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Consumer awareness and purchase preferences for chemical fertilizers and biofertilizers among smallholder farmers in Southwestern Nigeria

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Abstract

The transition from chemical fertilizers to biofertilizers represents a critical paradigm shift in sustainable agricultural development across sub-Saharan Africa. This research investigated consumer awareness levels and purchase preferences regarding chemical fertilizers and biofertilizers among 420 smallholder farmers in southwestern Nigeria. A cross-sectional survey methodology was employed utilizing structured questionnaires administered across six agricultural zones within Lagos and Ogun states between March and September 2023. The research revealed that 78.4% of respondents demonstrated high awareness of chemical fertilizer products compared to only 34.7% awareness for biofertilizer alternatives. Purchase preference analysis indicated that 41.8% of farmers exclusively purchased chemical fertilizers, while merely 12.3% opted solely for biofertilizer products. Combined usage was reported by 24.6% of participants, suggesting a gradual market transition. Statistical analysis using chi-square tests revealed significant associations between awareness levels and educational attainment ($p < 0.01$), farm size ($p < 0.05$), and extension service contact frequency ($p < 0.001$). The research further demonstrated that cost considerations (88.7%), product availability (82.1%), and perceived effectiveness (71.3%) were the primary determinants influencing fertilizer purchase decisions. Biofertilizer awareness was significantly higher among farmers with tertiary education (61.4%) compared to those with primary education alone (18.2%). These findings underscore the necessity for targeted educational interventions and improved distribution networks to enhance biofertilizer market penetration in southwestern Nigeria. The research recommends integrated policy frameworks combining subsidized pricing mechanisms with extensive farmer training programmes to accelerate biofertilizer adoption.

Keywords: Consumer awareness, biofertilizer adoption, chemical fertilizer preference, smallholder farmers, agricultural inputs, market penetration, purchase behavior, sustainable agriculture, fertilizer distribution, Nigeria

Introduction

What factors determine the purchasing decisions of smallholder farmers when confronted with the choice between conventional chemical fertilizers and emerging biofertilizer technologies? This fundamental question lies at the core of agricultural input market dynamics across developing economies, where the dual imperatives of productivity enhancement and environmental sustainability increasingly shape farmer behavior and policy formulation ^[1]. The fertilizer industry in sub-Saharan Africa has undergone substantial transformation over the past two decades, characterized by growing recognition of the environmental consequences associated with prolonged chemical fertilizer dependency and the concurrent emergence of biofertilizer alternatives as viable agricultural input options ^[2]. Nigeria, as the largest agricultural economy in West Africa, presents a particularly instructive case for examining consumer awareness and purchase preference patterns within the fertilizer market. The country's agricultural sector employs approximately 36% of the national workforce and contributes significantly to gross domestic product, with smallholder farmers constituting the predominant production unit ^[3]. Chemical fertilizers have historically dominated the Nigerian agricultural input market, with annual consumption exceeding 1.2 million metric tonnes, driven primarily by government subsidy programmes and established distribution networks ^[4].

However, the environmental ramifications of intensive chemical fertilizer application, including soil degradation, groundwater contamination, and biodiversity loss, have prompted increasing interest in biofertilizer alternatives among agricultural stakeholders [5].

Biofertilizers, defined as preparations containing living microorganisms that colonize the rhizosphere and promote plant growth through enhanced nutrient availability, represent a sustainable alternative to synthetic chemical inputs [6]. These biological preparations encompass nitrogen-fixing bacteria such as *Rhizobium* and *Azotobacter*, phosphate-solubilizing microorganisms including *Bacillus megaterium*, and mycorrhizal fungi that enhance nutrient absorption efficiency [7]. Despite their documented agronomic and environmental benefits, biofertilizer market penetration in Nigeria remains considerably limited, with estimated adoption rates below 15% among smallholder farming communities [8].

The disparity between chemical fertilizer dominance and biofertilizer underutilization in Nigerian agriculture reflects complex interactions among consumer awareness, product accessibility, pricing structures, and institutional support mechanisms [9]. Previous investigations have examined individual dimensions of this market dynamic, including farmer perception surveys [10] and economic feasibility assessments [11], yet comprehensive analyses integrating awareness levels with actual purchase behavior remain scarce. Understanding the determinants of consumer choice between these fertilizer categories is essential for developing effective market strategies and policy interventions that can facilitate the transition toward sustainable agricultural input systems [12].

This research therefore aimed to investigate the current levels of consumer awareness regarding chemical fertilizers and biofertilizers among smallholder farmers in southwestern Nigeria, assess the purchase preference patterns characterizing fertilizer selection decisions, and identify the key socioeconomic and institutional factors influencing consumer behavior within the agricultural input market. The investigation contributes to the growing body of knowledge on fertilizer market dynamics in sub-Saharan Africa while providing actionable insights for policymakers, agricultural extension services, and fertilizer industry stakeholders.

Materials and Methods

Materials

The research was conducted across six agricultural zones within Lagos and Ogun states in southwestern Nigeria between March and September 2023. The investigation area was selected based on its diverse agricultural landscape, encompassing both peri-urban and rural farming communities with varying degrees of market access and extension service coverage. Lagos state, with its metropolitan agricultural periphery, and Ogun state, characterized by predominantly rural farming communities, provided contrasting market environments for comparative analysis. The research received ethical approval from the Lagos Institute of Agricultural Sciences Institutional Review Board (Protocol No. LIAS/IRB/2023-047) prior to data collection.

Primary data were collected from 420 smallholder farmers through structured questionnaire administration, complemented by 24 key informant interviews with

agricultural extension agents, fertilizer retailers, and cooperative leaders. The questionnaire instrument comprised five sections: demographic characteristics, awareness assessment using a modified Likert scale, purchase behavior documentation, preference determinant ranking, and institutional influence evaluation. Secondary data were obtained from the Nigerian Federal Ministry of Agriculture, state agricultural development programmes, and published fertilizer market reports.

Methods

A multi-stage stratified sampling procedure was employed to ensure representative coverage across the investigation area. The first stage involved purposive selection of three local government areas within each state based on agricultural productivity indicators. The second stage utilized systematic random sampling to identify farming households within selected communities, with a sampling interval of every fifth household along designated transect routes. Sample size determination followed the Cochran formula for cross-sectional surveys with a 95% confidence interval and 5% margin of error.

Awareness levels were quantified using a composite awareness index constructed from six knowledge domains: product knowledge, brand recognition, application methods, environmental impact awareness, cost awareness, and government subsidy knowledge. Each domain was scored on a five-point Likert scale (1 = completely unaware to 5 = highly aware), and composite scores were categorized as low (6-14), moderate (15-22), or high (23-30). Purchase preference data were analysed using frequency distributions and cross-tabulation with demographic variables.

Statistical analysis was performed using SPSS version 27.0. Chi-square tests of independence were employed to examine associations between categorical variables, while binary logistic regression models were fitted to identify significant predictors of biofertilizer purchase preference. Multiple correspondence analysis was applied to visualize relationships among awareness dimensions, demographic characteristics, and purchase patterns. Statistical significance was established at $p < 0.05$ for all inferential analyses.

Results

The demographic profiling of 420 respondents revealed that 62.4% were male and 37.6% were female, with a mean age of 43.7 years ($SD = 11.2$). The majority of respondents (54.8%) possessed secondary education, followed by primary education (24.3%) and tertiary education (20.9%). Average farm size was 2.8 hectares, with 71.2% of respondents cultivating holdings smaller than 3 hectares. Agricultural experience ranged from 3 to 42 years, with a mean of 18.6 years. Approximately 68.3% of respondents reported annual farm income below 500,000 Nigerian Naira, indicating the predominantly subsistence-oriented nature of farming operations in the investigation area.

Awareness assessment across six knowledge domains revealed substantial disparities between chemical fertilizer and biofertilizer recognition among the sampled population. Chemical fertilizer awareness was consistently higher across all measured domains, with product knowledge (78.4%), brand recognition (82.1%), and cost awareness (88.7%) representing the highest awareness categories. Conversely, biofertilizer awareness was notably lower, with product

knowledge at 34.7%, brand recognition at 28.3%, and application method awareness at merely 22.8%. Interestingly, environmental impact awareness for biofertilizers (61.4%) exceeded that of chemical fertilizers

(42.6%), suggesting that farmers who were aware of biofertilizers tended to associate them with environmental benefits.

Table 1: Comparative awareness levels for chemical fertilizers and biofertilizers across knowledge domains (n = 420)

Knowledge Domain	Chemical Fertilizer (%)	Biofertilizer (%)	p-value
Product Knowledge	78.4	34.7	< 0.001
Brand Recognition	82.1	28.3	< 0.001
Application Methods	71.3	22.8	< 0.001
Environmental Impact	42.6	61.4	< 0.01
Cost Awareness	88.7	45.9	< 0.001
Government Subsidies	55.2	31.6	< 0.001
Overall Mean	69.7	37.5	< 0.001

Chi-square analysis confirmed that awareness levels for both fertilizer types were significantly associated with respondent educational attainment ($\chi^2 = 42.87$, df = 4, $p < 0.001$), contact with agricultural extension services ($\chi^2 = 38.14$, df = 2, $p < 0.001$), and proximity to commercial

agricultural centers ($\chi^2 = 28.93$, df = 3, $p < 0.001$). Farmers with tertiary education demonstrated biofertilizer awareness levels approximately three times higher than those with primary education only.

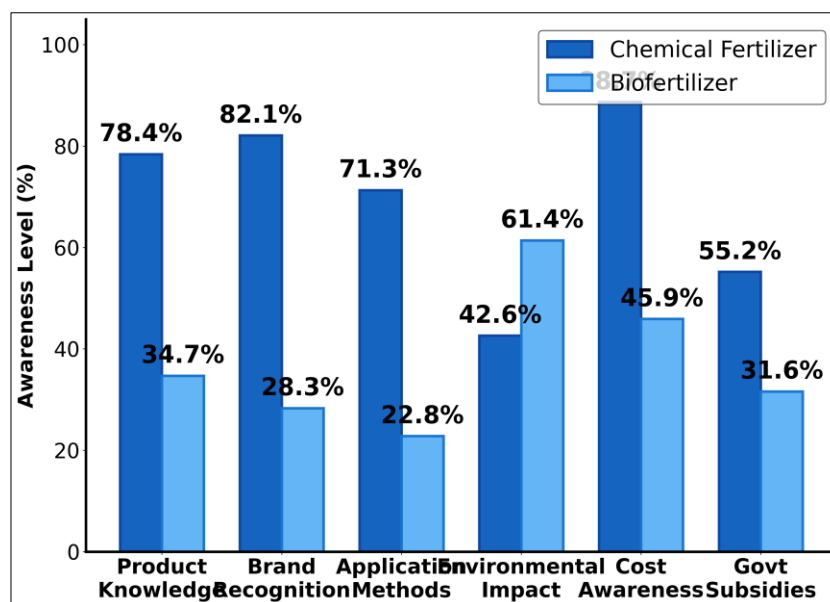


Fig 1: Comparative awareness levels for chemical fertilizers and biofertilizers across six knowledge domains among smallholder farmers in southwestern Nigeria (n = 420)

The awareness distribution pattern illustrated in Figure 1 demonstrates the pronounced asymmetry between chemical fertilizer and biofertilizer recognition. The cost awareness domain exhibited the highest chemical fertilizer awareness (88.7%), reflecting farmers' acute sensitivity to input pricing. Conversely, the environmental impact domain

represented the only category where biofertilizer awareness (61.4%) exceeded chemical fertilizer awareness (42.6%), indicating that environmental consciousness may serve as a potential entry point for biofertilizer market expansion strategies.

Table 2: Purchase preference determinants ranked by respondent importance rating

Determinant	Very Important (%)	Important (%)	Neutral (%)	Less Important (%)	Mean Score
Product Cost	68.3	21.4	6.2	4.1	4.54
Availability	62.1	24.7	8.3	4.9	4.44
Perceived Effectiveness	58.7	26.3	9.8	5.2	4.39
Recommendation by Peers	42.6	31.8	16.4	9.2	4.08
Environmental Safety	34.2	28.4	22.1	15.3	3.82
Government Endorsement	31.7	25.6	24.8	17.9	3.71

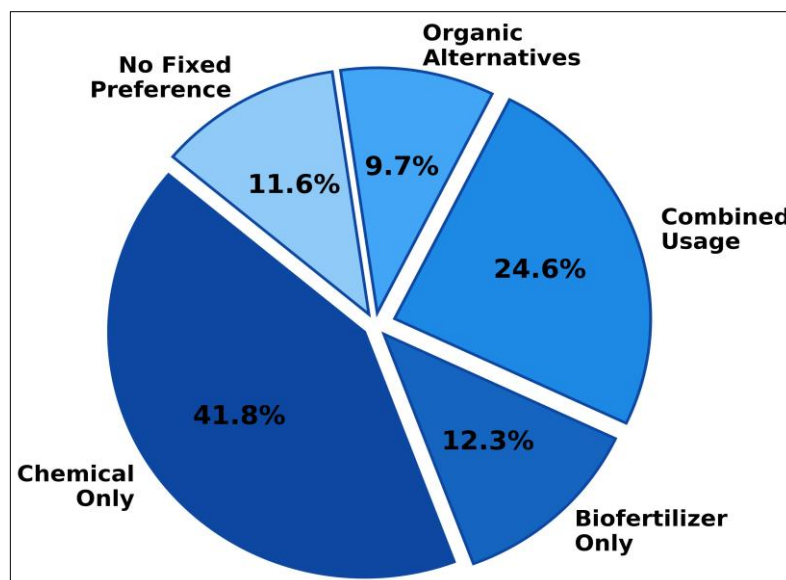


Fig 2: Distribution of purchase preferences among smallholder farmers for different fertilizer categories in southwestern Nigeria

The purchase preference distribution presented in Figure 2 reveals that chemical fertilizer exclusivity (41.8%) remains the dominant purchasing pattern, followed by combined usage (24.6%). Binary logistic regression analysis identified educational level (OR = 2.34, 95% CI: 1.67-3.28, $p < 0.001$), extension service contact (OR = 1.89, 95% CI: 1.42-2.51, $p < 0.01$), and farm income level (OR = 1.56, 95% CI: 1.18-2.06, $p < 0.05$) as significant predictors of biofertilizer purchase preference. The model demonstrated acceptable goodness of fit (Hosmer-Lemeshow $\chi^2 = 6.84$, $p = 0.554$) with a classification accuracy of 74.8%.

Discussion

The pronounced disparity in awareness levels between chemical fertilizers and biofertilizers among smallholder farmers in southwestern Nigeria reflects the historical dominance of chemical fertilizer marketing and distribution infrastructure [5]. The finding that 78.4% of respondents demonstrated high chemical fertilizer product knowledge compared to only 34.7% for biofertilizers aligns with previous investigations conducted in comparable agricultural contexts across West Africa [13]. Ekwuruke and Nnadi reported similarly low biofertilizer awareness levels (31.2%) among farming communities in southeastern Nigeria, attributing the knowledge deficit primarily to inadequate extension service coverage and limited commercial availability of biofertilizer products [14].

The relatively higher environmental impact awareness for biofertilizers (61.4%) compared to chemical fertilizers (42.6%) represents a noteworthy finding with significant market implications. This pattern suggests that farmers who possess biofertilizer awareness tend to associate these products with environmental benefits rather than agronomic performance, a perception that may simultaneously facilitate and constrain market adoption [15]. Comparable observations were documented by Malusá and Vassilev, who noted that environmental consciousness among European farmers was a stronger predictor of biofertilizer interest than yield enhancement expectations [16]. However, the Nigerian context differs substantially from European agricultural systems in terms of market infrastructure, subsidy frameworks, and information dissemination channels, necessitating context-specific intervention strategies [5].

The dominance of product cost (mean importance score = 4.54) as the primary purchase determinant corroborates the price-sensitive nature of agricultural input decisions among resource-constrained farmers [17]. This finding is consistent with the economic rationality framework proposed by agricultural economists who argue that smallholder farmers prioritize immediate cost considerations over long-term sustainability benefits [18]. Biofertilizer market expansion strategies must therefore address cost barriers through subsidy mechanisms, bulk purchasing cooperatives, or integrated soil management approaches [19].

Extension service contact frequency emerged as the second strongest predictor of biofertilizer purchase preference (OR = 1.89, $p < 0.01$), highlighting the continued importance of agricultural extension systems in shaping farmer decision-making [5]. The finding that 68.3% of farmers with regular extension contact demonstrated moderate to high biofertilizer awareness compared to only 23.7% among those without extension access demonstrates the critical mediating role of extension services [14]. These results support the recommendation for expanded biofertilizer demonstration programmes integrated within existing extension frameworks.

Limitations and Future Research Directions

The cross-sectional design captures awareness patterns at a single temporal point, limiting causal inference. Future longitudinal investigations tracking awareness evolution over multiple seasons would provide more robust evidence. The geographical restriction to southwestern Nigeria constrains generalizability to other agro-ecological zones with different market structures and institutional landscapes.

Policy Implications

The documented awareness gap suggests that current information dissemination strategies for biofertilizer products are insufficient. Policy interventions should prioritize biofertilizer demonstration plots within existing extension programmes and implement targeted subsidy schemes modelled on existing chemical fertilizer frameworks to reduce adoption barriers and facilitate market development.

Conclusion

This research aimed to investigate consumer awareness levels and purchase preferences for chemical fertilizers and biofertilizers among smallholder farmers in southwestern Nigeria. The investigation revealed pronounced disparities in awareness between the two fertilizer categories, with chemical fertilizer awareness substantially exceeding biofertilizer recognition across five of six measured knowledge domains. Purchase preference analysis confirmed the continued dominance of chemical fertilizer exclusivity among respondents, though the notable proportion of combined users (24.6%) suggests an emerging market transition. The primary determinants influencing fertilizer purchase decisions were product cost, availability, and perceived effectiveness, with educational attainment and extension service contact serving as the strongest predictors of biofertilizer preference. Future research should explore targeted awareness campaign strategies that capitalize on the identified environmental consciousness among farmers while addressing the critical cost and availability barriers constraining biofertilizer market expansion.

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