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ASSESSING THE EFFECTS OF FLOODING ON ROAD INFRASTRUCTURE AND HOUSEHOLD LIVELIHOODS IN DOMA LOCAL GOVERNMENT AREA, NASARAWA STATE, NIGERIA

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Abstract

Flooding remains one of the most devastating natural hazards affecting transportation infrastructure and the socioeconomic well-being of communities in developing countries. In Nigeria, recurrent flood events have increasingly disrupted road networks, damaged public infrastructure, restricted mobility, and undermined household livelihoods, particularly in vulnerable rural and semi-urban settlements. Despite various flood management initiatives, limited empirical evidence exists on the combined impacts of flooding on road infrastructure and the living conditions of affected households in Doma Local Government Area of Nasarawa State. This study therefore examined the effects of flooding on road infrastructure and household livelihoods in Doma Local Government Area, with the aim of providing evidence to support sustainable flood risk management and infrastructure resilience. A cross-sectional survey research design was adopted, integrating field observations with structured questionnaire administration among residents of flood-prone communities. Descriptive and inferential statistical techniques were employed to analyze the data, while Geographic Information System (GIS)-based evidence from the broader study provided contextual understanding of flood vulnerability within the study area. The findings revealed that recurrent flooding significantly deteriorates road infrastructure through pavement failures, erosion,

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drainage blockage, and bridge damage, leading to reduced accessibility, increased transportation costs, disruption of economic activities, and adverse effects on household livelihoods. The study further established that inadequate drainage systems, poor land-use management, and increasing rainfall intensity contribute substantially to the severity of flood impacts. The study concludes that strengthening resilient road infrastructure, enforcing sustainable land-use planning, improving drainage systems, and adopting integrated flood risk management strategies are critical for reducing infrastructure losses and enhancing community resilience. The findings provide valuable evidence for policymakers, infrastructure planners, disaster risk management agencies, and development partners seeking to improve climate adaptation and sustainable transportation systems in flood-prone regions of Nigeria.

Introduction

Flooding is widely recognized as one of the most frequent and destructive natural hazards globally, accounting for substantial losses of lives, infrastructure, and livelihoods each year. The increasing frequency and intensity of flood events, largely driven by climate change, rapid urbanization, environmental degradation, and inadequate land-use planning, have heightened concerns regarding the resilience of critical infrastructure, particularly transportation networks. Road infrastructure is especially vulnerable because it serves as the backbone of socioeconomic activities, facilitating the movement of people, goods, and essential services. Damage to road infrastructure not only disrupts transportation systems but also generates cascading economic and social consequences that impede sustainable development. Consequently, enhancing the resilience of transport infrastructure against flood hazards has become a major priority within global disaster risk reduction and climate adaptation agendas (IPCC, 2022; UNDRR, 2023).

Across Africa, flood disasters have intensified over the past two decades, posing serious threats to infrastructure development and community resilience. The continent's rapid urban expansion, coupled with inadequate drainage systems, weak environmental governance, and increasing climate variability, has significantly amplified flood risks. Many African countries continue to experience recurring road failures, bridge collapses, and transport disruptions following heavy rainfall events, resulting in reduced market accessibility, increased transportation costs, and significant economic losses. These challenges are particularly severe in developing economies where investment in resilient

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infrastructure remains inadequate and disaster preparedness mechanisms are still evolving (African Development Bank [AfDB], 2023; UNECA, 2022).

Nigeria has experienced an increasing pattern of flood disasters that have severely affected transportation infrastructure and human settlements. The catastrophic floods of 2012, regarded as one of the worst in the country's history, affected over 30 states, displaced millions of residents, destroyed public infrastructure, and caused enormous economic losses. Since then, annual flood events have continued to threaten communities across the country, with road networks among the most severely affected public assets. Flood-induced pavement failures, erosion, bridge deterioration, drainage blockage, and prolonged road closures have significantly constrained mobility, disrupted commercial activities, reduced agricultural market access, and increased the cost of transportation. Although governments at federal and state levels have implemented several flood management initiatives, many flood-prone communities continue to experience recurring infrastructure damage due to inadequate maintenance, poor drainage design, weak enforcement of land-use regulations, and increasing rainfall intensity associated with climate change (NEMA, 2023; NIHSA, 2024).

Within Nasarawa State, Doma Local Government Area represents one of the locations frequently affected by seasonal flooding because of its physical characteristics, river systems, low-lying terrain, and expanding human activities. Recurrent flood events have resulted in the deterioration of road infrastructure, erosion of road shoulders, destruction of drainage facilities, disruption of transportation services, and restricted access to agricultural communities and public facilities. These conditions adversely affect household livelihoods by limiting access to markets, healthcare services, educational institutions, and other essential socioeconomic opportunities. Given that agriculture constitutes the dominant livelihood source for many households within the study area, the repeated disruption of transportation infrastructure further compounds rural poverty and livelihood vulnerability.

Although previous studies have extensively examined the causes of flooding, flood vulnerability mapping, climate change, and disaster management in Nigeria, relatively few have specifically investigated the interconnected effects of flooding on both road infrastructure and household livelihoods at the local government level. Existing studies have largely emphasized flood occurrence, environmental degradation, or general socioeconomic impacts, while providing limited empirical evidence on how transportation infrastructure damage directly influences the living conditions of affected populations in Doma Local Government Area. Furthermore, there remains insufficient locally generated

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evidence to guide infrastructure resilience planning and integrated flood risk management within the study area.

Addressing this knowledge gap is essential for developing evidence-based policies that promote sustainable infrastructure development, strengthen disaster preparedness, and enhance community resilience in flood-prone regions. By examining the effects of flooding on road infrastructure and household livelihoods, this study contributes to the growing body of knowledge on disaster risk reduction, climate adaptation, and sustainable transportation planning. Specifically, the study seeks to assess how recurrent flooding affects road infrastructure and the living conditions of affected households in Doma Local Government Area, Nasarawa State, Nigeria, with the ultimate goal of providing practical recommendations for improving infrastructure resilience and reducing flood-related socioeconomic vulnerabilities.

Statement of the Problem

Flooding has become one of the most persistent environmental hazards threatening transportation infrastructure and sustainable livelihoods in many developing countries, particularly in sub-Saharan Africa. While climate change has increased the frequency and intensity of extreme rainfall events, the impacts of flooding are often aggravated by inadequate drainage infrastructure, poor land-use planning, weak environmental governance, and uncontrolled urban expansion. These conditions have significantly increased the vulnerability of road infrastructure, resulting in frequent pavement failures, erosion, bridge damage, and disruption of transportation networks that support economic development and social well-being.

In Nigeria, recurrent flooding has evolved from an occasional natural disaster into a recurring developmental challenge with profound implications for infrastructure sustainability and socioeconomic growth. The devastating nationwide flood events experienced in 2012 and subsequent annual flood occurrences exposed the fragility of the country's transportation infrastructure, particularly in rural and semi-urban communities. Although considerable investments have been made in road construction and rehabilitation, many roads continue to deteriorate rapidly following flood events due to inadequate drainage systems, poor maintenance practices, encroachment on natural waterways, and increasing rainfall variability. Consequently, affected communities experience restricted mobility, increased transportation costs, disruption of commercial activities, reduced access to healthcare and educational services, and declining household incomes.

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Doma Local Government Area of Nasarawa State represents one of the flood-prone areas where recurrent flooding has continuously affected road infrastructure and the livelihoods of residents. Seasonal floods frequently render major and feeder roads impassable, isolate rural communities, damage bridges and drainage facilities, and interrupt the movement of agricultural produce to markets. Given that agriculture constitutes the primary source of livelihood for many households in the area, disruptions to transportation networks have far-reaching consequences for food security, household income, and overall socioeconomic welfare. Despite the recurring nature of these flood events, infrastructure rehabilitation efforts have largely focused on post-disaster repairs rather than proactive resilience-building measures capable of reducing future risks.

Although previous studies have examined flood occurrence, flood vulnerability mapping, climate change impacts, and disaster management in different parts of Nigeria, limited empirical attention has been devoted to understanding the combined effects of flooding on road infrastructure and household livelihoods within Doma Local Government Area. Existing studies have predominantly emphasized the physical causes of flooding or generalized socioeconomic impacts without comprehensively examining how infrastructure damage translates into reduced accessibility, livelihood disruption, and community vulnerability. Furthermore, there remains inadequate localized evidence to support policy formulation, infrastructure investment prioritization, and integrated flood risk management strategies tailored to the unique environmental and socioeconomic conditions of the study area.

This knowledge gap limits the capacity of policymakers, disaster management agencies, transportation planners, and development practitioners to design effective interventions that simultaneously strengthen road infrastructure resilience and improve the adaptive capacity of vulnerable communities. Consequently, there is a pressing need for empirical evidence that examines the extent to which flooding affects road infrastructure and household livelihoods in Doma Local Government Area. Such evidence is essential for informing sustainable infrastructure planning, improving disaster risk reduction strategies, enhancing climate adaptation policies, and promoting resilient community development. Accordingly, this study addresses this gap by examining the effects of flooding on road infrastructure and the living conditions of affected households in Doma Local Government Area, Nasarawa State, Nigeria.

Significance of the Study

This study provides significant theoretical, practical, and policy contributions by generating empirical evidence on the effects of flooding on road infrastructure and

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household livelihoods in Doma Local Government Area, Nasarawa State. As flooding continues to threaten sustainable transportation systems and socioeconomic development in Nigeria, the findings of this study offer valuable insights for multiple stakeholders involved in disaster risk reduction, infrastructure development, and climate adaptation.

The findings will assist the Federal Government of Nigeria, the Nasarawa State Government, and Local Government authorities in formulating evidence-based policies aimed at strengthening flood-resilient transportation infrastructure. Specifically, the study will provide empirical information that can guide the prioritization of road rehabilitation projects, improve budgetary allocation for infrastructure maintenance, and support the integration of climate resilience into road development programmes. Furthermore, the study will contribute to achieving national development priorities related to sustainable infrastructure and disaster risk reduction.

The study offers practical insights for agencies such as the National Emergency Management Agency (NEMA), Nasarawa State Emergency Management Agency (NASEMA), the Federal Ministry of Works, the Federal Road Maintenance Agency (FERMA), and other infrastructure management organizations. By identifying the major flood-related factors responsible for road deterioration and livelihood disruption, the study will support the design of more effective mitigation measures, emergency preparedness plans, infrastructure maintenance programmes, and post-disaster recovery strategies.

For residents of Doma Local Government Area and other flood-prone communities, the study highlights the socioeconomic consequences of recurrent flooding on household livelihoods, mobility, and access to essential services. The recommendations arising from the study can contribute to improved community awareness, enhanced disaster preparedness, and increased adoption of local resilience strategies that reduce vulnerability to future flood events. Ultimately, improved road accessibility will facilitate better access to markets, healthcare facilities, educational institutions, and employment opportunities, thereby enhancing community well-being and sustainable development.

The study contributes to the growing body of literature on flood risk management, transportation resilience, disaster risk reduction, and climate adaptation within the Nigerian context. It fills an important empirical gap by simultaneously examining the effects of flooding on road infrastructure and household livelihoods at the local government level, an area that has received relatively limited scholarly attention. The study also provides a useful reference for future researchers interested in infrastructure

resilience, environmental hazards, transportation planning, and sustainable development, while offering a methodological framework that can be replicated in similar flood-prone regions.

Protection Motivation Theory (PMT)

This study is anchored on the **Protection Motivation Theory (PMT)**, originally developed by **Rogers (1975)** to explain how individuals respond to health-related threats through protective behavioural intentions. The theory was later revised and expanded by **Rogers (1983)** to include broader environmental and disaster-related risks. Over the years, PMT has been widely applied in disaster risk reduction, climate change adaptation, environmental management, and hazard preparedness studies to explain how individuals and communities perceive risks and adopt protective measures against natural hazards, including flooding (Bubeck et al., 2012; Grothmann & Reusswig, 2006).

The theory posits that individuals evaluate environmental threats and make decisions regarding protective actions based on two principal cognitive processes: **threat appraisal** and **coping appraisal**. Threat appraisal involves assessing the severity of a hazard and one's vulnerability to its occurrence, whereas coping appraisal concerns the perceived effectiveness of available protective measures, confidence in implementing those measures, and the associated costs or barriers.

Protection Motivation Theory has increasingly been adopted in studies examining flood preparedness, climate change adaptation, disaster resilience, and community vulnerability. Researchers have used the theory to explain why households comply or fail to comply with flood early warning systems, evacuation orders, infrastructure maintenance practices, and community-based disaster preparedness programmes. The theory also provides insight into institutional responses to flood hazards by emphasizing the importance of risk perception and confidence in mitigation strategies.

In the context of transportation infrastructure, PMT explains how government agencies and communities respond to recurring flood events through investments in improved drainage systems, resilient road construction, routine infrastructure maintenance, and environmental conservation measures. Where perceived flood risks are high and confidence in mitigation strategies exists, greater investments in infrastructure resilience and disaster preparedness are expected.

Protection Motivation Theory is particularly relevant because it explains how perceptions of flood risk influence preparedness, infrastructure protection, and livelihood adaptation in flood-prone communities. In Doma Local Government Area, repeated flooding has

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exposed road infrastructure and households to recurring losses. The theory provides a useful lens for understanding how residents and relevant government institutions perceive these risks and respond through preventive and adaptive measures such as improved drainage maintenance, compliance with land-use regulations, timely evacuation, resilient road construction, and community-based flood management initiatives.

Furthermore, PMT supports the study's central argument that reducing the adverse effects of flooding requires not only physical infrastructure improvements but also enhanced awareness, institutional preparedness, and behavioural adaptation among communities and policymakers. Consequently, the theory offers a comprehensive foundation for examining the relationship between recurrent flooding, road infrastructure resilience, and household livelihoods while informing practical recommendations for sustainable flood risk management in Doma Local Government Area.

Conceptual Framework

The conceptual framework for this study illustrates the hypothesized relationship between recurrent flooding (independent variable), road infrastructure damage (mediating variable), and household livelihood outcomes (dependent variable). It is based on the premise that flooding exerts both direct and indirect effects on the socioeconomic well-being of residents through its impacts on transportation infrastructure.

Flooding, characterized by intense rainfall, overflow of rivers, inadequate drainage systems, and poor land-use practices, constitutes the principal hazard affecting communities in Doma Local Government Area. These flood events damage critical road infrastructure by causing pavement deterioration, erosion, bridge failures, culvert blockage, and drainage collapse. As road conditions deteriorate, transportation efficiency declines, resulting in restricted accessibility, increased travel time, higher transportation costs, interrupted commercial activities, and reduced access to healthcare, education, and agricultural markets.

The deterioration of road infrastructure consequently affects household livelihoods by reducing income-generating opportunities, limiting market access for agricultural products, disrupting employment and business activities, increasing household expenditure on transportation, and lowering overall quality of life. Conversely, effective flood risk management interventions including improved drainage systems, resilient road construction, regular maintenance, enforcement of land-use regulations, and community

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preparedness can moderate these adverse relationships by enhancing infrastructure resilience and reducing flood-related disruptions.

Accordingly, the framework proposes that while recurrent flooding is the primary environmental stressor, the magnitude of its impact on household livelihoods is largely mediated by the condition and resilience of road infrastructure. This relationship provides the analytical foundation for examining how investments in resilient transportation infrastructure can contribute to sustainable livelihood outcomes and disaster risk reduction in flood-prone communities.

Figure 1. Conceptual Framework of the Study

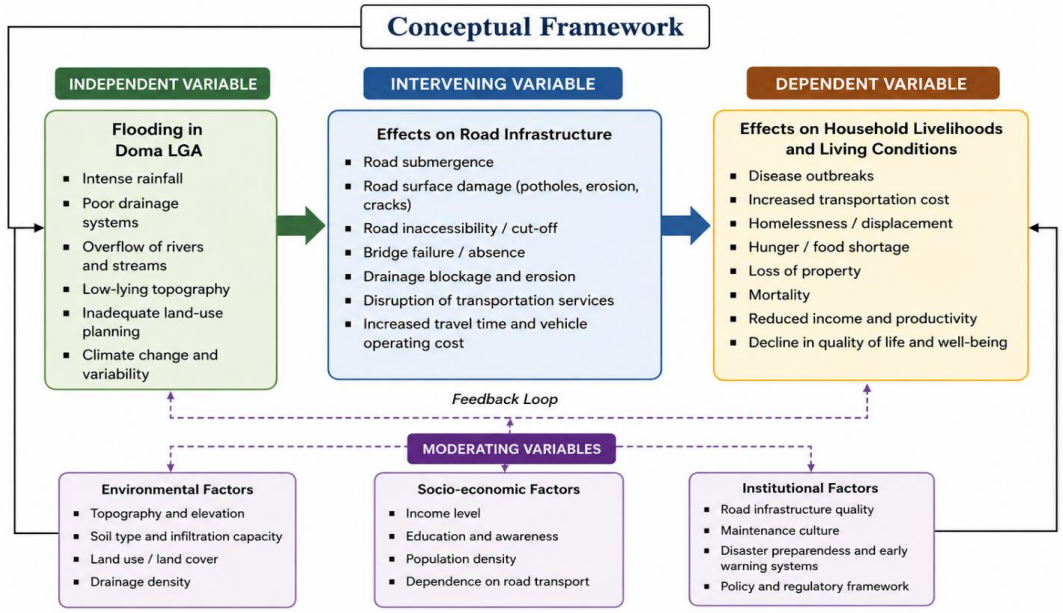

Figure 1: Conceptual Framework of the Effects of Flooding on Road Infrastructure and Household Livelihoods in Doma Local Government Area, Nasarawa State, Nigeria.

Source: Author's Conceptualization (2026)

The framework demonstrates that recurrent flooding serves as the principal hazard influencing both infrastructure and human welfare. Flood events damage road infrastructure, thereby disrupting transportation systems and reducing accessibility to essential socioeconomic services. The resulting infrastructure deficiencies negatively affect household livelihoods through increased transportation costs, loss of income, restricted access to markets, healthcare, and education, and declining living standards. However, the implementation of resilient infrastructure, effective flood risk management strategies, proper land-use planning, and improved drainage systems can significantly reduce these impacts and strengthen community resilience.

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This conceptual model provides the basis for analysing the causal pathways through which flooding affects transportation infrastructure and household livelihoods in Doma Local Government Area while informing practical interventions for sustainable disaster risk reduction and climate-resilient infrastructure development.

Study Area

The study was conducted in **Doma Local Government Area (LGA), Nasarawa State, Nigeria**. Doma LGA is located in the southern part of Nasarawa State and is characterized by a tropical wet-and-dry climate with distinct rainy and dry seasons. The area experiences its peak rainfall between **May and October**, during which flooding frequently occurs due to prolonged rainfall, overflow of nearby rivers and streams, inadequate drainage systems, and low-lying topography. The local economy is predominantly agrarian, with farming, fishing, petty trading, and transportation serving as the principal livelihood activities of residents. Road transportation constitutes the primary means of movement within the area, making the road network highly critical for economic activities, access to markets, healthcare services, educational institutions, and administrative functions. However, recurrent flooding has continued to damage road infrastructure, disrupt transportation services, and adversely affect the socioeconomic well-being of households.

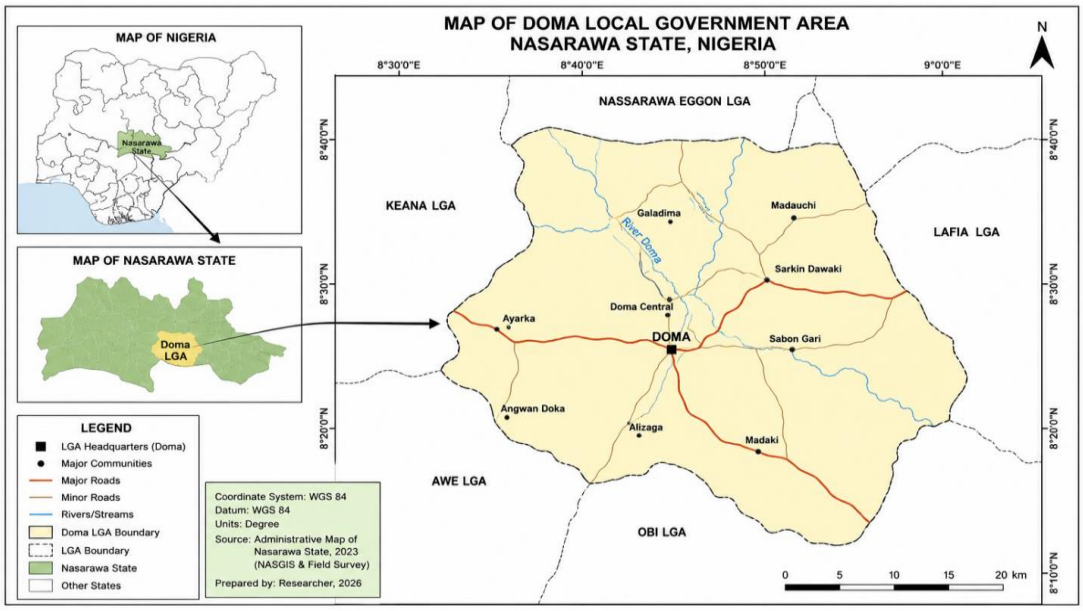

Figure 2: Map of Doma Local Government Area, Nasarawa State, Nigeria (Study Area)

Research Design

The study adopted a **cross-sectional survey research design**. This design was considered appropriate because it enabled the collection of quantitative data from respondents at a

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single point in time regarding their experiences with flooding, the condition of road infrastructure, and the effects on household livelihoods. The design also facilitated the examination of relationships between flooding and infrastructure performance while providing empirical evidence for disaster risk management and policy formulation.

Population of the Study

The target population comprised **households residing in flood-prone communities within Doma Local Government Area**, particularly those that had experienced recurrent flooding and its associated impacts on transportation infrastructure and living conditions. The population also included road users and community members directly affected by flood-induced road deterioration.

Sample Size

The study utilized a sample size of **353 respondents**, as determined in the original research project using an appropriate scientific sampling procedure. The sample size was considered adequate to ensure reliable statistical analysis and meaningful representation of the target population.

Sampling Technique

A **multistage sampling technique** was employed. In the first stage, flood-prone communities within Doma Local Government Area were purposively identified based on documented records of recurrent flood events and observable impacts on road infrastructure. Subsequently, households within the selected communities were chosen through systematic sampling procedures, ensuring that respondents possessed adequate knowledge of flooding experiences and their effects on transportation infrastructure and household livelihoods.

Instrument for Data Collection

Primary data were collected using a **structured questionnaire** designed to capture respondents' perceptions of flood occurrence, the condition of road infrastructure, and the socioeconomic effects of flooding on households. The questionnaire comprised both closed-ended and Likert-scale items organized into sections covering respondents' socio-demographic characteristics, flood experiences, infrastructure condition, and livelihood impacts.

In addition to questionnaire administration, **field observations** were conducted to assess the physical condition of selected road infrastructure affected by flooding. These observations complemented the survey findings by providing visual evidence of

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pavement deterioration, drainage failures, erosion, and other flood-related infrastructure damage.

Validity of the Instrument

To ensure **content and face validity**, the questionnaire was subjected to expert review by specialists in disaster risk management, transportation planning, and research methodology. Their observations and recommendations guided revisions to improve the clarity, relevance, and comprehensiveness of the instrument before field administration.

Reliability of the Instrument

The reliability of the questionnaire was assessed through a pilot study conducted among respondents from a community with characteristics similar to those of the study area but excluded from the main survey. Internal consistency was evaluated using **Cronbach's Alpha**, and the reliability coefficient exceeded the generally accepted threshold of **0.70**, indicating that the instrument was sufficiently reliable for data collection.

Data Collection Procedure

Data collection was undertaken through direct administration of questionnaires by the researcher and trained research assistants. Respondents were informed of the purpose of the study, assured of confidentiality, and encouraged to provide honest responses based on their personal experiences. Completed questionnaires were retrieved immediately after completion to maximize the response rate and minimize missing data.

Data Analysis

Data obtained from the field were coded, entered, cleaned, and analyzed using the **Statistical Package for the Social Sciences (SPSS), Version 26.0**. Descriptive statistical techniques, including frequencies, percentages, means, and standard deviations, were used to summarize respondents' characteristics and perceptions of flood impacts. Where applicable, inferential statistical analyses including correlation and regression analysis were employed to examine the relationships between flooding, road infrastructure condition, and household livelihood outcomes. Results were presented using professionally formatted tables and figures to enhance clarity and facilitate interpretation.

Ethical Considerations

Ethical principles guiding social science research were strictly observed throughout the study. Participation was entirely voluntary, and informed consent was obtained from all respondents prior to data collection. Participants were assured that their identities would

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remain anonymous and that all information provided would be treated with strict confidentiality and used solely for academic purposes. Respondents were also informed of their right to withdraw from the study at any stage without any consequences. Furthermore, the study adhered to established ethical standards relating to privacy, confidentiality, and responsible handling of research data.

Effects of Flooding on Road Infrastructure and Household Livelihoods

This section presents the findings relating to the study objective, which examined the effects of flooding on road infrastructure and household livelihoods in Doma Local Government Area, Nasarawa State. The findings are presented using descriptive statistics and interpreted alongside relevant empirical literature to provide a comprehensive understanding of the observed patterns. The presentation below is based on the results reported in the uploaded thesis and reformatted into a journal-style presentation.

Table 1: Effects of Flooding on Road Infrastructure in Doma Local Government Area

Effect on Road Infrastructure	Percentage (%)
Road Submergence	46
Road Surface Damage	21
Road Inaccessibility/Cut-off	17
Bridge Failure/Absence	16
Total	**100**

Source: Field Survey Data (2026), adapted from the original study.

The findings indicate that **road submergence (46%)** was the most prevalent impact of flooding on transportation infrastructure in Doma Local Government Area. This suggests that nearly half of the affected road network becomes inundated during major flood events, significantly reducing accessibility and disrupting the movement of people, agricultural produce, and essential services. Floodwaters frequently overtop road surfaces, rendering many roads temporarily impassable during the rainy season.

Road surface damage accounted for **21%** of the reported impacts, reflecting extensive pavement deterioration, pothole formation, erosion, and weakening of road foundations following prolonged water exposure. Additionally, **17%** of respondents identified complete road inaccessibility as a major consequence of flooding, indicating that several communities become isolated when floodwaters sever transport links. Bridge failure or the absence of bridges constituted **16%** of the reported impacts, highlighting critical deficiencies in transport infrastructure across flood-prone communities.

These findings demonstrate that recurrent flooding substantially compromises transportation efficiency and infrastructure functionality. The observed pattern is

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consistent with studies by Okoye and Ezezika (2013) and Achi et al. (2019), which reported that flooding increases travel time, vehicle operating costs, infrastructure deterioration, and reduces accessibility, thereby constraining economic productivity and regional connectivity. The findings underscore the urgent need for climate-resilient road infrastructure, improved drainage systems, and strategic investment in bridge construction to reduce flood-induced transport disruptions.

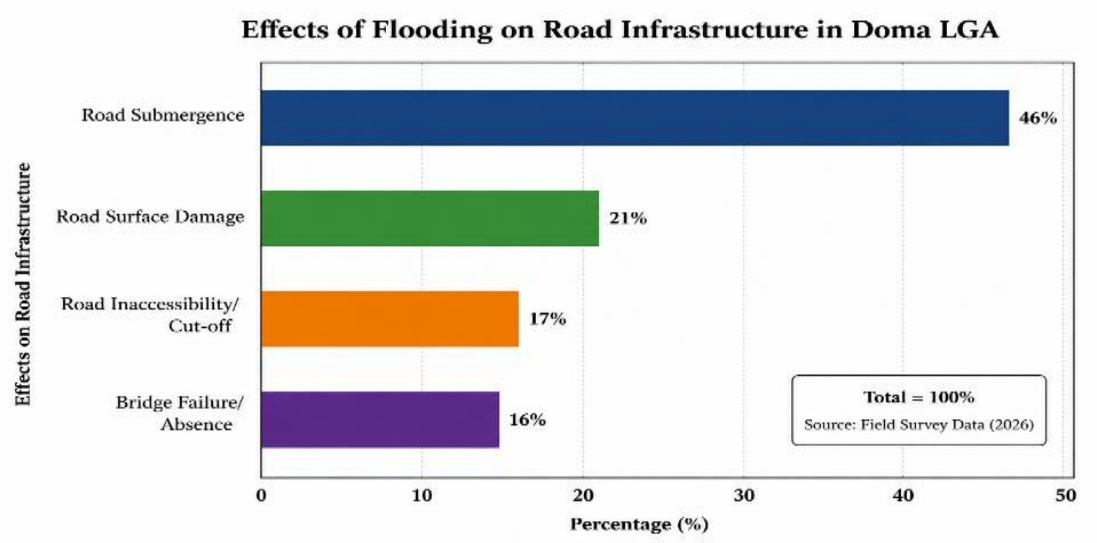

Figure 4: Effects of Flooding on Road Infrastructure in Doma Local Government Area (n = 353)

Table 2: Spatial Distribution of Road Submergence across Selected Communities

Community	Road Submergence (%)
Madauchi	61
Galadima	56
Sarkin Dawaki	50
Sabon Gari	50
Madaki	6

Source: Field Survey Data (2026).

Flood impacts varied considerably across the study communities. **Madauchi (61%)** experienced the highest level of road submergence, followed by **Galadima (56%),** while **Sarkin Dawaki** and **Sabon Gari** each recorded **50%.** In contrast, **Madaki** recorded only **6%,** suggesting comparatively lower flood exposure or more effective drainage conditions.

The spatial differences indicate that flood impacts are strongly influenced by local topography, drainage conditions, and infrastructure quality. Communities situated on

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low-lying terrain or close to natural drainage channels experienced greater inundation than relatively elevated areas. These findings reinforce the importance of incorporating spatial vulnerability assessments into transportation planning and flood mitigation strategies.

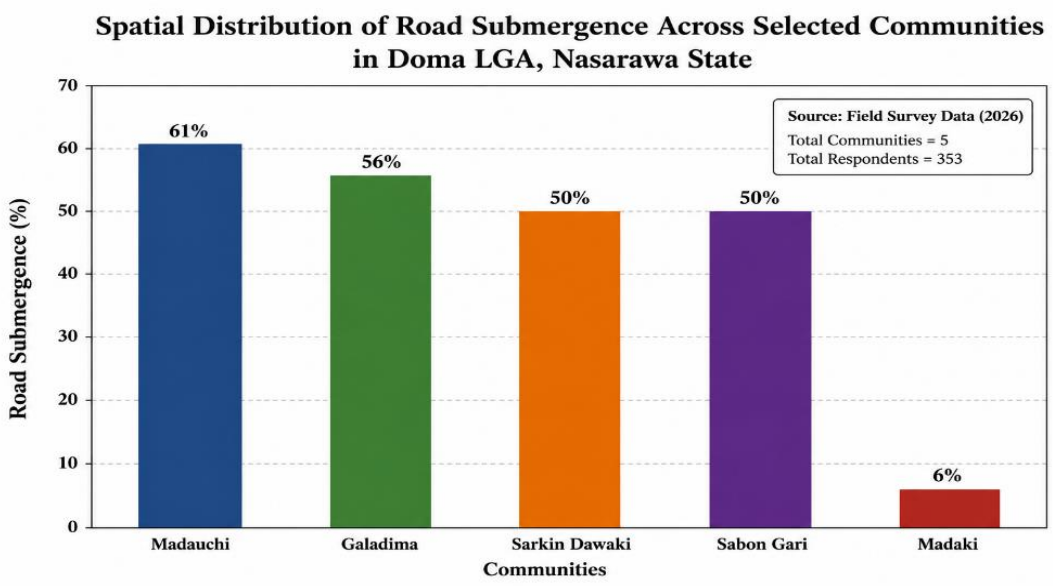

Figure 5: Spatial Distribution of Road Submergence Across Selected Communities in Doma Local Government Area, Nasarawa State

Table 3: Effects of Flooding on Household Living Conditions

Living Condition Impact	Percentage (%)
Disease Outbreaks	33
Increased Transportation Cost	14
Homelessness/Displacement	10
Hunger/Food Shortage	10
Loss of Property	8
Mortality	8
Total	**100**

Source: Field Survey Data (2026).

Flooding had substantial consequences for household livelihoods and well-being. **Disease outbreaks (33%)** emerged as the most significant impact, reflecting increased exposure to contaminated water, poor sanitation, and water-borne diseases during flood events. Damaged transport infrastructure also contributed to **higher transportation costs (14%)**, as residents were forced to use longer or more expensive travel routes due to submerged or damaged roads.

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Furthermore, flooding resulted in **homelessness (10%)**, **food shortages (10%)**, **loss of property (8%)**, and **mortality (8%)**, demonstrating that its effects extend beyond infrastructure damage to encompass broader humanitarian and socioeconomic challenges. These findings highlight the interconnected nature of infrastructure resilience and household welfare in flood-prone communities.

The results agree with previous studies that identified flooding as a major driver of displacement, disease transmission, food insecurity, and livelihood disruption in vulnerable communities. Similar observations have been reported by Rabalao (2010), Hu et al. (2019), Umaru and Hafiz (2019), and NEMA (2021), all of whom documented the multidimensional consequences of recurrent flooding on affected populations.

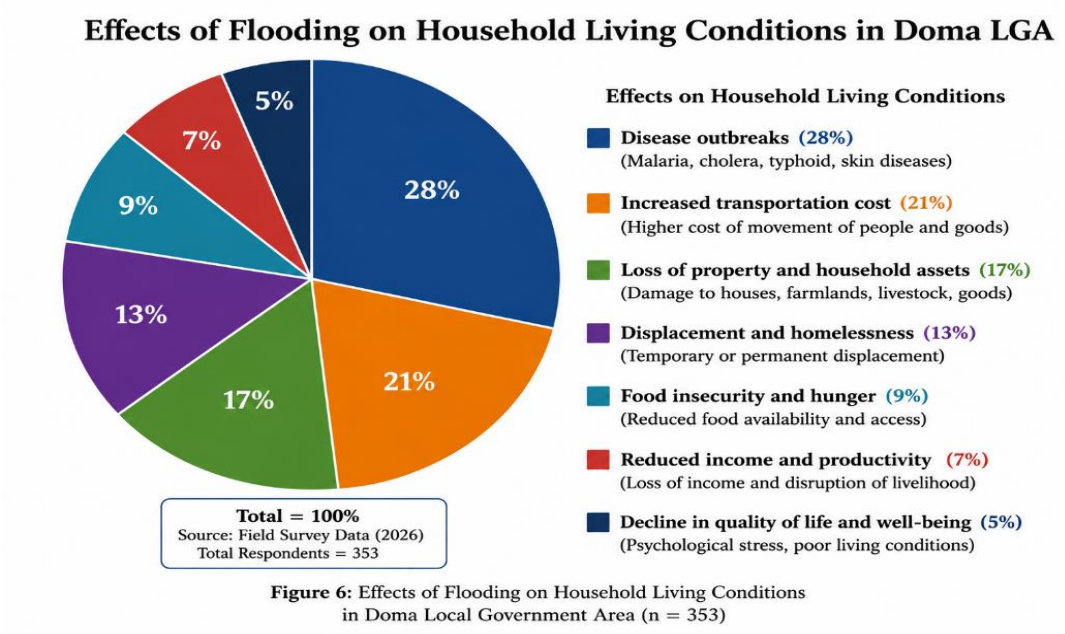

Figure 6: Effects of Flooding on Household Living Conditions in Doma Local Government Area (n = 353)

Table 4: Overall Effects of Flooding

Effect Category	Percentage (%)
Environmental Impacts	40
Health and Human Impacts	33
Socioeconomic Impacts	27
Total	**100**

Source: Field Survey Data (2026).

Discussion

The findings reveal that **environmental impacts (40%)** constituted the largest category of flood effects in Doma Local Government Area. These impacts include land degradation,

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pollution, erosion, drainage blockage, and environmental deterioration resulting from prolonged inundation. **Health and human impacts (33%)** ranked second, while **socioeconomic impacts (27%)** reflected property losses, displacement, reduced income, and increased household vulnerability.

Collectively, these results demonstrate that flooding represents not only an environmental hazard but also a significant development challenge affecting transportation systems, public health, economic productivity, and household resilience. The findings emphasize the need for integrated flood risk management strategies that combine resilient road infrastructure, improved drainage systems, environmental protection, and community-based adaptation measures to reduce future flood impacts.

Overall, the study establishes that recurrent flooding significantly undermines both the functionality of road infrastructure and the livelihoods of affected households in Doma Local Government Area. The concentration of impacts in specific communities further suggests that targeted, location-specific interventions will be more effective than uniform flood management approaches.

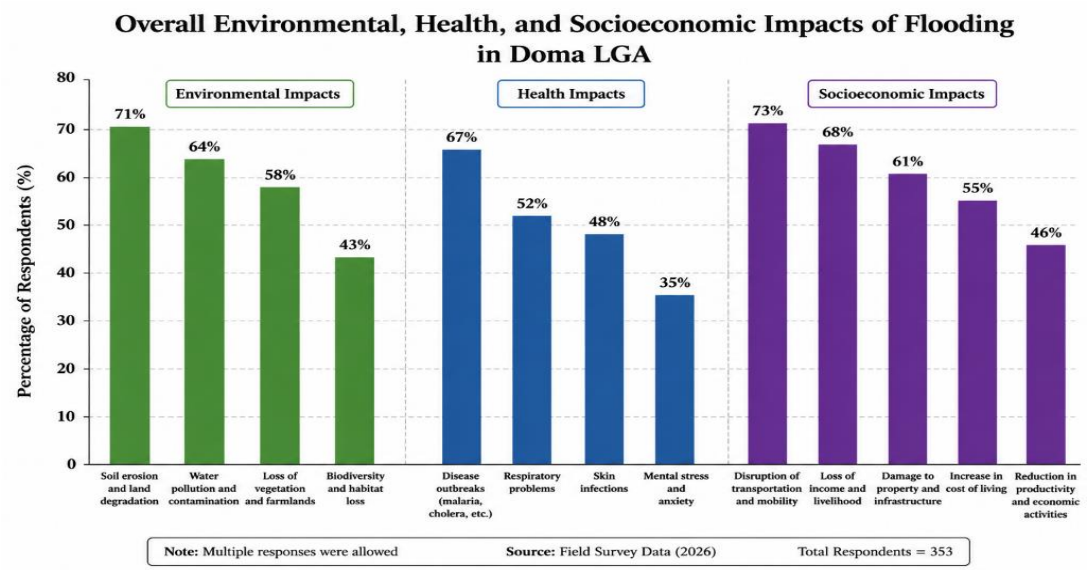

Figure 7: Overall Environmental, Health, and Socioeconomic Impacts of Flooding in Doma LGA (n = 353)

Conclusion

This study examined the effects of flooding on road infrastructure and household livelihoods in Doma Local Government Area, Nasarawa State, Nigeria. The findings demonstrate that recurrent flooding remains a significant threat to transportation infrastructure and the socioeconomic well-being of residents in the study area. Flood-induced road submergence, pavement deterioration, erosion, drainage blockage, and bridge failures have substantially reduced road accessibility, disrupted transportation

services, and increased travel costs, thereby constraining economic activities and limiting access to essential services such as healthcare, education, and agricultural markets. Beyond infrastructure damage, the study established that flooding has profound implications for household livelihoods. The findings revealed increased incidences of disease outbreaks, displacement, food insecurity, property loss, and declining household income among affected communities. These impacts collectively undermine community resilience and exacerbate existing socioeconomic vulnerabilities, particularly in predominantly agrarian settlements where livelihoods depend heavily on reliable transportation networks.

.Overall, the study concludes that recurrent flooding significantly affects both road infrastructure and household livelihoods, with important implications for sustainable development, transportation planning, and disaster risk reduction. Addressing these challenges requires a comprehensive approach that integrates climate-resilient infrastructure development, effective land-use planning, improved drainage systems, environmental conservation, and community-based disaster preparedness. Such integrated interventions will not only reduce future flood losses but also strengthen infrastructure resilience, improve mobility, enhance household livelihoods, and support sustainable socioeconomic development in flood-prone communities.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

i. **Climate-resilient road infrastructure should be prioritized.** Government at the federal, state, and local levels should incorporate climate-resilient engineering standards into the planning, construction, and rehabilitation of roads and bridges in flood-prone communities to improve their resistance to recurrent flooding.

ii. **Drainage systems should be upgraded and regularly maintained.** Relevant agencies should construct adequate drainage channels, desilt existing drains before each rainy season, and ensure routine maintenance to facilitate efficient stormwater runoff and reduce road inundation.

iii. **Flood risk considerations should be integrated into transportation planning.** Transportation and physical planning authorities should incorporate flood hazard assessments, hydrological studies, and climate projections into infrastructure planning to reduce future vulnerability.

iv. **Land-use regulations should be strengthened and enforced.** Government should prevent construction activities along floodplains, natural waterways, and drainage corridors through strict implementation of physical planning regulations and environmental laws.

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v. **Routine road maintenance should be institutionalized.** Proactive maintenance programmes should be implemented to repair minor road defects before they deteriorate into major infrastructure failures during flood events.

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