illiteracy rates. The disruptions to normal human activities such as schooling, can result in schools closing and children being unable to attend classes. This finding highlights the urgent need to address conflict situations to ensure the continuity of education for all. Similarly, rapid population growth though insignificant in Column (1) but positive and significant at 5% significance level in the remaining columns is associated with higher illiteracy rates. Particularly in regions like Africa, where educational infrastructure is often insufficient to accommodate a large number of students. Overcrowded classrooms

Table 2: Indicator: If Cluster Received any Educational Aid

Variables	(1) Educational Aid	(2) Rated Projects	(3) Interactions
	Dependent Variable: Illiteracy (6-24 years)		
Educational project	1.753***		
	(0.3014)		
HS		-2.634***	-0.2665
		(0.4395)	(0.5406)
MS		0.1794	1.590***
		(0.3138)	(0.3703)
LS		4.718***	8.152***
		(0.5704)	(0.8353)
HS × MS			-4.006***
			(0.5796)
HS × LS			-4.003***
			(0.9465)
MS × Low			-3.382***
			(0.6681)
Num. conflicts 5 years prior	0.0183***	0.0185***	0.0153**
	(0.0069)	(0.0069)	(0.0069)
Population per 100,000	0.0169	0.0323**	0.0321**
	(0.0133)	(0.0132)	(0.0132)
Year	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Weather Controls	Yes	Yes	Yes
Cluster demographics	Yes	Yes	Yes
Clusters with compl. edu. aid	21,676	21,676	21,676
Clusters with compl. aid	37,924	37,924	37,924
Clusters with edu. aid	37,169	37,169	37,169
Clusters with aid	57,341	57,341	57,341
Num. DHS clusters	57,341	57,341	57,341
Observations	58,182	58,182	58,182
Within R^2	0.01100	0.01196	0.01378

Notes: The dependent variable is the share of individuals between the ages of 6 and 24 who are illiterate (see Section 2 for definition of illiteracy) multiplied by 100. Each column comes from a unique regression. Weather-related controls include mean precipitation, mean temperature, and mean drought. DHS cluster controls include the average age in the cluster, average household size, and the share of sons and daughters in the cluster. All regressions include year and district (that is, administrative level 2) FE. Clustered standard errors by DHS clusters in parentheses. *Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

and the inability of school systems to absorb the growing population exacerbate the problem, leaving many children without access to education (UNESCO, 2024b).

Column (2) investigates further to differentiate projects based on overall managerial quality using the IEG rating obtained. In contrast to earlier estimates in Column (1), I found negative and statistically

Table 3: Marginal Effects – Indicator

(1) HS	(2) MS	(3) LS	(4) Freq.	(5) Freq.(%)	(6) Marginal Effects HS	(7) Marginal Effects MS	(8) Marginal Effects LS
0	1	0	7,645	38.82	–	**1.59**	–
1	1	0	4,484	22.77	**-4.01**	**-2.42**	–
1	0	0	4,051	20.57	0	–	–
0	1	1	1,061	5.39	–	-1.79	4.77
1	1	1	886	4.50	-8.01	-5.80	0.77
0	0	1	620	3.15	–	–	**8.15**
1	0	1	609	3.09	**-4.00**	–	**4.15**
0	2	0	191	0.97	–	1.59	–
0	2	2	54	0.27	–	-5.17	1.39
2	0	0	39	0.20	0	–	–
2	2	0	38	0.19	-8.01	-6.42	–
2	0	2	10	0.05	-8.01	–	0.15
0	0	2	4	0.02	–	–	8.15
0	3	3	2	0.01	–	-8.56	-1.99
0	3	0	1	0.01	–	1.59	–

Notes: This table quantifies the marginal effects of combinations of managerial quality types (HS, MS, LS) on the illiteracy rate. Columns (1)–(3) represent unique combinations of project quality types observed in the data, while columns (4)–(5) provide the frequency of each combination as raw counts and percentages. Marginal effects in columns (6)–(8) are computed using Equations (5)–(7) and coefficients from Table 2, column (3). For example, the marginal effect for a single MS project (row 1) is derived using Equation (6): $1.590 - 4.006 \times HS_{dct} - 3.382 \times LS_{dct}$. Substituting $HS_{dct} = 0$ and $LS_{dct} = 0$, the result is -1.59 percentage points. Insignificant coefficients are treated as zero. Calculations are performed with maximum decimal and rounded to two decimal places. Bolded values are mentioned in the paper.

significant effect at 1% for HS educational project. Implying that when HS educational project exist in an area, illiteracy is reduced by approximately 2.63 percentage points. While I do not find significant effects for MS project. HS projects are likely to be more effective in improving education. However, LS project is associated with higher illiteracy rates of about 4.72 percentage points. It suggests that poorly managed projects fail to achieve their intended goals, leading to a continued growth in the illiteracy rate in a given spatial unit. Poor management can lead to inefficiencies and resource wastage in addressing the needs of the target population. This suggests that examining the presence of educational aid without considering other factors such as the quality of project management can be misleading.

Table 2, Column (3), evaluates the dependencies of aid management quality, specifically analyzing whether the coexistence of different educational management quality projects within the same cluster can improve illiteracy. The corresponding marginal effects for unique combinations of project quality categories are presented in Table 3. For example, the presence of a single MS project, which is the most frequently observed case in the data (38.82%), results in a significant positive marginal effect, increasing illiteracy rates by approximately 1.59 percentage points (Table 3, row 1; see table footnotes for calculation

Table 4: Counts: Number of Completed Educational Projects

	(1)	(2)	(3)
	Dependent Variable: Illiteracy (6-24 years)		
Variables	Educational Aid	Management Rating	Interactions
Num. educational projects	0.0877***		
	(0.0271)		
HS		-0.7783***	-0.4049***
		(0.1285)	(0.1453)
MS		0.3194***	0.5228***
		(0.0810)	(0.0938)
LS		2.193***	2.769***
		(0.2505)	(0.3050)
HS × MS			-0.2635***
			(0.0508)
HS × LS			-0.3952**
			(0.1833)
MS × LS			-0.1231***
			(0.0428)
Num. conflicts 5 years prior	0.0186***	0.0196***	0.0157**
	(0.0068)	(0.0069)	(0.0070)
Population per 100,000	0.0232*	0.0260**	0.0248*
	(0.0134)	(0.0133)	(0.0133)
Year	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Weather controls	Yes	Yes	Yes
Cluster demographics	Yes	Yes	Yes
Clusters with compl. edu. aid	21,676	21,676	21,676
Clusters with compl. aid	37,924	37,924	37,924
Clusters with edu. aid	37,169	37,169	37,169
Clusters with aid	57,341	57,341	57,341
Num. DHS clusters	57,341	57,341	57,341
Observations	58,182	58,182	58,182
Within R^2	0.01038	0.01207	0.01259

Notes: The dependent variable is the share of individuals between the ages of 6 and 24 years who are illiterate (see Section 2 for definition of illiteracy) multiplied by 100. Each column comes from a unique regression. Weather-related controls include mean precipitation, mean temperature, and mean drought. DHS cluster controls include the average age in the cluster, average household size, and the share of sons and daughters in the cluster. All regressions include year and district (that is, administrative level 2) FE. Clustered standard errors by DHS clusters in parentheses. *Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

details). Similarly, a single LS project, in the absence of other projects, leads to an even greater increase in illiteracy, approximately 8.15 percentage points (row 6 column (8)). Conversely, no significant effect is observed for clusters containing only HS projects (Table 3, row 3), which represent the third-highest frequency in the data.

In cases where at least one HS and one MS project coexist within a cluster, the marginal effects indicate reductions in illiteracy rates by 4.01 and 2.42 percentage points, respectively (Table 3, row 2).

These results suggest that clusters with both HS and MS projects experience a significant decline in the proportion of uneducated individuals aged 6–24 years. In contrast, clusters with a combination of HS and LS projects show opposing effects, with marginal reductions of approximately 4 percentage points for HS and increases of 4.15 percentage points for LS. In conclusion, the findings in Table 3 indicate that a combination of HS and MS projects leads to improved literacy rates, whereas clusters with only LS projects exhibit adverse outcomes. These findings highlight the critical importance of synergy between different types of educational aid projects, to achieve meaningful positive impacts on educational outcomes within a given spatial unit.

Counts of Educational Aid: Table 4 presents the results for completed educational aid by counting the number of projects per cluster. Column (1) results indicate that the mere number of completed educational projects does not reflect an improvement in literacy. This finding suggests that providing more educational resources might not necessarily produce the desired outcome. Probing further into project performance in Column (2) also confirms the results in Table 2 Column (2). Indicating that an additional completed HS project results in a reduction in the illiteracy rate of 0.78 percentage points. This finding emphasizes the critical role of not just the quantity but also the quality of educational projects in improving outcomes. The results further suggest that increasing the number of projects is insufficient to reduce illiteracy if those projects are not effectively managed. Effective management is essential to ensure that the resources and efforts invested in educational initiatives translate into meaningful and tangible results. That is, the combination of these projects with robust management practices will drive the rapid achievement of SDG 4. An additional implemented MS and LS project, in contrast, increase illiteracy by about 0.32 and 2.19 percentage points, respectively, signaling a more damaging effect on educational outcome for LS educational projects.

Column (3) examines the effects of interactions between different types of projects. Table 5 presents the marginal effects for a subset of unique project quality combinations observed in the data, focusing on combinations with a percentage frequency of $\geq 1\%$ (see table footnotes for details on the calculation of marginal effects)[10]. The results in Table 5 indicate that HS projects consistently reduce illiteracy rates. For example, areas with only HS projects, which occur 11.6% of the time, experience a marginal effect of approximately -0.40 percentage points (rows 2, 5, 14, and 17). Conversely, MS projects typically increase illiteracy rates, except when coexisting with HS projects in instances where HS projects outnumber MS projects. In such cases, the marginal effects of MS projects can turn negative. For instance, in the last row of Table 5, the marginal effect of MS becomes negative when at least six HS projects and one MS

[10]Marginal effects for remaining project combinations are available upon request.

Table 5: Marginal Effects – Counts

(1) HS	(2) MS	(3) LS	(4) Freq.	(5) Freq.(%)	(6) Marginal Effects HS	(7) Marginal Effects MS	(8) Marginal Effects LS
0	1	0	3,919	19.90	–	0.52	–
1	0	0	2,284	11.60	**-0.40**	–	–
0	2	0	1,859	9.44	–	0.52	–
1	1	0	1,139	5.78	-0.67	0.26	–
2	0	0	733	3.72	**-0.40**	–	–
0	3	0	713	3.62	–	0.52	–
0	1	1	530	2.69	–	0.40	2.65
0	0	1	487	2.47	–	–	**2.77**
2	1	0	480	2.44	-0.67	-0.00	–
0	6	0	466	2.37	–	0.52	–
2	2	0	404	2.05	-0.93	-0.00	–
1	3	0	386	1.96	-1.20	0.26	–
0	4	0	385	1.95	–	0.52	–
3	0	0	330	1.68	**-0.40**	–	–
0	5	0	291	1.48	–	0.52	–
1	2	0	255	1.29	-0.93	0.26	–
4	0	0	245	1.24	**-0.40**	–	–
2	0	1	227	1.15	-0.80	–	1.98
6	1	0	202	1.03	-0.67	**-1.06**	–

Notes: This report analyzes marginal effects for project combinations appearing with $\geq 1\%$ frequency (222 unique combinations) for project counts. Columns (1)–(3) present unique project quality combinations, whereas columns (4)–(5) show raw counts and percentages. Columns (6)–(8) display marginal effects calculated using Equations (5)–(7) and coefficients from Table 4, column (3). For example, for a single HS project, substituting $MS_{dct} = 0$ and $LS_{dct} = 0$ into $-0.4049 - 0.2635 \times MS_{dct} - 0.3952 \times LS_{dct}$ yields -0.40 percentage points. Insignificant coefficients are treated as zero. Bolded values are mentioned in the paper. Calculations use maximum decimals and are rounded to two decimal places.

project coexist within the same geographical area.

LS projects, on the other hand, consistently worsen illiteracy. A single LS project, which occurs in 2.47% of the data, leads to a 2.77 percentage point increase in illiteracy rates. The marginal effect of LS projects only turns negative in rare cases where HS projects significantly outnumber LS projects. For example, when at least eight HS projects and two LS projects coexist, the marginal effect becomes -0.39 percentage points (not shown in Table 5). However, such cases are exceptionally rare, occurring in only 0.005% of the data[11]. In summary, the findings in Table 5 suggest that HS projects are the only project management category that consistently improves literacy rates. By contrast, MS and LS projects, either independently or in combination, generally have the opposite effect. These results reinforce the importance

[11]Table 5 reports only combinations with a frequency of $\geq 1\%$, emphasizing the rare occasions where LS projects exhibit negative effects. Such cases typically occur when LS coexist with a substantial number of HS projects.

of considering interactions between different project categories, as their coexistence can produce varying effects on educational outcomes within an area.

Table 6: Disbursement: Total Value of Educational Aid

	(1)	(2)	(3)
	Dependent Variable: Illiteracy (6-24 years)		
Variables	Educational Aid	Management Rating	Interactions
ln(Value Edu.)	0.0846***		
	(0.0155)		
ln(HS)		-0.1329***	-0.1089***
		(0.0216)	(0.0233)
ln(MS)		0.0139	0.0041
		(0.0156)	(0.0160)
ln(LS)		0.2428***	0.3389***
		(0.0305)	(0.0351)
ln(HS × MS)			-0.0091***
			(0.0014)
ln(MS× LS)			-0.0102***
			(0.0024)
ln(MS× LS)			-0.0080***
			(0.0017)
Num. conflicts 5 years prior	0.0184***	0.0186***	0.0154**
	(0.0068)	(0.0069)	(0.0069)
Population per 100,000	0.0163	0.0315**	0.0315**
	(0.0133)	(0.0132)	(0.0132)
Year	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Weather controls	Yes	Yes	Yes
Cluster demographics	Yes	Yes	Yes
Clusters with compl. edu. aid	21,676	21,676	21,676
Clusters with compl. aid	37,924	37,924	37,924
Clusters with edu. aid	37,169	37,169	37,169
Clusters with aid	57,341	57,341	57,341
Num. DHS clusters	57,341	57,341	57,341
Observations	58,182	58,182	58,182
Within R^2	0.01092	0.01192	0.01374

Notes: The dependent variable is the share of individuals between the ages of 6 and 24 years who are illiterate (see Section 2 for definition of illiteracy) multiplied by 100. All disbursements are logged transformed using ln(0.01+..). Each column comes from a unique regression. Weather-related controls include mean precipitation, mean temperature, and mean drought. DHS cluster controls include the average age in the cluster, average household size, and the share of sons and daughters in the cluster. All regressions include year and district (that is, administrative level 2) FE. Clustered standard errors by DHS clusters in parentheses. *Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Disbursement of Educational Aid: In Table 6, I used the log of total disbursements to measure educational aid. As in previous results, Column (1) shows a positive effect, which implies that a 1%

dollar increase in disbursement leads to approximately 0.0008% increase in illiteracy. That is, the volume of educational aid does not necessarily improve illiteracy, which aligns with the results with indicators and count measures. In Column (2), an increase in disbursement for HS projects significantly decreases the illiteracy rate by about 0.001%. At the mean, it leads to a reduction of about 2.1%. In Column (3), the total marginal effect for an increase in disbursements for HS projects consistently leads to a significant reduction in illiteracy ($-0.1089 - 0.0091 \times ln(MS_{dct}) - 0.0102 \times ln(LS_{dct})$). At the mean, this is approximately -0.39 ($-0.1089 - 0.0091 \times 15.4 - 0.0102 \times 14.3$; for mean values[12], see Table 1). For MS and LS projects, evaluating at the mean will be approximately -0.26 ($-0.0091 \times ln(HS_{dct}) - 0.0080 \times ln(LS_{dct}) \Rightarrow -0.0091 \times 15.9 - 0.0080 \times 14.3$) and 0.05 ($0.3389 - 0.0102 \times ln(HS_{dct}) - 0.0080 \times ln(MS_{dct}) \Rightarrow 0.3389 - 0.0102 \times 15.9 - 0.0080 \times 15.4$), respectively, on illiteracy rate. The impact of educational aid on illiteracy diminishes with project management quality.

5 Robustness Checks

The primary findings are examined to address two main concerns. First, I assess the sensitivity of the baseline results to two alternative sample restrictions—urban and rural—to determine whether educational aid and management effectiveness on illiteracy rates differ. Second, I show results for different buffer sizes. Table 7 presents the urban–rural sample results for the three baseline estimates.

In analyzing the indicator measures for both educational aid and management quality in Panels A and B, a similar positive effect (1.11 and 1.88 percentage increase for urban and rural areas, respectively) of completed projects on illiteracy rates is observed. However, when considering project management, additional HS projects in urban clusters improve literacy by approximately 3.76 percentage points (column (2)), whereas MS and LS management quality show no or some positive significant effects, respectively, for additional implemented educational projects. In contrast, an HS project in a rural cluster results in an estimated 1.96 percentage point reduction in illiteracy rates (column (5)), whereas an LS project results in an estimated increase in illiteracy (urban = 5.53; rural = 4.15 percentage points). The key difference between urban and rural areas is most evident in the stronger impact on illiteracy in urban compared to rural areas.

Panels A and B, column (3), report the coefficients of interactions between project management quality categories for the indicator measure. The marginal effects for urban and rural clusters with respect to the indicator measure are detailed in Appendix Tables A.2 and A.3 Panel A, respectively, with an example of calculation provided in the table notes. In urban areas, 44% of educational projects are classified as

[12]Note that the reported means do not include clusters with zero disbursements.

Table 7: Replication of Baseline Results: Sample Split

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Illiteracy (6-24 years)					
	Educational Aid	Management rating	Interactions	Educational aid	Management Rating	Interactions
	Panel A: Indicator – Urban			***Panel B: Indicator–Rural***		
Educational project	1.111***			1.875***		
	(0.3910)			(0.3895)		
HS		-3.762***	-1.027		-1.964***	0.1252
		(0.6798)	(0.8998)		(0.5367)	(0.6572)
MS		-0.3108	0.9750**		0.0389	1.548***
		(0.4143)	(0.4599)		(0.4014)	(0.4822)
LS		5.526***	8.246***		4.152***	9.213***
		(1.054)	(1.383)		(0.6794)	(1.049)
HS × MS			-4.154***			-3.600***
			(0.9244)			(0.7207)
HS × LS			-2.743*			-5.828***
			(1.458)			(1.239)
MS × LS			-3.178***			-4.951***
			(1.013)			(0.9041)
Within R^2	0.02234	0.02539	0.02833	0.00832	0.00871	0.01094
	Panel C: Counts – Urban			***Panel D: Counts–Rural***		
Num. educational projects	-0.0608**			0.1447***		
	(0.0304)			(0.0489)		
HS		-1.217***	-0.7080***		-0.6318***	-0.3317*
		(0.2174)	(0.2424)		(0.1560)	(0.1773)
MS		0.1363	0.3780***		0.1216	0.3442**
		(0.1011)	(0.1141)		(0.1314)	(0.1519)
LS		1.513***	1.844***		3.219***	4.332***
		(0.3166)	(0.3781)		(0.4270)	(0.5189)
HS × MS			-0.4169***			-0.1660**
			(0.0804)			(0.0659)
HS × LS			0.0706			-0.7359***
			(0.2821)			(0.2405)
MS × LS			-0.1337***			-0.3125***
			(0.0457)			(0.1132)
Within R^2	0.02204	0.02506	0.02694	0.00770	0.00909	0.00962
	Panel E: Disbursement – Urban			***Panel F: Disbursement–Rural***		
ln(value edu.)	0.0624***			0.0809***		
	(0.0200)			(0.0203)		
ln(HS)		-0.1784***	-0.1227***		-0.1023***	-0.1120***
		(0.0329)	(0.0350)		(0.0267)	(0.0300)
ln(MS)		-0.0195	-0.0334		0.0063	-0.0149
		(0.0203)	(0.0208)		(0.0203)	(0.0213)
ln(LS)		0.2757***	0.3403***		0.2100***	0.3616***
		(0.0549)	(0.0602)		(0.0370)	(0.0439)
ln(HS × MS)			-0.0089***			-0.0081***
			(0.0021)			(0.0018)
ln(HS × LS)			-0.0061*			-0.0151***
			(0.0035)			(0.0033)
ln(MS × LS)			-0.0073***			-0.0129***
			(0.0026)			(0.0024)
Within R^2	0.02246	0.02524	0.02790	0.00807	0.00864	0.01097
Clusters with compl. edu. aid	8,159	8,159	8,159	13,517	13,517	13,517
Clusters with compl. aid	14,202	14,202	14,202	23,722	23,722	23,722
Observations	21,205	21,205	21,205	36,977	36,977	36,977
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows sample split for urban and rural clusters. The dependent variable is the share of individuals between the ages of 6 and 24 years who are illiterate (see Section 2 for definition of illiteracy) multiplied by 100. All disbursements are logged transformed using ln(0.01+..). Each column comes from a unique regression. Baseline controls include: geographic controls (number of conflicts 5 years prior to the survey date, population per 100,000 and mean nighttime light); weather (mean precipitation, mean temperature and mean drought) and DHS cluster controls (average age in the cluster, average household size and the share of sons and daughters) in the cluster. All regressions include year and district (that is, administrative level 2) FE. Clustered standard errors by DHS clusters in parentheses. *Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

MS. These projects exhibit a positive marginal impact on illiteracy, with an effect size of approximately 0.98 percentage points (Appendix Table A.2, Panel A, column (7)). By contrast, in rural areas, MS projects (comprising the largest share at 35.85%) have a stronger negative effect, increasing illiteracy by approximately 1.55 percentage points. HS projects consistently reduce illiteracy in both urban and rural areas, regardless of other coexisting educational projects. However, HS projects alone show no significant marginal effect. For example, in cases where two HS and LS projects coexist within the same vicinity (observed only 4 times in the urban sample and 6 times in the rural sample) the marginal effect of HS is -5.49 percent points in urban areas and -11.66 percent points in rural areas.

Interestingly, whereas MS projects alone contribute to higher illiteracy, their coexistence with other project types (either HS or LS) results in negative marginal effects in both urban and rural communities. In urban settings, the marginal effect of at least one MS and one HS project is a 3.18 percent unit decrease in illiteracy, whereas in rural areas, the effect is -2.05 percentage points. Similarly, when an MS project coexists with one LS project, the marginal effect of MS is -2.20 percentage points in urban areas and -3.40 percentage points in rural areas. Another notable finding is the variation in effect size when an MS project coexists solely with HS or LS projects. In urban areas, the effect size for MS coexisting with HS is much larger than in rural areas. However, the reverse is true when MS coexists only with LS projects. Finally, LS projects exhibit a negative marginal effect in rural areas when coexisting with more than one other project category (HS or MS). For example, in rural areas, when LS projects share the same buffer zone with two MS or HS projects, the marginal effects are -0.69 and -2.44 percentage points, respectively. Such effects are not observed in urban areas. Similarly, when all three project categories (HS, MS, LS) coexist, the marginal effect for LS in rural areas is -1.57 percentage points, while in urban areas, it is positive at 2.33 percentage points, holding other factors constant.

Panels C and D provide estimates for the number of completed projects and their effects on illiteracy rates. While urban clusters experience a reduction of 0.06 percentage points in illiteracy with additional completed projects (Panel C, column (1)), rural communities show a contrasting increase of 0.14 percentage points (Panel D, column (4)) holding all things constant. However, a further analysis of project management quality offers a more nuanced understanding. In rural areas, the total number of educational projects alone appears to increase illiteracy rates, but the presence of HS projects significantly improves outcomes. Specifically, HS projects reduce illiteracy by approximately 0.63 percentage points in rural areas (Panel D, column (5)) and by an even greater magnitude of 1.2 percentage points in urban areas (Panel C, column (2)). In contrast, MS and LS projects show either insignificant or positive effects on illiteracy, respectively.

Examining the marginal effects (see Appendix Tables A.2 and A.3, Panel B and table notes for calculations) of interactions between management quality categories reveals consistent reductions in illiteracy rates for HS projects, whether alone or coexisting with other MS and LS projects. For example, HS projects alone lead to a reduction in illiteracy of 0.71 percentage points in urban areas and 0.33 percentage points in rural areas. MS projects, when they exist alone, worsen illiteracy by 0.38 percentage points in urban areas and 0.34 percentage points in rural areas. Interestingly, in urban areas, the marginal effect of MS becomes negative when coexisting with one or more HS projects. For instance, with two HS projects and one MS project, the marginal effect for MS is -0.46 percentage points in urban areas but remains negligible at 0.01 percentage points in rural areas. LS projects consistently show positive marginal effects, exacerbating illiteracy rates even when coexisting with other projects, but seldom coexist with MS or HS project categories.

Finally, using the disbursement measure in Panels E and F of Table 7, we observe similar patterns for both urban and rural areas. For project interactions (Columns (3) and (6)), the marginal effect of an HS project, when evaluated at the mean, reduces the illiteracy rate by approximately 0.35 percentage points in urban areas ($-0.1227 - 0.0089 \times MS - 0.0061 \times LS \Rightarrow -0.1227 - 0.0089 \times 15.4 - 0.0061 \times 14.3 = -0.35$; see Table 1 for mean values) and by 0.45 in rural areas ($-0.1120 - 0.0081 \times MS - 0.0151 \times LS \Rightarrow -0.1120 - 0.0081 \times 15.4 - 0.0151 \times 14.3 = -0.45$) ceteris paribus. An MS project reduces illiteracy by approximately 0.25 percentage points in urban and 0.31 in rural clusters (Urban: $-0.0089 \times ln(HS_{dct}) - 0.0073 \times ln(LS_{dct}) \Rightarrow -0.0089 \times 15.9 - 0.0073 \times 14.3 \approx -0.25$; Rural: $-0.0081 \times ln(HS_{dct}) - 0.0129 \times ln(LS_{dct}) \Rightarrow -0.0081 \times 15.9 - 0.0129 \times 14.3 \approx -0.31$). An LS project, on the other hand, shows an increase in illiteracy of 0.13 percentage points in urban areas ($0.3403 - 0.0061 \times ln(HS_{dct}) - 0.0073 \times ln(MS_{dct}) \Rightarrow 0.3403 - 0.0061 \times 15.9 - 0.0073 \times 15.4 \approx 0.13$), but a reduction in illiteracy by 0.08 percentage points in rural areas, all else being equal ($0.3616 - 0.0151 \times ln(HS_{dct}) - 0.0129 \times ln(MS_{dct}) \Rightarrow 0.3616 - 0.0151 \times 15.9 - 0.0129 \times 15.4 \approx -0.08$).

From Table 7, it can be deduced that there are small, significant differences between urban and rural clusters for the indicator and count analyses. The effects observed in the main analysis are consistent across both contexts—any positive changes associated with educational aid yield equivalent results in both urban and rural communities, but the magnitude of change is higher in urban than in rural areas. For disbursement, rural areas show a stronger reduction in illiteracy for the HS and MS projects (HS = -0.45% and MS = -0.31%) compared to urban clusters (HS = -0.35%, MS = -0.25%). Although LS projects reduce illiteracy in rural areas (-0.08%), they increase illiteracy in urban communities (0.13%). The results suggest that project funding can contribute immensely to reducing rural illiteracy when managed well. If the educational aid is effectively managed, it can produce a slightly higher positive outcome in both rural and urban settings. This suggests that the quality of World Bank educational project management is a more important factor than the geographic location, volume of funding, or number of projects.

Finally, I investigate whether these findings hold when using different buffer sizes, in case there is selection bias. Specifically, I consider whether a 5 km buffer interval (i.e., 20, 25,..., 45 km) might bias the results. Tables A.4, A.5 and A.6 demonstrate that the main results are not sensitive to the choice of buffer size. The results are essentially similar to the baseline findings, with only minor changes in significance in specific columns. For instance, in Panels B to F of Table A.4 Column (3), the HS project is significant at 5% and 1% and in Table A.6 Panels C and E Column (3), the interaction term $HS \times LS$ and $ln(HS \times LS)$ is not significant compared to the baseline results in Tables 4 and 6, respectively. This means that changes in buffer size do not significantly alter the observed effects. The measurements used to evaluate the impact of educational aid are precise enough to capture the effects consistently, regardless of slight variations in the buffer size.

6 Discussion

This study's empirical analysis has shown a heterogeneous relationship between the quality of management in World Bank–funded educational projects and illiteracy rates in more than 57,000 DHS clusters in Africa. The picture that emerges for aggregate educational aid is consistent. The three measures—indicator, count and disbursement volume of completed educational aid projects—show a significant rise in illiteracy. The extended analyses on management quality indicate that highly satisfactory projects improve literacy rates, in contrast to moderately satisfactory and less satisfactory projects and the findings remain robust across measures and buffer sizes. Additionally, I found interaction effects between different categories of management quality, showcasing that management quality of projects influence the effectiveness of other projects within a shared spatial unit. An HS project, for example, will positively influence LS projects within the same geographical unit. The findings carry significant implications for our understanding of the quality and effectiveness of educational aid management.

To begin, my analyses of educational aid impact on illiteracy rates revealed statistically significant increases in illiteracy ranging from 0.8 to 1.8 percentage points. Without further investigation into the quality of management in these projects, one might conclude that educational aid does not improve educational outcomes. Sole reliance on an indicator of the presence or absence of educational aid may not adequately reflect the effectiveness of project execution, which may subsequently impact the project's intended outcomes. Therefore, in evaluating educational aid's impact on specific outcomes such as illiteracy, there must be a measure that considers management quality, overall project performance and the intensity or scale of the project. Disregarding these may affect conclusions drawn. For example, Yogo (2017) emphasized that achieving the goal of universal primary education would necessitate more than doubling the current levels of aid. Yet this projection might change if existing projects were more effectively managed and implemented. The findings in Table 6, column 1, suggest that an additional dollar of aid increases illiteracy. When management quality is considered (as shown in column 2 of Table 6), however, it becomes evident that it is poor management that significantly undermines project outcomes. Each additional dollar allocated to HS projects reduces illiteracy by approximately 0.001 percentage points, translating into an average reduction of 2.1 percentage points, ceteris paribus. Conversely, MS and LS projects exhibit opposite effects, further emphasizing the need to enhance managerial oversight rather than merely increase aid volumes. Since World Bank educational projects are significant developmental initiatives designed to offer incentives and resources to governments grappling with complex economic challenges that impede growth (Stubbs et al., 2016), the overall performance of project management must be considered when measuring aid effectiveness.

Crucially, my analysis demonstrates that the quality of management oversight in educational aid can have a significant positive or negative effect on the overall impact of a project. For instance, the findings indicate that highly satisfactory educational projects consistently lead to reductions in illiteracy rates, whereas moderately and less satisfactory projects fail to achieve such outcomes. Effective management not only minimizes misappropriation of project funds but also reduces errors at critical stages of the project lifecycle, such as approval, implementation, supervision and monitoring, which are all essential for achieving the intended objectives (Ika et al., 2012; Kilby, 2000). A persistent challenge highlighted in the literature, particularly in Africa, is the prevalence of corruption and mismanagement of project funds, which undermines the effectiveness of foreign aid (Dollar & Levin, 2005; Heyneman & Lee, 2016; Honig, 2018; Moyo, 2009). For instance, Miningou (2019) report that Sub-Saharan African (SSA) countries exhibit the lowest efficiency in converting educational aid into improved educational outcomes. This evidence shows the importance of sound management practices, reinforcing Heinzel and Liese (2021)'s argument that the World Bank must strategically reevaluate its organizational incentive structures. Specifically, this involves emphasizing management factors such as employing skilled and experienced TTLs, who have been shown to play a critical role in enhancing project performance (Denizer et al., 2013).

Furthermore, the findings reveal notable interactions between evaluated projects within the same vicinity, illustrating how the quality of educational aid impacts overall outcomes. HS projects within clusters are observed to reduce illiteracy rates when there are few or no other project types in the same area. In contrast, MS educational aid projects in urban areas require the existence of HS projects to achieve a reduction in illiteracy, whereas the combination of MS and HS projects in rural areas only increases illiteracy. The results highlight that, in urban areas, MS projects tend to perform better when part of a network of HS projects. This suggests that with less intensive management, projects might lack the resources or infrastructures necessary to achieve the desired impact. Strategic management appears to be key to maximizing the impact of educational aid and achieving sustainable improvements in educational development.

Additional evidence from my analysis reveals that the results are consistent across urban and rural areas, aligning with claims about aid targeting (Briggs, 2018b; Öhler & Nunnenkamp, 2014; Öhler et al., 2019), which argue that the World Bank does not necessarily prioritize regional needs. The findings in my paper suggest that especially in rural areas, effective coordination between projects with different levels of management quality is critical. Policymakers should consider regional strategies that promote complementary project combinations and minimize detrimental overlaps. Moreover, when it comes to the magnitude of impact, there are no significant differences between urban and rural areas, but the effects are generally more pronounced in urban areas. A plausible explanation for this difference is that urban regions, despite being more developed, may still face significant educational challenges, particularly among marginalized groups. Educational aid targeting not only impoverished regions but also relatively affluent areas where vulnerable populations such as orphans remain excluded could address fundamental needs in both settings. Ultimately, the quality of project management outweighs the influence of geographic location on educational aid effectiveness. This reinforces the argument that management quality is crucial for accelerated progress in educational development, regardless of the contextual disparities between urban and rural areas.

7 Conclusion

In this paper, I have shown that, although other factors influence educational achievement in Africa, the management quality of World Bank–funded educational projects affects the illiteracy rate. This paper has contributed to the literature on World Bank project management effectiveness as it draws a connection between aid management quality and educational development. It has also expanded on the use of sub-national data to demonstrate that the quantity, monetary value, or location of educational aid is not the sole factor relevant for educational development in Africa but that management quality also plays an important role. Additionally, the findings of my research suggest the need for a more comprehensive methodology to measure the true impact of educational aid: that is, a measure that captures aid management quality, intensity, volume and duration.

Finally, the paper demonstrates that, despite significant improvements in educational development in Africa, management efficiencies can significantly accelerate educational development, underscoring the pivotal role of aid management in shaping educational outcomes in Africa. Good management practices among all stakeholders are essential. Enhancing the effectiveness of educational interventions can accelerate progress by improving enrollment rates, learning outcomes and educational infrastructures. To maximize the impact of educational assistance, the World Bank must prioritize the management quality of its operations when it comes to education. Through concerted efforts to improve aid management quality, donors can fulfill their mission of promoting inclusive and quality education for all.

In conclusion, further research can enhance the measurement of educational outcome. Due to data limitations, my study adopted a proxy for illiteracy focusing on individuals with no formal education or those who had not completed primary education, under the assumption that these individuals may lack basic literacy skills if they never attended school or dropped out early. Although I was able to provide evidence of the effect of aid management quality on educational outcomes despite this constraint, future studies could benefit from incorporating more detailed educational metrics, such as disaggregated test scores or other comprehensive data, as they become available.

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A Tables

Table A.1: Descriptive Statistics – Actual Disbursement

Statistics	Obs.	Mean	St. Dev.	Min	Max
Disbursement	58,182	72,120,681	131,801,719	0	723,262,747
Edu. disbursement	58,182	6,838,527	26,549,611	0	415,563,490
Highly satisfactory edu. disb.	58,182	2,575,795	10,637,138	0	128,650,425
Moderately satisfactory edu. disb	58,182	3,552,316	22,678,475	0	413,839,142
Less satisfactory edu. disb	58,182	380,821.1	4,433,806	0	85,965,303

Notes: This table presents summary statistics of the actual disbursements of aid projects in U.S. dollars for the sample used in the analysis.

Table A.2: Marginal Effects – Urban

(1) HS	(2) MS	(3) LS	(4) Freq.	(5) Freq.(%)	(6) Marginal Effects HS	(7) Marginal Effects MS	(8) Marginal Effects LS
Panel A: Indicators							
0	1	0	3,170	43.95	–	**0.98**	–
1	1	0	1,353	18.76	-4.15	**-3.18**	–
1	0	0	1,205	16.71	0	–	–
0	1	1	486	6.74	–	**-2.20**	5.07
1	1	1	344	4.77	-6.90	-6.36	**2.33**
0	0	1	275	3.81	–	–	8.25
1	0	1	234	3.24	-2.74	–	5.50
0	2	0	89	1.23	–	0.98	–
0	2	2	20	0.28	–	-5.38	1.89
2	2	0	15	0.21	-8.31	-7.33	–
2	0	0	14	0.19	0	–	–
2	0	2	4	0.06	**-5.49**	–	2.76
0	0	2	2	0.03	–	–	8.25
0	3	0	1	0.01	–	0.98	–
0	3	3	1	0.01	–	-8.56	-1.29
Panel B: Counts							
0	1	0	1,425	19.76	–	**0.38**	–
0	2	0	853	11.83	–	**0.38**	–
1	0	0	749	10.38	**-0.71**	–	–
0	3	0	331	4.59	–	0.38	–
1	1	0	323	4.48	-1.12	**-0.04**	–
0	6	0	267	3.70	–	0.38	–
2	0	0	264	3.66	-0.71	–	–
0	1	1	257	3.56	–	0.24	1.71
0	0	1	198	2.75	–	–	1.84
6	1	0	167	2.32	-1.12	-2.12	–
0	4	0	160	2.22	–	0.38	–
1	3	0	159	2.20	-1.96	-0.04	–
2	2	0	99	1.37	-1.54	-0.46	–
2	1	0	96	1.33	-1.12	**-0.46**	–
0	5	0	92	1.28	–	0.38	–
8	1	0	90	1.25	-1.12	-2.96	–
3	3	0	89	1.23	-1.96	-0.88	–
2	0	1	86	1.19	-0.71	–	1.84
3	0	0	75	1.04	-0.71	–	–

Notes: This table presents the marginal effects for the urban sample. Panel A reports the marginal effects for indicators and Panel B for project counts.
Columns (1) to (3) present unique project quality combinations, while columns (4) to (5) show frequencies and percentages. Columns (6) to (8) display marginal effects calculated using Equations (5)–(7) and coefficients from Table 7, columns (3) and (6). For example, for a single MS project (row 1, Panel A, column (7)), substituting $HS_{dct} = 0$ and $LS_{dct} = 0$ into $0.9750 - 4.154 \times HS_{dct} - 3.178 \times LS_{dct}$ yields ≈ 0.98 percentage points.
Panel B calculates marginal effects using project counts and reports the marginal effects for project combinations appearing with $\geq 1\%$ frequency (166 unique combinations). For example, for a single HS project (Panel B, row 3, column (6)), substituting $MS_{dct} = 0$ and $LS_{dct} = 0$ into $-0.7080 - 0.4169 \times MS_{dct} - 0 \times LS_{dct}$ gives -0.71 percentage points as the marginal effect.
Insignificant coefficients are treated as zero. Bolded values are mentioned in the paper. Calculations use maximum decimals and are rounded to two decimal places.

Table A.3: Marginal Effects – Rural

(1) HS	(2) MS	(3) LS	(4) Freq.	(5) Freq.(%)	(6)	(7) Marginal Effects	(8)
					HS	MS	LS
			Panel A: Indicators				
0	1	0	4,475	35.85	–	**1.55**	–
1	1	0	3,131	25.08	-3.6	**-2.05**	–
1	0	0	2,846	22.80	0	–	–
0	1	1	575	4.61	–	**-3.40**	4.26
1	1	1	542	4.34	-9.43	-7.00	**-1.57**
1	0	1	375	3.00	-5.83	–	3.39
0	0	1	345	2.76	–	–	9.21
0	2	0	102	0.82	–	1.55	–
0	2	2	34	0.27	–	-8.35	**-0.69**
2	0	0	25	0.20	0	–	–
2	2	0	23	0.18	-7.20	-5.65	–
2	0	2	6	0.05	**-11.66**	–	**-2.44**
0	0	2	2	0.02	–	–	9.21
0	3	3	1	0.01	–	-13.31	-5.64
			Panel B: Counts				
0	1	0	2,494	19.98	–	**0.34**	–
1	0	0	1,535	12.30	**-0.33**	–	–
0	2	0	1,006	8.06	–	0.34	–
1	1	0	816	6.54	-0.50	0.18	–
2	0	0	469	3.76	-0.33	–	–
2	1	0	384	3.08	-0.50	**0.01**	–
0	3	0	382	3.06	–	0.34	–
2	2	0	305	2.44	-0.66	0.01	–
0	0	1	289	2.32	–	–	4.33
0	1	1	273	2.19	–	0.03	4.02
3	0	0	255	2.04	-0.33	–	–
1	3	0	227	1.82	-0.83	0.18	–
0	4	0	225	1.80	–	0.34	–
4	0	0	207	1.66	-0.33	–	–
1	2	0	202	1.62	-0.66	0.18	–
0	5	0	199	1.59	–	0.34	–
0	6	0	199	1.59	–	0.34	–
2	0	1	141	1.13	-1.07	–	2.86

Notes: This table provides the marginal effects analysis for the rural sample, divided into two panels: Panel A presents results for indicator measure, while Panel B focuses on project counts.
Columns (1) to (3) describe unique project quality combinations, with columns (4) to (5) detailing their frequencies and percentages. Marginal effects are reported in columns (6) to (8), derived using Equations (5)–(7) and coefficients from Table 7, columns (3) and (6). For instance, the marginal effect of a single MS project in Panel A (row 1, column (7)) is computed as $1.548 - 3.600 \times HS_{dct} - 4.951 \times LS_{dct}$. Substituting $HS_{dct} = 0$ and $LS_{dct} = 0$ yields approximately 0.98 percentage points.
Panel B restricts the analysis to project counts with frequencies $\geq 1\%$ (208 unique combinations). For example, the marginal effect for a single HS project (Panel B, row, 2 column (6)) is calculated as $-0.3317 - 0.1660 \times MS_{dct} - 0.7359 \times LS_{dct}$, resulting in -0.33 percentage points when $MS_{dct} = 0$ and $LS_{dct} = 0$. Insignificant coefficients are assumed to be zero. Bolded marginal effects are mentioned in the paper. All calculations are performed with maximum decimals and rounded to two decimal places.

Table A.4: Replication of Baseline Results at Different Buffer Sizes – Indicators

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	**Dependent Variable: Illiteracy (6-24 years)**					
	Educational aid	Management rating	Interactions	Educational aid	Management rating	Interactions
	Panel A: 45 km buffer			***Panel B: 40 km buffer***		
Educational project	1.648***			1.158***		
	(0.2940)			(0.2886)		
HS		-2.848***	-0.4824		-3.132***	-1.183**
		(0.4390)	(0.5290)		(0.4230)	(0.5137)
MS		0.3075	1.809***		0.0701	1.352***
		(0.3118)	(0.3684)		(0.3111)	(0.3652)
LS		4.448***	7.422***		4.402***	6.928***
		(0.5818)	(0.8469)		(0.6115)	(0.8647)
HS × MS			-4.482***			-3.868***
			(0.5836)			(0.5893)
HS × LS			-2.851***			-2.015**
			(0.9555)			(0.9999)
MS × LS			-3.400***			-3.279***
			(0.6853)			(0.7073)
Clusters with compl. edu. aid	20,472	20,472	20,472	19,132	19,132	19,132
Clusters with compl. aid	36,756	36,756	36,756	35,312	35,312	35,312
Within R^2	0.01067	0.01161	0.01344	0.00998	0.01130	0.01262
	Panel C: 35km buffer			***Panel D: 30 km buffer***		
Educational project	0.8353***			0.7349***		
	(0.2808)			(0.2713)		
HS		-3.097***	-1.434***		-3.321***	-1.481***
		(0.4139)	(0.4993)		(0.4117)	(0.4871)
MS		0.0799	1.234***		-0.1206	1.018***
		(0.3104)	(0.3592)		(0.3119)	(0.3578)
LS		3.457***	5.736***		4.130***	6.216***
		(0.6193)	(0.8770)		(0.6208)	(0.8689)
HS × MS			-3.644***			-4.255***
			(0.6207)			(0.6535)
HS × LS			-1.362			-1.730*
			(1.011)			(1.009)
MS × LS			-3.272***			-2.725***
			(0.7367)			(0.7545)
Clusters with compl. edu. aid	17,672	17,672	17,672	15,967	15,967	15,967
Clusters with compl. aid	33,648	33,648	0.01153	0.00863	0.01003	0.01113
	Panel E: 25 km buffer			***Panel F: 20 km buffer***		
Educational project	0.6874**			0.7589***		
	(0.2677)			(0.2679)		
HS		-3.209***	-1.408***		-2.991***	-0.9729**
		(0.4165)	(0.4837)		(0.4196)	(0.4867)
MS		0.1696	1.274***		0.3194	1.328***
		(0.3197)	(0.3644)		(0.3311)	(0.3754)
LS		3.973***	5.396***		3.799***	5.390***
		(0.6543)	(0.8987)		(0.6979)	(0.9338)
HS × MS			-4.843***			-5.424***
			(0.6964)			(0.7485)
HS × LS			-0.7078			-2.360**
			(1.033)			(1.070)
MS × LS			-2.254***			-1.769**
			(0.7966)			(0.8183)
Clusters with compl. edu. aid	13,908	13,908	13,908	11,620	11,620	11,620
Clusters with compl. aid	29,291	29,291	29,291	26,055	26,055	26,055
Within R^2	0.00795	0.00914	0.01013	0.00739	0.00828	0.00924
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	58,182	58,182	58,182	58,182	58,182	58,182

Notes: The dependent variable is the share of individuals between the ages of 6 and 24 years who are illiterate (see Section 2 for definition of illiteracy) multiplied by 100. Each column comes from a unique regression. Base line controls include: geographic controls (number of conflicts 5 years prior to the survey date, population per 100,000, and mean nighttime light); weather (mean precipitation, mean temperature, and mean drought) and DHS cluster controls (average age in the cluster, average household size, and the share of sons and daughters) in the cluster. All regressions include year and district (that is, administrative level 2) FE. Clustered standard errors by DHS clusters in parentheses. *Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table A.5: Replication of Baseline Results at Different Buffer Sizes – Project Counts

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	**Dependent Variable: Illiteracy (6-24 years)**					
	Educational aid	Management rating	Interactions	Educational aid	Management rating	Interactions
	Panel A: 45 km buffer			***Panel B: 40 km buffer***		
Num. educational projects	0.0901***			0.0794**		
	(0.0299)			(0.0330)		
HS		-0.8391***	-0.4503***		-1.025***	-0.6799***
		(0.1383)	(0.1536)		(0.1499)	(0.1672)
MS		0.3298***	0.5536***		0.3268***	0.5115***
		(0.0887)	(0.1024)		(0.0973)	(0.1121)
LS		2.111***	2.592***		2.107***	2.469***
		(0.2681)	(0.3309)		(0.2854)	(0.3494)
HS × MS			-0.3640***			-0.3737***
			(0.0615)			(0.0789)
HS × LS			-0.2641			-0.2307
			(0.2210)			(0.2484)
MS × LS			-0.1279***			-0.0925*
			(0.0481)			(0.0545)
Clusters with compl. edu. aid	20,472	20,472	20,472	19,132	19,132	19,132
Clusters with compl. aid	36,756	36,756	36,756	35,312	35,312	35,312
Within R^2	0.01010	0.01156	0.01210	0.00971	0.01117	0.01151
	Panel C: 35km buffer			***Panel D: 30 km buffer***		
Num. educational projects	0.0741**			0.0955**		
	(0.0355)			(0.0392)		
HS		-1.138***	-0.7402***		-1.225***	-0.6878***
		(0.1634)	(0.1847)		(0.1858)	(0.2084)
MS		0.3622***	0.5426***		0.3342***	0.5184***
		(0.1052)	(0.1201)		(0.1165)	(0.1323)
LS		1.887***	2.187***		2.015***	2.277***
		(0.2993)	(0.3670)		(0.3044)	(0.3763)
HS × MS			-0.5163***			-0.7922***
			(0.1013)			(0.1253)
HS × LS			-0.1823			-0.2090
			(0.2750)			(0.3094)
MS × LS			-0.0645			-0.0249
			(0.0612)			(0.0706)
Clusters with compl. edu. aid	17,672	17,672	17,672	15,967	15,967	15,967
Clusters with compl. aid	33,648	33,648	33,648	31,701	31,701	31,701
Within R^2	0.00918	0.01044	0.01078	0.00855	0.00970	0.01012
	Panel E: 25 km buffer			***Panel F: 20 km buffer***		
Num. educational projects	0.1261***			0.1562***		
	(0.0449)			(0.0526)		
HS		-1.329***	-0.7929***		-1.475***	-0.6727***
		(0.2038)	(0.2348)		(0.2182)	(0.2513)
MS		0.4843***	0.6687***		0.5984***	0.8380***
		(0.1388)	(0.1556)		(0.1655)	(0.1852)
LS		2.059***	2.169***		2.156***	2.353***
		(0.3333)	(0.3715)		(0.3730)	(0.4076)
HS × MS			-0.9777***			-1.562***
			(0.1739)			(0.2196)
HS × LS			-0.0263			-0.5635
			(0.3285)			(0.3913)
MS × LS			-0.0082			0.0068
			(0.0801)			(0.0990)
Clusters with compl. edu. aid	13,908	13,908	13,908	11,620	11,620	11,620
Clusters with compl. aid	29,291	29,291	29,291	26,055	26,055	26,055
Within R^2	0.00791	0.00903	0.00934	0.00732	0.00839	0.00884
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	58,182	58,182	58,182	58,182	58,182	58,182

Notes: The dependent variable is the share of individuals between the ages of 6 and 24 years who are illiterate (see Section 2 for definition of illiteracy) multiplied by 100. Each column comes from a unique regression. Baseline controls include: geographic controls (number of conflicts 5 years prior to the survey date, population per 100,000, and mean nighttime light); weather (mean precipitation, mean temperature, and mean drought) and DHS cluster controls (average age in the cluster, average household size, and the share of sons and daughters) in the cluster. All regressions include year and district (that is, administrative level 2) FE. Clustered standard errors by DHS clusters in parentheses. *Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table A.6: Replication of Baseline Results at Different Buffer Sizes – Disbursement

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable: Illiteracy (6-24 years)					
	Educational aid	Management rating	Interactions	Educational aid	Management rating	Interactions
	Panel A: 45 km buffer			***Panel B: 40 km buffer***		
ln(Value edu.)	0.0761***			0.0498***		
	(0.0152)			(0.0150)		
ln(HS)		-0.1427***	-0.1111***		-0.1569***	-0.1294***
		(0.0216)	(0.0230)		(0.0209)	(0.0224)
ln(MS)		0.0194	0.0090		0.0079	-0.0059
		(0.0156)	(0.0160)		(0.0156)	(0.0160)
ln(LS)		0.2273***	0.3097***		0.2275***	0.2955***
		(0.0311)	(0.0356)		(0.0327)	(0.0368)
ln(HS× MS)			-0.0105***			-0.0091***
			(0.0014)			(0.0014)
ln(HS× LS)			-0.0074***			-0.0053**
			(0.0024)			(0.0025)
ln(MS × LS)			-0.0079***			-0.0076***
			(0.0018)			(0.0018)
Clusters with compl. edu. aid	20,472	20,472	20,472	19,132	19,132	19,132
Clusters with compl. aid	36,756	36,756	36,756	35,312	35,312	35,312
Within R^2	0.01053	0.01157	0.01338	0.00988	0.01127	0.01255
	Panel C: 35km buffer			***Panel D: 30 km buffer***		
ln(Value edu.)	0.0302**			0.0221		
	(0.0146)			(0.0142)		
ln(HS)		-0.1555***	-0.1310***		-0.1664***	-0.1447***
		(0.0206)	(0.0218)		(0.0205)	(0.0214)
ln(MS)		0.0095	-0.0085		-0.0012	-0.0203
		(0.0156)	(0.0158)		(0.0157)	(0.0157)
ln(LS)		0.1771***	0.2376***		0.2094***	0.2644***
		(0.0332)	(0.0372)		(0.0331)	(0.0368)
ln(HS × MS)			-0.0087***			-0.0102***
			(0.0015)			(0.0016)
ln(HS × LS)			-0.0034			-0.0043*
			(0.0025)			(0.0025)
ln(MS × LS)			-0.0076***			-0.0061***
			(0.0019)			(0.0020)
Clusters with compl. edu. aid	17,672	17,672	17,672	15,967	15,967	15,967
Clusters with compl. aid	33,648	33,648	33,648	31,701	31,701	31,701
Within R^2	0.00922	0.01043	0.01148	0.00854	0.00999	0.01105
	Panel E: 25 km buffer			***Panel F: 20 km buffer***		
ln(Value edu.)	0.0238*			0.0299**		
	(0.0141)			(0.0141)		
ln(HS)		-0.1610***	-0.1377***		-0.1506***	-0.1426***
		(0.0207)	(0.0214)		(0.0209)	(0.0213)
ln(MS)		0.0145	-0.0072		0.0228	-0.0040
		(0.0161)	(0.0161)		(0.0167)	(0.0165)
ln(LS)		0.2020***	0.2386***		0.1929***	0.2291***
		(0.0347)	(0.0380)		(0.0370)	(0.0399)
ln(HS× MS)			-0.0117***			-0.0130***
			(0.0017)			(0.0018)
ln(HS × LS)			-0.0022			-0.0068**
			(0.0026)			(0.0027)
ln(MS × LS)			-0.0047**			-0.0033
			(0.0021)			(0.0021)
Clusters with compl. edu. aid	13,908	13,908	13,908	11,620	11,620	11,620
Clusters with compl. aid	29,291	29,291	29,291	26,055	26,055	26,055
Within R^2	0.00788	0.00912	0.01007	0.00732	0.00827	0.00921
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	58,182	58,182	58,182	58,182	58,182	58,182

Notes: The dependent variable is the share of individuals between the ages of 6 and 24 years who are illiterate (see Section 2 for definition of illiteracy) multiplied by 100. All disbursement are logged transformed using ln(0.01+..). Each column comes from a unique regression. Baseline controls include: geographic controls (number of conflicts 5 years prior to the survey date, population per 100,000, and mean nighttime light); weather (mean precipitation, mean temperature, and mean drought) and DHS cluster controls (average age in the cluster, average household size, and the share of sons and daughters) in the cluster. All regressions include year and district (that is, administrative level 2) FE. Clustered standard errors by DHS clusters in parentheses. *Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table A.7: Description of DHS Variables

Variable	Description
Illiteracy	The variable is constructed using DHS variables "schooling status (hv129)"; "whether the household member is still in school" (hv110); whether the "household member attended school during current school year (hv121)"; "educational attainment (hv109)" and "highest educational level attained (hv106)". It is then aggregated to the cluster level and then the shares are calculated from it.
Average Age	Age of each household member ("based on the reported age of the individual (hv105")) and then take the average age in the cluster.
Average Household size	Equal to the number of persons in each household and then taking the average within the cluster (based on "number of household members (hv009)").
Son or Daughter	An indicator equals one if the member of the household is a son or daughter of the head. It is based on the "relationship to head (hv101)". Equals one if hv101 is equal to three.

Notes: The table gives a detailed description of all the DHS variables used in the analysis. The variables can be found in the household record (PR) of the DHS program data types. *Refer to supplementary data for how variables are computed.*

Table A.8: DHS Survey Version/Year

		DHS Version/Year	
Countries	**Year**	**Version (PR)**	**Version (GE)**
Angola	2006	51	52
Angola	2011	62	61
Angola	2015	71	71
Burkina Faso	1993	21	23
Burkina Faso	1999	31	32
Burkina Faso	2003	44	43
Burkina Faso	2010	62	61
Burkina Faso	2014	71	71
Benin	1996	31	33
Benin	2001	41	42
Benin	2012	61	61
Benin	2017	71	71
Burundi	2010	61	61
Burundi	2012	6A	6A
Burundi	2016	71	71
Democratic Republic of the Congo	2007	51	52
Democratic Republic of the Congo	2013	61	61
Central African Republic	1994	31	33
Côte d'Ivoire	1994	35	33
Côte d'Ivoire	1998	3A	3B
Côte d'Ivoire	2012	62	61
Cameroon	2004	45	42
Cameroon	2011	61	61
Cameroon	2018	71	71
Egypt	1992	21	22
Egypt	1995	33	32
Egypt	2000	42	42
Egypt	2003	4A	4B
Egypt	2005	51	52
Egypt	2008	5A	5D
Egypt	2014	61	61
Ethiopia	2000	41	42
Ethiopia	2005	51	52
Ethiopia	2010	61	61
Ethiopia	2016	71	71
Ethiopia	2019	81	81
Gabon	2012	61	61
Gabon	2019	71	71
Ghana	1993	31	33
Ghana	1998	41	42
Ghana	2003	4B	4B
Ghana	2008	5A	5A
Ghana	2014	72	71
Ghana	2016	7B	7A
Ghana	2019	82	81
Gambia	2019	81	81

Notes: The table shows country, version, and year of the DHS survey included in the sample. *PR* is household recode dataset and *GE* is the GPS dataset for cluster locations.

A.8 Continued

Countries	Year	DHS Version/Year Version (PR)	Version (GE)
Guinea	1999	41	42
Guinea	2005	53	52
Guinea	2012	62	61
Guinea	2018	71	71
Kenya	2003	42	43
Tanzania	2008	52	52
Kenya	2014	72	71
Kenya	2015	7A	7A
Kenya	2020	81	81
Liberia	2007	51	52
Liberia	2009	5A	5C
Liberia	2011	61	61
Liberia	2013	6A	6A
Liberia	2016	71	71
Liberia	2019	7A	7A
Lesotho	2004	41	42
Lesotho	2009	61	62
Lesotho	2014	71	71
Western Sahara	2003	43	43
Madagascar	1997	31	32
Madagascar	2008	51	53
Madagascar	2011	61	61
Madagascar	2013	6A	6A
Madagascar	2016	71	71
Malawi	2000	41	43
Malawi	2004	4E	4B
Malawi	2010	61	62
Malawi	2012	6A	6A
Malawi	2014	72	71
Malawi	2015	7A	7A
Malawi	2017	7I	7I
Mozambique	2009	51	52
Mozambique	2011	62	61
Mozambique	2015	71	71
Mozambique	2018	7A	7A
Nigeria	2003	4C	4B
Nigeria	2008	53	52
Nigeria	2010	61	61
Nigeria	2013	6A	6A
Nigeria	2015	71	71
Nigeria	2018	7B	7B
Niger	1992	22	23
Niger	1998	31	32
Niger	2012	61	61
Rwanda	2005	53	54

Notes: The table shows country, version, and year of the DHS survey included in the sample. *PR* is household recode dataset and *GE* is the GPS dataset for cluster locations.

A.8 Continued

Countries	Year	DHS Version/Year Version (PR)	Version (GE)
Rwanda	2008	5A	5B
Rwanda	2010	61	61
Rwanda	2014	70	72
Rwanda	2019	81	81
Sierra Leone	2008	51	53
Sierra Leone	2013	61	61
Sierra Leone	2016	73	71
Sierra Leone	2019	7A	7A
Senegal	1993	21	23
Senegal	1997	32	32
Senegal	2005	4A	4B
Senegal	2008	5A	5A
Senegal	2010	61	61
Senegal	2012	6D	6A
Senegal	2015	7H	7A
Senegal	2017	7Z	7R
Senegal	2018	81	81
Senegal	2019	8B	8B
Senegal	2020	8I	8I
Swaziland	2006	52	53
Chad	2014	71	71
Togo	1998	31	32
Togo	2013	61	62
Togo	2017	71	71
Tanzania	1999	41	43
Tanzania	2007	51	52
Tanzania	2010	63	61
Tanzania	2012	6A	6A
Tanzania	2015	7B	7A
Tanzania	2017	7I	7I
Uganda	2000	41	43
Uganda	2006	52	53
Uganda	2009	5A	5A
Uganda	2011	61	61
Uganda	2010	6A	6A
Uganda	2014	72	71
Uganda	2016	7B	7A
Uganda	2018	7I	7I
South Africa	2017	71	71
Zambia	2007	51	52
Zambia	2013	61	61
Zambia	2018	71	71
Zimbabwe	1999	42	42
Zimbabwe	2005	52	52
Zimbabwe	2010	62	61
Zimbabwe	2015	72	72

Notes: The table shows country, version, and year of the DHS survey included in the sample. *PR* is household recode dataset and *GE* is the GPS dataset for cluster locations.

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