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TOWARDS UNLEASHING SUB-SAHARA AFRICAN RESOURCES FOR SUSTAINABLE DEVELOPMENT: MULTIDISCIPLINARY APPROACH

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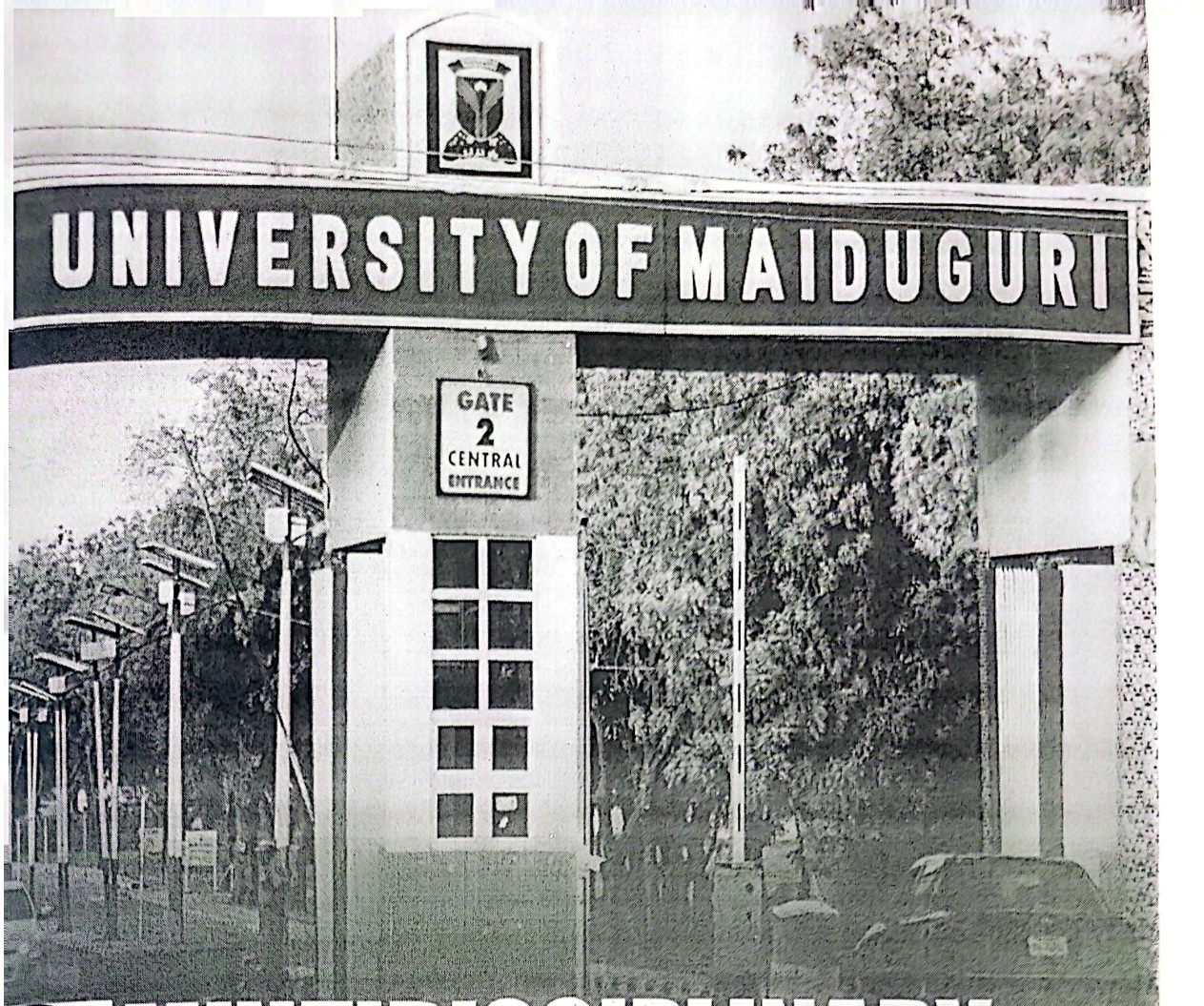

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Foreword

Dear Guests,

The Interdisciplinary Academic Conference on Achieving New Sustainable Development is multidisciplinary activities for academicians and institutions. This conferences is now wellknown as interdisciplinary academic events and the number of paper(s) submissions and attendees at its rises. The conference promote the development and dissemination of theoretical knowledge, conceptual research, and professional knowledge through conferences activities, the conference proceedings books and abstracts books. The focus of this conference is to create and disseminate knowledge about new developments in various field. This moment, the multidisciplinary academic conference is organized by Timbou-Africa Academic Publication collaboratively in University of Maiduguri, Borno, Borno State. This Conference has received almost 250 applications. The Conference Academic Advisory Board has accepted approximately 90 papers to be presented in multidisciplinary academic. We would like to thank Prof. Prof. S. H. Ahmad for his supports of organizing this Conference. We would also like to thank all participants who have presented their academic works in Multidisciplinary Academic Conference 2024, University of Maiduguri, Borno, Borno State and especially to our distinguished guests and keynote speakers for their collaboration and contribution for the success of this Multidisciplinary Academic Conference 2024. We wish you best.

Prof. Dr. D. Aaron
Prof. Dr. E. Ahmet

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SPATIAL DISTRIBUTION OF AUTOMOBILE REPAIR WORKSHOPS AND ENVIRONMENTAL IMPACT IN BIRNIN KEBBI METROPOLIS

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Abstract:
Urbanization in Sub-Saharan Africa has led to a rise in car ownership, resulting in more automobile workshops in densely populated areas like Birnin Kebbi. This can lead to socio-economic effects such as loss of green areas, noise pollution, traffic disruption, and increased road traffic congestion. This study aims to assess the environmental impacts of automobile repair workshops in Birnin Kebbi using integrated approach combining spatial analysis and experimental research The result reveals strategic clustering of workshops near roads and residential areas, indicating optimized accessibility and infrastructure utilization. The soil samples reveal a pH range of 6.45 to 7.05, which falls within the NESREA standard range of 6.0 to 7.5. However, workshop samples show slightly higher pH values, possibly due to alkaline influences. Electrical conductivity values vary significantly, with control points showing lower values, suggesting lower salinity. Organic matter content ranges from 0.172% to 0.688%, with higher values in workshops suggesting potential organic pollutants or waste materials from workshop activities. This contamination affects the organic matter and nutrient content of the soil, reducing plant growth and causing biotic degradation. The study emphasizes the need for improved spatial planning and regulatory enforcement to harness the region's resources for sustainable development.

Keywords: Urbanisation, Automobile repair workshops, Environmental impacts, Sustainable Practice, Pollution

Introduction

Urbanization in Sub-Saharan Africa has been characterized by rapid population growth and significant migration from rural to urban areas, driven by factors such as economic opportunities and social amenities. This demographic shift has placed immense pressure on the environment, leading to a range of environmental challenges.

Urbanization has led to an increase in the number of cars on the roads, which in turn has led to an increase in the number of automobile workshops in urban environments. As more people move into cities, the demand for personal transportation increases, resulting in a rise in the number of car owners. The number of car owners has rapidly increased over the past several decades, particularly in developing countries. Here are some statistics to illustrate this trend: According to the World Bank, there were 237 million passenger cars in the world in 1970. By 2017, this number had grown to 1.21 billion (World

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Bank, 2022).. This rapid increase in car ownership has had significant impacts on cities and their inhabitants, including increased air pollution, traffic congestion, and urban sprawl. It has also contributed to climate change by increasing carbon emissions from transportation.

Automobile workshops in urban environments are often located in densely populated areas, and this can have an adverse effect on the local environment. The disposal of waste products, such as used oil, tires, and batteries, can potentially pollute the soil and water in the area. Moreover, the use of hazardous chemicals and solvents in workshops can contribute to air pollution. Automobile workshops are known for producing a significant amount of environmental pollution due to the disposal of hazardous waste produced during vehicle maintenance and repair. These waste materials include used engine oil, coolant, brake fluid, batteries, and tires, among others. The disposal of these materials inappropriately can result in soil and water pollution. Studies show that the environmental pollution produced by automobile workshops can have adverse effects on human and environmental health. According to a study conducted by the United Nations Environment Programme (UNEP,2002), improper disposal of used oil by automobile workshops is responsible for 40% of oil pollution in the world's oceans and coastal zones. Automobile workshops contribute to environmental pollution through the release of hazardous chemicals and heavy metals into the soil and water. The soil near auto businesses can become contaminated with pollutants such as polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) (Oyewole *et al.*2023). These pollutants exceed permissible limits set by environmental standards, posing a risk to public health (Timothy *et al.*,2023). Additionally, the organic matter and nutrient content of the soil can be negatively affected, leading to contamination and reduced suitability for planting crops (Nwakife *et al.*, 2022; Duduyemi *et al.*, 2022). Mechanic activities can also result in the percolation of heavy metals, such as lead and copper, into the soil and water sources, potentially polluting underground water and causing biotic degradation (Duduyemi,*et al.*,2022). Furthermore, the indiscriminate location of automobile workshops can lead to adverse socio-economic effects, including loss of green areas, noise pollution, disruption of traffic flow, and increased road traffic congestion.

Automobile repair workshops play a significant role in Birnin Kebbi's economy and urban landscape, serving as vital nodes in the automotive sector and contributing to the city's economic vitality (Ojo, 2018). As crucial hubs for vehicle maintenance and repair services, these workshops not only provide employment opportunities for local residents but also support the functioning of various other sectors by ensuring the mobility of goods and people (Bako *et al.*, 2020). Moreover, they form an integral part of the urban landscape, often clustering in specific areas, thereby shaping the spatial configuration and dynamics of the city (Birnin Kebbi Municipal Council, 2019). However, the presence of automobile repair workshops also raises environmental concerns due to the potential for pollution from hazardous substances such as oil, grease, and chemicals used in automotive repair processes (Abdullahi & Maishanu, 2017). Balancing the economic significance of these workshops with the need for sustainable urban development presents a pressing challenge for Birnin Kebbi's policymakers and stakeholders.

Literature Review

Previous Studies on the Environmental Impacts of Automobile Repair Workshops

Previous studies have extensively investigated the environmental impacts of automobile repair workshops, shedding light on various aspects of pollution and sustainability in urban settings. Abdullahi and Maishanu (2017) conducted a study in Zaria, Nigeria, focusing on environmental pollution emanating from automobile workshops, highlighting concerns regarding pollutants such as oil, grease,

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and chemicals. Similarly, Bako et al. (2020) examined the role of automobile workshops in urban transportation development in Birnin Kebbi Metropolis, emphasizing their significance in the local economy while also acknowledging potential environmental repercussions. These studies underscore the importance of understanding and addressing the environmental implications of automobile repair activities in urban areas. Furthermore, Ojo (2018) explored the economic development implications of automobile workshops in Birnin Kebbi Metropolis, providing insights into the intertwined relationship between economic growth and environmental sustainability in the context of urban development. These previous studies collectively contribute to the understanding of the environmental impacts of automobile repair workshops and highlight the need for sustainable management practices to mitigate adverse effects on the environment.

Methodology

The study employs a combination of spatial and quantitative data, including surveys and experiments. Data sources include georeferenced satellite imagery, governmental agencies, and field surveys conducted using GPS devices. The study sampled 78 automobile workshops and 2 control points for soil sampling. The soil sample collected is subjected to laboratory tests to analyse soil contaminants level using Walkley-Black method of soil analysis for organic contents, glass-electrode pH meter for the pH level, and conductometer for the electric conductivity. Statistical analyses include Average Nearest Neighbour Index analysis for spatial distribution, descriptive were used.

Results

Spatial Distribution of Automobile Workshop in Birnin Kebbi Metropolis

The spatial distribution of automobile workshops in Birnin Kebbi Metropolis was assessed to understand their relationship with existing land use categories. Figure 1 illustrates the distribution based on land use, revealing a strategic clustering of workshops near roads, road reserved spaces, undeveloped land parcels, and areas under trees in front of residential buildings. This pattern suggests a rational approach to workshop location, leveraging transportation networks and optimizing available infrastructure.

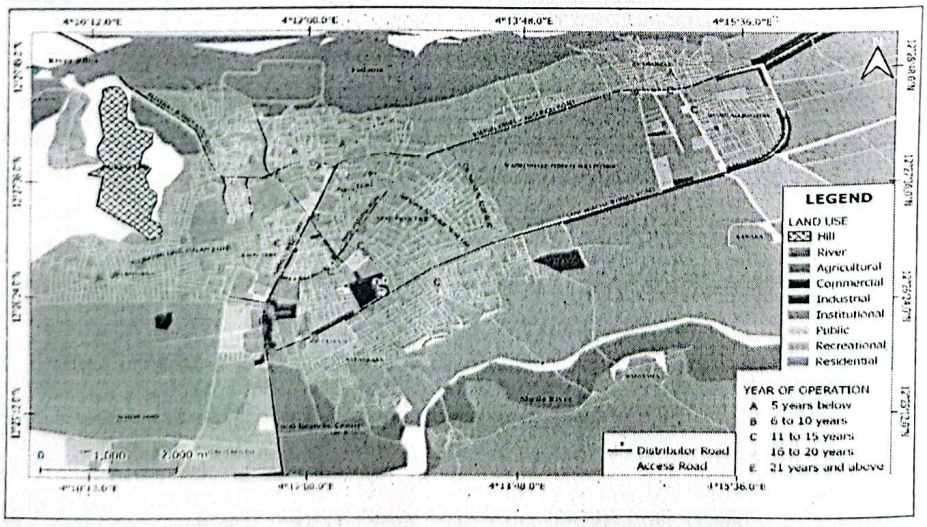

Figure 1: Automobile Repair Workshop Distribution based on Land Use in Birnin Kebbi

The distribution of automobile repair workshops across various land use categories in Birnin Kebbi Metropolis is presented in table 1. The majority of workshops (61.5%) are located in residential areas, followed by commercial (19.2%) and institutional (14.1%) areas. There is a relatively low presence of workshops in recreational (2.6%), industrial (1.3%), and public (1.3%) areas.

Table 1: Distribution of Automobile Repair Workshops by Land Use

Land Use	No of Workshops	Percentage (%)
Commercial	15	19.2
Industrial	1	1.3
Institutional	11	14.1
Public	1	1.3
Recreational	2	2.6
Residential	48	61.5
Total	78	100.0

Table 4.2 provides the results of the Nearest Neighbour Analysis (NNA) conducted for automobile repair workshops in different categories of years of operation. Across all categories, workshops exhibit significant clustering patterns, as indicated by high Nearest Neighbour Index (NNI) values and Z-Scores. For instance, workshops in the 5 years and below category have an observed mean distance of 451.20 meters, with an NNI of 53217.40 and a Z-Score of 352668.79, confirming significant clustering. Similar patterns are observed for workshops in other categories, highlighting the consistent trend of clustering across different periods of operation.

Table 2: The Nearest Neighbour Analysis (NNA) of the Automobile Repair Workshops

Years of Operation	Observed mean Distance (m)	Expected Mean Distance	Nearest Neighbour Index	Number of Points	Z-Score
<5 years	451.20	0.00848	53217.40	12	352668.79
6 to 10 years	437.68	0.00622	70328.44	25	672706.61
11 to 15 years	442.41	0.00627	70528.77	17	556308.26
16 to 20 years	310.21	0.00303	102472.32	15	759239.57
>21 years	588.39	0.00405	145240.64	09	833560.81

Table 3 shows the factors influencing the choice of workshop sites, with 45% indicating proximity to main roads or highways influenced their decision, while 55% did not. 50% identified accessibility for customers as a factor, while 50% did not. Cost of land/rental was acknowledged as a factor by 46%, while 54% did not. Zoning regulations were not a factor, with all respondents stating that they did not play a role. The data provides a comprehensive understanding of the factors influencing workshop site selection. The result reveals that workshop owners and managers consider factors like proximity to main roads, accessibility, and land cost when choosing locations. However, zoning regulations are not a significant consideration among respondents, suggesting they may be unaware of land use zoning and regulation.

Table 3: Factors That Influenced the Choice of Location for the Workshop

Location Factor	Response			
	Yes	%	No	%
Proximity to Main Roads/Highways	35	45	43	55
Accessibility to Customers	39	50	39	50

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Cost of Land/Rental	36	46	42	54
Zoning Regulations	00	0	78	100

Soil Pollution in Automobile Workshops in Birnin Kebbi Metropolis

The impact of automobile workshops on soil pollution in Birnin Kebbi was investigated by analysing key soil quality indicators such as pH, Electrical Conductivity (EC), organic matter content, and texture. The aim is to understand the extent of soil pollution caused by automotive repair activities in the area and assess the associated contamination risks, shedding light on implications for soil health and environmental sustainability in Birnin Kebbi. Table 4, present the various critical characteristics, including pH level, electrical conductivity (EC), and organic matter content, soil sampled in Birnin Kebbi (Figure 2)

Table 4: Soil Analysis Report for Automobile workshops in Birnin Kebbi

Sampled Point	pH level	pH Level (NESREA Standard) (6.0 - 7.5)	EC (mS/cm)	EC (mS/cm) (NESREA Standard) (< 4)	Organic Matter (%)	Organic Matter (NESREA Standard) (>2%)
CP1	6.47	Acceptable	6.66	varies	0.172	lesser
CP2	6.45	Acceptable	8.48	varies	0.180	lesser
A	6.96	Acceptable	55.30	potentially elevated	0.356	lesser
B1	7.02	Acceptable	47.20	potentially elevated	0.688	lesser
B2	7.04	Acceptable	48.50	potentially elevated	0.470	lesser
C	6.90	Acceptable	56.90	potentially elevated)	0.660	lesser
D	6.92	Acceptable	58.10	potentially elevated	0.340	lesser
E	7.05	Acceptable	53.30	potentially elevated	0.294	lesser

The result shows that the pH Level of the soil samples range from 6.45 to 7.05, falling within the NESREA standard range of 6.0 to 7.5, indicating a slightly acidic to neutral soil environment. Control points CP1 and CP2 exhibit pH levels within this range, suggesting no significant deviation from the standard. However, workshop samples A, B1, B2, C, D, and E show slightly higher pH values compared to the control point values, potentially implying alkaline influences from workshop activities. Also, the Electrical Conductivity (EC) values assess vary significantly across the sampled points, ranging from 6.66 to 58.10 mS/cm. Control points CP1 and CP2 show relatively lower EC values, suggesting lower salinity levels, while workshop samples A, B1, B2, C, D, and E exhibit substantially higher EC values, potentially indicating elevated levels of dissolved salts and ions in the soil, possibly from automotive repair activities. Organic Matter Content: The organic matter content in the soil samples ranges from 0.172% to 0.688%. Control points CP1 and CP2 exhibit lower organic matter content, while workshop samples A, B1, B2, C, D, and E show higher values than those of the control points. Although the values

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both at the control points and the workshops are less than the NESREA permissible percent, the higher values in the workshops suggest possible contributions of organic pollutants or waste materials from the workshops to the soil.

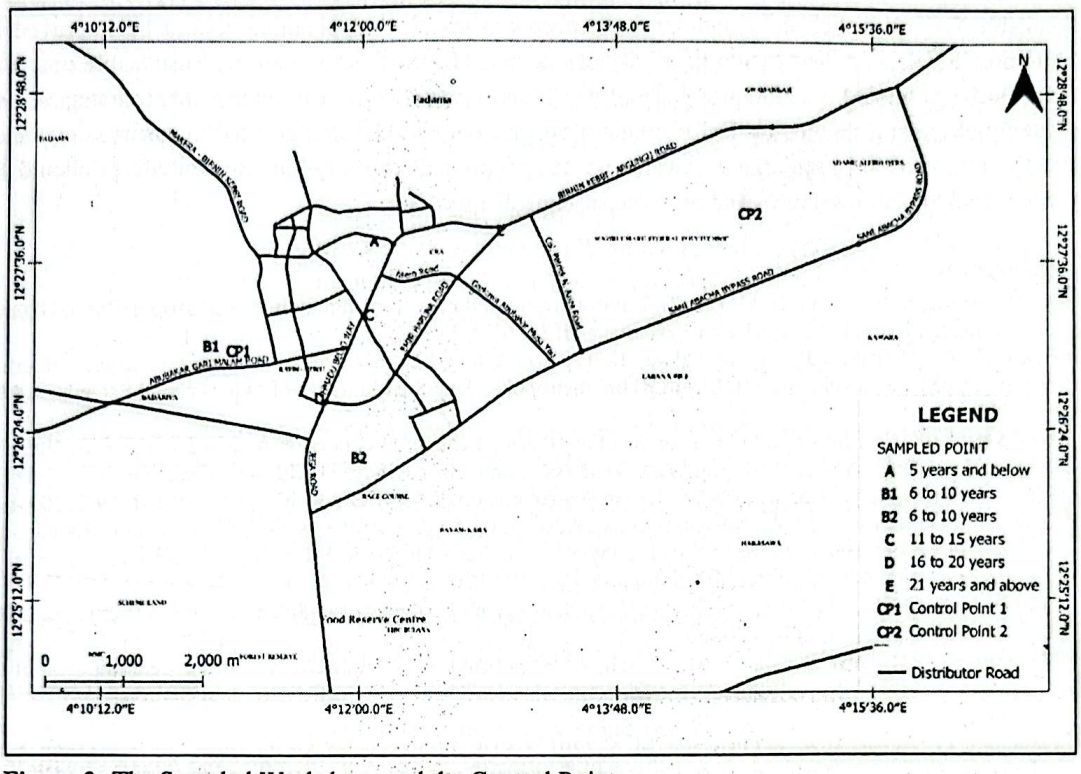

Figure 2: The Sampled Workshops and the Control Points

Discussion of Results

The spatial distribution analysis of automobile workshops in Birnin Kebbi Metropolis reveals a strategic clustering, particularly near roads, undeveloped land parcels, and residential areas. This clustering pattern suggests a rational approach by workshop owners to optimize available infrastructure. However, this concentration raises concerns about potential environmental and health impacts on nearby communities. Sustainable urban development requires balancing economic activities with environmental and social considerations. The distribution of workshops across land use categories indicates a predominant presence in residential areas, followed by commercial and institutional zones. This may contribute to soil and air pollution, noise disturbances, and negatively impact the environmental quality and well-being of residents. The Nearest Neighbour Analysis confirms significant clustering patterns among workshops, emphasizing the need to assess and mitigate environmental impacts.

The results of the soil analysis have significant implications for sustainable urban development in Birnin Kebbi. The relationship between workshop distribution and environmental impacts is evident through the soil analysis findings. The clustering of workshops near roads and residential areas, as indicated by Figure 4, correlates with higher pH levels, elevated electrical conductivity, and increased organic matter content in the soil, suggesting potential contamination and degradation of the environment.

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Conclusion

The study highlights the clustering of automobile repair workshops in Birnin Kebbi Metropolis, the workshops raise concerns about pollution, health impacts, and land use conflicts. The study recommends implementing zoning regulations to ensure the location of automobile repair workshops is suitable for residential areas and sensitive environments. Spatial planning should be improved to promote a balanced distribution of workshops across different land use zones. Sustainable practices should be promoted, including the use of eco-friendly materials, waste management strategies, and energy-efficient technologies. Enforcement mechanisms should be strengthened to ensure compliance with environmental regulations. Awareness campaigns and capacity-building initiatives should be conducted to raise awareness and promote sustainable practices.

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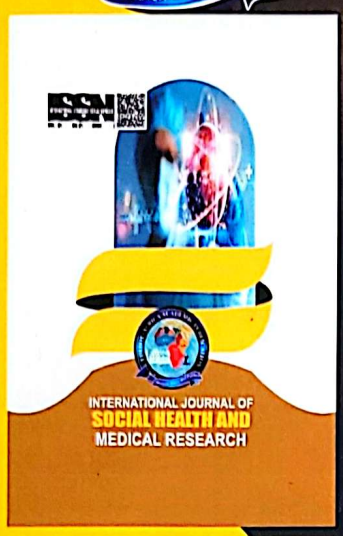

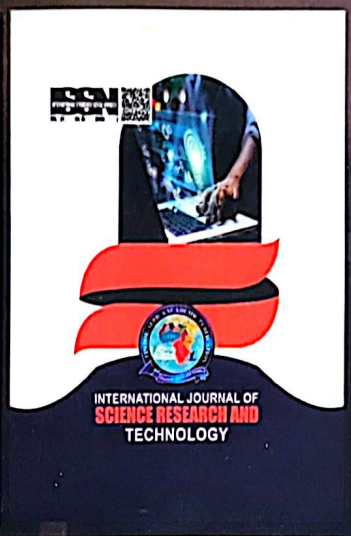

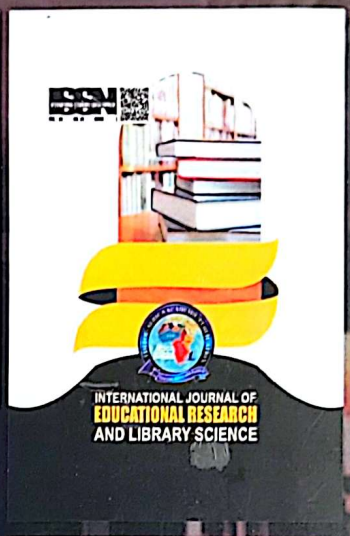

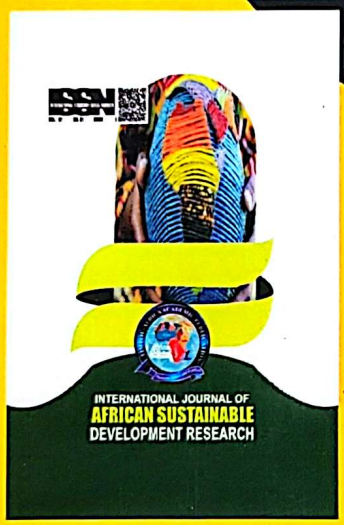

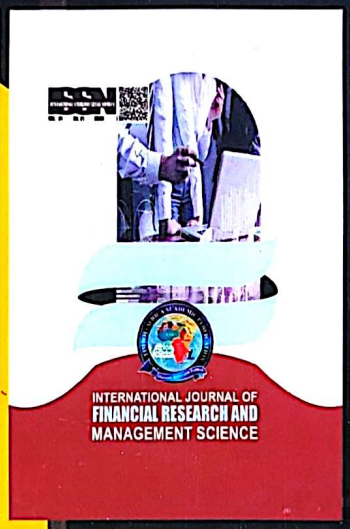

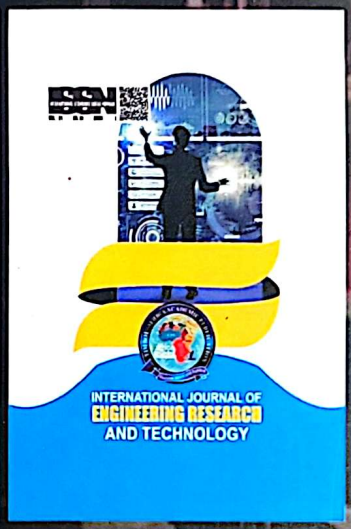

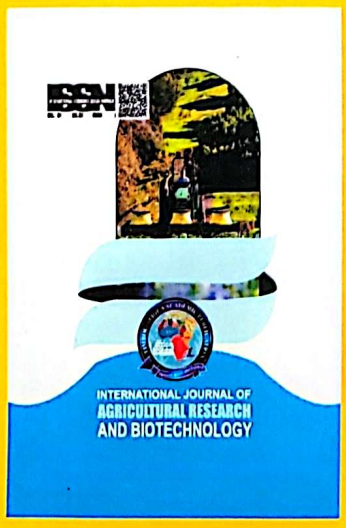

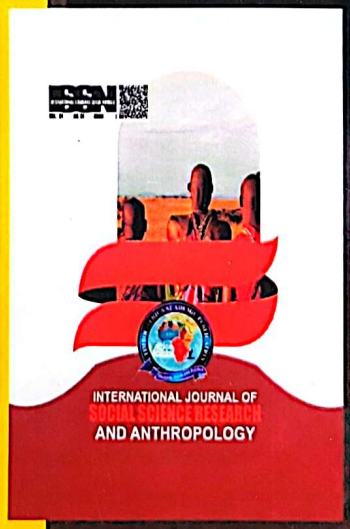

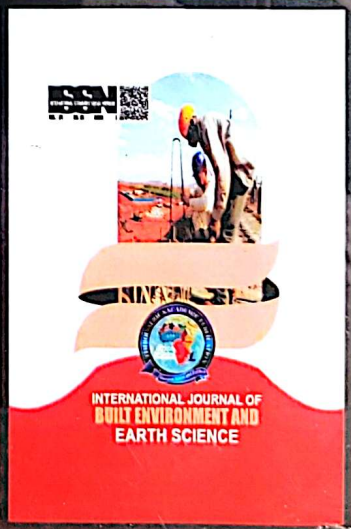

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