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SWOT ANALYSIS OF SUSTAINABLE COTTON PRODUCTION: A CASE STUDY OF PUNJAB, PAKISTAN

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ABSTRACT

This study investigates the strengths, weaknesses, opportunities, and threats (SWOT) associated with sustainable cotton production in Punjab, Pakistan. It focuses on two key cotton-growing districts, Toba Tek Singh and Bahawalnagar, examining the role of the Better Cotton Initiative (BCI) and the Lok Sanjh Foundation (LSF) in promoting sustainable practices. A multi-stage sampling technique was used to select 400 respondents from Learning Groups (LGs) involved in the BCI program. Data were collected through structured interviews and thematic analysis, with results highlighting key strengths, such as environmental stewardship, labor practices, and economic benefits. However, weaknesses, including poor adaptability to new technologies and labor challenges, were also identified. Opportunities such as market expansion and supply chain improvements offer potential, while threats like climate change and socio-political instability pose risks to sustainable cotton production. Regression analysis revealed a strong correlation between SWOT factors and cotton production, with strengths, opportunities, and threats significantly influencing outcomes. These findings emphasize the need for targeted interventions and policy support to enhance the sustainability and resilience of cotton farming in the region.

Keywords: *Cotton, BCI, LSF, SWOT*

Introduction

Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis is a methodology that identifies the situation related to any of the four terms forming the acronym with the first letter. Benefits related to strengths, talent areas, sufficient resources, and various available options (Jannah et al., 2026). In the SWOT study, weaknesses include issues to be changed, and low area performance (Tatikova et al., 2019). Available opportunities allow variations, market opportunities and successful changes, while constraints are challenges that hold us back and discourage success.

Cotton yield in Pakistan is declining every year (Fan et al., 2026). Many factors are responsible for lowering the cotton yield in Pakistan including high temperatures at sowing and flowering stages, late wheat harvesting, the cotton leaf curl virus, soil system, unpredictable weather, insect pest attacks and lack of awareness regarding new cotton production technologies (Ahmed et al., 2026). All of these factors contribute to decreased cotton production in the key cotton-growing regions of Sindh and Punjab (Ali et al., 2026; Syed et al., 2026). Cotton production is linked with several economic and social problems such as the extra use of agrochemicals, the irregular usage of synthetic fertilizers, the lack of education among farmers, the expensive input costs, the small-sized landholdings,

limited adaptability of innovations, insufficient assistance for farmers, high production costs and the lack of balance between market demand and supply (Qayyum et al., 2024). BCI in Pakistan was launched to address the sustainability issues associated with the cotton farming system i.e., environmental, economic, and social issues (Mehmood et al., 2025).

The SWOT analysis is also considered as planning as well as a strategic positioning tool (Kumar et al., 2025). It is a better understanding tool for planners because they can achieve the possible by enhancing the strength, using the available opportunities by overcoming threats and weaknesses (Putri and Prabandari, 2025; Helms and Nixon, 2010). A SWOT analysis is not only important for companies, but it can be useful for individuals, organizations and for team building. The SWOT analysis can be implemented at the individual, institutional, national and international levels. In different educational institutes, non-profit organizations, communities, governments and in different programs, it can be used easily (Gürel and Tat, 2017). No systematic data is available about strengths and opportunities in sustainable cotton production practices and about weaknesses and threats that are hurdles in sustainable production for cotton growers in Pakistan (Siddique and Sulehri, 2026).

Therefore, the objectives of this research study include:

1. *To identify and evaluate the strengths associated with sustainable cotton production practices in Punjab, Pakistan.*
2. *To analyze the weaknesses and challenges that hinder the adoption and effectiveness of sustainable cotton farming in the region.*
3. *To explore the opportunities available for promoting sustainable cotton production and enhancing environmental, social, and economic outcomes for farmers in Punjab.*
4. *To assess the potential threats to sustainable cotton production and provide strategic recommendations for overcoming these barriers to ensure long-term viability.*

This research study outlines the steps and processes undertaken to explore the strengths, weaknesses, opportunities, and threats (SWOT) related to sustainable cotton production in Punjab, providing a comprehensive approach to collecting and analyzing data from key stakeholders in the cotton value chain with a sustainable cotton farming system.

Methodology

Research Area-Universe

The research was conducted in the cotton-growing regions of Punjab, Pakistan, specifically focusing on the districts of Toba Tek Singh and Bahawalnagar. These districts were selected as they are key areas for cotton cultivation, with Toba Tek Singh representing non-core cotton-growing regions and Bahawalnagar representing core cotton-growing regions. The study focused on sustainable cotton production under the Better Cotton Initiative (BCI), implemented by the Lok Sanjh Foundation (LSF), which aims to promote sustainable farming practices among smallholder farmers. All the Learning Groups (LGs) formed by LSF in these districts served as the universe for the study.

Population

The study targeted the Learning Groups (LGs) involved in the Better Cotton Initiative in the selected districts. LGs are groups of farmers trained by the Lok Sanjh Foundation in sustainable cotton production practices. The population of this study comprised all LGs from Toba Tek Singh and Bahawalnagar who were actively participating in the BCI program.

Sampling Technique and Sample Size

A multi-stage sampling technique was employed to select the study participants. The cotton-growing areas were categorized into core and non-core districts based on the prevalence of sustainable cotton farming and the involvement of organizations like LSF (BCI, 2018). Two tehsils were randomly selected from each of the districts (Bahawalnagar and Toba Tek Singh). From each tehsil, 10 Learning Groups (LGs) were randomly chosen, and from each Learning Group, 10 sustainable cotton growers were selected through random sampling. This yielded a total sample size of 400 respondents, comprising sustainable cotton growers from both districts.

Research Instruments

To collect data, an interview schedule was developed. The interview schedule consisted of structured questions that included both closed- and open-ended formats. The questions were designed based on a thorough review of relevant literature, discussions with agricultural experts, and pre-surveys conducted with sustainable cotton producers who were not a part of the final sample. The schedule utilized a Likert scale to measure the frequency and extent of respondents' experiences and perceptions, ranging from "not at all" to "very high extent" (Alabi and Jelili, 2023).

Validity and Reliability of Instruments

The validity of the interview schedule was ensured by reviewing it with a panel of experts from the Institute of Agricultural Extension, Education, and Rural Development, University of Agriculture Faisalabad. The experts provided suggestions and revisions to enhance the relevance and clarity of the instrument. To ensure the reliability of the instrument, a pilot study was conducted, and the data were analyzed using Cronbach's alpha through the Statistical Package for Social Sciences (SPSS). The reliability score obtained was 0.741, indicating a satisfactory level of internal consistency (Bujang et al., 2024).

Data Collection

Data collection was carried out using interview schedules. The interview process involved individual meetings with the respondents, conducted by a team of trained enumerators familiar with the cultural and linguistic context of the study area. Before the interviews, respondents were informed about the objectives of the study to encourage accurate and unbiased responses. The interviews were conducted in local languages to ensure clarity and understanding.

***Quantitative Data Collection*:** Quantitative data were collected through structured questions in the interview schedule, capturing respondents' perceptions about the strengths, weaknesses, opportunities, and threats related to sustainable cotton production (Karadzhov, 2025).

***Qualitative Data Collection*:** To complement the quantitative data, qualitative data were collected through Key Informant Interviews (KIIs) with trainers, project personnel, and progressive farmers. Additionally, personal observations were made during field visits to document farming practices and environmental conditions (Chusniyah and Akhmad, 2023).

Data Analysis

The collected data were analyzed using descriptive statistics for quantitative data and thematic analysis for qualitative data.

***Quantitative Data*:** The quantitative data from the closed-ended questions were processed using SPSS and Microsoft Excel. Descriptive statistics such as means, standard deviations, frequencies, and percentages were used to analyze the data (Yu and Wang 2022).

***Qualitative Data*:** The qualitative data obtained from interviews and observations were analyzed using thematic analysis, identifying key themes and patterns related to the respondents' experiences and challenges in sustainable cotton production (Anwar and Sulaeman, 2025).

Assumptions and Limitations

***Assumptions*:** It was assumed that the respondents were knowledgeable about sustainable cotton production and would provide honest and accurate responses. It was also assumed that the findings from the selected districts would be representative of other cotton-growing regions in Punjab.

***Limitations*:** The study was limited to two districts in Punjab, and only 400 respondents were included in the sample. Time and resource constraints also restricted the scope of the research, and the accuracy of the findings depended heavily on the reliability of the self-reported data from the respondents.

Results and Discussion

Strengths

Sustainable cotton production offers a range of strengths that contribute to its appeal and effectiveness in modern agriculture (Vitale et al., 2024). One of its primary strengths lies in its ability to promote environmental stewardship by

reducing reliance on synthetic inputs, minimizing chemical runoff, and conserving natural resources such as soil and water. Sustainable farming practices, such as organic cultivation, crop rotation, and agroforestry, enhance soil health, biodiversity, and ecosystem resilience, leading to improved long-term sustainability and resilience to climate change. Moreover, sustainable cotton production prioritizes social responsibility by fostering fair labor practices, supporting rural livelihoods, and empowering local communities through capacity-building initiatives and inclusive supply chain partnerships (Abbasi, 2025). Additionally, sustainable cotton commands consumer trust and loyalty, as it aligns with the growing demand for ethically produced, environmentally friendly products. The adoption of sustainable practices also offers economic benefits, including reduced input costs, increased market access, and enhanced brand value for stakeholders across the cotton value chain. Overall, the strengths of sustainable cotton production lie in its holistic approach to sustainability, which integrates environmental, social, and economic considerations to create a more resilient and equitable agricultural system. Results regarding the strengths of sustainable cotton production are represented in Table 1.

Table 1: Mean, standard deviation (SD), weighted score and rank order regarding the strengths that exist in sustainable production of cotton

Strengths	Mean value	Std. Deviation	Weighted score	Rank order
No child labour	4.2150	0.89486	337.2	1
Democracy, participation, and transparency	4.2149	0.94658	337.2	2
Promote decent work	4.0550	1.04389	324.4	3
Quality assurance	3.9550	1.19228	316.4	4
Fiber quality improvement	3.9538	1.19228	316.3	5
No discrimination	3.9375	1.14756	315	6
Optimize water use	3.6125	1.24145	289	7
Payment on time	3.1475	1.53023	251.8	8
Improve soil health	3.1975	1.44177	255.8	9
Freedom of association	3.1475	1.53023	251.8	10
Natural habitat conservation	2.9750	1.12808	238	11
Improve crop protection	2.9475	1.07127	235.8	12
Cost conservation	2.9475	1.07127	235.8	13

1.Not at all 2. To some extent 3. Moderate 4. High extent 5. Very high

Table 1 shows that the respondents ranked "No child labour" ($\bar{x}$=4.2150,0.89486) at 1st position followed by "democracy, participation and transparency" ($\bar{x}$=4.2149,0.94658), "Promote decent work" ($\bar{x}$=4.0550, 1.04389), "quality assurance" ($\bar{x}$=3.9550,1.19228),"fibre quality improvement" ($\bar{x}$=3.9538,1.19228), "no discrimination" ($\bar{x}$=3.9375,1.14756), "optimize water use" ($\bar{x}$=3.6125,1.24145),"payment on time" ($\bar{x}$=3.1475,1.53023), "improve soil health" ($\bar{x}$=3.1975,1.44177), "freedom of association" ($\bar{x}$=3.1475,1.53023), "natural habitat conservation" ($\bar{x}$=2.9750, 1.12808) at 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th,10th, 11th and 12th position respectively. It was found that no child labour, democracy, participation, and transparency was placed between "high to very high" categories, followed by promoting decent work, quality assurance, fibber quality improvement, no discrimination, optimize water use, payment on time in "moderate to high" categories while remaining factors like improve soil health, freedom of association and natural habitat conservation fell between "moderate to some extent" categories.

A randomized control trial in the state Andhra Pradesh India with a sample size of 729 households, Kumar et al., (2019) found some savings on specific costs of BCI members, but they reported no significant statistical differences in total cost of production. The majority of the focus group members reported that "*It is cost-effective for us to use recommended*

fertilizer, pesticides and balanced use of water to maintain the soil quality for better production".

Weaknesses

Sustainable cotton production, while promising, faces several weaknesses that hinder its widespread adoption and effectiveness (Tlatlaa et al., 2023). One significant challenge lies in the complexity and costliness of transitioning from conventional to sustainable farming practices. Farmers may encounter barriers such as limited access to resources, technical knowledge, and financial incentives needed to implement sustainable methods. Moreover, the unpredictable nature of agricultural markets and fluctuating demand for sustainable products can pose risks to farmers' incomes and market competitiveness. Additionally, the scalability of sustainable cotton production methods may be limited by factors such as land availability, water resources, and infrastructure constraints, particularly in resource-constrained regions. Furthermore, ensuring compliance with sustainability standards and certifications can be burdensome for small-scale farmers, requiring additional investments in monitoring and verification systems (Ansah et al., 2026). Addressing these weaknesses requires coordinated efforts from stakeholders across the cotton value chain to provide targeted support, capacity-building initiatives, and policy interventions that enable farmers to overcome barriers and transition towards more sustainable practices effectively. Results regarding the weaknesses of sustainable cotton production are presented in Table 2.

Table 2: Mean, standard deviation (SD), Weighted score and rank order regarding the weaknesses that may exist in sustainable production of cotton

Weaknesses	Mean value	Std. Deviation	Weighted score	Rank order
Poor adaptability of latest agricultural Machinery	4.0000	1.32264	320	1
More insect pest attack	3.4975	1.63912	279.8	2
Inexperienced labor	3.4250	1.63434	279.8	3
Weeds attack	3.4900	1.60822	279.8	4
More labor and time-intensive	2.43	1.480	194.8	5
Quality degradation	2.3300	1.33625	186.4	6
Reduction in per-acre yield	2.2475	1.38058	178.8	7
Low fertility	2.2050	1.37393	176.4	8
Increased post-harvest losses	1.9150	1.27548	153.2	9
More area is required to produce	1.8200	1.34987	145.6	10

1. Not at all 2. To some extent 3. Moderate 4. High extent 5. Very high

Table 2 show that the respondents ranked "poor adaptability of latest agricultural machinery" ($\bar{x}$=4.0000, 1.32264) at 1st position followed by "more insect pest attack" ($\bar{x}$=3.4975, 1.63912), "inexperienced labor" ($\bar{x}$=3.4250, 1.63434), "weeds attack" ($\bar{x}$=3.4900, 1.60822), "more labor and time intensive" ($\bar{x}$=2.4350, 1.47520), "quality degradation" ($\bar{x}$=2.3300, 1.33625), "reduction in per acre yield" ($\bar{x}$=2.2475, 1.38058), "low fertility" ($\bar{x}$=2.2050, 1.37393), "increased post-harvest loses" ($\bar{x}$=1.9150, 1.27548), "more area required to produce" ($\bar{x}$=1.8200, 1.34987) at 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th and 10th position respectively.

It was found that poor adaptability of latest agricultural machinery, more insect pest attack was placed between "high to very high" categories, followed by inexperienced labor, weeds attack, more labour and time intensive, quality degradation and reduction in per acre yield in "moderate to high" categories while remaining factors like low fertility, increased post-harvest loses and more area require to produce fell between "moderate to some extent" categories. Addis *et al.* (2021) reported absence of different types of best cotton varieties, poor network of market, poor linkages between market networks, poor infrastructure and limited development and research as major weaknesses in cotton sector.

Similarly, Razaq *et al.* (2013) stated that poor management of sucking pests has become a

major challenge for conventional cotton which is mainly grown at the end of April while the early crop is sown in February and March. This challenge emerges when different sucking pests such as aphids, thrips, and jassids feed on the early crop and attack on the conventional crop later, ultimately destroying the whole cotton field.

Opportunities

Sustainable cotton production presents numerous opportunities for enhancing environmental stewardship, social well-being, and economic prosperity within the agricultural sector (Liang, 2025). Adoption of sustainable farming practices, such as organic cultivation, integrated pest management, and water-efficient irrigation methods, can mitigate environmental degradation, conserve natural resources, and reduce greenhouse gas emissions. Furthermore, investment in research and innovation facilitates the development of resilient cotton varieties, eco-friendly pest control solutions, and sustainable agronomic techniques tailored to local conditions. Community-based initiatives, farmer cooperatives, and fair-trade partnerships empower cotton producers, promote social equity, and strengthen rural livelihoods. Market demand for sustainably produced cotton continues to grow, offering opportunities for premium pricing, market differentiation, and brand reputation enhancement for stakeholders committed to sustainability. Additionally, policy support, incentives, and certification programs incentivize sustainable practices, fostering a conducive environment for the transition to more sustainable cotton production systems (Dristy et al., 2024). Collaboration among stakeholders across the cotton value chain, including producers, retailers, consumers, policymakers, and civil society, is essential for harnessing these opportunities and advancing the sustainable transformation of the cotton industry. Results regarding the opportunities of sustainable cotton production showed in the Table 3.

Table 3: Mean, Standard Deviation (SD), weighted score and rank order regarding the opportunities that may exist in sustainable production of cotton

Opportunities	Mean value	Std. Deviation	Weighted score	Rank order
New market establishment	4.3000	1.02842	344	1
Growth rate of textile industry	4.1700	1.18093	336.6	2
Supply chain modifications	3.6375	1.25899	291	3
Preservation of natural resources and environmental issues	3.5175	1.33384	277.4	4
Institutional linkages	3.2350	.98854	258.8	5
More information on marketing	3.1375	1.08929	251	6
Higher rate	2.8425	1.14716	227.4	7
Retailers & brands enhancement	2.7750	1.15226	222	8
Increase in cost-benefit ratio	2.7750	1.15226	220.2	9

1. Not at all 2. To some extent 3. Moderate 4. High extent 5. Very high

Table 3 shows that the respondents ranked "new market establishment" ($\bar{x}$=4.3000, 1.02842) at 1st position followed by "growth rate of textile industry" ($\bar{x}$=4.1700, 1.18093), "supply chain modifications" ($\bar{x}$=3.6375, 1.25899), "preservation of natural resources and environmental issues" ($\bar{x}$=3.5175, 1.33384), "institutional linkages" ($\bar{x}$=3.2350, 0.98854), "more information on marketing" ($\bar{x}$=3.1375, 1.08929), "higher rate" ($\bar{x}$=2.8425, 1.14716), "retailers and brands enhancement" ($\bar{x}$=2.7750, 1.1.15226), "increased in cost-benefit ratio" ($\bar{x}$=2.7750, 1.15226) at 2nd, 3rd, 4th, 5th, 6th, 7th, 8th and 9th position respectively. Addis *et al.* (2021) SWOT analysis results showed that the high demand of cotton is due to launching of many other industries despite of its high competition with other synthetic fibers.

It was found that new market establishment and growth rate of the textile industry were placed between "high to very high" categories followed by supply chain modifications, preservation of natural and environmental issues and institutional linkages in "moderate to high"

categories while remaining factors like more information on marketing, retailers and brands enhancement and increase in cost-benefit ratio fell between "moderate to some extent" categories. Recentaly, Kayes et al. (2025) revealed the same study that strengthens this research.

Focus group members of Toba Tek Singh district reflect that "*due to clean picking of cotton, sometimes we get 20 to 50 rupees extra (per mond)*". An optimistic picture was painted by some of the farmers during informal discussions "*Due to BCI, we earn an extra amount of Rs. 6000/acre because we can sell our cotton at a better price by using sustainable cotton production and protection practices*".

Threats

Sustainable cotton production faces various threats that jeopardize its long-term viability and resilience. One of the primary challenges is the intensification of climate change, leading to unpredictable weather patterns, extreme temperatures, and altered precipitation levels, which can disrupt cultivation schedules and increase the prevalence of pests and diseases (Nazeer et al., 2023). Additionally, the indiscriminate use of agrochemicals, including pesticides and fertilizers, poses risks to environmental and human health, as well as the ecosystem balance. Soil degradation and water scarcity further exacerbate the challenges, affecting soil fertility, water availability, and overall crop productivity. Socioeconomic factors such as labour shortages, inadequate infrastructure, and market volatility also undermine sustainable cotton production efforts. Moreover, socio-political instability, trade disputes, and policy uncertainties can disrupt supply chains and market access, posing significant risks to cotton farmers' livelihoods (Atieno, 2024). Addressing these multifaceted threats requires integrated approaches that prioritize sustainable agricultural practices, community engagement, policy support, and innovation across the cotton value chain. Results regarding the threats of sustainable cotton production in presented in Table 4.

Table Error! No text of specified style in document.**. Mean, standard deviation (SD), Weighted score and rank order regarding the threats that may exist in sustainable production of cotton**

Threats	Mean value	Std. Deviation	Weighted score	Rank order
Old cultivation techniques	3.8475	1.38167	307.8	1
May be a lower yield	3.7150	1.41023	297.2	2
Land and water management issues	3.5800	.91690	286.4	3
May produce less revenue	2.4500	1.13168	196	4
Increase in Poverty ratio	2.2125	1.36822	177	5
Unemployment	2.1250	1.31289	170	6

1. Not at all 2. To some extent 3. Moderate 4. High extent 5. Very high

Table 4 shows that the respondents ranked "old cultivation technique" ($\bar{x}$=3.8475, 1.38167) at 1st position followed by "may be lower yield" ($\bar{x}$=3.7150, 1.41023), "land and water management issues" ($\bar{x}$=3.5800, 0.91690), "may produce less revenue" ($\bar{x}$=2.4500, 1.13168), "increase in poverty ratio" ($\bar{x}$=2.2125, 1.36822), "unemployment" ($\bar{x}$=2.1250, 1.31289) at 2nd, 3rd, 4th, 5th and 6th position, respectively.

It was found that old cultivation techniques and lower yield were placed between "high to very high" categories, followed by "land and water management issues" and "less revenue produced" in "moderate to high" categories while the remaining factors increase in poverty ratio and unemployment fell between "moderate to some extent" categories.

In terms of total yield per acre, it was observed during informal discussions with farmers that some farmers never linked yield benefits with training and support by Lok Sanjh Foundation (LSF) while some farmers report an increase in yield per acre in comparison to their neighbourhood farmers who are not using BCI practices. Some focus group members reflect that "*We are trying our best for clean picking of*

cotton, and we do not get additional money". One of the female cotton pickers said "*LSF training is negatively affecting our income because we are applying less quantity of pesticide in our field and that is reducing the number of days of picking as compared to past. Clean picking of cotton requires more time, and we end up picking less and we are not paid extra for neat and clean picking of cotton*". Regression analysis of SWOT representing in Table 5.

Table 5: Regression analysis of Strengths, Weaknesses, Opportunities and Threats (SWOT) in sustainable cotton production

Variables	Mean	SD	B	T	Sig.	R
Cotton production	11.9625	2.55488	1.313	10.433	.000	
Strength (S)	46.2800	7.43504	0.017	-1.731	0.004	
Weaknesses (W)	27.4400	5.47094	0.026	-.044	0.084	0.87
Opportunities (O)	30.0425	6.31311	0.022	-.777	0.037	
Threat (T)	17.9300	3.10309	0.042	0.266	0.001	

Regression analysis was used for the estimation of relationships between cotton production and Strengths, Weaknesses, Opportunities and Threats (SWOT). It was utilized to assess the strength of the relationship between cotton production and SWOT. The *R*-value represents the simple correlation and is 0.87 which indicates a high degree of correlation. Results also indicated that the regression model of SWOT predicts cotton production. Strength, Opportunity and Threat predict cotton production, whereas weaknesses are non-significant with cotton production. Here, $p < .05$, which is less than 0.05 indicates that, overall, the regression model statistically significantly predicts the cotton production i.e., it is a good fit for the data.

Conclusion

This study explores the strengths, weaknesses, opportunities, and threats (SWOT) related to sustainable cotton production in Punjab, Pakistan, focusing on Toba Tek Singh and Bahawalnagar districts. It evaluates the role of the Better Cotton Initiative (BCI) and Lok Sanjh Foundation (LSF) in promoting sustainable farming practices. Using a multi-stage sampling technique, 400 farmers from Learning Groups (LGs) participated in structured interviews and thematic analysis. Key strengths identified include environmental benefits, improved labour practices, and economic advantages. However, weaknesses like limited adaptability to new technologies and labour challenges were also noted. Opportunities such as market expansion and supply chain improvements provide growth potential, while climate change and socio-political instability threaten sustainability efforts. Regression analysis showed a strong link between SWOT factors and cotton production, indicating that strengths, opportunities, and threats significantly influence outcomes. The study underscores the need for targeted interventions and policy support to strengthen sustainable cotton farming.

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