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Mapping Educational Exclusion: A Spatio-Temporal Analysis of Out-of-School Children in Nigeria*

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Abstract: Nigeria has one of the highest numbers (more than 20 million) of out-of-school children (OOSC) globally, underscoring the urgent need to address this crisis. Although contemporary studies on OOSC are largely concerned with the determinants, a spatio-temporal analysis, which examines the spatial distribution of OOSC and how it evolves overtime, can offer additional insights and inform spatially explicit solutions to the challenge of OOSC in Nigeria. Using spatial statistical techniques, such as Global Moran's I, Local Moran's I and Getis-Ord Gi*, we examine the geographical patterns of OOSC in Nigeria for 2016, 2018, and 2022. The findings suggest an increasing and strengthening trend of spatial concentration in the distribution of OOSC over time. Although significant clustering was present in 2016, it was more pronounced and spatially entrenched by 2022. Specifically, the Northwest and Northeast regions remain endemic to the crisis of OOSC. Southern states consistently maintained a low rate of OOSC relative to the North; however, the appearance of a High Low (HL) outlier in Ogun and Osun suggests that Southern states are not totally free from this crisis. The study recommends that the government implement targeted interventions that are context-specific to address the crisis of OOSC in Nigeria.

Keywords: OOSC, spatio-temporal, Northern Nigeria, Southern Nigeria, Nigeria,

1. INTRODUCTION

Sustainable Development Goal (SDG) 4 aims to achieve universal access to education by 2030 (UNESCO, 2025). Nevertheless, this target looks unrealistic for most developing countries, particularly in sub-Saharan Africa, where about 98 million children are still out of school (UNESCO Institute for Statistics, 2025), unless drastic measures are implemented. Unfortunately, the majority (more than 20 million) of these out-of-school children (OOSC) are in

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Nigeria, despite various policies put in place by the government, such as the Universal Basic Education, the National Policy of Education, National Gender Policy, among others (United Nations International Children Emergency Fund, 2022). The reasons for the ineffectiveness of these policies remain unclear; however, the lack of political will, poor implementation, and inadequate funding have been identified as possible factors (Ogunode et al., 2021). Expectedly, Nigeria grapples with the consequences of OOSC, including increased crime rates, poverty, and social inequalities (Kukawa et al., 2025).

While various studies have been conducted to understand and tackle the issue of OOSC in Nigeria, they are majorly concerned with the determinants/predictors (Lincove, 2009; Okoh et al., 2020; Ndanusa et al., 2021; Ogunode and Chinwuba, 2022; Oyekan et al., 2023; Ojuolape and Mohd, 2024; Lott, 2025) or geographical patterns (Adeleke and Alabede, 2022; Adeleke, 2024). However, to the best of our knowledge, no study has examined the spatio-temporal dimensions, which involve analyzing how the spatial distribution of OOSC in Nigeria has evolved over time. This approach is crucial for identifying locations that have made significant progress in addressing the issue of OOSC, areas where the issue remains endemic, and locations that should be prioritized for policy intervention by the government and other stakeholders. Consequently, the objective of this study is to examine the spatial distribution of OOSC in Nigeria and its variation over time.

2. OOSC IN NIGERIA: SOCIO-ECONOMIC AND SPATIOTEMPORAL PERSPECTIVES

Nigeria has one of the highest numbers of OOSC in the world (United Nations International Children's Emergency Fund, 2022). There are many issues that contribute to the OOSC crisis, but there are a few major determinants across the country. Disparities in access to basic education manifest across socioeconomic, cultural, spatial, and systemic dimensions. Poverty has been established as a determinant of OOSC (Adeleke and Alabede, 2022). Education has very low priority in poor households, resulting in the withdrawal of children from school to serve as income-generating help or domestic aids (United Nations International Children Emergency Fund, 2022). Several other studies have also confirmed a positive relationship between household unemployment and school dropout, with economic instability as a major driver of interruptions and the termination of schooling (Huisman and Smits, 2015; Di Maio and Nisticò, 2019).

Family size also plays a critical role (Weng et al., 2019). In big families with stretched resources, only some children, mainly boys, are sent to school, a "resource dilution" effect that also contributes to the gender gap. But, where school is available, it is not necessarily accessed equitably. This is cultural, formed by social expectations, but especially true for girls in Northern Nigeria (Azeez et al., 2026). Girls are taught the social value of early marriage and reproductive roles from a young age (Akpan and Akinmolayan, 2025). Beyond a certain point, longer years of formal education are not only seen as unnecessary but are actively discouraged by parents and families (Onochie, 2010). Informal educational systems, for example, Quranic schools, take precedence. While this could make up large portions of the child population in 'religious' education, they are not counted in official school enrollment (Akaka, 2024).

Communities and households affected by armed conflict, terrorism, insecurity, and banditry have been documented to shut down schools (Bertoni et al., 2019) and being forcefully displaced and made to flee into internally displaced persons camps. State and non-state actors kill, maim, abduct, and terrorize children. For instance, the abduction of schoolgirls in Dapchi, Yobe State, illustrates how targeted attacks on schools can amplify parental perceptions of risk. Even where schools remain physically accessible, the fear of such harm has made many parents withdraw their children from school as a protective strategy (United Nations, 2018) (United Nations, 2018). Similarly, the perennial underfunding of the education sector plays a major role in fuelling the OOSC crisis. Despite Nigeria's political commitments to the provision of the Universal Basic Education, public spending on education is a tiny fraction of the recommended benchmarks (Adeleke et al., 2021). It shows in the poor state of infrastructure, overcrowding, the low capacity of teachers, and the lack of access to water, sanitation, and hygiene (WASH) facilities and assistive learning devices for children with disabilities or other special needs (Ineye-Briggs, 2025). Policy documents, such as the Child Rights Act and the Universal Basic Education policy, among many other sectoral policy documents, commit the country to the provision of free, accessible, quality, and inclusive education to all Nigerian children, but the gap in implementation is wide (Ojo and Salman, 2024). In many states and communities, the most prominent barriers to inclusion have been persistent systemic inefficiencies and a lack of coordination and accountability across the various levels of government (Labo-Popoola and Atanda, 2009).

Migration, internal displacement, and forced mobility also play a role in the crisis of OOSC (Bertoni et al., 2019) (Assefa, 2025; Bertoni et al., 2019). As Nigeria's borders become more porous and the violence from Boko Haram insurgency and banditry grows more rampant, many children are displaced from their communities, lose access to regular schooling and face complex obstacles to their reintegration when it is available (Salihu and Shodunke, 2024). These intersecting issues reinforce one another and create a harmful mix of conditions in which children, and particularly the poorest, the most rural and the most marginalized, are shut out of the most basic forms of education (Oyekan et al., 2023).

While the studies on the determinants of OOSC provide critical insights into understanding this issue, the spatio-temporal dimension, which is rarely considered in the literature, can offer further insights and proffer spatially explicit solutions to the challenge of OOSC in Nigeria. Spatio-temporal analysis can be defined as a type of analysis where both the spatial and temporal dimensions of a particular phenomenon are considered (Pebesma, 2012). In recent years, spatio-temporal analysis has been widely used in various fields, such as geography, epidemiology, urban planning, climatology, and many more (Taiwo, 2021; Ayoade, 2018; Iyanda, et al., 2022) (Taiwo, 2021; Iyanda et al., 2022). Couclelis (2009) argues that separating time from space results in the reduction of complex phenomena, including the case of OOSC, to a static snapshot. Hence, a spatio-temporal analysis is essential for understanding the complex relationships between objects, events, and processes that change over time and space (Goodchild, 2001). When applied to the study of OOSC, it can help identify locations that are making progress in solving the problem of OOSC and areas where this problem persists, which is essential for formulating targeted policy interventions.

3. METHODS

3.1. Data Source

The data on OOSC aged 6 to 11 and the total school-aged population for the years 2016, 2018, and 2022 were obtained from the records of Universal Basic Education (UBEC) (2016, 2018, 2022). UBEC is a federal government agency responsible for coordinating all aspects of Universal Basic Education in Nigeria. In collaboration with the State Universal Basic Education Board and other educational agencies in all the states in Nigeria, it collected data that are essential to basic education delivery, including information on school enrollment and the number of school-age children. From the school enrollment and school-age children's data, we arrived at the total number of OOSC by deducting the total number of children enrolled in school from the total number of school-age children. The computation of the percentage of OOSC was based on the following formula:

The total number of children out of school divided by the total number of school-age children multiplied by 100.

3.2. Statistical Analysis

Spatial statistical techniques, including the Global and Local Moran's I and the Getis-Ord G_i^* statistics, were used to examine the patterns of OOSC and their changes over time.

3.2.1. Global Moran's I

The Global Moran's Index was applied to explore the presence or absence of an overall spatial clustering of OOSC across the country. Moran's I range from -1 through 0 to +1, such that Moran's I of +1 equates to a high positive spatial autocorrelation Anselin (2007). This denotes a clustered pattern of OOSC with adjacent states exhibiting similar values of OOSC. On the other hand, a value of 0 indicates no spatial autocorrelation (i.e., a random spatial pattern), indicating that neighboring states have dissimilar OOSC values. A value of -1 is a sign of negative spatial autocorrelation, suggesting a dispersed pattern. If z scores fall between -1.96 and +1.96, then a p-value greater than 0.05 means the pattern is random. In contrast, a p-value less than the confidence level represents a statistically significant spatial autocorrelation. Nevertheless, Global Moran's Index does not identify the exact geographical location where the clustering of OOSC occurs. Hence, the Local Moran's I was adopted to address this limitation.

3.2.2. Local Moran's I

Local Moran's Index was used to detect spatial outliers and clusters of high-high or low-low values of OOSC among states in Nigeria. This method distinguishes statistically significant clusters (High-High, Low-Low) from spatial outliers (Low-High, High-Low) at the 0.05 confidence level. A High-High spatial cluster means that states with a high value of OOSC are surrounded by states with similar values. A Low-Low cluster means that states with low

figures of OOSC are surrounded by states that also have low figures. In contrast, a Low-High spatial outlier indicates that states with low values of OOSC are encompassed by states with high values and vice versa.

3.2.3. *Getis-Ord G_i^**

Although Local Moran's I can identify local clusters and outliers, it does not identify the extent of the clustering. Therefore, the Getis-Ord G_i^* statistic, also known as hot spot analysis, was employed. The Getis-Ord G_i^* statistic is a local statistic that measures local spatial autocorrelation by identifying statistically significant clusters of high or low values (Ord and Getis, 1995). Specifically, it detects hot spots—areas with statistically significant clusters of high values of OOSC and cold spots (statistically significant spatial clusters of low values). The statistic also provides a range of confidence levels, which shows areas with the most deviation from the assumption of a random distribution. A high positive z-score and a small p-value indicate spatial clustering of statistically significant high values, or hot spots, of OOSC. A low negative z-score and small p-values indicate the presence of spatial clustering of statistically significant low values or cold spots of OOSC.

4. RESULTS AND DISCUSSION

4.1. Geographical Distribution of OOSC in Nigeria

4.1.1. *A North-South Divide in OOSC in 2016*

Figure 1a depicts regional variations in OOSC. The Northern states had the highest percentages of OOSC, while the Southern states had the lowest. Particularly, Bauchi, Gombe, Jigawa, Taraba, Sokoto, and Adamawa states recorded OOSC levels exceeding 39.57%. These states are all located in the poor and rural Northern region, which is known for high levels of exclusion from education. On the other hand, most Southern states had considerably lower OOSC percentages. The low rates of OOSC in Southern Nigeria can be partly explained by greater investments in education and by the overall better economic situation of this part of the country (Wong, 2025). Although most Southern states are in a far better position when it comes to education, they are yet to achieve 100% enrolment. This could be due to population increase, rising cost of living, and under-resourced schools, which could lead to a decline in enrolment rate, especially for the most vulnerable categories of children, like those from low-income families (Edema, 2024).

4.1.2. *Moderate Change but Persistent Spatial Inequality in OOSC in 2018*

Although the shape of Nigeria's education map in Figure 1b for 2018 has changed slightly, it has, by and large, remained static. In other words, there has been little change in the geographical distribution of OOSC. Most states in Northern Nigeria still occupied the highest categories. However, for 2018, a couple of states, especially Ogun, Ondo, Ekiti, Edo, Enugu, and Cross River, from the South that were able to maintain a low prevalence of OOSC in 2016 have now risen slightly, in the range of 24.62% to 39.57%. These changes are minor

in the grand scheme of the persistent prevalence of OOSC in the Northern States, as this region still very much dominates the highest categories of OOSC. Sokoto and Taraba still fall above the 39.57% range, extending to Plateau state. The continued prevalence of OOSC in the Northern region signifies systemic issues that prevent children's access to education, such as poor school infrastructure, low household income, and insecurity.

On the positive side, the 2018 map demonstrates that some states in the Northeast, especially Adamawa, Bauchi, Gombe, and Jigawa made progress in decreasing the OOSC percentages, but they did not match up to some of the more developed Southern states. The OOSC percentage in 2018 did show some improvement in certain areas, but the country's educational divide continued to be a major problem. The increased OOSC in some of the Southern states is an indication that even in the more developed states, problems continue to arise to deter children from going to school, often in the form of overcrowded schools, inadequate teaching staff, or economic factors that prevent children from attending school regularly (Edema, 2024).

4.1.3. Intensified Spatial Concentration of OOSC in 2022

The 2022 map (Fig. 1c) shows a marked shift in the geographical pattern of OOSC, typified by improvement in some parts of the South and intensified concentration in the Northern region. The most glaring change from previous maps is the decline of OOSC in many of the Southern states. For instance, Lagos, Ekiti, Bayelsa, Imo, Cross River, and Enugu now exist in a much lower OOSC range ($< 9.66\%$), suggesting a positive outcome of years of intervention and investment in education (Wong, 2025). However, despite some improvement in the South, the Northern region continues to face an overwhelming challenge. States like Sokoto, Zamfara, Yobe, and Borno maintain OOSC levels that are way beyond the average ($> 39.57\%$), expanding to Kebbi, Katsina, Niger, Jigawa, Bauchi, and Gombe, forming a contiguous zone of educational exclusion across the Northwest and Northeast. These states continue to be affected by challenges that have impeded educational attainment for decades—poverty, insecurity, and socio-cultural norms. While there are indicators of improvement in some Northern states, such as Plateau and Taraba, these states remain in the middle range (24.62 – 39.57%) of OOSC, hinting that there are still obstacles to educational access.

4.2. Global Geographical Pattern of OOSC in Nigeria

Table 1 1 presents the results of the Global Moran's I for 2016, 2018, and 2022. All the years have a "Clustered" pattern, which means that adjacent states have similar values of OOSC. However, the magnitudes of Moran's I, Z-score, and p-value show significant temporal changes in the strength and intensity of spatial clustering. In 2016, Moran's I was 0.116. This low but positive value indicates a weak positive spatial autocorrelation. It suggests that the regions with high or low values of OOSC are somewhat spatially clustered, but not strongly so. The Z-score of 0.853 suggests a modest deviation from spatial randomness. The p-value of 0.03 indicates statistical significance. However, the relatively low Moran's I value and Z-score suggest that the clustering of OOSC in 2016 was present but not strongly

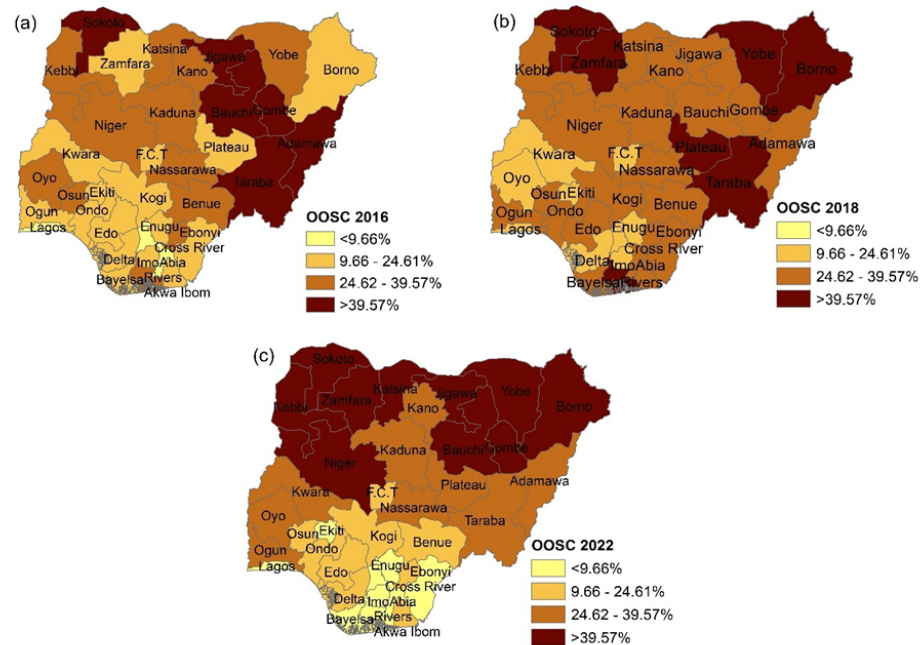


Figure 1: Geographical Distribution of OOSC in Nigeria

pronounced across the country.

In 2018, Moran's I rose to 0.174, indicating a higher degree of spatial autocorrelation. The Z-score of 1.982 exceeds the critical value threshold (approximately ± 1.96 for 95% confidence), implying statistically significant clustering of OOSC values. The p-value of 0.04 also supports this interpretation. The change in Moran's I from 0.116 to 0.174 reflects an intensification of the spatial structure in the OOSC data. In 2022, Moran's I increased sharply to 0.721, reflecting a substantial intensification of spatial dependence in the distribution of OOSC. The high Z-score of 7.054 indicates a very strong deviation from randomness, with the p-value of 0.000 confirming a highly statistically significant clustering pattern.

Overall, these results point to a trend of growing and intensifying spatial concentration in the distribution of OOSC over time. Spatial clustering was present in 2016, but to a greater degree and with a more spatially entrenched pattern in 2022. The upward trend in Z-scores, and consistently low p-values over time, points to a disturbingly growing concentration of educational exclusion in particular areas of the country.

Table 1: Global Patterns of OOSC in Nigeria

Year	Moran's I	Z Scores	P-value	Remark
2016	0.116	0.853	0.03	Clustered
2018	0.174	1.982	0.04	Clustered
2022	0.721	7.054	0.00	Clustered

Notes: Significance at: 0.05

4.3. Local Geographical Patterns of OOSC in Nigeria

4.3.1. *Emergence of North-South Clusters in OOSC in 2016*

Figure 2a reveals stark regional disparities in the distribution of OOSC in Nigeria. In 2016, the clustering of OOSC data highlights significant north-south disparities that are characteristic of the educational divide in Nigeria. The High-High (HH) cluster appears to be centered around Northern Nigeria, especially in Bauchi and Gombe. These two states are in themselves observed to have high values of OOSC but, in addition, are spatially surrounded by other states with comparably high values of OOSC, creating a pattern of spatial concentration of educational exclusion. The HH cluster thus serves to indicate the severity of the OOSC crisis in Northern Nigeria, influenced by socio-economic and political factors. However, an exception can be made for Plateau State. The Low-High (LH) outlier in Plateau State indicates that, while the state may fare better in terms of OOSC than its neighboring states due to localized or state-specific strategies, it is still not necessarily immune to the north-centric crisis in education and may need intervention before being plagued by educational exclusion.

Conversely, most of the Southern states, predominantly in the Southeast, South-South, and some parts of the Southwest, are in the Low-Low (LL) cluster. Ondo, Edo, Delta, Imo, Enugu, Anambra, Abia, and Cross River are states with low percentages of OOSC, and these states are surrounded by others that also show relatively low OOSC rates. The high concentration of LL clusters in Southern Nigeria supports the claim that the educational outcomes in this region are not as affected by the systemic issues that mar the situation in the North. However, there were few High-Low Outliers (HL) in Osun and Rivers states, that is, states with high OOSC values surrounded by low OOSC values. This pattern could suggest some state-specific issues or localized socio-economic problems driving the OOSC crisis.

4.3.2. *Transitional Shifts and Emerging Polarization of OOSC in 2018*

By 2018, the geography of OOSC had evolved further (Fig. 2b). The HH cluster had expanded eastwards to include Borno and Plateau states. The former in particular had become a new epicenter of the education crisis, a phenomenon that paralleled the spread of violent conflict and mass population displacement in this part of the country. Like Borno state, the intensification of insecurity and conflict, especially the farmer-herder conflict and the wide poverty ravaging the Northern region in general, has been documented to discourage school enrolment in Plateau state (Vwamse et al., 2023; Linus et al., 2024), and this may explain its shift from LH outlier in 2016 to HH cluster in 2018. Southern Nigeria, by contrast, appears to be relatively well insulated from this educational exclusion that characterizes the North, as revealed by the consistent LL clusters. Nevertheless, this does not mean that Southern states are totally free from the crisis of OOSC. For instance, the appearance of an additional HL outlier in Ogun state indicates that the Southern region, which was previously performing better, now faces rising OOSC rates. These outliers point to new challenges, such as overcrowded schools and potential strain on resources, that may be starting to affect educational access in these Southern areas (Ogunrobokin et al., 2023).

4.3.3. *Entrenchment of North-South Divide in OOSC in 2022*

Figure 2a reveals a further spatial reconfiguration in OOSC clustering. There was a development of a large High-High (HH) cluster in the Northwest corner of the country, where Sokoto, Zamfara, and Kebbi have all joined. This could be the result of widening educational inequality in the North, arising from a confluence of persistent insecurity, socio-cultural factors, and structural/infrastructural obstacles. Compared to previous years, the HH cluster has receded from the Northeast and the Northcentral of the country towards the Northwest. The LL cluster, meanwhile, has remained relatively strong in the Southern region, and has even expanded to include an increased number of states, such as Ebonyi, Enugu, Bayelsa, Imo, Abia, Anambra, Edo, Delta, Osun and Cross River. The most visually striking change on the 2022 map is the elimination of the HH clusters that had been a consistent feature of the Northeast and Northcentral in previous years, especially in Borno and Plateau states. Both states, notable for their high numbers of OOSC in 2018, are now labeled "Not Significant" (NS) in terms of spatial clustering. This does not necessarily mean that there has been a sudden, radical decline in the number of OOSC, but rather a weakening of spatial correlation between these states and their neighbors. This shift may be due to the targeted education-in-emergencies initiative, such as accelerated learning and teacher support programs implemented in Borno State with support from UNICEF and the Partnership for Learning for All in Nigeria (PLANE), which aim to bring displaced and vulnerable children into learning opportunities despite ongoing conflict Partnership for Learning for All in Nigeria (2025). In Plateau state, initiatives focused on reducing travel distance to schools by building new classroom blocks, improving educational facilities and water sanitation and hygiene infrastructure (WASH), and implementing Education Management Information Systems (EMIS) that better track school enrollment, plan resources, and ensure that underserved areas are identified for targeted interventions (Ifeanyi, 2025) may explain a drop in OOSC in 2022.

The complete lack of HL and LH outliers in the 2022 map also adds to the sense that the OOSC landscape is becoming more polarized. In other words, states are increasingly either a part of a broader regional cluster of high or low OOSC prevalence or show no evidence of meaningful spatial clustering. The disappearance of outlier states may be a sign of consolidation of regional dynamics: success or failure in educational outcomes is increasingly shaped by the situation in neighboring states instead of isolated state-level policies. This further suggests that tackling the issue of OOSC requires not only state-specific policies but also region-specific measures.

4.4. Hot and Cold Spots of OOSC in Nigeria

4.4.1. *Regional Disparities and Emerging Cold Spots in the North in 2016*

Figure 3b shows a pronounced geographic divide that mirrors the country's longstanding regional disparities in education. Hot spots were seen to be highly significant in Jigawa, Plateau, Bauchi, Gombe, and Adamawa in northern Nigeria. In contrast, most of the states in the Southern region emerged as cold spots. The other interesting feature in the 2016 map was the appearance of OOSC cold spots in a few states in the Northcentral region (Kwara

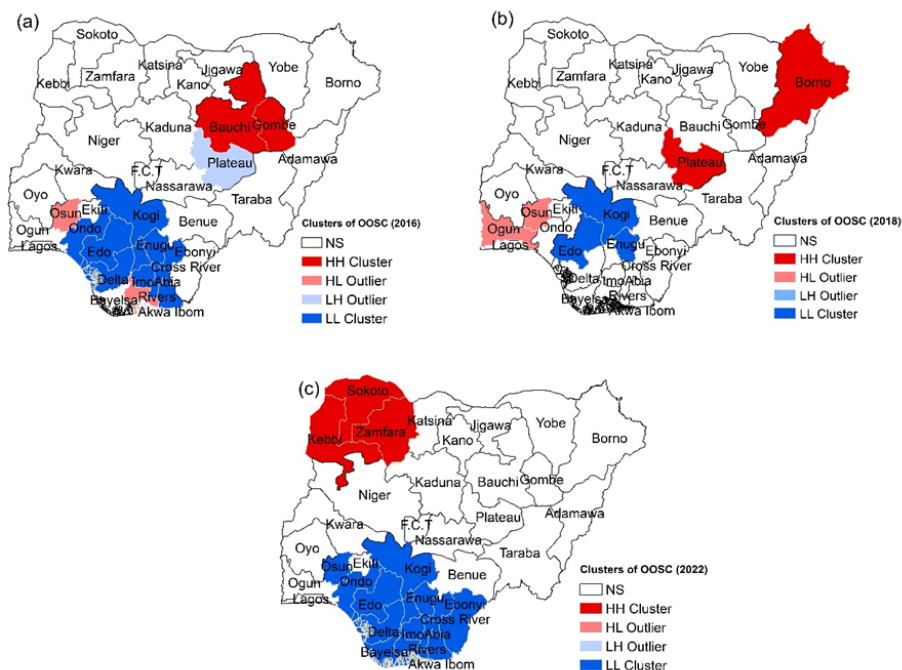


Figure 2: Clusters of OOSC in Nigeria

and Kogi), an indication that these states were starting to demonstrate patterns like the South in school enrollment. Large areas of the country, however, were denoted as “Not Significant,” which is evident in the Northcentral and parts of the Northwest. This pattern indicates either weak clustering or insufficient deviation from the national average, revealing areas where OOSC prevalence was high but not statistically concentrated. This underlines the need for localized interventions beyond mere regional categorizations.

4.4.2. Polarization and the Rise of Statistically Significant Hot Spots in 2018

Figure 3b shows that by 2018, the spatial distribution of OOSC had not only consolidated but also slightly changed its location. First, the expansion of hot spots into the far North of the country, especially Sokoto, Yobe, Borno, and Zamfara, at 99% confidence level has expanded the set of states facing the problem of educational exclusion. The transition of these states from a “not significant” category in 2016 to hot spots in 2018 further highlights the worsening situation of OOSC in Northern Nigeria. While the Northeastern part of Nigeria remained the epicenter of the OOSC crisis, the spread into the Northwest suggests a more deeply rooted and widespread challenge that had extended to a wider part of Northern Nigeria. A similar degree of consolidation was also visible in the South as the region’s cold spots had also shrunk in 2018. While States like Edo, Ondo, and Osun, managed to maintain their cold spot status, a good number of South-South and Southeast states that were previously in the cold spot region, such as Delta, Bayelsa, Enugu, Imo, Anambra, Ebonyi, and Cross River, no longer appear to enjoy such status. This suggests the possibility of the emergence of new pockets of educational exclusion in a region that was hitherto overall a region of

good performance. Northcentral remained a region of weak clustering in 2018, indicating a lack of homogeneity in its performance. States in this region, particularly Plateau and Kogi, showed dynamism by moving up and down between significant and non-significant levels. This could be reflective of the region's transitional nature, which is possibly affected by a volatile socio-political context, migratory patterns, or even uneven policy implementation (Vwamse et al., 2023; Linus et al., 2024), all of which could be influencing its educational outcomes.

4.4.3. *Entrenched Hotspot Clustering and Southern Resilience in 2022*

Figure 3c further illustrates the increasing concentration and aggravation of OOSC hot spots in Northern Nigeria. The high-confidence hot spot band now stretches along a continuous Northern corridor from Sokoto in the far Northwest to Borno in the far Northeast. Virtually all states in the Northern corridor, especially Sokoto, Zamfara, Kebbi, Katsina, Jigawa, Yobe, Borno, Bauchi, and Gombe had 95% to 99% confidence hot spots (Figure 3c). This implies that the incidence of OOSC not only failed to subside over the years but also became even more severe in these parts of the country. The westward expansion of the high-confidence hot spots to include Kebbi and Katsina underscores the systemic failure to meaningfully respond to Northern Nigeria's educational deprivation over the years. The Northcentral region once again features as a statistical liminal zone, forming neither hot nor cold clusters. This may hint at underlying volatility or transitional dynamics in access to education in this subregion. The absence of significant clustering could also be telling of subregional disparities, where educational success in urban centers is not necessarily reflective of the situation in the rural peripheries.

The COVID-19 pandemic may have intensified the spatial concentration of out-of-school children observed in Northern Nigeria in 2022 through both immediate disruptions and longer-term post-pandemic effects (UNICEF, 2021; The World Bank et al., 2021). Prolonged school closures, disruptions to household livelihoods, and uneven access to remote learning during the pandemic have been widely documented to exacerbate pre-existing educational inequalities, with evidence suggesting that these effects persisted beyond school reopening periods, particularly in contexts characterized by poverty, insecurity, and limited digital infrastructure, such as Northern Nigeria (Azubuike et al., 2021; Kim and Ogawa, 2024).

However, in Southern Nigeria, the cold spots remained stable and have become more spatially cohesive. South-South and Southeast were both consistently identified as cold spots at 95% or 99% confidence, and individual states such as Edo, Delta, Rivers, Akwa Ibom, and Cross River stand out within these regions. This relative stability, in spite of wider national challenges, could suggest the development of more resilient educational systems in some states and improved digital infrastructure in Southern Nigeria that promotes e-learning (Olanrewaju et al., 2021; Omotoso et al., 2025). Beyond the pandemic, between 2016 and 2022, persistently high OOSC rates in Northern Nigeria reflected deepening socio-economic and security-related pressures. Economic recession, rising inflation, and chronic poverty have been documented to constrain households' capacity to meet the indirect costs of schooling (Kazeem et al., 2010; Kukawa et al., 2025), leading many families to prioritize child labor and informal livelihoods (Liman et al., 2020). At the same time, escalating insecurity, char-

acterized by insurgency in the North-East and increasing banditry and school kidnappings in the North-West, has been shown to undermine access to safe education (Bertoni et al., 2019). These dynamics disproportionately affected rural areas, girls, and vulnerable households (Targba and Ribah, 2025), which may have produced sustained educational exclusion by 2022.

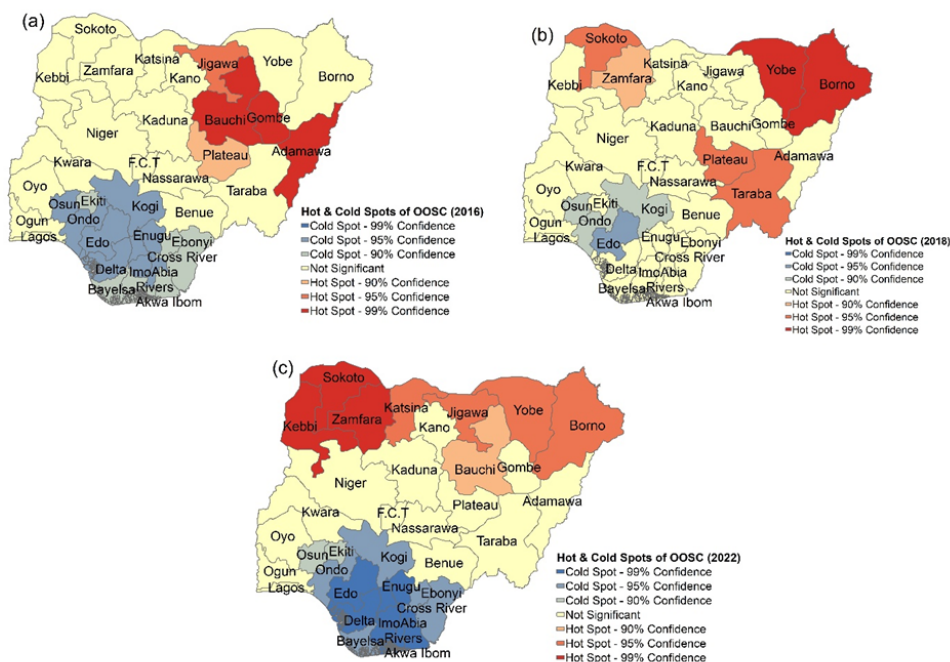


Figure 3: Hot and Cold Spots of OOSC in Nigeria

5. CONCLUSION

The spatial and temporal distribution of OOSC in Nigeria revealed a complex story. On one hand, Nigeria's educational landscape continued to be defined by a north-south divide, with the Northern States consistently exhibiting high rates of OOSC, particularly the Northwest and Northeast. This is consistent with the historical and contemporary challenges facing the Northern region in terms of access to education. Conversely, an emerging pattern began to take shape in the South-South and South-East. These regions seemed relatively sheltered from the harshest extremes of educational exclusion. The emergence of HL Outliers and LH Outliers, however, in Southern Nigeria was an indication that the states of this region were also not left untouched by the crisis of OOSC. This may reflect new pressures on the Nigerian education system, including rapid urbanization, limited educational resources and infrastructure, and other socio-economic factors. While the traditional north-centric crisis in educational exclusion remains the most visible and urgent issue, there were indications of a more dynamic and evolving educational landscape. In terms of policy and intervention, these trends might indicate the need for nuanced and context-specific strategies that consider the barriers and opportunities for education within different parts of Nigeria.

Moreover, the clustered pattern of OOSC across years of study confirms that spatially targeted interventions, as opposed to generalized ones, are key to addressing the issue of OOSC in Nigeria. The existence of strong regional concentrations of OOSC makes it highly unlikely that interventions that are uniform across space (national level) will have any impact on the problem. While the Nigerian government is making efforts toward addressing the crisis of OOSC in Northern Nigeria, it is far too little and with a blanket approach. Temporal analysis adds policy value by showing how educational exclusion evolves rather than merely where it is concentrated. For instance, the persistent and intensifying high-high clustering in the Northwest and Northeast over multiple years signals deep structural barriers that require sustained, long-term interventions, such as consistent and adequate education funding; efforts to address the root causes of poverty and insecurity; community-based engagement to challenge socio-cultural norms that discourage schooling; and longer-term investments in the digitalisation of education, not short-term enrolment campaigns. The movement of Plateau and Borno States to “not significant” clustering reflects spatial detachment from neighboring states, pointing to the need for more localized policies. In other words, context-specific interventions are required to help Nigeria emerge from the quagmire of disparities in educational outcomes, with the federal and state governments carrying the obligation of ensuring that every child can learn. Despite the strength of this study, it has some limitations. First, this study does not include 2020 as an observation year due to data unavailability at the state level, likely associated with widespread COVID-19-related disruptions. Second, this study is largely descriptive, drawing on existing studies to contextualize observed patterns in OOSC in Nigeria. However, future studies could build on this by employing spatio-temporal modeling to examine the predictors of OOSC over time.

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