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Do Farm Input Subsidies Stimulate Production? Insights from Cotton Farmers in Tanganyika District, Tanzania.

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Abstract

This study investigated the impact of government agricultural input subsidies on cotton production and farmers' welfare in Tanganyika District, Katavi Region, Tanzania. It focused on how subsidized fertilizers, improved seeds, and modern technologies affect productivity and household income among small and medium-scale cotton farmers. Using a quantitative cross-sectional survey of 100 farmers selected through stratified random sampling, data were collected via structured questionnaires and analyzed using Multiple Linear Regression. Results revealed that farm size ($p < 0.001$), fertilizer use ($p = 0.014$), adoption of modern technology ($p = 0.003$), and use of improved seeds ($p = 0.017$) significantly enhanced cotton output, explaining 79.2% ($R^2 = 0.7921$) of the variation in production. Likewise, food security ($p = 0.047$), farm size ($p < 0.001$), and fertilizer use ($p = 0.017$) significantly influenced farmers' welfare ($R^2 = 0.62$). The findings indicate that input subsidies substantially improve productivity and income but are constrained by uneven adoption, limited market access, and inequitable distribution of inputs. The study recommends strengthening extension services to promote efficient input use, decentralizing input delivery to prevent delays and elite capture, and fostering public–private partnerships for local fertilizer and seed production. Simplifying subsidy access through digital platforms could enhance transparency and inclusion of smallholders. Furthermore, sustaining productivity requires complementary measures such as affordable credit schemes, farmer training on soil management, and the establishment of collective marketing cooperatives.

Keywords: *Agricultural Subsidies, Farmers' Welfare, Cotton Farming*

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1. Introduction

Government input subsidy programs have become a major global concern, particularly in Sub-Saharan Africa, where they are praised for stabilizing food prices, ensuring access to agricultural inputs, alleviating poverty, and driving agricultural improvement and transformation (Karata, 2024). In Tanzania, government expenditure on the Input Subsidy Program (ISP) has significantly increased to boost agricultural productivity and meet the growing demand for food and raw materials driven by rapid population growth. Consequently, the agricultural budget allocated to subsidies has risen from about USD 300 million between 2008 and 2013 to approximately USD 700 million in 2022/2023 (World Bank, 2014). Like in other Sub-Saharan African countries, Tanzania's agricultural input subsidy program was designed to make key inputs such as inorganic fertilizers and hybrid seeds more affordable to small and medium-scale farmers, thereby enhancing food security and income generation (Jayne et al., 2018). However, the effectiveness of these programs in improving beneficiaries' welfare and boosting productivity has been limited due to various challenges, including political interference, bribery, and profit-driven behavior among private sector actors (Chinsinga, 2011; Burke et al., 2016; Hemming et al., 2018; Jayne et al., 2018). Moreover, studies have shown that the limited impact of these programs is linked to factors such as the incompatibility between inorganic fertilizers and local soil quality, gender disparities in input use, and the use of credit facilities for purchasing inputs (Sheahan and Barrett, 2017).

For years now, Tanzania has been making efforts to increase production, productivity welfare of the peasant in Tanzania under the Agricultural Sector Development Program Phase Two (ASDP II; Jamaldin & Laurent, 2025). For instance, financing agriculture by providing agricultural input subsidies to farmers to enhance their production capacity, promoting good agricultural practices, and improving extension services provided to smallholder farmers (URT, 2016). Despite the above efforts, cotton productivity among small-scale farmers is still low (FAO, 2013) as it evidenced by the study of Senkoro and Mkorongwe (2018) who revealed that production of cotton fiber per unit area in Tanzania is generally low which range about 0.8 - 1.1 tons per ha for farmers and 2 - 2.5 tons per ha for estates scale local peasant. Furthermore, there is still a doubt on the effectiveness of the government subsidy programs on improving cotton farmers' production level and their welfare status, as the average use of quality inputs, essentially improved seeds, fertilizers, and modern technology, remains low despite government financing about 50% of the market price of those inputs. This makes use of essentially improved seeds, fertilizers, and modern technology in the country to remain below other countries in Africa with the same economic conditions, hence the poverty line remains high at more than 28% in 2012 (TSB, 2018; Mkuna, 2017).

Few studies have adequately examined the effects of agricultural input subsidies on farmers' welfare and production efficiency. Research by Kato (2016) and Gine et al. (2019) found no significant impact of such subsidy schemes on agricultural productivity and welfare across different regions, while Ray (2019) focused narrowly on farmers' revenue improvement, overlooking broader aspects such as welfare and production capacity. Similarly, Karata (2020) emphasized the productivity impacts of government input subsidies but paid limited attention to their effects on farmers' livelihoods. This study therefore, seeks to fill this knowledge gap by comprehensively analyzing the influence of government input subsidies on both cotton production and farmers' welfare in Tanganyika District, using income improvement as a key welfare indicator. The findings will provide policymakers and development partners with valuable insights into the mechanisms and outcomes of subsidy programs, guiding future agricultural policy design and implementation in Tanzania and other Sub-Saharan African contexts (Gilbert, 2020; Mdee et al., 2020). Ultimately, the study aims to deepen understanding of how government agricultural subsidies affect production and farmers' living standards, thereby supporting the development of more effective initiatives to enhance productivity and welfare among smallholder cotton farmers.

2. Theoretical Underpinnings

This study draws upon the Theory of Production and the Theory of Change. The production theory was established by Adam Smith, who is regarded as the father of economics, in his book "The Wealth of Nations" in 1776. He introduced this theory, basically trying to explain the existing relationship between physical factors of production (capital and labor) and the level of output. also, the theory explained the optimization process among firms that helps them to find out the best input combination which will maximize output production and minimize the production cost.

The essence of the theory of production is presented by using the production function, which is a mathematical equation that describes the technical relationship that aids in transforming input or production resources into outputs or commodities (Debertin, 2012).

And production function takes several forms, but in a general way production function can be written as,

$$Y = f(K, L)$$

Where Y represents firm output, K represents the level of capital, and L represents the level of labor force used in production. Thus, the production function shows the maximum quantity of output (Y) that can be produced by the combination of two input factors of labor and capital. The above relation described by the production function is that the given output Y can be produced by more capital K and less labor, or using more labor L and less capital. In this study theory of production will provide the foundation of the maize production within the respective research area. It will provide the basic understanding that high cotton production is obtained at the expense of various factors. Hence, the Theory of Change emerged from the field of program theory in the mid of 1990 and was established by Peter Drucker. Theory of change, as a theory, is used to explain interventions or a set of interventions that are expected to bring about the development changes. A theory of change helps to identify solutions to effectively address the causes of problems that hinder progress and guide decisions on which approach should be taken.

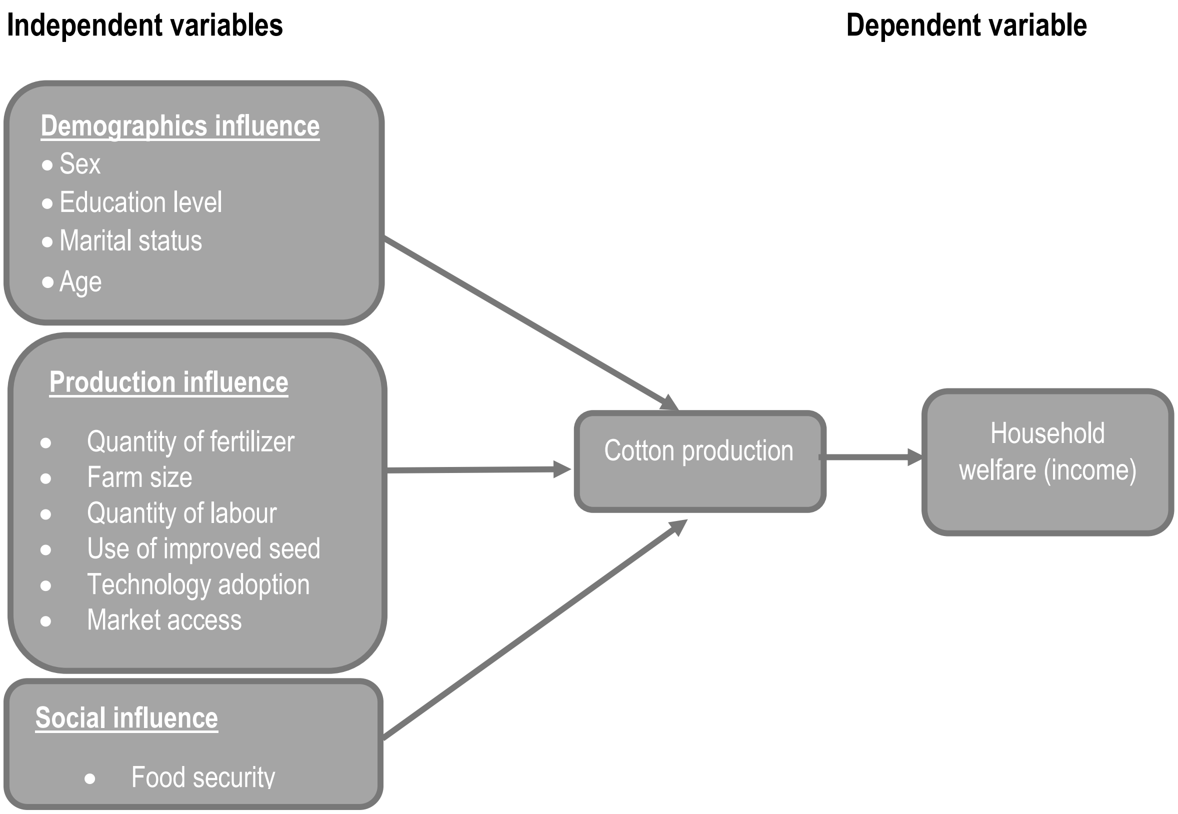
Since the theory of change has underlying assumptions about how change happens, it will be a guiding theory to explain how cash subsidy programs play a transformative social role in boosting agricultural production in the developing countries, including Tanzania. Theory of change is the transfer to improve household capital, production capacity together with economic growth. Hereby, through government input subsidies programs as initiatives or an intervention, as explained in the theory of change, will bring out development and growth in the targeted groups by enabling the stakeholders easy access to credit, improving their consumption level, increasing their capacity to own productive assets such as land, and helping in financial assets accumulation (Laurent & Mushi, 2024). Therefore the theory of change will provide foundation on how an intervention (subsidies programs) are effective in the farmers development both social and economically, the theory of change in this study will help provide crucial understanding on the improvement of social and economic welfare of program beneficiaries as this theory emphasizes on investment in programs that can bring required changes to the society (World Bank, 2014).

3. Empirical Review

Government input subsidies have lately been an area of interest in both academic and policy discussions worldwide. Several studies in African countries had tried to investigate the influence of government input subsidies to the crops production and welfare of the farmers, and come out with multidimensional results, for instance the study of Omoregie, (2017) indicated the quantity of fertilizer has statistically significant effect on the level of farmers production and food security which is among of welfare indicator, the study postulated that the subsidized farmers are likely have productive potential than non-subsidized. In contrast to this, other studies found little effect of fertilizer on improving crop production and welfare since there mismatch of inorganic fertilizer and soil quality, the gender gap in the assessment and use of those inputs (Hemming et al. 2018; Jayne et al. 2018; Sheahan and Barrett 2017).

In addition, government agricultural input subsidy programs have received significant attention by being the essential model and are responsible for agricultural production, and as the government's effort to reduce poverty (Eyitayo et al., 2021; Zhou et al., 2022). Recent studies have evidenced the impact of poverty reduction as one of the impacts of government input subsidies on the level of farmers’ production and welfare. However, such results are inconsistent with some studies that found that the government subsidy programs have no significant influence on production, development of human capital, and reduction of poverty level among program beneficiaries (Agbigbe, 2016; Bighelli et al., 2023; Omoregie OK, 2017). Since one of the government's objectives in establishing agriculture input subsidies is to increase crop production and their income level, it targets to ensure food security among farmers. Food as an outcome of the subsidy program has a vital influence in improving farmers’ crop production and their level of welfare, as shown by different studies. (Ragasa and Mazunda, 2018; Kinuthia & Kinyanjui, 2020). Also, Omoregie (2017) indicated that agricultural practices positively and significantly impact poverty reduction. Consistently, a study by Karata (2024) and Kinuthia & Kinyanjui (2020) postulated that the program also resulted in participants increasing the land allocated to crops, which are supported by the government input subsidies.

Futhermore, (Badu & Lee, 2020) on the study of government agricultural subsidy programs impact on rice production in Ghana, showed that increase in the use of labor force have the significant and the positive influence on the rice production, on the use of improved seeds (Olomola, 2020) on the impact of agricultural input subsidy scheme on farmers' productivity, food security and nutrition outcomes in the northcentral and southwest regions of Nigeria, the results of the study found a heterogeneity effect of quantity of improved seeds on farmers production. A study by Sibande et al., (2017), implied that farm input subsidies increase farm households’ market access and participation among the study respondents.



Source: Author’s design 2025

Fig 1: Conceptual Framework

4. Methodology

The study was conducted in the Katavi Region, specifically the Tanganyika District council. Katavi region is located at western Tanzania. The region lies approximately between latitudes 5°15' S and 7°03' S, and longitudes 30° E and 33° E. Katavi covers an area of about 45,843 km. According to the 2022 national census, the region has a population of approximately 1,152,958. The region is bordered to the north by Urambo District (Tabora Region), to the east by the Sikonge District (also Tabora Region), to the south by Rukwa Region and Songwe Region, and to the west it shares part of the border with the Democratic Republic of the Congo via Lake Tanganyika. About 91.7 % of the population lives in rural areas, heavily dependent on agriculture, and about 52 % are aged between 15 and 64 years, representing the working-age demographic (NBS, 2022).

A quantitative research approach was employed to collect data from the respondents to answer research questions. A cross-sectional research design was used as a quantitative research method, since data were collected from study respondents at one point in time without any repetition from the sample population. To obtain a representative sample study used both probability and non-probability sampling procedures. Non-probability sampling was used for purposive sampling to select Tanganyika district and the main cotton producers’ wards, which are sibwesa, Mpanda ndogo and katuma due to their intensive cotton production.

Thereafter, to create equal chance for each farmer to participate on the study a sample random sampling was applied to select sample respondents (cotton farmers) from the targeted study population. Through Yamane's (1967) sample size formular, a 0.1 margin of error was helpful to obtain 100 sample size. Since small & medium-sized scaled cotton farmers are the unit of analysis, Primary data were collected from them through a structured questionnaire.

Multiple Linear Regression Model

The concept of cotton production among farmers will be captured with production function, which will show the possible maximum output (Y) which can be produced with the combination of various inputs such as land, labor, capital and other supporting factors (x1, x2, x3……xn). Production function may take number functional forms such as quadratic production function, linear, quadratic polynomial, square polynomial and Cobb Douglas functional.

For the sake of estimating the first objective of the study, which is to examine the influence of input subsidies on cotton production, the study will use the Cobb-Douglas production function, which was introduced by Cobb-Douglas. This production function tries to explain the relationship of two key production inputs (labor and capital) in conjunction with the level of technology and the quantity of output produced, the function taking the form of,

$$y = AK^{\alpha}l^{\beta} \text{ ……………………………………………………. } (1)$$

Whereby,

Y is the level of output produced
A is the technology level
K is the capital
L is labor
α, β are factor elasticity

Since the model is multiplicative (is against attributes of economic model) which is difficult to estimate the individual contribution of each variable in the dependent variable (y), the model will be transformed to be addictive which will be easy to find out the contribution of individual variables, and this will be done by introducing natural logarithm in both sides of the model (first equation), as illustrated by the second equation below,

$$lny = \ln(AK^{\alpha}L^{\beta}) \text{ ……………………………………………………….. } (2)$$

$$lny = lnA + \alpha lnK + \beta lnL \text{……………………………………………………. } (3)$$

For the sake of this study, the transformed Cobb Douglas function will be extended to include other variables (inputs) that also affect the produced output,

$$lny = ln\beta 0 + \beta 1 lnx1 + \beta 2 lnx2 + \beta 3 lnx3 + \cdots \ldots \ldots . \beta n \; lnxn \text{ ……………………………..… } (4)$$

For better estimation of the above extended production function, the function in equation (4) must include the random variable, by including a random variable the production function will transformed to econometric model;

$$lnY = ln\beta 0 + \beta 1 lnx1 + \beta 2 lnx2 + \beta 3 lnx3 + \cdots .. \beta n lnxn + \mu i \text{…………………… } (5)$$

And the above function can be generalized as follow

$lny = ln\beta o + \sum_{i=1}^{n} ln\beta ixi + \mu i$.. (6)

Thereafter, to estimate the second specific objective of the study which is estimating the influence of input subsidies in cotton farmer's welfare, study will employ the log linear econometric model which will take form of,

$$lnY = \beta 0 + \beta 1x1 + \beta 2x2 + \beta 3x3 + \cdots \beta nxn + \mu i$$

Whereby y stand for income from cotton production
β1- βn stand for parameters to be estimated
βo stand for constant
μ is an error term

5. Results.

5.1 Descriptive Analysis

Descriptive analysis was performed to provide a general description of the study sample and to analyze individual characteristics of small and medium farmers found in Tanganyika, Tanzania.

Table 1. Summary of description for continuous variables

Variable	*Observation*	*Mean*	*Std. dev.*	*Minimum*	*Maximum*
Age	100	40.81	13.81164	19	74
Farm size	100	4.09	2.531	1	12
Labor size	100	6.3	2.276361	2	13
Food security	100	1.94	.7630349	1	3
Cotton production	100	2.64	1.396388	1	6
Income level	100	1066930	748891.5	430000	5400000

Source: Field data 2025

Results from Table 1 show that respondents' ages ranged from 19 to 74 years, with an average of 40.81 and a standard deviation of 13.81, indicating a diverse age composition with a concentration of middle-aged farmers who are typically at an optimal stage for handling both the physical and managerial aspects of agriculture. The presence of younger and older farmers suggests varying levels of experience and resource access, though older farmers may face difficulties in adopting modern technologies. Farm sizes ranged from 1 to 12 hectares, with a mean of 4.09 and a standard deviation of 2.53, showing that most respondents operated small to medium-scale farms. This limited land access constrains economies of scale, as larger farms generally achieve higher resource efficiency and productivity, while smaller farms often fail to fully capitalize on subsidies. Labor size per farm varied between 2 and 13 workers, with an average of 6.3 and a standard deviation of 2.28, reflecting moderate labor use typical of small-scale cotton farming, which remains largely labor-intensive. Food security, measured by the number of daily meals, ranged from 1 to 3 meals per day, averaging 1.94 with a standard deviation of 0.76. This reveals persistent food insecurity among farming households, which may reduce farmers' capacity and focus on cotton production.

Table 1 results show Cotton yields range from 1 to 6 tons per hectare, with an average of 2.64 tons and a standard deviation of 1.39, indicating substantial variations in productivity. Also, findings show that Farmers' income spans from TZS 430,000 to TZS 5,400,000, with a mean of TZS 1,066,930 and a standard deviation of TZS 748,891, reflecting significant income inequalities among cotton farmers. The disparity in income points to unequal access to resources and market opportunities.

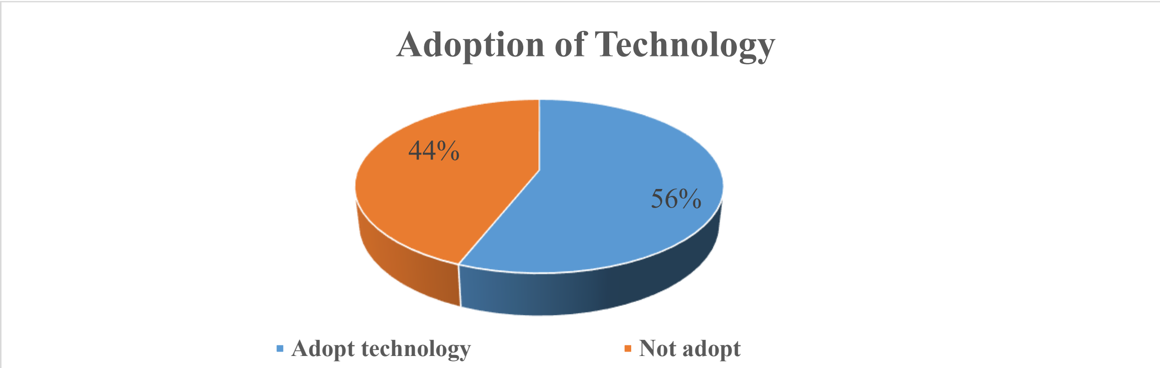
Table 2. Summary of description for categorical variable

Variable	*Categories*	*Frequency*	*Percentage*	*Cum*
Sex	Male	56	56	56
	Female	44	44	100
Marital status	Single	54	54	54
	Married	46	46	100
Improved seed	Use improved seed	54	54	54
	Not use	46	46	100
Fertilizer	Use fertilizer	48	48	48
	Not use	52	52	100
Market access	Access market	53	53	53
	Not access	47	47	100
Technology adoption	Adopt technology	56	56	56
	Not adopt	44	44	100
Education level	Primary education	23	23	23
	Secondary education	19	19	42
	Certificate &diploma	28	28	70
	University	17	17	87
	Never attend	13	13	100

Source: Field data 2025

The survey form Table 2 reveals a gender imbalance, with 56% of respondents being male and 44% female, suggesting that men dominate farming activities in the area. These disparities reflect entrenched gender norms in agriculture, where men often hold an advantage in accessing land, financial resources, and decision-making platforms. But, marital status of respondents is relatively balanced, with 54% single and 46% married. From the study findings in Table 2, only 54% of farmers reported using improved seeds, leaving 46% reliant on traditional seeds. The relatively low uptake of improved seeds reveals significant challenges in subsidy delivery. Farmers may struggle with affordability, limited awareness, or the availability of region-specific seed varieties. Hence, Fertilizer adoption is low, with 48% of respondents using fertilizers and 52% not utilizing them. The underuse of fertilizers is concerning, as they are essential for soil enrichment and yield improvement.

From Table 2, a slight majority (53%) of farmers have market access, while 47% lack reliable market connections. Market access is critical for improving agricultural incomes and sustainability. Farmers without access to stable markets often sell at unfair prices, limiting their income and ability to reinvest. Modern farming technologies are adopted by 56% of respondents, while 44% rely on traditional methods. The moderate technology adoption rate points to a reliance on conventional practices, which constrains productivity. Barriers such as high costs, inadequate training, and limited access to credit are common obstacles.



Source: Field data 2025

Fig 2: Representing Technology adoption from sample size

Results from Table 2, indicate that educational attainment among respondents varies: 13% never attended school, 23% completed primary education, 28% have certificates or diplomas, 19% finished secondary education, and 17% hold a university degree. Those with higher education levels are better equipped to understand and implement advanced agricultural practices.

5.2 To assess the effect of subsidies on cotton production among farmers in Tanganyika

The findings in Table 3 indicate that Food security, farm size, Fertilizer use, Adoption of technology, and use of Improved seed (as a dummy variable) are all statistically significant factors that have an effect on cotton production among small & medium farmers in Tanganyika.

Table 3: Multiple regression model on the effect of government subsidies on cotton production among farmers in Tanganyika District

cotton production	*Coef.*	*Std. Err.*	*t*	*P>|t|*	*[95% Conf. Interval]*	
age	.00201	.005752	0.35	0.728	-.0094264	.0134465
Food security	.3355454	.1092221	3.07	0.003	.1183827	.5527082
Labor size	-.0098222	.0317253	-0.31	0.758	.0729006	-.0532561
Farm size	.2493033	.0378296	6.59	0.000	.174088	.3245187
male	.0800763	.1471295	0.54	0.588	-.2124566	.3726092
primar	.2239813	.2471112	0.91	0.367	-.267342	.7153045
secondary	.0186624	.2643895	0.07	0.944	-.5070147	.5443395
undergraduate	.3242865	.2387214	1.36	0.178	-.1503555	.7989285
Postgraduate	.0968072	.2752067	0.35	0.726	-.4503775	.6439919
access_markt	.1767196	.1611283	1.10	0.276	-.1436466	.4970859
use_fertlizer	.405083	.1619203	2.50	0.014	.0831421	.7270239
adopt_tech	.5538877	.180396	3.07	0.003	.195212	.9125633
maried	.2292331	.1524583	1.50	0.136	-.0738948	.532361
use_imprvd_seed	.4212919	.1736651	2.43	0.017	.0759991	.7665846

cons	-.1891429	.3796204	-0.50	0.620	-.94393	.5656442

Model strength	*Number of obs = 100*
	F (14, 85) = 23.14
	Prob > F = 0.0000
	R-squared = 0.7921
	Adj R-squared = 0.7579

The model accounts for a substantial proportion of the variance in cotton production, with an R-square value of 0.7921 and an adjusted R-squared value of 0.7579. This indicates that approximately 79% of the variation in cotton output is explained by the variables considered. The high F-statistic (23.14) and its corresponding p-value (0.0000) confirm the statistical significance of the model. Collectively, the variables have a meaningful influence on cotton production, demonstrating the robustness of the findings.

Test for multicollinearity

Multicollinearity tested by using variance-inflated factor (VIF) by using STATA, the results show that there was no serious problem of multicollinearity between the independent variables as shown in the table with an average of 1.68, which is tolerable, and the maximum VIF of variable was 2.43.

Table 4 Multicollinearity test results for the independent variable

Variables	***VIF***	***1/VIF***
certificate	2.43	0.410903
primary	2.29	0.436525
secondary	2.28	0.438820
university	2.26	0.441741
Farm size	1.92	0.520152
Technology adoption	1.70	0.588733
used improved	1.59	0.630139
food security	1.46	0.686544
fertilizer use	1.39	0.721383
market access	1.37	0.729954
Age	1.32	0.755535
maried	1.22	0.817635
male	1.13	0.885060
labor_size	1.09	0.914292
		Mean VIF 1.68

Test for heteroscedasticity

Test for heteroskedasticity in the model was done by using Breusch Pagan test, where the null hypothesis is there is homoscedasticity. Test yield a high chi2 (1) = 2.12 statistics, which is insignificance (Prob > chi2

=0.1451), as shown below. In which the null hypothesis was failed to be rejected and conclude that there was no a problem of heteroskedasticity in the model.

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of cotton_prod
chi2 (1) = 2.12
Prob > chi2 = 0.1451

6. Discussion of Findings.

Table 3 results show a coefficient of 0.3355 (p = 0.003), which indicates a significant positive relationship between food security and cotton production. Households with improved food security demonstrate higher productivity levels. Food security influences a farmer's capacity to focus on agricultural pursuits. Stable food availability reduces the need to divert time and resources toward meal acquisition, allowing for greater attention to cotton farming. This result is consistent with Ragasa and Mazunda (2018), who highlighted the role of food security in enhancing agricultural efficiency and household resilience by lowering vulnerabilities and freeing up labor for farming activities. These insights underscore the importance of addressing food insecurity as part of strategies to boost cotton output. Integrating food aid initiatives with input subsidies can provide farmers with the necessary energy and tools for optimized production.

Results from Table 3 depict that, with a coefficient of 0.2493 (p = 0.000), farm size reveals a highly significant positive effect on cotton output. Larger farms correlate with higher yields. Bigger farm sizes enable farmers to benefit from economies of scale by distributing input costs over larger areas and utilizing resources more effectively. This aligns with findings from Karata (2024) and Kinuthia and Kinyanjui (2020), which identified farm size as a crucial factor for productivity in subsidy-supported farming systems. However, challenges remain for smallholder farmers who face hurdles like limited access to land and financial barriers to expansion. Policies that promote equitable land distribution and encourage cooperative models for smallholders can foster inclusivity and enhance overall productivity.

Study findings from Table 3 show that fertilizer use has a positive and significant impact on cotton production, with a coefficient of 0.4051 (p = 0.014). Farmers using fertilizer achieve notably higher productivity. Fertilizer contributes to replenishing vital soil nutrients, thereby improving crop output. This finding resonates with Olomola (2020), who documented a robust positive impact of fertilizers on agricultural productivity in Nigeria. However, effectiveness relies on proper application and soil compatibility. Challenges such as mismatched fertilizer types and unsuitable soil conditions, as noted by Hemming et al. (2018), can reduce benefits. Thus, while subsidized fertilizers are essential, providing support through soil testing services and training programs is critical to achieving optimal results.

From Table 3 findings indicate that, with a coefficient of 0.5539 (p = 0.003), there is a significant positive link between technology adoption and cotton productivity. Farmers using modern tools and systems achieve substantially better results. Hence, technologies like mechanization, irrigation systems, and precision agriculture boost efficiency and yield. Similar trends were observed by Badu and Lee (2020) in Ghana, where technology adoption backed by government initiatives led to improved rice yields. However, barriers such as high upfront costs, limited access to credit, and insufficient technical knowledge hinder adoption, especially among smallholders. Policymakers should focus on subsidizing advanced tools and providing accessible training programs to ensure widespread adoption and maximize productivity gains.

Results from Table 3 indicate that Improved seed use significantly boosts cotton production, with a coefficient of 0.4213 (p = 0.017). Farmers using these seeds report higher yields compared to those relying on traditional varieties. Improved seeds are engineered to deliver higher yields, greater pest resistance, and better adaptability to local climates. This finding mirrors Olomola (2020), who observed significant gains in agricultural productivity with improved seed varieties in subsidy-supported systems. However, the success of improved seeds hinges on their compatibility with local conditions and proper use by farmers. Obstacles like limited access to region-specific seeds and inadequate farmer training could impede adoption. Policymakers should ensure these seeds are locally adapted and widely accessible, paired with educational initiatives to enhance their effective utilization.

5.3 To analyse the influence of input subsidies on farmers' welfare

The findings in Table 5, indicate that Food security, farm size, Fertilizer use, married (as a dummy variable), and Use of Improved seed (as a dummy variable) are all statistically significant factors that influence cotton farmers' welfare in Tanganyika. The model’s R-squared value stands at 0.62, indicating that 62% of the variation in farmers' welfare is explained by the variables under study. This reflects a relatively strong model fit. An F-statistic of 9.91 (p = 0.0000) underscores the collective significance of the variables in explaining welfare outcomes. However, the unexplained 38% of variation suggests that other factors, such as credit access, stable markets, and social support systems, should also be considered.

Table 5. Multiple regression model on the effect of government subsidies on cotton production among farmers in Tanganyika District

ln_income	*Coef.*	*Std. Err.*	*t*	*P>|t|*	*[95% Conf. Interval]*	
age |	-.0007638	.0030604	-0.25	0.804	-.0068487	.0053212
Food security |	.1170794	.0581137	2.01	0.047	.0015338	.2326249
Labor size |	.0115915	.01688	0.69	0.494	-.0219706	.0451535
Farm size |	.097885	.0201279	4.86	0.000	.0578652	.1379047
male |	.0536577	.078283	0.69	0.495	-.1019899	.2093053
primary |	.019176	.1314801	0.15	0.884	-.2422418	.2805937
secondary |	-.0646216	.1406734	-0.46	0.647	-.344318	.2150747
undergraduate |	.1313454	.1270162	1.03	0.304	-.1211968	.3838875
postgraduate |	.0705685	.1464289	0.48	0.631	-.2205713	.3617084
Access market |	.0330579	.0857313	0.39	0.701	-.137399	.2035148
Use of fertlizer |	.2099615	.0861527	2.44	0.017	.0386669	.3812562
Adopt technology |	.0278983	.0959831	0.29	0.772	-.1629418	.2187384
married |	.1783421	.0811183	2.20		.0170572	.339627
Use improved seed |	.1677646	.0924018	1.82	0.073	-.0159549	.3514841

_cons |	12.65814	.2019842	62.67	0.000	12.25654	13.05974
			Model strength		*Number of obs = 100* *F (14, 85) = 9.91* *Prob > F = 0.0000* *R-squared = 0.6200* *Adj R-squared = 0.5574*	

Test for multicollinearity

Multicollinearity tested by using variance-inflated factor (VIF) by using STATA, the results show that there was no serious problem of multicollinearity between the independent variables as shown in the table with an average of 1.68, which is tolerable, and the maximum VIF of variable was 2.43.

Table 6 Multicollinearity test results for the independent variable

Variables	***VIF***	***1/VIF***
certificat~p	2.43	0.410903
primary_edu	2.29	0.436525
secondary_~u	2.28	0.438820
university	2.26	0.441741
farm_size	1.92	0.520152
adopt_tech	1.70	0.588733
use_imprvd~d	1.59	0.630139
food_secur~y |	1.46	0.686544
use_fertli~r	1.39	0.721383
access_markt	1.37	0.729954
age	1.32	0.755535
maried	1.22	0.817635
male	1.13	0.885060
labor_size	1.09	0.914292
	Mean VIF	*1.68*

Test for heteroscedasticity

Test for heteroskedasticity in the model was done by using Breusch Pagan test, where the null hypothesis is there is homoscedasticity. Test yield a high chi2 (1) = 2.62 statistics, which is insignificance (Prob > chi2 =0.1053), as shown below. In which the null hypothesis was failed to be rejected and conclude that there was no a problem of heteroskedasticity in the model.

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of ln_income
chi2 (1) = 2.62
Prob > chi2 = 0.1053

6. Discussion of Findings.

The analysis from Table 5, reveals that food security has a positive impact on farmers' welfare, as indicated by a coefficient of 0.1171 ($p = 0.047$). This result is statistically significant, showing that enhanced food security correlates with higher incomes for farmers. When farming households experience greater food security, they can focus their resources on productive ventures rather than dealing with food scarcity. Outcome aligns with insights from Ragasa and Mazunda (2018), who demonstrated that government input subsidies enhancing food security significantly uplift household welfare and boost productivity. Furthermore, consistent access to food reduces susceptibility to economic disruptions, empowering farmers to reinvest in their agricultural activities. This reinvestment often translates into increased earnings. However, the modest magnitude of the effect suggests that food security alone may not fully address welfare challenges. Complementary initiatives, like food assistance programs and strategies for diversifying income streams, could strengthen these benefits further.

From Table 5**,** Fertilizer usage shows a positive relationship with farmers' welfare, with a coefficient of 0.2100 ($p = 0.017$). The evidence indicates that fertilizer application significantly increases farmers' income. Since, fertilizers play a critical role in improving soil fertility, which directly boosts crop yields and, by extension, farmers' revenues. These findings are in line with Olomola (2020), which observed that subsidized fertilizers enhanced productivity and welfare among Nigerian farmers. However, the effectiveness of fertilizers hinges on proper application techniques and their compatibility with specific soil conditions. Hemming et al. (2018) also cautioned that inefficient usage could undermine potential benefits. To optimize the impact of fertilizers, governments could prioritize soil testing services and training programs for farmers, ensuring fertilizers are used effectively. Additionally, stabilizing prices through subsidies would make fertilizers more affordable and encourage widespread adoption, particularly among smallholder farmers.

Study findings from Table 5, show that the use of improved seeds shows a positive effect on farmers' welfare, with a coefficient of 0.1678 ($p = 0.073$). This implies that improved seeds are engineered to boost crop yields and enhance resilience against pests and environmental challenges. While the data suggests a positive influence, external factors such as seed quality, compatibility with local conditions, or farmers' lack of knowledge about proper usage may limit the benefits. These findings are consistent with Olomola (2020) observation that the effectiveness of improved seeds depends on appropriate education and adaptation to local needs. To amplify their impact, policymakers should focus on providing region-specific seed varieties and improving farmers’ access to knowledge through robust extension services.

7. Conclusion.

This study evaluated the effects of government agricultural subsidies on cotton production and farmers’ welfare in the Tanganyika District, Tanzania. The findings reveal that government-supplied agricultural inputs, particularly fertilizers, improved seeds, and modern technologies, significantly enhance cotton productivity. Econometric analysis confirmed that fertilizer use, farm size, and technology adoption have strong positive correlations with yield increases, accounting for much of the observed improvement in output. However, despite these gains, the study also highlights that production levels have not yet reached their full potential due to inefficiencies in subsidy distribution and implementation, as well as unequal access among farmers.

Beyond increasing production, the study found that subsidies play a vital role in improving farmers' livelihoods by enhancing income levels and food security. Beneficiaries of input subsidies reported higher household earnings and improved meal frequency, demonstrating that subsidies contribute to both financial stability and better nutrition. Increased income allows farmers to reinvest in expanding their farms, adopt modern equipment, and diversify income-generating activities, thereby strengthening their resilience against market and climatic shocks. These results underscore the dual importance of subsidies not only as a tool for productivity growth but also as a mechanism for poverty reduction and rural welfare improvement.

Based on these findings, several policy actions are recommended to enhance the effectiveness and accessibility of input subsidy programs. The government should promote local fertilizer and seed production through public–private partnerships, negotiate bulk import agreements to stabilize prices, and streamline subsidy access through a simplified, digital registration system managed at local agricultural offices. Strengthening agricultural extension services is crucial to ensure farmers are trained in efficient input use, while low-interest credit schemes should be introduced to support smallholders in purchasing inputs and equipment. Finally, establishing cotton marketing cooperatives and implementing minimum price guarantees would help farmers secure fair market returns, protect them from exploitation, and create sustainable pathways for agricultural and economic growth.

Author Contributions:
Benjamin Mushi: Conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing, review and editing, visualization.

Future Research Direction*:* Future research should employ longitudinal or panel data to assess the long-term effects of agricultural input subsidies on cotton productivity and farmers' welfare

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