

Technology adoption and the performance of *Adire* textile firms

Abstract

The study investigated the types of technology adopted in *adire* textile firms and evaluated the effect of the adopted technologies on business performance in Osun State, Nigeria. Three *adire* textile processing centres were randomly selected from each Senatorial District. Questionnaire was administered to fifteen designers (managers inclusive) from each of the selected processing site totaling one hundred and twenty-two (122) respondents. The data was analysed using descriptive and inferential statistics. The result showed that majority (77%) adopted traditional dye, batik, eleko, oniko, and alabere techniques, while 23% used freehand and stencil techniques. None employed Computer Numerical Control (CNC) or Computer-Aided Design (CAD) software. A positive and significant relationship exists between affordability and dye technology ($r = 0.279$; $p < 0.01$). There was a positive and significant relationship between increase in price and batik technology ($r = 0.301$; $p < 0.01$) and communication technology ($r = 0.191$; $p < 0.05$). The study concluded that technologies adopted in the study area contributed significantly to *adire* business performance implying that adoption of modern technology will improve the operations.

Keywords: *Adire*, technology, adoption, performance, textile firms

Volume 12 Issue 1 - 2026

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Received: December 28, 2025 | **Published:** February 4, 2026

Introduction

Nigeria is a culturally diverse nation endowed with creativity, traditional skills, and rich artistic heritage. Among the country's many indigenous crafts, textiles occupy a significant position, playing important roles in cultural identity and tourism development.^{1,2} They often communicating personality, status and prestige.³

Adire, a Yoruba resist-dyed textile, is one of Nigeria's most enduring indigenous crafts. Evidence suggests that related strip-woven fabrics existed as early as the eleventh century, as shown by textile fragments found in Mali's Tellem caves.⁴ *Adire* production uses local materials such as raffia, indigo dye, and handwoven cotton fabrics. The term *adire* is derived from two Yoruba words *adi* (to tie) and *re* (to dye), describing a process in which fabric sections are tied, stitched, or knotted before dyeing to create patterned motifs.⁵ Depending on design preferences, producers may incorporate seeds, pebbles, or tight stitching to generate various resist effects.

Adire is traditionally produced by women in southwestern Nigeria and carries strong aesthetic and cultural meanings. Several varieties of *adire* exist, including *adire eleko*, created using a cassava-paste resist applied with quills or wooden tools.^{6,7} Classic motifs include *adire eleso*, *osubamba*, and *alakete* with knotting, binding, folding, stitching, and clamping.⁸ Over the years, innovations such as combining tie-dye with batik have expanded design possibilities. *Adire* continues to thrive due to its popularity among artists and consumers, and its craftsmanship has contributed to Nigeria's visibility in global fashion markets.^{8,9} The craft also supports employment and local economies. The early twentieth-century textile boom, enabled by European merchants who supplied factory-produced cloth, further expanded the scale of *adire* production.¹⁰

Within the informal sector, enterprises are typically small-scale, labour-intensive, and reliant on personal capital and family labour.¹¹

Limited production capacity remains a persistent challenge in the Nigerian *adire* textile firms. Manual production methods restrict output, as resist-dye and hand-printing techniques are labour-intensive

and time-consuming.¹² Stenciling and freehand drawing further limit scalability, making it difficult for producers to meet growing demand.¹³ Without effective technology evaluation, innovations may fail to perform as expected in the total quality aspect.¹⁴

Although recent innovations have emerged in *adire* production, there is limited empirical documentation on the types of technologies adopted, factors influencing adoption, and their effects on production performance in Osun State. This gap underscores the need for the present study.

The study therefore aims to assess the technologies adopted by *adire* producers in Osun State. Specifically, it seeks to identify the technologies adopted, examined the factors influencing the adoption, and evaluated how these technologies affect the performance of *adire* processing centres. Findings will benefit scholars and policymakers by providing updated evidence on technology adoption patterns and their implications for strengthening the *adire* industry.

Material and methods

The study was carried out in Ile-Ife, Ede and Osogbo, in Osun State, Nigeria. Osogbo is notable for indigo dyeing in Nigeria. The population of this study consists of *adire* textile designers.

The study employed multi-stage sampling technique. Three senatorial districts were selected in Osun State including the Osun Central District, Osun West district and Osun East Districts. Three *adire* textile processing centres were randomly selected from each Senatorial district. A questionnaire was administered to fifteen (15) designers and managers from each of the selected centres totaling one hundred and twenty-two (122) respondents. Ethical considerations were ensured by obtaining informed consent from all participants before data collection.

Results and discussions

Table 1 shows the characteristics of the *adire* centres. Specialisation centred on Tie-dye/Batik (41.8%) and Tie-dye/Batik/Eleko (27.9%).

All the centres produced Batik and tie-dye using similar technology. Training modes include *Adire* School (38.5%), apprenticeship/Industrial Training (35.2%), family tutelage (23.8%) and no formal training (2.5%).^{8,15} Over 74.6% of centres were established after 2001, with 40.2% established since 2011, confirming rapid growth in Osogbo, the traditional home of indigo dyeing.¹⁶ The majority (73%) had less than 10 years' experience in the business reflecting dominance of young practitioners and apprentices, while those with 11–30 years provide training.¹⁷

Table 1 Characteristics of the *Adire* textile firms

| Characteristic | Category | Frequency | Percentage |
|------------------------|--------------------------------------|-----------|------------|
| Area of Specialization | Tie and Dye | 13 | 10.6 |
| | Batik | 15 | 12.3 |
| | Tie and Dye/Batik | 51 | 41.8 |
| | Tie and Dye/Batik/Eleko | 34 | 27.9 |
| | Adire Eleko/ Batik/ Bleaching | 9 | 7.4 |
| | 1971 – 1980 | 4 | 3.3 |
| Year of Establishment | 1981 – 1990 | 17 | 13.9 |
| | 1991 – 2000 | 10 | 8.2 |
| | 2001 – 2010 | 42 | 34.4 |
| | 2011 – 2020 | 49 | 40.2 |
| | Below 10 years | 89 | 73 |
| Years of Experience | 11 – 20 years | 16 | 13.1 |
| | 21 – 30 years | 12 | 9.8 |
| | 31 – 40 years | 4 | 3.3 |
| | 41 years and above | 1 | 0.8 |
| Mode of Training | Apprenticeship / Industrial Training | 43 | 35.2 |
| | Family Tutelage | 29 | 23.8 |
| Source of Capital | Adire School | 47 | 38.5 |
| | No Formal Training | 3 | 2.5 |
| | Loan from Bank | 21 | 17.2 |
| | Personal Savings | 81 | 66.4 |
| | Government Grant | 2 | 1.6 |
| | Loan from Friends and Family | 6 | 5 |
| | Mobilization of Advance Payment | 12 | 9.8 |

Table 2 shows technology adoption in *adire* production. A majority (77%) of *adire* producers adopted traditional dye, batik, eleko, oniko, and alabere techniques, while 23% used freehand and stencil techniques. None employed CNC or CAD software, confirming the predominance of manual batik and *eleko* methods indigenous to Osogbo.^{8,18} About 46.7% combined knotting, binding, folding, and stitching (using the *iko*/raffia-based resist techniques), 17.2% used knotting and folding, while stitching is rarely adopted (0.8%). Also, 55.7% relied solely on mobile phones for customer communication, 36.1% used mobile plus web, and 8.2% included e-mail. This reflects a growing digital outreach.¹⁹

Table 2 Technology adoption in the *Adire* firms

| Characteristic | Category | Frequency | Percentage |
|-----------------------------|--|-----------|------------|
| Types of Technology Adopted | Dye/ Batik technology | 94 | 77 |
| | Adire eleko/eleso/oniko/alabere/Freehand & Stencil | 28 | 23 |
| | CNC/CAD | 0 | 0 |
| | Knotting | 10 | 8.2 |
| | Binding | 6 | 5 |
| | Folding | 16 | 13.1 |
| Techniques Used from Tying | Stitching | 1 | 0.8 |
| | All of the above | 57 | 46.7 |
| | Knotting and Binding | 2 | 1.6 |
| | Knotting, Binding, Folding | 9 | 7.4 |
| | Knotting and Folding | 21 | 17.2 |
| | Mobile Phone | 68 | 55.7 |
| Communication Technology | E-mail | 10 | 8.2 |
| | Mobile Phone and Web | 44 | 36.1 |
| | Direct / German dye | 31 | 25.4 |
| | Dipping dye | 19 | 15.6 |
| | Indigo dye | 16 | 13.1 |
| Dye Used for Production | All of the above | 22 | 18 |
| | Direct and Dipping dye | 30 | 24.6 |
| | Direct and Indigo dye | 4 | 3.3 |
| | Use of Computer Design | 36 | 29.5 |
| | No | 86 | 70.5 |

Majority (70.5%) still depended entirely on manual sketching while 29.5% used graphic design.¹³ Sources of capital were predominantly personal savings (66.4%), bank loans (17.2%), family/friends (4.9%), government grants (1.6%), and advance payments (0.8%). There is a limited formal financial support for the artisan.²⁰

Table 3 shows the factors influencing technology adoption in *adire*. There is a positive and significant relationship between increase in sales and age of processing centre ($r = 0.231$; $p < 0.05$) which suggested that when a firm is located in a particular area for a very good number of years, it tends to have more patronage than a newly opened firm in the same location.²¹ There is also a positive and significant relationship between education and access to information ($r = 0.186$; $p < 0.05$). Information on technology adoption is needed to improve efficiency. When a firm adopts a new technology, it improves performance.

Table 4 presents the result of multiple linear regression analysis for the nexus between technology adoption and factors influencing adoption. The residual (0.709) implied a positive nexus between technology adoption and factors. The proportion of R^2 indicates that

the model is reliable since the goodness of fit is 50% which shows that about 50% variation in technology adoption is being captured by the variation of affordability of technology, reduction of hazard, market demand from customer, size of processing centre and observation of other technologies. Irrespective of the factors, technology adoption would increase by 0.967%. A unit increase in price of new technology could reduce its affordability by 0.376%. This result is expected because when the price of a commodity increases, the quantity

demanded reduces or the commodity may not be bought. Reduction of hazard was also a significant determination of technology adoption ($p < 0.05$). The coefficient of determination was 0.281 which indicated that a unit increase in hazard from a technology may cause 0.281 decreases in the adoption of such technology. This further suggested that in *adire* textile making, hazardous chemical may discourage its adoption. The coefficient for size of processing centre is 0.177 which is significant ($p < 0.05$).

Table 3 Factors influencing technology adoption in *Adire* textile firms

| Factors | Dye Tech | Eleko | Alabere | Stencil | Freehand | Batik | Oniko | Comm |
|-----------------------------------|--------------------|--------------------|------------------|--------------------|----------|--------------------|-------|------------------|
| Affordability of Technology | 0.279 (0.002)** | – | – | – | – | – | – | – |
| Increase in Price | – | – | – | – | – | 0.301 (0.001)** | – | 0.191 (0.036) |
| Complexity of Technology | – | 0.180 (0.047) | – | – | – | – | – | – |
| Availability of Labour | – | 0.264 (0.004)** | 0.184 (0.034) | 0.277 (0.002)** | – | 0.497 (0.000)** | – | – |
| Increase in Sales | – | – | – | 0.231 (0.011) | – | – | – | – |
| Awareness & Access to Information | – | – | – | – | – | – | – | – |

Table 4 Regression analysis of factors influencing technology adoption in *Adire* textile processing centres Cont'd

| Variables (Constant) | B | Std. Error | Beta | T | P |
|-------------------------------------|--------------|--------------|--------|------------|----------|
| | 0.967 | 0.215 | | 4.5 | 0 |
| Affordability of Technology | -0.376 | 0.106 | -0.33 | -0.545 | 0.001 |
| Complexity of Technology | 0.025 | 0.074 | 0.03 | 0.34 | 0.734 |
| Reduction of Hazard | -0.281 | 0.066 | -0.345 | -4.271 | 0 |
| Availability of Labour | 0.069 | 0.095 | 0.071 | 0.724 | 0.471 |
| Education | -13 | 0.115 | -0.01 | -0.114 | 0.91 |
| Awareness and Access to Information | -0.114 | 0.085 | -0.114 | -1.342 | 0.183 |
| Market demand from Customer | 0.176 | 0.082 | 0.373 | 2.244 | 0.036 |
| Government Policy | 0.139 | 0.079 | 0.164 | 1.766 | 0.081 |
| Age of Processing Centre | 0.093 | 0.095 | 0.087 | 0.985 | 0.327 |
| Size of Processing Centre | 0.177 | 0.078 | 0.207 | 2.284 | 0.025 |
| Observation of Dye Technology | -0.192 | 0.085 | -0.204 | -2.245 | 0.027 |
| Location of Processing Centre | -0.006 | 0.112 | -0.005 | -0.053 | 0.958 |
| Availability of Training | 0.055 | 0.123 | 0.046 | 0.449 | 0.654 |
| Perceived Usefulness | -0.099 | 0.118 | -0.91 | -0.84 | 0.403 |

R = 0.709, R Square = 0.503, F = 3.486, Sig = 0.000

Table 5 shows the effect of technologies adopted on performance of *adire* textile. Performance variables were measured with profit of the *adire* processing centre in the last three years in binary scale such as improvement and no improvement. Also, the table shows the Wald statistics and related probabilities that provide index of significance of each feature of technology adopted variable as independent variable on profit of the *adire* textile processing centres. Freehand technology ($r = 4.304$; $p < 0.038$), contributed significantly to the profit of *adire* fabric making in the study area. Dye technology ($r = 0.784$; $p < 0.000$) is highly significant to performance of *adire* textile processing centres. Also, Batik technology ($r = 15.894$; $p < 0.000$) contribute significantly to the performance of the *adire* textile. This implied that about 77% of *adire* fabric makers in the study area produced batik on daily basis; this has contributed more significantly to its profit.

Communication technology ($r = 0.260$; $p < 0.031$) such as mobile phone, electronic mail, and web have contributed significantly on the overall performance of the selected *adire* textile processing centres in the study area as it enables the artists and managers relate well with customers both locally and internationally. The constant is negative which implies that the sales of *adire* products in the study area had a negative coefficient value of -5.470. It is highly significant at 1% probability level and could reduce business performance by N5.47k. In addition, technologies adopted in the study area contributed significantly to business performance of *adire* textile processing centres while sales made at the same study area had a negative contribution. This establishes that technology is transforming the textile firms (Figures 1–3).^{22–33}

Table 5 Binary logistic regression on the effect of adopted technologies on the performance of Adire textile processing centres

| Technology | B | Wald | Sig. | Exp(B) |
|--------------------------|-------|--------|---------|--------|
| Freehand Technology | 0.209 | 4.304 | 0.038* | 0.232 |
| Dye Technology | 0.784 | 12.568 | 0.000** | 0.457 |
| Batik Technology | 0.951 | 15.894 | 0.000** | 2.589 |
| Communication Technology | 0.26 | 4.646 | 0.031* | 0.771 |
| Constant | -5.47 | 13.683 | 0.000** | 0.004 |

**p < 0.01 (Significant at 0.01)

*p < 0.05 (Significant at 0.05)

**Figure 1** Adire Designers busy with drawing pattern on fabric at Nike Art Gallery.**Figure 2** Adire textile designers during dyeing process at processing centre.**Figure 3** Adire designers drawing pattern on fabric using freehand technology.

Conclusion

The study concludes that *adire* textile processing centres adopt a range of technologies, including freehand, batik, *adire eleko*, *adire oniko*, dye, and communication technologies. The adoption of these technologies has contributed significantly to the business performance of the processing centres, particularly in terms of efficiency, productivity, and sales growth. However, the findings reveal that formal financial support available to artisans remains limited, which may constrain the extent and speed of technology adoption.

The use of information and communication technologies indicates a growing level of digital engagement among artisans, enhancing access to market information and customer networks. A positive and significant relationship was observed between sales growth and the age of the processing centres, suggesting that more established centres—often benefiting from better location and reputation—attract higher patronage. Additionally, education was found to have a positive and significant relationship with access to information, highlighting the role of educational attainment in improving awareness and utilization of technological innovations.

Furthermore, access to information on technology adoption was shown to improve operational efficiency and overall performance. At the same time, concerns about hazardous technologies were identified as a significant determinant of adoption decisions, indicating that artisans may delay or avoid adopting technologies perceived as unsafe. This underscores the importance of promoting safer technologies and strengthening awareness of hazard-reduction measures to encourage sustainable technology adoption in *adire* textile processing.

Recommendations

- 1) Government agencies, microfinance institutions, and non-governmental organizations should design accessible and affordable credit schemes specifically targeted at *adire* textile artisans.
- 2) Regular training programmes should be organized to improve artisans' technical skills and knowledge of modern textile technologies. Emphasis should be placed on safe production practices and hazard-reduction measures to reduce health risks and encourage wider technology adoption.
- 3) Stakeholders should promote the use of information and communication technologies by providing digital literacy training and affordable internet access. Increased ICT use will enhance market access, customer communication, and information sharing, leading to improved sales and business sustainability.
- 4) Adult education programmes and extension services should be strengthened to improve artisans' educational capacity and access to relevant information. Enhanced education will improve awareness of technological innovations and support informed decision-making in technology adoption.
- 5) Efforts should be made to strengthen market demand for *adire* products through branding, exhibitions, trade fairs, and online platforms. Increased market demand will motivate artisans to adopt improved technologies and expand production.

Acknowledgments

None.

Funding

None.

Conflicts of interest

No conflict of interest declared

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