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Funding Trees Planting to Enhance Greenery and Provide Nature-Based Solutions to Natural Disasters

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ABSTRACT

This study proposes a sustainable funding mechanism for afforestation and reforestation initiatives in Lagos, Nigeria, through the Land Use Charge System under the Reducing Emissions from Deforestation and Forest Degradation (REDD) framework. The initiative seeks to enhance urban greenery, mitigate natural disasters, and improve air quality and biodiversity. The paper outlines the goals, implementation plan, business model, and expected outcomes of the project, highlighting its alignment with national climate change policies.

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Introduction

Climate change is one of the most pressing challenges of the 21st century, with far-reaching impacts on ecosystems, economies, and human well-being. Tropical latitudes, including regions like Lagos State in Nigeria, are particularly vulnerable to the adverse effects of climate change due to their reliance on agriculture, high population density, and exposure to extreme weather events. In recent years, Lagos State has experienced increased flooding, soil erosion, and loss of biodiversity, exacerbated by rapid urbanization, deforestation, and unsustainable land utilize practices. These challenges underscore the urgent necessity of innovative and sustainable solutions to enhance environmental resilience and mitigate the impacts of climate change.

One promising approach is the strategic funding of afforestation and reforestation initiatives initiatives to enhance urban veobtaination and mitigate the impacts of natural disasters. Trees play a critical role in regulating the climate, preventing soil erosion, reducing flood risks, and enhancing biodiversity. By leveraging the Land Use Charge System in Lagos State, afforestation and reforestation initiatives can be integrated into urban planning, agricultural practices, and disaster risk management strategies. This paper explores the potential of funding afforestation and reforestation initiatives as a nature-based solution to enhance urban veobtaination and build resilience against natural disasters in Lagos State, with a focus on the intersection of climate change and agriculture in tropical latitudes.

Background

Climate Change and its Impacts in Lagos State

Lagos State, located in the tropical latitude of West Africa, is highly susceptible to the impacts of climate change. Rising temperatures, erratic rainfall patterns, and sea-level rise have intensified the frequency and severity of natural disasters such as flooding, which has become a recurring challenge in the region. For instance, the 2022 floods in Lagos displaced thousands of residents, destroyed crops, and disrupted economic activities, highlighting the State's vulnerability to climate-induced disasters.

Agriculture, a key sector in Lagos State, is particularly affected by these changes. Smallholder farmers, who constitute a significant portion of the population, face reduced crop yields, soil degradation, and increased pest infestations due to changing climatic conditions. These challenges threaten food security and livelihoods, exacerbating poverty and inequality in the region.

Air Pollution in Lagos State: A Growing Public Health Crisis

Air pollution remains a significant global public health challenge, with the State of the World Population reporting that it contributes to an estimated 2.7 million to 3 million deaths annually [1]. This alarming statistic underscores the far-reaching consequences of environmental degradation, including damage to groundwater, soil, and air quality. Such environmental harm not only threatens biodiversity but also poses severe risks to human health, manifesting in respiratory disorders, cardiovascular dysfunction, and neuropsychiatric complications [2].

In Lagos State, recent measurements indicate that the concentration of particulate matter (PM2.5 or PM10) has soared to an average of 68 micrograms per cubic meter (µg/m³), far exceeding the World Health Organization (WHO) guideline of 10 µg/m³ for safe air quality [2]. This stark disparity highlights the urgent necessity of tarobtained interventions to address the sources of pollution and mitigate its health impacts.

Major Sources of Pollution in Lagos

The primary contributors to Lagos's elevated pollution levels include:

- Road Transport: The rapid urbanization and increasing vehicular density in Lagos have led to significant emissions from road transport, including particulate matter and nitrogen oxides (NOx).
- Industrial Emissions: Industrial activities, particularly in areas like Apapa and Ikeja, release large quantities of pollutants into the atmosphere, exacerbating air quality issues.
- Generator Emissions: Due to unreliable electricity supply, the widespread utilize of diesel and petrol generators has become a major source of air pollution, releasing harmful pollutants such as carbon monoxide (CO) and sulfur dioxide (SO_2).
- 2.2.2 Pollution Levels in Selected Areas

The table below presents pollution levels in selected areas of Lagos State, as measured by the Optimum Pollution Counter (OPC) in 2020

Air Pollution Index (API) Readings in Lagos State
(Units: PM2.5/PM10 in µg/m³; gases in ppb/ppm; API scale: 0–500)

SN	Location	Readings: GHG Emissions	Remarks
1.	Alausa Ikeja (Government/ Commercial Hub)	PM2.5: 48 µg/m³ (Unhealthy for Sensitive Groups) PM10: 120 µg/m³ (Unhealthy) NO_2: 50 ppb (Traffic emissions from Secretariat complex) CO: 1.5 ppm (Elevated from generators and vehicles)	API Score: 132(Unhealthy for Sensitive Groups) Government buildings relying on diesel generators, high vehicular traffic, and waste burning at Olusosun waste dump.
2.	Apapa (Port/Industrial Zone)	PM2.5: 220 µg/m³ (Very Unhealthy) PM10: 350 µg/m³ (Hazardous) SO_2: 40 ppb (Ship fuels and refinery emissions) Black Carbon: 15 µg/m³ (Diesel trucks and port activity)	API Score: 287 (Very Unhealthy) Cargo ships, congested diesel trucks, and industrial plants like the Odogunyan steel complex.
3.	Victoria Island (High-Income Residential/Commercial)	PM2.5: 35 µg/m³ (Moderate) PM10: 75 µg/m³ (Unhealthy for Sensitive Groups such as asthma patients) O_3: 60 ppb *(Afternoon smog from traffic) VOCs: 0.2 mg/m³ (From construction and coastal breezes)	API Score: 95 (Moderate) Luxury vehicles, construction sites, and occasional generator use.
4.	Ajegunle (Low-Income Residential)	PM2.5: 85 µg/m³ (Unhealthy) PM10: 200 µg/m³ (Very Unhealthy) CO: 4 ppm (Trash burning, wood/charcoal cooking and kerosene stoves) NO_2: 55 ppb (Old vehicles and poor roads)	API Score: 175 (Unhealthy) Open waste burning, overcrowded roads, and lack of clean energy access.
5.	Lekki (Suburban/New Development)	PM2.5: 25 µg/m³ (Moderate) PM10: 50 µg/m³ (Moderate) CO_2: 950 ppm (Indoor ventilation issues) Radon: 1.8 pCi/L (Safe)	API Score: 68 (Moderate) Fewer industries but rising construction and traffic from new estates.

Key: ppm-parts per million; ppb-parts per billion; PM-particulate matter; VOC-volatile organic compounds

Interpretation & Trends

Worst Areas: Apapa and Ajegunle exceed WHO limits due to industrial activity and waste burning, with API scores in the "Very Unhealthy" to "Hazardous" range.

Moderate Zones: Alausa Ikeja and Victoria Island demonstrate elevated PM2.5 from generators and traffic, while Lekki benefits from lower density.

Health Risks: PM2.5 levels in Apapa (220 µg/m³) are 22× higher than WHO's safe limit (10 µg/m³), linked to respiratory diseases and premature deaths.

Health Implications

The persistent exposure to high levels of air pollution in Lagos has severe public health implications. Respiratory disorders, such as asthma and chronic obstructive pulmonary disease (COPD), are increasingly prevalent among residents. Additionally, cardiovascular diseases and neuropsychiatric complications have been linked to prolonged exposure to polluted air, further burdening the healthcare system [3].

Deforestation and Land use Challenges

Rapid urbanization and population growth in Lagos State have led to widespread deforestation and the conversion of green spaces into built-up areas. The loss of tree cover has diminished the state's capacity to absorb carbon dioxide, regulate temperatures, and manage stormwater. Additionally, unsustainable land utilize practices, such as unregulated construction and agricultural expansion, have further degraded the environment, making the state more prone to natural disasters.

The current land utilize system in Lagos State is characterized by a lack of integration between urban planning, environmental conservation, and disaster risk management. This disconnect has resulted in fragmented efforts to address climate change and its impacts, underscoring the necessity of a more holistic and coordinated approach.

The Role of Tree Planting in Climate Change Mitigation and Adaptation

Tree planting is widely recognized as a cost-effective and sustainable strategy for mitigating and adapting to climate change. Trees act as carbon sinks, absorbing carbon dioxide from the atmosphere and reducing greenhoutilize gas emissions. They also provide ecosystem services such as soil stabilization, water regulation, and habitat provision, which are essential for maintaining ecological balance and supporting agricultural productivity.

In the context of Lagos State, afforestation and reforestation initiatives can serve as a nature-based solution to address multiple challenges simultaneously. By increasing greenery, afforestation and reforestation initiatives can enhance the aesthetic and environmental quality of urban areas, reduce the urban heat island effect, and improve air quality. In rural and peri-urban areas, trees can be integrated into agroforestry systems to improve soil fertility, increase crop yields, and provide additional sources of income for farmers.

The Land Use Charge System as a Funding Mechanism

The Land Use Charge System in Lagos State is a property tax levied on real estate properties, including residential, commercial, and agricultural lands. It is a significant source of revenue for the state government, which utilizes the funds for infrastructure development, public services, and environmental management. By allocating a portion of the Land Use Charge revenue to fund afforestation and reforestation initiatives initiatives, Lagos State can create a sustainable and reliable funding mechanism for large-scale reforestation and afforestation projects.

The integration of afforestation and reforestation initiatives into the Land Use Charge System offers several advantages:

- **Sustainable Funding:** The Land Use Charge provides a consistent and predictable source of revenue, ensuring long-term funding for afforestation and reforestation initiatives initiatives.
- **Incentivization:** Property owners can be incentivized to participate in afforestation and reforestation initiatives programs through tax rebates or reductions, encouraging community involvement and ownership.
- **Scalability:** The Land Use Charge System covers a wide range of properties across the state, enabling the scaling up of afforestation and reforestation initiatives efforts to achieve significant environmental and social benefits.
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Objectives of the Paper

This paper seeks to:

- Examine the potential of afforestation and reforestation initiatives as a nature-based solution to enhance urban veobtaination and mitigate the impacts of natural disasters in Lagos State.
- Analyze the role of the Land Use Charge System as a sustainable funding mechanism for afforestation and reforestation initiatives initiatives.
- Explore strategies for integrating afforestation and reforestation initiatives into urban planning, agriculture, and disaster risk management using the Land Use Charge System.
- Provide policy recommendations for leveraging the Land Use Charge System to promote afforestation and reforestation initiatives and enhance climate resilience in Lagos State.

Climate Change Issues in Lagos

Lagos, like many cities below sea level, continues to experience flooding, flash flooding, and erosion due to the loss of green areas and wetlands, which have been sand-filled for housing and infrastructure development. A flooded or eroded farmland produces no food, exacerbating food insecurity.

In 2011, the world experienced unprecedented effects of climate change, including ice and glacier melting, flooding, forest fires, drought, and water stress. Lagos was not spared, as the July 10, 2011, floods submerged low- and highlands, eroding areas like Thomas in Ajegunle and Ikorodu. These events could have been mitigated with sufficient green areas, as demonstrated by the role of trees during the 2011 tsunami in Japan.

In 2018, flooding affected 80% of Nigeria, displacing over 600,000 people—a disaster that could have been prevented with adequate green areas [4]. The National Climate Change Policy for Nigeria 2021-2030 seeks to reduce greenhoutilize gas (GHG) emissions and mitigate the socio-economic impacts of climate change. Regular funding for afforestation and reforestation initiatives, as proposed in this paper, will support the policy's goals by sequestering GHGs, regulating weather patterns, and reducing ocean surges, flooding, and erosion.

Climate Change Impacts on Agriculture and Food Security in Lagos

Effects on Crop Production Systems

The agricultural sector in Lagos State faces mounting threats from climate variability, with disproportionate impacts across key staple crops:

Table 1: Comparative Crop Yield Trends (1998-2018)

SN	Crop	Yield Stability	Climate Vulnerability Factors	Luc-Linked Mitigation Strategy
1	Maize	▼ 22% decline	Erratic rainfall, temperature spikes	Agroforestry buffers with drought-resistant species (e.g., Neem)
2	Cassava	► Stable	Resilient to moisture variability	Intercropping with nitrogen-fixing acacias. 3
3	Vegetables	▼ 15% decline	Flood susceptibility	Raised bed systems with perimeter tree belts.

Data source: Lagos State Ministry of Agriculture (2019) [5]

- Land Use Charge Integration:
- The LUC system can incentivize climate-smart agriculture through:
- 15-25% tax rebates for farms implementing approved agroforestry systems
- Priority funding for afforestation and reforestation initiatives in flood-vulnerable agricultural zones mapped through GIS-based LUC records
- Cross-subsidization were commercial property taxes support rural afforestation

Flooding Impacts on Agricultural Systems

Crop Production Losses

Historic Flood Events

The 2011 floods submerged farmlands across Lagos, with LUC records demonstrateing 68% of affected properties lacked proper drainage buffers. The catastrophic 2022 event destroyed 440,000 hectares of farmland nationally, with Lagos accounting for 23% of losses - disproportionately impacting LUC-designated agricultural zones.

Aquaculture Disruptions

Ikorodu Fish Farm Case Study:

Recurrent flooding cautilizes:

- 40% annual production losses ($2.1m economic impact)
- 75% higher operating costs for pond rehabilitation

LUC-based solution: Allocation of 5% annual LUC revenue from Apapa industrial properties (API score: 287) to fund:

1. Mangrove buffers along fish farm perimeters
2. Elevated pond designs with integrated tree root systems
3. Community-based monitoring tied to LUC compliance

4.3 Agroforestry Implementation Framework

4.3.1 Recommended Species Mix

SN	Location	Primary Species	Secondary Species	LUC Benefit Category
1	Coastal Farmlands	Rhizophora racemosa (mangrove)	Terminalia catappa (Almond)	Flood mitigation (25% rebate)
2	Inland Fields	Leucaena leucocephala (Leadtree	Moringa oleifera	Soil improvement (15% rebate)
3	Urban Periphery	Khaya senegalensis (Mahogany)	Azadirachta indica (Neem)	Air quality (20% rebate)

Implementation Plan

The implementation plan is divided into four phases:

Phase 1 (1–3 months): Needs Assessment, Framework Development, and Policy Alignment

- Conduct surveys to identify areas most in need of afforestation and reforestation initiatives.
- Develop a comprehensive project framework, including goals, tarobtain species, and methods of engagement.
- Collaborate with local governments to align policies with REDD principles.
- Phase 2 (4–6 months): Community Engagement and Awareness Campaigns
- Launch awareness campaigns to educate the public about the importance of afforestation and reforestation initiatives.
- Organize workshops and training sessions for community members on tree care and maintenance.
- Recruit volunteers and local organizations for planting activities.
- Phase 3 (7–12 months): Initial Tree Planting and Monitoring
- Begin afforestation and reforestation initiatives in selected neighborhoods.
- Expand planting efforts to additional areas, ensuring species diversity.
- Establish a maintenance plan and assign responsibilities to community groups.
- Phase 4 (25–26 months): Comprehensive Evaluation and Reporting
- Conduct a comprehensive project evaluation to assess effectiveness and impact.
- Publish a report detailing outcomes, lessons learned, and recommendations for future initiatives.

Implementation (Food Production Focus)

Phase 1 (Pilot):

- Tarobtain 50 high-LUC-value commercial properties to fund 100ha of demonstration agroforestry plots
- Link 10% LUC penalty waivers to verified tree survival rates

Phase 2 (Scale-up):

- Establish nursery networks using 2% of LUC infrastructure allocation
- Train 500 farmers annually through LUC-funded extension services

Monitoring:

- GIS-tracked tree canopy growth tied to LUC assessment cycles
- Biennial productivity impact assessments for rebate calibration

Systemic Benefits

The integrated LUC-agroforestry model delivers:

- 30% reduction in flood-related crop losses (projected $200m annual savings)
- 15% increase in farm incomes through diversified agroforestry products
- 20% improvement in LUC compliance via green incentive programs

Business/Economic Model

Revenue Streams: Land Use Charge System, corporate sponsorships, grants, and donations.

Stakeholders: Local government, communities, NGOs, and corporate partners.

Activities: Awareness campaigns, afforestation and reforestation initiatives events, and monitoring.

Bud obtain: ₦436,135,000 for planting 73,300 trees along 100 canals.

Projection: Increase Land Use Charge by ₦1,000 per tar obtained building

- 2024 = 1,704,000,000 @ 1,704,000 buildings (estimated)
- 2025 = 1,746,000,000 @ 1,746,000 buildings (estimated)
- 2026 = 1,788,000,000 @ 1,788,000 buildings (estimated)
- 2027 = 1,830,000,000 @ 1,830,000 buildings (estimated)

- 2028 = 1,872,000,000 @ 1,872,000 buildings (estimated)
- 2029 = 1,914,000,000 @ 1,914,000 buildings (estimated)
- 2030 = 1,956,000,000 @ 1,956,000 buildings (estimated)

Expected Outcomes

- • Increased food production and security.
- • Enhanced biodiversity and reduced wastelands.
- • Improved quality of life and reduced heatwaves.
- • Employment opportunities and revenue generation.

Challenges, Risks, and Solutions

- Uprooting: Use tree guards, deep planting techniques, and community stewardship.
- Theft: Engage community watch groups and utilize low-value materials.
- Community Acceptability: Conduct awareness campaigns and involve local leaders.
- Alignment with Canals: Select flood-resistant species and establish buffer zones.
- Poverty: Provide alternative livelihoods and incentivize participation.

Conclusion

Funding afforestation and reforestation initiatives through the Land Use Charge System represents a sustainable approach to addressing climate change and environmental degradation in Lagos State. By leveraging this funding mechanism, Lagos can enhance its greenery, build resilience to natural disasters, and improve the livelihoods of its residents. This paper contributes to the growing body of knowledge on climate change and agriculture in tropical latitudes, offering insights and recommendations for policymakers and stakeholders.

Key Message: Tree planting in Lagos will mitigate climate change impacts, enhance urban greenery, and improve community resilience.

Call to Action: Support funding through the Land Use Charge System and partnerships.

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