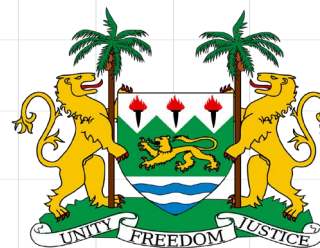




GRID³
SIERRA LEONE



Education Coverage in Sierra Leone

July 2021

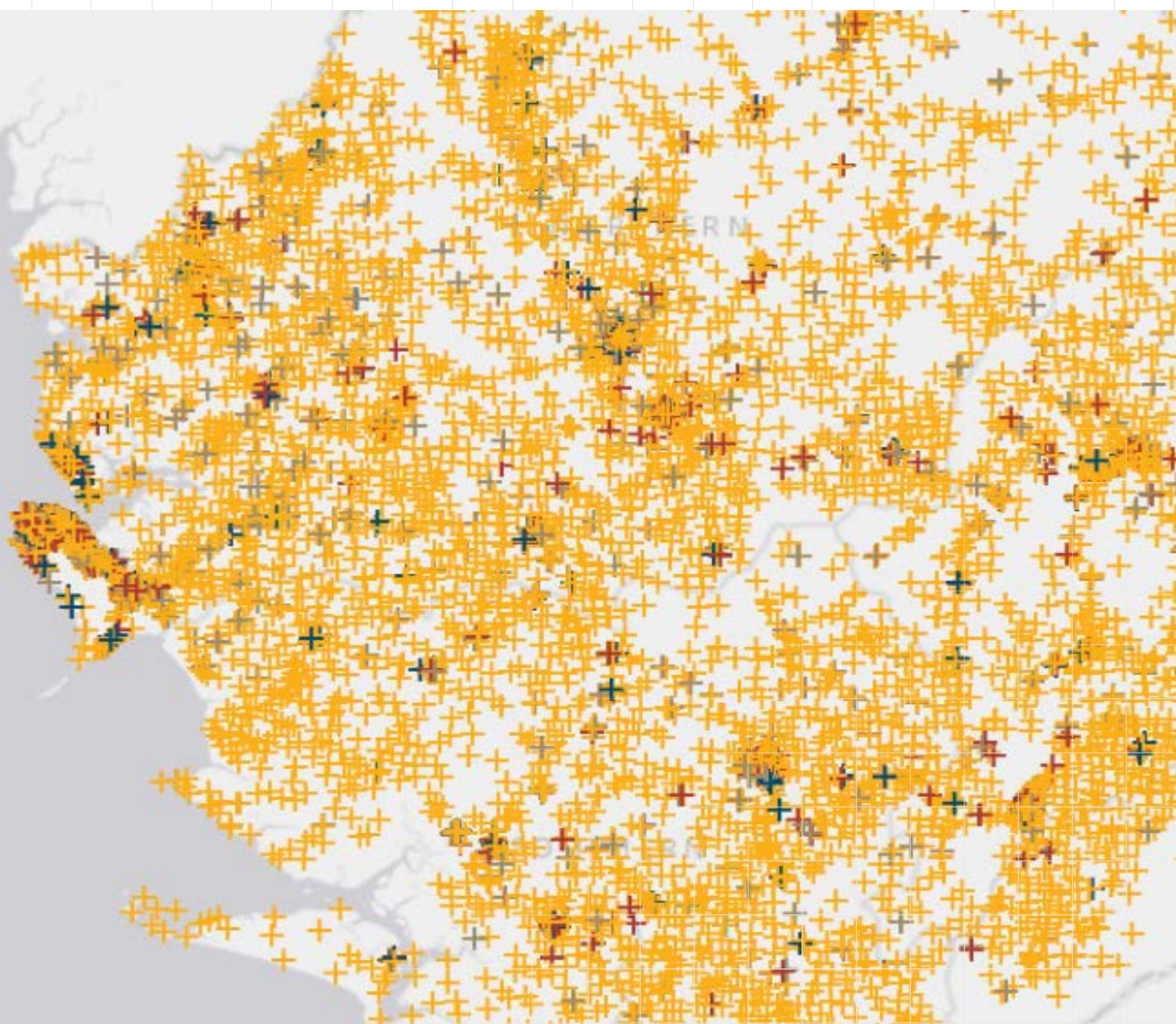


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An aerial photograph of a coastal town, likely in the Philippines, showing a bay with several small boats, a densely populated shoreline with colorful buildings, and lush green hills and mountains in the background under a cloudy sky. A faint grid pattern is overlaid on the bottom half of the image.

This report presents a foundational analysis on school coverage mapping and will lead into further work on school catchment planning and strategy development.

The Ministry of Basic and Senior Secondary Education (MBSSE, referred henceforth as “the ministry”) is interested in identifying suitable school catchment areas across Sierra Leone (SLE) and publishing a companion strategy for school development. To that end, this report outlines the findings from a preliminary school mapping and coverage analysis whose aim is to provide insights into existing school coverage using the population estimates created jointly by Statistics-Sierra Leone and GRID3 (WorldPop and Statistics Sierra Leone, 2020) and the existing school locations from the 2019 Annual School Census (MBSSE, 2019).

Context

There are four types of schools that children can attend in Sierra Leone: Pre-primary (3-5 years), Primary (6-11 years), Junior Secondary (12-14 years), and Senior Secondary (15-17 years).¹ The ministry defines a school catchment area as a geographic area where pupils are eligible to attend that area’s respective schools (although children can also choose to attend schools outside their catchment area). The government’s Free Quality School Education (FQSE) policy provides tuition, exam fees, furniture, and core teaching and learning materials to support the enrollment of all children eligible to attend school. School attendance and enrollment is driven by a principle of Universal Access as a right for every child. The government has also provided transportation for pupils in district headquarter towns. An existing target scenario that will be explored throughout this analysis is that in both urban and rural areas, children should be within three miles of a school.²

Data

The annual school census (ASC) from 2019 (MBSSE, 2019) contains geolocated data on schools for the whole of Sierra Leone. It includes additional information such as school type, ownership, and enrolment figures. There are 11,166 schools within the dataset; 1,757 are Pre-Primary Schools (PP), 7,154 are Primary Schools (P), 1,632 are Junior Secondary Schools (JSS), and 623 are Senior Secondary Schools (SSS).

Population estimates and disaggregated age breakdowns at ~100 meter spatial resolution (Statistics Sierra Leone and WorldPop, 2020) were used for comparison to the existing school locations. The population dataset was produced based on the 2015 Population and Housing Census data provided by Statistics Sierra Leone and the Directorate of Science, Technology and Innovation in Sierra Leone. Due to this, it reflects the population recorded during the 2015 census.

Figure 1 maps school locations by school type. There is a much higher concentration of primary school locations across the country in comparison to Junior Secondary, Senior Secondary Schools, and Pre-primary Schools (the last of which were not under the ministry’s mandate prior to the 2018 Free Quality School Education Policy). Primary coverage is the highest among school types across the country, whereas SSS have a visibly lower coverage due to the lower number of SSS schools. Densely populated areas such as Freetown and Bo have high coverage across school types.

1. In this paper, these school types will be occasionally referred to by the following acronyms: PP, P, JSS, and SSS.

2. This existing scenario is initially explored in this report; however, it needs to be further costed and explored in subsequent analyses.

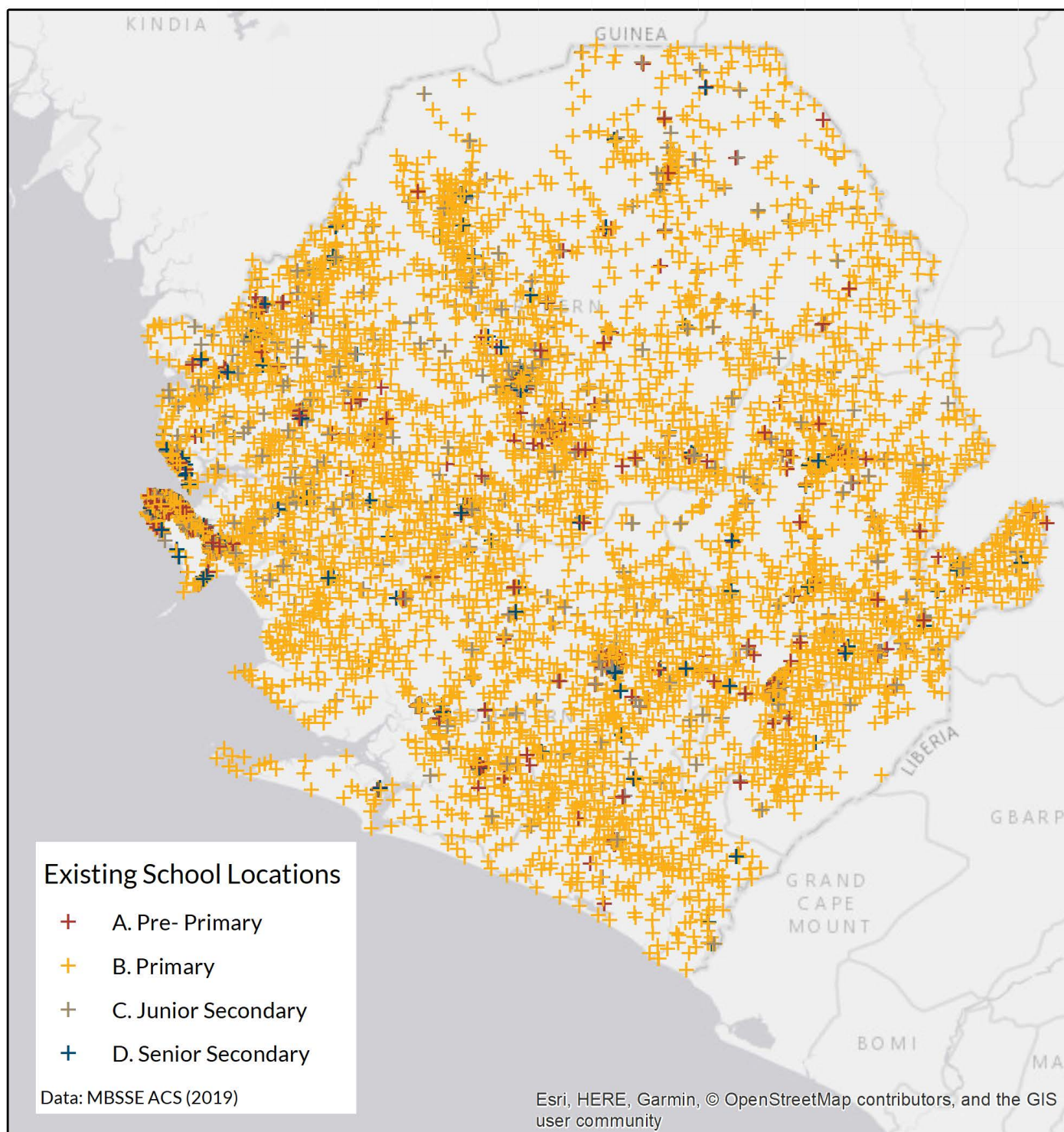
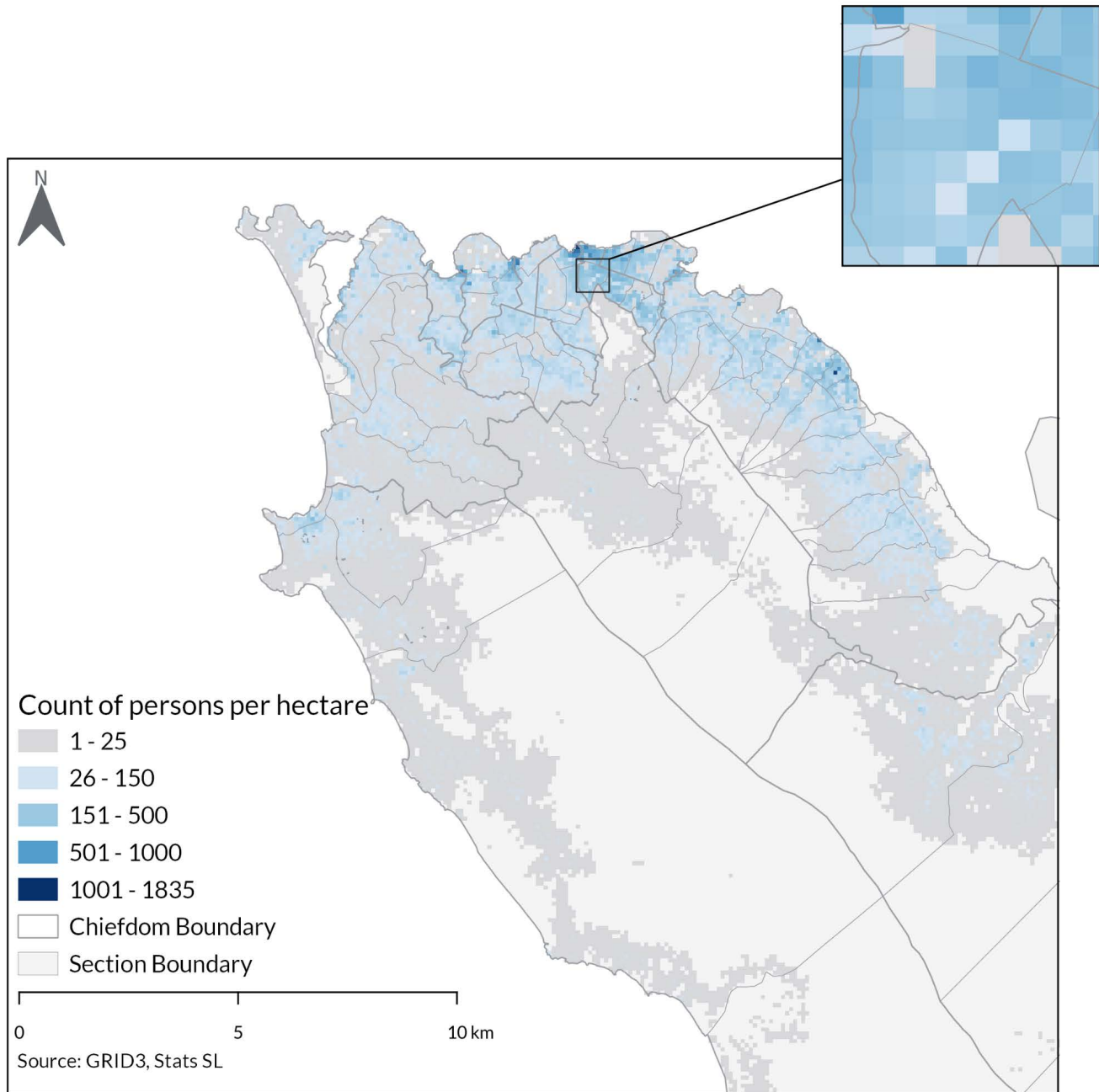


Figure 1: School locations, by school type.

Figure 2 displays the population estimates dataset for the area covering the Freetown Peninsula. Every pixel, or square, represents a 100m x 100m area and with it a predicted number of people. This dataset is also available by specific age/sex structures in five-year intervals (e.g. female, 15-19 years and male, 15-19 years).



Methods

The GRID3 population estimates, split by age (WorldPop and Statistics Sierra Leone, 2020), were used for analyses of the four different school types. The GRID3 population estimate age breakdowns are supplied in five-year increments that do not directly align with the age groups for school types. Due to this, the age groups were re-grouped using the penalized composite link model (Rizzi et al., 2015) to fit the relevant school age for SLE, where PP age spans 3-5 years, P is 6-11, JSS is 12-14, and SSS is 15-17. The amended population rasters follow the same distribution as the original gridded population raster, with values adjusted to correspond with the school age groups.

Figures 3 and 4 present an example of the methods taken in this report. The locations of schools by type were mapped and compared with the relevant population raster to provide an indication of existing school coverage, where coverage can be described as the number of people within a certain distance from schools.

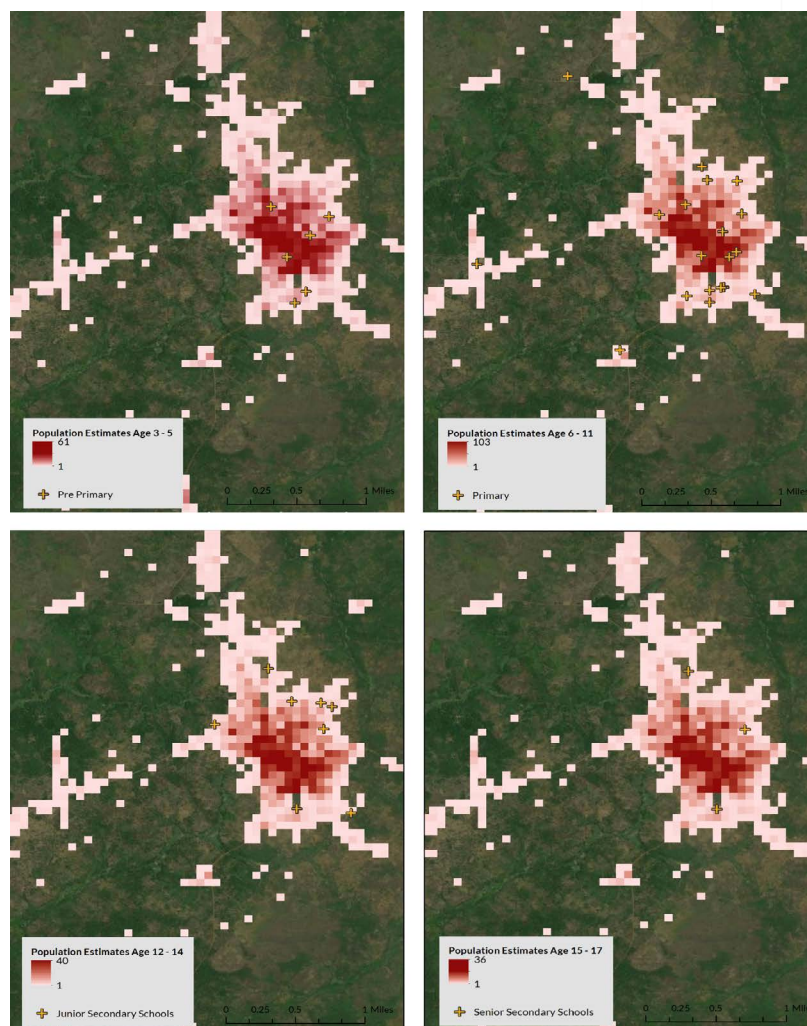
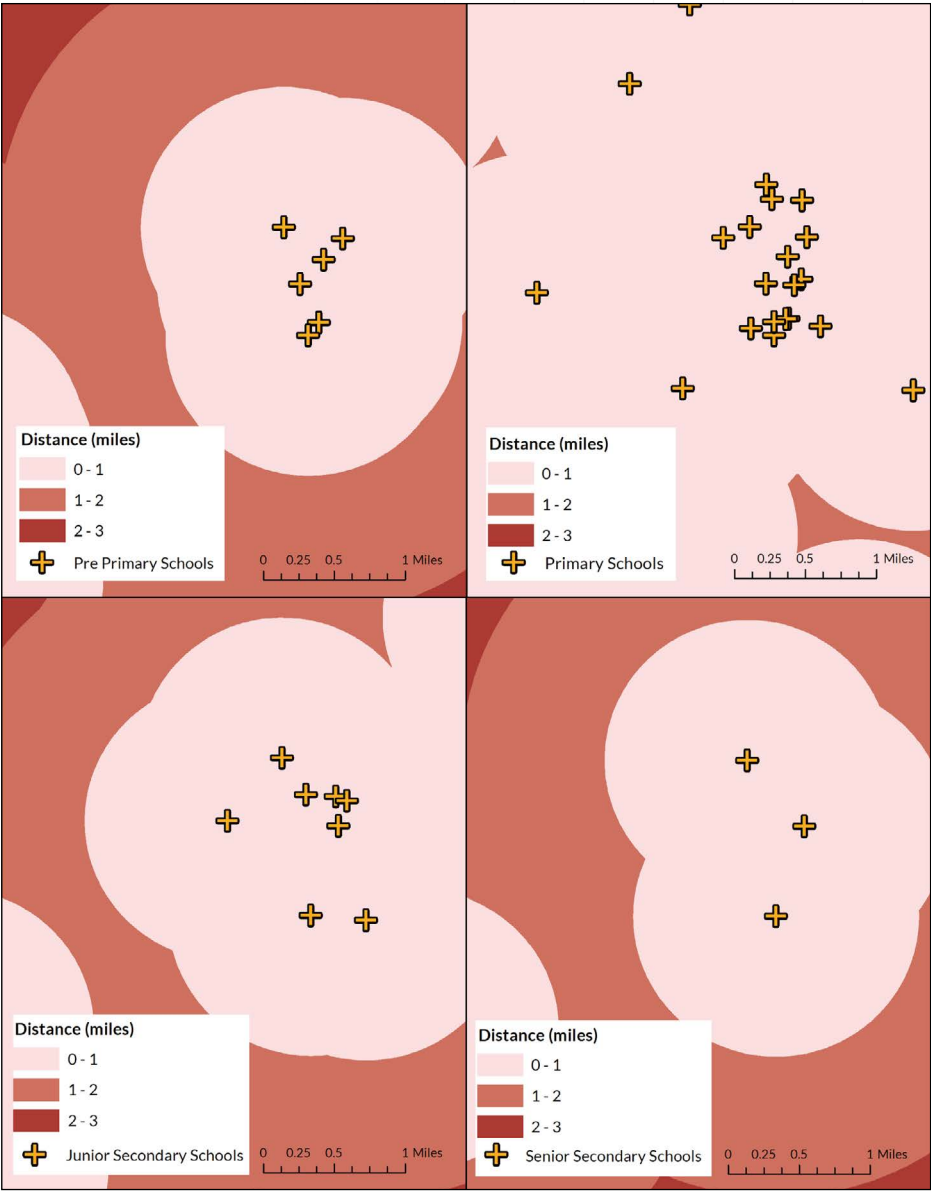


Figure 3: School locations by type and their relevant age group gridded population estimates, for Magbema chiefdom. (From top-left clockwise: PP, P, SSS, JSS)

To measure the population within a set distance of school locations, the distance from schools was calculated in miles across Sierra Leone. Figure 4 demonstrates the distance from schools. The distance from school locations was then compared to the gridded population estimates (shown in Figure 3) to calculate the percent (%) coverage of population within three miles of a school and to identify where the population is located in relation to school locations across the country.



Data: MBSSE ASC (2019)

Figure 4: School locations by type, and the distance from locations in miles, for Magbema chiefdom.

Results

Assessing School Coverage

The percentage of the age-relevant population inside and outside the three-mile distance from schools was calculated for each school type. Table 1 presents the results, school age group used for analysis, and school type to be compared to. Primary schools have the highest coverage rate, where 99 percent of children aged 6-11 are within the three-mile radius of a school. This is due to the high concentration and spread of primary school locations across Sierra Leone, while coverage rates for PP, JSS, and SSS are lower (63 percent, 78 percent, and 55 percent, respectively). Table 2 presents the population count and percentage of population within three miles of different school types at district level.

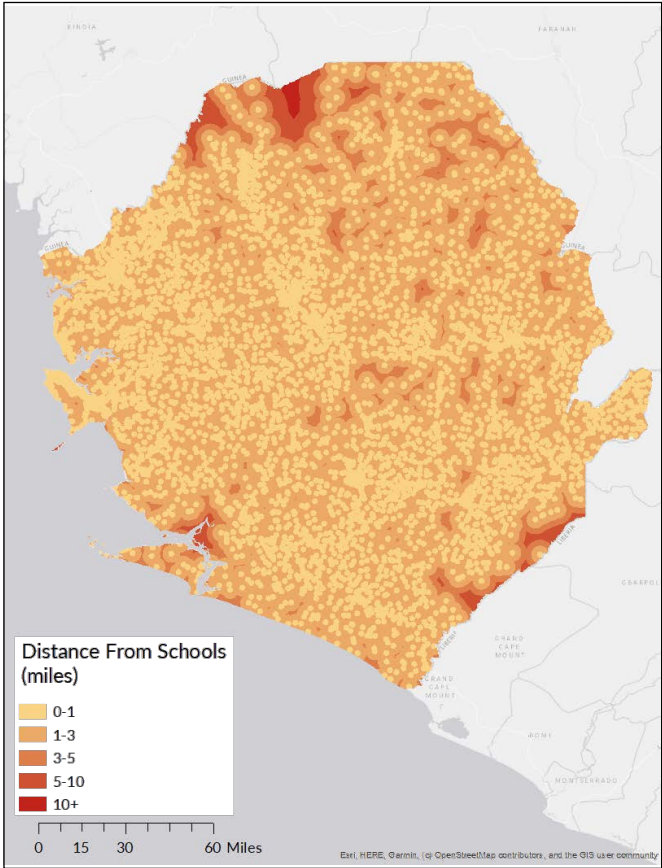
School-age group	School Type	% Gridded population covered by school	Population count covered by school	% Gridded population not covered	Population count not covered by school
3 - 5	Pre-Primary	63	414,996	37	241,943
6 - 11	Primary	99	1,202,596	1	7,987
12 - 14	Junior Secondary	78	417,414	22	120,842
15 - 17	Senior Secondary	55	272,625	45	221,988

Table 1: Coverage (percentage and population count) of schools by school type, compared to the GRID3 population estimates split by relevant age group for the whole country. This uses the three mile distance target set by MBSSE.

District	Population count covered by school				% Gridded population within 3 miles of school			
	Pre Pri	Pri	JSS	SSS	Pre Pri	Pri	JSS	SSS
Bo	34,147	97,852	33,869	21,818	63	100	79	55
Bombali	30,903	74,625	28,419	19,487	75	99	87	67
Bonthe	7,910	35,204	7,108	3,304	40	98	50	25
Kailahun	3,797	40,932	7,472	1,314	20	96	41	8
Kambia	27,056	98,952	28,880	15,397	58	100	68	37
Karene	25,710	63,934	21,482	13,507	67	100	86	60
Kenema	11,377	49,114	16,835	6,873	41	98	77	36
Falaba	32,595	101,875	32,818	20,962	58	99	72	48
Koinadugu	7,869	41,199	10,327	5,867	42	98	57	36
Kono	30,129	91,133	30,443	15,320	65	100	73	40
Moyamba	12,704	55,711	13,880	7,835	36	100	61	40
Port Loko	36,063	91,633	37,532	21,178	66	100	94	62
Pujehun	15,437	66,250	14,545	6,842	47	100	52	25
Tonkolili	30,106	97,893	26,716	13,673	54	100	70	40
Western Area Rural	36,930	63,271	32,669	29,572	100	100	100	100
Western Area Urban	72,259	133,009	74,415	69,674	100	100	100	100

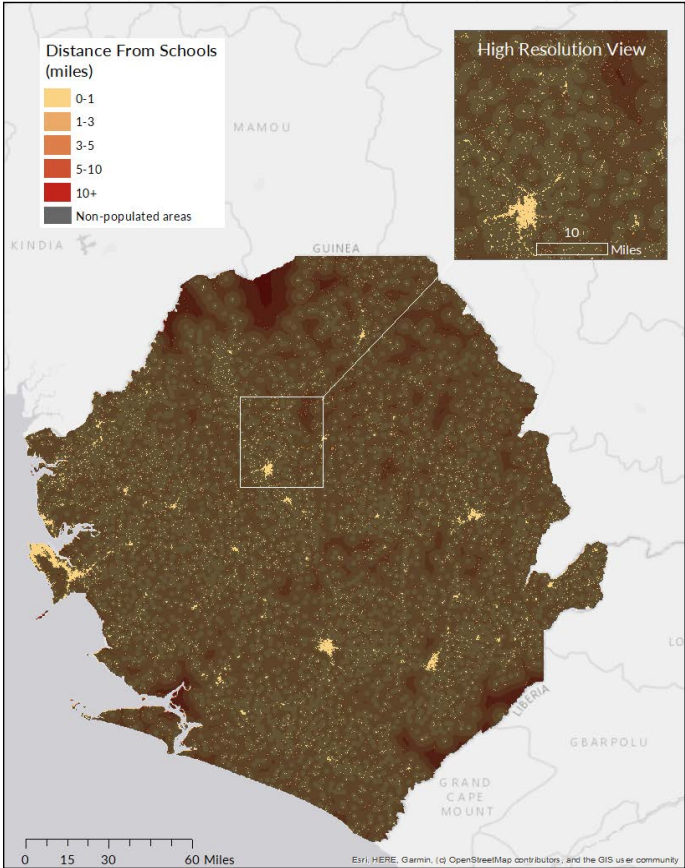
Table 2: Coverage (percentage and population count) of schools by school type, compared to the GRID3 population estimates split by school age group for each district. This uses the three mile distance target set by MBSSE.

Figure 5 presents the distance from all school locations. This allows us to view how far the population is from school locations and enables the identification of populated areas that are not covered by an existing school location. The graph in Figure 7 shows the population coverage for each school type, for distances 0-10 miles from schools. The population coverage (%) was calculated for each school type using the GRID3 population estimates for the school age group (age groups shown in Table 1). 89.95 percent of children are within one mile of a Primary school, compared to 59.18 percent (JS), 50.12 percent (PP), and 46.06 percent (SSS).



Data Source: Worldpop and Statistics Sierra Leone (2020), MBSSE ASC (2019).

Figure 5: Distance from school locations across all of Sierra Leone



Data Source: Worldpop and Statistics Sierra Leone (2020), MBSSE ASC (2019).

Figure 6: Distance from school locations with non-populated areas masked out in grey.

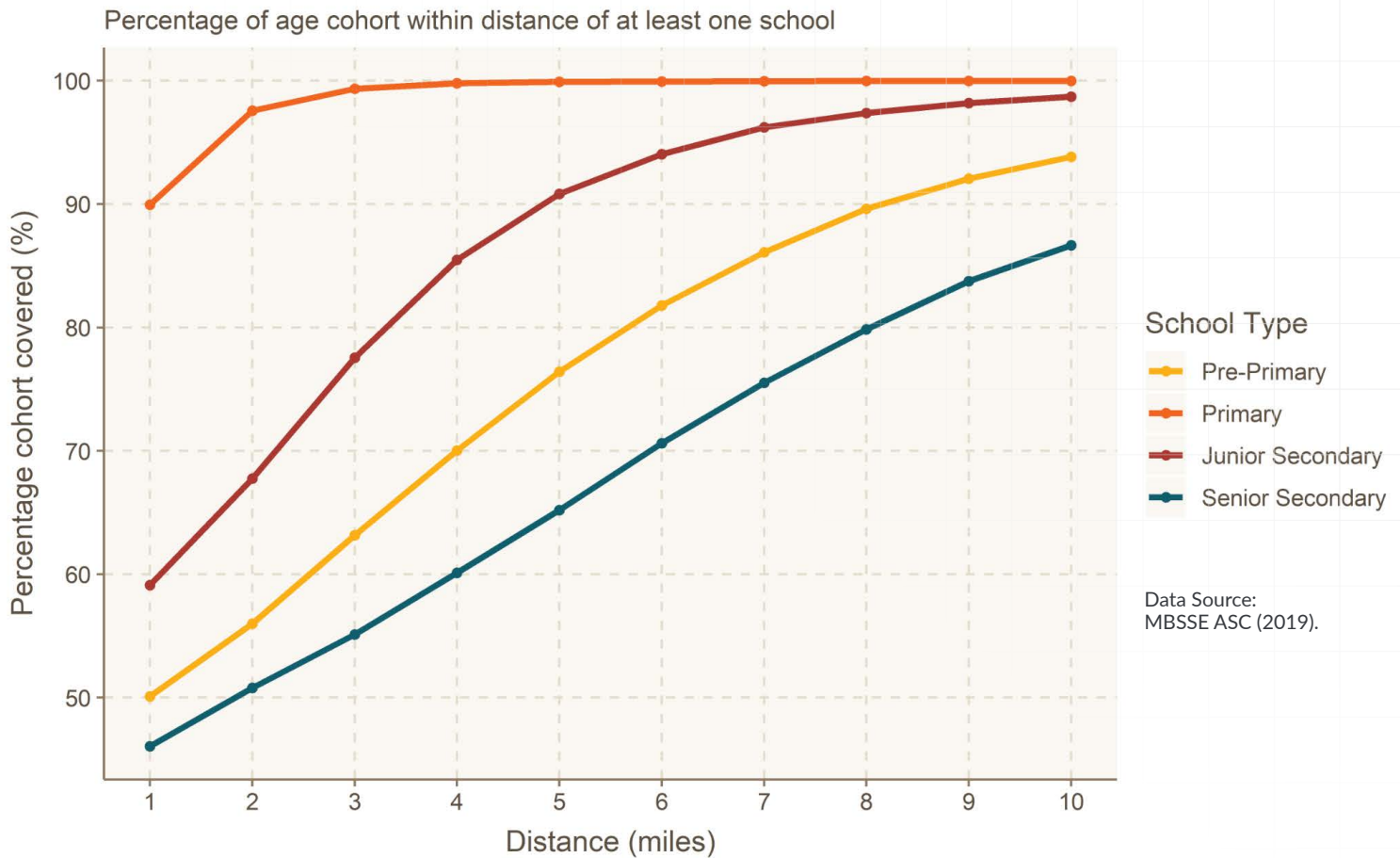


Figure 7: Population coverage (%) as distance from schools increases (miles) for each school type.

Assessing Coverage by Ownership

Out of the total 11,166 schools in the ASC dataset, 1,810 are private and 9,356 are public schools (16.2 percent and 83.79 percent, respectively), where the locations of these are shown in Figure 8. Coverage by ownership was measured using the GRID3 population estimates and school types (PP, P, JSS, and SSS). Figure 9 shows the percentage of population coverage as distance from schools increases, where public schools have the highest population coverage across all four school types. Private schools follow a similar level of population coverage across each school type. Table 3 displays the public/private school coverage using the three mile scenario by school type, for each district, including a breakdown of the percentage of schools that are private/public.

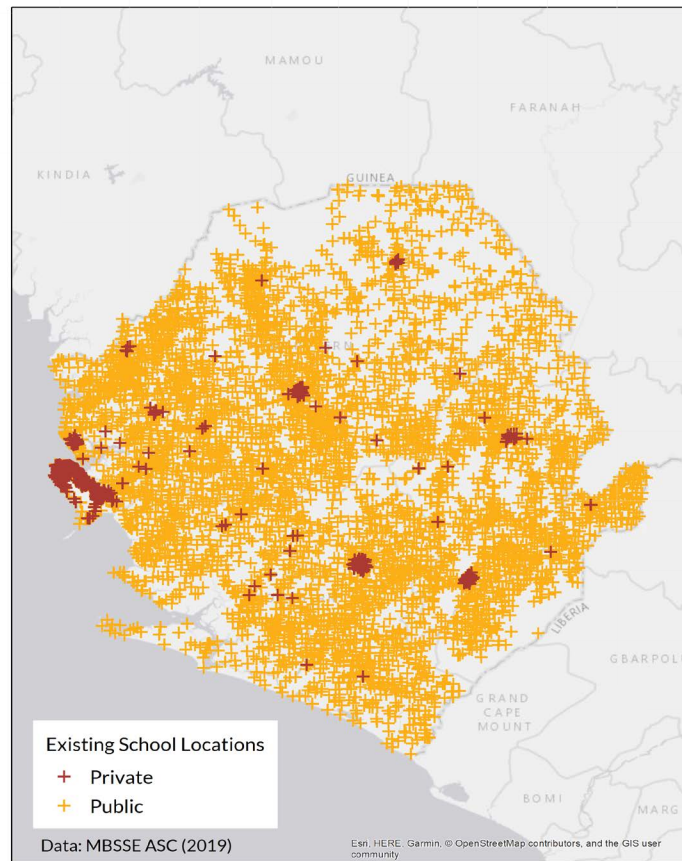


Figure 8: Private (red) and public (yellow) school locations.

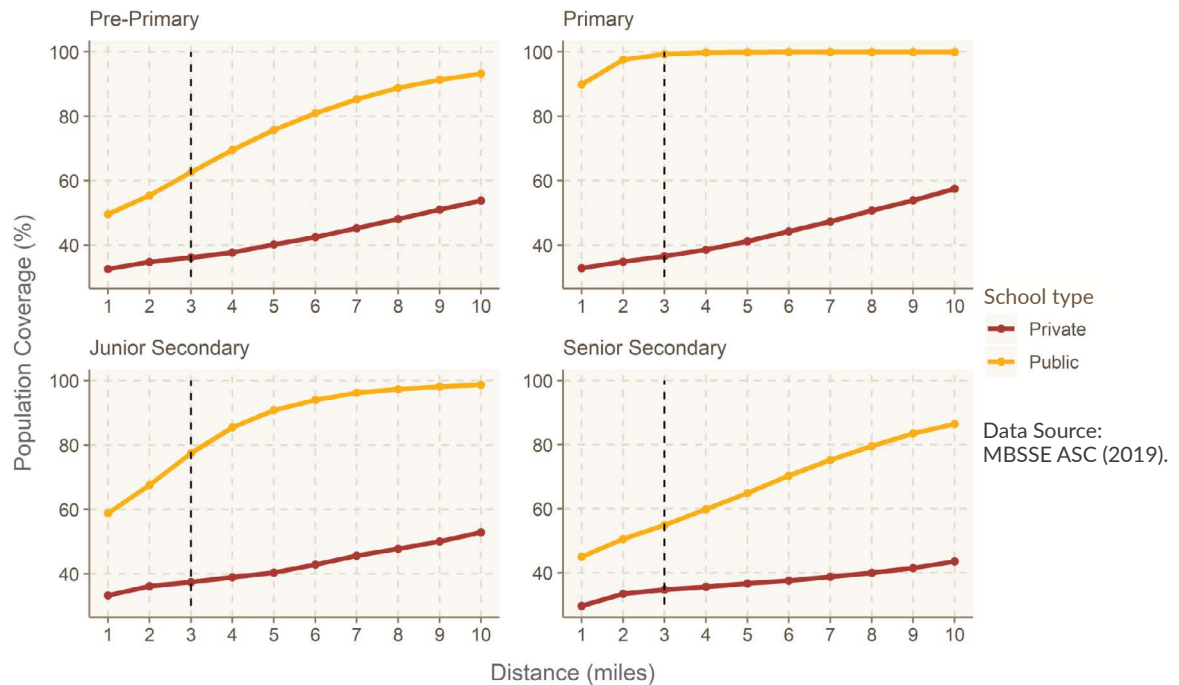


Figure 9: Population coverage (%) as distance from schools increases (miles) for public and private schools, split by school type (PP, P, JSS, and SSS).

District	% Schools								% Gridded population within 3 miles of school							
	Public				Private				Public				Private			
	Pre Pri	Pri	JSS	SSS	Pre Pri	Pri	JSS	SSS	Pre Pri	Pri	JSS	SSS	Pre Pri	Pri	JSS	SSS
Bo	71	93	84	77	29	7	16	23	63	100	79	55	43	43	44	42
Bombali	80	93	88	82	20	7	12	18	73	99	86	66	51	51	51	48
Bonthe	95	100	100	100	5	0	0	0	38	98	50	25	11	8	0	0
Kailahun	100	100	100	100	0	0	0	0	20	96	41	8	0	0	0	0
Kambia	96	99	96	100	4	1	4	0	58	100	68	37	8	8	8	0
Karene	92	99	100	100	8	1	0	0	67	100	86	60	13	13	0	0
Kenema	100	100	98	100	0	<1	2	0	41	98	77	36	1	1	12	0
Falaba	70	95	77	66	30	5	23	34	57	99	72	48	35	38	34	34
Koinadugu	90	97	92	90	10	3	8	10	42	98	57	36	23	24	23	22
Kono	92	97	92	92	8	3	8	8	65	100	73	40	30	32	29	28
Moyamba	91	99	93	85	9	1	7	15	36	100	61	38	15	16	12	10
Port Loko	73	95	91	91	27	5	9	9	64	100	94	62	42	44	42	25
Pujehun	100	100	100	100	0	0	0	0	47	100	52	25	0	9	0	0
Tonkolili	97	99	98	97	3	1	2	3	54	100	70	39	13	14	11	7
Western Area Rural	47	61	55	61	53	39	45	39	100	100	100	98	99	99	92	98
Western Area Urban	37	58	53	51	63	42	47	49	100	100	100	100	100	100	100	100

Table 3: School age population within three miles of a public/private school, by school type at district-level.

Assessing Quality

Country-level

An exploratory analysis of school quality was conducted using available data on national exam pass rates. Of the 11,166 school locations, 4,106 (36.77 percent) of schools host national exams and have data on the pass rate, which were used in this analysis. The remainder of schools do not host national exams, where children travel to sit exams in host schools. Thus, it should be noted that actual coverage may be different if more schools were to host national exams. Table 4 outlines the percentage of schools that do host exams, by school type for each district.

District	Percent of schools that host exams with national exam pass rates available			
	Pre Pri	Pri	JSS	SSS
Bo	46	45	47	68
Bombali	43	44	36	49
Bonthe	36	34	25	92
Kailahun	45	45	46	47
Kambia	64	72	31	52
Karene	41	42	33	62
Kenema	37	35	41	55
Falaba	14	13	18	17
Koinadugu	33	35	13	40
Kono	35	36	21	56
Moyamba	37	39	26	33
Port Loko	51	57	29	49
Pujehun	41	40	38	78
Tonkolili	51	50	51	59
Western Area Rural	32	32	30	39
Western Area Urban	57	57	57	56

Table 4: Percent of schools that host exams, available by school type and district.

A threshold of 50 percent was selected by MBSSE for the pass rate, categorising schools that host exams based on whether they fell above or below the threshold. 2,826 of the schools were above or equal to the 50 percent pass rate, with 1,280 schools falling below the 50 percent pass rate. While the ministry uses a much broader approach of defining “quality” for pass rates at national examinations, the 50 percent threshold provides an initial entry into our understanding of school quality. Figure 10 shows school locations above or equal to 50 percent pass rate and those below 50 percent pass rate, including school locations that do not host exams.

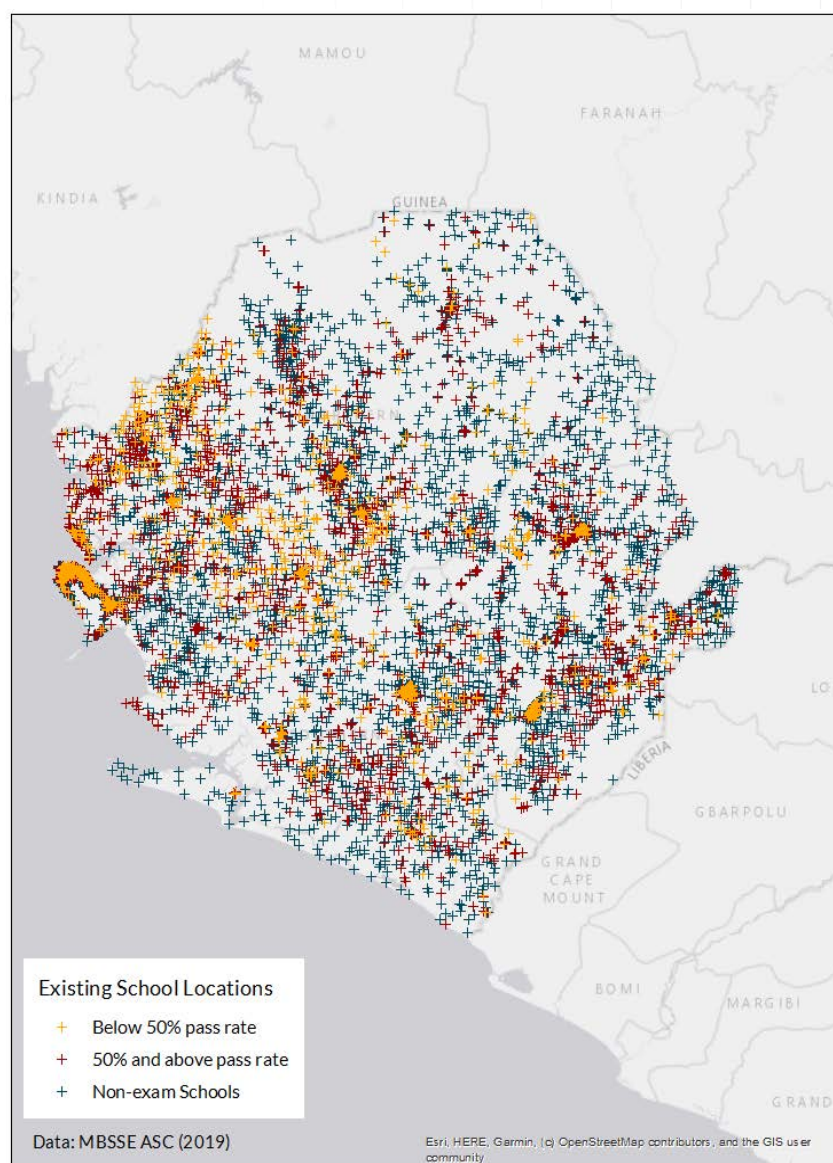


Figure 10: School locations above the 50 percent pass rate threshold (red) and below the 50 percent pass rate (yellow).

Coverage by quality was broken down by school type (Primary, JSS, and SSS); pre-primary schools were not included in the analysis, as these students do not participate in the national exams. 44 percent (3,156/7,154) of primary schools host exams, compared to 38 percent (620/1,632) for JSS and 53 percent (329/623) for SSS. Due to this, coverage was also measured for schools that are “non-exam centres.” As mentioned above, this does not provide a full picture of the coverage of all schools by quality across Sierra Leone, which should be considered when observing this analysis. Figure 11 shows the coverage of schools above a 50 percent pass rate, those below a 50 percent pass rate, and those schools that do not host exams (Non-exam Schools), broken down by school type. Table 5 displays the pass rate school coverage by school type, for each district.



Figure 11: Population coverage (%) as distance from schools increases (miles) for schools that have a pass rate above 50 percent, those with a pass rate below 50 percent, and those that do not host exams, split by school type (Primary, JSS, and SSS).

	Number of schools						% Gridded population within 3 miles of school					
	Below 50% pass rate			Above 50% pass rate			Below 50% pass rate			Above 50% pass rate		
District	Pri	JSS	SSS	Pri	JSS	SSS	Pri	JSS	SSS	Pri	JSS	SSS
Bo	69	39	32	238	22	0	65	54	52	92	56	0
Bombali	35	15	22	139	27	0	69	58	61	91	65	0
Bonthe	10	8	11	70	0	0	27	26	25	63	0	0
Kailahun	7	0	1	22	4	0	10	0	3	32	5	0
Kambia	26	10	9	151	16	0	34	22	28	90	35	0
Karene	101	21	14	153	3	0	76	62	49	94	16	0
Kenema	9	5	8	116	13	0	20	11	30	84	39	0
Falaba	42	23	26	193	28	0	51	35	43	83	54	0
Koinadugu	25	2	4	59	3	0	30	6	27	53	27	0
Kono	23	5	21	162	20	1	42	29	40	88	43	26
Moyamba	48	10	9	146	9	0	42	23	22	79	18	0
Port Loko	66	33	22	241	14	0	69	54	53	95	51	0
Pujehun	24	4	7	92	6	0	38	18	22	85	20	0
Tonkolili	92	40	17	192	10	0	59	44	30	85	29	0
Western Area Rural	26	35	33	126	31	0	98	97	99	100	99	62
Western Area Urban	42	62	87	411	102	5	100	100	100	100	100	87

Table 5: Population within 3 miles of a school, by school pass rate at district-level (calculated using schools that host exams).

Chiefdom level

As highlighted, data on school quality is not available for each school location across Sierra Leone due to some schools not hosting exams. The percent of schools that do host exams varies at district and chiefdom level across SLE. The map in Figure 12 shows the distance from schools that host exams for P, JSS, and SSS. Chiefdom administrative boundaries are included, providing an insight into the coverage of schools that host exams at chiefdom level.

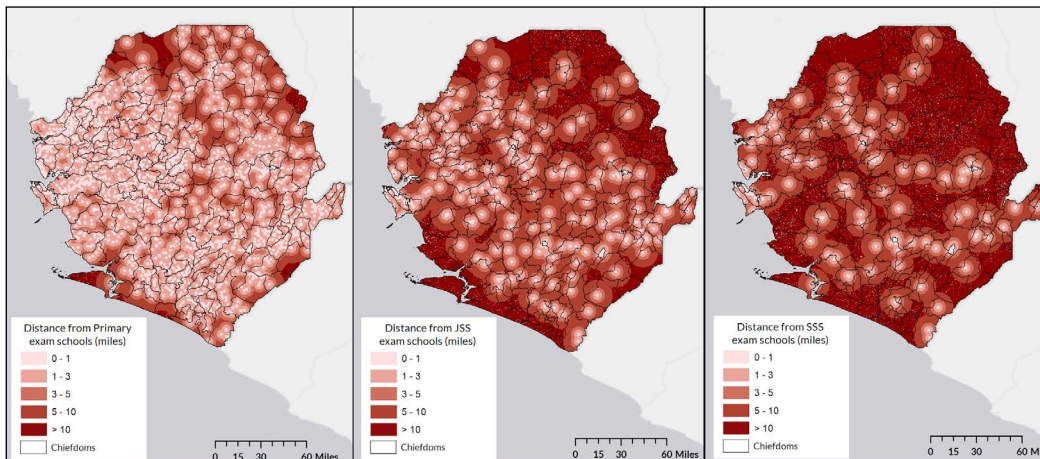


Figure 12: The distance from schools that host exams, split by school type.

Data Source: MBSE ASC (2019).

To get an idea of the coverage of schools with a pass rate above or below 50 percent for areas where there is more data present (with more schools hosting exams), 13 chiefdoms were selected for further analysis (shown in Figure 13). These chiefdoms had 50 percent or more of their schools hosting exams across the three school types used in analysis (P, JSS, and SSS). Using this subset of chiefdoms can give a more accurate indication of coverage of schools below/above the 50 percent pass rate, as there is more data available. Figure 14 shows the coverage of population within a set distance to these school locations for the 13 chiefdoms of focus.

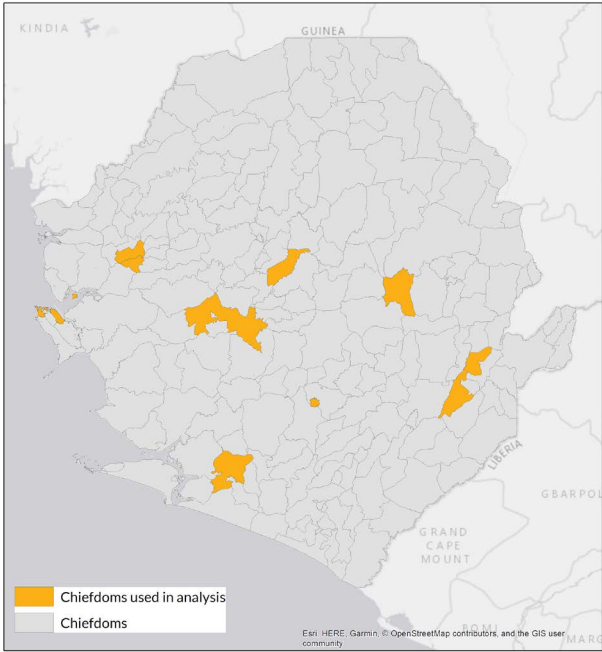


Figure 13: Chiefdoms with more than 50 percent of schools hosting exams across P, JSS, and SSS school types used in this analysis.

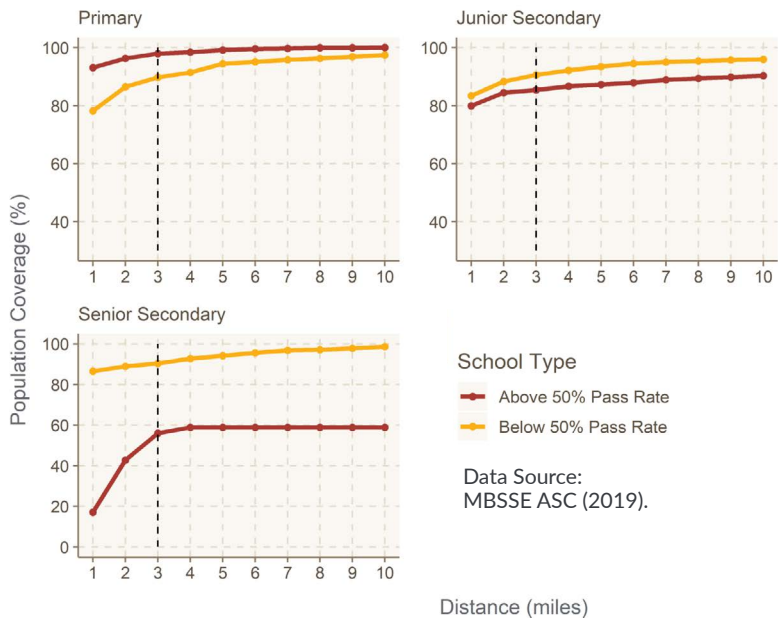


Figure 14: For 13 chiefdoms with more than 50 percent of data available, the cumulative increase in population coverage (%) as distance from schools increases (miles) for schools that have a pass rate above 50 percent and those with a pass rate below 50 percent, split by school type (P, JSS, and SSS).

Assessing Coverage by Urban/Rural

Population coverage was also calculated based on whether a school was located in an urban or rural area. To classify as either urban or rural, settlement extents (CIESIN, 2020) were combined with the gridded population estimates. Settlements greater than 2,000 people were classified as “urban” and those with fewer than 2,000 people were classified as rural, based on definitions provided by Statistics-Sierra Leone and MBSSE. School locations and population were then categorised as urban/rural based on which settlement area they fell within. 5,670 (50.77 percent) schools were located in urban areas and 5,496 (49.23 percent) schools were located in rural areas. Figure 15 shows the urban/rural classification of settlements, defined by the total population.

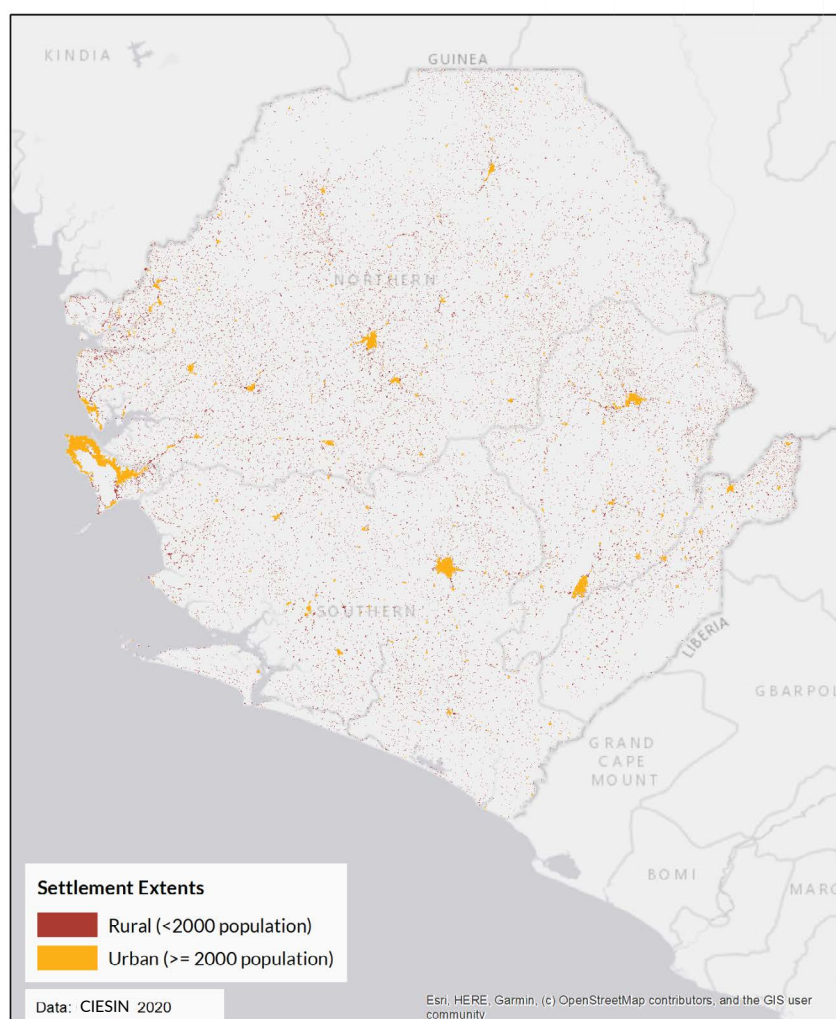


Figure 15: Rural settlements with fewer than 2,000 population (red) and urban settlements with equal to or greater than 2,000 population (yellow).

School-age population was classified as either urban or rural depending on what settlement area it fell within and was compared to the urban/rural school locations split by type. Figure 16 shows the population coverage percentage for PP, P, JSS, and SSS schools in urban/rural areas. Across all school types, the urban population is well-covered by schools in urban settlements, as compared to those in rural areas. Table 6 displays the urban/rural school coverage by school type, for each district.

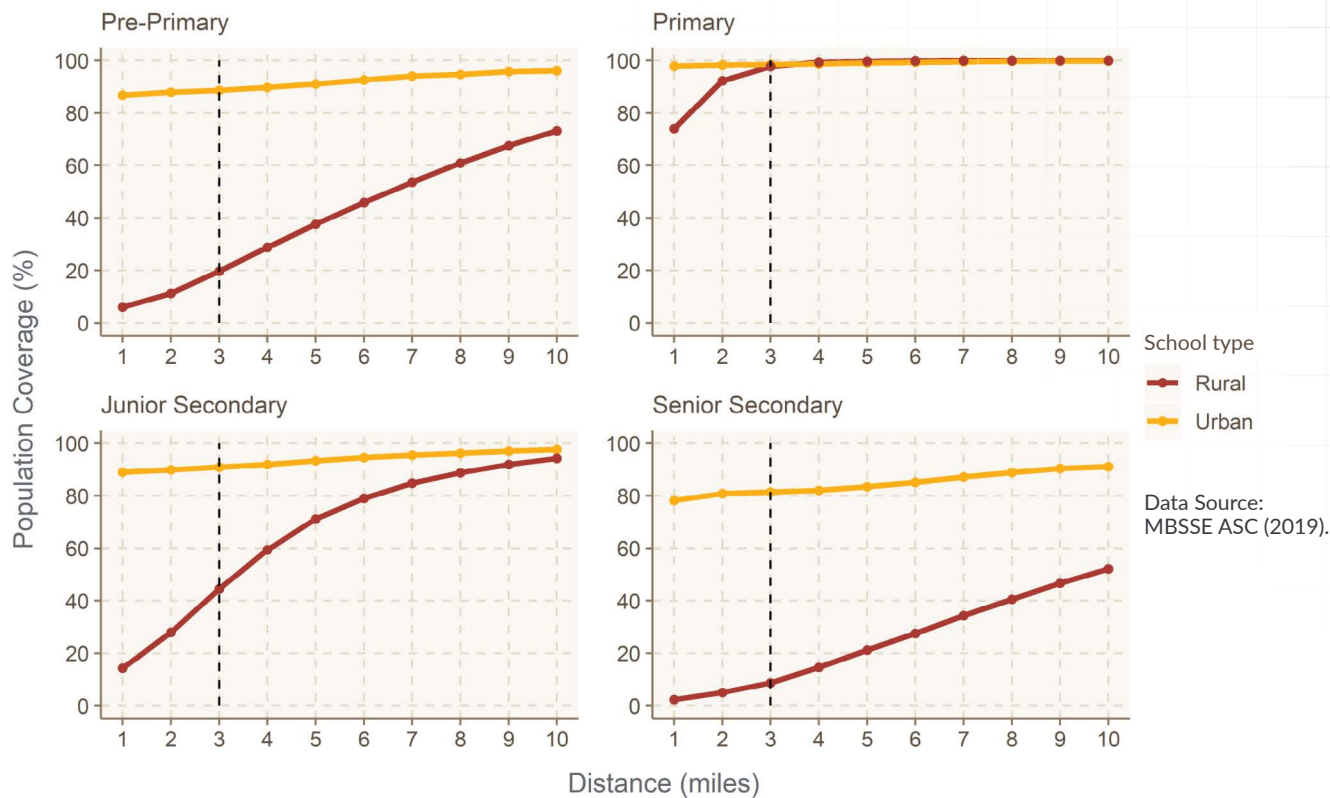


Figure 16: TThe cumulative increase in population coverage (%) as distance from schools increases (miles) for schools and population in urban and rural areas, split by school type (PP, P, JSS, and SSS).

District	Population breakdown (%)		% Urban population within 3 miles of a school				% Rural population within 3 miles of a school			
	Urban	Rural	Pre Pri	Pri	JSS	SSS	Pre Pri	Pri	JSS	SSS
Bo	57	43	90	98	93	80	8	99	38	9
Bombali	55	45	96	98	98	95	35	98	65	18
Bonthe	26	74	84	93	79	79	21	95	35	0
Kailahun	30	70	33	92	56	8	3	89	13	0
Kambia	46	54	75	98	67	51	18	99	34	9
Karene	45	55	85	98	90	68	39	99	70	20
Kenema	26	74	65	92	79	56	11	97	61	12
Falaba	51	49	86	98	86	80	15	97	37	4
Koinadugu	43	57	68	96	79	62	7	94	22	3
Kono	46	54	95	99	96	75	28	99	41	5
Moyamba	34	66	72	98	80	76	7	99	37	7
Port Loko	54	46	91	100	99	90	19	100	81	9
Pujehun	33	67	65	100	54	32	25	99	30	7
Tonkolili	34	66	85	97	88	66	26	99	50	13
Western Area Rural	97	3	100	100	100	100	73	97	80	35
Western Area Urban	100	0	100	100	100	100	N/A	N/A	N/A	N/A

Table 6: Urban/rural population within three miles of a school, by school type at district-level

Further work

This report highlights existing coverage of population and explores the existing target scenario of children being within three miles of a school location, which can provide an indication of population currently underserved by school locations, using straight-line distance. This existing analysis does not take into account enrollment figures for schools, so further work should focus on these underserved areas alongside enrollment figures to identify ways to increase service among populations.

This exercise is a first step in understanding the spatial configuration of school locations in Sierra Leone, where further work will need to be undertaken for school catchment area planning. Moving forward, the ministry and partners will delve into further constraints and iterate current analyses that will inform government strategy on school catchment area planning, placement of pupils who attempt and pass transition examinations, and the development and construction of additional classrooms.

However, from these initial analyses, more Pre-primary and Senior Secondary schools need to be constructed to meet the three-mile distance threshold, particularly in rural areas. The more granular and independent analyses at the district and chiefdom level reveal a different need from regional or national average analyses. A strategy for school construction or development should be informed by an updated analysis reflecting 2020 datasets, if available.

Acknowledgements

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Revision Note

A first version was released on 22 December 2020. This revised report is based on updated population data that includes amendments to specific location discrepancies.



GRID3 (Geo-Referenced Infrastructure and Demographic Data for Development) works with countries to generate, validate and use geospatial data on population, settlements, infrastructure, and subnational boundaries. GRID3 combines the expertise of partners in government, United Nations, academia, and the private sector to design adaptable and relevant geospatial solutions based on capacity and development needs of each country.

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