TECHNOLOGY AND SUSTAINABLE CLOTHING AND TEXTILE PRACTICES FOR YOUTH LIVELIHOODS IN BADE LOCAL GOVERNMENT AREA, YOBE STATE, NIGERIA

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ABSTRACT

The clothing and textile industry is one of the most resource-intensive sectors globally, characterised by high waste generation and energy consumption. In Nigeria, these challenges are compounded by rising youth unemployment, particularly among youths with skills in clothing and textile production. This study examined the role of technology and innovation in reducing waste and energy consumption, the contribution of clothing and textile careers to sustainable livelihoods, and strategies for enhancing youth empowerment in Bade Local Government Area. A descriptive survey research design was adopted, and data were collected from 330 skilled youths using a structured questionnaire. Descriptive statistics (mean and standard deviation) were employed for data analysis. The results showed that technology and innovation effectively promote sustainability in clothing and textile production, with a grand mean of 3.03 (SD = 0.97). Training on sustainable production methods (Mean = 3.18) and the use of digital cutting and design software (Mean = 3.12) were the most effective practices, while solar-powered equipment (Mean = 2.91) and eco-friendly dyes (Mean = 2.85) were moderately effective. Clothing and textile careers contributed significantly to sustainable livelihoods, recording a grand mean of 3.12 (SD = 0.93), with tailoring and textile entrepreneurship emerging as major sources of income and employment (Mean = 3.21 each). Strategies for youth empowerment were also rated effective (Grand Mean = 3.03; SD = 0.97), particularly the establishment of training centres (Mean = 3.18) and access to modern technologies (Mean = 3.09). The study concludes that integrating modern technologies with clothing and textile skills can reduce environmental impact while enhancing youth livelihood security. It recommends strengthened vocational training, improved access to sustainable technologies, and increased policy and industry support to maximise the benefits of sustainable textile practices in Nigeria.

Keywords: *Technology, Innovation, Waste Reduction, Energy Consumption, Sustainable Clothing, Textile, Youth Empowerment.*

INTRODUCTION

Clothing and textile manufacturing is one of the most resource-demanding industries globally, consuming vast amounts of water, chemicals, and energy (Figure 1). In Nigeria, this industry also presents an opportunity to address youth unemployment, which continues to rise due to limited job opportunities. Skilled youths can benefit from the sector by adopting innovative practices (Figure 2) that conserve resources and generate sustainable income.

This dual focus on livelihood and sustainability underscores the importance of examining technologies and innovations that reduce waste (Figure 3) and energy consumption (Figure 4) (Aina, 2020). Technological advancement has reshaped how clothing and textiles are produced, marketed, and consumed. Tools such as automated cutting machines, computer-aided design (CAD) software,

and energy-efficient sewing machines have reduced errors, lowered costs, and minimised material waste. For Nigerian youths with tailoring and design skills, these technologies are crucial for establishing competitive small businesses that are both profitable and environmentally responsible (Olawale, 2021).

Fig.1: The Textile Sector

Fig. 2: Innovative practices
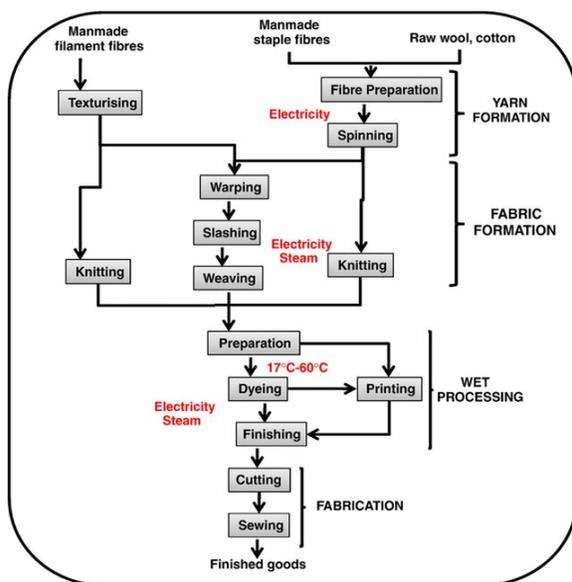

Fig. 3: Textile wastes

Fig. 4: Processing flow of textile products with energy indication. Source: Martínez (2010)

Innovation in the textile industry increasingly emphasises sustainability through practices such as recycling and upcycling (Figure 5). Instead of discarding fabric scraps and worn garments, skilled youths can redesign them into new products, thereby reducing waste while creating affordable fashion items. These practices not only encourage environmental responsibility but also offer viable entrepreneurship pathways for Nigerian youths

trained in clothing and textiles (Okonkwo, 2022). Waste reduction is particularly important in Nigeria, where weak waste management systems have led to environmental pollution. In the clothing and textile industry, waste often comes from off-cuts, overproduction, and rejected garments. Applying techniques like zero-waste pattern cutting and fabric repurposing provides practical solutions. This enables young entrepreneurs to create sustainable businesses while supporting global environmental goals (Nwosu, 2020). Energy consumption remains a pressing challenge in textile production.

Fig. 4: Recycling and upcycling

Traditional methods consume large amounts of electricity, often driving up production costs. By adopting renewable energy sources, such as solar-powered equipment, youths can lower expenses while promoting eco-friendly practices. This approach is particularly relevant in Nigeria, where energy supply is unstable but solar potential remains high (Figure 6) (Chukwu, 2021). The concept of sustainability emphasises the need to balance economic, environmental, and social objectives. For youths engaged in clothing and textile manufacturing, this means creating businesses that provide income while also protecting natural resources. Home Science education has been central to this process by equipping students with practical skills and knowledge for applying sustainability principles in textile-related careers (Bello, 2022).

Small and medium-sized enterprises (SMEs) dominate clothing and textile production in Nigeria. However, many lack access to advanced technologies, making their operations less efficient. Equipping youths with modern tools and innovative approaches could transform these enterprises into sustainable ventures. This would not only empower young entrepreneurs but also contribute to broader national economic growth (Adeyemi, 2023). Skilled youths represent a valuable workforce for sustainable clothing and textile enterprises. Training in garment construction, fabric care, and fashion design provides a foundation for entrepreneurship. When these skills are combined with modern

technology and innovative practices, young people can develop businesses that reduce waste, conserve energy, and strengthen livelihood security (Ibrahim, 2023).

Fig. 6: Solar-powered sewing machine

Technology also expands market opportunities for youth entrepreneurs. Through e-commerce, digital fashion showcases, and online inventory management, clothing products can reach broader audiences with minimal waste.

These platforms also allow youths to engage in global networks, fostering collaboration and enhancing visibility for sustainable Nigerian fashion. This demonstrates how digital innovation supports both entrepreneurship and sustainability (Umeh, 2021).

Therefore, the integration of technology and innovation into clothing and textile manufacturing offers a viable pathway for Nigerian youths to overcome socio-economic challenges.

By reducing waste, conserving energy, and adopting sustainable practices, they can establish businesses that promote environmental responsibility while generating income. This study, hence, explores technologies and innovations in clothing and textile careers as strategies for sustainable livelihood among skilled youths in Nigeria.

Statement of the Problem
The clothing and textile sector in Bade Local Government (Figure 7) is confronted with serious challenges, including high waste generation, inefficient use of energy, and continued dependence on traditional production methods.

While many youths possess skills in clothing and textile construction, they often lack access to modern technologies and innovative practices that can improve efficiency and sustainability. As a result, their potential for creating sustainable livelihoods is limited, and opportunities to contribute

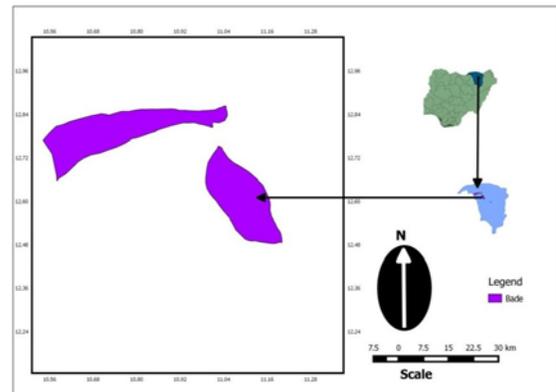meaningfully to local economic development are reduced.

Fig. 7: Bade Local Government

The growing socio-economic challenges in the area make it necessary to seek alternative approaches that can empower skilled youths. Introducing technology and innovation in clothing and textile production can help reduce waste, minimise energy consumption, and promote environmental sustainability.

Therefore, this study addresses the need to optimise sustainable clothing and textile practices as a pathway for improving the livelihoods of youths in Bade Local Government and ensuring long-term socio-economic benefits for the community.

Objectives of the Study
1. To examine the role of technology and innovation in reducing waste and energy Consumption in clothing and textile production among skilled youths in Bade Local Government.
2. To assess the contributions of clothing and textile careers to sustainable livelihoods amid Socio-economic challenges in the study area.
3. To identify strategies that can enhance youth empowerment through sustainable clothing and Textile practices for improved economic and environmental outcomes.

LITERATURE REVIEW
The integration of technology and innovation in textile and clothing production has become increasingly important for reducing environmental impacts. Many scholars emphasise that innovations such as automated cutting machines, energy-efficient sewing equipment, and advanced recycling techniques play a crucial role in addressing the twin challenges of waste generation and high energy usage in textile industries. According to Olaniyan and Aderibigbe (2025), young entrepreneurs who

adopt such technologies not only conserve resources but also improve efficiency in their production processes, thereby reducing operational costs and promoting sustainable practices. In line with Adeloye, Emidun, and Akinnibosun (2024), digital tools such as computer-aided design (CAD) software and automated looms have minimised textile waste by optimising fabric use and reducing errors in production. These authors note that such innovations are particularly relevant in Nigeria, where large amounts of textile waste arise from traditional manual processes. Their study showed that students trained in these technologies were better equipped to produce eco-friendly designs and reduce material losses.

Also, Emidun, Akinnibosun, and Adeloye (2023) argued that innovation in the form of recycling and upcycling textile waste provides a dual advantage: reducing waste and offering entrepreneurial opportunities for youths. They observed that students who were exposed to sustainable design methods created new products such as reusable bags and accessories, demonstrating that innovation can serve both environmental and economic objectives. Moreover, Onu (2020) highlighted the significance of renewable energy in clothing and textile production. He reported that integrating solar-powered sewing and weaving machines into training centres could drastically reduce energy consumption in small-scale fashion enterprises. This finding indicates that energy efficiency is not only a technical matter but also a strategic investment in sustainability that can empower young entrepreneurs to run low-cost businesses.

However, Aiyedun and Adeyemi (2002) stressed that energy audits are essential for identifying areas of inefficiency in production processes. Although their work focused on flour milling, the principle applies to the textile sector, where outdated equipment and poor maintenance increase energy costs. They argued that systematic technological upgrades are necessary for sustainable production, and this insight remains relevant for Nigerian textile firms struggling with high operating costs. Sustainable clothing practices have been recognised as key to reducing textile waste and promoting longer product life cycles. Aipoh, Olukanni, and Kalabo (2018) found that waste-to-wealth initiatives in tertiary institutions helped reduce clothing disposal by encouraging students to repurpose old garments into new items. This approach highlights that maintenance and creativity can significantly reduce the environmental footprint of fashion consumption.

In addition, Adebisi and Akintaro (2022) emphasised that entrepreneurship in fashion design contributes to both sustainability and socio-economic empowerment. They argued that youths who adopt sustainable practices such as using biodegradable dyes, eco-friendly fabrics, and repair services ensure that clothing items last longer, thereby reducing demand for fast fashion and its associated waste. Their findings demonstrate that sustainable maintenance is both an environmental and economic imperative. Furthermore, Okeke (2025) highlighted the role of the circular economy in textile sustainability. He explained that strategies such as recycling, reusing, and upcycling are crucial for maintaining clothing and reducing resource exploitation. Okeke's study revealed that young entrepreneurs who integrate circular practices into their businesses are more likely to build long-term success while protecting the environment.

Refab Africa (2025) pioneered a mobile clothes bank initiative in Nigeria, where old clothes are collected, repaired, or upcycled into new products. This initiative serves as a practical example of how sustainable clothing maintenance can generate employment opportunities for youths while reducing textile waste in urban areas. Such private-sector innovations demonstrate the real-world potential of sustainability-driven practices. Equally, Maina (2025) reported that designers in Ibadan have embraced patchwork fashion as a creative form of clothing maintenance. By transforming textile scraps and old garments into new fashion items, they reduce the demand for new raw materials while also promoting a culture of sustainability among young designers. This example highlights how traditional practices can be reimagined for modern sustainability challenges.

Youth empowerment through clothing and textile skills has been widely discussed as a strategy for addressing unemployment and promoting self-reliance. Muhammad, Alhassan, and Ahmad (2020) found that improved operational efficiency in manufacturing, achieved through skill development, not only reduces energy consumption but also enhances productivity. Their study showed that training youths in efficient textile production equips them to manage resources responsibly and sustain their businesses. In contrast, Yusuf (2021) argued that the decline of textile firms in northern Nigeria was largely due to poor adoption of modern skills and innovation. He noted that without adequate training, youths are unable to compete with imported textiles, leading to unemployment and wasted resources. This demonstrates that skill acquisition is central to revitalising the textile industry and empowering young Nigerians.

Therefore, Okegbe (2025) asserted that digital entrepreneurship is transforming youth opportunities in textiles by reducing reliance on traditional energy-intensive production and marketing processes. With online platforms, youths can promote upcycled products, access global markets, and reduce waste associated with physical retail. His study highlights the growing importance of digital skills for sustainable textile entrepreneurship. Finally, Otokiti, Igwe, Ewim, and Ibeh (2024) maintained that social entrepreneurship in Nigeria depends on the combination of technology adoption, supportive policies, and skill development. They suggested that empowering youths with both technical and business skills ensures they can create ventures that address waste reduction and energy conservation. Their framework underscores the need for multi-sector oral support in building sustainable textile-based livelihoods.

METHODOLOGY

This study adopted a descriptive survey research design to examine the role of technology and innovation in reducing waste and energy consumption, sustainable clothing and textile maintenance, and youth empowerment through skills in Nigeria. The population of the study comprised all youths with skills in clothing and textile activities within Bade Local Government Area, totalling 1,200 individuals. Using Yamane's (1967) formula at a 95% confidence level, a sample size of 330 respondents was determined to provide a representative and manageable group for data collection. A purposive sampling technique was employed to select respondents who have active engagement in clothing and textile practices, ensuring that participants were knowledgeable about the subject matter and could provide relevant information. The instrument for data collection was a structured questionnaire titled "Technology and Innovation in Clothing and Textile Careers for Sustainable Livelihood" (TICTCSL). The questionnaire contained six items per research objective, structured on a four-point Likert scale ranging from Very Effective (4), Effective (3), Neutral (2), to Not Effective (1). Data collected were analysed using descriptive statistics, including frequency, percentage, mean, and standard deviation (SD), to determine the level of agreement among respondents regarding the study variables. The Grand Mean and Grand SD were also calculated to provide an overall interpretation for each objective. This methodology ensures that the study accurately captures respondents' perceptions and experiences while providing reliable and valid results to address the research objectives.

RESULT OF THE STUDY

Table 1: Distribution of Respondents by youths with skills in clothing and textiles in Bade LGA.

Gender Population	(N = 1,200)	Sample (n = 330)	Percentage (%)
Male	720	198	60.0
Female	480	132	40.0
Total	1,200	330	100.0
Age Range (Years)	Population (N = 1,200)	Sample (n = 330)	Percentage (%)
18 – 25	480	132	40.0
26 – 30	360	99	30.0
31 – 35	240	66	20.0
36 and above	120	33	10.0
Total	1,200	330	100.0
Skill Type	Population (N = 1,200)	Sample (n = 330)	Percentage (%)
Tailoring / Sewing (Creative Design)	480	132	40.0
Fashion Design	300	83	25.2
Textile Production (Weaving/Dyeing)	240	66	20.0
Embroidery / Other Crafts	180	49	14.8
Total	**1,200**	**330**	**100.0**

Table 2: Role of technology and innovation in reducing waste and energy consumption in clothing and textile production among skilled youths in Bade Local Government.

S/N Items Statement	VE	E	N	NE	N	Mean	STD	Remakes
1 Use of energy-efficient sewing machines	140	110	50	30	330	3.09	0.97	Effective
2 Recycling textile waste into reusable products	120	130	50	30	330	3.03	0.94	Effective
3 Adoption of solar-powered equipment	110	120	60	40	330	2.91	1.00	Moderately
4 Use of digital cutting/ design software	150	100	50	30	330	3.12	0.98	Effective
5 Introduction of eco-friendly & chemicals	90	140	60	40	330	2.85	0.96	Moderately
6 Training on sustainable production methods	160	100	40	30	330	3.18	0.97	Effective
Grand mean						**3.03**	**0.97**	**Effectively**

Key: VE= Very Effective: E= Effective: N= Neutral: NE= Not Effective

Table 3: Contributions of clothing and textile careers to sustainable livelihoods amid Socio-economic challenges.

S/N Items Statement	VE	E	N	NE	N	Mean	STD	Remakes
1 Tailoring as a source of steady income	170	90	40	30	330	3.21	0.98	Effective
2 Textile entrepreneurship creating job opportunities	150	120	40	20	330	3.21	0.88	Effective
3 Skills in fashion design for youth empowerment	140	120	50	20	330	3.15	0.89	Effective
4 Embroidery and weaving as traditional income sources	110	130	60	30	330	2.97	0.94	Moderately
5 Training apprentices to generate employment	130	110	60	30	330	3.03	0.97	Effective
6 Clothing and textile skills as an alternative to unemployment	120	140	40	30	330	3.06	0.92	Effective
Grand mean						**3.12**	**0.93**	**Effectively**

Key: VE= Very Effective: E= Effective: N= Neutral: NE= Not Effective

Table 4: To identify strategies that can enhance youth empowerment through sustainable clothing and Textile practices for improved economic and environmental outcomes.

S/N Items Statement	VE	E	N	NE	N	Mean	STD	Remakes
1 Establishment of training centres for sustainable fashion	160	100	40	30	330	3.18	0.97	Effective
2 Government support through loans and grants	120	110	60	40	330	2.94	1.01	Moderately
3 Access to modern textile technologies for youths	140	110	50	30	330	3.09	0.97	Effective
4 Awareness programs on eco-friendly clothing	110	130	60	30	330	2.97	0.94	Moderately
5 Collaboration with fashion industries & cooperatives	100	140	50	40	330	2.91	0.97	Moderately
6 Encouraging youth entrepreneurship in textile recycling	130	120	50	30	330	3.06	0.95	Effective
Grand mean						**3.03**	**0.97**	**Effectively**

Key: VE= Very Effective: E= Effective: N= Neutral: NE= Not Effective

Table 1 assessed the perceived role of technology and innovation in reducing waste and energy consumption. The results show that "training on sustainable production methods" (Mean = 3.18) and "use of digital cutting/design software" (Mean = 3.12) were rated most effective, while "introduction of eco-friendly dyes and chemicals" had the lowest effectiveness (Mean = 2.85). The grand mean of 3.03 indicates that respondents generally perceived technology and innovation as effective in promoting sustainable practices. This implies that youths recognise digital and training-based innovations as vital in minimising waste and energy usage, though the affordability of eco-friendly inputs remains a challenge. These findings are supported by Okafor (2021), who reported that sustainable innovations such as digital design and energy-efficient equipment significantly reduce textile waste and improve production efficiency.

Table 2 focused on contributions of clothing and textile careers to sustainable livelihoods amid socio-economic challenges. The results revealed that "tailoring as a source of steady income" and "textile entrepreneurship creating job opportunities" had the highest mean scores (3.21 each), showing their strong role in providing income and employment. Meanwhile, "embroidery and weaving as traditional income

DISCUSSION OF THE FINDINGS
The findings of this study indicate that technology and innovation play a crucial role in promoting sustainable practices in clothing and textile production among skilled youths in Bade Local Government Area. The overall grand mean score of 3.03 (SD = 0.97) shows that respondents generally perceived technological and innovative practices as effective in reducing waste and energy consumption. Specifically, training on sustainable production methods recorded the highest mean score (Mean = 3.18; SD = 0.97), followed by the use of digital cutting and design software (Mean = 3.12; SD = 0.98). These results suggest that capacity-building initiatives and digital innovations are the most impactful and readily adoptable measures for minimising material waste, improving production accuracy, and enhancing energy efficiency. This finding supports earlier studies, which emphasise that skills development and digitalisation are key drivers of sustainability in the textile sector.

However, the adoption of solar-powered equipment (Mean = 2.91; SD = 1.00) and the use of eco-friendly dyes and chemicals (Mean = 2.85; SD = 0.96) were rated as only moderately

sources" had the lowest mean (2.97), suggesting moderate effectiveness in contemporary times. With a grand mean of 3.12, the overall interpretation indicates that clothing and textile careers are effective in sustaining livelihoods, particularly in contexts of high unemployment. This finding aligns with Ibrahim (2020), who emphasised that tailoring and related careers serve as alternative employment pathways that empower youths in Nigeria.

Table 3 examined strategies for enhancing youth empowerment through sustainable clothing and textile practices. The results show that "establishment of training centres" (Mean = 3.18) and "access to modern textile technologies" (Mean = 3.09) were perceived as the most effective strategies, while "collaboration with fashion industries" (Mean = 2.91) was the least effective. The grand mean of 3.03 indicates that, overall, respondents considered these strategies effective. This implies that skill acquisition and access to modern facilities remain central to youth empowerment in clothing and textiles, while industry collaborations are underutilised. The results are in line with Aliyu (2021), who asserted that vocational training and modern technologies are critical in empowering Nigerian youths for sustainable livelihoods.
effective. This indicates that while respondents recognise the environmental benefits of green technologies, their application is limited by high initial costs, inadequate infrastructure, and restricted access to modern equipment. These constraints reflect the broader challenges associated with renewable energy and eco-friendly inputs in Nigeria, where limited financial capacity and weak supply chains often hinder large-scale adoption. As a result, the potential of these technologies to significantly reduce energy costs and environmental pollution has not yet been fully realised in the study area.

The study further revealed that clothing and textile careers contribute significantly to sustainable livelihoods amid socio-economic challenges, as indicated by a grand mean of 3.12 (SD = 0.93). Tailoring as a source of steady income (Mean = 3.21; SD = 0.98) and textile entrepreneurship as a means of job creation (Mean = 3.21; SD = 0.88) recorded the highest mean scores, demonstrating their strong role in income generation and youth employment. Skills in fashion design also contributed substantially to youth empowerment (Mean = 3.15; SD = 0.89), reinforcing the relevance of modern fashion-related careers as viable alternatives to unemployment. These findings highlight the economic significance of the

clothing and textile sector in supporting household livelihoods and promoting self-reliance among youths in the study area.

In contrast, traditional practices such as embroidery and weaving were rated as moderately effective in sustaining livelihoods (Mean = 2.97; SD = 0.94). This suggests that although these activities remain culturally important, they are less competitive in contemporary markets due to limited innovation, declining demand, and insufficient market access. The result implies that integrating traditional crafts with modern design concepts, improved quality standards, and digital marketing platforms could enhance their economic relevance and sustainability.

Regarding strategies for enhancing youth empowerment through sustainable clothing and textile practices, the findings showed an overall grand mean of 3.03 (SD = 0.97), indicating general effectiveness. The establishment of training centres for sustainable fashion recorded the highest mean score (Mean = 3.18; SD = 0.97), followed by access to modern textile technologies for youths (Mean = 3.09; SD = 0.97). These results underscore the importance of structured training environments and technological exposure in equipping youths with the competencies required for sustainable and competitive textile enterprises. Encouraging youth entrepreneurship in textile recycling was also rated effective (Mean = 3.06; SD = 0.95), highlighting the potential of circular economy practices to generate income while reducing textile waste.

Conversely, government support through loans and grants (Mean = 2.94; SD = 1.01), awareness programmes on eco-friendly clothing (Mean = 2.97; SD = 0.94), and collaboration with fashion industries and cooperatives (Mean = 2.91; SD = 0.97) were perceived as moderately effective. This suggests gaps in policy implementation, funding accessibility, and institutional collaboration. Many youths may face difficulties accessing financial support or lack awareness of available programmes, while weak industry linkages limit opportunities for mentorship, market access, and practical exposure.

Overall, the merged findings and discussion demonstrate that technology, innovation, and clothing and textile careers collectively offer a viable pathway for reducing waste, conserving energy, and enhancing sustainable livelihoods among youths in Bade Local Government Area. While individual skills, training, and digital tools play a central role, their effectiveness is strongly influenced by the availability of supportive policies, affordable green technologies, and robust industry partnerships. Strengthening these enabling factors will significantly enhance the capacity of skilled youths to establish environmentally responsible and economically viable clothing and textile enterprises, thereby contributing to long-term socio-economic and environmental sustainability.

RECOMMENDATIONS
The study recommends promoting sustainable technologies and energy-efficient practices through subsidies and affordable access, strengthening vocational training with modern tools and sustainability principles, and supporting youth entrepreneurship with mentorship, grants, and microcredit. Additionally, robust policy frameworks and stronger collaboration between training institutions, industries, and cooperatives are needed to enhance practical skills and market access. Finally, awareness programmes should be implemented to encourage eco-friendly production, waste reduction, and circular economy practices, ensuring both economic empowerment and environmental sustainability.

CONCLUSION
This study examined the role of technology and innovation in reducing waste and energy consumption, the contribution of clothing and textile careers to sustainable livelihoods, and strategies for enhancing youth empowerment through sustainable practices in Bade Local Government Area. The findings revealed that technology and innovation, particularly the use of energy-efficient machines, digital cutting software, and sustainable production training, play an effective role in promoting environmental sustainability. Clothing and textile careers were also shown to be vital in creating income, reducing unemployment, and supporting youth empowerment amid socio-economic challenges. Furthermore, strategies such as establishing training centres, fostering industry collaboration, and promoting awareness of eco-friendly practices emerged as key drivers for sustainable development, though government support and access to modern technologies remain areas requiring improvement.

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