

Sustainability Analysis of the Cotton Sector in Tanzania

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Abstract:- This study assesses the sustainability of the cotton sector in Tanzania. The data collection involved a documentary review on cotton sustainability focusing on environmental, economic, and social aspects. Also, policies and regulations related to the cotton sector were reviewed. To complement the document analysis, the surveys involved targeted 34 cotton farmers from 17 Regions, Eight (8) officials from the Ministry of Agriculture, Registrar of Cooperative Societies, Representative from TARI-Ukiliguru (a center which focused on cotton research), Cooperative societies representatives (17), (TCB) officers (1), and Workers and owners of ginneries (8) were interviewed. Thematic and framework analysis was used to analyze the collected data. The findings show that The cotton cultivation practices in Tanzania demonstrate limited strengths in enhancing sector sustainability. Challenges such as economic barriers to scale up of ongoing sustainable environmental interventions (Piloted organic farming); inadequate awareness of sustainable farming practices to the majority of farmers; low yield compared to global average; inadequate technologies including high yield seeds, and effective water management techniques, limited value addition, international market price fluctuations, and social inequalities present obstacle to full attainment of sustainable cotton production in Tanzania. To this end, the study recommends the establishment of Price Transparency mechanisms; clear quality standards for cotton production, processing, and trading; capacity-building programs to enhance the skills and knowledge of farmers, ginneries, and traders; traceability systems to track the origin and journey of cotton from farm to the market; information sharing platforms for sharing market information, agronomic best practices, and regulatory updates provision of Government incentives and policies to support sustainable practices and encouraging value addition through Promotion of Market Diversification.

Keywords:- Agriculture, Cotton, Cotton Cultivation, Sustainability, Environmental; Economic Sustainability, Social Sustainability, and Tanzania.

I. INTRODUCTION

The cotton sector in most African countries has not achieved its true potential (COMESA, 2009). The principal subsectors are cotton growing, mainly by smallholder cotton farmers, ginning, spinning, and textile, garment, and apparel manufacturing.

In Tanzania, the cotton industry plays a crucial role in the country's economy. It is pivotal in the agricultural sector, providing employment, income for millions of smallholder farmers, foreign exchange earnings, and supporting numerous industries. In the financial year 2023/24 the sector contributed 349,832,000 million USD of the export value against the actual potential of 2,030,265,000 USD (Mtunga, 2024). This is attributed to several challenges including fluctuating market prices, environmental degradation, and limited access to modern technology (ibid).

According to Mtunga (2024), other challenges include inadequate availability of agricultural inputs, the use of inappropriate and low-quality mechanization equipment, rainfall dependency, inadequate extension services, climate change impact, inadequate value addition, inadequate research and development, lack of comprehensive farmers' registration database, inadequate awareness of the importance of cooperatives, and limited political will.

In addressing the challenges above the country has been implementing various interventions including the mechanization of the agriculture practice by supplying 300 tractors to farmers in the financial year 2024/25; Piloting contract farming in 40 Wards, each ward provided with 5 tractors; Enhancing extension service by employing 179 extension officers graduates from Sokoine University of Agriculture under a special youth program (Building a Better Tomorrow extensions services); Supplying 200 boom sprayers and 40 drones to farmers; and introduction of irrigation practice in the sector by purchasing 5 equipment to be used for dams and boreholes construction (URT, 2024).

However, Sustainability in the cotton industry involves implementing interventions that balance economic viability, social responsibility, and environmental stewardship throughout the entire production process (TraceX technology, 2023). This is envisaged to guarantee long-term productivity, environmental health, and socio-economic benefits.

This study aims to analyze the sustainability of the cotton sector in Tanzanian. By evaluating current policies, programs, and initiatives, this paper seeks to identify strengths, weaknesses, and areas for improvement.

➤ *The Objectives of this Study are to:*

- Examine existing interventions aimed at promoting sustainability.

- Assess the adequacy of these interventions using established criteria.
- Offer recommendations for enhancing sustainability in the sector.

II. LITERATURE REVIEW

➤ Sustainability Principles in the Cotton Sector

According to GIZ (2022), the Report "Our Common Future" of the UN World Commission on Environment and Development (WCED) published in 1987, commonly known as the Brundtland Report, has defined Sustainable Development as development that meets the needs of the present without compromising the ability of the future generations to meet their own needs. The Brundtland report treats the social, economic, and environmental pillars of sustainability in an integrated and coherent manner (GIZ, 2022).

One of the first publications that claimed to summarize sustainable agricultural practices with a particular focus on cotton dates back to 2003 and thus was published before many standards systems were created after 2004 (GIZ, 2022). Sendouca and Oosterhuis (2003) identified economic aspects and productivity as measures of sustainable cotton

productivity. Additionally, GIZ (2022), prioritizes sustainable systems of cotton farming in the environmental, social, and economic aspects. The environmental aspect includes: Pest and pesticide management (Environmental contamination by pesticides, Pest management and crop production, and human exposure to pesticides), Water management, (Water depletion, crop water management, soil salinization, and water quality), Soil management (Soil fertility and soil management), Biodiversity and Land use (Land conservation, and land productivity) and Climate Change (Greenhouse Gas emissions, decomposition and mineralization, Energy use and Carbon stock change);

The economic aspect includes: Economic viability, poverty Reduction, Food Security, and Economic Risk management; and the Social aspect includes: labor Rights and Standards (Child labor, employment conditions, freedom of association, and social protection), Worker health and safety, Equity and gender, and Farmer organization.

III. CONCEPTUALIZING SUSTAINABLE COTTON SECTOR

The sustainability of the cotton sector involves integrating the environmental, economic, and social aspects as presented in Figure 1.

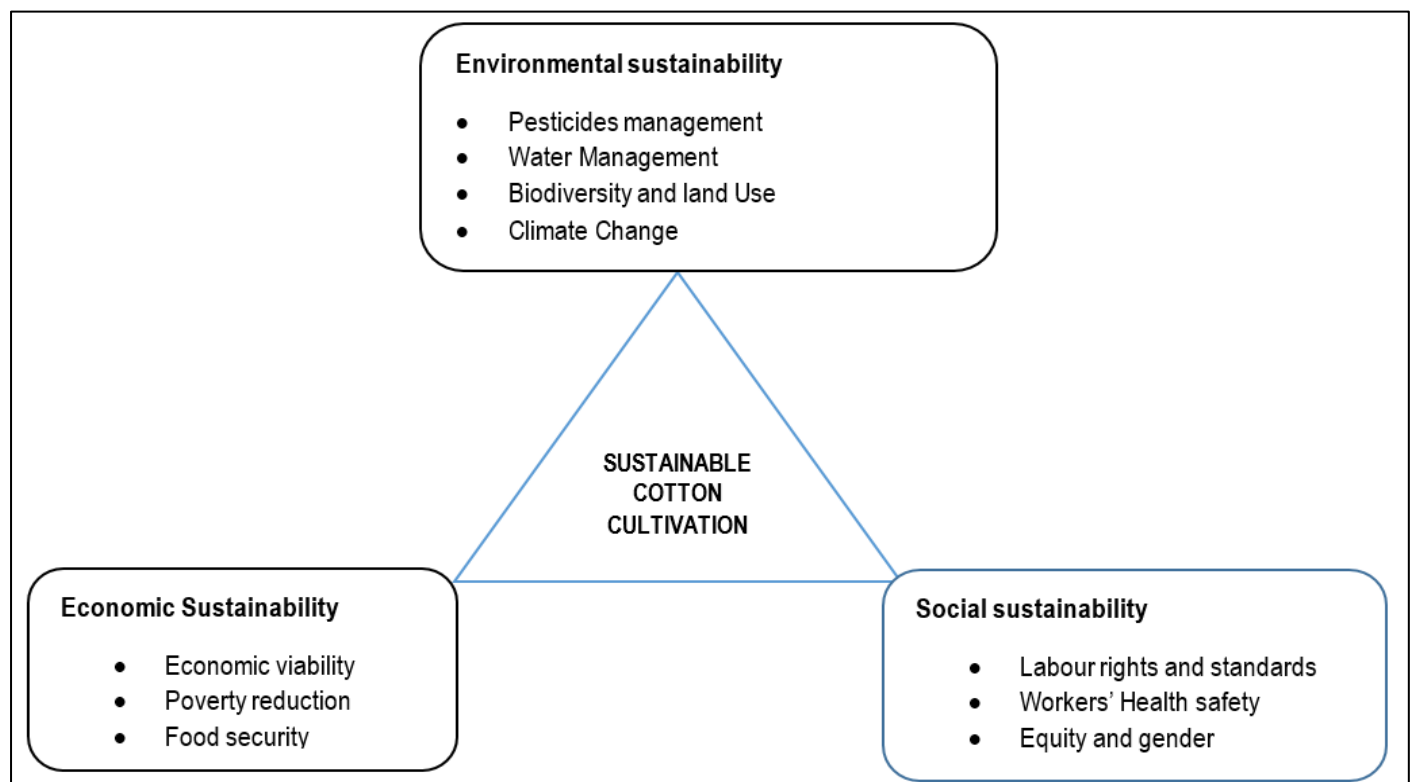


Fig 1 Cotton Sector Sustainability Framework

Source: Own construct, 2024.

➤ Environmental Sustainability

Environmental sustainability consists of four variables which are Pest and pesticide management; water management, Biodiversity and Land uses, and Climate Change. Under pesticide management, the sustainability issues include integrated pest management practices,

Reduction of Pesticide chemical usage, and promotion of Organic farming practices. In the case of water management, sustainability issues include efficient irrigation techniques, water harvesting practices, and sustainable water usage policies.

In addition to that, the sustainability of the cotton sector under biodiversity and land use includes issues related to crop rotation and polyculture practices, protection of native species and their habitats, and soil management and conservation practices.

In the case of climate change, the sustainability of the cotton sector must consider issues related to adaptation strategies, especially in case of climate change impacts; carbon footprint reduction initiatives, and sustainable land management/

➤ *Economic Sustainability*

The economic sustainability of the cotton sector is guided by 3 variables which are economic viability, poverty reduction role, and support of food security. The economic viability considers issues related to fair pricing and market access, investment in sustainable technologies, and support for smallholder farmers. For the case of poverty reduction, the sector must guarantee job creation opportunities, income source diversification for cotton farmers, and access to credit and financial services. On food security, the sustainability issues include the integration of cotton farming with food crop production, support for local food systems, and education and training on sustainable agriculture.

➤ *Social Sustainability*

The sustainability of the sector in a social context includes four components which are labor rights and standards, workers' health, equity and gender, and farmer organization. For the case of labor rights and standards, the sustainability elements include issues related to the enforcement of fair labor practices, compliance with national and international labor standards, and awareness programs on workers' rights. The sustainability of the cotton sector under the component of workers' health and safety includes aspects related to the provision of protective gear and training, provision of regular health check-ups and monitoring, and safe working conditions in cotton cultivation and processing.

On the equity and gender component, the sustainability element for the cotton sector includes empowerment programs, especially for women in cotton farming, development and implementation of gender-sensitive policies, and encouragement of women to participate in decision-making bodies in the sector.

For the case of farmer organization, among the elements for enhancing cotton sector sustainability it is imperative to strengthen cooperative societies and farmer groups, to build their capacity, and to create platforms for collective bargaining and advocacy.

It is also worth noting that, the 3 sustainability aspects (Environmental, Economic, and Social) are interlinked. For example, sustainable pest management can improve farmer's health and reduce costs, while economic viability can enhance social conditions through better wages and working conditions. Therefore, the framework calls for the policies and practices to take into consideration this interdependencies for the sector sustainability.

IV. METHODOLOGY

The study focused on 17 cotton-producing regions whereby more than 64 districts councils and more than 600,000 farmers are involved in cotton cultivation. The study applied a descriptive and exploratory research design using both qualitative and quantitative research approaches. The data were collected through a literature review, surveys, interviews, Focus group discussions, and Field observations.

Literature on cotton sustainability focusing on environmental, economic, and social aspects was reviewed. Also, policies and regulations related to the cotton sector were reviewed.

The surveys involved targeted 34 cotton farmers from 17 Regions, Eight (8) officials from the Ministry of Agriculture (Department of Crop Development (2), Policy and Planning (2), Food Security and Marketing(2), and Environment Management unit(2)), Registrar of Cooperative Societies, Tanzania Agriculture Research Institute-Ukiliguru center which focused on cotton research (1), Cooperative societies representatives (17), Tanzania Cotton Board (TCB) officer (1), and Workers and owners of ginneries (8).

The study applied Excel spreadsheet software and narrative analysis to analyze the collected data. The narrative analysis focuses on personal accounts shared by the participants including their knowledge, experiences, and perceptions regarding cotton industry sustainability based on environmental, economic, and social aspects. Further to that, the context, structure, and content of the narratives were examined to gain insights into socio-economic and environmental factors.

The findings were validated by cross-checking information from different sources (interviews, documents, observations). The use of multiple data sources has enriched the analysis and provided a more comprehensive understanding of the cotton sector's sustainability.

The findings are presented in bar charts, tables, and a structured format, highlighting key issues, key themes, quotes from participants, and implications for cotton sustainability in Tanzania.

V. FINDINGS

❖ *Economic Sustainability*

A. *Economic Viability:*

➤ *Fair Pricing and Market Access to Farmers*

• *Market Access to Farmers*

While assessing the effectiveness of the marketing system in the cotton sector, a registrar of the cooperative society has indicated that,

"Tanzania has a robust legal framework that guarantees market to cotton farmers through their cooperatives. Section

23 (c) of the ACT, provides for Cooperative societies including in the cotton industry to engage in collective marketing of their produce, which gives them greater bargaining power with buyers and processors". Through Tanzania Cotton Board farmers have been enjoying a reliable market whereby in each season 30 to 50 buyers are shortlisted by the Board".

He further added,

"Through cooperatives farmers stand a chance of establishing processing facilities to add value to cotton products, leading to higher incomes and increased local processing capacity".

On the other hand, a representative from Tanzania Cotton Board has indicated that,

"There is no market issue for the produced cotton in the country. Tanzania Cotton Board (TCB) has been facilitating access to necessary infrastructure for cotton production and marketing, including ginneries, warehouses, and transport networks. Each season the TCB has been providing 20 to 30 licences for cotton buyers to guarantee 100 percent off-taking for all produced cotton. There are about 50 functional ginneries countrywide. However, ginneries have been working only 4 months in a year due to lack of enough cotton which attributed to low productivity caused by inadequate extension services".

Again, a representative from the TCB has highlighted that,

"TCB has been promoting the establishment and modernization of ginneries, where cotton is processed after harvest. These facilities have been crucial for separating cotton fibers from seeds, which is an essential step before marketing. Modern ginneries have improved the efficiency and quality of ginning, ensuring that Tanzanian cotton meets international standards and managed to access Regional and International markets which allow export and higher revenues". Also, through TCB the Cooperative unions of Kahama, Chato, Mbogwe, Bukombe, and Simiyu by the facilitation of the Tanzania Agriculture Development Bank have managed to revive the closed cotton ginneries which are now fully functional. The revived ginneries include; Kahama, Chato, Mbogwe, and Sola cotton Ginneries.

Additionally, the study found quality issues in the cotton industry which may affect the cotton price and thus, the income of the farmers. A representative from the directorate of marketing and food security in the Ministry of Agriculture has indicated that, "There has been inconsistency in the quality of the cotton produced in the country. In turn, this affects the market of our cotton as buyers normally prefer higher quality cotton".

• Exchange Rate Fluctuations

The fluctuation of exchange rates against major currencies was found to affect the sustainability of the cotton sector in Tanzania. While responding on the economic

sustainability of the cotton Industry in Tanzania, a representative of the Ginners has indicated that,

"The Exchange rate fluctuations, particularly depreciation of the Tanzanian shilling against major currencies such as the US dollar and the Euro, have impacted the purchasing power of cotton farmers, input costs, and export earnings. For example over the last five years, the Tanzanian shilling has been experiencing periods of depreciation against major currencies, impacting the affordability of imported inputs (e.g., fertilizers, pesticides, and machinery) for cotton farmers and affecting the profitability of cotton production.

However, the TCB respondent has indicated that,

"The only way to help farmers against the exchange rate fluctuation is to address the issues of productivity. The TCB in collaboration with the Private sector has employed 237 extension officers in the financial year 2023/24 placed in 40 Wards for pilot. The target is to have 500 extension officers by the financial year 2024/25. The pilot has been very successful whereas, in the financial year 2024/25 there are some farmers recorded a productivity of 2,600kg per acre compared to 80kg per acre in some areas like Igunga which is an increase of over 3000 percent".

Additionally, He indicated that,

"TCB has identified 5000 lead farmers in all cotton cultivating regions whereby, their farms will be used as demonstrating farms. For effective reach out TCB has started procurement arrangement of 2,500 bicycles for extension services at village level".

• Global Cotton Market Price Fluctuation

Tanzania's Agriculture sector policy, 2013 outlines the government's commitment to promoting contract farming to improve agricultural productivity and ensure food security. One of the policy statements states that,

"The Government shall promote commodity supply chains and regulate contract farming while ensuring that the rights of farmers, particularly women, and men, are duly respected"

This statement emphasizes the need for fair and equitable contracts that protect the interests of smallholder farmers. However, the policy lacks a law or regulations that protect farmers in contract farming in the case of fluctuation in the global cotton price.

While responding on the effectiveness of contract farming in insulating farmers against global market prices, the Assistant Director on crop development has said,

"Purchase prices are based on the prevailing global market prices at harvest time and are thus unknown to farmers in advance. Consequently, companies generally limit their pre-financing activities to seeds and pesticides. As a result, per-hectare yields are significantly lower in many parts

of the country (500 to 700kg/ha) compared to the global average (800 to 1200kg/ha). However, The organic farming pilot project conducted in 2024 in the Simiyu region (Meatu and Maswa districts) and Mara Region (Musoma district) has shown some success whereas, farmers who are supplied with organic inputs their yield have increased by over 300%.

Also, she added that,

"Growers have been switching cotton buyers from season to season, which disincentivizes cotton companies to pre-finance farmers' inputs. The situation has also been aggravated by the widespread problem of side selling, a practice whereby producers sell their cotton to the companies offering the highest price at harvest time rather than to the company that pre-financed their inputs".

Furthermore, during the interviews it was found that the existing legal framework fails to provide clear contract terms,

and dispute resolution mechanisms, which may undermine the effectiveness of contract farming arrangements especially, in the events of fluctuation in the global market price.

"In the case of market prices decline below the contracted price, farmers may face financial losses, particularly if they have already invested in production based on the contract terms". Said an officer from the Ministry of Agriculture.

➤ Support for Smallholder Farmers

• Supplying Agriculture Inputs

In effecting Sections 23 (c) and 24 (c) of the Cooperatives Societies Act, 2013, the study found that the Tanzania Cotton Body (TCB) through cooperatives has managed to supply enough inputs to its members.

Table 1 Inputs Distribution under Cooperative from the Financial year 2017/18 to 2022/23

Inputs	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Seeds (Tons)	20,438	27,820	18,318	12,588	15,548	22,146
Pesticides (bottles)	5,960,000	6,671,079	2,326,342	7,300,000	9,992,723	11,000,000
Pesticides sprayers	23,500	23,000	9,985	11,000	3000	54,000

Source: Field survey, 2024

Table 1 shows the input supply from 2017/18 to 2022/23. The trends show the general increase in the supply of pesticides with exceptional of few years.

The services provided to farmers through cooperatives are found to contribute to the increasing productivity in the cotton sector which is very essential for cotton industry sustainability.

Table 2 Pesticides Supply through Cooperatives and its impact on Cotton Productivity

Inputs	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Pesticides (bottles)	5,960,000	6,671,079	2,326,342	7,300,000	9,992,723	11,000,000
Productivity (kg/acre)	153	187	95	93	154	173

Source: Field Survey, (2024)

From Table 2, with exceptions of the fiscal year 2020/21, it becomes evident that the supply of pesticides in an organized fashion through cooperatives has increased productivity.

However, while responding on the role of cooperatives in access to farm inputs, a representative from cooperative societies has highlighted that,

"While the cooperative aims to supply us with farm inputs, we have been experiencing challenges such as delays in receiving the inputs, and on some occasions, there have been quality issues on the supplied inputs. The prices of the inputs can also be a burden to some members, making it difficult for us to afford them. We hope that the cooperative can address these issues to better support us".

Another, representative from a cooperative society in Simiyu Region has declared that,

"Our Cooperative has been instrumental in the provision of farm inputs for cotton farming. The seeds,

fertilizers, and pesticides supplied have helped to improve the quality and yield".

In another development, a cooperative society leader from Bukombe while responding on the effectiveness of the cooperative societies in supplying inputs to its members has highlighted that,

"Our Cooperative is committed to supporting our members by providing high-quality farm inputs for cotton cultivation. We have established partnerships with reliable suppliers to guarantee that our members have access to the best seeds, fertilizers, and pesticides. Our goal is to increase productivity and profitability for our members in the cotton Industry".

➤ Investing in Sustainable Technologies

While responding to the technological investment in value addition in the cotton sector in Tanzania, The director from the Cotton Board while presenting at the Annual Cotton Conference in 2024 has indicated that,

"There is minimum value addition of the produced cotton in Tanzania. For example, a kilogram of fiber is sold at 1.6 USD, but the same 1 kilogram can produce 2 trousers which can be sold at 38.0 USD at retail price. This is to say that the country is losing 37.20 USD for every kg of the produced cotton". Therefore, take the example of crop season of 2022/2023 whereby 174, 486 tons of fiber were produced,

over 6.4 Billion USD lost due to inadequate value addition practices".

He further added,

"Investing in local processing facilities can allow Tanzania to retain more value within the country, rather than exporting raw cotton."

Table 3 Value Addition Impact Potential per kilogram of Fibre in US Dollars

Component	Value (USD)
Fibre (1kg)	1.60
Yarn (0.75kg)	3.40
Fabric (3.35metre)	8.50
Garment (2 trousers)	15.50
Retail (2 trousers)	38.80

Source: Field survey, 2024

Table 3 shows a Kilogram of fibre has a potential of generating 38.8 Us Dollars from value addition by making just a pair of trousers.

However, the current income from the cotton sector for the last 11 years is indicated in Figure 3, which shows revenue below 250,000,000 USD compared to its potential of 6.4 billion USD, which is only 3.85% of its potential.

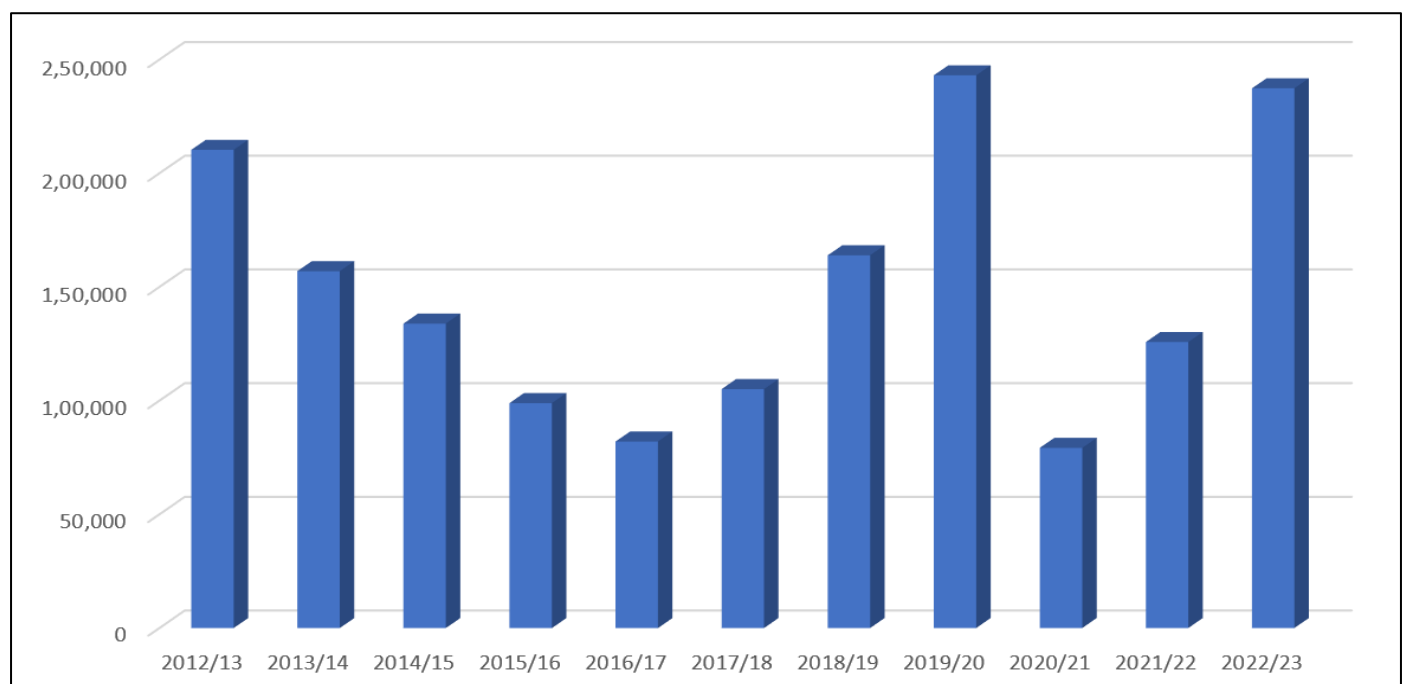


Fig 2 Revenue (USD "000") from the Cotton Sector between 2012/13 to 2022/23

B. Poverty Reduction

➤ Access to Credits and Technical Assistance

Section 72 of the Cooperative Societies Act of 2013, provides the opportunity to access loans for the farmers including in the cotton industry. This helps small-scale cotton farmers to organize themselves and participate more actively in the industry. Further, section 69 (1) (a and b) provides for access to education and privileges including technical support, training in agricultural best practices, financial management, and governance. This empowers farmers to run their cooperatives efficiently, thereby improving productivity and sustainability in the cotton industry.

In response to their role in ensuring members access to credits and technical assistance, a leader from the Cooperative Society in the Chato Region has said,

"Our Cooperative is dedicated to supporting our members in accessing credits for their agricultural activities, including cotton farming. We have established partnerships with financial institutions to provide affordable credit facilities to our members. Additionally, we offer technical assistance through training programs and workshops to enhance their skills and knowledge. The positive feedback from our members indicates that our efforts are making a significant impact in the cotton industry".

On the other hand, a member of the Cooperative Society has highlighted that,

"While the Cooperatives aims to assist us in accessing credits and technical assistance, we have faced challenges such as lengthy process for credit approval and limited availability of technical training programs. Some members have also reported high- interest rates on the credit facilities, making it difficult for them to access financial support. We hope that the Cooperative can address these challenges to better support us."

Furthermore, during the World Cooperative Day in Tabora (1st July 2024) while responding to the Deputy Minister of Agriculture's (Hon David Silinde) question regarding interest rates on credit extended to farmers from Financial Institutions, only Tanzania Commercial Bank was found to provide a single digit interest. Other Banks including NMB, CRDB, and AZANIA, the interest rate was found to be in the range of 10 to 14 percent. This was claimed to be high

by the Hon Minister who stressed that the Government advocate for a single-digit interest rate.

➤ *Creation of Job Opportunities in the Cotton Supply Chain*
While responding on job creation opportunities in the cotton value chain, a respondent from the Ministry of Industry and Trade has indicated that,

"There are inadequate cotton value addition industries in the country. This has affected job creation opportunities through the cotton sector".

Additionally, a representative from the Cotton Board has indicated that,

"The sector job creation potential is inadequately capitalized. The jobs are mostly created in the cultivation and at the ginneries in the value chain. Impliedly we are exporting much of the jobs through the exportation of the raw cotton".

Table 4 Impact of value Addition on Job Creation Per Kg of Fibre

Component	Job creation potential (Person)
Fibre (1kg)	0.5
Yarn (0.75kg)	0.75
Fabric (3.35metre)	2
Garment (2 trousers)	4

Source: Field survey, 2024

Table 4 shows by value addition a kilogram of fibre can generates 7.24 jobs. Impliedly, for the 2022/2023 season whereby 174, 486 tons were produced the sector has a potential of achieving the target of the country of creating 8 million jobs by 2025.

➤ *Contribution of Cotton Industry to Food Security*

Although cotton is a non-food cash crop, the revenues it generates are found to boost food security among smallholder farmers via the income gained from selling the cotton produce. While Responding on the contribution of the cotton Industry to Income Generation Mr. Ngosha (A farmer from the SIMIYU Region) said,

"Cotton farming provides a significant source of income to farmers. The gained income helped us to purchase food, invest in other agricultural activities, and improve our living standards"

Further to that, on the issue of the contribution of the cotton industry to employment creation opportunities, Bi Nyakwesi, who is a member of the AMCOS from Geita Region has indicated that,

"The cotton industry creates employment opportunities in farming, processing, and related sectors, thus enhancing the economic stability of most of us living in villages. The farming and ginning industry helps a lot".

❖ *Social Sustainability*

Ensuring social equity and inclusivity within the cotton industry is a crucial aspect of sustainability. Consumption and

production patterns need to be socially responsible(Roger Peltzer & Michael Brüntrup, 2023). Social sustainability may include issues related to land tenure, labor rights, gender equality, access to extension services and social amenities

A. *Labour Rights and Standards: Social Security*

The study conducted by Salisali, (2016) revealed the absence of any formal social security coverage (NSSF, PPF, LAPF, GEPP, and NHIF) in the cotton production level in the history of social security in Tanzania. They were originally meant to cater to the formal sector only. But also due to the nature of most cotton farmers being subsistent and smallholding, it has proved difficult for Social Security Funds to engage them. In recent years, there have been some efforts to incorporate informal sector workers like cotton farmers voluntarily, but the efforts have not registered any success until now. In cotton growing areas, the NSSF, for example, during the interview with members of AMCOS from Bariadi, claimed that,

"The National Social Security Fund (NSSF) initiated efforts to recruit members in Bariadi some years ago, however, the initiative failed on what seems to have been inadequate preparations and sensitization of farmers on the benefits of the scheme as well as the conditions for participating in such a scheme".

While responding to the failure of social security schemes in the cotton Industry, the officer from NSSF has indicated that,

"Collapse of Cooperative Unions and thriving of the private sector after cotton sector liberalization disrupted all the existing systems that could have been used to host social security benefits"

B. Effective Platform for Collective Bargaining and Advocacy

During the interview with representatives from the Ministry of Agriculture, it was found that there is an organization of cotton farmers in Tanzania named Tanzania Cotton Growers Association (TACOGA). However, during the study, 50 farmers were asked about the organization, out of which only 4 (8%) claimed to know it. During the interview one of the respondents claimed that,

"This Organization which is supposed to be a representative body of cotton farmers, is unknown to many farmers. For example, it has no member from my village which is predominantly cotton farmers".

However, while responding on cotton farmers having a collective voice, a representative from the cotton Board has indicated that,

"The Association is well known by the government, as recently, in June, it was able to advocate the government to announce a better cotton indicative price for the currently ongoing season, which has been well received by farmers, who last season received less price per kg, much to their displeasure".

C. Equity and Gender

➤ Gender-Sensitive Policies and Practices

While responding on the issue of decision-making power, a representative from AMCOS in the SIMIYU region has highlighted that,

"Women are highly marginalized when it comes to decision-making within our households and communities as far as cotton farming is concerned. We have very little voice in how income from cotton production is used or invested. This sometimes demoralizes our efforts in farming activities."

Further, to that, a member from another Cooperative Society has indicated that,

"Often women working in the cotton Industry including myself are subjected to unsafe working conditions, including long working hours and inadequate access to essential services including healthcare. This affects our wellbeing compared to men".

She further added,

"This is because social inequities in the cotton industry contribute to unequal distribution of benefits and risks among different stakeholders, exacerbating poverty, social exclusion, and vulnerability among marginalized groups such as women, youth, and Indigenous communities"

D. Child Labour Practice

While responding on the extent of Child labour in the cotton industry a representative from TCB claimed that,

"It is very true that children are involved in farming activities as part of their daily life in rural communities, especially during off-schooling hours. There are only a few extreme cases where children engage in farming activities during school hours. In recognizing that the Board is collaborating with other stakeholders including the International Labour Organization (ILO) to raise awareness on the importance of excluding children in cotton-related activities to allow them to concentrate in school".

❖ Environmental Sustainability

A. Soil Health Management and Conservation Practices

➤ Promotion of Organic Farming Practices

While responding on the organic practice in the cotton Industry, a representative from the cotton Board has indicated that,

"In the 2023/24 Crop season, organic fertilizer has shown tremendous achievement in increasing productivity. The TCB engages Fertilizer producing companies including MINJINGU to increase the production of Organic fertilizer to reduce the consumption of industrial fertilizer".

Further, he highlighted,

"Contour tillage has also been practiced by cotton farmers in various regions. This has been helping in reducing runoff, soil erosion, and nutrient loss".

Additionally, while responding to the initiatives taken by the TCB in ensuring the minimum soil degradation a representative from the TCB has said,

"The TCB has continued to enhance efforts on substituting chemicals with biological pesticides. In the financial year 2023/24, TCB continues with research on 7 organic pesticides from India, Tanzania, and Uganda. It is our sincere hope that soon will get alternatives to chemicals for the betterment of our mother nature".

He further added,

"We are expecting to increase the use of organic fertilizer as a substitute for chemical fertilizers. This envisaged not only to reduce soil degradation but has also proven to increase productivity in Musoma and Meatu districts by 300 percent".

B. Biodiversity Conservation and Land uses

➤ Crop Rotation and Polyculture Practices

While responding on the biodiversity conservation practices in Tanzania, a respondent from the Ministry of Agriculture in the directorate of crop development has indicated that,

"Cotton farmers in all cotton-producing regions in the country practice intercropping whereby, cotton is grown alongside food crops such as maize, beans, and groundnuts. This practice helps in improving food availability and nutrition".

She further, highlighted that,

"Farmers are encouraged to adopt crop rotation, intercropping, and timely planting to disrupt pest life cycles. The practice has been fairly embraced by farmers in almost all cotton-producing Regions. This has been helping in

enhancing soil health and biodiversity, making crops less prone to pest infestations"

C. Pest and Pesticides Management

➤ Reduction of Pesticides Chemical usage

While responding on the extent of the use of chemical pesticides, a representative from the cotton board has indicated the overuse of chemicals in the cotton industry. The trends have shown a consistent increase in the use of pesticides in the country as shown in Figure 3.

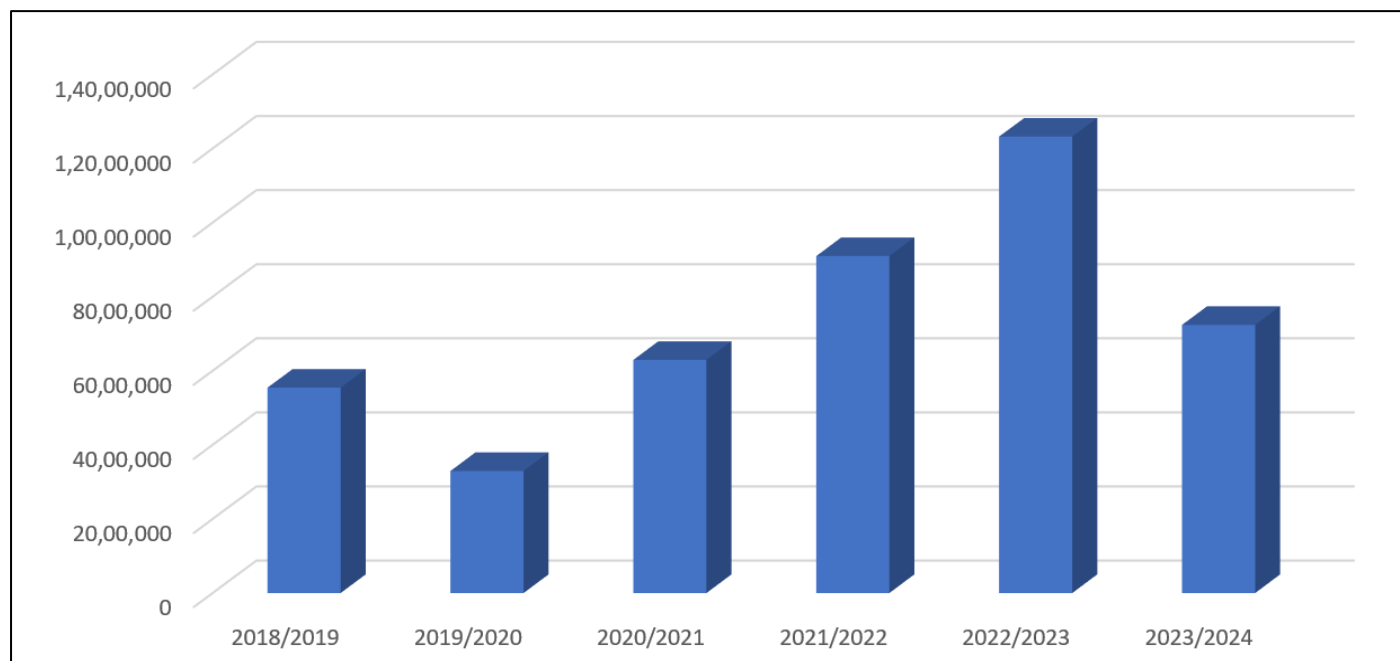


Fig 3 Trends of Pesticides usage (bottles used) in Cotton Cultivation from 2018 to 2024

The trends have shown a general increase in pesticide usage in the country. However, the interview with officials from the Cotton Board of Tanzania indicated that.

"The decrease in chemical usage in 2023/24 was associated with an audit conducted through the Building a Better Tomorrow (BBT) Extension services program whereby, 200 extension officers were hired".

He further added,

"Through the hired extension officers it was found that the presented pesticides requirement by Cooperative Societies does not match with actual requirement".

However, while responding to the initiatives taken by the Ministry of Agriculture in reducing the chemical use in the cotton sector, a representative from the Directorate of Policy and Planning has indicated that,

"The Ministry of Agriculture through TANIPAC Project has constructed a Biological Control Laboratories in Kibaha district in Pwani Region which meant to promote utilization of natural predators and parasitoids in helping control of pest population including in the cotton industry".

While responding on the benefits of introducing biological pesticides, A representative from Tanzania Plant Health and Pesticides Authority has indicated that,

"The introduction of the beneficial insects that prey on cotton pests will tremendously reduce the need for chemical interventions". The Biological control laboratory is a very positive intervention in integrated pest management in the cotton sector".

Further to that, Assistant Director from the Crop Development Directorate in the Ministry of Agriculture stressed that,

"The Ministry in collaboration with the board has been enhancing extension services through farmers' education on Integrated Pesticides management practices. Several trainings have been conducted with the focus on identification, and selection of less harmful pesticides and their application in a targeted manner to minimize the environmental impact".

Additionally, a representative from TCB has reported that,

"The TCB through the letter dated 19th August 2024 has instructed the 47 cotton buyers including Union of Cooperative Societies, Ginneries, and cotton buying companies to employ five (05) extension officers, pay their salaries for one year, and cover the cost of fuel for their motorbike in a chosen Wards for their operations. This envisaged to complement the 4 tractors provided by the Government for enhancing extension services in targeted cotton producing Wards."

D. Water Management

On the environmental impact related to the excessive use of water in the cotton sector, a representative from TCB has acknowledged the excessive use of water in the cotton sector. However, he claimed that,

"TCB has continued to advocate for water use efficiency. TCB supports the water use efficiency and erosion prevention technologies in various cotton producing areas".

Additionally, while responding to water management efficiency in the cotton sector, Mr Saidia who is a researcher from TARI Ukiliguru has said,

"There are widely used water harvesting techniques and contour cultivation especially in the Lake zone. The central zone especially Chilolo and other parts mostly uses infiltration pits. He further added that, multiple cropping commonly known as "Kilimo mseto" locally is widely practiced by smallholder farmers".

Moreover, in reducing the use of chemical pesticides the study found that TCB procured 200 tons of molasses from Bagamoyo Sugar Industry for combating pests.

E. Climate Change

➤ Adaptation Strategies

While responding on the adaptive measures taken by farmers in addressing climate change a respondent from the Ministry of Agriculture in the directorate of crop development has indicated that,

"Farmers have been diversifying crops which helps in reducing risk associated with dependence on a single crop. In case of a poor cotton season, farmers still have food crops to rely on".

On the other hand, a representative from TCB has indicated that,

"In addressing the effect of climate change while ensuring an increase in production to meet the demand the Cotton Board has been supporting Ukiliguru Agricultural Research Institute in developing high-yield and disease-resistant cotton varieties. The center has helped farmers to access improved seeds, which significantly boost cotton productivity and quality".

In an interview with Mr. Paul Saidia, a researcher from Tanzania Agriculture Research Institute- Ukiliguru Centre, he highlighted that from 1971 to 2017 a total of eight varieties were developed.

Table 5 Developed Cotton Seeds Varieties from 1971 to 2017 by TARI –Ukiliguru Centre

S/No.	Developed Variety	Characteristics
1.	UK77	Yield 480 – 600 kg/acre Ginning out turn (GOT) 39.2% Tolerant to insect pests' attack Tolerant to fusarium wilt disease and bacterial blight Possess acceptable fiber quality standards
2.	UK74	Yield 400 – 600 kg/acre Ginning out turn (GOT) 38.0% Tolerant to insect pests' attack Tolerant to fusarium wilt disease and bacterial blight far better than UK 77 Possess acceptable fiber quality standards
3.	UK83	Yield 600 – 800 kg/acre Ginning out turn (GOT) 39.3% Tolerant to insect pests' attack Tolerant to fusarium wilt disease and bacterial blight far better than UK 74 Possess acceptable fiber quality standards
4.	UK91	Yield 600– 800 kg/acre Ginning out turn (GOT) 39.6% Tolerant to insect pests' attack Tolerant to fusarium wilt disease and bacterial blight far better than UK 77 Possess acceptable fiber quality standards Fiber strength = 27.9g/tex, Fiber Length = 1.151in. Fiber Micronaire = 4.16mic/in.
5.	UK08	Yield 800 – 1000 kg/acre Ginning out turn (GOT) 40.2% Tolerant to insect pests' attack

		Tolerant to fusarium wilt disease and bacterial blight far better than UK 77 Possess acceptable fiber quality standards Fiber strength 28.2 g/tex Fiber Length 1.276 in Fiber Micronaire 4.20 mic/in
6.	UKM08	Yield 1000 – 1200 kg/acre Ginning out turn 42.3% Tolerant to insect pests' attack Tolerant to fusarium wilt disease and bacterial blight Possess acceptable fiber quality standards Possess acceptable fiber quality standards Fiber strength 30.2g/tex Fiber Length 1.275in Fiber Micronaire 4.03mic/in
7.	UK171	Yield 1000– 1200 kg/acre Ginning out turn 43.6% Tolerant to insect pests' attack Tolerant to fusarium wilt disease and bacterial blight Possess acceptable fiber quality standards Possess acceptable fiber quality standards Fiber strength 28.33 g/tex Fiber Length 1.096 in Fiber Micronaire 4.33 mic/in
8.	UK173	Yield 1000 – 1100 kg/acre Ginning out turn 43.9% Tolerant to insect pests' attack Tolerant to fusarium wilt disease and bacterial blight Possess acceptable fiber quality standards Possess acceptable fiber quality standards Fiber strength 27.08 g/tex Fiber Length 1.105 in Fiber Micronaire 4.22 mic/in

Source: Field survey (2024)

The developed varieties in Table 5 claimed by Mr. Saidia to have increased resiliency of the cotton in response to the effect of climate change, especially the pest attacks.

➤ Carbon Footprints Reduction

While responding to the initiatives taken to reduce carbon footprints in the cotton Industry, a representative from the Tanzania Cotton Board has indicated that,

"There are ongoing initiatives to reduce the use of chemical pesticides as indicated in section 5.3.3. For the Financial year 2023/23 the use of chemical pesticides has decreased by over 58 percent compared to 2022/2023".

Further, he indicated that,

"There is a substantial initiative in promoting organic farming practices in the Country. In collaboration with Minjingu Fertilizer company, the TCB is implementing a pilot project on organic fertilizer which contributes to the reduction of Greenhouse gas emissions".

"As you know, conventional cotton farming often involves heavy use of chemicals. Pesticides applied to cotton can pollute the soil and both ground and surface water, with potential drift affecting nearby crops. Additionally, the widespread use of synthetic fertilizers to boost yields

contributes to water contamination and substantial greenhouse gas emissions". He added

➤ Sustainable Land Management Practices

While responding on the sustainable land management practices in cotton cultivation, a respondent from the crop development directorate in the Ministry of Agriculture has indicated that,

"There are several practices for enhancing sustainable land management are applied in cotton cultivation in Tanzania. This includes crop rotation for enhancing soil fertility and disrupting pest cycles which in turn reduce reliance on chemical fertilizers and pesticides".

Further to that, a representative from TARI-Ukiliguru has highlighted that,

"Some areas have been applying soil and water conservation techniques such as contour plowing and terracing. The techniques have been proven to reduce soil erosion, improve water filtration, and preserve soil moisture".

Additionally, a representative from TCB has attested that,

"The board is now implementing a pilot project on the use of organic fertilizer from Minjingu Fertilizer Company as well as Organic pesticides. The use of Organic instead of synthetic fertilizers will enhance soil health and reduce chemical runoff which may compromise water quality in cotton producing regions".

VI. CONCLUSION

The cotton cultivation practices in Tanzania demonstrate limited strengths in enhancing sector sustainability. Challenges such as economic barriers to scale up of ongoing sustainable environmental interventions (Piloted organic farming); inadequate awareness of sustainable farming practices to the majority of farmers; low yield compared to global average; inadequate technologies including high yield seeds, and effective water management techniques, limited value addition, global market price fluctuations, and social inequalities present obstacle to full attainment of sustainable cotton production in Tanzania.

RECOMMENDATION

➤ *Investing in Industrial Parks:*

Industrial park development can significantly boost the cotton sector's attractiveness for investment and business. Governments can encourage private investors to create industrial parks for cotton production through incentives and special facilitation. This can be achieved through the provision of industrial credit for private enterprises. The Government can also encourage private investment in the cotton industry by either reducing or exempting domestic taxes on new cotton-spinning enterprises. The good example can be found in several countries including Egypt (10th Ramadhan city), China, India (Kakatiya Mega Textile Park, Telangana), Uzbekistan (Tashkent Textile Park), and Turkey (Aegean Free Zone). In these Parks, Governments and the private sector have invested in industrial parks that integrate cotton cultivation, processing, and textile manufacturing;

➤ *Promoting Market Diversification:*

Encourage value-addition initiatives and market diversification strategies to reduce dependency on volatile global cotton prices and enhance economic resilience among smallholder farmers;

➤ *Development of Small-Scale and Village Industries:*

This has proven successful in several countries. For example, in Egypt, small-scale spinning and weaving units in rural areas utilize high-quality cotton produced; In India, the Khadi and Village Industries Commission supports small-scale industries, particularly in hand spinning and handloom weaving of cotton; In Bangladesh Small-scale handloom weaving is prevalent in rural areas, where family produce cotton;

➤ *Establishment of Integrated Agro-Industrial Park (IAIP)*

Which aims to revolutionize the agriculture sector. IAIP is a geographic cluster of firms grouped to share different infrastructures and to exploit the opportunities for joint buying, selling, training, extension services, and other

synergies. The business model of the IAIPs is well working in Ethiopia. It is an end-to-end approach linking production to the market. The agro-industrial parks can be established within a 100-kilometer radius from the input source and output market;

➤ *Stabilizing Farm Gate Prices:*

Governments can establish national mechanisms to stabilize farm gate prices to incentivize cotton farming. For example, India has introduced Minimum Support Price (MSP) in cotton to ensure farmers receive a guaranteed price for their produce; China has put in place a Target Price Policy that compensate farmers when market prices fall below a certain level; and Pakistan and Brazil have introduced cotton Price Stabilization Funds to support farmers during the price downturns;

➤ *Supporting Tailors' Cooperatives:*

Governments can support and strengthen the formation of tailors' cooperatives and associations. For example, in Ethiopia, the Addis Ababa Textile and Garment Manufacturers Association (AATGMA) supports small-scale tailors, including cooperatives focused on cotton textiles; and Bangladesh Knitting and Dyeing Industries supports small-scale tailors through training and cooperatives initiatives;

➤ *Establish Capacity Building Program:*

Tanzania Cotton Board through the existing Framer training centers (formerly known as MATIs) establishes capacity-building programs through training to enhance the skills and knowledge of farmers, ginnerers, and traders. This may include topics such as agronomy, post-harvest handling, quality management, and marketing strategies;

➤ *Establish Price Transparency Mechanisms:*

This may include a transparency system for price discovery, such as commodity exchanges or price reporting platforms. The system will provide real-time information on market prices, enabling farmers, ginnerers, and traders to make informed decisions and negotiate fair deals;

➤ *Establish Clear Quality Standards for Cotton Production, Processing, and Trading:*

The use of certification schemes or quality assurance programs may be applied to certify compliance against the established standards. In turn, this may enhance market confidence, facilitate trade, and ensure farmers receive premiums for producing high-quality cotton;

➤ *Establish Traceability Systems*

To track the origin and journey of cotton from the farm to the market. This can be implemented through the use of blockchain or QR technologies to record relevant information such as farm practices, input usage, harvest dates, and processing methods. This will help to enhance product integrity, support sustainability claims, and foster trust among consumers and trading partners;

➤ *Introduction of Government Incentives and Policies*

That support sustainable practices such as organic farming are necessary to encourage widespread adoption.

This may include upfront investment which can be a barrier to smallholder farmers;

Establish information-sharing platforms for sharing market information, agronomic best practices, and regulatory updates. These platforms could include farmer cooperatives, Government agencies, or online portals. This will empower stakeholders to make better decisions and adapt to changing market conditions.

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