



Full length article

Determinants of Contract Farming Adoption: An Inclusive Business Analysis of the Cotton Sector in Zambia

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ABSTRACT

This study explores the factors influencing the adoption of contract farming in the cotton sector through a logistic regression model. The analysis identifies key determinants, including cotton price, price mechanisms, extension services, market access, competition, production costs, and mechanization, which significantly encourage contract farming. Although age and gender are not significant predictors, gender dynamics highlight systemic inequalities. Transparent pricing and market access agreements emerge as critical motivators, mitigating uncertainties and fostering farmer participation. Mechanization and cost reduction play pivotal roles in improving productivity and profitability, while extension services and market connectivity provide resources and opportunities essential for engagement. Conversely, competition from alternative cash crops presents challenges that require targeted policy interventions. These findings underline the need for tailored policies, investments in agricultural technology, and support programs to enhance the sustainability and inclusiveness of contract farming, ultimately contributing to the empowerment and economic resilience of smallholder farmers.

1. Introduction

At the advent of privatization in the early 1990s in some parts of Africa, Zambia included, governments had to scale back public development finance in the agricultural sector in the context of free-market reforms and increasingly looked to the private sector to bring new investment into rural areas. In so doing, the concept of “Inclusive Business” emerged as key in framing initiatives to enhance the compatibility between agribusiness expansion and rural livelihoods. These initiatives have been actively embraced by leading agro-processing companies, donors, NGOs, and governments worldwide. While the characteristics defining these initiatives may vary considerably, the general understanding tends to imply vulnerable, smallholder farmers benefitting through their integration into the value chains of the agri-businesses with mutual benefits for both parties. Inclusive businesses, therefore, integrate low-income individuals at the Bottom of the Pyramid (BoP) into the agri-business

value chains in various capacities, such as employees, entrepreneurs, distributors, and producers, and offer the unique benefit of bringing growth directly to low-income communities. These models target the BoP by balancing profitability with social impact, leveraging trusted networks, and utilizing local influencers and community leaders to build trust and drive the adoption of agricultural practices.

Seventy-five percent of the poor live in rural areas (International Finance Corporation [IFC], 2018), on smallholdings that yield just enough to support the families' basic needs. In Zambia, one hundred percent of the cotton is produced by smallholder farmers (Cotton Board of Zambia [CBZ], 2024), and despite the so many formidable challenges for many of these rural citizens, agriculture has the greatest potential to lift them out of poverty. Therefore, by harnessing the private sector and MNCs there is potential to make a difference in the lives of millions of smallholder farmers in Zambia and worldwide. As such, to scale inclusive business models, MNCs must enhance farmer education by providing sustainable farming practices that improve yields and reduce environmental impact. In addition, there is a need for improved market linkages, for example, by creating better access through cooperatives or digital platforms to help farmers get fair prices. Further, promoting sustainable farming practices is critical, and this can be achieved through promoting organic and sustainable cotton initiatives. Addressing these challenges and incorporating some of these suggestions requires a holistic and stakeholder approach that integrates economic, social, and environmental considerations to create a more sustainable and inclusive cotton sector.

During the 1970s, the socialist Government of the Republic of Zambia (GRZ) set up several national corporations and conglomerates that were charged with managing the growth of different economic sectors in Zambia. In the agriculture sector, the government set up the 100% state-owned Lint Company (Lintco) to drive the growth of cotton production in the sector. By 1987, Lintco had planted over 78,000 hectares and achieved record production of over 64,000 tons of seed cotton. However, the change in the political environment from the one-party socialist regime to a multiparty democracy in 1990 heralded the free-market economy and the privatization of state-owned enterprises (SOE), including Lintco, which was privatized in 1995. The privatization of Lintco, which controlled the entire cotton value chain, resulted in a duopoly comprised of Lonhro Cotton and Clark Cotton, which were subsequently sold to Dunavant (which later became NWK Agri-services and, subsequently, Louis Dreyfus Company) and Cargill (which was later sold to Parrogate). The duopolies continued to dominate the cotton sector until the arrival of new competitors in 2001/2. Since then, several other multinational corporations (MNCs) have invested in cotton production, but the sector has remained turbulent, with production falling from a record high of 275,000 hectares in 2012 to 24,000 hectares in 2022. On the other hand, cotton prices in the local markets have experienced a rise from ZMK3/kg in 2011 to ZMK15/kg in 2022. Although this was not without volatility, the price of cotton on the International Cotton Exchange (ICE) has risen from US 40 cents/lb. in 2011 to \$1.50/lb. in 2022.

Despite these positive economic trends in the local and international markets, there has been a drastic reduction in cotton production in Zambia. The general economic conditions in the sector indicate that cotton production is still profitable, and yet, the sector has experienced a phenomenal drop in production, with farmers expressing mistrust of the pricing mechanism offered by the MNCs. Cotton production and lint exports are essential to the economy of Zambia because lint exports are a crucial source of forex among the non-traditional exports. The challenges in the cotton sector are complex and cannot be attributed to economic factors surrounding the price alone. It requires examining the economic performance of the sector and analyzing the social and environmental factors at the BoP inhibiting the scaling of inclusive business models. The business models targeting the BoP must balance profitability with social impact. This can include leveraging trusted networks by utilizing local

influencers and community leaders to build trust and drive the adoption of cotton production. Furthermore, integrating advanced agricultural techniques and providing access to affordable financing, training, and resources can empower these farmers to increase productivity and yield. The models can also invest in multilevel agent networks by developing local agents who can educate and sell to smallholder farmers. In other instances, the business model can co-create solutions by engaging with the community to develop products or solutions that meet their needs (Siwivaliondo & Dar, 2025). Therefore, while numerous studies have applied the resource-based lens to identify challenges at the BoP, the rationale of this study is to apply a stakeholder approach in studying the determinants of the adoption of contract farming and the inclusive business models used in the cotton value chain in Zambia.

2.0 Literature Review

2.1 Global Cotton Production Outlook

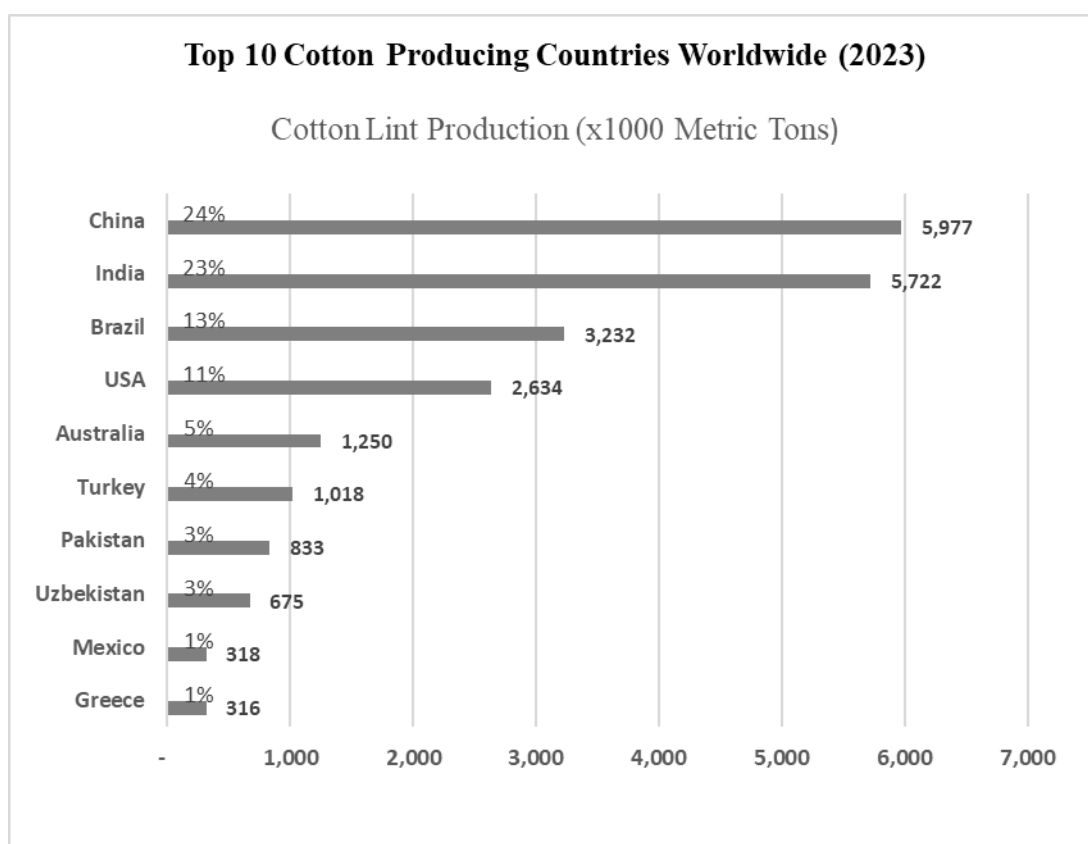
Agriculture is the main contributor to most national economies in developing countries, and cotton production is an important cash crop in these economies. Cotton is the most widely used natural fiber in textiles, accounting for one-third of the total manufactured fiber worldwide (Grishanov, 2011). It has revolutionized the world and become one of the most important staples. It is called “white gold” in some countries because of its significant role as a foreign exchange earner. According to Voora et al. (2020), cotton supports the global textile mills market and the apparel manufacturing market that produces garments for broad use, valued at USD 748 billion and 786 billion, respectively, in 2019. Further, the report indicates that cotton supports a USD 3 trillion global industry, with global clothing exports valued at USD 1.3 trillion in 2019. However, cotton use goes beyond textiles; its seed can be crushed to produce cholesterol-free oil, used in cooking, as an ingredient in pharmaceuticals and cosmetics, and other industrial applications, such as rubber and plastics. The cotton cake derived from crushing is also used to produce poultry and livestock feed.

The cotton industry plays a pivotal role in the economic development of many countries, providing livelihoods for millions of farmers and workers along the value chain. It is a crucial player in the global supply chain, impacting various industries and livelihoods. According to the International Cotton Advisory Committee, an association of members of cotton-producing, consuming, and trading countries (International Cotton Advisory Committee [ICAC], 2024), the annual production of cotton lint was 24,412 metric tons in 2023. The report shows that the top-producing countries contributed 21,975 metric tons, representing 90% of world production. Except for the USA, Brazil, Australia, Mexico, and Greece, most of the cotton produced by the rest of the world is done by small-holder farmers at the bottom of the pyramid (BoP). For instance, U.S. cotton is grown predominantly in the southern “Cotton Belt” states, from Virginia to California, by approximately 18,600 commercial farmers (United States Department of Agriculture [USDA], 2023), and yet the USA produces 11% of the total global production. U.S. cotton production is highly mechanized using highly specialized equipment. Traditional crop insurance and risk management programs, biotechnological innovations, increased farm mechanization, and legislative support from the government drive high yields.

On the other hand, China and India, which are, respectively, the first and second most prominent producers of cotton, use labour-intensive practices and engage millions of their citizens at the BoP to maintain their global lead. China is the leading cotton-producing country in the world, with 24% of total global production coming from there. In China, cotton is grown in 24 of the 35 provinces, with approximately 300 million people involved (Lu et al., 2022). Unlike the highly mechanized production systems used in the USA, China applies labour-

intensive technologies and high plant population density techniques in combination with cultural farming practices like seedling transplanting and double cropping. The differences in the cotton production approaches signify the diversity that cotton offers in terms of its production and use. In India, cotton is one of the most important commercial crops, accounting for 23% of the total global production. Cotton plays a significant role in poverty alleviation and sustaining the livelihoods of an estimated 95 million smallholder farmers and another 140-150 million people in other related industries like cotton processing, textile, apparel, and trade industries (Blaise & Kranthi, 2019). Although this relates to a very low yield per hectare planted, cotton remains one of the largest contributors to India’s net foreign exchange by way of exports of lint, yarn, fabrics, and ultimately finished products in the form of garments and knitwear.

Figure 2.1: Top 10 Cotton Producing Countries



Source: ICAC (2024) data.

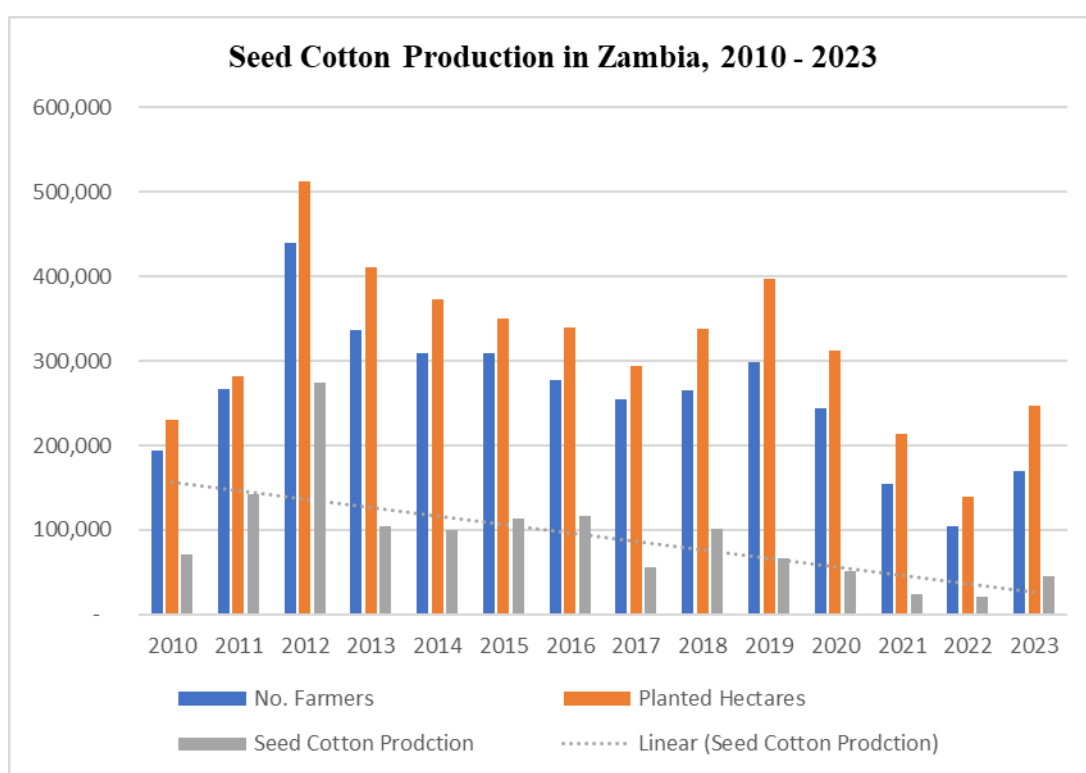
Other notable producers in the top ten are Australia (5%) and Turkey (4%), which are also highly mechanized producers. For instance, cotton in Australia is highly mechanized, and although it produces around 5% of the world’s cotton, cultivation is done by only 1,500 family-owned farms (Egan & Stiller, 2022). As such, while Australia is number five in cotton production by volume, it has the highest yield per hectare of any region globally and is a significant global exporter. On the other hand, Turkey, as the sixth largest cotton producer, also boasts a cotton yield well above the world average. However, apart from its yields, Turkey is also known for producing organic cotton using non-transgenic seeds, and its cotton is branded as “GMO-Free Turkish Cotton” (Tokel et al., 2022, p. 2). Because of this, Turkey has earned itself a privileged position in the world as the leading producer of non-GMO cotton. Of the other 10% of global production, 7% is grown in Africa, and it is a leading sector in the top African producers, bringing foreign exchange to these countries and creating a

sizeable labor-intensive workforce at the BoP. In addition, it impacts rural and values chain development, from farming to textiles production, that can stimulate industrial growth and diversification, fostering broader economic development.

2.2 Cotton Production in Zambia

After maize and soya beans, cotton is Zambia's third most widely grown crop. Until recently, cotton was the second most widely grown crop, with the United Nations Conference on Trade and Development (UNCTAD) approximating that 250,000 smallholder farmers grew cotton annually, which supported approximately one million Zambians in 2016. However, since the liberalization of the cotton industry in the 1990s, seed cotton production has remained volatile in the three decades after privatization.

Figure 2.2: Cotton Production in Zambia, 2010 - 2023



Source: Cotton Board of Zambia data (CBZ, 2024)

Baffes (2017) examines the volatility in seed cotton production in Zambia over the years. Some key points summarized from the study are as follows:

- 1) *Early 2000s.* Seed cotton production ranged between 45,000 to 75,000 tons per year. This period was marked by fluctuations due to various factors, such as changes in international cotton prices and local agricultural policies.
- 2) *2011.* Production dropped to a low of 37,000 tons. This decline could be attributed to unfavorable weather conditions, pest infestations, or economic challenges faced by farmers.
- 3) *2012.* Production spiked to a record high of 275,000 tons. This significant increase was likely due to favorable weather conditions, improved farming practices, and better access to inputs and markets.

- 4) *Post-2012*. Production stabilized at around 100,000 tons per year. Despite the volatility, the overall trend showed an increase in production compared to the early 2000s.

In the subsequent years until 2018, cotton production averaged around 100,000 tons per annum until dropping to an all-time low of 45,160 tons in 2023. Baffes (2017) attributes this volatility to several factors, including fluctuations in seed cotton producer prices, competition from other crops, and policy-related challenges. The study emphasizes the need for stable policies and support mechanisms to help farmers manage risks and improve productivity.

From Figure 2.2, the sector performance improves significantly in post-privatization years, in which smallholder-based production systems coexist in harmony with the newly introduced input credit schemes or outgrower schemes by the MNCs. Further, Sall et al. (2023) attribute this expansion in production to increases in yield and the number of farmers and to the effective system of input distribution, credit recovery, and extension services introduced by Dunavant. The period between 1990 and 2010 is characterized by a concentrated market with two dominant players, Dunavant (now called Louis Dreyfus Company) and Cargill (Parrogate), in a duopoly that supports farmers with input credit and farmer extension services. Beyond 2010, the market evolved into a fully competitive market with several active actors entering the cotton sector. However, it was beyond this date that the cotton industry started a downward trend in seed cotton production. According to CBZ (2024), eight active ginners in 2023 produced 45,160 tons compared to a high of 275,000 tons in 2012.

The drop in production has been attributed to unfavourable input loan recovery and volatile international prices. Cotton prices on the global market can be highly volatile, making it difficult for farmers to predict their income and plan accordingly. This volatility can be influenced by global supply and demand, trade policies, and competition from synthetic fibres. However, it has also been exacerbated by a general shift by farmers to growing soya beans, groundnuts, and maize, whose prices are viewed as favourable. This shift can be attributed to relative profitability, low switching costs, and lower risk associated with these crops.

2.3 Inclusive Business and Contract Farming

Most commercial seed cotton produced in Zambia is cultivated by smallholder farmers through contract farming with the MNCs that dominate the cotton sector. The MNCs provide logistical and technical support to the farmers through out-grower schemes in which they provide seeds and other inputs (Siwialiondo & Dar, 2025). The cotton is produced mainly in Eastern, Southern, Central, and Lusaka Provinces, where the MNCs have invested in multi-million-dollar plants called ginneries. While it is estimated that approximately 250,000 farmers grow cotton perennially (Chita, 2017; Sall et al., 2023), the CBZ (2024) indicates that 168,870 farmers participated in 2023, producing 45,160 tons of cotton. However, even though most of the commercial cotton is grown by smallholder farmers, the foundation cotton (less than 0.2% of national cotton output) is grown by the Cotton Development Trust (CDT).

The type of contract farming scheme available in the cotton value chain combines resource-providing and production-management contracts. In these contracts, the MNC provides agricultural inputs and technical assistance and specifies how the commodity is to be grown. Apart from providing crop resources and management techniques, this contract specifies the terms of the sales transaction regarding product attributes, timing, quantity, and, most importantly, price (Minot & Sawyer, 2016). The lack of specificity of the price at the signing of the contract (pre-planting price) is a source of contention and is regarded as one of the causes of mistrust and the drop in volumes of cotton produced over the last decade. Minot and Sawyer (2016) explore the opportunities and limitations of contract farming. They highlight that contract farming can significantly increase

income for smallholders, with income benefits ranging from 25% to 75%. However, they also note that the lack of price specificity at the signing of contracts and lack of clear pricing mechanism can lead to mistrust and reduced production volumes. This lack of clarity creates uncertainty for farmers, who may be hesitant to invest in their crops without knowing the price they will receive.

Even when a pre-planting price is determined, side-selling may occur when the market price is higher at harvest time (Mukucha et al., 2024). This is where the farmer violates the terms of the contract by selling some or all of their harvest elsewhere. It often happens when farmers seek to maximize their income, especially when they feel the contracted price is too low or face financial pressures. In the study, Mukucha et al. (2024) examine the impact of contract farming on cotton yield in Zimbabwe. They found that while supplier development initiatives have a statistically significant impact on yield, the actual yield is still below the national target. According to Minot and Sawyer (2016), setting up a contract farming scheme involves enormous fixed costs. This is why no domestic corporations take part in the cotton value chain. The agro-processor needs a team of technocrats to manage the distributors, provide technical assistance, and provide logistical support to move vast volumes of cotton. Further, ginning is a capital-intensive operation requiring ready access to capital, production knowledge, and market information that may not be readily available to domestic firms.

Further, the world cotton price volatility does not assist domestic firms in entering the cotton value chain (Kalinda & Bwalya, 2014). In their study, Kalinda and Bwalya (2014) examine the challenges faced by Zambia's cotton industry. One of the key findings is that world cotton price volatility significantly impacts domestic firms' ability to enter and remain competitive in the cotton value chain. The scholars suggest that the fluctuating world cotton prices create uncertainty for domestic firms. When prices are low, firms struggle to cover production costs, and when prices spike, they may face difficulties in securing contracts at a favorable rate. Whereas the subsidiary of an MNC may leverage its financial strength with the parent company and absorb some of the volatility, local or domestic companies do not have that leverage. Zambia's cotton market is highly exposed to global price fluctuations due to its openness. Regulations providing financial support mechanisms, such as subsidies or low interest rates loans, can help domestic firms manage volatility. Additionally, offering risk management tools like futures contracts or price stabilization funds can mitigate the impact of price fluctuations. To mitigate these challenges, Kalinda and Bwalya (2014) suggest targeted interventions to raise farm-level productivity and facilitate informed policy debates on critical issues such as biotechnology adoption. They also recommend consensus-building between cotton buyers and farmers on price-setting mechanisms to provide more stability

Therefore, it is no wonder that the various MNCs in the Zambian cotton industry collaborate with various local and international NGOs and development organizations. For example, most of the NMCs operating in Zambia collaborate with Cotton Made in Africa (CmiA) to improve the working conditions of smallholder farmers and contribute to environmental protection and improvements. According to CmiA (2023), the project supports about 900,000 smallholder farmers, mainly in remote and structurally weak areas of Benin, Ivory Coast, Cameroon, Malawi, Mozambique, Tanzania, Uganda, and Zambia. In Zambia, it supports the integration of smallholder farmers in the cotton value chain, provides training courses for sustainable cultivation, develops appropriate gender tools, and coordinates farmer business schools (FBS) through which it provides courses to enhance the farmers' agricultural management and entrepreneurial skills. This is done to raise the productivity of smallholder farmers at the farm level and increase their revenue from cotton production. At the company level, the NGO assists in enhancing the skills and knowledge of the producer (CmiA, 2023), thereby strengthening rural services and coordinating the promotion of agricultural policies and support strategies.

2.4 Determinants of the Adoption of Contract Farming

Several studies have established the factors influencing the decision to participate in contract farming and export crop production. While the motivation for the smallholder farmer is access to credit, extension services and training, and access to markets, other socioeconomic and demographic factors determine the adoption of contract farming. For example, Musara et al. (2011) find that age, gender, education, farm size, family size, family labour supply, and farmer group size influence the adoption of contract farming. Ma et al. (2024) argue that enabling smallholder farmers to fully participate in the market, providing a transparent pricing system, and considering their preferences significantly influence their decision to commercialize. Regarding gender, Tsvuura et al. (2021) identify a strong negative correlation between being female and participating in contract farming, attributing this to the high illiteracy rates among women in smallholder farming communities. This indicates that women are generally less likely to adopt contract farming compared to men, a disparity influenced by factors such as limited access to resources, lower education levels, and cultural norms that restrict women's involvement in agricultural decision-making.

On the other hand, the importance of pricing in fostering contract farming is well-documented in research by Mukucha et al. (2024), Mukucha & Chari (2022), Kaur et al. (2021), and Meemken & Bellemare (2020). Mukucha et al. (2024) emphasize that competitive pricing plays a crucial role in attracting farmers to participate in contract farming, ultimately boosting yields and overall productivity in the cotton industry of Zimbabwe. Similarly, Mukucha and Chari (2022) identify price as a key factor influencing contract farming decisions, highlighting that competitive pricing enhances flexibility and transparency within the supply chain. Kaur et al. (2021) further affirm this by demonstrating that favorable pricing significantly increases farmers' willingness to adopt contract farming practices. Further, effective price mechanisms, such as equitable pricing strategies and clear market practices, play a key role in motivating farmers to engage in contract farming. Mukucha and Chari (2022) emphasize that transparent pricing systems help minimize uncertainties and risks, fostering farmers' willingness to participate. Their study underscores the significance of implementing transparent pricing frameworks within contract farming arrangements.

Further, research shows that extension services offer significant advantages for both large-scale production (Kalinda & Bwalya, 2014; White & Aylward, 2016) and small-scale production (Minot & Sawyer, 2016), contributing to reduced implicit labor costs. By equipping farmers with up-to-date knowledge and innovative techniques, these services help enhance productivity and business growth. Additionally, consistent and dependable support from extension services fosters trust among farmers, distributors, and MNCs. Sall et al. (2023) further affirm that extension services play a critical role in expanding cotton production, improving yields, streamlining input distribution, and facilitating credit recovery. In addition, the assurance that MNCs will purchase crops at a predetermined price greatly minimizes farming-related uncertainties and risks. This finding is emphasized in discussions around export markets (Sukume, 2012; Moyo, 2011), which highlight the role of connecting farmers to markets (Ma et al., 2024) and providing market information (Tschirley and Kabwe, 2010). Access to markets positively influences contract farming by enabling farmers to sell their cotton on international platforms, potentially securing higher prices and reaching broader markets than they could independently. In other studies, there is a negative correlation between competition from other cash crops and participation in contract farming. This inverse relationship is supported by various studies, including those by Kaur et al. (2021), Blaise & Kranthi (2019), Kabungo & Jenkins (2016), and Binswanger-Mkhize (2014).

Finally, mechanization enhances the scalability and uniformity of agricultural operations, enabling farmers to better align with market requirements and sustain a competitive edge. These observations are backed by several studies, including those by Daum & Birner (2020), Saliou et al. (2020), Aryal et al. (2019), and Zhang et al. (2017). Saliou et al. (2020), for instance, highlight the transformative role of mechanization in improving productivity and generating higher incomes for smallholder farmers. Their research further emphasizes that mechanization paves the way for the adoption of modern farming techniques, which contribute to sustainable agricultural practices. Mechanization involves incorporating machinery and advanced technologies into farming operations, ranging from planting and harvesting equipment to irrigation systems and precision agriculture tools. This shift reduces manual labor intensity, lowers production costs, and enhances efficiency, enabling farmers to allocate their resources more effectively. Mechanization can also help bridge gaps in agricultural knowledge by enabling the implementation of innovative techniques that were previously inaccessible to smallholder farmers. These advancements not only boost profitability but also play a significant role in driving rural development and alleviating poverty among farming communities.

3.0 Methodology

The research employed a quantitative design, with data collected through a face-to-face survey administered using a structured questionnaire. This approach was based on the study by Kamoyo et al. (2015) on agricultural export crops in Zimbabwe. The study was conducted in Mambwe district, Eastern Province, Zambia, a region managed by the Cotton Board of Zambia (CBZ). The CBZ, established under Zambia's Cotton Act No. 21 of 2005, operates across major cotton production districts, with regional inspectors facilitating operations. The study specifically targeted the distributors within the Mambwe district, who play dual roles as cotton farmers and intermediaries in the cotton value chain. These distributors, numbering 406, distribute farming inputs and purchase cotton during the marketing season.

$$n = \frac{N}{1 + Ne^2} \quad (3.1)$$

$$n = \frac{406}{1 + 406 \times (0.05)^2}$$

$$n = 201.4$$

Where:

n is the estimated sample size

N is the total population

e is the margin of error

The sample size was calculated as 201 using Slovin's formula, with a 95% confidence level and a 5% margin of error, ensuring precision as recommended by Krejcie and Morgan (1970). This approach ensures that the sample is large enough to be representative of the population, while maintaining an acceptable level of accuracy. As such, given this desired degree of accuracy and Slovin's formula (Adam, 2020), the sample size was estimated in equation 3.1 above. Systematic sampling was used to select respondents, supported by a detailed list of all registered distributors from CBZ. This method reduced bias and ensured equal representation. Data was gathered via a mixed-format questionnaire, combining dichotomous and closed questions with a Likert-scale design to

measure respondents' perceptions quantitatively. The Likert scale's adaptability in transforming qualitative attributes into measurable data made it ideal for this study, as supported by Joshi et al. (2015).

3.1 Data Analysis

The study established non-household factors that determine the adoption of contract farming. An understanding of such factors will assist in formulating proper strategies for cotton farmers and provide policy direction on how to promote rural smallholder farmers' participation in contract farming. To determine such factors, binary logistic regression models were run, where contract farming was treated as a binary choice, to predict the odds likelihood of a smallholder farmer engaging in contract farming. Binary logistic regression involves predicting a dependent variable with two distinct categories using one or more independent variables, which may be either metric or non-metric in nature (Sreejesh et al., 2014). In this context, it was applied to examine the relationship between the adoption of contract farming (scaling) and various independent variables. The logistic regression model that was developed is presented in equation (3.1) below.

$$y_i = \beta_0 + \beta_1 age_i + \beta_2 gender_i + \beta_3 price_i + \beta_4 pricemechanism_i + \beta_5 preplantingprice_i + \beta_6 extensionservices_i + \beta_7 marketaccess_i + \beta_8 competition_i + \beta_9 productioncost_i + \beta_{10} mechanization_i + \varepsilon_i \quad (3.2)$$

Where:

y_i is the contract farming status, a binary choice variable for i^{th} farmer. It assumes a value of 1 if the farmer will participate in contract farming and 0 otherwise.

B_0 is the intercept term

$\beta_1, \beta_2, \dots, \beta_k$ are the coefficients of the predictors.

ε_i is the base of the natural logarithm.

The aim of the model in equation (3.1) is to predict the log odds that the i^{th} farmer will participate in contract farming leading to scale. The prediction is modelled given the age of the respondent, gender, cotton price, pricing mechanism, pre-planting price, level of extension services provided, market access, competition from other cash crops, production costs of cotton, and smallholder mechanization.

4.0 Results and Discussion

4.1 Logistic Regression Results

Prior to conducting the regression analysis, Cronbach's Alpha was evaluated to determine if the test items designed to assess a single general construct yielded comparable scores. A higher Cronbach's Alpha reflects greater consistency among the test items, suggesting they effectively measure the same underlying concept. According to Taber (2018), a Cronbach's Alpha (α) value of 0.7 or higher is generally deemed acceptable. As shown in Table 4.1, the internal consistency test produced positive results, with α calculated at 0.730. Given these results, logistic regression was used to analyze the relationship between the predictor variables: cotton price, pricing mechanism, pre-planting price, extension services, market access, competition, production cost, mechanization and the response variable, contract farming. Further, the variables were subjected to a goodness-of-fit test, and the results are summarized in Table 4.2. The goodness-of-fit of the logistic regression model was assessed using the Hosmer and Lemeshow test, which indicated a good fit, $\chi^2 (8, N = 201) = 11.25, p = .118$.

Further, the logistic regression model was statistically significant, $\chi^2 (11, N = 201) = 119.89, p < .001$. From the results in Table 4.2, we can also conclude that the model explained 67.8% (Nagelkerke $R^2 = .678$) of the variance in contract farming and correctly classified 90.0% of cases. The results of the regression are presented in Table 4.3.

Table 4.1: Cronbach Alpha for Determinants of Adoption of Contract Farming

Reliability Statistics				
Cronbach's Alpha	N of Items			
0.730	8			

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Total Correlation	Cronbach's Alpha if Item Deleted
Cotton Price	32.11	13.212	.273	.728
Pricing Mechanism	32.14	12.250	.442	.700
Pre-planting Price	32.05	12.698	.381	.710
Extension Services	32.18	13.088	.301	.723
Market Access	32.17	11.765	.504	.697
Competition	32.18	11.638	.527	.693
Production Cost	32.05	12.368	.405	.706
Mechanization	32.05	12.642	.395	.708

Source: Study Results (2024)

Age and Gender

Age is not a significant predictor of contract farming, with $B = -0.055, SE = 0.052, p = .287, OR = 0.946$. These results resonate with Kamoyo et al. (2015, p. 118), who found that “age has no effect on the decision to participate in cotton contract farming.” Given such, tailored interventions and programs to encourage contract farming should include farmers of all ages, recognizing that other socioeconomic and contextual factors are more significant in influencing farmers’ decisions. Similarly, gender is not a significant predictor of contract farming, $B = 0.179, SE = 0.665, p = .788, OR = 1.196$. Despite this insight, a negative association exists between the female gender and contract farming. For instance, Tsvuura et al. (2021) attribute high illiteracy rates among the female gender when they found a very high negative association between the female gender and contract farming. Gender inequality and dynamics are evident in several studies (Kabungo & Jenkins, 2016; Kabwe et al., 2018; Broadberry & Gardner, 2022). Nonetheless, even though there was an underrepresentation of the female gender in the sample, there were relatively more females adopting contract farming than males. This implies that while traditional gender roles limit women’s participation in certain economic activities, including agriculture, relatively more women in the study adopted contract farming.

Table 4.2: Goodness-of-fit test Results

Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	119.893	11	.000
	Block	119.893	11	.000
	Model	119.893	11	.000

Model Summary				
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square	
1	98.741 ^a	0.449	.678	

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	11.249	8	.188

Source: Study Results (2024)

Cotton Price

On the other hand, cotton price is a significant predictor of contract farming, $B = 1.003$, $SE = 0.376$, $p = .008$, $OR = 2.726$. This indicates that holding all other predictor variables constant, the odds of contract farming occurring increased by 2.726 (95% CI [1.303, 5.701]) for each unit increase in cotton price. Various studies support this finding and contend that price is a significant predictor of contract farming. For instance, research conducted by Mukucha et al. (2024), Mukucha & Chari (2022), Kaur et al. (2021), and Meemken & Bellemare (2020), all of which emphasize the pivotal role of price in promoting contract farming. Mukucha et al. (2024) highlight that competitive pricing is essential to attract farmers into contract farming arrangements, leading to improved yields and overall productivity in the Zimbabwean cotton industry. Similarly, Mukucha and Chari (2022) found that price is a significant predictor of contract farming decisions, as competitive pricing ensures supply chain flexibility and visibility. Kaur et al. (2021) also support this notion, demonstrating that favorable pricing positively influences farmers' willingness to engage in contract farming. When prices are attractive, farmers are more likely to participate in these arrangements, resulting in increased agricultural productivity and stability. These findings suggest that attractive cotton prices incentivize farmers to engage in contract farming arrangements. Consequently, policymakers and stakeholders in the agriculture sector should consider the

influence of commodity prices when designing and implementing programs aimed at promoting contract farming.

Table 4.3: Variables in the Equation of Determinants of Adoption of Contract Farming

Step		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
1 ^a	Age	-0.06	0.052	1.135	1	.287	0.946	0.855	1.047
	Gender (1)	0.179	0.665	0.073	1	.788	1.196	0.325	4.406
	Cotton Price	1.003	0.376	7.094	1	.008	2.726	1.303	5.701
	Pricing Mechanism	0.929	0.380	5.992	1	.014	2.533	1.203	5.330
	Pre-planting Price	0.488	0.355	1.894	1	.169	1.630	0.813	3.268
	Extension Services	1.444	0.456	10.00	1	.002	4.236	1.732	10.36
	Market Access	1.237	0.405	9.348	1	.002	3.446	1.559	7.618
	Competition	-0.809	0.404	4.005	1	.045	2.246	1.017	4.962
	Production Cost	-0.807	0.408	3.914	1	.048	2.242	1.008	4.988
	Mechanization	1.559	0.464	11.28	1	<.001	4.755	1.914	11.81
	Constant	-29.0	5.409	28.71	1	.000	0.000		

a. Variable(s) entered on step 1: Age, Gender, Cotton Price, Pricing Mechanism, Pre-planting Price, Extension services, Market Access, Competition, Production Cost, Mechanization.

Price Mechanism

Further, the price mechanism is also a significant predictor of contract farming, $B = 0.929$, $SE = 0.380$, $p = .014$, $OR = 2.533$. As such, keeping all other predictor variables constant, the odds of contracting farming occurring increased by 2.533 (95% CI[1.203, 5.330]) for a one-unit improvement in price mechanism. This suggests that effective price mechanisms, including fair pricing strategies and transparent market practices, are crucial in encouraging farmers to participate in contract farming. This is supported by Mukucha and Chari (2022), whose study highlights that transparent pricing mechanisms can reduce uncertainties and risks, encouraging farmers to commit to contract farming. The study found that transparent pricing mechanisms significantly reduce uncertainties and risks for farmers, making them more willing to commit to contract farming agreements. It advocates for implementing a transparent pricing mechanism, ensuring that contract farming agreements incorporate clear, fair, and transparent pricing terms to build trust and confidence and encourage participation among farmers.

Pre-Planting Price

Table 4.3 also shows that pre-planting price is not a significant predictor of contract farming, $B = 0.488$, $SE = 0.355$, $p = .169$, $OR = 1.630$. This indicates that the odds of contract farming occurring do not change significantly with variations in the pre-planting price. A possible explanation for this finding could be that other factors, such as post-harvest prices, availability of inputs, or overall market stability, play a more critical role in influencing farmers' decisions to enter contract farming. However, these findings do not align with studies discussing pre-planting prices (Mukucha et al., 2024; Minot & Sawyer, 2016) that suggest a statistically significant relationship. The reason could be contextual factors specific to the study area or period that affect the relationship, which the model does not capture. Extant literature expounds on how the lack of specificity of the pre-planting price in contract farming agreements can lead to mistrust between the MNCs, distributors, and

smallholder farmers. When farmers do not have a transparent fixed price at contract signing, they feel uncertain about their potential earnings. This leads to a lack of commitment and a drop in the adoption of contract farming or reduced motivation to fulfill the contract.

Extension Services

Regarding the level of farming extension services provided by MNCs, the results in Table 4.3 indicate that the provision of extension services is a significant predictor of contract farming, $B = 1.444$, $SE = 0.456$, $p = .002$, $OR = 4.236$. Thus, with all other predictor variables held constant, a one-unit increase in extension services results in a 4.236 times increase in the odds of contract farming occurring, with a 95% CI of 1.732 to 10.362. These results are supported by Sall et al. (2023), who attribute the expansion in the production of cotton, improved yields, effective input distribution, and credit recovery to extension services. Other studies in support posit that extension services provide the benefit of large-scale production (Kalinda & Bwalya, 2014; White & Aylward, 2016) and small-scale production (Minot & Sawyer, 2016) that lower implicit labour costs. Extension services provide farmers with the latest knowledge and techniques, helping to increase their yields and scale their businesses. Further, by providing consistent and reliable support, extension services assist farmers in building trust with the farmers, distributors, and the MNCs. This trust is crucial to the success of contract farming agreements, as it encourages farmers to commit to their contracts and reduces the likelihood of side-selling. Overall, extension services play a multifaceted role in enhancing the productivity, efficiency, and stability of contract farming.

Market Access

Market access was also found to be a significant predictor of contract farming. All other variables being constant, the odds likelihood of contract farming occurring increased by 3.446 (95% CI [1.559, 7.618]) for a unit increase in market access. The data shows that market access significantly predicted contract farming, $B = 1.237$, $SE = .405$, $p = .002$, $OR = 3.446$. This finding underscores the significance of market access to contract farming. Access to markets provides farmers with better opportunities to sell their produce at fair prices, reducing uncertainty and risks associated with market fluctuations. Knowing that the MNC will purchase their crop at an agreed price significantly reduces the uncertainty and risk associated with farming. The significance of this finding is stressed in the discourse on export markets (Sukume, 2012; Moyo, 2011), linking farmers to markets (Ma et al., 2024) and market information (Tschirley & Kabwe, 2010) in relation to market access. Market access has a positive effect on contract farming because it opens doors for farmers to sell their cotton internationally, potentially fetching higher prices and providing access to larger markets than they could reach on their own. Market access is a pivotal factor that drives farmers to contract farming. It offers them the security of a guaranteed market, the potential for higher earnings through export opportunities, and valuable information that aids decision-making. These benefits collectively enhance the attractiveness of contract farming, as reflected in the associative data findings.

Competition from other Crops

Competition and production costs have relatively small beta coefficients, but their relations with contract farming are statistically significant. Holding all other variables constant, the odds of contract farming occurring increased by 2.246 (95% CI [1.017, 4.962]) for a unit decrease in competition. Nonetheless, the analysis indicates that competition significantly predicts contract farming, $B = 0.809$, $SE = 0.404$, $p = .045$, $OR = 2.246$. The negative beta coefficient indicates an inverse relationship between competition from other cash crops and contract farming. Several studies (Kaur et al., 2021; Blaise & Kranthi, 2019; Kabungo & Jenkins, 2016;

Binswanger-Mkhize, 2014) support this inverse relationship. As such, the odds of contract farming occurring increase by 2.246 (95% CI [1.017, 4.962]) for every unit decrease in competition. Traditionally, maize was a food crop, and the government was the sole purchaser of the crop from the smallholder farmer. Changes in the agricultural policies in the last two decades, with surplus production, have transformed maize into a cash crop. With the emergence of soya, cotton has faced serious competition for both the markets and farmland for cultivation. Therefore, understanding the competitive landscape among cash crops and its influence on the cotton value chain is crucial for designing effective interventions and policies. Policies that provide support and incentives for crops can help mitigate the impact of competition from other crops. For example, cotton can be supported through the Farmer Input Support Program (FISP) like it does for maize and soya. This could include providing subsidies, research, and extension services to enhance the profitability and sustainability of cotton contract farming.

Production Costs

Similarly, the odds of contract farming occurring increased by 2.242 for a one-unit production cost reduction (95% CI [1.008, 4.988]). In addition, the cost of production significantly predicts contract farming, $B = 0.807$, $SE = 0.408$, $p = .048$, $OR = 2.242$. These findings are consistent with the findings of Rubhara and Mudhara (2019). The negative beta coefficient reinforces the inverse relationship between production and adoption of contract farming. The perception that production costs are not a deterrent, combined with the significant findings in the regression model, suggests that contract farming can offer benefits that outweigh the costs. These benefits include financial support, improved farming practices, and increased market access.

Mechanization

Finally, the results (Table 4.3) indicate that mechanization significantly predicts contract farming, $B = 1.559$, $SE = 0.464$, $p < .001$, $OR = 4.755$. This means that, with all other variables being constant, the odds likelihood of contract farming occurring increased by 4.755 (95% CI [1.914, 11.811]) for every increase in mechanization. These findings highlight the pivotal role that mechanization plays in facilitating contract farming. The significant increase in the odds of contract farming occurring with higher levels of mechanization suggests that investment in agricultural technology is crucial. These findings are supported by various studies (Daum & Birner, 2020; Saliou et al., 2020; Aryal et al., 2019; Zhang et al., 2017). For example, Saliou et al. (2020) discuss the positive impact of mechanization on smallholder farmers, particularly in terms of productivity and income generation. The study also notes how mechanization facilitates the adoption of modern farming techniques. Mechanization, which includes the use of machinery and advanced technologies in farming, can significantly enhance productivity, efficiency, and profitability for farmers. Farmers can effectively manage more extensive land areas by adopting mechanized farming practices, reducing labor costs, and increasing their yields. These improvements make contract farming more attractive and feasible, as they provide the means to meet the demands and standards set by the contractors. Therefore, policymakers and agribusiness leaders can prioritize supporting farmers mechanization to promote the growth, scaling, and sustainability of contract farming.

5.0 Conclusion

The study utilized a logistic regression model to evaluate how various factors influence the adoption of contract farming in the cotton sector. The model findings indicate that cotton price, price mechanisms, extension services, market access, competition, production costs, and mechanization are key determinants influencing the adoption of cotton farming. The findings reveal that while age and gender are not significant predictors, gender-related inequalities and challenges remain noteworthy. Cotton price and price mechanisms play a crucial role in

encouraging contract farming through competitive and transparent pricing. Pre-planting prices, though not significant, highlight the need for clarity to reduce uncertainties. Extension services and market access are pivotal in providing resources, knowledge, and secure opportunities for farmers. Competition inversely affects contract farming, emphasizing the need for supportive policies to maintain cotton's viability. Reducing production costs and increasing mechanization significantly enhance participation by improving efficiency, productivity, and profitability. Together, these factors underscore the importance of tailored policies, transparency, and technological support to promote sustainable contract farming practices.

Implications of the Study

The study identifies two practical implications and areas of focus: Enhanced Mechanization and transparent price mechanism.

- 1) *Enhanced Mechanization*. Farmers should focus on adopting mechanization and utilizing extension services to enhance productivity and profitability in contract farming. These elements offer access to modern techniques and improved efficiency, making contract farming more viable and sustainable.
- 2) *Transparent Price Mechanism*. Building trust through transparent pricing mechanisms and clear market access agreements can significantly encourage farmer participation. Ensuring fair and stable returns will reduce uncertainties and motivate more farmers to engage in contract farming.

The study also suggests two policy implications and areas of focus: Prioritizing subsidies and financial incentives and establishing supportive programs.

- 1) *Prioritize Subsidies and Financial Incentives*. Policymakers should prioritize subsidies and financial incentives to make mechanization and production cost reduction accessible to smallholder farmers. These measures would enhance participation and productivity in contract farming.
- 2) *Establish Supportive Programs*. Initiatives should be established to support cotton farming amid competition from other crops, such as implementing programs akin to the Farmer Input Support Program (FISP). This can include providing input subsidies, research support, and tailored extension services to maintain cotton's competitiveness.

Mechanization and utilizing extension services can enhance farmers' productivity and profitability, making contract farming more viable. Transparent pricing mechanisms and secure market access can build trust and motivate greater farmer participation. On the policy front, subsidies and financial incentives are essential to make mechanization and production cost reductions accessible, while targeted initiatives, such as input subsidies and research support under programs like FISP, can sustain cotton farming amidst crop competition.

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