ITFP-GH
Institute of Textiles and Fashion Professionals - Ghana

Fashion and Textiles Review

Volume 6, (2025), Pages 155-176
ISSN: 2665-0983 (ONLINE)

Journal homepage: https://journal.itfpgh.com/ftr/index



ORIGINAL ARTICLE

DOI: https://doi.org/10.35738/ftr.v6.2024.22

Advancing Sustainable Soil Health Practices: Strategies for Quality and Global Competitiveness Among Cotton Farmers in Ghana

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Abstract

Purpose: The research aims to evaluate how cotton farmers in Ghana currently manage their soil and how these methods align with the Better Cotton Initiative (BCI) criteria for sustainable soil health. This assessment will provide a baseline understanding of existing practices and their compatibility with international standards.

Methodology/Design: Semi-structured interviews were conducted with 40 cotton farmers to gather in-depth insights into their perceptions, practices, and needs related to sustainable soil management. Thematic analysis was used to identify key themes and patterns within the data.

Findings: The study revealed that while farmers recognise the importance of soil health, their understanding of specific sustainable practices, such as cover cropping and reduced tillage, is limited, and misconceptions about costs and benefits are prevalent. Current soil management practices often rely on conventional tillage and inorganic fertilisers, with limited use of crop rotation, posing challenges to long-term sustainability. The study identified a complex interplay of technical (access to equipment, knowledge), economic (cost of inputs, market prices), social (community norms, extension services), and institutional (government policies, NGO support) factors influencing adoption decisions. Farmers expressed a strong need for practical, hands-on training, access to soil testing and expert advice, and financial support (credit, subsidies) to transition to sustainable methods. They also recommended information and education delivered through demonstrations and farm field schools.

Practical and Social Implications: The findings underscore the need for targeted interventions addressing these multifaceted challenges. Promoting sustainable soil health requires a holistic approach encompassing practical training, financial incentives, improved access to resources and information, and supportive policies. This study offers valuable insights for policymakers, extension services, and NGOs, informing the development of effective strategies to empower cotton farmers and promote the wider adoption of sustainable soil management practices, thereby contributing to a more resilient and productive agricultural sector.

Originality: This study provides a nuanced understanding of the specific challenges and needs of cotton farmers in Ghana's Northern and Upper West Regions, particularly in relation to sustainable soil health practices. It highlights the importance of context-specific interventions and emphasises the necessity of addressing technical, economic, social, and institutional factors simultaneously to achieve meaningful and lasting change.

Keywords
Sustainable Cotton Farming, conservation, benchmark, quality outputs, soil health

Abbreviations

BCI	Better Cotton Initiative
NGO	Non-governmental organisations

1 | INTRODUCTION

Ghana's cotton industry, once a promising sector, is facing a catastrophic downturn with devastating effects for farmers, communities, and the national economy. This isn't only a claim; it's a fact proven by a 30% loss in cotton output between 2018 and 2022, resulting in a $15 million decrease in export

Received: December 27, 2024. **Revised:** April 06, 2025. **Accepted:** May 06, 2025

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DOI: https://doi.org/10.35738/ftr.v6.2024.22

earnings. This reduction (Figure 1) directly affects the lives of approximately 200,000 cotton farmers in the Northern and Upper West Regions, where cotton farming is a key source of revenue. Furthermore, the closure of three large textile mills in the previous five years, directly connected to the declining supply of raw cotton (Amankwah-Amoah, 2015), shows the cascading impact of this reduction on downstream sectors and jobs.

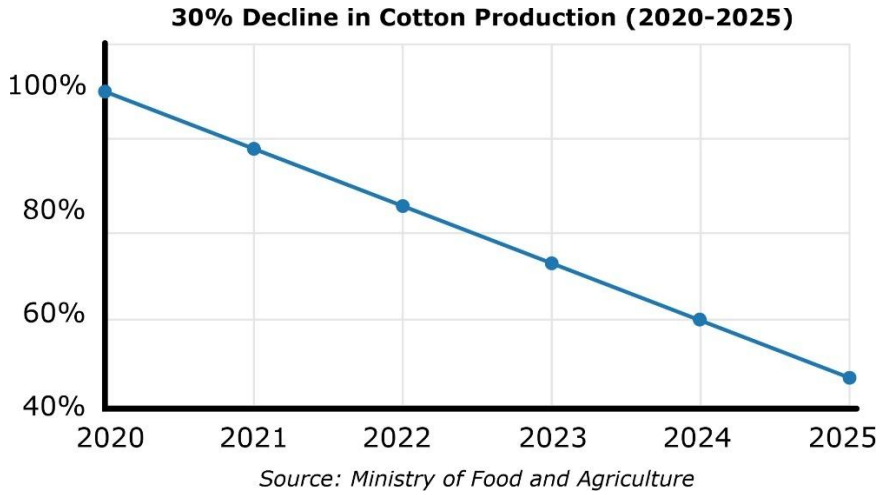


Figure 1: Decline in cotton production (2020 – 2025). (Field Data, 2025)

This research focuses explicitly on the role of soil health management in this decrease, evaluating how unsustainable soil management methods lead to decreasing yields and assessing the possibilities of sustainable alternatives. While variables like climate change and availability of inputs contribute to the issue, research has demonstrated a substantial association between unsustainable agricultural methods, notably concerns about soil health, and lower cotton yields (Nizzoli, 2023). For example, research by Adam and Abdulai (2023) indicated that cotton farms in Ghana adopting conventional tillage procedures saw a 20% lower production compared to those implementing conservation tillage methods. These unsustainable methods not only affect the environment but also pose major health hazards to cotton farmers and their communities (Nizzoli, 2023).

The shift to sustainable cotton farming, especially addressing soil health, is not merely an ecologically good decision; it's a strategic need for rejuvenating Ghana's cotton business. Sustainable soil management strategies, such as crop rotation, cover cropping, and decreased tillage, provide a road to boosting soil fertility, promoting water retention, and increasing resistance to drought (Hussain et al., 2021). These changes may translate directly into greater cotton yields, better fibre quality, and decreased input costs, ultimately enhancing farmer profitability and strengthening Ghana's competitive advantage in the global cotton market. Figure 2 shows the cotton production in Ghana. Importantly, sustainable cotton production fits with the expanding worldwide consumer demand for ethically produced commodities, offering new market possibilities and the possibility for premium pricing. This change in consumer desire creates a tremendous economic incentive for farmers to embrace sustainable techniques. International programs like the Better Cotton Initiative (BCI) (BCI, 2024) and Cotton Made in Africa (CmiA) (CmiA, 2023) encourage sustainable cotton production via farmer education, certification systems, and market access. While BCI works in Ghana, its adoption rate remains low, demonstrating the existence of context-specific constraints. For instance, a 2022 report by the BCI Ghana Chapter stated that just 15% of cotton farmers in the target areas had implemented BCI-compliant methods, citing lack of access to technical help and the perceived high cost of implementation as main barriers. This research

Fashion and Textiles Review, **2025**, Volume 6, Pages 155-176, https://doi.org/10.35738/ftr.v6.2024.22

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will look at the causes for this low adoption, including how variables such as farmer knowledge, resource availability, and institutional support impact the adoption of sustainable soil health practices.

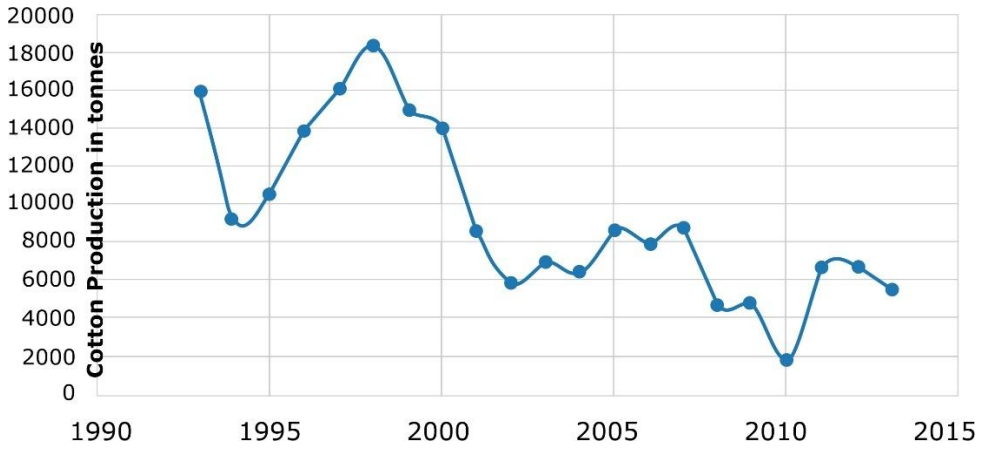


Figure 2. Cotton Production in Tonnes (Zakaria, 2016)

Despite the widely recognised relevance of sustainable cotton farming, putting this notion into practice needs a focused and in-depth study of the Ghanaian cotton farming setting. While there is a large body of research on sustainable agriculture in general, as well as cotton production in other regions, there is a critical gap in understanding how sustainable soil health practices can be effectively implemented in Ghana. Existing research generally focuses on national-level agriculture policies and frameworks (Dalla et al., 2021), which are too broad to address the specific difficulties that cotton producers experience at the district level. These obstacles include limited access to specialised extension services for soil health management, the impact of local political dynamics on resource allocation for agricultural development, and the complexities of engaging with diverse farming communities to promote the adoption of new practices. For example, although national agricultural extension policies may promote integrated soil fertility management, they often fail to give practical advice on how farmers may apply these ideas to their individual soil types, cropping systems, and resource restrictions at the district level. This research fills a vacuum by focusing on the process of establishing sustainable soil health practices in cotton-growing communities in the target regions.

The research aims to evaluate how cotton farmers in Ghana currently manage their soil and how these methods align with the Better Cotton Initiative (BCI) criteria for sustainable soil health. This assessment will provide a baseline understanding of existing practices and their compatibility with international standards. In order to achieve this, the following research questions need to be addressed: 1) How do the present soil management methods of cotton producers in the target areas relate to the BCI's sustainable soil health criteria? 2) What technical, economic, social, and institutional variables permit or limit these farmers' adoption of sustainable soil health practices? 3) How do these elements combine to impact farmers' decisions on soil health management? 4) What specific, actionable interventions may be developed to overcome the identified obstacles and increase the adoption of sustainable soil health practices among Ghanaian cotton farmers? By answering these questions, this research will give a thorough knowledge of the processes and dynamics involved in adopting sustainable soil health measures in Ghanaian cotton cultivation. The findings will provide valuable, context-specific insights for policymakers, extension services, NGOs, and cotton farmers, guiding the development of targeted interventions to improve soil health, increase cotton yields, and contribute to the long-term sustainability and revitalisation of Ghana's cotton industry.

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2 | LITERATURE REVIEW

2.1| The Triple Bottom Line (TBL)

Elkington and Rowlands (1999) Triple Bottom Line (TBL) paradigm, a fundamental concept in sustainability, advocates for the integration of environmental stewardship, economic viability, and social equity within agricultural practices, specifically cotton farming. This framework moves beyond mere profit maximisation, emphasising that long-term success necessitates a balanced approach to protecting natural resources through reduced chemical inputs and water conservation, ensuring financial viability via efficient farming and fair market access, and enhancing social well-being through fair labour practices, gender inclusion, and community development. By harmonising these three pillars, the TBL provides a holistic strategy for sustainable cotton cultivation, encouraging stakeholders to adopt practices that foster environmental resilience, economic growth, and social fairness (Gimenez et al., 2012; Nizzoli, 2023; FAO, 2017; Jehangir et al., 2024; Ullah et al., 2016; Srivastava et al., 2022).

In this study, the TBL framework served as a guiding principle to analyse the multifaceted factors influencing the adoption of sustainable soil health practices among cotton farmers in Ghana. Specifically, it provided a lens through which to examine how environmental concerns (e.g., soil and water pollution), economic factors (e.g., input costs, market prices), and social considerations (e.g., community norms, and labour practices) interact to shape farmers' decisions. By considering these three dimensions, the research aimed to identify holistic interventions that not only improve soil health but also enhance the economic and social well-being of cotton farming communities. The TBL theory informed the development of interview questions and the interpretation of findings, ensuring that the study addressed the interconnectedness of sustainability in the context of Ghanaian cotton farming.

2.2| The Diffusion of Innovations Theory

Rogers' (2003) Diffusion of Innovations Theory explains how new ideas and technologies spread through a population over time. It posits that adoption is a process influenced by the characteristics of innovation, the communication channels used, the social system, and time. Key elements include innovation’s relative advantage, compatibility, complexity, trialability, and observability. Individuals are categorised into adopter groups: innovators, early adopters, early majority, late majority, and laggards. The theory emphasises that adoption is not instantaneous but a gradual process involving awareness, persuasion, decision, implementation, and confirmation. Effective diffusion strategies consider these stages and tailor communication and support accordingly.

In this study, the Diffusion of Innovations Theory provided a framework to understand how sustainable soil health practices are adopted among cotton farmers in Ghana. Specifically, it helped to analyse the factors influencing the rate and extent of adoption. The theory guided an investigation into how farmers perceive the relative advantage, compatibility, and complexity of sustainable practices like cover cropping, reduced tillage, and organic fertilisation. It also informed the exploration of communication channels, such as farmer field schools and extension services, and the role of social networks in spreading information. By identifying the characteristics of sustainable practices that facilitate or hinder adoption, and by understanding the different adopter categories within the farming community, the research aimed to provide insights for developing targeted interventions and communication strategies to accelerate the diffusion of sustainable soil health management. This theory helped to explain the current levels of adoption and why some farmers were more likely to use certain practices than others.

DOI: https://doi.org/10.35738/ftr.v6.2024.22

2.3| Better Cotton Initiative

The concept of sustainable industrialisation is central to the UN's Sustainable Development Goals (Faulkner et al., 2012). Participants in the Better Cotton Initiative (BCI) should produce cotton in an ecologically friendly and socially sustainable manner (Addis et al., 2021). The World Wide Fund for Nature (WWF) initiated the BCI standard-setting process in 2003-2004. The WWF chose palm oil, soy, sugar cane, and cotton as commodities for development due to the sustainability impact, financial sector traction, and added value that the IFC/WWF sector-wide initiatives could provide for each commodity (IIED/ProForest, 2004; Addis et al., 2021). This included the introduction of the BCI standard-setting procedure (Figure 3).

BCI farmers:

- minimise the harmful impact of crop protection practices
- use water efficiently and care for the availability of water
- care for the health of the soil
- conserve natural habitats
- care for and preserve the quality of the fibre
  promote decent work

Figure 3: The BCI's production principles and criteria (BCI, 2013)

2.4| Sustainable Cotton Farming

The concept of sustainable cotton farming is multifaceted, lacking a universally accepted definition. While it generally encompasses ecological soundness, social equity, and economic viability, its practical application varies across studies (Elkington & Rowlands, 1999). Some research adopts a farm-centric approach, focusing on "Better Management Practices" (BMPs) such as integrated pest management, soil health enhancement, and water conservation (Ullah et al., 2016; Vitale et al., 2024). These studies prioritise field-level agronomic techniques and assess sustainability through yield improvements, cost reductions, and environmental indicators (Jehangir et al., 2024). However, this approach may overlook broader socioeconomic factors.

Conversely, organisations like the Ethical Trading Initiative and Fairtrade International expand the definition to include supply chain and market considerations. They emphasise fair prices, decent working conditions, and market access for sustainably produced cotton, recognising the link between farm-level sustainability and larger economic and social systems (Gimenez et al., 2012). This study adopts a comprehensive definition that integrates both on-farm techniques and the broader socioeconomic framework to provide a holistic understanding of sustainability in Ghana's cotton sector. This approach acknowledges that technical improvements must be coupled with systemic reforms in market access, pricing, and social equity to achieve lasting impact (Nizzoli, 2023).

2.5| Cotton Farming in Ghana

Ghana's cotton farming has experienced fluctuating fortunes since its colonial origins, marked by initial stagnation due to infrastructure limitations and competition with crops like cocoa. Post-independence efforts to revitalise the sector through state-run entities faced challenges from internal inefficiencies and global market volatility, resulting in marginal global market participation, as shown in Table 1. Agricultural sector liberalisation in the 1980s and 1990s further complicated matters, but a resurgence in the early 2000s, driven by demand for sustainable cotton and NGO initiatives, offered new opportunities. Despite these efforts, the sector remains underdeveloped, facing issues like poor agronomic practices, limited technology access, inadequate irrigation, and climate change impacts.

DOI: https://doi.org/10.35738/ftr.v6.2024.22

Establishing Ghana as a competitive player requires collaborative efforts from the government, private sector, and civil society, learning from past experiences to create a conducive environment for sustainable cotton farming.

Table 1. Cotton Production and Exports in Ghana (1980-2007)

Year	World Production ('000 tonnes)	Ghana Production ('000 tonnes)	Ghana % of World	World Export ('000 tonnes)	Ghana Export ('000 tonnes)	Ghana % of World
1980	13,799	12	0.09	5,719	6	0.10
1985	17,450	18	0.10	6,114	10	0.16
1990	18,975	24	0.13	6,437	15	0.23
1995	20,439	35	0.17	5,958	20	0.34
2000	19,400	42	0.22	5,705	25	0.44
2001	21,491	38	0.18	6,347	22	0.35
2002	19,809	30	0.15	6,632	18	0.27
2003	21,067	28	0.13	7,229	16	0.22
2004	26,441	35	0.13	7,624	20	0.26
2005	25,383	30	0.12	9,708	17	0.18
2006	26,561	24	0.09	8,077	14	0.17
2007	26,245	18	0.07	8,370	10	0.12

Source: The Agricultural Management Practices Survey Data (2025)

2.6| Current Soil Management Practices

Studies highlight the dominance of traditional agricultural practices in Ghana's cotton sector, posing threats to long-term sustainability (Vitale et al., 2024; Nizzoli, 2023). Concerns have been raised about the excessive use of synthetic pesticides and the deterioration of soil health due to monocropping and poor land management (Akmal, 2023). While studies advocate for IPM and soil-enhancing practices, they often lack detailed information on specific practices. This study aims to fill this gap by documenting pest management practices, tillage, fertiliser use, and crop rotation schemes in the Northern and Upper West Regions. Table 2 presents the adoption rates of these practices, showing variations between regions, with crop rotation being the most adopted practice and organic fertilisation the least.

Table 2. Adoption Rates of Soil Management Practices in Northern and Upper West Regions

Soil Management Practice	Northern Region (%)	Upper West Region (%)
Crop Rotation	65	55
Cover Cropping	40	35
Organic Fertilization	30	25
Conservation Tillage	50	45

Source: The Agricultural Management Practices Survey Data (2025)

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Ghana's rain-fed cotton farming is vulnerable to climate change-induced variable rainfall (Yaouba et al., 2024). Precision irrigation success in other developing countries contrasts with technical and financial barriers in Ghana (Brahmanand & Singh., 2022; Yaouba et al., 2024). This study examines adaptation measures like water conservation and drought-resistant varieties. By documenting these strategies, this research aims to identify climate-resilient agricultural practices. Existing studies lack detailed data on specific soil management practices in the Northern and Upper West Regions, which this study addresses. Figure 4, based on the 2025 Agricultural Management Practices Survey data, will visually represent the adoption rates of soil management practices, providing a clearer picture of the current situation and its sustainability implications.

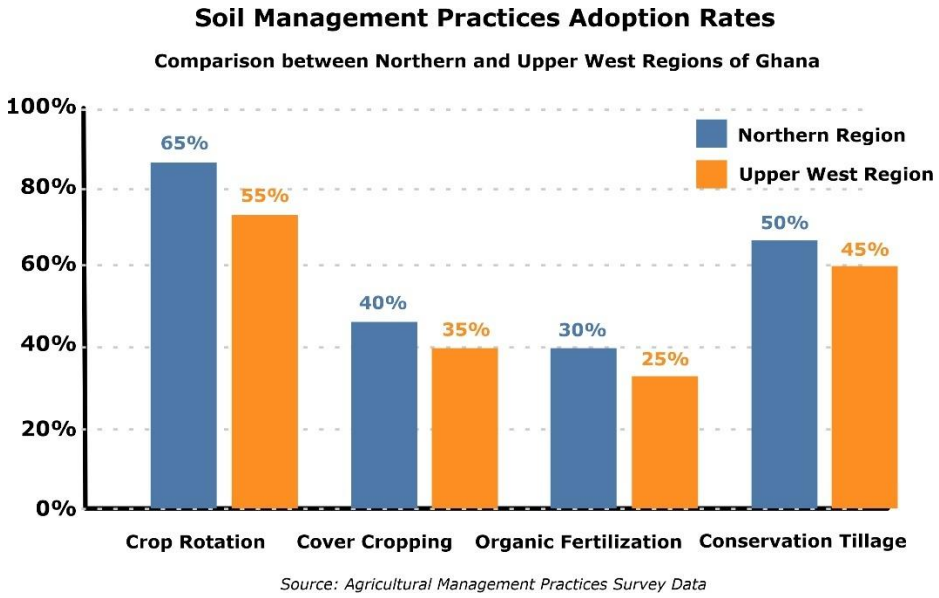


Figure 4. Soil Management Practices Adoption Rates

2.7| Farmers' Understanding of Sustainable Soil Health Practices

Research highlights a general sustainability awareness in agriculture, but lacks specific insights into Ghanaian cotton farmers' understanding of sustainable soil health practices. Current studies often focus on broad sustainability principles, neglecting farmers' nuanced comprehension of soil-specific methodologies (Ullah et al., 2016). This study bridges this gap by assessing cotton farmers' comprehension of key sustainable soil health principles, such as cover cropping, reduced tillage, and organic fertilisation. It goes beyond mere awareness measurement, investigating the depth of farmers' knowledge and identifying any misconceptions.

Furthermore, while experiences from other developing nations offer valuable comparative insights, they often lack a nuanced understanding of how Ghanaian cotton farmers perceive these practices within their socio-cultural and agro-ecological contexts. This study addresses this gap by examining farmers' perceived advantages and obstacles related to implementing sustainable soil health measures. It seeks to understand the reasons behind farmers' reluctance to adopt certain practices, despite awareness, and aims to understand the rationale behind farmers' actions by examining how their perceptions of sustainable soil health practices influence their adoption choices. By directly evaluating farmers' comprehension, investigating perceived advantages and obstacles, and analysing how these perceptions influence decisions, this research offers a context-specific understanding of factors affecting adoption among Ghanaian cotton farmers. This comprehension is essential for formulating effective interventions that address farmers' specific needs and concerns, fostering broader adoption of sustainable soil management practices.

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2.8| The Adoption of Sustainable Soil Health Practices

Current research identifies numerous obstacles to sustainable cotton production in Ghana, spanning agronomic, economic, social, and institutional domains (Vitale et al., 2024; Yaouba et al., 2024; Seini & Nyanteng, 2005), but often lacks a focused analysis of how these factors specifically impact the adoption of sustainable soil health measures. This study aims to explore the complex interactions of these elements, going beyond mere identification to understand their influence on farmers' soil management decisions, specifically investigating the relationships between economic variables like price volatility, input costs, and loan access, and their impact on soil health management choices, as well as the interplay of social variables, including community norms, peer influence, and access to extension services through cooperatives, with other determinants of farmers' soil management choices.

This study moves beyond identifying technical, economic, social, and institutional factors to understand their interactions and impact on farmers' decisions about sustainable soil health. By analysing how limited equipment access (technical) combines with perceived high costs (economic), and how community norms (social) and government policies (institutional) influence farmers' decisions, this study will provide a comprehensive understanding of factors influencing the adoption of sustainable soil health practices among Ghanaian cotton farmers. This understanding is essential for formulating effective interventions that address the complex, interrelated challenges faced by farmers and promote widespread adoption of sustainable soil management.

3 | METHODOLOGY

This study employed a qualitative research methodology to explore the perspectives and experiences of cotton farmers in Ghana's Northern and Upper West Regions regarding the adoption of sustainable soil health practices. A qualitative approach was chosen for its ability to provide in-depth insights into the complex social dynamics surrounding agricultural practices, yielding rich, contextualised data on farmers' motivations, challenges, and perceived needs (Creswell & Poth, 2016). This research aimed to uncover the rationale behind farmers' soil management practices through a qualitative approach that emphasises thorough investigation and interpretation of meaning. As Guest et al. (2006) argue, qualitative research excels in examining complex social phenomena where contextual understanding is paramount.

Specifically, semi-structured interviews were conducted with forty cotton farmers from the Northern and Upper West Regions. The sample size was determined using the concept of data saturation, aiming to reach a point where subsequent interviews yielded minimal new insights (Guest et al., 2006). This approach ensures the data collected is sufficiently rich and comprehensive to address the research objectives, aligning with best practices in qualitative research. Rahimi (2024) emphasises data saturation as a fundamental requirement for sample size in qualitative research, ensuring credibility and reliability. Purposive sampling was employed to ensure representation of farmers with diverse experiences and perspectives on soil health management, including those who had adopted sustainable practices (e.g., crop rotation, cover cropping, reduced tillage) and those who primarily relied on traditional methods. This diversity enabled a holistic understanding of the factors influencing adoption. The sample comprised 25 men and 15 women, with an average age of 48 years and an average of 15 years of cotton farming experience. Recognising women's crucial role in agricultural decision-making in many African contexts, the gender balance was deemed essential to capture any gender-based variations in soil management practices or perspectives (Puskur et al., 2023). The average age and experience reflect the established

DOI: https://doi.org/10.35738/ftr.v6.2024.22

nature of cotton farming in these regions, indicating participants possessed valuable insights into long-term trends and challenges concerning soil condition.

The interview guide was developed based on a comprehensive review of literature on sustainable soil health practices and agricultural extension in similar contexts (Röling, 2019; Hazell & Haddad, 2001; Dalla et al., 2021). The guide consisted of open-ended questions designed to elicit farmers' views on their current soil management practices, their understanding of sustainable soil health practices, the perceived advantages and challenges of adopting these practices, sources of information on soil health, and their perceived support needs for transitioning to sustainable methods. The open-ended nature of the questions allowed participants to elaborate on their experiences and provide rich, detailed responses, aligning with the principles of qualitative interviewing as suggested by Rubin and Rubin (2011). The interview guide was pilot tested with five farmers in the target areas to ensure clarity, relevance, and cultural appropriateness. Based on the pilot test, minor adjustments were made to the phrasing of some questions to improve flow and understanding.

Interviews, conducted for approximately 45 to 60 minutes, were conducted using the primary languages spoken in the target areas. Interviews were typically conducted on farmers' fields or in their homes, providing comfortable and familiar settings conducive to candid discussions. Audio recordings were made using encrypted digital recorders to ensure data security and anonymity. A professional transcription service provided verbatim transcripts, which were then reviewed for accuracy by the researcher. Several strategies were employed to ensure the credibility of the data. First, member checking allowed participants to review their interview transcripts and provide feedback on the accuracy of interpretations. As Lincoln and Guba (1988) argue, this process not only validated the data but also empowered participants by giving them a voice in the research process. Second, triangulation was used to compare interview data with data from secondary sources and reports from agricultural NGOs operating in the region. This triangulation enhanced the validity of the findings by contextualising the interview data and identifying any contradictory evidence (Patton, 2014). Third, a detailed audit trail was maintained throughout the study, documenting all decisions made regarding data collection, processing, and interpretation. This audit trail ensured the rigour and credibility of the research process through transparency, thereby enhancing the reliability of the findings (Shenton, 2004).

Data analysis was conducted using thematic analysis, following Braun and Clarke's (2006) six-phase framework. This involved several key stages. First, the researcher became familiar with the data through repeated listening to the recordings and reading the transcripts. This immersion facilitated a comprehensive understanding of the farmers' perspectives and experiences. Second, a coding system was developed based on the research questions and the interview guide. The initial coding was primarily descriptive, labelling segments of text related to key topics such as current soil practices, understanding of sustainable practices, perceived advantages and challenges, information sources, and support needs. Initial codes included "Tillage Methods," "Fertiliser Use," "Crop Rotation Knowledge", "Cost of Inputs," and "Access to Extension Services." Coding was done manually. To ensure inter-coder reliability, a second researcher independently coded 20% of the transcripts. Code discrepancies were resolved through discussion and consensus. Third, codes were organised based on recurring patterns and relationships. This involved identifying broader themes that captured the essence of the data for each research objective. For example, codes related to resource access, input costs, and credit availability were organised under the overarching theme of "Economic Factors Influencing Adoption." Fourth, each theme was clearly defined and named to convey its meaning. The themes were reviewed in relation to the research questions to ensure they provided relevant and insightful answers. Fifth, carefully selected

DOI: https://doi.org/10.35738/ftr.v6.2024.22

quotations from participants were used to support and illustrate each theme, providing rich, contextualised evidence for the findings. Finally, the report was written, integrating the themes and supporting them with farmers' narratives, providing a comprehensive and nuanced picture of their perspectives and experiences. Thematic analysis was chosen for its flexibility and rigour in analysing qualitative data, enabling the identification of both explicit and implicit themes (Nowell et al., 2017).

This study received ethical approval from the KNUST Institutional Review Board before data collection. Information consent forms were provided to all participants, outlining the study's purpose, methods, potential risks and benefits, and their right to withdraw from the study at any time. All data were stored securely, and participants were assured of the anonymity of their responses. The study adhered to the highest ethical standards for research involving human participants, as outlined in the Belmont Report (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1978), ensuring their well-being and respecting their autonomy.

4 | RESULTS AND DISCUSSION

This section presents and discusses the study's findings, focusing on current soil management practices, farmers' knowledge and perceptions of sustainable soil health, the factors influencing adoption, and their needs and recommendations for support. By analysing these results, we aim to provide a comprehensive understanding of the challenges and opportunities for promoting sustainable soil management in Ghana's Northern and Upper West Regions, specifically in the cotton farming sector.

4.1| Current Soil Management Practices

This section delves into the current soil management practices employed by cotton farmers in the Northern and Upper West Regions of Ghana, providing a foundational understanding of the context within which sustainable practices are either adopted or resisted. Understanding these existing practices is crucial for identifying entry points for promoting sustainable soil health management. The analysis is structured around three key sub-themes: tillage methods, fertiliser use, and crop rotation practices.

4.1.1| Tillage Methods

Tillage is crucial for seedbed preparation, weed control, and soil aeration. Farmers in the study area use various tillage techniques, often in combination. Conventional tillage, characterised by heavy ploughing with tractor-drawn tools, remains common. "We plough deep because our elders taught us this way. It makes planting simpler and loosens the ground," Farmer A stated. However, this heavy tillage disrupts soil structure, increasing erosion vulnerability, especially during heavy rains. "We watch the topsoil washing away after the storms. Our fields are losing their richness," Farmer B observed. Reduced tillage techniques, such as chisel ploughing or ridge tillage, which disturb less of the soil surface, are gaining some momentum. "We've heard about these new ways of ploughing," Farmer C said, "but we're not sure if they'll work for cotton. We lack the tools." No-till farming is almost non-existent.

While conventional tillage offers immediate benefits, its long-term impact on soil health is negative. Soil structure disruption increases erosion risk (Hussain et al., 2021), reduces water infiltration, and depletes soil organic matter (Reicosky, 2020). Low tillage and no-till methods offer significant soil health benefits by minimising erosion, enhancing water conservation, and promoting soil biological activity (Reicosky, 2020), although they may require initial investments in equipment and expertise. The prevalence of conventional tillage, as reported by farmers, indicates a reliance on traditional practices

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despite their negative long-term impacts on soil health. The observations of topsoil loss by farmers align with Hussain et al. (2021), highlighting the increased erosion risk associated with heavy tillage. The limited adoption of reduced tillage, despite its potential benefits, underscores the challenges related to access to equipment and knowledge, as noted by Reicosky (2020). Figure 5 shows the tillage methods used by cotton farmers.

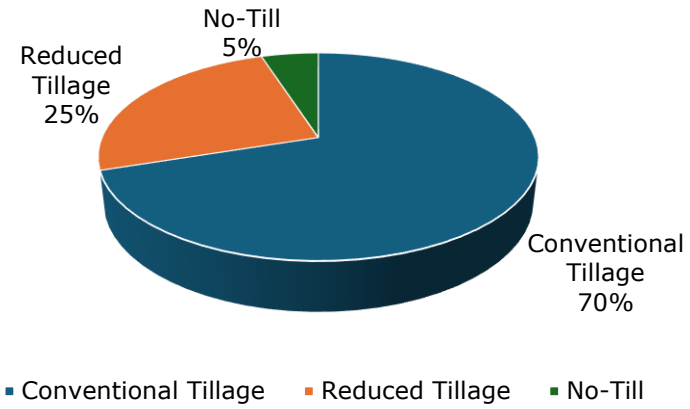


Figure 3. Tillage Method Distribution Among Cotton Farmers (Field Data, 2025)

4.1.2| Fertiliser Use

Cotton farmers in the study region extensively use both inorganic and organic fertilisers to enhance crop development and yields. Nitrogen-based inorganic fertilisers are the most commonly used. "We use fertiliser to make the cotton grow big and strong," Farmer D stated. However, the use of inorganic fertilisers often lacks soil testing or recommended application rates, leading to potential environmental and financial consequences. Over-application can lead to water contamination (Galloway et al., 2003), while under-application limits yield. Inorganic fertilisers are a significant financial outlay, and price fluctuations can cause hardship. Organic fertilisers, such as manure and compost, are less commonly used due to limited availability and labour requirements. "We know organic fertiliser is good," Farmer E noted, "but it's hard to get enough, and it takes a lot of work".

While inorganic fertilisers provide rapid crop growth, their unsustainable use can degrade soil quality and cause environmental issues. Integrating organic fertilisers can improve soil structure, enhance nutrient cycling, and reduce reliance on chemical inputs (Magdoff & van Es, 2000). The high usage rate of inorganic fertilisers, as shown in Table 3, reflects a strong reliance on chemical inputs. The farmers' statements regarding the benefits of fertilisers align with the immediate yield increases associated with inorganic applications. However, the lack of soil testing and the potential for over-application, as noted by Galloway et al. (2003), highlight environmental concerns. The limited use of organic fertilisers, despite their long-term benefits, is attributed to availability and labour constraints, as discussed by Magdoff & van Es (2000).

Table 3. Fertiliser Usage and Perceived Challenges

Fertiliser Type	Usage Rate (%)	Perceived Challenges
Inorganic	90	High cost, water pollution risk, inconsistent supply
Organic	30	Limited availability, labour-intensive application

Source: Field Data (2025)

DOI: https://doi.org/10.35738/ftr.v6.2024.22

4.1.3| Crop Rotation Practices

Crop rotation offers numerous benefits, including improved nutrient cycling, reduced pest and disease pressure, and enhanced soil structure. While some farmers practice crop rotation, it is not widely adopted, and rotations are often limited. "We normally plant cotton one year and then maize the next year," Farmer F said. However, continuous cotton farming is a common practice. "Sometimes we plant cotton year after year because we need the income," Farmer G stated. Limited crop rotations in the study region do not provide the full benefits of more diverse rotations. Rotations with legumes, for example, fix nitrogen, reducing the need for nitrogen fertilisers (Peoples et al., 2001).

Diverse rotations disrupt pest and disease cycles, reducing the need for chemical pesticides. Promoting varied and well-planned crop rotations can enhance the resilience of cotton farming systems, reduce input costs, and improve soil conditions. The limited diversity in crop rotations, as indicated by farmer responses, suggests that farmers are not fully leveraging the benefits of this practice. The reliance on simple cotton-maize rotations and the prevalence of continuous cotton farming, limit the potential for nitrogen fixation and pest/disease control, as discussed by Peoples et al. (2001). This highlights the need for promoting more diverse and strategically planned rotations.

4.2| Knowledge and Perceptions of Sustainable Soil Health Practices

This section explores the knowledge and perceptions of sustainable soil health practices among cotton farmers in the Northern and Upper West Regions of Ghana. Understanding these perceptions is crucial for designing effective interventions that promote the adoption of sustainable practices. The analysis focuses on farmers' understanding of sustainable practices, their perceived benefits, and the challenges they face in implementing these practices.

4.2.1| Understanding of Sustainable Practices

Farmers' knowledge of environmentally friendly soil management (Figure 6) techniques differed greatly. Although most farmers understood that cotton output depended on the condition of the soil, their knowledge of sustainable methods was frequently lacking or based on misunderstandings. Although some farmers rotate their crops, their full advantages were not always clear-cut. "We cycle cotton with maize," Farmer H said, "since that's what we have always done. It allows the ground to relax. Still, it wasn't always clear how rotations may be used to enhance nutrient cycling or interrupt pest cycles." Most farmers were not aware of cover cropping, a technique wherein certain crops are planted to preserve and enhance the soil. "I have never heard of cover crops," Farmer I said. "What are they for?" While considerable momentum was gained, reduced tillage was often confused with minimum tillage, and the advantages of minimising soil disturbance were not completely grasped. Farmer J said, "We plough less now than we used to," but "we still have to plough to prepare the land".

Common misconceptions regarding sustainable methods also abound. For instance, some farmers thought organic fertilisers were less effective than chemical fertilisers, while others linked sustainable practices to lower yields. "Rich people are suited for sustainable farming," Farmer K said. "It's too expensive for us." These misunderstandings highlight the need for targeted education and extension initiatives to clarify the benefits and practical applications of sustainable soil health methods. Farmers who want to make informed decisions about their soil management must have a clear and precise understanding of these methods. The varying levels of understanding among farmers highlight the need for targeted educational interventions. The confusion between reduced and minimum tillage, and the lack

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of knowledge about cover cropping, indicate significant knowledge gaps. Misconceptions about organic fertilisers and the perceived high cost of sustainable practices further underscore the need for clear, practical information and demonstrations.

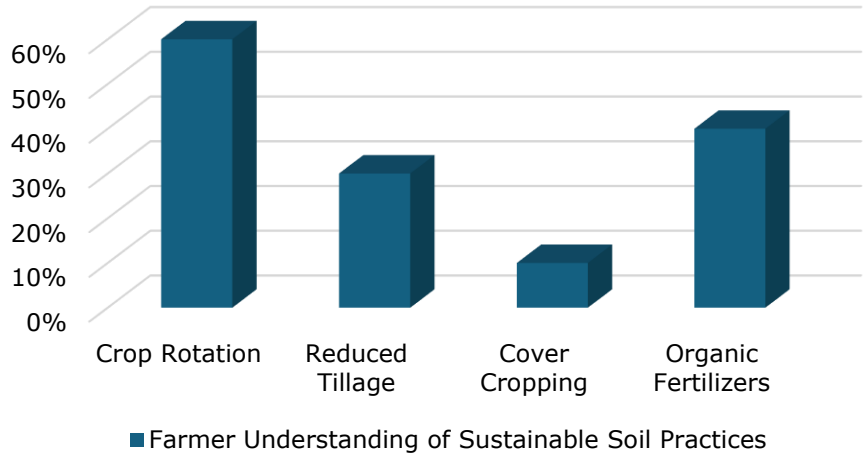


Figure 6. Farmer's Understanding of Sustainable Soil Practices (Field Data, 2025)

4.2.2| Perceived Benefits

Farmers perceived a variety of benefits from sustainable soil health activities, but these perceptions were not necessarily consistent with the entire range of possible benefits. The most often mentioned advantage was greater yield. "We use fertilisers to get bigger harvests," Farmer L stated. While farmers understood the relationship between soil health and productivity, they often prioritised short-term profits above long-term sustainability. "If the soil is good, cotton will grow well," Farmer M said. However, the link between sustainable practices and increased soil resistance to drought and other environmental pressures was less widely discussed. Some farmers saw the economic advantages of lowering input costs via sustainable techniques. "If we use less fertiliser, we'll save money," Farmer N said. However, the opportunity to enter premium markets for responsibly produced cotton was not generally recognised.

Farmers seldom highlighted environmental advantages, such as decreased pollution or increased biodiversity, indicating a need to promote a deeper understanding of the wider environmental consequences of soil management methods. Understanding farmers' perceived advantages is critical for designing sustainable practices that align with their interests and encourage uptake. Highlighting the economic and production benefits, as well as the long-term sustainability and environmental benefits, may be a successful method for encouraging sustainable soil health management (Anibaldi et al., 2021). The focus on increased yield as the primary benefit highlights the farmers' immediate economic concerns. The limited recognition of long-term and environmental benefits suggests a need for education that broadens their understanding of sustainable practices. The perceived economic benefits of reduced input costs, though mentioned, are overshadowed by concerns about initial implementation costs.

Table 4. Benefits and Challenges of Sustainable Practices

Category	Specific Benefit/Challenge	Percentage of Farmers Reporting
Benefits	Increased Yield	70
Benefits	Reduced Input Costs	40
Benefits	Environmental Benefits	15
Challenges	High Implementation Cost	80
Challenges	Lack of Information	65
Challenges	Labor Constraints	50

Source: Field Data (2025)

DOI: https://doi.org/10.35738/ftr.v6.2024.22

4.2.3| Perceived Challenges

Farmers encountered numerous challenges in implementing sustainable soil health measures, which frequently served as obstacles to broader adoption. The most often mentioned problem was the expense of implementation. "Sustainable farming is too expensive," Farmer O said. "We can't afford the new equipment or the organic fertilisers." Access to information and technical support was another key difficulty. "We don't know much about these new methods," Farmer P said. "We need someone to teach us." Some farmers also highlighted labour difficulties, especially when it came to activities like composting or cover planting. "Organic farming requires a lot of work," Farmer Q stated. "We don't have enough labour." Institutional considerations, such as a lack of credit or incentives for environmentally friendly measures, also had an impact. "The government doesn't support sustainable farming," Farmer R said. "They only give subsidies for chemical fertilisers". These perceived limitations underscore the need for specialised treatments that address the various hurdles farmers encounter while implementing sustainable soil health practices. Providing financial help, enhancing access to information and training, and fostering a supportive policy climate are critical for overcoming these obstacles and increasing the adoption of sustainable soil management. The high perceived cost of implementation, lack of information, and labour constraints are significant barriers to adoption. The farmers' concerns about institutional support, particularly the lack of subsidies for sustainable practices, highlight the need for policy interventions. These findings emphasise the importance of addressing both economic and knowledge-related challenges to promote sustainable soil health management.

4.3| Factors Influencing Adoption

This section examines the various factors that influence the adoption (Figure 7) of sustainable soil health practices among cotton farmers in the Northern and Upper West Regions of Ghana. Understanding these factors is crucial for developing effective strategies to promote sustainable agriculture. The analysis is structured around four key sub-themes: technical factors, economic factors, social factors, and institutional factors.

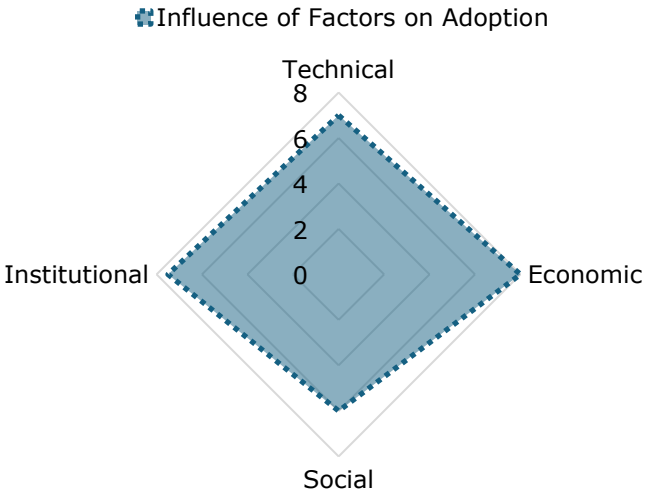


Figure 7. Influence of Factors on Adoption (Field Data, 2025)

4.3.1| Technical Factors

Technical issues, such as access to equipment, the availability of quality seeds, and an understanding of sustainable procedures, all have a substantial impact on farmers' adoption choices. Access to appropriate equipment, such as reduced-tillage instruments or seed drills designed for cover cropping,

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can sometimes be a barrier. "We would like to try these new methods," Farmer S remarked, "but we don't have the machines". Another important concern is the availability of high-quality seeds, especially for cover crops or cotton varieties that are most suited to sustainable methods. "Sometimes the seeds we get are not good," Farmer T said. "They don't germinate well." Successful adoption requires knowledge of sustainable approaches, such as how to properly execute crop rotation and maintain cover crops. "We need training on how to do these things," Farmer U said. "We're not sure how they work".

A lack of trustworthy information and technical competence might make it difficult for farmers to successfully apply sustainable practices. Improving access to adequate equipment, assuring the availability of quality seeds, and offering targeted training and extension services on sustainable approaches are critical for breaking down these technical hurdles. The farmers' statements highlight the critical role of technical factors in the adoption process. The lack of access to appropriate equipment and quality seeds directly hinders their ability to implement sustainable practices. The need for training underscores the importance of knowledge and technical competence. These findings suggest that interventions aimed at improving access to resources and providing targeted training are essential for promoting adoption.

4.3.2| Economic Factors

Farmers' choices are much influenced by economic considerations like input costs, loan availability, market pricing for cotton grown responsibly, and creditworthiness. One big impediment is the expense of switching to sustainable methods, particularly the initial outlay in organic fertilisers or the purchase of new equipment. "Sustainable farming is expensive," Farmer V said. "We don’t have the funds to make investments in it." Farmers might overcome these early expenses by employing financing or financial aid. Farmer W said, "If we could get loans to buy the equipment," "we would be more likely to try it." Crucially too are market pricing for cotton grown responsibly. "We would be more ready to adopt sustainable practices if we could get a better price for our cotton," Farmer X said.

Lack of price rewards for sustainably farmed cotton might deter farmers from using these methods of production. Promoting more acceptance depends on addressing these financial obstacles through focused financial incentives, enhanced loan availability, and the creation of market connections for cotton grown sustainably. The farmers' responses emphasise the significant impact of economic factors on adoption decisions. The high cost of implementation and the lack of financial support are major barriers. The potential for price premiums for sustainably produced cotton is a strong motivator. These findings highlight the need for financial incentives and market-based approaches to encourage farmers to adopt sustainable practices.

4.3.3| Social Factors

Farmers' choices for adoption also depend on social elements like community standards, the impact of other farms, and access to extension services. Farmers' decisions might be influenced by conventional agricultural techniques and community norms. "Our neighbours all farm the same way," Farmer Y said. "It's difficult to act differently." One very effective incentive is the impact of other farmers, especially those who have effectively embraced sustainable methods. "We have seen some farmers using sustainable farming who are doing rather well," Farmer Z said. "We could learn from them." Promoting adoption depends critically on access to efficient extension services, which provide farmers with knowledge and assistance. "We need more help from the extension officials", Farmer AA said. "They can

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impart fresh approaches to us". Utilising strengthened social networks among farmers, encouragement of farmer-to-farmer learning, and enhancement of the reach and efficacy of extension services, one may contribute to building a more favourable social climate for the acceptance of sustainable practices. The farmers' statements highlight the influence of social factors on adoption. Community norms and peer influence play a significant role. The importance of extension services underscores the need for effective knowledge dissemination. These findings suggest that leveraging social networks and strengthening extension services are crucial for promoting adoption.

4.3.4| Institutional Factors

Institutional variables such as government policy, subsidy availability, and non-governmental organisation (NGO) assistance all play an important role in defining the agricultural environment and influencing farmer choices. Government measures that promote sustainable agriculture, such as subsidies for sustainable practices or investments in R&D, might encourage adoption. "The government should do more to help farmers who want to adopt sustainable practices," Farmer BB urged. Subsidies for environmentally friendly supplies or equipment may help farmers adopt these methods. "If we could get subsidies for organic fertilisers," Farmer CC told me, "we would use them more often".

Non-governmental organisations (NGOs) and other agricultural organisations may also provide valuable support. "The NGOs have been providing us with training and technical assistance," Farmer DD said. "They've been very helpful". Creating a supportive legislative climate, offering targeted incentives for sustainable practices, and encouraging cooperation among government agencies, NGOs, and research institutions are critical for increasing the adoption of sustainable soil health management. The farmers' responses highlight the critical role of institutional factors. Government policies, subsidies, and NGO support are essential for creating an enabling environment for sustainable agriculture. These findings suggest that strengthening institutional support and promoting collaboration among stakeholders are crucial for promoting adoption.

4.4| Needs and Recommendations for Support

This section explores the needs and recommendations of cotton farmers in the Northern and Upper West Regions of Ghana regarding the support required for transitioning to sustainable soil health practices. Understanding these needs is essential for designing effective interventions.

4.4.1| Technical Assistance

Farmers indicated a strong need for technical support customised to their unique circumstances and concerns. Many farmers expressed a need for training in particular sustainable soil health strategies, such as crop rotation design, cover crop management, and composting procedures. "We need someone to show us how to do these things," Farmer EE said. "Just telling us about them is not enough." Hands-on, practical training, preferably delivered on farmers' fields, was the preferred mode of instruction. "We learn best by doing," Farmer FF said. "If we can see it and try it ourselves, we'll understand it better." Soil testing services were highlighted as a critical requirement. "We don't know what our soil needs," Farmer GG said. "We need to get it tested so we know what kind of fertilisers to use".

Access to professional guidance on soil health management, including suggestions for suitable techniques and inputs, was very valuable. "We need someone we can ask questions to," Farmer HH said.

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"Someone who knows about soil and can help us." Giving farmers access to practical, field-based training, soil testing services, and continuing professional assistance is critical for increasing their ability to successfully adopt sustainable soil health measures. The farmers' strong preference for hands-on, field-based training highlights the importance of practical learning (Figure 8). The demand for soil testing services and professional guidance indicates a desire for data-driven and expert-led support. These findings suggest that technical assistance should focus on practical demonstrations, accessible soil analysis, and ongoing mentorship.

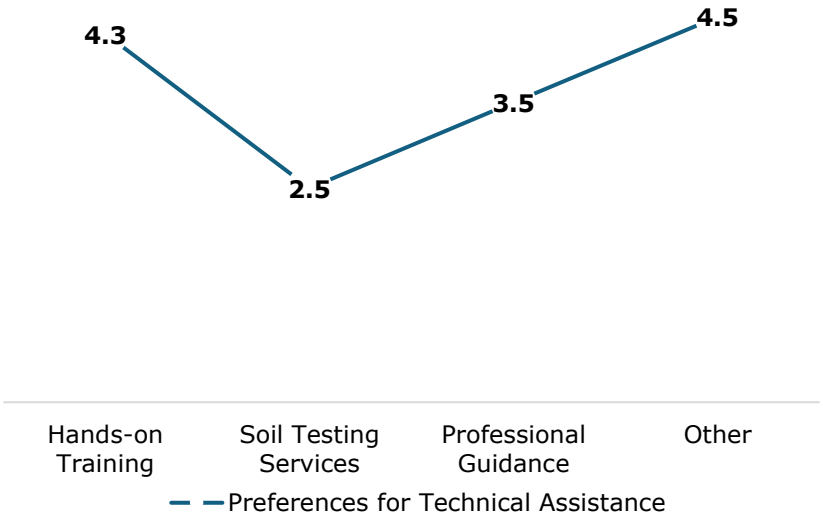


Figure 8. Preferences for Technical Assistance (Field Data, 2025).

4.4.2| Financial Support

Financial assistance has developed as an urgent necessity for many farmers, especially those experiencing economic restraints. Credits or subsidies for sustainable inputs, such as cover crop seeds or organic fertilisers, were regularly discussed. "Sustainable farming is expensive," Farmer II said. "We need help with the costs." Providing financial support to offset the early expenses of shifting to sustainable techniques will help farmers adopt these methods. "If we could get loans with low interest rates", Farmer JJ told me, "it would be easier for us to try these new methods." Incentives for implementing sustainable practices, such as compensation for ecosystem services or price premiums for sustainably produced cotton, were also considered viable motivators. "If we knew we could get a better price for our cotton," Farmer KK says, "we would be more likely to adopt sustainable practices".

Creating targeted financial incentives, expanding loan availability, and investigating market-based systems to reward sustainable activities are critical for promoting widespread adoption. The farmers' statements underscore the critical role of financial support in enabling the adoption of sustainable practices. The high cost of implementation and the need for access to credit are significant barriers. The potential for price premiums and subsidies highlights the importance of financial incentives. These findings suggest that financial interventions should focus on providing affordable credit, subsidies for sustainable inputs, and market-based incentives.

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4.4.3| Information and Education

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5 | IMPLICATIONS OF THE STUDY

This research adds to the literature on sustainable agriculture and technology adoption by presenting empirical evidence of the various elements that influence farmers' choices on soil health management. The results provide credence to previous theories emphasising the relevance of technical, economic, social, and institutional aspects, as well as underlining Ghanaian cotton farming's unique problems and potential. The results provide practical assistance for agricultural extension services, non-governmental organisations (NGOs), and other organisations striving to promote sustainable agriculture. The research emphasises the need to target interventions to meet cotton farmers' individual technical, economic, and informational demands. The focus on practical training, resource availability, and financial incentives serves as a road map for developing successful initiatives to increase the adoption of sustainable soil health practices. The research emphasises the need for government policies that encourage sustainable agriculture and provide an environment conducive to farmers transitioning to more sustainable methods. Policies that address farmers' economic hurdles, such as providing subsidies for sustainable inputs or creating market links for sustainably produced cotton, are critical. Investing in research and development to enhance the availability of suitable equipment and high-quality seeds is also critical.

6 | CONCLUSIONS AND FUTURE STUDIES

This research suggests that encouraging sustainable soil health management in Ghanaian cotton farming needs a multifaceted strategy that considers the complex interplay of variables affecting farmers' actions. While farmers recognise the significance of soil health, their understanding of sustainable practices is often inadequate, and they confront several technical, economic, social, and institutional impediments to implementation. Targeted interventions that provide practical training, financial assistance, and access to knowledge and resources are crucial for enabling farmers to adopt and sustain long-term soil health practices. Creating a conducive legislative climate and encouraging stakeholder engagement are critical steps for the broad and long-term adoption of sustainable agriculture in Ghana's cotton industry. Future research should explore the long-term impacts of sustainable soil health practices

DOI: https://doi.org/10.35738/ftr.v6.2024.22

on cotton yield and quality in Ghana. Longitudinal studies could assess the effectiveness of specific interventions, such as farmer field schools or financial incentive programs, in promoting adoption. Further research is also needed to investigate the role of climate change adaptation strategies in enhancing the resilience of cotton farming systems. Additionally, studies focusing on the development of market linkages for sustainably produced cotton could provide valuable insights for improving farmers' economic viability.

ACKNOWLEDGMENTS

The authors would like to acknowledge all the respondents who agreed to contribute to the study by answering the related questions in the survey.

ETHICS APPROVAL STATEMENT

The Ethics Committee at the Ho Technical University approved the set of questions before data collection started. The respondent was informed about the purpose of the study; therefore, his consent was obtained before he proceeded to answer the interview questions. Also, the confidentiality and anonymity of respondents were assured.

DATA AVAILABILITY STATEMENT

Data sharing in this article is applicable upon a reasonable request from researchers.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the author(s) used basic tools such as Quill Bot for checking grammar, spellings, references etc. in order to reduce plagiarism. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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REFERENCES

Adam, B., & Abdulai, A. (2023). Minimum tillage as climate-smart agriculture practice and its impact on food and nutrition security. *Plos one*, *18*(12), e0287441. https://doi.org/10.1371/journal.pone.0287441

Addis, T., Kachi, A., & Wang, J. (2021). A review of current state and future directions of cotton production in Ethiopia, *Cogent Food & Agriculture*, 7(1), 1880533, https://doi.org/10.1080/23311932.2021.1880533

Akmal, M. (2023). *The cotton crop, its challenges, and potential solutions in Pakistan*. Available at: https://www.linkedin.com/pulse/cotton-crop-its-challenges-potential-solutions-pakistan-akmal/ (accessed on September 30, 2023)

Amankwah-Amoah, J. (2015). Explaining declining industries in developing countries: The case of textiles and apparel in Ghana. *Competition & Change*, *19*(1), 19-35. https://doi.org/10.1177/1024529414563004

DOI: https://doi.org/10.35738/ftr.v6.2024.22

Anibaldi, R., Rundle-Thiele, S., David, P., & Roemer, C. (2021). Theoretical underpinnings in research investigating barriers for implementing environmentally sustainable farming practices: Insights from a systematic literature review. *Land*, *10*(4), 386.

Brahmanand, P. S., & Singh, A. K. (2022). Precision irrigation water management-current status, scope and challenges. *Indian J. Fertil*, *18*, 372-380.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2), 77-101.

Better Cotton Initiative (BCI). (2024). Annual report 2023. Available at: https://bettercotton.org/who-we-are/annual-report/ (accessed May 3, 2024)

Better Cotton Initiative (BCI). (2013). Better cotton production principles and criteria. Available at: https://bettercotton.org/wp-content/uploads/2014/10/production-principles-and-criteria.pdf (accessed May 3, 2024)

Cotton Made in Africa (CmiA). (2023). CmiA impact report 2022. Available at: https://cottonmadeinafrica.org/en/impacts/ (accessed May 3, 2024)

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage Publications.

Dalla Pellegrina, L., De Michele, A., Di Maio, G., Landoni, P., & Parravicini, S. (2021). Group meeting frequency and borrowers' repayment performance in microfinance: evidence from a quasi-natural experiment in South Africa. *Journal of African Economies*, *30*(5), 447-477. https://doi.org/10.1093/jae/ejab004

Elkington, J., & Rowlands, I. H. (1999). Cannibals with forks: The triple bottom line of 21st century business. *Alternatives Journal*, 25(4), 42.

Food & Agriculture Organization of the UN (2017). *The state of food and agriculture 2016: Climate change, agriculture and food security*. Food & Agriculture Organization of the UN (FAO). Available at: https://openknowledge.fao.org/server/api/core/bitstreams/07bc7c6e-72e5-488d-b2f7-3c1499d098fb/content (accessed on September 30, 2023)

Faulkner, W. B., Hequet, E. F., Wanjura, J., & Boman, R. (2012). Relationships of cotton fiber properties to ring-spun yarn quality on selected high plains cottons. *Textile Research Journal*, *82*(4), 400–414. https://doi.org/10.1177/0040517511426613

Galloway, J. N., Aber, J. D., Erisman, J. W., Seitzinger, S. P., Howarth, R. W., Cowling, E. B., & Cosby, B. J. (2003). The nitrogen cascade. *Bioscience*, *53*(4), 341-356. https://doi.org/10.1641/0006-3568(2003)053[0341:TNC]2.0.CO;2

Gimenez, C., Sierra, V., & Rodon, J. (2012). Sustainable operations: Their impact on the triple bottom line. *International journal of production economics*, *140*(1), 149-159.

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field methods*, *18*(1), 59-82.

Hazell, P., & Haddad, L. J. (2001). *Agricultural research and poverty reduction* (Vol. 34). Intl Food Policy Res Inst.

Hussain, S., Hussain, S., Guo, R., Sarwar, M., Ren, X., Krstic, D., Aslam, Z., Zulifqar, U., Rauf, A., Hano, C., & El-Esawi, M. A. (2021). Carbon Sequestration to Avoid Soil Degradation: A Review on the Role of Conservation Tillage. *Plants*, *10*(10), 2001. https://doi.org/10.3390/plants10102001

IIED/ProForest. (2004). *Development of a standard-setting process for sustainable cotton*. Available at: https://www.iied.org/sites/default/files/pdfs/migrate/G02263.pdf (accessed on November 3, 2023)

Jehangir, S., Khan, S.M., Ejaz, U., Zahid, N., Rashid, N., Noshad, Q., Din, Z.U. and Shoukat, A. (2024). Alien flora of Pakistan: taxonomic composition, invasion status, geographic origin, introduction pathways, and ecological patterns. *Biological Invasions*, *26*(8), 2435-2451. https://doi.org/10.1007/s10530-024-03311-8

Lincoln, Y. S., & Guba, E. G. (1988). Criteria for Assessing Naturalistic Inquiries as Reports. Available at: https://files.eric.ed.gov/fulltext/ED297007.pdf (accessed on November 3, 2023)

Magdoff, F. & Van Es, H. (2000). *Building soils for better crops* (Vol. 4). Beltsville: Sustainable Agriculture Network. Available at: https://core.ac.uk/download/pdf/554813727.pdf (accessed on November 3, 2023)

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. (1978). *The Belmont report: ethical principles and guidelines for the protection of human subjects of research* (Vol. 2). Department of Health, Education, and Welfare, National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. Available at: https://videocast.nih.gov/pdf/ohrp_appendix_belmont_report_vol_2.pdf (accessed on November 3, 2023)

Nizzoli, G. (2023). *Is Cotton Bad for the Environment? The No-Fluff Truth!* ProjectCece, Available at: https://www.projectcece.com/blog/445/is-cotton-bad-for-the-environment-the-no-fluff-truth/#:~:text=Negative%20impact%20of%20cotton%20production,look%20at%20these%20issues%20individually (accessed on November 3, 2023)

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International journal of qualitative methods*, *16*(1), 1609406917733847.

Patton, M. Q. (2014). *Qualitative research & evaluation methods: Integrating theory and practice*. Sage publications.

DOI: https://doi.org/10.35738/ftr.v6.2024.22

Peoples, M. B., & Baldock, J. A. (2001). Nitrogen dynamics of pastures: nitrogen fixation inputs, the impact of legumes on soil nitrogen fertility, and the contributions of fixed nitrogen to Australian farming systems. *Australian Journal of Experimental Agriculture*, *41*(3), 327-346.

Puskur, R., Jumba, H., Reddy, B., Etale, L., Ragasa, C., Mishra, A., Mangheni, M.N., Nchanji, E., and Cole, S. (2023). Closing Gender Gaps in Productivity to Advance Gender Equality and Women's Empowerment. CGIAR GENDER Impact Platform Working Paper #014. Nairobi, Kenya: CGIARGENDER Impact Platform. https://hdl.handle.net/10568/129710

Rahimi, S. (2024). Saturation in qualitative research: An evolutionary concept analysis. *International Journal of Nursing Studies Advances*, *6*, 100174.

Reicosky, D. (2020). Conservation agriculture systems: Soil health and landscape management. In *Advances in conservation agriculture* (pp. 87-154). Burleigh Dodds Science Publishing.

Rogers, E. M. (2003). Diffusion of innovations, 5th edn Tampa. *FL: Free Press.[Google Scholar]*.

Röling, N. (2019). The agricultural research-technology transfer interface: a knowledge systems perspective. In *Making the link* (pp. 1-42). CRC Press.

Rubin, H. J., & Rubin, I. S. (2011). *Qualitative interviewing: The art of hearing data*. Sage Publications Inc. United States of America.

Seini, A. W., & Nyanteng, V. K. (2005). Smallholders and structural adjustment in Ghana. In *The African food crisis: lessons from the Asian Green Revolution* (pp. 219-237). Wallingford UK: CABI Publishing.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for information*, *22*(2), 63-75. https://doi.org/10.3233/EFI-2004-22201

Srivastava, A. K., Dixit, S., & Srivastava, A. A. (2022). Criticism of triple bottom line: TBL (with special reference to sustainability). *Corporate reputation review*, 1-12. https://doi.org/10.1057/s41299-021-00111-x

Ullah, A., Perret, S. R., Gheewala, S. H., & Soni, P. (2016). Eco-efficiency of cotton-cropping systems in Pakistan: an integrated approach of life cycle assessment and data envelopment analysis. *Journal of Cleaner Production*, 134, 623-632. https://doi.org/10.1016/j.jclepro.2015.10.112

Vitale, G. S., Scavo, A., Zingale, S., Tuttolomondo, T., Santonoceto, C., Pandino, G., Lombardo, S., Anastasi, U., & Guarnaccia, P. (2024). Agronomic strategies for sustainable cotton production: A systematic literature review. *Agriculture*, 14(9), 1597. https://doi.org/10.3390/agriculture14091597

Yaouba, B., Martial, N. G., Lawe, D. T., Mbue, I. N., & Dieudonné, B. (2024). Effects of Climate Change on Cotton Production and Level of Adaptation. *The International Journal of Climate Change: Impacts and Responses*, *16*(2), 27. https://doi.org/10.18848/1835-7156/CGP/v16i02/27-64

Zakaria, H. (2016). Underlying constructs of farmers' perceptions towards Bt cotton among former cotton farmers in northern Ghana: empirical application of Q methodology. *International Journal of Agricultural Science, Research and Technology in Extension and Education Systems*. 6(1), 41-56

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DOI: https://doi.org/10.35738/ftr.v6.2024.22

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