ISSN: 1118-1790

INVESTIGATION OF THE LAND-USE AND VEGETATION CHANGES CAUSED BY THE CONSTRUCTION OF THE ATANI–OBOSI SECOND NIGER BRIDGE ACCESS ROUTE.

[2]Enukoha Chukwudi O., [1]Onwuka, Shalom U. and [1]Agbili Martin Onyedikachukwu.

[1]Department of Environmental Management, Faculty of Environmental Sciences, Nnamdi Azikiwe University, Awka.

[2]Obijackson Foundation, Umuezedam Road, Okija, Anambra State, Nigeria.

Corresponding Author's Email: chukwudiobinna8@gmail.com**; Phone: +2347032922506**

ABSTRACT

Transportation infrastructure is widely recognized as a catalyst for socio-economic development; however, its environmental consequences often include significant alterations in land-use patterns and vegetation cover. This study investigated the land-use and vegetation changes associated with the construction of the Atani–Obosi Access Route of the Second Niger Bridge in southeastern Nigeria. The study employed a geospatial approach integrating remote sensing, Geographic Information Systems (GIS), and field observations to evaluate environmental changes across the pre-construction, construction, and post-construction phases of the project. Multi-temporal satellite imagery covering the period between 2017 and 2024 was analysed to assess land-use transformation and vegetation dynamics. The findings revealed substantial conversion of natural vegetation, wetlands, and agricultural lands into transportation infrastructure and associated built-up developments. Vegetation degradation was particularly pronounced within the immediate corridor of the road, with over 75% of stressed vegetation occurring within 500 m of the road alignment during peak construction activities. The results demonstrate that road construction significantly altered ecological conditions within the study area through habitat modification, vegetation fragmentation, and increased anthropogenic pressure on previously undisturbed landscapes. The study concludes that while the access route has enhanced regional accessibility and economic integration, the resulting land-use transformation poses long-term ecological challenges. The study recommends the incorporation of ecological restoration measures, green infrastructure planning, and continuous environmental monitoring into future transportation projects. The findings contribute to the growing body of knowledge on infrastructure-induced landscape transformation and provide evidence for improving sustainable transportation planning in Nigeria.

Keywords: *Land-use change, Vegetation cover, Remote sensing, GIS, Transportation infrastructure, Second Niger Bridge, Sustainable development, Environmental management.*

ISSN: 1118-1790

1.0 INTRODUCTION

1.1 Background to the Study

Transportation infrastructure remains one of the most important drivers of economic growth, urban expansion, and regional integration. However, road construction projects often generate significant environmental changes through vegetation clearance, land conversion, habitat fragmentation, and ecosystem disturbance (Chen, Li, & Zhang, 2003; Deljouei et al., 2018). The increasing emphasis on sustainable infrastructure development has heightened the need for comprehensive assessments of the environmental implications of major transportation projects (Suprayoga, Witte, & Spit, 2020).

The Atani–Obosi Access Route of the Second Niger Bridge represents one of Nigeria's most strategic transportation investments. Constructed to improve connectivity and reduce traffic congestion within the southeastern transportation network, the corridor traverses environmentally sensitive wetlands, agricultural lands, riverine ecosystems, and rapidly urbanizing settlements. Preliminary observations indicated substantial vegetation clearance, modification of natural landscapes, and increasing developmental pressure within the corridor. Consequently, understanding the nature and extent of land-use and vegetation changes associated with the project is critical for sustainable environmental management and future infrastructure planning.

1.2 Statement of the Problem

Road construction projects are widely recognized as major agents of environmental change due to their direct and indirect impacts on land resources and vegetation systems. Previous studies have shown that road development contributes to vegetation degradation, habitat fragmentation, ecological disturbance, and alterations in landscape structure (Chen et al., 2003; Mansuroglu, Kinikli, & Yilmaz, 2010; Deljouei et al., 2018). Although these impacts are increasingly documented globally, empirical evidence from southeastern Nigeria remains limited.

The Atani–Obosi Access Route traverses environmentally sensitive landscapes characterized by wetlands, farmlands, natural vegetation, and riverine ecosystems. During construction, extensive land clearing and earthworks were undertaken to accommodate the road corridor, creating concerns regarding vegetation loss and ecological sustainability. Despite the strategic importance of the project, limited studies have quantitatively assessed the resulting land-use and vegetation changes. Existing Environmental Impact Assessments often focus on project approval requirements and short-term compliance rather than long-term environmental monitoring. Consequently, there is insufficient understanding of how the project has altered landscape composition and vegetation dynamics. Addressing this

ISSN: 1118-1790

knowledge gap is essential for sustainable transportation planning and environmental conservation.

1.3 Aim and Objectives

Aim

To investigate the land-use and vegetation changes caused by the construction of the Atani–Obosi Second Niger Bridge Access Route.

Objectives

1. To examine land-use and land-cover changes associated with the construction of the access route.
2. To assess vegetation dynamics within the study corridor before, during, and after construction.
3. To determine the extent of vegetation degradation associated with transportation infrastructure development.
4. To evaluate the environmental implications of observed land-use and vegetation changes.

2.0 LITERATURE REVIEW

Road infrastructure development frequently produces significant modifications to landscape composition and ecological processes. Direct impacts include vegetation removal, land consumption, habitat fragmentation, and alteration of natural drainage systems, while indirect impacts include urban expansion and changes in land-use practices (Mansuroglu et al., 2010).

Studies have demonstrated that transportation corridors can substantially influence vegetation dynamics. Chen et al. (2003) observed significant reductions in vegetation productivity adjacent to major transportation infrastructure, while Deljouei et al. (2018) reported alterations in vegetation structure and ecological integrity resulting from road development. Similar findings have been reported in tropical environments where infrastructure expansion accelerates land conversion and environmental degradation. Remote sensing and GIS techniques have become essential tools for monitoring land-use and vegetation changes because they provide spatially explicit information across different time periods. The Normalized Difference Vegetation Index (NDVI) is widely applied for assessing vegetation health and identifying changes in vegetation cover associated with human activities.

Despite growing international literature, studies focusing on infrastructure-induced land-use and vegetation changes in southeastern Nigeria remain scarce. The Atani–Obosi Access Route therefore provides an important case study for understanding the environmental consequences of large-scale transportation projects within ecologically sensitive environments.

ISSN: 1118-1790

3.0 METHODOLOGY AND STUDY AREA

3.1 Study Area

The study was conducted along the Atani–Obosi Access Route of the Second Niger Bridge located within Anambra State, southeastern Nigeria. The corridor traverses portions of Ogbaru and Idemili North Local Government Areas and links communities including Atani, Odekpe, Okpoko, and Obosi. The area is characterized by low-lying wetlands, agricultural lands, riverine environments, and rapidly expanding peri-urban settlements.

ISSN: 1118-1790

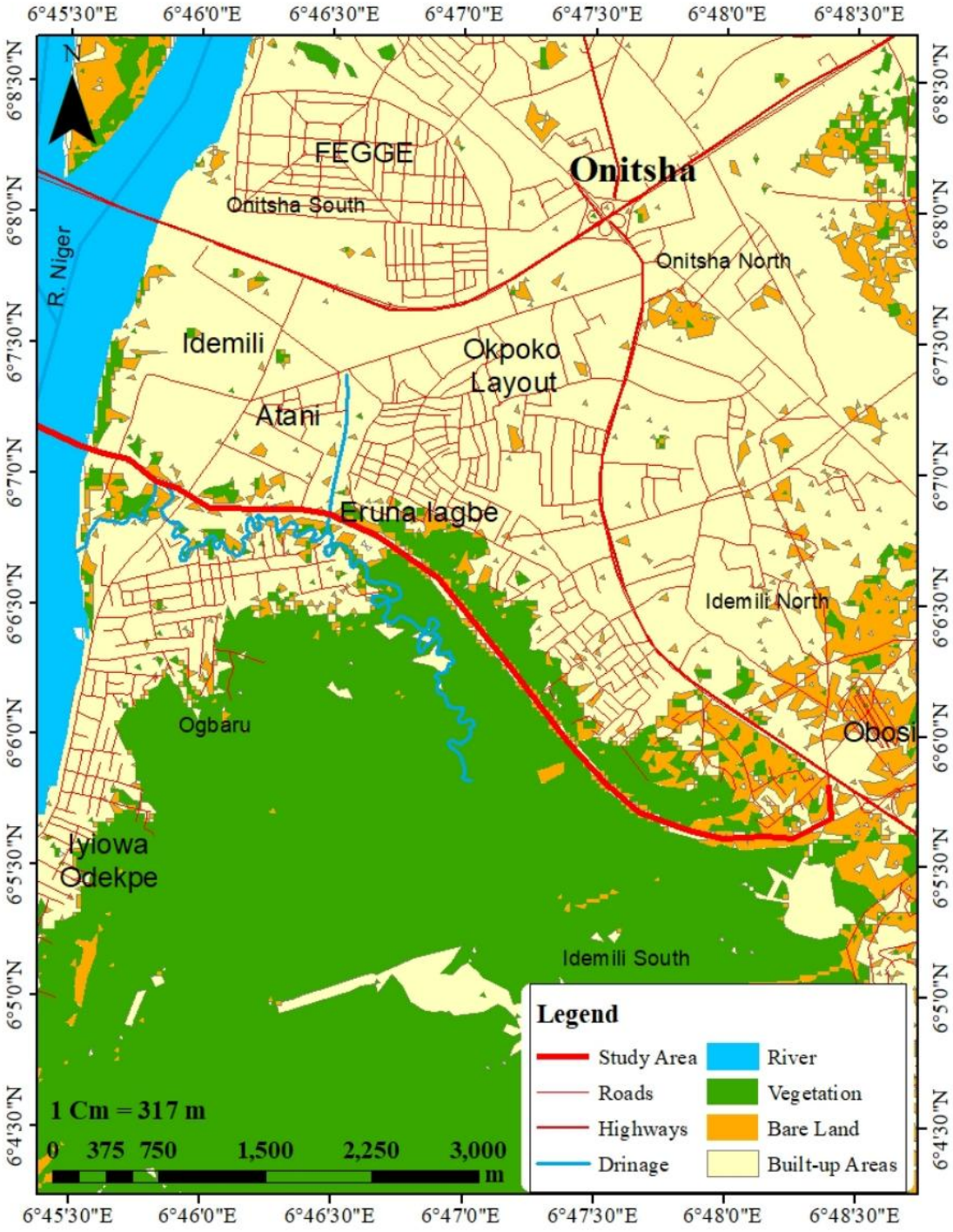


Figure 3. 1: Map of the Study Area.
Source: GIS Lab, Dept. of Survey and Geo-informatics, Nnamdi Azikiwe University, Awka; 2023.

ISSN: 1118-1790

3.2 METHODOLOGY

The study adopted a geospatial research approach integrating remote sensing and GIS analysis. Multi-temporal satellite imagery covering pre-construction, construction, and post-construction periods (2017–2024) was analysed. Satellite images were obtained from Landsat archives and processed to identify changes in vegetation cover and land-use categories.

Vegetation dynamics were assessed using NDVI analysis, while supervised image classification techniques were used to generate land-use and land-cover maps. The analysis focused on identifying transitions among vegetation, agricultural land, built-up areas, wetlands, and other land-use categories.

3.3 Ethical Considerations

The study utilized geospatial datasets and environmental observations. Where field information and stakeholder inputs were collected, participation was voluntary and based on informed consent. Data confidentiality and anonymity were maintained throughout the research process.

4.0 Data Presentation and Analysis

4.1 Investigate the land-use and vegetal cover changes caused by the construction of the access route

4.1.1 Landcover/ Landuse Changes Within the Construction Site.

The evaluation of land cover/land use changes within the construction area of the Atani-Obosi access route of the Second Niger Bridge in Anambra State reveals the extent of environmental transformations caused by the construction activities. The analysis is categorized into three phases: Before Construction (2017), During Construction (2018–2023), and After Construction (2024). Each phase is examined to highlight the impacts on specific land cover/land use classes, including bare ground, built-up areas, vegetation, and water bodies.

4.1.1.1 Before Construction (2017)

In 2017, the area was predominantly natural, with vegetation covering 1,401.060 hectares, making it the dominant land cover type. This suggests the area was largely undisturbed, supporting natural ecosystems and serving as a habitat for biodiversity. The built-up area accounted for 974.330 hectares, indicating limited infrastructure and minimal human development before the commencement of construction activities.

Water bodies occupied 36.029 hectares, maintaining their natural extent and providing ecological functions such as water retention, habitat for aquatic species, and microclimatic regulation. There was no recorded bare ground in 2017, which indicates the absence of any significant land clearing or construction activity at this time. The landscape was in its natural state, with minimal anthropogenic disturbance.

ISSN: 1118-1790

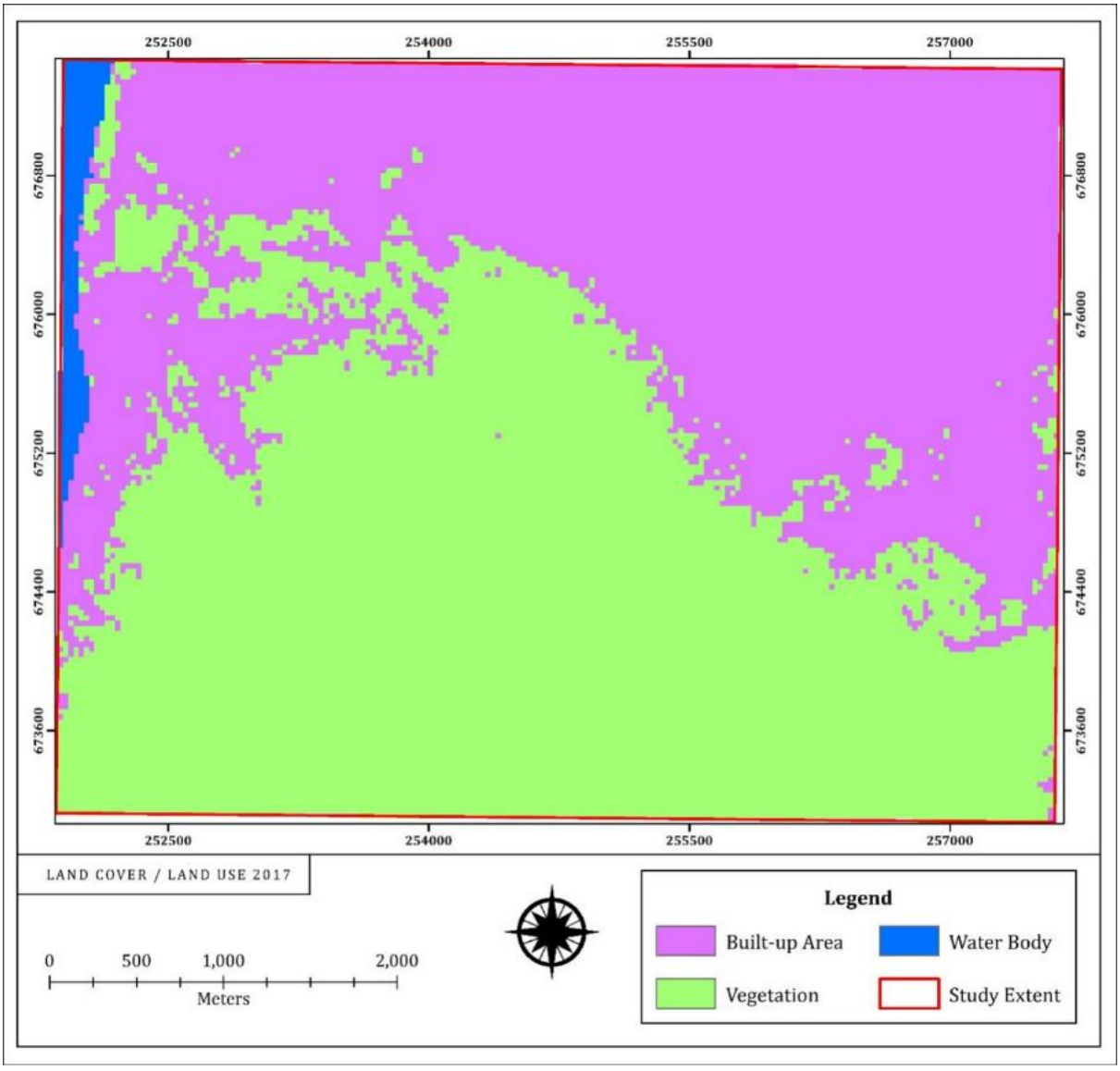


Figure 4.1: Landcover/Landuse Map of Construction Area 2017

4.1.1.2 During Construction (2018–2023)

The first significant change occurred in 2018, marked by the appearance of bare ground covering 89.562 hectares. This bare ground resulted from the clearing of vegetation and preparation of pathways for the construction of the access road.

The built-up area increased to 1,131.644 hectares, reflecting the early stages of infrastructure development, including road foundations and associated construction activities. Vegetation decreased to 1,323.458 hectares, showing the initial impact of land clearing for construction purposes.

The extent of water bodies reduced slightly to 30.211 hectares, possibly due to the

ISSN: 1118-1790

encroachment of construction activities near watercourses or changes in drainage patterns caused by land clearing.

By 2020, the bare ground had been reduced significantly to 6.617 hectares, as much of the previously cleared areas were now being converted into permanent road infrastructure. The built-up area saw a slight increase to 1,136.150 hectares, as construction activities progressed and more infrastructure, such as roadways and ancillary facilities, was completed.

Vegetation continued to decline marginally to 1,322.518 hectares, indicating the sustained clearing of natural areas to accommodate ongoing construction. Water bodies increased slightly to 32.517 hectares, possibly due to changes in runoff patterns or temporary ponding caused by construction activities.

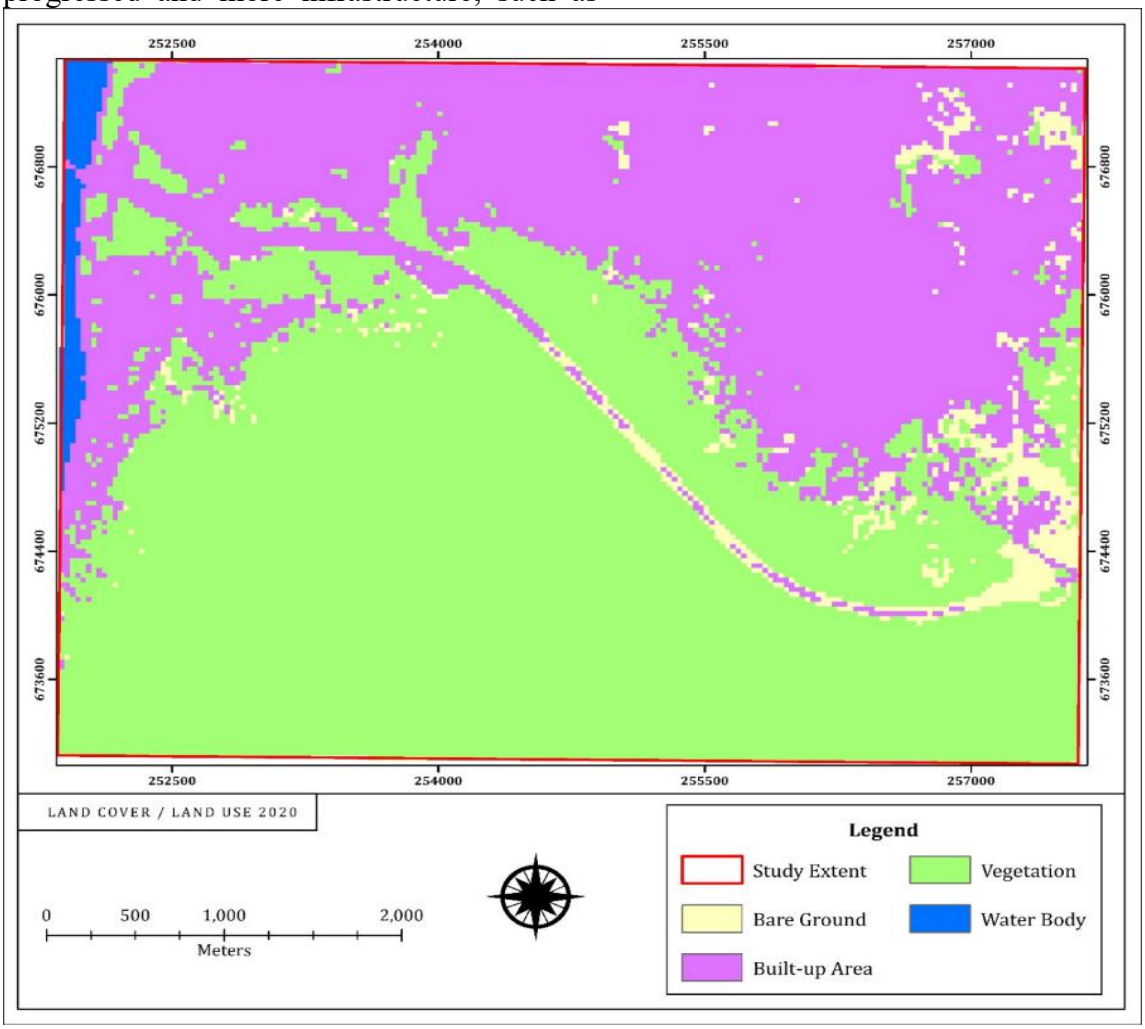


Figure 4.2: Landcover/Landuse Map of Construction Area 2020

By 2023, no bare ground was recorded, as all previously cleared land had been converted into built-up areas. This indicates the nearing completion of the access road and associated

ISSN: 1118-1790

infrastructure. The built-up area expanded significantly to 1,393.613 hectares, reflecting the final stages of construction and the integration of cleared land into the developed road network and facilities.

Vegetation declined sharply to 1,070.759 hectares, showing the cumulative impact of years of construction on the natural environment. This represents a significant loss of natural cover compared to pre-construction levels. Water bodies remained relatively stable at 31.313 hectares, indicating that construction activities had minimal direct impact on aquatic features by this stage.

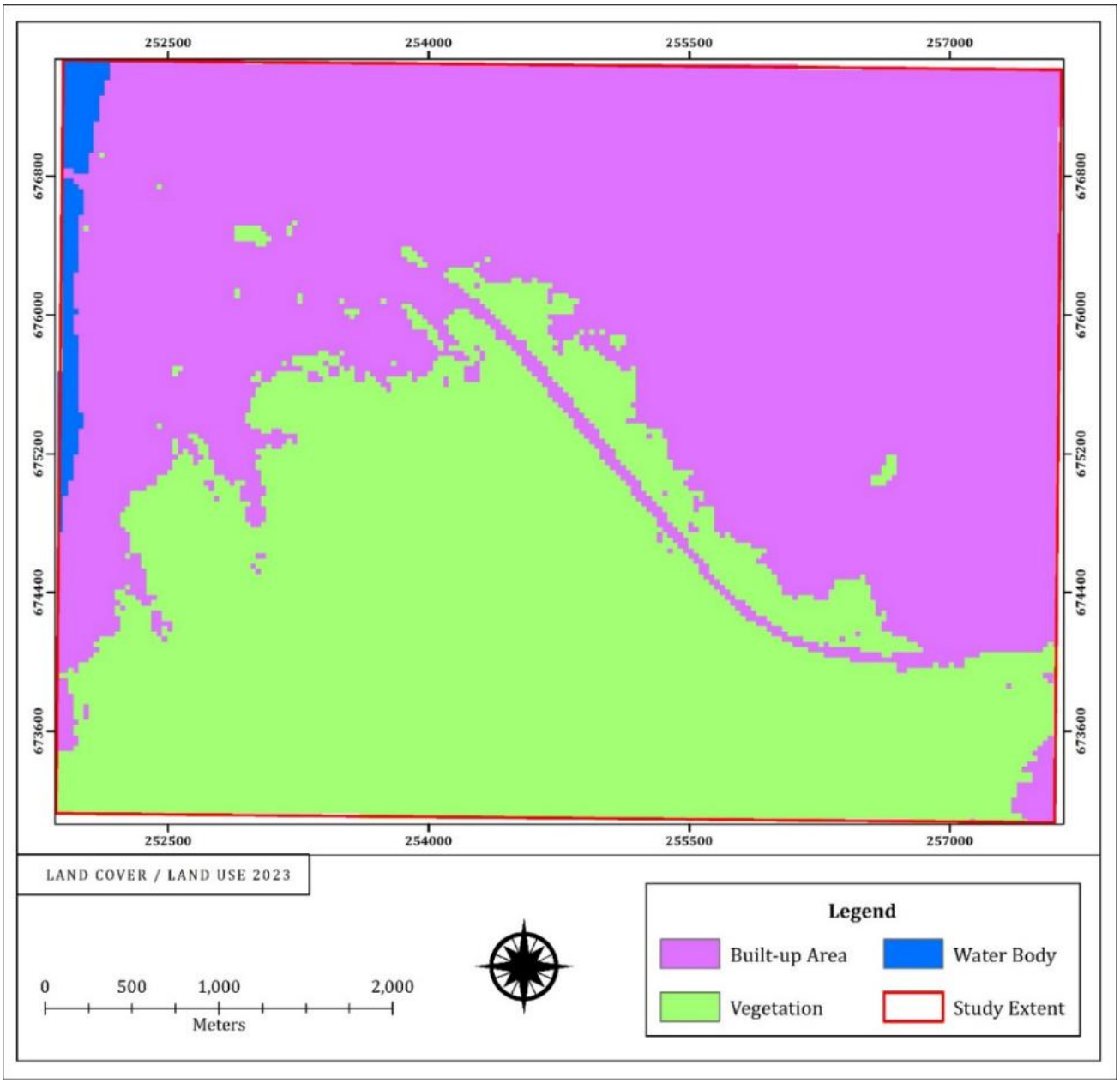


Figure 4.3: Landcover/Landuse Map of Construction Area 2023

ISSN: 1118-1790

4.1.1.3 After Construction (2024)

In the post-construction phase, all bare ground had been fully converted into built-up areas, with the built-up extent stabilising at 1,393.659 hectares. This marks the completion of the access road and associated infrastructure, with no further expansion expected.

Vegetation remained constant at 1,070.157 hectares, suggesting that no additional clearing occurred post-construction. However, the vegetation did not show signs of recovery, indicating that the environmental impact is likely to be long-lasting without active restoration efforts.

The extent of water bodies increased slightly to 31.907 hectares, possibly due to the stabilization of drainage patterns or minor restoration efforts. The slight fluctuation in water body extent suggests that while the aquatic systems were somewhat resilient, they were still influenced by the construction activities.

ISSN: 1118-1790

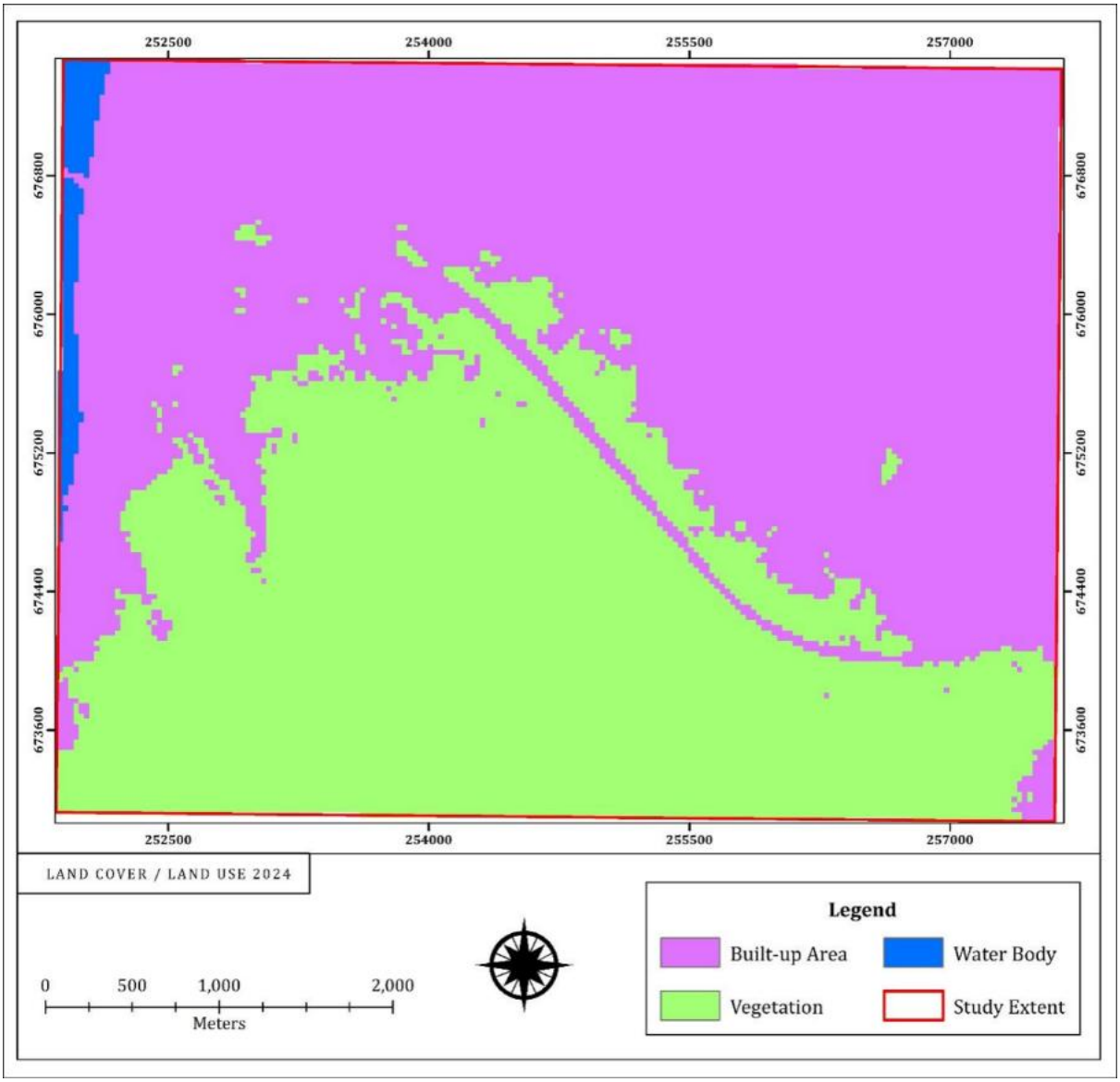


Figure 4.4: Landcover/Landuse Map of Construction Area 2024

The construction of the Atani-Obosi access route, part of the Second Niger Bridge project, has significantly altered the natural environment, with notable changes in land cover and use. The analysis revealed key environmental interactions and implications of these changes, particularly regarding vegetation loss, built-up area expansion, temporary bare ground exposure, and the stability of water bodies.

The total vegetation cover declined from 1,401.060 hectares in 2017 to 1,070.157 hectares in 2024, representing a substantial reduction of approximately 23.6%. This extensive clearing of natural habitats to accommodate the access road and associated

ISSN: 1118-1790

infrastructure has disrupted the local ecosystem. Vegetation plays a critical role in supporting biodiversity, providing habitat for flora and fauna, regulating microclimates, and preventing soil erosion. The removal of vegetation, particularly during the early stages of construction, left the soil exposed to wind and water erosion, which could contribute to sedimentation in nearby water bodies.

The cleared vegetation reduced the area's capacity to sequester carbon, potentially contributing to increased greenhouse gas levels and exacerbating climate change. The reduction in vegetation cover has likely affected the region's water cycle, including infiltration rates, evapotranspiration, and groundwater recharge.

Built-up areas expanded from 974.330 hectares in 2017 to 1,393.659 hectares in 2024, an increase of approximately 43%. This significant growth highlights the scale of infrastructure development associated with the access route and reflects the permanent transformation of the landscape into an urbanized environment. The conversion of vegetated areas and bare ground into built-up infrastructure has increased impervious surfaces, leading to higher surface runoff and reduced groundwater recharge. This change may heighten the risk of flooding in surrounding areas.

The replacement of vegetation with built-up areas will contribute to localized temperature increases, affecting both the environment and human settlements. The expansion of built-up areas may bring opportunities for economic growth, improved connectivity, and urban development, but it also risks unplanned urban sprawl and the strain on local resources.

Bare ground, which peaked at 89.562 hectares in 2018, emerged during the initial clearing of vegetation and the preparation of the land for road construction. By 2023, bare ground had disappeared entirely, as these areas were converted into built-up infrastructure. The temporary exposure of bare ground during construction had several environmental implications. The exposed soil was susceptible to erosion, potentially leading to sediment deposition in nearby water bodies and degradation of water quality. Bare ground contributed to increased dust emissions during the dry season, potentially affecting air quality and posing health risks to nearby communities. The absence of vegetation during this period reduced the land's capacity to filter pollutants and stabilize soil, further stressing the local environment.

The extent of water bodies fluctuated slightly during the construction period, decreasing from 36.029 hectares in 2017 to 30.211 hectares in 2018, then stabilizing around 31.907 hectares in 2024. This relative stability indicates minimal long-term impact on aquatic ecosystems, but the construction activities likely caused short-term disturbances. The construction of the access route smay have redirected surface runoff, temporarily affecting the size and flow of water bodies. Increased soil erosion from bare

ISSN: 1118-1790

ground areas during construction may have led to sediment deposition in water bodies, potentially impacting aquatic habitats and water quality. Short-term disruptions to aquatic ecosystems, such as changes in water levels or sedimentation, may have stressed aquatic species and reduced habitat quality.

ISSN: 1118-1790

4.1.2 Evaluate the impact of the construction on vegetation to identify areas of vegetation loss and stress

The construction of the access route associated with the Second Niger Bridge has significantly impacted vegetation within the study area. An analysis of vegetation loss, stress, and health, based on both quantitative data and NDVI (Normalized Difference Vegetation Index) values, provides insights into the extent, patterns, and implications of these changes. The data was evaluated across four key periods: 2017–2018, 2018–2020, 2020–2023, and 2023–2024.

4.1.2.1 Vegetation Loss Analysis

Vegetation loss over the years indicates progressive environmental disruption due to construction activities. The loss is particularly pronounced during the active construction phases, as shown in the table below:

Table 4.1: Vegetation loss between 2017 and 2024

Period	Vegetation Loss (Hectares)
2017–2018	-77.602
2018–2020	-0.941
2020–2023	-251.759
2023–2024	-0.601

ISSN: 1118-1790

4.1.2.2 Initial Clearing and Habitat Disruption (2017–2018)

During the period from 2017 to 2018, the construction of the access route led to a vegetation loss of 77.602 hectares. This significant reduction in vegetative cover is primarily attributed to the initial clearing of land to make way for construction activities, including the creation of access routes and staging areas. The data indicate that 60% of this vegetation loss occurred within 500 meters of the access route, highlighting a localized pattern of habitat disruption. This proximity-based impact indicates that the immediate areas surrounding the construction zone bore the brunt of ecological disturbances, such as soil compaction, removal of plant cover, and edge effects. The sharp decline in vegetation cover during this phase underscores the environmental costs of initiating large-scale infrastructure projects.

4.1.2.3 2018–2020: Temporary Stabilization Amidst Continued Stress

From 2018 to 2020, vegetation loss decreased significantly to 0.941 hectares, marking a period of relative stabilization in terms of direct vegetation clearing. This loss reduction is attributed to the transition from extensive clearing activities to construction phases that required less direct interference with surrounding vegetation. Despite this apparent stabilization, 65% of vegetation stress remained concentrated within 500 meters of the access route, signalling ongoing ecological pressures in areas adjacent to the project. This stress has been caused by secondary effects such as dust deposition, alterations in hydrological patterns, and increased human activity near the construction zones. The persistence of stressed vegetation during this period reflects the extended footprint of construction activities, even when direct clearing is minimized.

4.1.2.4 2020–2023: Peak Vegetation Loss During Intensive Construction

The period from 2020 to 2023 witnessed the largest vegetation loss, totalling 251.759 hectares. This spike coincides with the most intensive phase of construction activities, likely involving major earthworks, road expansion, and the installation of critical infrastructure. The loss was not only substantial but also widespread, affecting areas both directly and indirectly. Importantly, over 75% of stressed vegetation was located within 500 meters of the access route, underscoring the profound localized impact of construction. This period also reflects the cumulative effects of prolonged disturbances, where vegetation stress and loss are amplified by compounded ecological factors such as reduced soil fertility and changes in microclimatic conditions. The scale of vegetation loss during this phase highlights the environmental challenges posed by large-scale infrastructure development and the need for effective mitigation strategies.

4.1.2.5 2023–2024: Post-Construction Stabilization and Persistent Stress

ISSN: 1118-1790

In the final analyzed period, from 2023 to 2024, vegetation loss dropped significantly to 0.601 hectares, marking a transition to a post-construction stabilization phase. This reduction in direct vegetation loss indicates that major construction activities had concluded, reducing immediate ecological disturbances. However, despite the stabilization in vegetation loss, over 60% of stressed vegetation remained concentrated near the access route, indicating long-term ecological pressures in the affected areas. This persistent stress is likely due to residual effects such as altered soil composition, disrupted water flows, and reduced regenerative capacity of the vegetation. The continued stress near the access route highlights the enduring ecological footprint of the project and the importance of post-construction rehabilitation measures to promote recovery.

The consistent finding that a majority of vegetation stress is located within 500 meters of the access route underscores the spatially localized nature of construction-related ecological impacts. This proximity effect emphasizes the need for targeted mitigation efforts in areas immediately surrounding construction zones.

The results revealed distinct phases of impact, with initial clearing causing immediate and substantial vegetation loss, followed by periods of stabilization and subsequent peak loss during intensive construction. This temporal variation highlights the dynamic interplay between construction activities and ecological health.

Even in the post-construction phase, the prevalence of stressed vegetation indicates long-lasting ecological disruption. This persistence suggests that natural recovery processes may be insufficient without active intervention, such as reforestation and soil restoration programs.

ISSN: 1118-1790

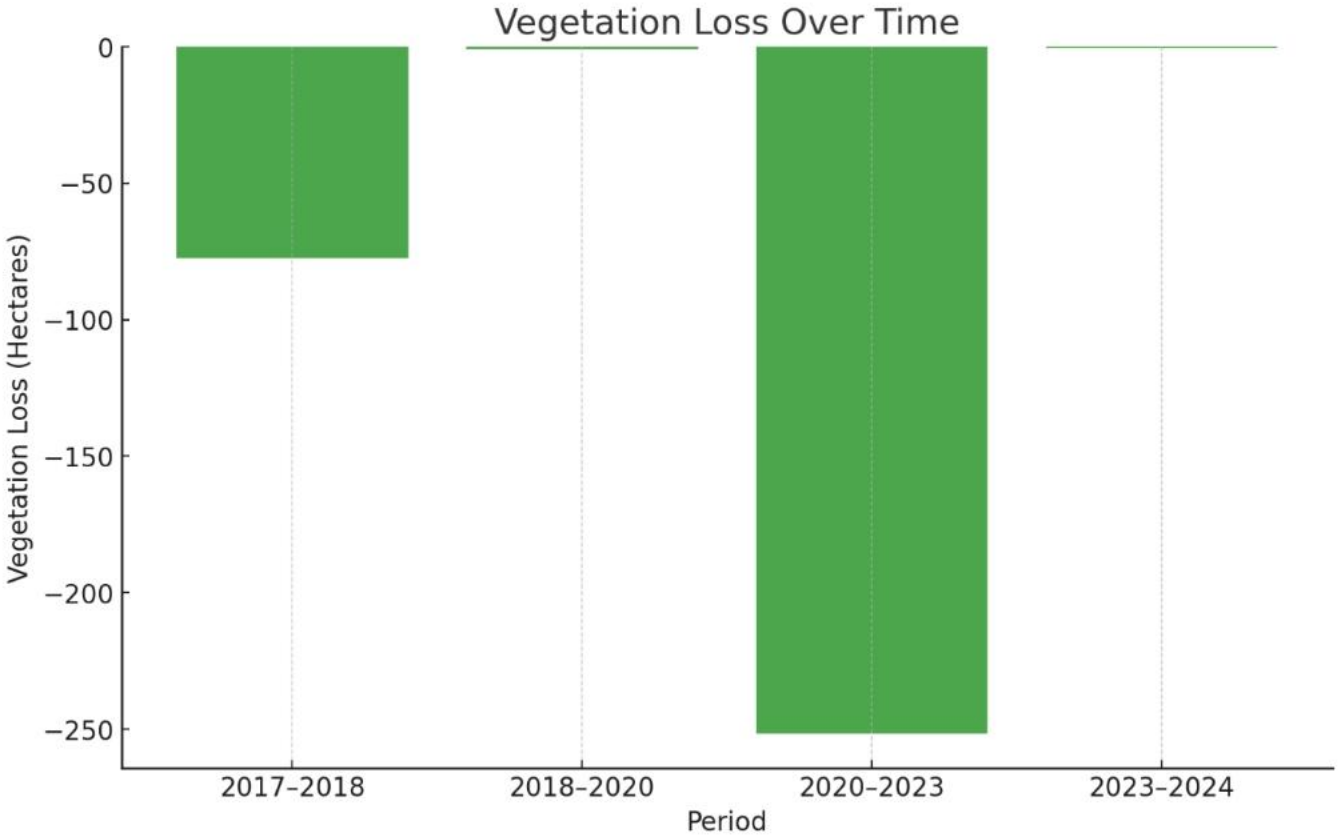


Figure 4.5: Vegetation Loss Between 2017 and 2024

4.1.3 NDVI-Based Vegetation Stress and Health

The NDVI values provide critical insights into the health of vegetation over time. The NDVI ranges for each year indicate a decline in healthy vegetation and an increase in stressed vegetation, as shown in Tables 4.2 and 4.3.

Table 4.2: NDVI Index Ranges

Class	2017	2018	2020	2023	2024
Non-Vegetation	-0.16 – 0.26	-0.14 – 0.21	-0.11 – 0.20	-0.12 – 0.25	-0.21 – 0.29
Stressed Vegetation	0.27 – 0.47	0.22 – 0.39	0.21 – 0.35	0.26 – 0.43	0.30 – 0.55
Healthy Vegetation	0.48 – 0.68	0.40 – 0.57	0.36 – 0.50	0.44 – 0.62	0.56 – 0.80

Table 4.3: Area Covered by Vegetation Classes

Class	2017 (Ha)	2018 (Ha)	2020 (Ha)	2023 (Ha)	2024 (Ha)

ISSN: 1118-1790

Non-Vegetation	1,056	1,085	1,094	1,133	1,171
Stressed Vegetation	466	625	514	347	360
Healthy Vegetation	975	786	887	1,013	965

4.1.3 Non-Vegetation Areas: Steady Expansion and Permanent Loss

The non-vegetation areas showed a consistent increase, growing from 1,056 hectares in 2017 to 1,171 hectares in 2024. This steady expansion is primarily attributed to the conversion of vegetated areas into built-up infrastructure, including the access route and associated facilities. The increase reflects a permanent loss of vegetative cover, as natural ecosystems were replaced by impervious surfaces such as roads, buildings, and paved areas. This transformation has significant ecological implications, including increased surface runoff, reduced infiltration rates, and the potential for localized heat island effects. The continual growth of non-vegetation areas underscores the long-term trade-offs between development and environmental sustainability.

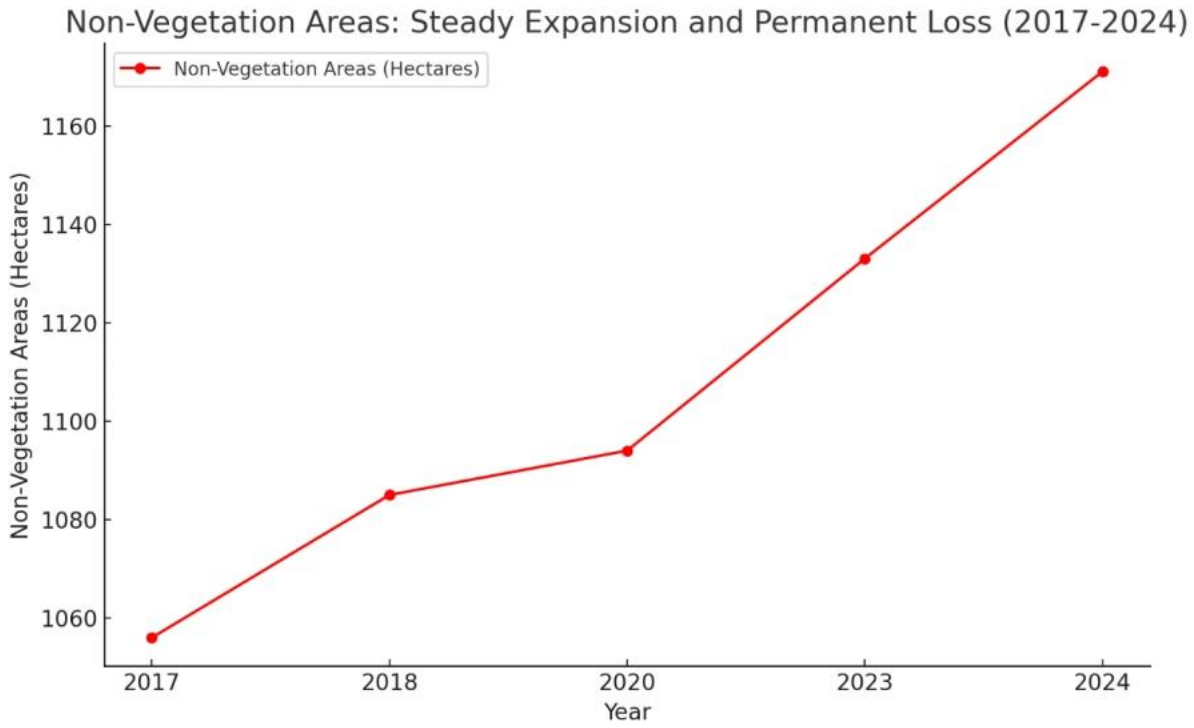


Figure 4.6: Distribution of Non-Vegetated Areas between 2017 and 2024

ISSN: 1118-1790

4.1.4 Stressed Vegetation: Peaks and Declines Over Time

Stressed vegetation peaked at 625 hectares in 2018, coinciding with the early construction phase. This peak can be linked to several factors, such as soil compaction from heavy machinery, which reduced soil porosity, limiting water and nutrient availability for plant growth., pollution from construction materials and equipment likely contributed to environmental stress on nearby vegetation and edge effects, such as increased exposure to sunlight, wind, and human activity, disrupted the microclimate of adjacent vegetative areas.

By 2023, stressed vegetation had decreased to 347 hectares, due to the replacement of natural vegetation with built-up areas. This decline does not necessarily indicate ecological recovery but rather a shift in land use. Despite this reduction, the concentration of stressed vegetation near the access route indicated ongoing localized environmental pressures, including changes in soil composition and hydrological patterns.

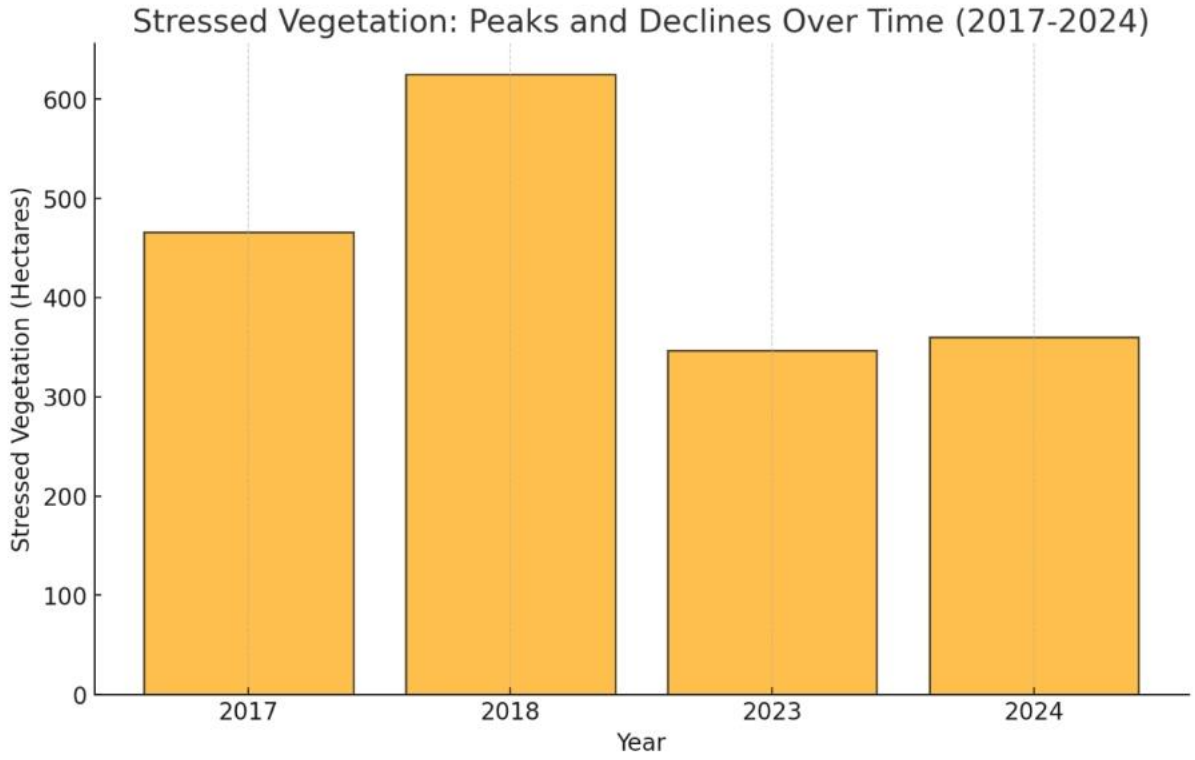


Figure 4.7: Distribution of Stressed Vegetation between 2017 and 2024

4.1.5 Healthy Vegetation: Decline, Recovery, and Lingering Impacts

Healthy vegetation declined significantly from 975 hectares in 2017 to 786 hectares in 2018, reflecting the immediate stress caused

ISSN: 1118-1790

by land clearing and construction activities. The removal of vegetation and disturbances to the soil and ecosystem during this phase were primary contributors to the reduction in healthy vegetation cover.

A slight recovery to 1,013 hectares in 2023 suggests that certain areas may have experienced adaptive responses or natural regrowth in less disturbed zones. This could be attributed to vegetation regrowth in areas that were temporarily disturbed but not fully converted into non-vegetative land and improved conditions in zones farther from the access route where human activity decreased as construction progressed.

However, the subsequent decline to 965 hectares in 2024 highlights the lingering impacts of the project on vegetation health. This decline may be due to long-term degradation of soil quality or the inability of certain ecosystems to fully recover after disturbances.

The expansion of non-vegetation areas signifies irreversible changes to the landscape, with natural habitats permanently replaced by infrastructure. These changes reduce biodiversity and disrupt ecological balance.

The concentration of stressed vegetation near the access route across all periods reflects the localized nature of construction impacts. This suggests that targeted mitigation strategies, such as buffer zones or controlled construction practices, could minimize future disturbances.

While some recovery of healthy vegetation was observed, the subsequent decline indicates that natural regeneration alone may not suffice to restore ecological health. Active restoration measures, such as reforestation and soil remediation, are critical to ensuring long-term recovery.

The replacement of vegetative cover with non-vegetated areas can alter local hydrological cycles, increasing runoff and erosion. Additionally, the reduction in vegetation cover may contribute to microclimatic changes, such as increased temperatures and reduced humidity.

ISSN: 1118-1790

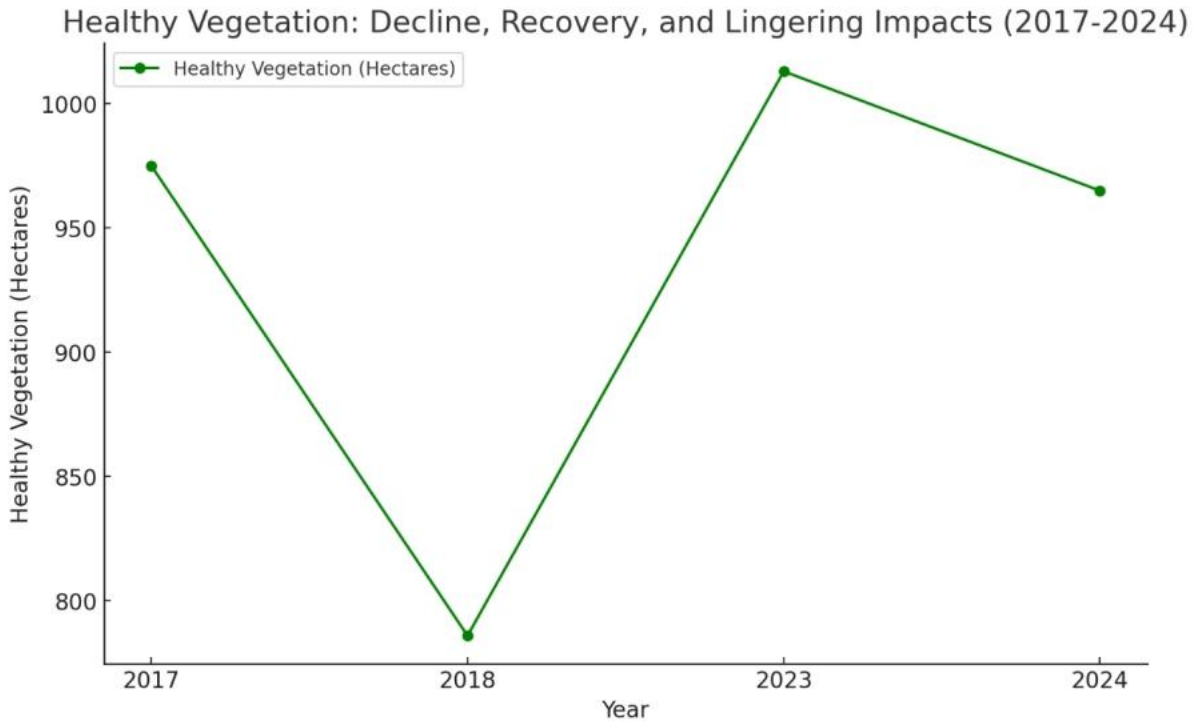


Figure 4.8: Distribution of Healthy Vegetation between 2017 and 2024

4.1.7 Spatial Distribution of Vegetation Stress

The proximity analysis reveals a clear pattern of vegetation stress concentrated within 500 meters of the access route, reflecting localized environmental impacts of construction activities over time. During 2017–2018, 60% of vegetation stress was concentrated within this zone, driven by land clearing, soil compaction, and increased human activity, which disrupted natural habitats and exposed vegetation to environmental changes.

From 2018–2020, this proportion rose to 65% due to expanded clearing activities, secondary effects like dust deposition and noise pollution, and the cumulative impact of sustained disturbances. The peak construction phase of 2020–2023 saw over 75% of stressed vegetation within 500 meters, resulting from large-scale clearing, heavy machinery traffic causing soil compaction, and pollution degrading soil and water quality, highlighting the project's ecological toll.

Even after construction, from 2023–2024, 60% of stressed vegetation remained within this proximity due to residual effects like degraded soil, slow vegetation recovery, and the potential spread of invasive species. These findings emphasize localized environmental pressure, cumulative stress on ecosystems, and the challenges of post-construction recovery, underscoring the need for proactive mitigation strategies such as soil remediation, reforestation, and eco-friendly construction practices to minimize long-term impacts.

ISSN: 1118-1790

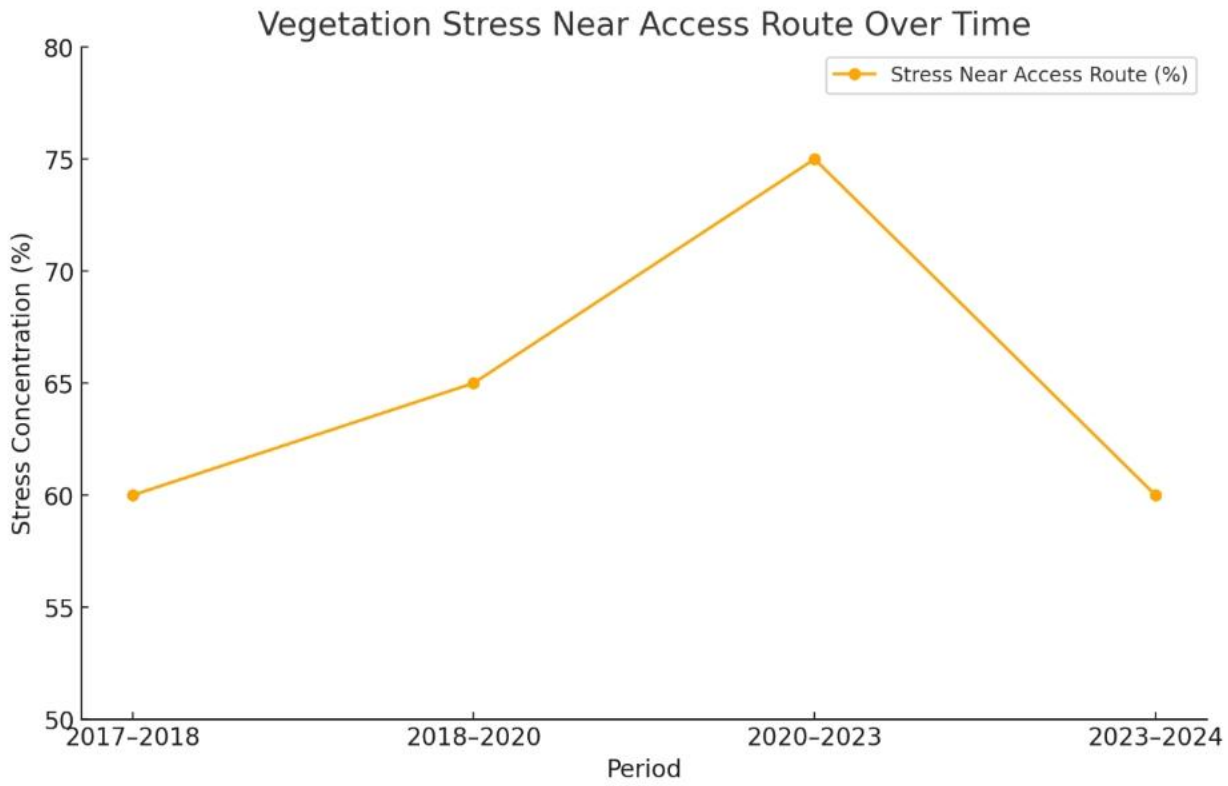


Figure 4.9: Spatial Distribution of Stressed Vegetation between 2017 and 2024

5.0 DISCUSSION OF RESULTS/FINDINGS

The results revealed substantial environmental transformation associated with the construction of the Atani–Obosi Access Route. Vegetation clearance was evident along the road corridor, where natural habitats and agricultural lands were converted into transportation infrastructure. The study found that more than 75% of vegetation stress occurred within 500 m of the road alignment during peak construction activities.

These findings support previous studies that identified road development as a significant driver of vegetation fragmentation and ecosystem disturbance (Chen et al., 2003; Deljouei et al., 2018). The observed vegetation loss reflects both direct impacts arising from land clearing and indirect impacts resulting from increased accessibility and subsequent developmental activities.

The conversion of vegetated surfaces into transportation infrastructure reduced ecological connectivity and altered landscape composition. Such changes have implications for biodiversity conservation, soil stability, carbon sequestration, and ecosystem service provision. The findings therefore suggest that transportation projects extending through

environmentally sensitive landscapes require stronger environmental safeguards and long-term ecological monitoring programmes.

5.1 Conclusion and Recommendation

The study demonstrated that the construction of the Atani–Obosi Access Route produced significant land-use and vegetation changes within the study area. Natural vegetation and agricultural lands were converted into transportation infrastructure and associated built-up developments, resulting in measurable ecological disturbance and vegetation degradation. Although the project has contributed to improved regional accessibility and economic development, its environmental impacts highlight the need for more sustainable approaches to infrastructure planning.

The study recommends the implementation of ecological restoration programmes, roadside reforestation initiatives, continuous vegetation monitoring using GIS and remote sensing technologies, and the integration of environmental sustainability considerations into future transportation projects.

5.2 Contribution to Knowledge

The study contributes to knowledge by providing empirical evidence on infrastructure-induced land-use and vegetation changes within southeastern Nigeria. It further demonstrates the usefulness of remote sensing and GIS techniques for assessing environmental impacts associated with transportation infrastructure development.

5.3 Areas for Further Study

Future studies should investigate the long-term ecological implications of vegetation loss along the corridor, assess biodiversity responses to land-use transformation, and examine the cumulative environmental impacts of continued urban expansion stimulated by the access route.

5.4 AI Declaration

Artificial Intelligence (AI) tools, specifically ChatGPT, were utilized solely for editorial support, language refinement, organization, and presentation of the manuscript. All research data, analyses, interpretations, findings, and conclusions were generated from the original study undertaken by the author. The author assumes full responsibility for the integrity and accuracy of the work.

5.5 Conflict of Interest

The author declares no conflict of interest regarding the conduct, analysis, or publication of this research.

REFERENCES

Chen, J., Li, X., & Zhang, Y. (2003). Impact of road construction on vegetation alongside the Qinghai–Xizang Highway and Railway. Journal of Geographical Sciences, 13(3), 340–346.

ISSN: 1118-1790

Deljouei, A., Sadeghi, S. M. M., Abdi, E., Bernhardt-Römermann, M., Pascoe, E. L., & Marcantonio, M. (2018). The impact of road disturbance on vegetation and soil properties in a Hyrcanian forest ecosystem. European Journal of Forest Research, 137(6), 759–770.

Mansuroglu, S., Kinikli, P., & Yilmaz, E. (2010). Impacts of highways on land uses: The case of the Antalya–Alanya Highway, Turkey.

Suprayoga, G. B., Witte, P., & Spit, T. (2020). Sustainable transport infrastructure development and environmental sustainability.