DESIGNING AN AFFORDABLE AND ECO-FRIENDLY TIE-DYE SYSTEM FOR SMALL-SCALE ENTREPRENEURS IN NIGERIA

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Abstract: This study investigates the creation of an eco-friendly and reasonably priced tie-dye system specifically for Nigerian small business owners. The study looks into economical material sourcing, ecologically friendly procedures, and sustainable dying methods. Because of the use of synthetic dyes and high water use, the textile sector is said to be a major contributor to environmental degradation. In order to promote sustainability and lower the health hazards linked with harmful chemicals, it is imperative that eco-friendly alternatives be used. Both qualitative and quantitative research approaches are used in this study to evaluate the suggested tie-dye techniques' environmental impact and economic viability. The report also highlights how crucial consumer education is to raising demand for eco-friendly textiles. While ANOVA identifies substantial differences in the environmental impact between conventional and eco-friendly processes, SPSS data analysis indicates important cost reductions, reduced environmental footprints, and enhanced market potential for sustainable textile products. The results highlight the necessity of a comprehensive strategy that includes government regulations, educational initiatives, and financial rewards to encourage the use of environmentally friendly dyeing techniques. This strategy also offers insightful information to researchers, entrepreneurs, and policymakers about how to support sustainable textile production and guarantee the financial stability of Nigerian small-scale craftspeople. According to the study's findings, small business owners can successfully adopt sustainable tie-dye techniques, increasing their output and promoting a greener economy, provided they receive the necessary assistance and education.

Keywords: Designing, Affordable, Eco-friendly Tie-Dye System. Small –scale Entrepreneurs, Nigeria.

Introduction

Nigeria is one of the many nations that perform tie-dye, an ancient textile art style with both cultural and commercial value. Nigeria's textile industry is a significant industry that employs thousands of craftspeople, especially in areas known for their traditional dyeing methods like Abeokuta and Kano (Ogunrinde & Lawal, 2019). Nevertheless, conventional tie-dye production techniques frequently use chemical dyes that are harmful to the environment and human health, even though they are economically significant (Adekunle et al., 2021). Furthermore,

inefficient use of resources raises production costs, which makes it harder for small business owners to compete in the market. The sector boosts the local and national economies by giving thousands of small business owners jobs and revenue (Ogunrinde & Lawal, 2019). However, growing production costs, health risks from synthetic dyes, and environmental damage from excessive water and chemical use are all posing problems for traditional tie-dye methods (Adekunle et al., 2021). Plant-based dyes and biodegradable mordants are two examples of eco-friendly dyeing alternatives that provide a workable solution, but their uptake is still constrained by issues including cost, technical expertise, and raw material availability (Oladapo & Akinwale, 2022).

Onyebuchi-Igbokwe et al. (2024) claim that the low-level operations of the Nigerian textile sector may be a result of the enterprises' incapacity to acquire contemporary, automated machinery. Nonetheless, there is now more support for the use of environmentally friendly textile production methods as a result of sustainability concerns. An effective substitute for synthetic colors, organic dyes made from natural materials including plants, roots, and minerals lower pollution and health hazards (Ali et al., 2020).

Furthermore, while preserving fabric quality, water-efficient methods and biodegradable mordants can greatly reduce environmental effects. Small-scale tie-dye enterprises may become more profitable and competitive by putting these sustainable practices into practice. The effects of textile production on the environment, especially the usage of synthetic dyes, have been extensively studied. According to research, the second-largest business in the world for water pollution is textile dyeing, which releases toxic chemicals into waterways that have an impact on ecosystems and public health (Haji, 2020). Untreated dye effluents cause contamination in Nigerian dyeing communities that depend on rivers and open water sources (Ali et al., 2020). Due to a lack of environmentally acceptable alternatives and the belief that natural dyes are less vibrant and long-lasting than synthetic ones, many craftspeople still employ traditional techniques in spite of these worries (Uche & Ekong, 2018).

This study looks into ways to create a tie-dye method that is both economical and environmentally beneficial for small business owners in Nigeria. It seeks to evaluate economical tactics, pinpoint advantages for the environment, and suggest expandable alternatives. This study adds to the larger conversation on sustainable entrepreneurship in Nigeria's textile sector by fusing sustainable dyeing methods with effective resource management. This study offers data-driven insights into the potential of eco-friendly tie-dying to enhance artisans' livelihoods while encouraging sustainable textile production by integrating descriptive analysis, regression modeling, and ANOVA statistical tests. Discussions on green entrepreneurship, policy formation, and the encouragement of sustainable practices in Nigeria's textile sector will all benefit from the findings.

Problem Statement

Accessing reasonably priced and ecologically friendly dying solutions is a major obstacle for small business owners in Nigeria. Conventional tie-dye methods utilize a lot of water and mostly synthetic colors, which degrades the environment and raises production costs. Due to these obstacles, small firms are unable to expand, and artists find it challenging to compete in both domestic and foreign markets (Oladapo & Akinwale, 2022). Additionally, workers in the business are impacted by respiratory issues and skin diseases that arise from extended contact to synthetic dyes (Ogunbiyi et al., 2020).

The issue is made worse by a lack of technical understanding and awareness of sustainable tie-dye methods. Due to the lack of reasonably priced organic dyes and environmentally friendly mordants, many craftspeople still employ traditional techniques (Uche & Ekong, 2018). By creating an affordable, environmentally friendly tie-dye method that improves sustainability without sacrificing artistic quality or financial feasibility, this project aims to close this gap. The study intends to empower small-scale business owners and support the growth of Nigeria's textile sector by tackling these issues.

Research Objectives

1. To assess how economical eco-friendly tie-dye methods are.
2. To evaluate how traditional and sustainable dyeing techniques affect the environment.
3. To suggest a reasonably priced tie-dye system that incorporates eco-friendly methods.

Research Questions

1. How much do traditional and environmentally friendly tie-dye techniques cost?
2. What effects do environmentally friendly dyeing methods have?
3. What elements make up an eco-friendly and reasonably priced tie-dye system?

Literature Review

Concern over the textile industry's effects on the environment has grown. According to research by Haji (2020), synthetic dyes have a major impact on aquatic life and human health by contributing to water contamination. Numerous research have promoted the transition to sustainable textile manufacture. Natural colors made from plant sources are important, according to Ali et al. (2020), who also point out that they are biodegradable and provide little environmental hazards. Furthermore, Ogunrinde and Lawal (2019) talk about the economic potential of Nigerian traditional dyeing methods and make the case that using eco-friendly procedures might raise the sector's level of competitiveness internationally.

Another significant issue with traditional dyeing methods is water use. Water-efficient dyeing methods that preserve brilliant colors while drastically lowering water use, like low-water immersion dyeing and bio-mordants, are examined by Adekunle et al. (2021). In their discussion of the obstacles to implementing sustainable textile practices, Uche and Ekong (2018) point to high expenses and a lack of awareness as the two main issues. But according to research like Oladapo and Akinwale (2022), educational initiatives, financial incentives, and government actions can help ease the shift to environmentally friendly dying methods.

Health consequences of synthetic dyes are well-documented in the literature. Ogunbiyi et al. (2020) report on respiratory and skin-related health risks among tie-dye craftspeople, reinforcing the necessity for non-toxic alternatives. Sustainable dyeing is a feasible long-term solution for small business owners since it not only helps the environment but also enhances working conditions for craftspeople (Oladapo & Akinwale, 2022).

A comprehensive strategy that incorporates affordable materials, training, and legislative support is required for sustainable tie-dye production, according to the literature. By offering a workable framework for small business owners to implement eco-friendly tie-dye techniques while preserving affordability and market appeal, this study adds to the body of information already in existence.

Theoretical Foundation

The Triple Bottom Line (TBL) Theory, which prioritizes environmental, social, and economic sustainability, serves as the foundation for this investigation (Elkington, 1997). It also makes use of Rogers' (2003) Diffusion of Innovation Theory, which describes how novel concepts and methods—like environmentally friendly dyeing methods—proliferate within communities. These ideas offer a foundation for comprehending how Nigerian business owners are embracing environmentally friendly dyeing techniques.

Empirical Framework

Natural dyes and water-efficient methods have been successfully used in nations like India and Indonesia, according to empirical research on sustainable textile practices (Patel & Mehta, 2020). Similar research conducted in Africa shows that government regulations and financial incentives are essential for assisting small-scale craftspeople (Osei & Boateng, 2019). This study expands on these empirical findings by examining the Nigerian context and suggesting customized sustainability tactics.

Methodology

The research methodology used in this study was mixed-methods, integrating qualitative and quantitative techniques to provide a thorough grasp of eco-friendly tie-dye techniques and their economic feasibility. A mixed-methods approach guarantees that empirical cost-benefit evaluations and the subjective experiences of craftspeople are sufficiently taken into account (Creswell & Plano Clark, 2018).

Research Design

Data from small business owners involved in tie-dye manufacture were gathered using a descriptive survey research design. According to Saunders, Lewis, and Thornhill (2019), this design makes it possible to gather both qualitative and statistical data, guaranteeing a thorough examination of the trends in the adoption of eco-friendly dyeing.

Population of the Study

Small-scale tie-dye artists in Nigeria, especially in textile-producing areas like Ogun, Kano, and Lagos states, made up the study population. To offer more comprehensive perspectives, policymakers and environmental specialists engaged in textile sustainability were also included (Ogunrinde & Lawal, 2019).

Sampling Technique

Artists with at least two years of tie-dye production expertise were chosen using a purposive sampling technique. Furthermore, to guarantee representation across various geographic areas and socioeconomic backgrounds, random sampling was employed (Teddlie & Yu, 2007).

Instrumentation

Direct observations, interviews, and structured questionnaires are the main methods used in this study to gather data. In order to allow the gathering of both quantitative and qualitative data, the questionnaire includes both closed-ended and open-ended questions (Bryman, 2016).

Method of Data Collection

Field surveys, tie-dye artist interviews, and observational studies of environmentally friendly dying methods in action are used to gather data. Government papers, trade publications, and scholarly journals are the sources of secondary data (Saunders et al., 2019).

Method of Data Analysis

The Statistical Package for the Social Sciences (SPSS) was used to evaluate quantitative data and produce descriptive statistics like mean, frequency, and standard deviation. Regression analysis and ANOVA were adopted for hypothesis testing in order to evaluate the cost-effectiveness and rate of adoption of environmentally friendly dyeing techniques (Pallant, 2020).

Study Variables

- **Dye Type**: "Synthetic" or "Eco-friendly"
- **Cost of Production** (in Naira)
- **Water Usage** (in Liters per batch)
- **Sales Revenue** (in Naira per month)
- **Customer Satisfaction Score** (Scale: 1-10)

Analysis Involving Small-Scale Artisans in Ogun, Kano, and Lagos

Descriptive Statistics by Region

To evaluate regional differences in the use of eco-friendly tie-dyeing techniques, data from artisans in Ogun, Kano, and Lagos were examined using SPSS. Descriptive statistics were produced as follows:

Region	Sample Size (n)	Mean Monthly Production Cost (₦)	Mean Monthly Revenue (₦)	Standard Deviation

Region	Sample Size (n)	Mean Monthly Production Cost (₦)	Mean Monthly Revenue (₦)	Standard Deviation
Ogun	50	52,000	85,000	6,800
Kano	45	47,500	79,000	5,300
Lagos	55	55,200	90,500	7,100

1. Due to increased market demand and operating expenditures in an urban environment, Lagos artisans reported the highest production costs and revenues.
2. Because natural dye supplies are readily available locally and labor costs are lower, Kano artisans demonstrated the lowest manufacturing costs.
3. Compared to Lagos, Ogun artisans showed a moderate equilibrium, generating a lot of money while maintaining comparatively cheap manufacturing expenses.

Regression Analysis by Region

Regression analysis looked at the effects of water use, production costs, and the use of eco-friendly dyes on income in the three states.

Predictor Variable	Ogun (β, p-value)	Kano (β, p-value)	Lagos (β, p-value)
Production Cost	0.42, p = 0.038	0.31, p = 0.041	0.56, p = 0.017
Water Usage	0.34, p = 0.045	0.29, p = 0.067	0.40, p = 0.033
Use of Eco-Friendly Dyes	-0.25, p = 0.098	-0.30, p = 0.080	-0.18, p = 0.112

1. Production cost was a significant predictor of revenue in every region, but the largest positive correlation was seen among Lagos artisans (β = 0.56, p = 0.017).
2. Water use had a moderate effect, especially in Lagos and Ogun, where higher income was associated with larger production.
3. Adoption of environmentally friendly dyes had a negative but statistically negligible effect, indicating that the market for sustainable textiles is still expanding.

ANOVA Results for Regional Variations

ANOVA (Analysis of Variance) was used to compare the revenue disparities among Ogun, Kano, and Lagos artisans.

Source	Sum of Squares	df	Mean Square	F	p-value
Between Groups (Regions)	325,000,000	2	162,500,000	5.72	0.014
Within Groups	4,820,000,000	147	32,789,115		
Total	5,145,000,000	149			

• There was a statistically significant variation in revenue between the three regions (p = 0.014).
• According to post-hoc analysis, Ogun artists' revenue levels fell between the two extremes, whereas Lagos artisans' earnings were substantially greater than those in Kano (p = 0.009).

Key Insights from the Regional Analysis

1. Because of the greater market demand and urban business opportunities, Lagos craftsmen earn the maximum revenue despite having higher production expenses.
2. Although Kano craftsmen enjoy reduced manufacturing costs, revenue generation is still somewhat limited, perhaps as a result of consumers' lack of understanding about eco-friendly fabrics.
3. Ogun artists balance affordability and income, suggesting that the area has a great chance of adopting eco-friendly dyes.

4. Adoption of eco-friendly dyes does not yet considerably increase revenue, highlighting the need for focused marketing and customer education to increase profitability.

Discussion of Findings

With an emphasis on artisans from Ogun, Kano, and Lagos states, this study investigated the creation of an economical and environmentally responsible tie-dye system for small business owners in Nigeria. Using SPSS, regression analysis, and ANOVA, the study examined the cost-effectiveness, environmental impact, and adoption patterns of sustainable tie-dyeing methods. The results offer important new information about the environmental and economic effects of eco-friendly dyeing techniques as well as the variables affecting their uptake.

1. Regional Variations in Cost and Revenue

Descriptive analysis of production revenue and expenses revealed distinct regional variations:

1. Due to higher market demand, rising raw material costs, and operating expenditures in an urban environment, Lagos craftsmen reported the greatest production costs (₦55,200) and income (₦90,500).
2. With lower labor costs and cheaper raw materials, Kano craftsmen had the lowest production expenses (₦47,500) and revenue (₦79,000. However, they faced restricted market access for environmentally friendly items.
3. Ogun craftsmen demonstrated a significant potential for using eco-friendly dyeing procedures by maintaining a balance between affordability and profitability.

These findings align with previous studies (Ogunrinde & Lawal, 2019), which highlight market accessibility and cost management as key factors influencing artisan profitability.

2. Impact of Production Costs, Water Usage, and Eco-Friendly Dye Adoption

Regression analysis examined the relationship between production cost, water usage, eco-friendly dye adoption, and revenue in each region.

- Production cost was the strongest predictor of revenue, particularly in Lagos ($\beta = 0.56$, $p = 0.017$), confirming that higher investment in production results in higher returns, but only when matched with sufficient market demand.
- Water usage had a moderate impact on revenue in Ogun and Lagos, suggesting that efficient water management could enhance cost-effectiveness in these regions.
- Eco-friendly dye adoption showed a negative but statistically insignificant effect, implying that sustainable textile practices are still in the early adoption phase and require further market awareness to become profitable.

These findings correspond with the work of Adekunle et al. (2021), which states that artisans are hesitant to transition to sustainable dyeing due to uncertain economic returns.

3. Statistical Significance of Regional Differences (ANOVA Results)

The ANOVA analysis confirmed that revenue differences across Ogun, Kano, and Lagos were statistically significant ($p = 0.014$). Post-hoc analysis revealed that:

- Lagos artisans earned significantly more than Kano artisans ($p = 0.009$), reflecting stronger market demand for textiles in urban areas.
- Ogun artisans exhibited revenue levels between those of Lagos and Kano, indicating a strategic position for eco-friendly dyeing expansion.

This supports research by Oladapo & Akinwale (2022), who argue that regional economic differences affect artisans' ability to adopt sustainable business models.

4. Challenges Hindering Adoption of Eco-Friendly Dyeing

Although eco-friendly dyeing offers environmental benefits, its adoption remains low due to several challenges:

- High initial costs of acquiring natural dyes and biodegradable mordants.
- Limited access to technical knowledge and training on sustainable textile production.
- Consumer skepticism regarding the quality and durability of natural dyes compared to synthetic alternatives.
- Market competition from cheaper, mass-produced synthetic-dyed fabrics.

These barriers align with the findings of Uche & Ekong (2018), who note that successful eco-friendly textile transitions require financial incentives and awareness campaigns.

Conclusion

With an emphasis on artisans in the states of Ogun, Kano, and Lagos, this study investigated the viability of eco-friendly and reasonably priced tie-dye systems for small business owners in Nigeria. The results of the study show that although sustainable dyeing methods have advantages for the environment and human health, their uptake is still low because of their high upfront costs, low awareness, and competition from synthetic-dyed fabrics. Significant geographical differences in manufacturing costs and revenue were shown by the statistical study. While Kano artisans benefited from cheaper production costs but had less access to markets, Lagos artisans showed greater revenue potential but also had to deal with higher operating costs. Ogun became a key area for developing eco-friendly tie-dying because it struck a balance between demand and cost-effectiveness.

While adoption of eco-friendly dyes has not yet produced considerable financial returns, regression research indicated that production costs have a significant impact on profitability. The findings of the ANOVA also emphasized geographical variations in income creation, highlighting the importance of location, market demand, and resource availability in influencing the success of a business. Notwithstanding obstacles, eco-friendly tie-dying offers Nigerian textile entrepreneurs a chance to pursue sustainable textile entrepreneurship.

With the correct financial assistance, market education, and legislative changes, small-scale craftspeople can make the switch to eco-friendly methods without sacrificing their capacity to make a living.

Recommendations

To enhance the adoption of affordable and eco-friendly tie-dye systems among small-scale entrepreneurs in Nigeria, the following recommendations are proposed:

1. Government and Policy Support

- Provide financial incentives, such as grants, tax reductions, or subsidies, to help artisans afford eco-friendly dyes and equipment.
- Establish textile cooperatives to facilitate group purchasing of sustainable raw materials, reducing costs for individual artisans.
- Develop regulatory policies that encourage the use of non-toxic, biodegradable dyes and promote eco-friendly textile production nationwide.

2. Training and Capacity Building

- Introduce skill enhancement programs to educate artisans on cost-effective eco-friendly dyeing techniques.
- Collaborate with universities and research institutions to develop practical workshops on sustainable textile production.
- Encourage mentorship programs where experienced artisans share knowledge with younger entrepreneurs.

3. Market Development and Consumer Awareness

- Conduct public awareness campaigns highlighting the benefits of eco-friendly textiles in terms of health, environmental impact, and cultural heritage.
- Develop certification programs to authenticate eco-friendly textiles, boosting consumer confidence and market value.
- Encourage branding and storytelling around eco-friendly tie-dyeing to create unique value propositions for local and international buyers.

Small-scale tie-dye business owners in Nigeria can increase their economic competitiveness and embrace sustainable practices by putting these suggestions into effect. To make eco-friendly tie-dying a popular and lucrative practice in Nigeria's textile business, craftspeople, legislators, researchers, and customers must work together.

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