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ORIGINAL RESEARCH ARTICLE

Geospatial Analysis of Agricultural Encroachment on Natural Forest in Ife South Local Government Area, Osun State, Nigeria

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ABSTRACT

This study examines the spatio-temporal dynamics of agricultural encroachment on natural forests in Ife South Local Government Area, Osun State, South-Western Nigeria. Over the past two decades (2002 – 2022), the region has witnessed significant land use changes, driven by economic transformation and population growth, leading to the conversion of forested areas for cultivation. The study utilized Landsat imageries for 2002 (ETM+), 2015, and 2022 (OLI/TIRS) were acquired from the United States Geological Survey (USGS) at a 30-meter spatial resolution. The images were processed and classified using ArcGIS 10.8 and ERDAS Imagine 2015. A supervised classification was performed to quantify land use/land cover changes. Supplementing the geospatial analysis, in-depth interviews were also conducted in selected communities within the study area to gauge perceptions. The findings reveal a complex pattern of change: while natural vegetation showed a net increase of 28.13% over the 20-year period, it experienced a significant decline of 39% between 2002 and 2015 before recovering. Cultivated land and plantations decreased by 28.78% and 63.31% respectively, whereas built-up areas expanded dramatically by 138.62%. Qualitative data identified agriculture as the primary driver of forest loss (90% of respondents), leading to negative impacts on livelihoods, including reduced crop yields and loss of forest benefits, as well as environmental degradation such as reduced air quality and land degradation. The study recommends an integrated approach involving sustainable land-use planning, agroforestry, community participation in forest management, and strengthened law enforcement to mitigate encroachment and achieve a balance between agricultural development and environmental conservation.

Introduction

Forests play a vital role in maintaining a balanced global ecosystem, providing essential goods and services, and supporting the livelihoods of billions (Centre for People and Forests, 2012). However, escalating pressures from population growth and increasing demands for food, fuel, and land have led to widespread depletion and degradation of forest resources (Pant et al., 2000). In Nigeria, the national goal of transforming from an oil-based to an agrarian-based economy has intensified pressure on the agricultural sector, resulting in the opening up of natural forests for cultivation (Mengistu and Salami, 2007).

The forest ecosystem, by virtue of its location and the many goods and services it can supply "for free", is highly depended upon for daily sustenance and livelihood by rural communities and, indeed, humanity. According to the Centre for People and Forests (2012), more than 1.6 billion people worldwide depend on forest resources for their livelihoods. Forests provide us with a wide range of goods and services, some of which include food, shelter, timber, paper, non - wood forest products such as medical plants, and other daily needs. They serve as wildlife habitat, preserving biodiversity and providing essential ecosystem services such as pollination (birds, bats, and insects), decomposition (important for soil arthropods, fungi, and micro-organisms), seed dispersal (insects and birds), etc. Forests also modify temperature and affect rainfall through evapotranspiration, and they act as "carbon sinks", taking up carbon dioxide from the atmosphere (Food and Agriculture Organization, 2011).

The continuous degradation of forests has profound effects, including erosion, loss of biodiversity, soil degradation, and unfavourable hydrological changes (Salami, 1998; Mengistu and Salami, 2007). In South-Western Nigeria, studies have reported a decrease in forests and derived savannah with a corresponding increase in farmland and settlements. Ife South Local Government Area (LGA) has experienced a revived attraction to farming, with incursions even into government forest reserves like the Shasha reserve, threatening their existence.

Remote sensing and GIS are considered invaluable tools for resources evaluation, monitoring, planning and detection of the change on forest area for sustainable management of population needs (Romijn et al., 2015). Land use maps provide the basis for discussions with local land users and stakeholders on improving land management practices for the purpose of achieving sustainability, the drawback being that land use changes rapidly and consequently, the existing maps become archaic fast (Turner et al., 2007). Land use planners have to prepare new land use maps or update the existing ones consequent to planning using remote sensing data sources. Landsat TM and SPOT data are effective for preparing land use maps at scales ranging from 1:100000 to 1:50000. Map products derived from satellite image interpretation have since been the dominant output of forest inventories in many tropical dry countries.

With the aid of remote sensing (RS) and Geographic Information Systems (GIS) approaches, the objective of this study is to analyse the quantity and patterns of forest change and associated land use patterns between 2002 and 2022 using Landsat images.

Reliable information on the current status and trends of forest resources aids key players orienting forestry policies and programmes. Conservation strategies need to focus on the local regeneration of natural forests and maintain continuity of forests, thereby ensuring sustenance of the livelihood of dependent populations. This study aims to assess the influence of agricultural encroachment on natural forests with the goal of achieving a sustainable environment. The research however assessed the vegetal cover changes in the study area from 2002 to 2022; examined the forest area and its changes over time; evaluated the perception of various groups of dwellers to deforestation activities, and proposed methods for future forest planning in the region.

Theoretical Framework

***Forest Transition Theory**: How Does Forest Cover Change Over Time?*

The forest transition hypothesis, first proposed by Friedrich (1904) and Whitaker (1940), and later formalized by Mather (1992), explains the dynamics of forest cover over time through the depletion-melioration model. It argues that resource destruction is inevitable in early development stages to meet human needs. Forest transition theory emphasizes temporal changes in forest cover, focusing on the "transition point" when forest cover reaches its lowest level before recovery begins (Mather, 1992; Lambin & Meyfroidt, 2010). This transition marks the shift from deforestation to reforestation.

Forest transition typically follows one cycle: initial decline followed by recovery (Grainger, 1995). In the neo-development phase, population growth and food demand drive agricultural expansion, reducing forest cover. Later, as economies mature, demand for forest products and ecosystem services stimulates reforestation.

Recent studies reveal more complex, multi-phase transitions (Yeo & Huang, 2013). Several paths explain these dynamics:

Forest scarcity path: Scarcity raises forest product prices, including amenity and environmental values, encouraging reforestation.

Economic development path: Off-farm job opportunities reduce rural dependence on land, leading to reforestation or land conversion back to forest (Rudel et al., 2005).
State forest policy path: Government policies promote forest cover for tourism and national image (Yeo & Huang, 2013).

Globalization path: Integration of economies through trade, migration, and conservation ideologies reshapes forest use. Rural-urban migration leaves marginal lands for forest regrowth, while urban-rural migration by wealthier groups increases demand for environmental services (Mather, 2007). Global institutions also spread conservation ideas internationally.

Forest transition theory has been applied to diverse contexts, showing that socio-political upheavals, technological disturbances (e.g., nuclear hazards), government policies, and demographic shifts significantly influence forest cover change (Yeo & Huang, 2013; Hostert et al., 2011; Bae et al., 2012).

Environmental Kuznets Curve (EKC) for Deforestation: How Does Income Affect Forest Cover?

Income growth is a critical factor in deforestation. The EKC, adapted from Kuznets' (1955) economic model linking income and inequality, was extended to environmental economics to explain the relationship between income and degradation. López (1994) argued that as income rises, deforestation declines once the role of forest resources in agricultural productivity is internalized.

In early development (low income levels), rising per capita income accelerates deforestation until a turning point is reached. Beyond this, higher income reduces deforestation as societies invest in forest conservation and environmental quality.

Empirical evidence suggests deforestation occurs earlier in development than heavy industrialization (Panayotou, 1993), since forest loss is less visible compared to other pollutants. This highlights the importance for developing countries to learn from the environmental damages experienced by industrialized nations. By restructuring development programs, they can pursue sustainable growth while avoiding severe degradation.

Culas (2007) concludes that the EKC framework can help developing countries achieve turning points at lower income levels, thereby reducing environmental harm along their development path. Policy recommendations include: Establishing clear property rights (Motel et al., 2009);Strengthening governance and political institutions (Dasgupta et al., 2006); Enforcing environmental regulations and standards (Munasinghe, 1999).

Together, forest transition theory and the EKC provide complementary perspectives on how forest cover evolves under pressures of development, globalization, and income growth.

Materials and Methods

Study Area

The study was conducted in Ife South LGA, Osun State, South-West Nigeria (Figure 1). It is located within Latitudes 7°09'N and 7°12'N and within longitudes 4°26'E and 4°42'E. Its headquarters is in Ifetedo, and it comprises several towns and villages, including Olode, Abiri, and the Reserve Farm settlement. The LGA covers an area of 730 km² and lies within a humid tropical climate characterized by distinct wet and dry seasons, with an average temperature of 28°C while relative humidity range between 67% and 88% (Toyobo et al., 2004). Farming is a major economic activity for the inhabitants as shown *in Figure 1.*

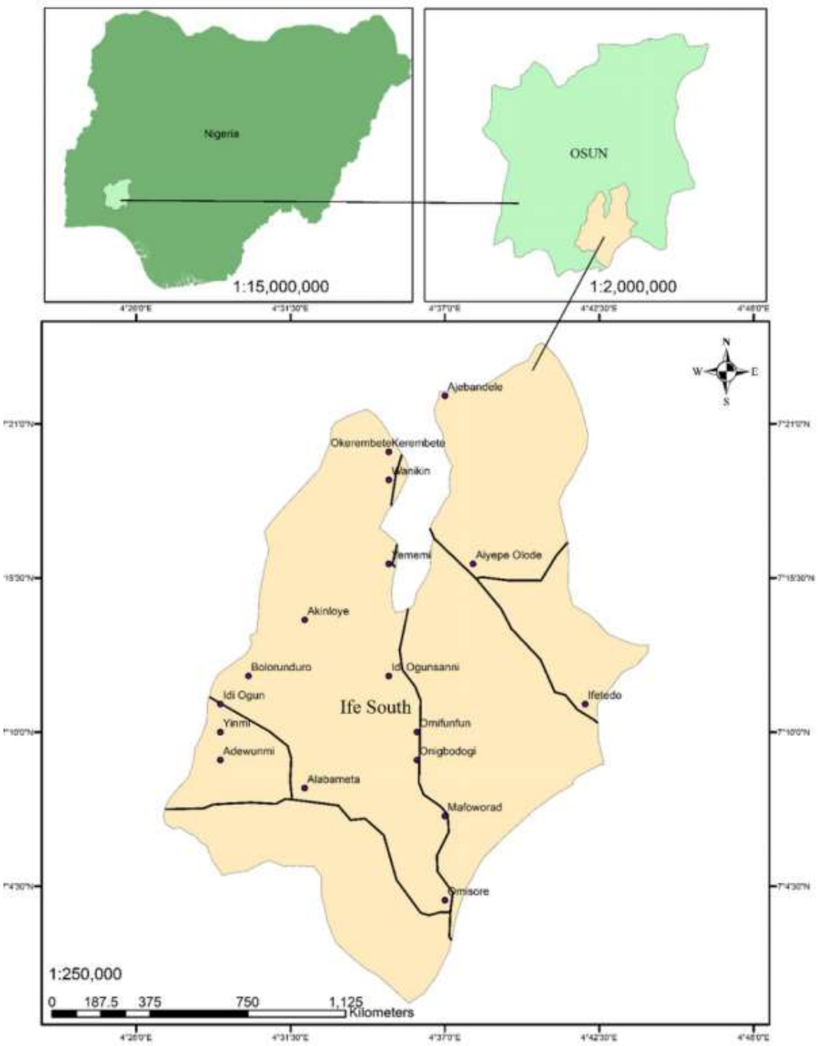

Figure 1: The Study Area

Ife South local government area is in Osun state, South-west geopolitical zone of Nigeria and has its headquarters in the town of Ifetedo. Ife South LGA is made up of several towns and villages such as Abiri, Olode, Oke-Owena, Kere, Aye-amodo, Mefoworade, Ifetedo, and Osi. The estimated population of Ife South LGA is put at 89,556 inhabitants with the Yoruba ethnic group as the most prominent tribe in the area. The widely spoken language in the area is Yoruba while the commonly practiced religions in the area are Christianity and Islam. Notable landmarks in Ife south LGA include the Reserve Farm settlement (manpower.com.ng).

Ife south LGA occupies a total area of 730km^2 and has an average temperature of 28°C. The average humidity level in the area is 58% while the area witnesses two distinct seasons which are the dry and the rainy seasons. Farming is one of the major economic activities engaged in by the dwellers of Ife south LGA. Also, trade flourishes in the area with the LGA hosting several markets where a variety of commodities are bought and sold. Other important economic enterprises undertaken by the people of Ife south LGA include textile weaving, logging, blacksmithing and the making and sales of health products from roots and herbs (manpower.com.ng).

Data Collection and Analysis

The study employed a mixed-methods approach, utilizing both primary and secondary data.

Satellite Imagery: Landsat images for 2002 (ETM+), 2015, and 2022 (OLI/TIRS) were acquired from the United States Geological Survey (USGS) at a 30-meter spatial resolution. The images were processed and classified using ArcGIS 10.8 and ERDAS Imagine 2015. A supervised classification was performed to categorize the land into six classes: Natural Vegetation, Cultivation, Plantation, Bare Surface, Rock Outcrop, and Built-up. The accuracy assessment of the LULC Classification is as shown in Table 1.

Table 1: Classification Accuracy Assessment Summary

Metric	**Result**
Overall Accuracy	85.73%
Producer's Accuracy (Natural Vegetation)	90.50%
User's Accuracy (Natural Vegetation)	87.33%
Lowest Accuracy Class	Built-up (73%)
Highest Accuracy Class	Plantation (98%)

Interview Data: In-depth interviews were conducted with ten respondents from five communities within the LGA (Olode, Ifetedo, Reserve Area, and Abiri Ogudu) to gather qualitative data on perceptions, impacts, and potential solutions. The interview data were analyzed using the Chi-square test, with the results presented as frequencies and percentages.

Land use change was calculated using the formulas:

* % Change = [(Area in Final Year – Area in Initial Year) / Area in Initial Year] * 100
* Frequency of Change = (Area in Final Year – Area in Initial Year) / Number of Years

In this study both primary and secondary methods were used to source data. The primary data include indepth interview and coordinates point of the interview locations. The secondary data were obtained from the United States Geological Surveys (USGS) which include Landsat satellite images from

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2002 (Landsat ETM7), 2015 and 2022 (Landsat 8 OLI/TIRS).

Satellite imagery was utilized to assess forest and forest cover changes from 2002 until the 2022. The data included Landsat satellite images of 2002 (Landsat ETM7), 2015 and 2022 (Landsat 8 OLI/TIRS) were obtained from the United States Geological Surveys (USGS) at a spatial resolution of 30 meters. The images were selected based on availability and cloud cover to ensure comparability of vegetation signatures. Spectral stability was maximized to accurately measure changes in land cover within the forest reserve. Although higher spatial resolution images were available, the freely available Landsat images were suitable for assessing land use processes in the forest ecosystem, as demonstrated in previous studies (Basommi et al., 2015; Acheampong et al., 2018; Appiah et al., 2021).

Interviews played a crucial role in collecting information on the perception of residents regarding the impact of forest encroachment and obtaining additional insights into land use and land cover changes. Ten individuals from local communities, farmers, and other stakeholders knowledgeable about the area were identified. The indepth interviews were conducted in person at different location with some virtual and audio record.

The selected ccommunities within the study area for the interviews and focus group discussions are shown below with their geographic coordinates:
Olode: 7°15′38″ N 4°38′8″ E (two respondents),
Ifetedo: 7°11′19″ N 4°41′52″ E (two respondents),
Reserve Area: 7°09′18″ N 4°27′16″ E (three respondents), and
Abiri Ogudu: 7°22′53″ N 4°38′56″ E (three respondents).

Data Analysis

Satellite Image Interpretation

Systematic processing and interpretation were performed to extract the necessary information from the satellite image data. A preliminary legend was established to guide the interpretation phase. ArcGIS 10.8 was used to prepare the band composite for the land satellite images and clip image to the study area, while ERDAS Imagine 2015 was used for supervised classification of the image.

Landsat Image Classification Process

The Landsat images were classified into six categories: Natural Vegetation, Cultivation, Plantation, Bare Surface, Rock Outcrop, and Built-up. This classification was based on field observations within the study area and visual inspection of the Landsat and Google Earth Pro images. The forest land cover category included deciduous, semi-deciduous, and evergreen vegetated trees. The Cultivation category consisted of row crops, harvested crop footprints. The Plantation consist of tree cash crops such as cocoa and plantains, the Bare Surface not in use, the Rock Outcrop are areas shadow by rocks/mountains. The Built-up class encompassed human settlement land use, industrial (mining) land use, and transportation land use/land cover.

Land use change was calculated using the formulas below:
LULC FORMULAE
% of Change: [(Previous yr – Initial yr)/ Initial yr] * 100

Frequency of change: (Previous yr – Initial yr)/ numbers of years.
Annual % increase: % of change/ numbers of yrs

For classified Landsat image:
Area of a feature= 30x30xnumber of counts in attribute table/10,000 in hectares or by 1,000,000 in square kilometre.

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Interview Analysis

The interview data, including residents' perceptions regarding the impact of forest encroachment and other relevant information, were analysed using Chi square analysis. Results were presented in tables as frequencies and percentages.

Results and Discussion

The study utilized Landsat imageries, in-depth interviews, and field surveys to gain insights into the extent and impact of agricultural encroachment on natural forests. The analysis revealed clustering of encroachment near human settlements and transportation routes, indicating the influence of accessibility and market proximity. The encroachment hotspots identified can guide targeted interventions and land-use planning. The interviews and surveys confirmed the socio-economic factors driving encroachment, including population growth, limited access to alternative livelihood options, and unclear land tenure systems. They also highlighted the negative impacts on livelihoods and the environment.

The study builds upon previous literature by incorporating qualitative insights obtained through interviews and surveys. The findings emphasize the urgency of implementing targeted interventions and strategies to address agricultural encroachment and promote sustainable land use. Capacity-building programs and knowledge sharing are important for empowering local communities to adopt practices that balance agricultural productivity and environmental conservation.

Land Use and Land Cover Change (2002 – 2022)

The analysis of Landsat imagery revealed significant land use changes over the 20-years period (Table 2, Figures 2-4). In 2002, Natural Vegetation was the dominant land cover (54.88%), followed by Cultivation (22.52%) and Plantation (20.59%).

Table 2: Land use changes in kilometre square and percentage (2002 – 2022)

LULC CLASS	2002 (Sq.km)	2002 (%)	2015 (Sq.km)	2015 (%)	2022 (Sq.km)	2022 (%)
Natural Vegetation	400.56	54.88	244.42	33.49	513.25	70.32
Cultivation	164.36	22.52	34.78	4.77	117.06	16.53
Plantation	150.32	20.59	349.27	47.85	55.16	7.56
Bare Surface	0	0	0.44	0.06	5.859	0.8
Rock Outcrop	4.53	0.62	85.72	11.74	13.78	1.49
Built-up	10.16	1.39	15.27	2.09	24.24	3.30

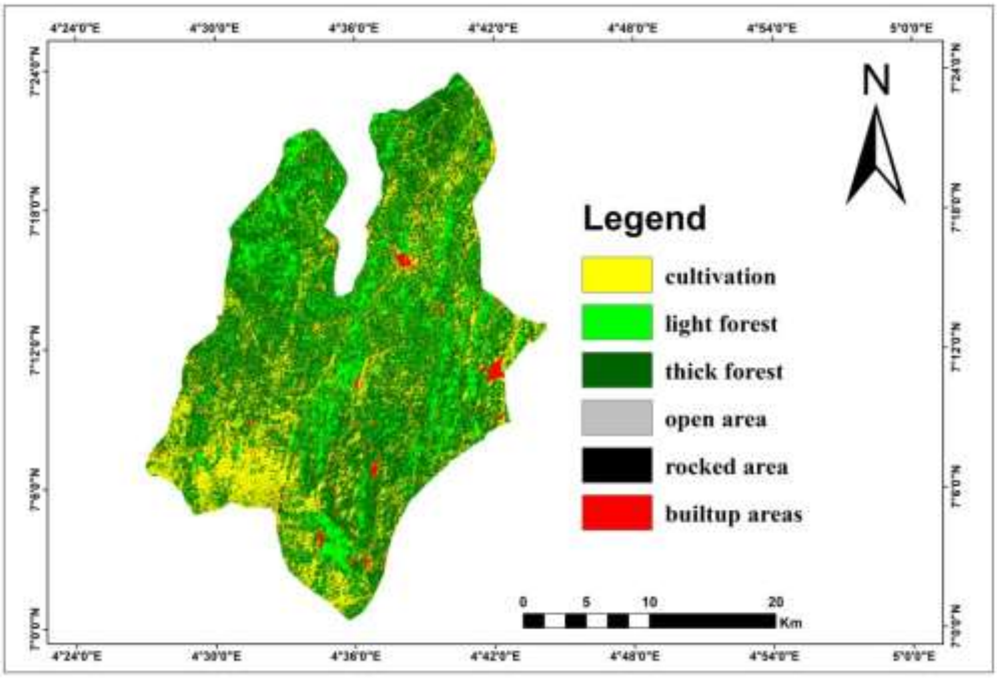

Figure 2: Land Use Map of the Study Area in 2002

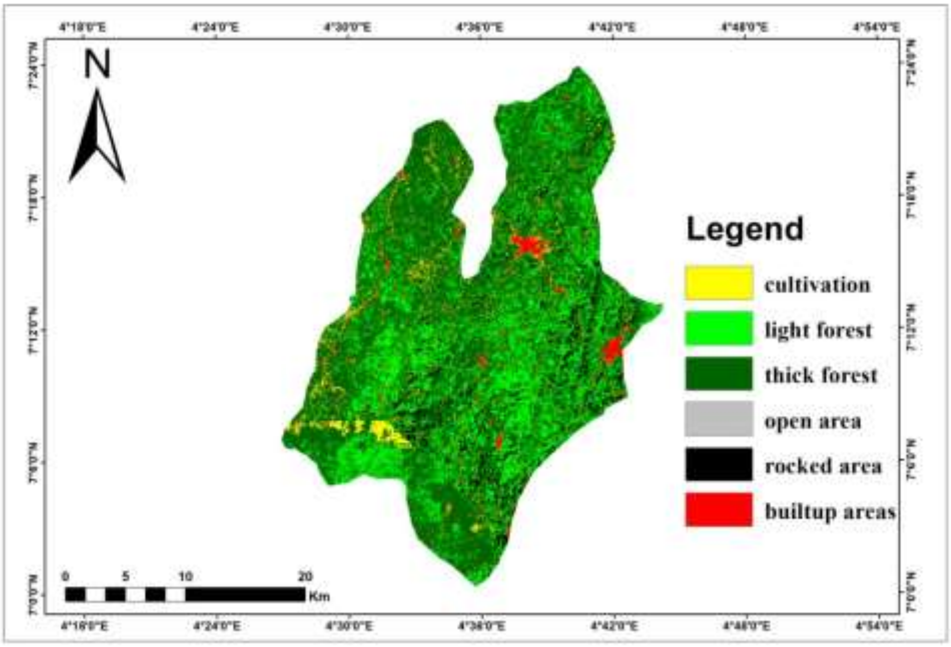

Figure 3: Land Use Map of the Study Area in 2015

The Figure 3 shows that by 2015, a dramatic shift occurred. Natural Vegetation decreased to 33.49%, while Plantation areas expanded significantly to 47.85%, indicating a major conversion of land for cash crops.

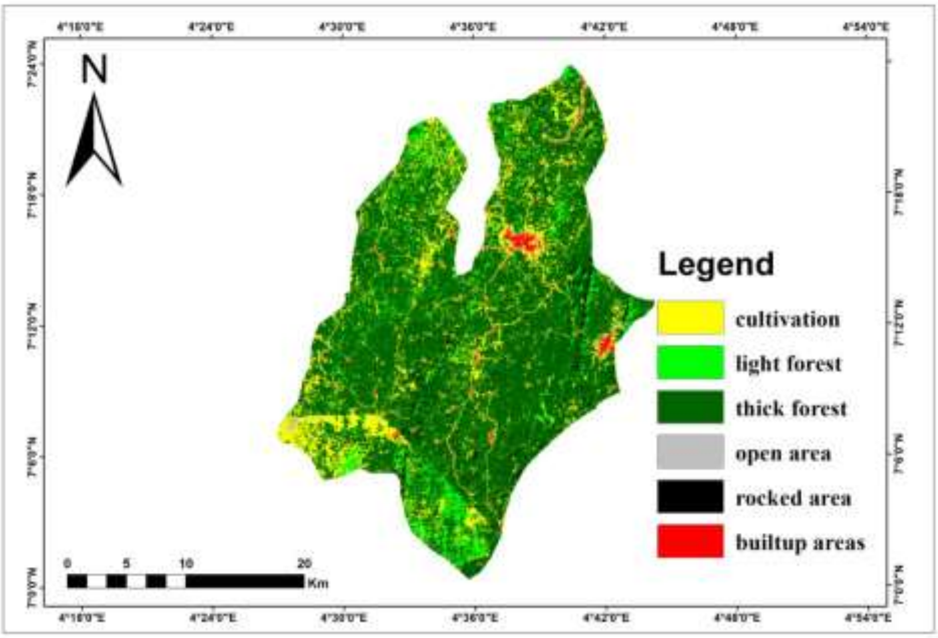

Figure 4: Land Use Map of the Study Area in 2022

In 2022 (Figure 4), a recovery of Natural Vegetation to 70.32% is observed, while Plantation areas receded. However, built-up areas show a consistent increase across all periods.

The data shows a net increase in natural vegetation of 28.13% from 2002 to 2022. However, this trend was not linear; a sharp decline of 39% occurred between 2002 and 2015, followed by a recovery of 110% from 2015 to 2022. Conversely, cultivated land and plantations saw net decreases of 28.78% and 63.31%, respectively. The most striking change was in built-up areas, which expanded by 138.62% over the two decades, attributed to population growth and immigration.

Assessment of the forest area and its changes over time

From the images classified into various land cover classes, the change over time was determined as shown in Table 3. This shows the land use change from 2002 – 2022 in the study area. There was an increase in natural vegetation over the 20-year period (28.13% change), while cultivation and plantation decrease by 28.78% and 63.31% respectively. However, built up areas increased by 138.62% over the 20-year period. The increase in built up is due to population increase in the area and immigration from other neighbouring local government areas facing community crisis and land grabbing from farmers who leased them by stakeholders in those area for mining or sales.

The findings align with the Forest Transition Theory, illustrating a complex cycle of forest decline and recovery within the study period. The initial decline (2002-2015) can be linked to agricultural expansion driven by population growth and economic needs, consistent with the neo-development phase of the theory. The subsequent recovery (2015-2022) may be attributed to increased awareness, policy interventions, or economic diversification, though this requires further investigation.

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Table 3: Land use changes from 2002 – 2022 in the study area

LULC CLASS	2002 (Sq.km)	2015 (Sq.km)	2022 (Sq.km)	LULC (2002 – 2022)		% Change	Freq. Change	Annual Increase
Natural Vegetation	400.56	244.42	513.25	112.69	0.28	28.13	5.63	1.41
Cultivation	164.36	34.78	117.06	-47.30	-0.29	-28.78	-2.37	-1.44
Plantation	150.32	349.27	55.16	-95.16	-0.63	-63.31	-4.76	-3.17
Bare Surface	0	0.44	5.86	5.86			0.29	
Rock Outcrop	4.53	85.72	13.78	9.25	2.04	204.31	0.46	10.22
Built-up	10.16	15.27	24.24	14.08	1.39	138.62	0.70	6.93
Total Area	729.90	729.90	729.90					

The study area has experienced significant land use changes over time. Initially, it had mostly natural forests, which provided a home for various plants and animals. However, due to increasing agricultural activities, particularly through encroachment, the forest cover has been steadily decreasing. This has led to the conversion of forested areas into agricultural lands, primarily for subsistence farming and cash crop cultivation. The expansion of agriculture has resulted in fragmented forest patches, changing the landscape and affecting ecological connectivity.

Agricultural encroachment on natural forests has had profound impacts on both individuals and the local community (Tovar, 2009). Traditional livelihood practices like hunting, gathering, and non-timber forest product collection have been severely disrupted. This has caused a decline in income, food security, and the loss of cultural traditions tied to the forest (Boafo et al, 2016). Additionally, encroachment has increased competition for resources and land conflicts, further worsening livelihood challenges.

The effects of agricultural encroachment on natural forests have far-reaching consequences for the local environment and ecosystem. The loss of forest cover has led to a decline in biodiversity as many species that rely on forests are displaced or face increased vulnerability (Mengistu and Salami, 2007). Deforestation also contributes to climate change by releasing significant amounts of carbon dioxide (Tejasmi, 2007). Changes in land use patterns disrupt natural water cycles, leading to alterations in hydrology, reduced water and air quality, and decreased water availability for humans and animals (Senior et al., 2017). Soil erosion and degradation are prevalent in areas where forests have been cleared, negatively impacting soil fertility and agricultural productivity (Sakiyo et al., 2020).

Socio-Economic Characteristics and Community Perceptions

The majority of respondents were male (70%), aged 41-50 years (40%), with senior secondary education (60%), and identified farming as their major occupation (50%).

Drivers of Change: 90% of respondents identified agriculture as the major land use change leading to forest loss ($X^2 = 1.111$, $p = 0.292$), with it accounting for loss of forest cover in the area, while agriculture and housing was identified by 10%.

Impact on Livelihoods: 50% reported the loss of forest cover that shields crops from wind and sun and prevents water loss. Another 40% stated that yields from hunting and cash crop production have become low due to agricultural encroachment ($X^2 = 1.667$, $p = 0.435$). This shows the impact on livelihood associated with agricultural encroachment on natural forest as observed in the study area by respondents.

Environmental Impacts: assessing the impact on local environment and ecosystem associated with agricultural encroachment on natural forest as observed in the study area by respondents. Forty percent (40%) cited the loss of protection for crops and the environment as the major impact on environment brought about by agricultural encroachment on natural forest, while 30% highlighted reduced air quality from bush burning (X^2 = 1.667, p = 0.797) and 10% cited land degradation and ozone layer depletion respectively.

Stakeholder Roles: 80% of respondents emphasized the need for stakeholders to focus on licensing, monitoring, and creating awareness on the negative impact of natural forest encroachment (X^2 = 0.278, p = 0.598) while twenty percent (20%) called for regulation of excessive logging.

Mitigation Strategies: The suggested strategies by the respondents included regulation/prohibition of tree felling (30%), tree planting (20%), and creating awareness (20%). In order to address agricultural encroachment on natural forest in the study area, 30% of the respondents suggested regulation/prohibition of felling trees to curb encroachment on natural forest in the area, while tree planting, and creation of awareness regarding the impact of agricultural encroachment on natural forest and the benefits of maintaining natural forest cover as well as the awareness on the need for appropriate licensing before execution.

The qualitative data confirms that agricultural encroachment has disrupted traditional livelihoods and led to environmental degradation, including biodiversity loss and soil degradation, as noted by Mengistu and Salami (2007) and Sakiyo et al. (2020). The dramatic increase in built-up areas underscores the role of population pressure as an indirect driver of deforestation, as identified by Tole (1998).

The socio-economic characteristics of respondents in the study area were analysed. The distribution by location and political ward revealed that Ward 10 had the highest number of respondents (30%), followed by wards 2 and 7 (20% each). In terms of gender and age, male respondents dominated (70%), with the highest percentage in the age group of 41-50 years (40%). The majority of respondents practiced Christianity (60%), were married (80%), and had senior secondary education (60%), with farming as the major occupation (50%). The length of stay in the area varied, with 50% residing for 1-10 years. The degree of agricultural encroachment on forest area was examined through respondents' observations. Ninety percent of respondents noted that agriculture was the major land use change, leading to forest loss. The impact of agricultural encroachment on livelihoods included loss of forest cover (50%) and reduced yields (40%). In terms of environmental impacts, loss of protection for crops and the environment (40%) and air quality reduction through bush burning (30%) were identified. Stakeholders were recommended to regulate logging (20%) and focus on licensing, monitoring, and awareness (80%) to address encroachment. Community involvement indicated positive (50%), negative (40%), and indifferent (10%) results. Respondents suggested strategies like regulation of tree felling (30%) and tree planting (20%) to curb encroachment, emphasizing economic benefits and enhanced crop production (70%). However, some respondents lacked awareness or understanding of potential outcomes. Overall, the findings highlighted the prevalence of agricultural encroachment on natural forest, its impact on livelihoods and the environment, and the need for stakeholder involvement to mitigate these issues. Land use change analysis from 2002 to 2022 showed an increase in natural vegetation and built-up areas, while cultivation and plantation decreased.

To effectively address agricultural encroachment on natural forests, the local government and stakeholders should consider several measures. This includes implementing robust land-use planning processes that designate suitable areas for agriculture while safeguarding ecologically sensitive forest areas. Encouraging the adoption of sustainable farming techniques like agroforestry and organic farming can minimize the need for further forest conversion and promote biodiversity conservation (Acheampong et al., 2019). Strengthening law enforcement mechanisms to deter illegal encroachment, fostering community involvement in decision-making processes, and providing alternative income-generating opportunities are also essential steps.

Local communities have actively participated in efforts to mitigate agricultural encroachment by engaging in awareness campaigns, reforestation activities, and capacity-building programs on sustainable land management practices (AGRA, 2013). However, broader collaboration and support from government agencies and stakeholders are necessary for more significant and lasting impact. Communities should be engaged in decision-making processes, encouraged to participate in sustainable land-use planning, and provided with alternative income-generating activities compatible with forest conservation (Yeo & Huang, 2013).

Conclusion

The study discusses the geospatial analysis of agricultural encroachment on natural forests in the Ife South Local Government Area (LGA) of Osun State. Over the years, the LGA's economic transformation has put pressure on the agricultural sector, leading to the clearing of natural forests for cultivation. This degradation of forests has resulted in adverse effects on the environment, including erosion, loss of biodiversity, soil degradation, and unfavourable hydrological changes. The study assessed the influence of agricultural encroachment on natural forests and develop strategies for achieving a sustainable environment by assessing vegetal cover changes from 2002 till 2022, examine the forest area and its changes over time, evaluate the perception of the various groups of dwellers to the deforestation activities and recommending methods that may help in future forest planning in the region.

The study utilized satellite imageries, focused interviews, and surveys to understand the extent and impact of agricultural encroachment. The data was analysed using geospatial and statistical analysis. The findings showed that agricultural encroachment has led to significant changes in land use, with a decline in forest cover (28%) and an increase in cultivated and built-up areas. This has disrupted traditional livelihood practices, affected biodiversity, and negatively impacted the local environment and ecosystems.

Specific solutions and strategies for addressing agricultural encroachment include promoting the establishment of agroforestry networks to connect forest patches, effectively managing protected areas, and developing integrated land-use management plans through collaboration between government agencies, community-based organizations, and other stakeholders. Provision of support and resources for the development of sustainable livelihood alternatives that reduce dependency on forest resources and promote economic resilience is also crucial. Also, when addressing agricultural encroachment, it is important to carefully consider the benefits and trade-offs of different solutions. Balancing agricultural productivity, livelihood improvement, and ecological conservation requires a holistic approach. Decision-makers should assess the environmental, social, and economic impacts of each strategy, considering short-term and long-term benefits and potential unintended consequences. Engaging in participatory processes and conducting thorough impact assessments can help identify the most suitable interventions while minimizing negative trade-offs.

Sustainable land-use planning should be a priority, involving the designation of protected areas, identification of suitable lands for agriculture, and implementation of zoning regulations. Community involvement is critical for successful mitigation, and law enforcement mechanisms should be strengthened. Ongoing research and monitoring are necessary to assess the long-term impacts of mitigation measures. Additionally, exploring the social and cultural dimensions of encroachment through qualitative research methods and integrating emerging technologies like machine learning can enhance monitoring and assessment accuracy.

In conclusion, the integrated analysis of satellite imageries, interviews, and surveys provides a comprehensive understanding of agricultural encroachment on natural forests. Context-specific interventions are needed to balance ecological and socio-economic dimensions. The findings can inform evidence-based policies and interventions, ensuring sustainable land-use practices, forest conservation, and community resilience. Future land-use planning can be more informed, preserving critical forest areas and promoting sustainable agriculture. The study contributes to the broader understanding of agricultural encroachment and provides guidance for sustainable land management practices.

This study demonstrates that agricultural encroachment has been a significant force shaping the landscape of Ife South LGA, resulting in complex land use dynamics and negative socio-ecological impacts. While a recent recovery in natural vegetation is a positive sign, the substantial expansion of built-up areas and the persistent pressure from agriculture highlight the ongoing challenges.

To address these challenges, the following recommendations are proposed:

1. Integrated Land-Use Planning: Implement robust land-use plans that designate protected areas and suitable agricultural zones to prevent further encroachment.
2. Promotion of Sustainable Practices: Encourage the adoption of agroforestry and sustainable farming techniques to increase yield without expanding into forest lands.
3. Community Involvement and Enforcement: Foster community participation in forest management and strengthen law enforcement to deter illegal logging and encroachment.
4. Stakeholder Collaboration: Develop integrated land-use management plans through collaboration between government agencies, community-based organizations, and other stakeholders.
5. Livelihood Diversification: Provide support and resources for developing sustainable livelihood alternatives that reduce dependency on forest resources.

Moreso, joint management of forests by involving all stakeholders - local communities and others, would help in curtailing illegal logging, encroachments, wildlife protection and sustainable management of forests. By implementing these strategies, a balance can be struck between agricultural development and environmental conservation, ensuring a sustainable and resilient future for Ife South LGA.

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