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RESEARCH ARTICLE

ASSESSING COMMUNITY-LED REFORESTATION AND OFF-FARM LIVELIHOODS AS STRATEGIES FOR COMBATING DESERTIFICATION IN DAMBATTA, NIGERIA

PANKYES BULUS FWANG'AR, IKWUO NNACHI NNACHI, CHINDANG DONATUS DAYIL, HAPPY O. JOHN-NWAGWU

[1,2 & 4] Department of Geography, Federal University Lokoja, Lokoja, Kogi State, Nigeria.
[3] Department of Geography and Planning, University of Jos, Nigeria

ABSTRACT

Desertification in Dambatta Local Government Area (LGA), Kano State, Nigeria, threatens environmental sustainability and rural livelihoods due to a combination of climatic variability and human-induced factors such as deforestation and overgrazing. This study evaluates the effectiveness of community-led reforestation initiatives and the potential of off-farm activities as strategies to mitigate desertification and enhance socio-economic resilience. Employing a mixed-methods approach, the research integrates reconnaissance surveys, community questionnaires, semi-structured interviews, and geospatial analysis across four communities: FayamFayam, Dukewa, Zago, and Gwanda. Findings reveal moderate to severe desertification, with limited effectiveness of reforestation efforts due to inadequate funding, low community participation, and technical constraints. Off-farm activities, including craftsmanship, small-scale trading, and agro-processing, show significant potential for income diversification but face barriers such as lack of training, market access, and financial resources. An integrated strategy combining enhanced reforestation with off-farm livelihood development, supported by targeted policies and capacity-building, is proposed to address desertification and foster sustainable development. These findings contribute to the discourse on sustainable land management and livelihood diversification in arid regions, offering actionable recommendations for policymakers, local authorities, and community stakeholders.

Keywords: Desertification, community-led reforestation, off-farm activities, sustainable livelihoods, Dambatta, ecosystem restoration

Corresponding Author

Pankyes Bulus FWANG'AR
Email Address: Pankyes.fwangar@fulokoja.edu.ng Telephone Number: +2347030684273

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INTRODUCTION

Desertification, defined as the degradation of productive land into arid, barren expanses, poses a profound challenge to environmental sustainability and human livelihoods in arid and semi-arid regions (UNCCD, 2019). In Dambatta LGA, located in the northern fringe of Kano State, Nigeria, desertification is driven by a complex interplay of climatic factors (e.g., recurrent droughts and unpredictable rainfall) and human activities (e.g., deforestation, overgrazing, and unsustainable agricultural practices) (Boko et al., 2007; Ogunkunle et al., 2018). These factors have transformed once-fertile land into degraded terrain, leading to reduced agricultural productivity, water scarcity, and increased socio-economic vulnerability, particularly for communities reliant on subsistence farming (Yusuf & Ibrahim, 2018).

This study focuses on two critical objectives derived from a broader research framework: evaluating the effectiveness of community-led reforestation initiatives and identifying viable off-farm activities to diversify income sources and reduce pressure on degraded land. Community-led reforestation, exemplified by initiatives like the Great Green Wall and the Green Nigeria Project, aims to restore vegetation cover, stabilize soils, and enhance ecosystem resilience (UNCCD, 2020). Off-farm activities, such as craftsmanship, small-scale trading, and agro-processing, offer alternative livelihoods to mitigate the environmental strain caused by over-reliance on agriculture (Ellis, 2000; Rahman & Sultana, 2020).

By integrating these strategies, this research seeks to propose holistic solutions for combating desertification while fostering economic resilience in Dambatta. The study addresses three key research questions: How effective are community-led reforestation initiatives in reducing desertification in Dambatta LGA? Which off-farm activities align with the socio-economic and ecological characteristics of the region? What barriers hinder the adoption of off-farm activities, and how can they be addressed to enhance community resilience?

The research is guided by the Sustainable Livelihoods Framework (SLF) and the Ecosystem Services Framework (ESF). The SLF emphasizes five capitals: human, social, natural, physical, and financial that communities leverage to sustain livelihoods (DFID, 1999). The ESF highlights the role of ecosystems in providing provisioning, regulating, cultural, and supporting services, which are critical for combating desertification and supporting livelihoods (MEA, 2005). Additionally, the Two-Eyed Seeing approach, which integrates Indigenous knowledge with Western science, informs the study's emphasis on community-driven solutions (Bartlett et al., 2012). This paper contributes to the African Journal of Social Sciences (AJSS) by providing empirical insights into sustainable land management and livelihood diversification in a desertification-prone region. The findings aim to inform policy and practice, aligning with Sustainable Development Goal 15 (Life on Land) to promote sustainable terrestrial ecosystems (UN, 2015).

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Desertification in Arid Regions

Desertification is a gradual process that degrades fertile land into desert-like conditions, primarily in arid, semi-arid, and dry sub-humid regions (UNCCD, 2018). In northern Nigeria, desertification affects over 50% of Kano State's arable land, driven by climate change-induced droughts, deforestation, and unsustainable land practices (Ahmed et al., 2015). These factors reduce soil fertility, increase erosion, and diminish water retention, severely impacting agricultural productivity and exacerbating poverty (D'Odorico et al., 2013). In Dambatta, the reliance on biomass fuels like firewood and charcoal accelerates deforestation, further intensifying land degradation (Mortimore, 2009).

CONCEPTUALIZATIONS AND THEORETICAL FRAMEWORK

Community-Led Reforestation

Community-led reforestation is a cornerstone of desertification control strategies. Initiatives like the Great Green Wall, a pan-African effort to create a vegetation barrier across the Sahel, aim to restore 100 million hectares of degraded land by 2030 (UNCCD, 2020). In Nigeria, the Green Nigeria Project focuses on nationwide tree planting, with a particular emphasis on northern regions (FAO, 2020). These initiatives stabilize soils, enhance biodiversity, and improve water retention, but their success hinges on community engagement, adequate funding, and technical support (Stringer et al., 2016). Gebrehiwot et al. (2019) found that agroforestry in sub-Saharan Africa improves soil health and supports livelihoods, yet challenges such as limited resources and low awareness often undermine effectiveness (Finckh et al., 2000).

The Two-Eyed Seeing approach advocates integrating Indigenous knowledge with scientific methods to enhance reforestation outcomes (Bartlett et al., 2012). Indigenous practices, such as traditional agroforestry and soil conservation techniques, offer context-specific insights into sustainable land management, complementing Western scientific approaches (Motsholapheko et al., 2015). However, barriers like insufficient funding and lack of community ownership often limit the scalability of reforestation efforts (Adamou et al., 2014).

Off-Farm Activities and Livelihood Diversification

Off-farm activities provide alternative income sources, reducing dependency on agriculture and mitigating environmental degradation (Barrett et al., 2001). In desertification-prone regions, activities such as small-scale trading, craftsmanship, and agro-processing are viable due to their alignment with local skills and market demands (Rahman & Sultana, 2020). For example, Kutsanedzie et al. (2019) found that agroecology-based off-farm activities in Ghana diversified incomes and reduced land pressure. Similarly, eco-tourism and artisanal production leverage cultural heritage and natural resources, fostering economic resilience while promoting environmental conservation (Goodwin, 2017).

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Despite their potential, off-farm activities face significant barriers, including lack of training, limited market access, and financial constraints (Alvi & Mirza, 2018). Community-based resource management, emphasizing local participation and knowledge sharing, can enhance the adoption of off-farm activities (Ouma et al., 2017). Integrating these activities with reforestation efforts can create synergies, reducing pressure on land resources while supporting economic diversification (Reid et al., 2013).

Theoretical Frameworks

The Sustainable Livelihoods Framework (SLF) provides a lens to analyze how communities leverage human, social, natural, physical, and financial capitals to sustain livelihoods (DFID, 1999). In Dambatta, natural capital (e.g., soil and vegetation) is critical for combating desertification, while human and social capital facilitate community-driven reforestation and off-farm activities. The Ecosystem Services Framework (ESF) underscores the role of ecosystems in providing services like soil stabilization and water regulation, which are essential for sustainable land management (MEA, 2005). The Two-Eyed Seeing approach complements these frameworks by advocating for the integration of Indigenous knowledge with scientific methods, ensuring culturally sensitive and effective interventions (Bartlett et al., 2012).

METHODOLOGY

Study Area

Dambatta LGA, located between Latitude 12°25’59"N to 12°30’00’’N and Longitude 8°30’00’’E to 8°50’00’’E, covers 732 km², representing 3.6% of Kano State’s land area (Olofin, 1987). With a projected population of 339,990 in 2024 (based on a 2.7% annual growth rate from the 2006 census), Dambatta is predominantly agricultural, with 75% of land used for rain-fed cultivation of crops like millet, sorghum, and groundnuts (Kano Agricultural Development Project, 2001). The region’s tropical climate, characterized by a mean annual rainfall of 880 mm and temperatures ranging from 27°C to 34°C, exacerbates desertification due to recurrent droughts and low soil moisture retention (Abdulhamid, 2000).

Research Design

A mixed-methods approach was employed, combining quantitative and qualitative methods to provide a comprehensive assessment of reforestation and off-farm activities. Reconnaissance surveys were conducted in four communities FayamFayam, Dukewa, Zago, and Gwanda selected for their pronounced exposure to desertification. These surveys validated satellite imagery and assessed community readiness for implementing sustainable strategies.

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Data Collection

A structured questionnaire was administered to 384 respondents across the four communities, capturing socio-demographic characteristics, perceptions of desertification severity, effectiveness of reforestation initiatives, and feasibility of off-farm activities. The questionnaire included sections on socio-demographic data, desertification impacts, and barriers to off-farm adoption. Semi-Structured Interviews: Interviews with community leaders, traditional councils, and stakeholders provided qualitative insights into reforestation efforts and off-farm opportunities. These interviews explored community perceptions, challenges, and potential solutions. Geospatial Analysis: Normalized Difference Vegetation Index (NDVI) data from 1986 to 2024, derived from satellite imagery via Google Earth Engine, were used to assess desertification trends. NDVI served as a proxy for vegetation health and density.

Data Analysis

Quantitative Analysis: Ordinal regression was used to evaluate the effectiveness of community-led reforestation on desertification severity, with desertification levels (Not severe, Slightly Severe, Moderately Severe, Very Severe, Extremely Severe) as the dependent variable and reforestation presence (Yes/No) as the independent variable. Descriptive statistics were analyzed from questionnaire responses on off-farm activities, including perceived benefits and barriers. Qualitative Analysis: Thematic analyses of interview data identified key themes related to reforestation challenges and off-farm opportunities, using NVivo software to code and categorize responses. Geospatial Analysis: Time series analysis of NDVI data quantified desertification trends, with linear regression assessing temporal variations in vegetation health.

PRESENTATION OF RESULTS AND DISCUSSION

Socio-Demographic Characteristics

The study revealed a predominantly male (68%) and married (72%) population, with 54% engaged in farming and 28% in livestock rearing. Most respondents (48%) had primary education, indicating limited formal education that may hinder technical skill acquisition for off-farm activities. Monthly income ranged from ₦18,000 to ₦50,000 for 65% of respondents, reflecting economic constraints that influence livelihood diversification.

Extent and Consequences of Desertification

Desertification severity varied across communities, with 42% of respondents rating it as moderately severe, 35% as very severe, and 10% as extremely severe. FayamFayam reported the highest severity (65% very/extremely severe), followed by Dukewa (60%). Land degradation significantly reduced agricultural productivity (78% of respondents) and water

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availability (82%), leading to reduced crop yields (60%), livestock health issues (25%), and drinking water shortages (15%). These impacts exacerbated food insecurity and income challenges, with 70% of respondents noting significant socio-economic consequences.

Effectiveness of Community-Led Reforestation

Ordinal regression analysis showed no significant relationship between community-led reforestation and desertification severity (coefficient = -5.703e-06, p = 0.9999971). Only 28% of respondents found reforestation campaigns highly effective, with FayamFayam showing the highest endorsement (35%). Key barriers included limited funding (40%), lack of technical support (30%), and low community participation (25%). Initiatives like the Great Green Wall and Green Nigeria Project were active but had limited impact due to resource constraints and inadequate community engagement. Interviews highlighted the need for culturally relevant tree species and better maintenance strategies to improve reforestation outcomes. The result partly affirmed Okoroafor et al. (2024) observation that though stakeholders may be willing to adapt and adopt the emerging AI innovations, willingness without basic capacities to back land users is just like swimming in the Ocean of failures.

Off-Farm Activities

Respondents identified craftsmanship (35%), small-scale trading (30%), and agro-processing (20%) as viable off-farm activities. FayamFayam showed the highest support for craftsmanship (40%), while Gwanda favored trading (35%). These activities were perceived to have a significant impact on income diversification (55%) and reducing agricultural dependency (60%). However, barriers included lack of training (45%), limited market access (30%), and insufficient resources (20%). Communities with higher awareness, like FayamFayam, were more optimistic about off-farm benefits (65% highly likely to yield economic benefits). Qualitative data revealed that women and youth were particularly interested in agro-processing and handicrafts, citing cultural alignment and market potential.

Integrated Strategy Perceptions

A majority (56%) rated policy recommendations for off-farm activities and reforestation as very important, with FayamFayam leading (69%). Training programs (32%) and technical support (31%) were prioritized as capacity-building initiatives, particularly in Dukewa (39%) and Zago (35%). Community consultations (28%) and funding support (33%) were seen as critical for successful integration, with Gwanda and FayamFayam emphasizing funding (35% each). Long-term outcomes included improved livelihoods (32%), enhanced environmental conditions (27%), and greater resilience (28%), with Zago showing the highest hope for resilience (35%). Interviewees stressed the importance of involving traditional leaders to foster community ownership and ensure equitable benefit distribution.

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Geospatial Analysis

NDVI analysis from 1986 to 2024 revealed dynamic vegetation trends. In 1986, the mean NDVI was 0.1064, increasing to 0.1378 in 2015, indicating improved vegetation health, possibly due to temporary rainfall increases or reforestation efforts. However, by 2024, NDVI declined to 0.1227, suggesting a reversal of gains. Linear regression analysis ($p = 0.258$) confirmed no significant linear trend in desertification, highlighting the complex, non-linear nature of environmental degradation in Dambatta.

DISCUSSION

Community-Led Reforestation

The limited effectiveness of reforestation initiatives in Dambatta aligns with findings by Stringer et al. (2016), who noted that community-based approaches require robust engagement and resources to succeed. In Dambatta, low participation and funding constraints mirror challenges observed in Niger, where participatory forest management faced similar barriers (Adamou et al., 2014). The Great Green Wall's mixed success in the Sahel underscores the need for sustained investment and local ownership (UNCCD, 2020). Integrating Indigenous knowledge, as advocated by the Two-Eyed Seeing approach, could enhance reforestation outcomes by aligning tree species selection with local ecological conditions (Bartlett et al., 2012). For instance, planting native species like acacias, which are prevalent in Dambatta's Sudanian savanna, could improve survival rates (UNEP, 2019).

The lack of statistical significance in the ordinal regression analysis ($p = 0.9999971$) suggests that current reforestation efforts do not significantly reduce desertification severity. This may be due to inadequate scale, poor maintenance, or unsuitable species selection. Qualitative data from interviews emphasized the need for community training in tree care and better coordination with government agencies to secure funding and technical support.

Off-Farm Activities and Livelihood Diversification

The potential of off-farm activities to reduce land pressure and enhance economic resilience corroborates Rahman and Sultana (2020), who found that diversified livelihoods stabilize incomes in desertified regions. Craftsmanship, trading, and agro-processing are culturally and economically feasible in Dambatta, leveraging existing skills and local markets. For example, pottery and leatherwork, noted by 20% of respondents, align with the region's cultural heritage and have market potential in nearby urban centers like Kano city (Liedholm & Mead, 1999). Agro-processing, such as milling grains or producing dairy products, adds value to agricultural outputs, as seen in similar contexts in Ghana (Kutsanedzie et al., 2019).

However, barriers like lack of training (45%) and market access (30%) echo findings by Alvi and Mirza (2018), who highlighted socio-economic and technological constraints in arid

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regions. Women and youth, who expressed a strong interest in off-farm activities, face additional barriers due to limited access to education and financial resources. Community-based resource management, as advocated by Ouma et al. (2017), can enhance adoption by fostering local participation and knowledge sharing. Cooperatives, suggested by 15% of respondents, could improve market access and resource pooling, as seen in successful models in East Africa (Reid et al., 2013).

Integrated Strategies

The strong community support for policy and capacity-building initiatives reflects findings by Yin et al. (2021), who emphasized the role of government support in promoting sustainable practices. Training programs and technical support are critical for overcoming adoption barriers, particularly in communities like Dukewa and Zago, which reported higher needs for technical assistance (39% and 35%, respectively). Community consultations, prioritized by 28% of respondents, align with Ouma et al. (2017), who stressed the importance of local engagement in designing context-specific solutions. Funding support, highlighted by 33% of respondents, is essential for scaling up off-farm ventures and reforestation efforts, as seen in successful public-private partnerships in Ethiopia (Tesfaye et al., 2019).

The SLF and ESF frameworks provide a robust lens for integrating reforestation and off-farm activities. By enhancing natural capital through reforestation and human/social capital through training and community engagement, these strategies can restore ecosystems while diversifying livelihoods (DFID, 1999; MEA, 2005). The Two-Eyed Seeing approach further underscores the value of incorporating Indigenous knowledge, such as traditional soil conservation practices, to enhance the cultural relevance and sustainability of interventions (Motsholapheko et al., 2015).

Comparison with Existing Studies

The findings align with Oyebade and Danladi (2021), who highlighted the role of community-based initiatives in northern Nigeria, but differ in their use of advanced geospatial tools like Google Earth Engine for precise desertification monitoring. Unlike broader studies by Zakari et al. (2020), this research's localized focus on Dambatta provides tailored insights into community-specific challenges. The integration of qualitative and quantitative methods, including ordinal regression and thematic analysis, distinguishes this study from Bello et al. (2021), who relied primarily on basic GIS tools.

CONCLUSION

This study provides a comprehensive analysis of community-led reforestation and off-farm activities as strategies for combating desertification in Dambatta LGA. The findings highlight moderate to severe desertification, with limited effectiveness of reforestation initiatives due

to resource constraints and low community participation. Off-farm activities, such as craftsmanship and agro-processing, offer significant potential for income diversification but face barriers like a lack of training and market access. An integrated strategy combining enhanced reforestation with off-farm livelihood development, supported by targeted policies, training, and community engagement, is essential for sustainable land management and socio-economic resilience. These insights contribute to the broader discourse on desertification control and align with Sustainable Development Goal 15, offering a blueprint for similar arid regions in sub-Saharan Africa.

RECOMMENDATIONS

1. **Strengthen Reforestation Efforts**: Increase funding for community-led reforestation through partnerships with the Federal Ministry of Environment and NGOs like the Nigerian Conservation Foundation. Prioritize native species like acacias and involve traditional leaders to enhance community ownership (UNCCD, 2020).

2. **Expand Off-Farm Training**: Develop training programs for craftsmanship and agro-processing in collaboration with Kano State University and vocational centers. Focus on women and youth to address gender and age-specific barriers (Kutsanedzie et al., 2019).

3. **Enhance Market Access**: Establish cooperatives to improve market linkages for off-farm products, connecting communities to urban markets in Kano city. Provide micro-finance schemes through the Rural Electrification Agency to support small-scale enterprises (Rahman & Sultana, 2020).

4. **Policy Integration**: Form inter-sectoral committees involving the Federal Ministry of Agriculture and Rural Development and Kano State's environment ministry to align reforestation and off-farm initiatives with environmental goals. Implement subsidies to reduce financial barriers (Yin et al., 2021).

5. **Community Engagement**: Conduct awareness campaigns through local leaders and community groups to foster ownership of reforestation and off-farm projects. Use participatory planning to ensure equitable benefit distribution (Ouma et al., 2017).

Competing Interest

The authors have declared that no conflicting exist in this manuscript.

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