

THE IMPACT OF SUBSURFACE EROSION ON BUILDINGS IN BIDA LOCAL GOVERNMENT, NIGER STATE

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ABSTRACT

The stability of building foundations is threatened by soil erosion that occurs in areas where the terrain is prone to erosion by water and wind. This paper examines the effect of erosion on building structures below ground level in Bida Local Government, Niger State, Nigeria. The study employed a mixed-method approach using structured questionnaires and field observation checklists as instruments of data collection, with a total of 120 buildings sampled across three erosion-prone areas in Bida Local Government. Through field surveys, soil analysis, and interviews with stakeholders, the study determined the magnitude of subsurface damage resulting from erosion and its socio-economic impact on local residents. The results show that buildings in the erosion-prone areas are characterized by high subsidence and structural instability, with repair costs on the increase. The paper recommends that better drainage systems, soil stabilization methods, and erosion-resistant materials be adopted in construction to reduce future damage. These measures are crucial for maintaining building structural integrity and the safety of residents in Bida Local Government.

Keywords: Erosion, Subsurface Damage, Building Foundations, Soil Stabilization, Bida Local Government Area.

INTRODUCTION

Soil erosion has become one of the most pressing environmental problems in many parts of Nigeria, and Bida Local Government Area in Niger State is no exception. Over the years, residents and property owners in the area have watched helplessly as erosion gradually damaged the foundations of their buildings, with some structures developing serious cracks while others have become completely uninhabitable.

This problem has drawn the attention of local authorities, engineers and researchers alike, as the consequences go beyond just physical damage to buildings. When erosion eats into the subsurface soil beneath a building, it removes the support that holds the foundation in place, eventually causing the structure to sink, tilt or even collapse (Ahmed et al., 2020; Olorunfemi et al., 2021).

A number of factors have been found to worsen the erosion situation in Bida. The town sits on terrain that naturally encourages water runoff, and this is made worse by the fact that drainage channels in many areas are either poorly designed or completely absent. Deforestation and uncontrolled land clearing for building construction have also removed much of the vegetative cover that would otherwise hold the soil together. In areas with heavy surface water runoff, the damage to building foundations tends to be far more severe. As Oke (2019) observed, soil erosion leads to a gradual and often irreversible loss of structural integrity in buildings, which can leave property

owners facing enormous repair bills or forcing them to abandon their homes altogether (Adedeji & Oladipupo, 2020).

It is against this background that this study was carried out to assess the extent of subsurface erosion damage to buildings in Bida LGA. The study also looks at the relationship between soil erosion and the stability of building foundations, and makes practical recommendations that can help reduce future damage. The findings of this study are expected to be useful to residents, building engineers, urban planners and government officials who are working to find lasting solutions to erosion problems in Bida and other communities facing similar challenges (Bello & Bamidele, 2018).

METHODOLOGY

To carry out this research, both quantitative and qualitative methods were used in collecting data. Three areas within Bida LGA were purposely selected for the study, namely Area 1 (Masaga), Area 2 (Anguwan Waziri), and Area 3 (Bida Central). These areas were chosen because they have a well-known history of erosion problems and are located close to major drainage channels that tend to worsen the situation during the rainy season. Altogether, 120 buildings were sampled across the three areas. Structured questionnaires and field observation checklists were the main tools used in collecting data. The people who participated in the study included local residents, property

owners, building engineers, and urban planners who are familiar with the erosion situation in Bida LGA.

Field Surveys. Field inspections were carried out across all three areas to document visible erosion damage including foundation cracks, wall tilting, and ground subsidence. Findings were compared across the three locations.

Soil Analysis. Soil samples were collected from beneath affected buildings and tested in the laboratory for cohesion, moisture content, permeability, and erosion liability — all key factors influencing the rate of erosion and its impact on foundations (Nwankwo & Igwe, 2019).

Interviews. Face-to-face interviews were held with selected individuals across the three study areas. Those interviewed included local residents, property owners, building engineers and urban planners who have direct experience with the erosion problem in Bida LGA. An

interview guide prepared in line with the objectives of the study was used to ensure that discussions remained focused and consistent. Only people who agreed to take part voluntarily were interviewed (Emeka & Obinna, 2022).

Data from all three methods were analysed to determine the level of subsurface instability and to identify viable mitigation measures.

RESULTS AND DISCUSSION

Out of the 120 buildings examined, about 40 percent showed clear signs of erosion-induced damage. The worst affected buildings were in areas with weak, moisture-saturated soil. Common problems observed included wall cracks, uneven floors, tilting structures, and ground subsidence — all signs of serious structural instability. Table 1 shows the damage distribution across the three study areas.

Table 1: Damage Due to Erosion in Bida LGA

Area	No. of Buildings Affected (%)	Type of Damage	Soil Composition
Area 1 (Masaga)	54 (45%)	Foundation cracks, Subsidence	Weak cohesion, High moisture
Area 2 (Anguwan Waziri)	36 (30%)	Uneven floors, Tilting	Moderate cohesion, Moderate moisture
Area 3 (Bida Central)	30 (25%)	Cracks, Settling	Poor cohesion, High erosion potential

Laboratory tests confirmed poor soil cohesion in the most affected areas, making the soil easily displaced by water. This creates voids beneath foundations and causes uneven settlement. The absence of adequate drainage in many

parts of Bida further accelerates the process during heavy rainfall. Detailed soil analysis results are shown in Table 2.

Table 2: Soil Analysis Results Across Study Areas in Bida LGA

Area	Cohesion Level	Moisture Content	Permeability	Erosion Liability
Area 1 (Masaga)	Weak	High	Low	High
Area 2 (Anguwan Waziri)	Moderate	Moderate	Moderate	Moderate
Area 3 (Bida Central)	Poor	Low	High	Very High

These findings are consistent with previous studies linking weak soil to higher erosion risk (Adedeji & Oladipupo,

2020). The study also found notable economic impacts — business owners reported declining customers as roads and

walkways deteriorated from subsidence. Erosion thus affects livelihoods as well as buildings (Aliyu & Garba, 2023). Table 3 presents the socio-economic impacts reported by participants. Taken together, the results of the soil tests and the field survey leave no doubt that subsurface erosion is a serious and growing threat to the

safety of buildings in Bida LGA. While natural factors such as rainfall and soil type play a role, the lack of proper planning and infrastructure has clearly made the situation worse. Many of the affected areas have no erosion control structures in place, and this has left buildings completely exposed to the damaging

Table 3: Socio-Economic Impact of Erosion on Residents and Property Owners in Bida LGA

Impact Category	No. Respondents	Percentage (%)	Severity Level
Rising repair costs	98	81.7%	Very High
Displacement / Relocation	74	61.7%	High
Decline in property value	87	72.5%	High
Loss of business / income	65	54.2%	Moderate
Psychological distress	52	43.3%	Moderate

effects of water movement underground. This observation is supported by Bello & Bamidele (2018), who noted that communities without adequate erosion control measures suffer far greater and longer-lasting structural damage.

Table 4 shows the mitigation strategies that stakeholders in the study areas considered most effective and most urgently needed.

Table 4: Stakeholder Perception of Erosion Mitigation Strategies in Bida LGA

Mitigation Strategy	Respondents Supporting (%)	Perceived Effectiveness	Priority Ranking
Improved drainage systems	108 (90.0%)	Very High	1st
Soil stabilization techniques	96 (80.0%)	High	2nd
Erosion-resistant building materials	84 (70.0%)	High	3rd
Gabion walls and retaining structures	78 (65.0%)	High	4th
Public awareness campaigns	60 (50.0%)	Moderate	5th

CONCLUSION

This study has shown that subsurface erosion is not just an environmental issue in Bida LGA — it is a direct threat to the safety of people's homes and the economic wellbeing of the entire community. The evidence gathered from the three study areas makes it clear that urgent action is needed. Buildings are cracking, foundations are sinking, and residents are being displaced, yet many areas still have no proper drainage or erosion control structures in place. If this situation is left unaddressed, the damage will only continue to get worse. The good news is that practical and proven solutions exist. When drainage systems are improved, soil is properly stabilised, and erosion-resistant

materials are used in construction, the rate of damage can be significantly reduced and buildings in Bida LGA can be made much safer for the people who live in them.

RECOMMENDATIONS

Based on what was found during this study, the following steps are recommended to help reduce the damage that soil erosion is causing to building foundations in Bida LGA:

1. Enhanced Drainage Systems. One of the most important things that can be done to reduce erosion in Bida LGA is to put proper drainage systems in place. At the moment, rainwater has no clear path to flow away from buildings, and this is a major reason why

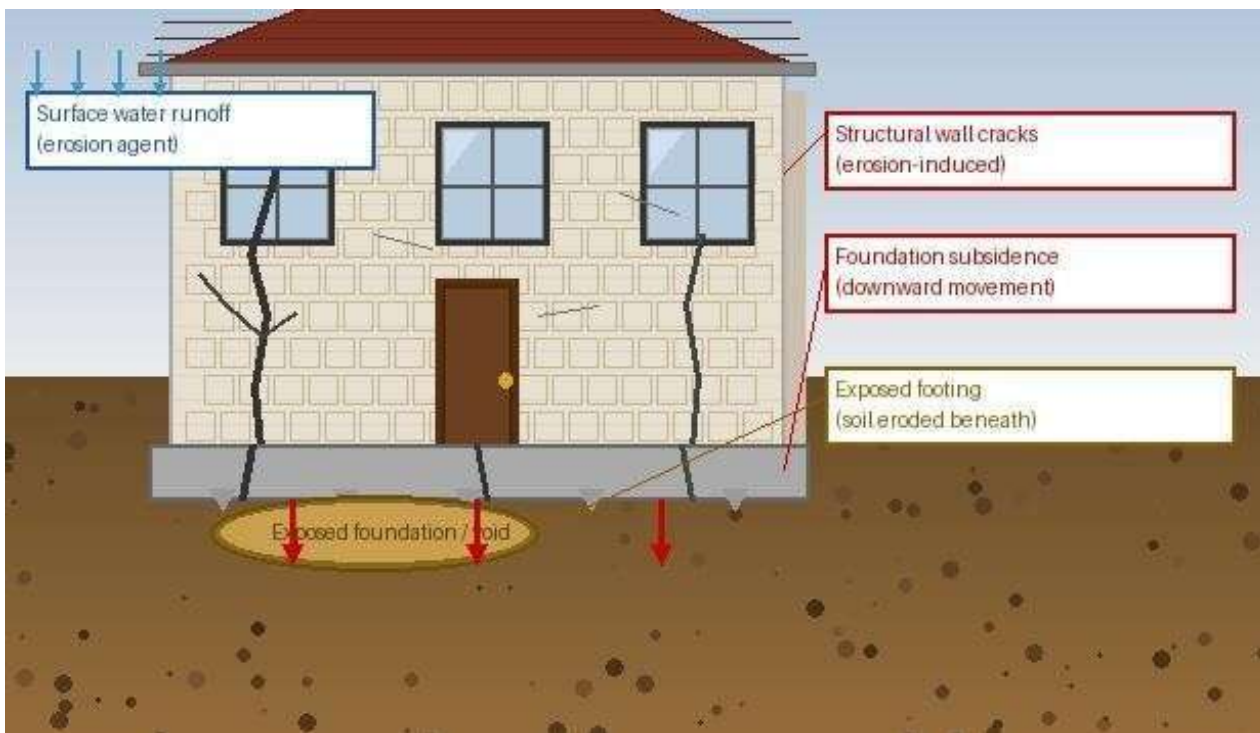


Figure 1: Dilapidation of Building Foundation due to Subsurface Erosion, Bida LGA.

Note: Wall cracking, foundation subsidence and void formation due to soil displacement due to runoff.



Figure 2: Gabion Retaining Wall as an Erosion Control Measure, Bida LGA.

erosion is so bad in certain areas. Gutters, drains and culverts that are properly designed and regularly maintained should be constructed to guide water away from building foundations before it has a chance to wash the soil away (Ibrahim & Musa, 2020).

2. Soil Stabilization. Soil stabilization techniques including afforestation, geotextile materials and ground reinforcement should be adopted to strengthen weak soils and improve foundation stability (Emeka & Obinna, 2022).
3. Erosion-Resistant Materials. Reinforced concrete and deep foundation pilings should be used in erosion-prone areas to withstand soil movement and prevent structural failure (Okeke & Nwosu, 2021).
4. Public Awareness and Education. Government agencies and community leaders should organise campaigns to educate residents on how activities such as waste dumping in drains and deforestation worsen erosion, and how to adopt sustainable building and land-use practices.
5. Erosion Control Structures. Physical barriers such as gabion retaining walls should be erected in areas where erosion is already severe. These walls, when properly installed with drain gravel, geotextile fabric and

compacted soil layers, are effective at holding back eroding soil and redirecting underground water flow. Additionally, drainage channels should be constructed to carry surface water away from buildings during

heavy rain. When all these measures are put in place together, they can make a real and lasting difference to the safety and lifespan of buildings across Bida LGA.

Figure 3: Six-Stage Mechanism of Subsurface Erosion and Its Effect on Building Foundations
Bida Local Government Area, Niger State, Nigeria

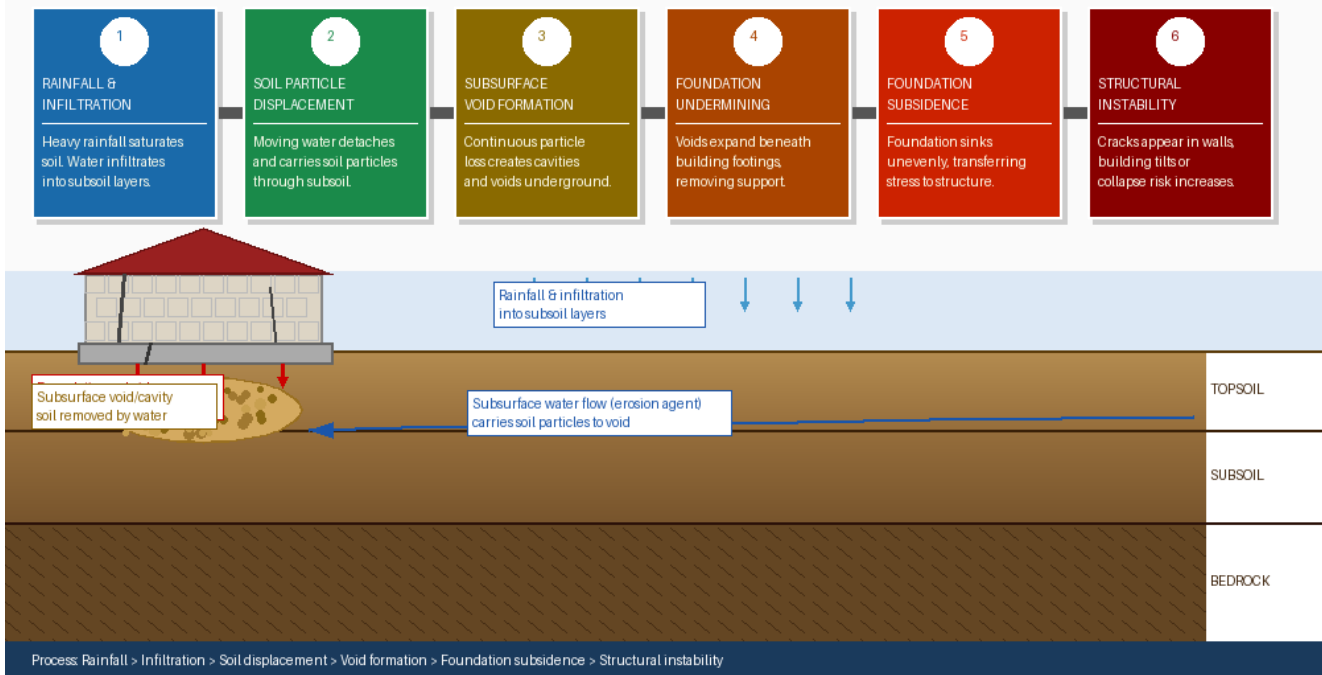


Figure 3: Six-Stage Mechanism of Subsurface Erosion and Its Effect on Building Foundations, Bida LGA.

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