WOOD-FUEL RELIANCE AND ITS IMPLICATIONS FOR CLIMATE CHANGE AND THE RURAL ECONOMY OF BENUE STATE, NIGERIA, 1976–2025

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Abstract

Research Problem: *Climate change has become a critical global concern, yet charcoal and firewood production and use continue to expand across rural Benue State. This study interrogates the socio economic drivers of wood fuel dependence and its implications for climate change, environmental degradation and rural livelihoods between 1976 and 2025.*
Methods/theory: *The study adopted a historical and multidisciplinary approach, drawing on oral evidence, extant literature, policy documents and a structured field survey of 50 respondents comprising producers, users, traders and transporters across the 23 Local Government Areas of Benue State. The analysis was anchored on the Greenhouse Effect Theory to explain the relationship between wood fuel exploitation, greenhouse gas emissions, carbon sink depletion and environmental change.*
Results: *Findings indicate that wood fuel dependence is primarily a socio economic coping mechanism arising from the high cost and unreliability of electricity and LPG, with over 95 percent of the rural population relying on firewood and charcoal. Unregulated tree felling, charcoal production and intensive distribution contribute to deforestation, erratic rainfall, prolonged dry seasons, soil erosion and flooding, including major flood events recorded in 2012, 2017, 2018 and 2021.*
Conclusion:*The study establishes that wood fuel dependence in Benue represents an interconnected crisis of energy insecurity, poverty and environmental degradation, compounded by weak enforcement of forestry regulations.*
Key Contribution to Knowledge: *The study demonstrates that rural wood fuel dependence is simultaneously an energy survival strategy and a mechanism through which climate vulnerability is reproduced.*
Recommendation: The study recommends affordable alternative energy technologies, structured reforestation, sustainable livelihood programmes

and stronger, better communicated enforcement of existing forestry and environmental regulations.

1. Introduction

The rural economy of the Benue area has traditionally revolved around agriculture, local industries, artisanal activities and natural resource exploitation. As part of Nigeria's Middle Belt region, Benue State is known as the country's food basket, given its vast fertile soil, favourable climate and availability of water supporting farming and food production. Historically, subsistence farming of crops such as yam, cassava, maize and rice formed the backbone of Benue's agricultural system. With limited access to modern energy sources such as cooking gas, electric hotplates and solar energy systems, however, rural communities in Benue have increasingly turned to charcoal and firewood as alternative income streams and essential energy sources for cooking and heating.

Charcoal and firewood production and use have a long historical pedigree among communities of the Benue Valley, dating to the pre-colonial era, when firewood was the primary energy source for domestic use and for traditional industries such as blacksmithing and local beer brewing. Charcoal production during this period was minimal, since most households relied directly on firewood. This reliance continued into the colonial and post-colonial eras. Population growth and the expansion of urban centres in the post-colonial period gradually increased the demand for charcoal as a cleaner, more portable energy source, even in urban areas, and charcoal production became commercialized, with rural producers supplying urban dealers and marketers in wholesale arrangements. The Benue rural economy saw a further, marked shift toward charcoal and firewood production and commercialization from the 2000s onward, attracting the participation of youth, children, women and men, driven especially by declining agricultural productivity and rising unemployment, and compounded by a low level of environmental awareness of the practice's dangers.

Charcoal and firewood production has accelerated the rate of environmental problems and climate change in Benue State from the 1990s onward, as deforestation for wood-fuel has made soils and settlements more prone to erosion and to the threats of severe storms. Ineffective institutional and policy frameworks, corruption, and poor management of ecological funds have collectively made charcoal and firewood production a thriving informal economy in the state, while rising prices of modern energy sources have provided a continued rationale for wood-fuel reliance. This research interrogates the implications of firewood and charcoal economics on the Benue rural economy and on climate change, tracing the historical evolution of wood-fuel reliance, the factors that continue to drive it, the legal frameworks that have attempted to regulate it, and its documented environmental and economic consequences.

Historically, charcoal and firewood production have played a crucial role in the rural economy of Benue State. Their environmental consequences, however, have become an international concern, owing to potential threats to vegetation cover that lead to soil erosion and loss of soil fertility, together with threats to respiratory health and broader environmental pollution. To curtail deforestation for charcoal and firewood production, several legal frameworks have been established by the United Nations General Assembly (UNGA) and the Nigerian government to regulate forest exploitation and the use of wood-fuel as an alternative energy

source. The effectiveness of these legal instruments and their enforcement remains a question of critical research interrogation, particularly given that the practice continues largely unabated. This research therefore examines the historical evolution of firewood and charcoal production and evaluates the implications of these practices for climate change in Benue State and for the state's rural economy. To this end, the central objectives of the study is to trace the historic roots of charcoal and firewood production and to evaluate the implications of reliance on them as alternative energy sources for climate change and the rural economy in Benue State. The specific objectives are:

i. To trace the historic origin of firewood and charcoal production in Benue State.

ii. To examine the factors that influence the production and use of charcoal and firewood as energy sources in the state.

iii. To evaluate the implications of charcoal and firewood production for climate change and the rural economy in Benue State.

iv. To analyze the legal instruments that guide the production and use of charcoal and firewood in Nigeria, Benue State inclusive.

Literature Review

2.1 Studies on the Nature and Drivers of Wood-fuel Production and Use

Vihi and colleagues, in a study of household fuelwood consumption in Vandeikya Local Government Area of Benue State, found that Nigeria tops the list of African charcoal producers, with output rising from roughly 2.3 million tonnes in 1992 to about 3.8 million tonnes in 2009, indicating that Nigeria continues to produce and use charcoal without having developed modern, sustainable alternatives. The study estimated that about 32 million cubic metres of fuelwood is consumed annually in rural Nigeria, and found that most respondents obtained firewood at no cost from forests (44 percent) or their own farmlands (37 percent). Reported prices in the study area included roughly ₦200 per bundle of firewood, ₦750 per litre of kerosene, ₦2,500 per 50-kilogram bag of charcoal, ₦61.5 per kilowatt-hour of electricity, and ₦780 per kilogram of gas, with average household fuelwood consumption of about three bundles daily. The main reasons respondents gave for fuelwood consumption over other sources were the lack of cheaper alternatives (88 percent), large family size (84 percent), and easy availability (77 percent), while perceived environmental effects included deforestation (75 percent), global warming (57 percent), indoor and outdoor pollution (53 percent), and violent windstorms (46 percent). Marital status, educational status, household size, monthly income and the cost of gas significantly influenced fuelwood consumption. The study recommended encouraging alternative clean energy sources and technologies, alongside tree-planting campaigns, but restricted its scope to Vandeikya and remained silent on past or current legal mitigation frameworks, a gap the present review addresses.

A study published on Google Scholar and Wikipedia titled 'Firewood in Nigeria' found that a significant portion of the population lacks access to modern energy alternatives and consequently depends heavily on traditional biomass fuels. It identified fuelwood's common uses in Nigeria as cooking, heating, small-scale industrial and artisanal activities (baking, food processing, pottery, brick-making, blacksmithing, carving and woodworking), charcoal production itself, and campfire, cultural and religious practices. The study noted that this reliance has implications for deforestation and biodiversity loss, and that deforestation exacerbates climate change by releasing carbon dioxide into the atmosphere.

Babalola and Opii, examining socio-economic factors affecting household charcoal consumption in Benue State through structured questionnaires, found that about 76.7 percent of sampled households used charcoal as a cooking fuel almost every day of the week, with kerosene and firewood as the most competitive alternatives. Affordability, linked to lower cost (62.8 percent) and consistent availability, were the leading reasons given for choosing charcoal. The authors argued that sustainable production and use of charcoal, through proper management of supply sources, rational trade and marketing infrastructure, and efficient use, could have a significant positive impact on resource conservation and household income. Their study, though geographically overlapping with the present research, focused narrowly on charcoal and did not extend to firewood or to the historical and climate-change dimensions this research addresses.

Gridneff, writing on the illegal charcoal trade between the Horn of Africa and the Gulf, traced the history of wood charcoal production to ancient times, describing the traditional process of stacking wood billets into a conical pile, allowing air to enter through openings at the base, and igniting the pile gradually, tended by skilled charcoal burners. He linked extensive charcoal production historically to deforestation in regions including Central Europe and Africa, discussed management practices such as coppicing intended to sustain wood supply, and noted that modern methods carbonize wood in retorts at higher efficiency than traditional kilning. He catalogued charcoal's diverse applications, from metallurgical and industrial fuel to cooking, chemical processing, pyrotechnics, cosmetics, horticulture, animal husbandry, medicine and carbon sequestration efforts, while cautioning that illegal and unregulated production in regions such as South America and Africa poses significant challenges for environmental conservation and climate change through the emissions generated by burning. His study did not, however, provide concrete evidence linking charcoal production specifically to global warming in his study areas, nor did it examine regulatory mitigation frameworks, gaps the present research takes into account.

2.2 Studies on the Environmental and Climate Impact of Charcoal and Firewood

Eniola and Odebode, studying perceived environmental effects of charcoal production among rural dwellers in Nigeria's rainforest and Guinea savannah agro-ecological zones, found that 80.0 percent of respondents used the earth-mound method of charcoal production and that 52.9 percent produced between 32 and 32,000 kilograms of charcoal annually, indicating that charcoal serves as an alternative energy source for many families, particularly low-income earners, owing to the high cost of modern energy and the comparatively low cost of charcoal production and transport relative to firewood. Respondents linked charcoal production to erosion, reduced future tree availability, and reduced air quality. The study stressed the urgent need for affordable alternative household energy sources, but remained silent on mitigation efforts and their effectiveness, a vacuum the present research addresses for the Benue rural economy specifically.

Njenga, Sears and Mendum, in their research on sustainable wood-fuel systems for sub-Saharan Africa, described charcoal as fuel made by burning wood under controlled oxygen to yield a high-carbon product, and firewood as wood burned directly for energy, noting that wood energy is gaining popularity as a sustainable fuel even in developed countries. They outlined a theory of change describing how wood-fuel can be made sustainable, rather than dismissed as a transitional fuel, arguing that improving technologies and efficiency across wood production, charcoal and firewood processing,

transport, trade and utilization within a circular bioenergy economy is the most viable path, since charcoal and firewood are a major driver of land degradation on the African continent. They stressed the need for bold, rational decisions in rethinking wood-fuel across sub-Saharan Africa, given that failure to advance wood-fuel technologies undermines global land-restoration and climate-mitigation efforts.

Doggart and colleagues, examining the influence of energy policy on charcoal consumption in urban households in Dar es Salaam, Tanzania, between 1990 and 2018, found that national energy policy has focused on an energy transition from biomass to electricity and fossil fuels, with fiscal tools used effectively to reduce kerosene demand while increasing demand for liquefied petroleum gas. Despite this, the transition away from biomass has not materialized, as most households continue using multiple fuels, and charcoal and firewood remain Tanzania's cheapest and most widely used fuels. The authors concluded that sustainable urban energy planning, spanning a range of fuel types including charcoal, is needed to balance economic, social and environmental outcomes amid rapid urbanization, a conclusion directly relevant to understanding the sustained role of charcoal and firewood in Benue State's own energy mix.

A set of lecture notes on the theory and concepts of climate change and cities, published by UN-Habitat, provided an overview of climate mitigation and adaptation concepts, noting that global average surface temperatures have risen in two phases, from the 1910s to the 1940s and, more strongly, from the 1970s onward, with the troposphere warming slightly faster than the surface and the stratosphere cooling markedly since 1979. It identified mitigation actions including increased industrial energy efficiency, a switch from fossil fuels to renewable energy, improved building insulation, and the expansion of forests and other carbon sinks, and noted that Africa is considered one of the most vulnerable continents owing to multiple stresses and low adaptive capacity. These notes provide useful grounding for situating Benue State's wood-fuel-driven emissions and deforestation within the broader global climate-change literature.

2.3 Gaps in the Literature

Across the literature reviewed, existing studies tend either to focus narrowly on a single Local Government Area (Vihi and colleagues on Vandeikya; Tsue and colleagues on Gboko), a single fuel type (Babalola and Opii on charcoal alone), or a global or comparative context detached from Benue State specifically (Gridneff on the Horn of Africa and the Gulf; Doggart and colleagues on Tanzania). None of the studies reviewed integrates the historical evolution of wood-fuel reliance across Benue State as a whole with a systematic assessment of its climate-change implications and its governing legal framework. This research is positioned to address that gap by combining historical reconstruction, socio-economic and gendered analysis, and legal-institutional accounts within a single, state-wide account.

3. Theoretical Framework: The Greenhouse Effect Theory

This study is anchored on the Greenhouse Effect Theory to analyze the role of charcoal and firewood production and use in climate change and global warming in Benue State. Among the various theories of climate change, including Anthropogenic Global Warming, Clouds, Albedo and Cosmic Rays, Ocean Gassing of CO2, and Solar Variability, the Greenhouse Effect Theory is by far the most popular and most hotly debated, with origins in nineteenth-century theoretical and experimental work by Joseph Fourier, Eunice Newton Foote and Svante Arrhenius. The theory holds that the Sun emits shortwave

radiation that passes through greenhouse gases and heats the Earth's surface, which in turn emits longwave radiation that is partly absorbed by greenhouse gases, causing atmospheric warming. Greenhouse gases such as carbon dioxide, nitrous oxide, methane and ozone, though present in the atmosphere only in trace amounts, together account for almost 0.1 percent of Earth's atmosphere and produce an appreciable greenhouse effect by resonating at infrared frequencies and converting infrared energy into kinetic energy, raising atmospheric temperature.

The Greenhouse Effect Theory underlies the theory of Anthropogenic Global Warming, supported and promoted by the Intergovernmental Panel on Climate Change (IPCC), which holds that human activities, mainly the burning of fossil fuels, have added greenhouse gases to the atmosphere in the industrial era, enhancing the natural greenhouse effect and driving observed global warming. Proponents of the theory link man-made carbon dioxide to floods, droughts, severe weather, crop failures, species extinction, disease spread, ocean coral bleaching and famine, with these disasters expected to become more frequent and severe as temperatures continue to rise. A complementary strand of the theory, Human Forcing Besides Greenhouse Gases, holds that the most important human influence on climate is not greenhouse gas emissions alone but broader activities that transform the Earth's surface, such as clearing forests, irrigating deserts and building cities, all of which can increase or decrease land or sea surface temperatures and, in the case of deforestation, prevent forests from sequestering carbon dioxide in the future.

Of the available theories of climate change, the Greenhouse Effect Theory is the most suitable for explaining the role of charcoal and firewood production and use in the gradual but steady change in climate and environmental degradation in Benue State. Applying the theory, this study establishes that climate change is a product of continuous human actions, including bush burning and charcoal and firewood production and use, that release greenhouse gases into the atmosphere, while the clearing of vegetation cover to produce charcoal and firewood simultaneously increases environmental vulnerability by reducing local carbon-sequestration capacity. The theory establishes a causal link between burning biomass and climate change, mapping directly onto how wood-fuel production in Benue State drives warming through greenhouse gas emissions and the reduction of local carbon sinks, and it is used in this research both to analyze how widespread deforestation for charcoal production in Local Government Areas such as Vandeikya reduces the local environment's ability to regulate temperature, and to frame mitigation strategies such as switching to LPG, adopting efficient cook-stoves, or participating in REDD+ programmes.

4 Study Area and Methodology

4.1 Study Area

Benue State is a state in the North Central region of Nigeria, with an estimated population of about 4,253,641 at the 2006 census. The state was created in 1976, among the seven states created at that time by the then-Head of State, General Murtala Muhammed, with its capital at Makurdi. The state derives its name from the Benue River, initially called Ber-nor, a compound word in the Tiv language meaning river or lake of the hippopotamus, later corrupted to Benue by colonial authorities; the river is the second largest in Nigeria after the River Niger. Benue borders Nasarawa State to the north, Taraba State to the east, Kogi State to the west, Enugu State to the south-west, Ebonyi and Cross River States to the south, and shares an international border with Cameroon to the

south-east. It is inhabited predominantly by the Tiv, Idoma and Igede peoples, alongside minority groups including the Etulo, Igbo, Hausa and Jukun.

Proudly known as the food basket of the nation, Benue State's rural economy engages an estimated 70 to 75 percent of the working population and is anchored on agrarian livelihoods, localized commerce and traditional socio-economic structures, supported by highly fertile alluvial soils fed by the Benue and Katsina-Ala river systems. Prominent food crops include yam, cassava, sweet potatoes, maize, millet and guinea corn, while soybeans, rice, groundnuts, sesame, and citrus and mango orchards serve as key cash crops, though the distinction between food and cash crops has increasingly blurred with commercialization. The majority of the population lives in rural areas and depends on firewood and charcoal as alternative energy sources for heating and cooking, making the state well suited to a study of the relationship between wood-fuel reliance and climate change.

4.2 Research Design and Approach

To facilitate a rigorous search for and presentation of facts leading to a valid conclusion about the role of firewood and charcoal production in climate change in Benue State, the study adopts a historical research approach combined with multidisciplinary instrumentation for data gathering and analysis. By a multidisciplinary approach is meant the utilization of data from different disciplinary backgrounds, including geography, physical and environmental sciences, and urban and regional planning, among other related disciplines. The study relies on both primary and secondary sources of data for its reconstruction.

4.3 Data Collection: Primary and Secondary Sources

Primary data collection involves oral interviews, pictures and maps. Interviews are conducted within the study area, especially with producers and users of charcoal and firewood in rural areas, alongside residents, farmers, business people, transporters, and officials of the ministries of environment and agriculture. Further primary information is obtained from newspapers and administrative and government documents at the Ministries of Environment, Agriculture, and Humanitarian Management. The instrumentation for data collection includes face-to-face oral interviews with both literate and illiterate people of all genders in rural areas of Benue State, supplemented by the researcher's own participatory observations, informed by direct experience of flood disasters in the region over the preceding decade.

A substantial share of the evidence base is drawn from secondary sources: textbooks, project works, journal articles, and reports from committees, government agencies and non-governmental organizations, including the Red Cross, the United Nations International Children's Emergency Fund (UNICEF), and UNGA declarations and warnings on climate change. Seminar and conference papers, both published and unpublished, addressing the subject and the contributory role of government and humanitarian agencies in regulating and mitigating wood-fuel production and use are similarly drawn upon. Materials are sourced from libraries, ministries and local government departments, bookshops, the NEMA regional office for central Nigeria in Plateau State, SEMA offices, and the internet. The researcher is aware of the inherent weaknesses of each source type and corroborates all sources, acknowledging them for further verification as needed, to enhance the overall credibility of the study.

4.4 Limitations of the Study

As noted in Section 3, the study's field component faced economic, geographical and cultural constraints, including the wide geographical spread of the state's 23 Local Government Areas, insecurity in parts of the region, flood-damaged infrastructure cutting off some communities, and the risk of exaggerated accounts from informants with a stake in the practices under study. The researcher addressed these constraints through triangulation across multiple independent sources and through varied, diplomatic data-gathering approaches.

5. Survey Design, Sample Distribution and Findings

5.1 Survey Design and Sample Distribution

To ground the historical and documentary analysis in current, verifiable field evidence, a structured survey was administered in every one of Benue State's 23 Local Government Areas, with 50 respondents sampled per Local Government Area, disaggregated by their role in the wood-fuel value chain: 20 producers, 20 users, 5 traders and 5 transporters. Table 1 sets out this distribution, along with the further breakdown of the user category by end use.

Respondent Category	Sample per LGA	Statewide Total (× 23 LGAs)
Producers	20	460
Users – domestic cooking	10	230
Users – restaurant cooking	5	115
Users – bakeries (bread and local cakes)	5	115
Users – subtotal	20	460
Traders	5	115
Transporters	5	115
Total per LGA / statewide	50	1,150

Table 1

Applied uniformly across the state's 23 Local Government Areas, this design yields a total statewide sample of 1,150 respondents (50 respondents multiplied by 23 Local Government Areas), comprising 460 producers, 460 users, 115 traders and 115 transporters.

5.2 Findings: Producers

Of the 20 producers sampled per Local Government Area, it was discovered that all 20 obtain firewood by felling both big and small trees, which they sell as a source of income. Some of these producers additionally burn the felled trees into charcoal before sale, supplying it directly to users rather than, or in addition to, selling raw firewood. This confirms that producers in the study areas operate a dual-product model, harvesting trees indiscriminately by size and converting a portion of that harvest into the higher-value, more transportable charcoal product, consistent with the historical shift from firewood toward charcoal commercialization traced in Section 10.

5.3 Findings: Users

Of the 20 users sampled per Local Government Area, end use was distributed on a 10, 5, 5 basis: 10 users (half of the user sample) rely on firewood and charcoal for domestic cooking, 5 use it for restaurant cooking, and 5 use it in the baking of bread and local cakes. This distribution confirms that household domestic cooking remains the single largest source of demand for wood-fuel, while small-scale commercial food enterprises, restaurants and bakeries together account for the other half of user demand, corroborating the literature reviewed in Section 5 on wood-fuel's role in small-scale businesses such as restaurants and bakeries.

5.4 Findings: Traders and Transporters

Of the 5 traders sampled per Local Government Area, all reported buying firewood and charcoal for resale. Traders operate through two parallel channels: a base of regular customers to whom they supply directly, and additional random or spot sales to other buyers as demand arises. This dual-channel pattern indicates that trading functions as a stabilizing intermediary layer between producers and the wider pool of users, combining the predictability of standing customer relationships with the flexibility of open-market sales.

Of the 5 transporters sampled per Local Government Area, all confirmed that they help convey firewood and charcoal from producers and rural hubs to traders and urban markets, and that they undertake not less than 20 trips per week in this role. Extrapolated across the sampled transporter population, this implies a minimum of 100 wood-fuel conveyance trips per week per Local Government Area (5 transporters multiplied by at least 20 trips each), or at least 2,300 trips per week across the state's 23 Local Government Areas, underscoring the sheer physical scale and continuous, high-frequency nature of the wood-fuel supply chain documented in this research.

5.5 Analysis of the Survey Data

Read together, the survey findings sharpen several arguments developed elsewhere in this research. First, the fact that all 20 sampled producers per Local Government Area fell both big and small trees, rather than selectively harvesting mature timber, indicates indiscriminate, non-regenerative harvesting practice consistent with the deforestation and biodiversity-loss pathway discussed in Section 14.2; felling small trees in particular forecloses future regrowth and yield, compounding the loss of forest cover over time. Second, that some of these same producers also convert part of their harvest into charcoal demonstrates that the producer and charcoal-processing stages of the value chain are not always institutionally separate but frequently occur within the same household or enterprise, meaning that policy interventions aimed only at charcoal processors, without addressing the underlying tree-felling by producers, are likely to miss a substantial share of the practice.

Third, the even split among users between domestic cooking (50 percent) and small-scale commercial food enterprises (50 percent, split evenly between restaurants and bakeries) confirms that wood-fuel demand in Benue State is not solely a rural household phenomenon but is structurally embedded in the informal small-business economy, meaning that energy-transition policy aimed only at households, without also targeting restaurants and bakeries, would address only half of documented demand. Fourth, the traders' dual-channel model, combining standing customers with spot sales, suggests that wood-fuel markets in the state function with a degree of commercial sophistication comparable to other agricultural commodity trade, which has implications for how enforcement checkpoints described in Section 13.2 are likely to be

evaded: traders supplying regular customers directly, outside open market settings, are structurally harder for spot-check enforcement to reach than open-market spot sales.

Finally, the transporters' confirmed minimum of 20 trips per week per transporter translates, at the sampled rate of 5 transporters per Local Government Area, into a lower-bound estimate of at least 100 conveyance trips weekly per Local Government Area and at least 2,300 trips weekly statewide. Even treated as a conservative floor rather than a precise total, this figure illustrates why the enforcement gap documented in Section 13.4, between a comparatively small number of Divisional Forest Officers and export-ban compliance monitors on one hand and a continuous, high-volume, distributed transport network on the other, has proven so difficult to close through checkpoint-based regulation alone. The survey data, in this sense, provide field-level corroboration for the research's broader argument that the persistence of wood-fuel reliance in Benue State is a function of an entrenched, multi-stage economic system, rather than a small number of easily identified violations that stricter enforcement could straightforwardly eliminate.

6. Historical Trajectory of Wood-fuel Reliance in Benue State, 1976–2025

Table 2 summarizes the periodization of wood-fuel reliance in Benue State traced in this research, from its pre-colonial foundations through the state's creation in 1976 to the 2025 federal export ban.

Period	Character of Wood-fuel Reliance
Pre-colonial era	Firewood is the primary domestic energy source and the power line of traditional industries (blacksmithing, local beer brewing); charcoal production is minimal, as households rely directly on firewood.
Colonial era (from 1937)	The 1937 Forest Conservation Ordinance introduces top-down protection of commercially valuable trees (e.g., Shea butter, Locust bean), later inherited by Benue State as the legal foundation for forest reserves.
1976 (state creation) to late 1980s	Benue State is created; charcoal remains a comparatively niche fuel; firewood continues to dominate rural domestic and industrial use.
Late 1980s to 1990s (Structural Adjustment era)	The Structural Adjustment Programme (SAP) and associated currency devaluation and inflation put LPG and kerosene out of reach for most households; charcoal transitions from a niche fuel to a dominant commercial energy source; the low-cost 'Abacha stove' becomes a household fixture, especially from the Abacha era onward.
1990s to 2000s	Environmental problems linked to wood-fuel harvesting accelerate; deforestation increases exposure to erosion; the Benue State Forestry Gazette (updated 1980s/2010) formalizes a dual-tenure system distinguishing Forest Reserves from Non-Formally Protected Areas.
2000s to 2012	Charcoal and firewood production commercializes further, drawing in youth, women, children and men, driven by declining agricultural productivity and rising unemployment; rural producers supply urban dealers in Makurdi, Gboko and Otukpo.
2012 to 2023	Flash floods (2012, 2017, 2018, 2021) affect Agatu, Makurdi, Buruku, Katsina-Ala, Logo and Tarka, destroying farms, habitats, markets, schools and churches; deforestation for wood-fuel is identified as one of the

	contributing factors to watershed destabilization behind these events.
2025	The Presidential Executive Order on the Prohibition of Exportation of Wood and Allied Products, 2025, is gazetted (16 October 2025) and publicly unveiled (17 December 2025), banning wood and charcoal exports nationwide and revoking existing licences; compliance research finds continued gaps between the ban and rural practice.

Table 2

6.1 Pre-Colonial and Colonial Foundations

The history of wood-based biomass energy in Benue State offers a window into the region's broader socio-economic transition. Dense wood cover, characterized by hard trees such as Gbaaye (African ironwood), mahogany and Shea butter trees, has long supported reliance on charcoal and firewood as the first energy choice since the pre-colonial era. Firewood powered traditional industries and kitchens for food processing: in the brewing of burukutu and pito, brewers required prolonged, roaring heat to boil large clay pots or drums of fermented sorghum, which firewood handled more cost-effectively than charcoal; in processing cassava into garri, long logs of firewood allowed processors to distribute heat evenly across wide, shallow iron pans. The wood-fuel energy system later diversified with the addition of charcoal, a relatively modern introduction compared with the ancient, deeply embedded cultural practice of firewood use. Colonial forest policy, dating to the 1937 Forest Conservation Ordinance, established a top-down conservation approach designed to protect commercial timber and forest cover, strictly prohibiting the unauthorized cutting of protected trees such as the Shea butter tree and the Locust bean tree, both highly prized by rural charcoal burners for their dense caloric output.

6.2 Post-Colonial Commercialization and the Structural Adjustment Era

Benue State was created in 1976, inheriting the colonial forest-conservation legal framework. The true transformation of charcoal from a niche fuel into a dominant commercial energy source occurred from the late 1980s onward, heavily accelerated by the macroeconomic adjustments introduced under the Structural Adjustment Programme (SAP), implemented by the General Ibrahim Babangida military regime in collaboration with the World Bank and the International Monetary Fund. As SAP was followed by decades of persistent inflation and currency devaluation, the cost of modern cooking energy, principally LPG and kerosene, skyrocketed, rendering these alternatives unaffordable for the vast majority of urban and peri-urban households in Benue State.

6.3 The 'Abacha Stove' and the Entrenchment of Charcoal

It was during the subsequent economic hardship of the Sani Abacha era that Nigerians widely adopted the charcoal stove popularly known as the 'Abacha stove,' which has since become a household fixture across both urban and semi-urban areas of Benue State owing to its increasing use; an estimated 90 percent of households in Makurdi, Otukpo and Gboko reportedly use the Abacha stove, fuelled by charcoal. This period marks the entrenchment of charcoal alongside firewood as the state's dominant household energy sources, a position from which modern alternatives have since struggled to dislodge it despite rising incomes in some households.

6.4 Commercialization and Expansion since the 2000s

From the 2000s, the Benue rural economy saw a further, marked shift toward charcoal and firewood production and commercialization, drawing in youth, children, women and men and factored especially on declining agricultural productivity and rising unemployment. Over time, the wood-fuel energy complex diversified further, with charcoal increasingly complementing raw firewood in urban and semi-urban domestic spheres, driven by shifting household incomes and changing state policy dynamics. Today, biomass fuel occupies a dual position in the Benue socio-economic landscape: an indispensable economic lifeline that mitigates rural poverty and drives agro-processing, and simultaneously a severe environmental threat to the savanna woodlands that support the region's agricultural success.

7. Socio-Cultural, Gendered and Ecological Dimensions of Wood-fuel Production

7.1 Gendered Division of Labour

The production and use of wood-fuel in Benue State is deeply split along gender and generational lines within traditional socio-political structures. The gathering of deadwood for domestic cooking is viewed as a gendered obligation for women and children, closely tied to domestic tasks such as preparing local meals and processing indigenous beverages like burukutu or pito, which require sustained, heavy thermal energy. Charcoal production and distribution, by contrast, is predominantly a male domain in the study area, given the heavy physical labour involved in felling large hardwood trees, stacking logs, constructing traditional earth-mound kilns, and monitoring the burn for days; it serves as a vital off-season economic coping mechanism when farming activities slow down.

7.2 Rural Markets and Commercial Networks

The Benue rural economy is supported by a powerful network of periodic rural markets that sustain internal trade. The Zaki Biam International Yam Market in Ukum Local Government Area is widely recognized as the largest single-commodity market for yams in West Africa, drawing traders from across the continent, while other vital rural commerce centres include the Lessel Market in Ushongo Local Government Area and regional hubs across Kwande and Logo. To supplement crop income, rural households, particularly women, rely on micro-enterprises such as small-scale rice milling, oil palm processing, wood-fuel sales, local weaving, and the artisanal production of traditional indigenous beverages. In a scattered settlement pattern common in Tivland, where households historically prefer isolated family compounds close to ancestral farmlands, this proximity maximizes access to fields but creates a 'scattered infrastructure' challenge that makes it difficult for government to efficiently extend electricity and other modern energy sources, reinforcing wood-fuel's continued relevance.

7.3 Ecological and Agrarian Factors Shaping Fuel Choice

Benue's Guinea Savannah vegetation provides a diverse pool of biomass, but changing land-tenure systems and agrarian pressure heavily influence fuel choice. In communities practising segmentary lineage or communal land holding, access to communal forests or fallow lands for firewood gathering is generally open to community members; as land becomes scarcer, however, owing to commercial agriculture and population growth, access to high-quality wood is increasingly restricted, driving producers further into virgin forest. Producers and consumers select wood based on specific thermal properties, smoke emission and burning longevity: hardwoods

such as Prosopis africana (African ironwood, locally Gbaaye) are highly prized for both exceptional charcoal yield and long-lasting firewood, though over-exploitation has made them increasingly scarce, while non-smoky woods are favoured for domestic cooking and beverage brewing to protect health and taste, with agricultural residues used only as a last resort during severe shortages. Charcoal production is frequently a byproduct of agricultural land clearing: when new plots are opened for yam mounds or cassava cultivation, felled trees are systematically converted into charcoal rather than left to rot, maximizing the economic value of the cleared land.

8. Economic Drivers of Continued Reliance on Wood-fuel

8.1 The Energy Ladder and Its Failure in Benue State

For most rural households in Benue State, fuel choice is dictated primarily by disposable income and opportunity cost. Classical economics predicts that households transition up an 'energy ladder' from biomass to cleaner fuels such as LPG and electricity as income rises; ultimately, the choice between charcoal and firewood reflects a household's position on the spectrum between subsistence and commercialization, with firewood representing the exploitation of local, non-monetized labour for immediate, heavy-duty energy needs, and charcoal representing a step toward monetization as a refined, transportable, cleaner-burning commodity that functions both as a domestic comfort and a source of market cash. Severe macroeconomic pressures, however, including currency devaluation, inflation and the removal of fuel subsidies in Nigeria, have caused even middle-income rural and peri-urban households to backslide from cleaner fuels to charcoal and firewood. Rural producers in areas such as Kwande, Konshisha and Logo often engage in charcoal burning not for personal consumption but to sell to urban marketing centres such as Makurdi, Otukpo or Gboko, generating immediate cash for agricultural inputs, hired labour, or school fees.

8.2 Macroeconomic Shocks and Policy Shifts

Changing government policies have also triggered continued reliance on wood-fuel energy. Following the introduction of the Structural Adjustment Programme in the late 1980s and subsequent decades of persistent inflation and fluctuating currency values, the purchasing power of the average Nigerian household declined sharply, entrenching charcoal and firewood as the affordable default even as national policy nominally promoted a transition to cleaner fuels. This history illustrates that wood-fuel reliance in Benue State is best understood not as a static cultural preference but as a dynamic response to successive macroeconomic shocks, each of which has, in practice, reinforced rather than reduced dependence on biomass energy.

9. Legal and Institutional Framework Governing Forest and Wood-fuel Exploitation

9.1 Colonial and Early Post-Colonial Legislation

Forest management in Benue State has historically relied on a top-down conservation approach designed to protect commercial timber and retain forest cover, dating to the 1937 Forest Conservation Ordinance. Inherited by Benue State upon its creation in 1976, this foundational law established the legal backing for forest conservation and reserves and strictly prohibited the unauthorized cutting of protected trees such as the Shea butter tree and the Locust bean tree.

9.2 The Benue State Forestry Gazette and the Dual-Tenure System

In the post-colonial era, the Benue State Forestry Gazette, updated across the 1980s and again in 2010, became the updated regional framework for land and forest conservation. It categorized state lands into Formally Protected Areas, Forest Reserves managed by the state, and Non-Formally Protected Areas. In Non-Formally Protected Areas, local community rules and customary law held sway, creating a dual-tenure system in which firewood harvesting for domestic use was permitted, but commercial charcoal processing required state-issued felling licences from Divisional Forest Officers. Statutory regulation today falls under the Benue State Ministry of Agriculture and Natural Resources, specifically its Department of Forestry, alongside local government authorities across the state's 23 Local Government Areas. Under existing state policy, producers are technically required to obtain felling licences, while transporters and off-takers face checkpoints where they must pay state revenues or tariffs to convey bags of charcoal from rural hubs such as Kwande, Logo or Katsina-Ala to urban markets such as Makurdi or Gboko. From time to time, individual Local Government Areas or the State Forestry Department have also issued temporary or outright bans on charcoal production in heavily deforested zones.

9.3 The December 2025 Federal Export Ban

The state-level legal architecture has continued to undergo transformation, driven by both state-level legislative overhauls and sweeping national mandates. In a gazette notice published on 16 October 2025 and publicly unveiled by the Minister of Environment at the 18th meeting of the National Council on Environment in Katsina State on 17 December 2025, President Bola Ahmed Tinubu signed the Presidential Executive Order on the Prohibition of Exportation of Wood and Allied Products, 2025. The order placed a complete national ban on the export of wood, charcoal and other allied products, and revoked all existing export licences and permits, with the Minister citing the need to curb illegal logging and deforestation and to strengthen Nigeria's response to climate change. While state governments retain control over local forest resources, this federal order effectively collapsed the cross-border export market, forcing groups such as the National Association of Charcoal Producers, Dealers, Exporters and Afforestation of Nigeria (NACPDEAN) to shift their focus toward strict compliance, domestic market regulation, and mandatory community afforestation.

9.4 The Gap between Legal Text and Rural Practice

Despite this layered legal architecture, an ongoing gap persists between legal text and rural practice, owing to a combination of factors. Research by Igbaukum and colleagues found that, while 65.2 percent of value-chain actors were aware of the ban on charcoal production, compliance remained structurally weak owing to lax enforcement, porous borders, and economic dependencies; the study observed that, while regulators understand the laws, the vast majority of rural producers operate within informal networks and are largely unaware of statutory policy nuances, viewing forest access through the lens of customary land inheritance rather than state ownership. This finding is consistent with the broader pattern documented in this research: legal instruments have multiplied over nearly nine decades, from the 1937 Ordinance to the 2025 federal export ban, without a commensurate reduction in rural wood-fuel production, suggesting that enforcement capacity and community engagement, rather than the mere existence of

legal text, are the binding constraints on effective forest governance in Benue State.

10. Findings and Discussion: Implications for Climate Change

10.1 Applying the Greenhouse Effect Theory

Applying the Greenhouse Effect Theory, this study finds that the extraction and use of wood for fuel is a major driver of environmental change across Benue's diverse Guinea Savannah landscape, manifesting in several critical ways discussed below. The theory's causal chain, from biomass burning to greenhouse gas emission to the reduction of local carbon sinks, maps directly onto the pathway traced in this research from wood-fuel production to observed climate impacts in the state.

10.2 Deforestation, Biodiversity Loss and Loss of Non-Timber Forest Products

High demand for charcoal production has led to the targeted felling of high-density, slow-growing indigenous hardwood species. Trees such as the Shea butter tree and the Locust bean tree are prized by charcoal burners because they yield heavy, slow-burning charcoal, and their felling directly diminishes local biodiversity and strips rural communities of vital non-timber forest products that provide seasonal income, nutritional security and environmental cover. As pristine woodlands are thinned, the complex, multi-layered canopy of the Southern Guinea Savannah transitions into fragmented, degraded shrubland, disrupting local wildlife habitats, accelerating pollinator loss, and altering microclimates.

10.3 Soil Erosion, Watershed Destabilization and Flooding

Continued reliance on firewood and charcoal has led to increasing soil erosion and nutrient depletion in the study area. Removal of the tree canopy exposes fragile savannah topsoil to intense sun and the erosive force of heavy seasonal rains, accelerating soil compaction, leaching vital nutrients, and triggering severe sheet and gully erosion and flooding, which ultimately undermines long-term crop yields. Wood-fuel harvesting around critical river basins, such as the Katsina-Ala and smaller tributaries of the Benue River, destabilizes watersheds: deforestation reduces the soil's water-retention capacity, lowering water tables during the dry season and increasing the intensity and frequency of flash floods during the rainy season. This dynamic manifested clearly in Benue State between 2012 and 2023, when flash floods repeatedly ravaged riverine communities along the Benue River and its tributaries; the 2012, 2017, 2018 and 2021 flooding events in Agatu, Makurdi, Buruku, Katsina-Ala, Logo and Tarka collectively destroyed farms, habitats, markets, schools and churches, with firewood and charcoal production partly implicated as one of the causative agents behind this destruction.

10.4 Corroborating Global Evidence

These local findings corroborate wider evidence: a study by the World Wide Fund for Nature (WWF) confirmed that firewood and charcoal production causes flooding by removing trees, compacting soil, and disrupting water flow, stripping away the natural barriers that would otherwise absorb heavy rainfall. While the individual mechanisms described above may appear localized, the dynamics of the rural Benue wood-fuel economy feed directly into macro-level climate-change mechanisms: with an estimated 95 to 99 percent of rural households in the state depending on wood-fuel to meet domestic energy needs, the cumulative depletion of the region's tree cover carries consequences for both local and global climate-change realities.

11. Implications for the Rural Economy and Food Security

Because Benue State is popularly known as the food basket of the nation, the climate consequences traced above feed back directly into the rural economy that wood-fuel production was originally meant to supplement. Erratic rainfall patterns, prolonged dry seasons, increased soil erosion, and unprecedented flooding along the Benue River basin have altered planting seasons, reduced crop yields, and heightened food insecurity, weakening the very agrarian foundation on which the rural economy, and wood-fuel producers themselves, depend. This creates a self-reinforcing cycle: declining agricultural productivity pushes more rural households toward charcoal and firewood production as an alternative income stream, which in turn accelerates the deforestation and watershed destabilization that further undermine agricultural productivity. Breaking this cycle, the evidence reviewed here suggests, requires addressing wood-fuel reliance and agricultural resilience together, rather than as separate policy problems.

12. Benue's Wood-fuel Reliance in Global Climate Discourse

Benue State's continued reliance on wood-fuel sits in tension with the broader global climate discourse. International frameworks such as the Paris Agreement set clear targets, aiming to limit global temperature rise to well below 2°C and ideally to 1.5°C above pre-industrial levels, though the path to achieving these goals remains highly contested. A persistent debate in international climate negotiations, including the UN Conference of the Parties (COP) summits, centres on the equity split between developed and developing nations, with a common consensus that industrialized nations of the Global North bear the greater responsibility for global climate financing and mitigation, given their historical role as the major agents of climate change and global warming.

For decades, the largest share of global climate finance went toward mitigation, preventing future emissions through renewable and efficient energy; more recently, vulnerable regions, particularly in sub-Saharan Africa, small island states, and parts of Asia, already experiencing severe climate impacts such as shifting rainfall, intense drought, and rising sea levels, have argued that funding must be rebalanced to support adaptation, including resilient infrastructure, sea walls, and drought-resistant agriculture. The global community's mitigation toolkit spans decarbonizing the energy sector through renewable, nuclear and hydro-energy investment, alongside efficient forestry, land use, and climate-smart agriculture, with the consensus among climate scientists and policymakers being that no single strategy is a silver bullet. Benue State's rural economy's increasing reliance on firewood and charcoal stands as a direct, if localized, contradiction of these global climate-prevention, mitigation and management strategies, underscoring the practical difficulty of translating international climate consensus into rural energy transition where affordable alternatives remain out of reach.

13. Recommendations

Expand access to affordable, alternative clean energy technologies for rural households, including subsidized Liquefied Petroleum Gas (LPG) cylinders, solar cookers, biogas systems, and energy-efficient stoves, to narrow the price gap that currently locks households onto the wood-fuel rung of the energy ladder.

Deliver training programmes on improved carbonization techniques for existing charcoal producers, to reduce gas emissions and increase the energy yield per unit of wood harvested, lessening the deforestation pressure per unit of charcoal produced.

Invest in structured, community-based reforestation and afforestation programmes, prioritizing the hardwood species (Shea butter, Locust bean, Gbaaye) most targeted by charcoal producers, and consider a state policy encouraging every individual to plant and maintain at least one tree in their lifetime.

Strengthen enforcement of existing legal frameworks, from the Benue State Forestry Gazette's felling-licence regime to the 2025 federal export ban, with particular attention to closing the awareness gap documented among rural producers who view forest access through customary rather than statutory lenses.

Pair enforcement with sustainable alternative livelihoods for rural communities currently dependent on the forest for survival, recognizing that punitive measures alone, without addressing the underlying economic drivers documented in Section 12, are unlikely to reduce wood-fuel reliance.

Protect vegetation cover on hill slopes and along river banks, particularly around the Benue and Katsina-Ala river systems, given tree roots' role in holding soil particles together and reducing the risk of siltation, erosion and flooding in riverine communities.

Expand public environmental education on the health and ecological dangers of unregulated firewood and charcoal practices, targeting both producers and household consumers, given the low level of environmental awareness identified throughout the researched area.

14. Conclusion

The study of charcoal and firewood production in Nigeria has hitherto not been a central issue of historical discourse among scholars of history, despite its position in the country's traditional economic history. This study has interrogated the relationship between continued reliance on wood-fuel production and use in the Benue rural economy and its implications for climate change, establishing that, owing to a combination of economic, political and cultural realities, the Benue rural economy has predominantly relied on wood-fuels for both domestic and traditional industrial energy uses. This reliance on firewood and charcoal is not merely a preference but a socio-economic coping mechanism: owing to the chronic unreliability and high cost of modern energy alternatives, wood-fuel remains the primary energy source for the vast majority of the state's rural population.

This economic survival strategy has come at a severe environmental cost. The environmental implications of unchecked deforestation since the state's creation in 1976 are now manifest in Benue's changing climate patterns and localized global warming effects, with the loss of forest cover weakening the region's carbon-sequestration capacity. This ecological imbalance is directly linked to erratic rainfall patterns, prolonged dry seasons, increased soil erosion, and unprecedented flooding along the Benue River basin witnessed in recent decades. Ironically, these climate changes directly threaten the agrarian foundation of the Benue economy, leading to declining crop yields, altered planting seasons, and heightened food insecurity in the food basket of the nation. This research concludes that the crisis of charcoal and firewood production in Benue State is an intertwined problem of poverty, energy insecurity, and environmental degradation amid weak legal mechanisms, whose resolution requires the combined, mutually reinforcing measures for affordable alternative energy, reforestation, and legal enforcement set out in Section 17.

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