Finias Dogeje,
Centre for Economics and Community Economic Development,
The Open University of Tanzania; Tanzania
https://orcid.org/0009-0006-1345-9461

Deus Ngaruko,
Centre for Economics and Community Economic Development,
The Open University of Tanzania; Tanzania
https://orcid.org/0000-0001-7009-1081

EFFECT OF CONTRACT FARMING ON SMALLHOLDER FARMERS' GREEN LEAF TEA PRODUCTION IN TANZANIA

Abstract. *This paper investigates the impact of contract farming on green leaf tea output among Tanzanian smallholder farmers. Data from 393 growers from Mbeya and Njombe regions were collected in a cross-sectional survey and analysed descriptively using IBM Statistics Version 26. A multiple linear regression model was used to test the null hypothesis. The findings show that contract farming engagement (β=140.102; P=0.058) positively impact production. Moreover, household size (β=2.268; P=0.903) and gender (β=294.978; P=0.000) positively impact green leaf tea production. Besides, age (β=-2.719), education (β=-3171.868), and farm size (β=-20.866) all negatively impact production, but education only was statistically significant at P=0.002. We conclude that, contract farming has a favourable impact on green leaf tea production and suggests recognising its potential for farmers' growth. Besides, its nuanced importance and borderline P value (0.058) prompts further research on contract design, capacity-building, and market dynamics. Additionally, this paper highlights nuanced effects of farmer attributes. While household size and gender positively influences production, age, education, and larger farms negatively impact it. A comprehensive approach to tea production optimization, considering age-appropriate practices, education-specific interventions, and efficient farm management, is crucial. Further investigation into the combined effects of age, education, and gender is suggested for holistic insights.*
Keywords: *Contract Farming, Smallholder Farmers, Green Leaf Tea Production in Tanzania.*

Introduction

Tea (Camellia sinensis) has the distinction of being the world's most ancient beverage, having a roughly 5,000-year history, and is the most extensively consumed beverage in the world after water, with possible health benefits (Andra-Warner, 2022). The global tea sector has risen rapidly in recent decades, with a significant increase in global consumers. In 2022, global consumption was approximately 6.7 billion kilogrammes (Kg), with a forecast increase to approximately 7.4 billion Kg by 2025 (Statista, 2023). The youth group, in particular, has significantly increased their tea intake, contributing to this boom. The tea industry is critical to socioeconomic growth, providing major employment and cash to disadvantaged families worldwide. Tea production employs over 13 million people worldwide and has an annual worth of more than $18 billion (FAO, 2023; Debnath et al., 2021).

Tea considerably enhances export income, with global output reaching $17 billion and trade valued at more than $9.5 billion. Smallholders account for 60% of global production most of which are women, and they play an important role in rural employment, which improves household food security and nutrition (FAO, 2023; FAO, 2022). Tea is produced in over 15 countries, and annual export demand has increased by about 0.5% in the recent decade (Debnath et al., 2021). Increased tea supply from various tea growing countries is expected to drive 1.4% growth in black tea exports during the next ten years (Statista, 2023). Globally, an annual tea output of 6,497,443 tonnes is realised. China is the world's leading tea producer, producing 2,791,837 tons annually, with India close behind at 1,390,080 tons. Particularly, China and India account for nearly 60% of global tea output. Kenya comes in third place with an annual tea production of 458,850 tons, followed by Sri Lanka (300,120 tons), Vietnam (269,281), Turkey (261,000), Indonesia (137,803) and Myanmar (132,494) (AtlasBig, 2023).

Tanzania is within 15 countries producing tea across the globe. Tea accounted for 5.8% of overall cash crop production of 0.639 million tonnes in 2018/19, ranking as the fifth most produced cash crop in Tanzania. Tea production was preceded by cashew nuts (35.2%), seed cotton (34.9%), coffee (10.4%), tobacco (8.6%), and sisal (5%) (TanzaniaInvest, 2023). Tea plays an important role in Tanzania as a substantial cash crop, employing over 50,000 people in tea farms and processing plants, with an indirect impact of approximately 2 million people. Furthermore, the tea production includes about 32,000 smallholder farmers. Tanzania's government additionally earns approximately 45 million US dollars each year from the tea business (United Republic of Tanzania (URT), 2023; Dogeje et al., 2023).

Tanzanian tea production is divided into two models: large-scale growers, primarily tea processor estates, and smallholder farmers. Tanzania's total tea growing area is 23,805 hectares, with approximately 51 percent dedicated for large-scale cultivators and nearly 49 percent designated for smallholder farmers (AtlasBig, 2023; URT, 2023).

Smallholders farmers are regarded as farmers who cultivate less than 2 hectares (5 acres) of land for agricultural cultivation, animal husbandry, or fish farming (Knight, 2022). Smallholder farmers are commonly classified as a family-based farmer since they frequently rely on the labour of family members for production and normally keep a portion of their produce for personal use. These farmers, includes those who own and do not own the land on which they farm. Smallholder farmers in underdeveloped countries typically run a family-owned firm on a modest scale, managing up to 10 hectares (24 acres) (Knight, 2022). Despite possessing relatively small land sizes, smallholder farmers plays a crucial role in world food supply chain. It is argued that smallholder farmers produce around 35% of world food output and 80% of food supply in Sub-Saharan Africa and Asia (Lowder et al., 2021; FAO, 2012). In Tanzania, smallholder farmers dominate the agricultural domain, caring to 5.1 million hectares each year, out of which food crops accounts for about 85 percent (TanzaniaInvest, 2016).

Even though smallholder farmers contribute significantly to the world food output and are crucial to socio-economic development of their respective countries, farmers are confronted with several challenges that humper their performance in terms of production efficiency and overall livelihood. For instance, even though, tea is the primary source of income for many underprivileged households, particularly in low-income countries, they face several challenges, including limited extension support, limited market access, low farm gate pricing, limited technology and financing access, and difficulties in meeting quality standards (FAO, 2023). This observation suggest that, these challenges, such as limited access to access to extension services are likely to cause low production, overall smallholder tea farmers performance and their livelihood. Smallholder tea growers in Tanzania face several challenges. These include limited input availability, insufficient access to extension support, and tiny land holdings, all of which contribute to lower production amongst smallholder tea farmers. It is estimated that, their average green leaf tea production ranges between, 2 and 3 tons per acre, which is about 2.5 tons per acre annually. This production average is about 50% lower than that of the tea processing estates, who achieve around 4.3 tons per acre per annum (IDH, 2021a; IDH, 2021b).

These challenges facing smallholder tea farmers underscore the importance of being resolved to improve smallholder tea performance, including improved production which contribute to improved income through, increased sales volumes. Resolving these challenges ensures that the tea sector benefits smallholder farmers and rural communities both in the short and long term (FAO, 2023). Contract farming, a sort of vertical integration, is considered to address these identified constraints and improve crop yield. Saroj et al. (2023), for example, discovered that contract farming increased the performance of wheat farmers in India by increasing access to production technologies and high-quality agricultural inputs. Likewise, Swain (2016) discovered that contract farmers could achieve higher production and efficiency by cultivating contract crops rather than non-contract crops in India.

Similarly, a study by Mpeta (2015) on the influence of contract farming on sunflower farmers' production in Tanzania discovered that contract farmers had more production per acre than non-contract farmers. Moreover, the URT's (2016) research on contract farming systems in Tanzania found that contract farming has a beneficial impact on sugarcane and tobacco production but not cotton. The favourable impact on sugarcane and tobacco production demonstrates that contract farming can boost crop yield and profitability by improving coordination and access to resources. However, the lack of a positive impact on cotton production underlines the complexities of contract farming's consequences, demonstrating that its success may be dependent on crop-specific characteristics, contract terms and market dynamics.

While the literature recognise the potential benefits of contract farming on improving smallholder crop performance, particularly production, there is limited literature on its impact on green leaf tea production among Tanzanian smallholder farmers. Moreover, the nuanced effects of contract farming on various crops suggest that contract farming might have crop-specific influence, necessitating a further focused inquiry. This study intends to fill this knowledge gap by examining how contract farming affects green leaf tea output among Tanzanian smallholders. It specifically test the null hypothesis (Ho) that contract farming does not impact green leaf tea production for smallholder tea farmers.

Literature Review

Production may be defined as obtaining the highest possible product output from a given input level (Mpeta, 2015). In the context of agriculture this may entail crop cultivation, and livestock keeping. It include activities such as planting, farm management, pest control, and harvesting. It also includes animal husbandry and breeding. The literature indicate that production is mainly measured in terms of productivity and efficiency interchangeably (Coelli et al., 2005) Neoclassical economic theory is the foundation for understanding agricultural production as a resource allocation process to maximise output given restricted inputs. The theory's emphasis on supply and demand interactions and elucidates how producers strive to optimise resource utilisation, achieve cost-effective output, and respond to market signals for various agricultural goods. Production functions, such as the Cobb-Douglas and Constant Elasticity of Substitution (CES) functions, describe the relationship between inputs and outputs, providing insight into production efficiency and technological development (Orlando, 2023; Wang & Fu, 2013).

Agricultural activities employ around 25% of the worldwide workforce. In many low-to-middle-income countries, agriculture employs a sizable proportion of the workforce and serves as their primary source of income. Besides, there are significant differences in incomes and production amongst smallholder farmers across the world. In different countries, the income ranges from negative to $2,000 or more, demonstrating that some smallholder farmers are running deficits, resulting in negative income outcomes (Roser, 2023). As income is the function of production volumes and prices, this indicate that, low production levels contributes to low income amongst smallholder farmers.

Delving into the tea subsector, low production and productivity is not an exception to the smallholder tea farmers across the globe. Literature indicate that smallholder tea farmers have relatively low green leaf tea out output due to various reasons, including limited access to inputs,

technology. For example, Hasan et al. (2023) study in China discovered that green leaf tea productivity is declining due to global warming and climate change, as well as inadequate irrigation. Likewise, a study by Rajeswar et al. (2017) discovered that smallholder tea growers in North East India have low productivity due to variables such as financial problems, power concerns, labour challenges, inadequate communication, higher pollution costs, and restricted transportation subsidies. Similarly, Perera's (2014) research identified impediments that limit the involvement of tea smallholders in Sri Lank. These include low production, poor business practises, insufficient expertise of tea farming, and limited service access. Moreover, a study by Hilal and Mubarak (2013) found that some farmers in Sir Lank have lower green leaf tea output because of older bushes and adverse weather condition.

According to a study conducted by Ngeno (2023) in Kenya, smallholder tea producers have low productivity due to technical inefficiency and a technological gap. Connectedly, according to Muzira et al. (2023), while tea output in Uganda has increased in Uganda, overall productivity and quality are still relatively poor since smallholder farmers are still growing volunteer tea seedlings. Similarly, Bitama et al. (2020) discovered that smallholder tea farmer in Burundi have poorer green leaf tea productivity than state-owned estates. Factors contributing to this disparity include limited education, family labour availability, high costs of hired labour, tea bush characteristics, and local customs. These findings also suggest that limited mechanisation exacerbate inefficiency in the entire tea production system amongst smallholders in Burundi. These results also indicate that inadequate mechanisation worsens inefficiencies in the complete tea production process among Burundian smallholders because of labour intensive nature of tea farming.

As study by Courbois et al. (2022) discovered that smallholder tea farmer have lower yearly yields per hectare than private estates, with values like fewer than 9 tonnes compared to 2,500 tonnes on estates. This gap is attributable to insufficient inputs, notably a lack of fertilisers, quality seedlings, pest management, and irrigation. In Tanzania, IDH studies (2021a; 2021b) found that smallholder tea producers have lower productivity due to a variety of variables. These include difficulties procuring inputs such as fertilisers and pesticides, limited access to extension services, credit constraints, and a strong reliance on rainfall. Smallholder tea farmers in Tanzania produce roughly between 2 ton and 3 tons of green leaf tea per acre per year, which is close to 50% less than tea processing estates, which produce approximately 4.3 ton per acre per year (IDH, 2021a; IDH, 2021b).

Evidence from the reviewed literature suggests that smallholder tea producers in various parts of the world are confronted with low productivity due to reasons like climate change, limited resources, inappropriate practises, and labour concerns, which effect green leaf tea yield and quality. Theoretically, contract farming can potentially address these challenges, which are mostly associated with spot market failures. Through contract farming, smallholders farmers can have access to resources, technology, and knowledge through structured arrangements with agribusinesses, resulting in enhanced farming practises, higher yields, and higher quality. Contract farming also provides stable markets and greater earning potential (Liang et al., 2023; Luh, 2020; Mpeta, 2015; URT, 2016).

A study by Saroj et al. (2023) in Inida, applied the data envelopment analysis and endogenous switching regression model on cross-sectional survey data from 754 wheat farmers, it founds that contract farming adopters are significantly more efficient than non- adopters. The same was attributed to improved access to quality inputs and production technology. Relatedly, in study by Swain (2016) in India used Heckman sample selection model was used to estimate the productivity differences between contract and non-contract farmers and stochastic production frontier was used to measure the technical efficiency. The results have indicated that contract farmers could achieve higher productivity and more efficiency by growing contract crop compared to non-contract crop.

A study by Mazhar et al. (2022) by using Stochastic Frontier Production (SFP) and Propensity Score Matching (PSM) revealed a significant and positive correlation between engagement in contract farming and technical efficiency of rice farmers in Pakistan. Furthermore,

land size, seed, and machinery expenses were identified as the principal inputs influencing the production. Similarly, a research by Rondhi et al. (2023) by using the same methodology found that contract farming influence technical efficiency of the chicken farmers. Connectedly, other factors contributing to smallholders performance, include age, farming experience, and education level (Singh, 2020; Kiet et al., 2020; Ali, 2019; Ngango & Kim, 2019).

In a study undertaken by Bidzakin et al. (2020) in Ghana, the results of the endogenous treatment effect regression model show that contract farming improves rice farmers' technical, allocative, and economic efficiency in Ghana. Moreover, farm size and contract farming were identified as shared characteristics that positively influenced the various efficiency indicators. Furthermore, the farmer's age, level of education, and the availability of family labour were indicated as favourable impacts on farmers' participation in contract farming. In Tanzania, the study undertake by Marwa and Manda (2022) by using endogenous switching regression (ESR) and PSM revealed that contract farming contribute to improved beans yield, income from beans and household income. Similarly, as this study focused on youth, these results may imply that age is critical to farmers performance. Moreover, the study undertaken by URT (2016) on contract farming systems in Tanzania found that contract farming has a positive impact on the production of sugarcane and tobacco, but its effect on cotton production was not observed. This imply that contract farming can enhance crop yield and profitability through better coordination and improved resource access in sugarcane and tobacco cultivation. However, it impact on cotton productivity is contested.

Despite the fact that existing literature recognises the potential benefits of contract farming in enhancing smallholder crop output, there is a lack of rigorous research on its effects on green leaf tea production among Tanzanian smallholders. Furthermore, the varied effects reported in diverse crops show that contract farming's influence make its effect to various crops unconclusive. This may suggest that, contract farming effect on productivity may be crop specific, necessitating more crop specific research. The purpose of this research is to fill this knowledge gap by evaluating the influence of contract farming on green leaf tea yield among Tanzanian smallholders. It explicitly explores the hypothesis that contract farming has no effect on smallholder tea producers' green leaf tea yield.

Methods
Research Design
The study employed a descriptive research design to evaluate how contract engagement affect smallholder farmers' green leaf tea production in Tanzania. The rationale for employing this study design was to offer a firm foundation of knowledge about a subject, investigate its qualities, and lay the platform for deeper inquiries. It is especially useful when the goal is to describe a scenario, occurrence, or relationship in a comprehensive and systematic manner (Elman, 2022).

Data Collection and Processing
This study used primary data from a cross-sectional survey of 393 smallholder tea growers in 37 villages across three districts in mainland Tanzania: Rungwe and Busokelo in the Mbeya region, and Njombe District Council in the Njombe region. Participants in this study were chosen based on their involvement in the green leaf tea market during the 2022 tea producing season. To ensure representation, participants were separated into two groups: contract participants (233 farmers, 59% of the sample) and non-participants (160 farmers, 41% of the sample). The sample was randomly drawn from distinct clusters within the 37 communities.

The dependent variable in this study is measured using green leaf tea production per acre in Kilograms (Kg). In contrast, the independent variable used is farmers' participation in vertical integration alongside other variables. Farmers' participation in vertical integration is represented as a dichotomous variable, coded as 1 for participation and 0 for non-participation. Other variables, included in a model are respondent's gender, age, household size and land size, the measurement of which are shown in Table 1.

Table 1
Variables Measurement

Variable	Indicator	Measurement	Number of Indicators
Depependend	Green leaf tea production outcome	Green leaf tea production per acre (Kg/acre) (scale variable)	1
Independent	Contract Farming Engagement (CFE)	Dichotomous (1=Engaged; 2=Otherwise) (categorical variable (nominal))	6
	Gender of respondent (GEN)	Nominal (1=Male; 0=Female/Otherwise)	
	Age of respondent of respondent (AGE)	Continous	
	Eduction of respondent (EDU)	Nominal (1=Completed primary school; 0=Otherwise)	
	Household of size of respondents (HHS)	Number of people in the respondent's househol (continous variable)	
	Tea land size of respondents (LS)	Land planted with tea in acres (continous variable)	
Total number of variables			**7**

Data Analysis

The collected data was cleaned in excel and imported in SPSS IBM Statistics for Mac Version 26 for analysis. Descriptive analysis of independent and dependent variables was performed using measures of central tendency. Moreover, independent sample t-test was done to test the association between production between smallholder farmers' engaged and those engaged to established whether there is statistically significant different between those engaged in contract farming and those who are not engaged in contract farming. Furthermore, a multiple linear regression model was used to examine the impact of contract farming engagement, along with farmer characteristics (gender, age, education, household size, and land size), on smallholder farmers' green leaf tea productivity in Tanzania. The significance level of 0.05 was used to accept or reject null hypotheses. Before undertaking data analysis, specific statistical tests were conducted to ensure the validity and reliability of the data. Furthermore, the vital assumptions of the multiple linear regression model, including tests for autocorrelation, homoscedasticity, collinearity, and the normal distribution of errors, were examined and found to be satisfied. Check of significant outliers was checked whereby 22 observations which had a Cook vale exceeding 0.01 which is equivalent to sample size divided by 4 (393/4) were removed from the model (Cook & Beckman, 2006). In this regard the regression model was run by using 371 observations.

Structural Equation

This study used the multiple linear regression model with the aforementioned variables to examine how contract farming engagement, in combination with various farmer attributes, affects green leaf tea production among Tanzanian smallholder farmers. The methodical estimation of the model are summarised below.

$$GP_k = \beta_0 + \beta_k X_k + \epsilon \qquad (1)$$

Whereby:

GP_k = Green leaf tea production for the kth farmer

β_0 = Intercept representing value of GP when all independent variables are set to zero

X_k = Coefficients indicate how GP changes with a one-unit shift in the predictor variable of interest, keeping other variables unchanged

ϵ = error term

By incorporating the designated independent variables listed in Table 2, Equation 1 can be reformulated structurally into equation two as shown below.

$$GP_k = \beta_0 + \beta_1(CFE)_k + \beta_2(GEN)_k + \beta_3(AGE)_k + \beta_4(EDU)_k + \beta_5(HHS)_k + \beta_6(LS)_k + \epsilon \qquad (2)$$

Whereby:
CFE=Contract farming engagement;
GEN=Gender of respondents;
AGE=Age of respondents;
EDU= Education of respondents;
HHS=Household size of respondents;
LS= Land size of respondents

Results
Descriptive Results
The proportion of farmers engaged in contract farming was higher (70%) compared to those not engaged in contract farming (30%). The study results show that, majority of the respondent were men (57%) compared to women (43%). Besides, the proportion men (63%) are engaged in contract farming was higher than those not in contract farming (43%). In contrast, the proportion of women (37%) engaged in contract farming was lower compared to those not engaged (57%) (Table 2).

Table 2
Respondents Disaggregated by Contract Farming Engagement and Gender

Status of Engagement in Contract Farming (ECF)	n / %	Sex		Total
		Female	Male	
Not ECF	n	66	50	116
	%	57	43	100
ECF	n	102	175	277
	%	37	63	100
Total	n	168	225	393
	%	43%	57	100

This finding suggests that there are gender-based difference in participation in contract farming, with a higher percentage of men being involved compared to women. On the other hand, the average of those engaged in contract farming was slightly lower (47 years) compared to those not engaged in contract farming (48 years) but this difference was not statistically significant at the at 5 percent precision level. This finding suggest that there is no significant age difference in the two groups however, the same indicate an aging population. The aging population of the smallholder tea farmers is in line with several studies reservations which show that, youth engagement in agriculture is relatively low because it is perceived as less prestigious and less remunerative (FAO, 2014; CARE International in Tanzania, 2023). The research outcomes indicate that a substantial proportion (90%) of the examined small-scale tea farmers had received primary school education, while a smaller fraction (10%) had not finished primary school. On the other hand, the average household size of survey respondents is 5.2 individuals, surpassing the national average of 4.6 individuals (URT, 2019). The average farm size of the surveyed smallholder tea farmers is 1.5 acres of tea farms.

The independent variable in the study was measured in terms of production per acre, which averaged around 3,308 kg per acre per annum. The median and mode were 3,500 kg/acre/year and 4,000 kg/acre/annum, respectively. Smallholder farmers engaged in contracting showed higher average production (3,375 kg/acre/year) compared to non-participants (3,150 kg/acre/year). This difference in production per acre was statistically significant at a 5 percent precision level. This finding implies that the disparity between contract farming participants and non-participants is not

coincidental; rather, it is likely influenced by the effect of farmers' engagement in contract farming. This is in line with theoretical expectations and other previous studies which indicate that smallholder farmers engagement, influence crops yield (Liang et al., 2023; Luh, 2020; Mpeta, 2015; URT, 2016). To establish causal effect between smallholder farmers' engagement and production, a multiple linear regression model is employed in the subsequent paragraphs.

Regression Results

The regression results are shown in Table 3. Description of the regression results on the influence of contract farming engagement on green leaf production, along with select farmer characteristics are provides in the subsequent paragraphs.

Table 3
Multiple Liner Regression Results

Model (a)	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error				Lower Bound	Upper Bound
(Constant)	3566.066	227.721		15.66	0.000	3118.252	4013.881
Contract farming engagement	140.102	73.772	0.098	1.899	0.058**	-4.971	285.176
Gender	294.868	68.372	0.227	4.313	0.000*	160.414	429.322
Age	-2.719	3.169	-0.046	-0.858	0.391	-8.95	3.512
Education	-371.457	118.019	-0.165	-3.147	0.002*	-603.542	-139.372
Household size	2.268	18.635	0.006	0.122	0.903	-34.377	38.913
Farm size	-20.866	41.795	-0.026	-0.499	0.618	-103.057	61.325
(a) Dependent Variable: Production/Acre; Independent variables (Constant), CFP status, Age, Farm size, Education, Sex, Household size							
(b) Adjusted R Square=0.078; F=6.211; df2=364; Sig. F Change=0.000; *Independent variables with a significance level below P<0.05; **Independent variables with a significance level below P<0.01							

Effect of Contract Farming Engagement on Green Leaf Tea Production

The findings indicate that there is a favourable positive impact (β = 140.102) resulting from farmers' participation in contract farming on the production of green leaf tea. Besides, the effect was not statistically significant at P=0.05 but it is at P=0.1 because the P value is 0.058. The analytical findings demonstrate a significant and relevant influence, denoted by the coefficient of 140.102, resulting from farmers' participation in contract farming in the field of green leaf tea production. The positive coefficient value, 140.102, implies that each incremental rise in farmers' engagement in contract farming correlates to a proportional raise of around 140.102 units in the domain of green leaf tea production.

Effect of Farmer Attributes on Green Leaf Tea Production

Regression results show a substantial positive influence (β=294.978; P=0.000) between gender and green leaf tea production among Tanzanian smallholder farmers. This finding suggest a strong evidence of the impact of gender on tea production in the context of Tanzanian tea smallholder farmers. Connectedly, the household size of tea smallholder farmers (β=2.268) favourably increases green leaf tea production, although it lacks statistical significance at a 5% precision level (P=0.903). This finding suggest that, despite the lack of statistical significance, the observed trend of a positive influence of household size on green leaf tea production provides insight into the potential relevance of this variable in the context of smallholder farmers' green leaf tea production.

In contrast, age, level of education, and size of farm are negatively associated with green leaf tea production. The specific regression coefficients are age (β = -2.719), level of education (β = -3171.868), and size of the tea farm (β = -20.866), respectively. Besides, in these variables it is the level of education only which was statistically significant at 5% precision level threshold (P=0.002). These finding implies that one unit increase in one of these variables (age, level of education, and

farm size) while holding other factors constant, leads to a decrease in the green leaf tea production. Moreover, the relationship observed in these variables shed light on the possible negative effects of age, education, and farm size on tea output, with education being the most statistically significant driver.

Discussion

The significant positive relationship between smallholder farmers contract engagement and green leaf production implies that when farmers participate in contract farming arrangements, their levels of green leaf tea yield improve noticeably and favourably. This entails that the null hypothesis is not supported instead the alternative hypothesis is considered. This findings aligns with other studies which indicate that participation in contract farming positively influence smallholder farmers productivity (Saroj et al., 2023; Bidzakin et al., 2020; Marwa & Manda, 2022; URT, 2016). Coherence of this study with results from others studies underscores that contract farming plays a substantial influence in increasing green leaf tea productivity among the farmers. It further imply that, formalised agreements and cooperation made through contract farming arrangements are favourably influencing the cultivation, management, and overall output of green leaf tea. The observed effect is likely due contract farmers access to resources, knowledge, and market opportunities, resulting in a significant boost in green leaf tea production capacity.

On the farmer attributes, a significant positive influence of gender and green leaf tea production among Tanzanian smallholder farmers suggests that, gender has a critical role in impacting green leaf tea production positively. This is most likely associated to a variety of roles and skills amongst gender, resource allocation decisions, and knowledge sharing. Similarly, women's participation is likely to improve labour force, crop care, and green leaf output by harnessing their unique insights and contributions. Likewise, the household size of tea smallholder farmers positively increases green leaf tea production. These findings resonates with other studies which indicate that some farmer characteristics, including gender and household size contributes to improved farmers performance (Mazhar et al., 2022; Singh, 2020; Kiet et al., 2020; Ali, 2019; Ngango & Kim, 2019).

Besides, lack of statistical significance on household size may entail that, the observed increase in tea production based on household size may not be strong enough to confidently conclude that it is a significant factor influencing green tea production in this study. In this regard, further studies, may explore if this factor plays a meaningful role in influencing smallholder farmers green leaf production.

The negative effect of age, level of education, and size of tea farm on green leaf production, collectively offer insights into the potential interplay between age, education, and farm size in influencing tea production, underscoring the pronounced role of education as a determinant of significance in this relationship. However, the level of education exerts a statistically significant negative impact on green leaf production within the context of the study, compared to age, and farm size. The negative effect of these variables on green leaf tea production contradicts other scholars who posits that select farmer attributes, including age, education level of smallholder farmers and farm size positively contributes to farmers efficiency (Singh, 2020; Mazhar et al., 2022; Ngango & Kim, 2019). Their position implies that certain characteristics, such as age, education level, and farm size, can improve farmers' tea production efficiency. These characteristics enable farmers to make better decisions, implement effective practises, and make the best use of resources, resulting in enhanced tea production outcomes.

Delving further in the findings of this study, the negative influence of age on green leaf tea production, show that as smallholder tea farmers get older, their green leaf tea production. This could be due to various factors, including; decreases physical capacity or energy levels, or a shift in concentration to other activities. Older farmers may have difficulty managing the labour-intensive duties required for tea cultivation, resulting in a decline in output. Similarly, the significant negative impact between education level and green leaf tea production implies that as farmers' education levels improve, their green leaf tea production drops. This conclusion may appear counterintuitive

but it could be due to educated farmers diversifying their activities or engage in other agricultural and non-agricultural activities, including home gardening, crafting, and running small shops.

Additionally, increased education may increase awareness of the obstacles in tea production, forcing producers to alter their attention or devote less effort. Moreover, the negative effect of tea farm size on green leaf tea production shows that larger tea farms produce less green leaf tea. This could mean that owing large tea farms could results into the management challenges that come with larger farms, such as difficulties in properly monitoring and maintaining the entire tea farm, for example, the process of preparing the green leaf tea plucking table. Furthermore, larger farms may necessitate more labour, resulting in insufficient resources being allocated to each plot, ultimately decreasing production

Conclusion

This study concludes that smallholder farmers' engagement in contract farming positively, influence green leaf tea production. We recommend that policy makers, tea processing companies, and agricultural extension agencies should recognise contract farming's potential for increasing green leaf tea output. Focusing on transparent and equitable contracts are likely to boost the improved production. Given the subtle significance at P=0.1 and the borderline P value (0.058), further research is recommended to look into the reasons driving this observation like, market dynamics, contract design and capacity-building. Relatedly, this study found a nuanced effect amongst farmer characteristics on green leaf tea production. These individual farmer characteristics add to the knowledge among the farmers in the study. On farmer characteristics we concluded that, while gender is associated with increased green leaf tea production, age, better education levels, and larger tea farms are associated with decreasing green leaf tea production. These consequences highlight the importance of having a comprehensive approach to optimising tea production, including aspects such as age-appropriate practises, education-specific interventions, and ways for efficiently managing larger tea. More research could be conducted to investigate the interactions between farmer characteristics (age, education, and gender) and their combined impact on green leaf tea production in Tanzania and beyond. By analysing these aspects collectively, this holistic approach may give insights for optimising productivity.

Conflicts of Interest: The authors declare that no potential conflicts of interest in publishing this work. Furthermore, the authors have witnessed ethical issues such as plagiarism, informed consent, misconduct, data fabrication, double publication or submission, and redundancy.

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References

Ali, E. (2019). Determinants of technical efficiency of cotton farmers in Togo. Review of Agricultural and Applied Economics, 22(2), 88–95. https://doi.org/10.15414/raae.2019.22.02.88-95

Andra-Warner, E. (2022). History in a Cup of Tea. Northern Wilds Magazine. Retrieved August 13, 2023, from https://northernwilds.com/history-in-a-cup-of-tea/

AtlasBig. (2023). World Tea Production by Country. Retrieved August 13, 2023, from https://www.atlasbig.com/en-ie/countries-by-tea-production

Bidzakin, J. K., Fialor, S. C., Awunyo-Vitor, D., & Yahaya, I. (2020). Contract farming and rice production efficiency in Ghana. Journal of Agribusiness in Developing and Emerging Economies, 10(3), 269–284. https://doi.org/10.1108/jadee-11-2018-0160

Bitama, P. C., Lebailly, P., Ndimanya, P., & Burny, P. (2020). Cash Crops and Food Security: A Case of Tea Farmers in Burundi. Asian Social Science, 16(7), 81. https://doi.org/10.5539/ass.v16n7p81

CARE International. (2023). Her money, her life project baseline survey.

Coelli, T. J., Prasada Rao, D. S., O'Donnell, C. J., & Battese, G. E. (2005). An Introduction to Efficiency and Productivity Analysis. https://doi.org/10.1007/b11008210.1007/b13638110.1007/978-0-387-25895-9

Cook, D. A., & Beckman, T. J. (2006). Current concepts in validity and reliability for psychometric instruments: Theory and application. The American Journal of Medicine, 119(2). https://doi.org/10.1016/j.amjmed.2005.10.036

Courbois, Blackmore, Mtukule, & Schwartz. (2022). Briefing: Challenges and opportunities for small-scale tea producers in Malawi. Died. Retrieved August 14, 2023, from https://www.iied.org/sites/default/files/pdfs/2022-07/21011iied_0.pdf

Debnath, B., Haldar, D., & Purkait, M. K. (2021). Potential and sustainable utilization of tea waste: A review on present status and future trends. Journal of Environmental Chemical Engineering, 9(5), 106179. https://doi.org/10.1016/j.jece.2021.106179

Dogeje, F., Ngaruko, D., & Lyanga, T. (2023). Influence of Farmer Quality Attributes on Farmers' Participation in Contract Farming in Tanzania's Tea Subsector. East African Journal of Business and Economics, 6(1), 265–276. https://doi.org/10.37284/eajbe.6.1.1363

Elman, R. J. (2022). Still Searching for Understanding: The Importance of Diverse Research Designs, Methods, and Perspectives. American Journal of Speech-Language Pathology, 31(5S), 2444–2453. https://doi.org/10.1044/2022_ajslp-21-00348

FAO. (2012). Smallholders and Family Farmers. Retrieved August 9, 2023, from https://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Factsheet_SMALLHOLDERS.pdf

FAO. (2014). Youth and agriculture: key challenges and concrete solutions. Retrieved August 15, 2023, from https://www.fao.org/3/i3947e/i3947e.pdf

FAO. (2022). International tea market: market situation, prospects and emerging issues. Retrieved August 15, 2023, from https://www.fao.org/3/cc0238en/cc0238en.pdf

FAO. (2023). International Tea Day 2023: Supporting smallholder tea producers is an integral part in the transformation of agrifood systems. Newsroom. Retrieved August 12, 2023, from https://www.fao.org/newsroom/detail/international-tea-day-2023--supporting-smallholder-tea-producers-is-an-integral-part-in-the-transformation-of-agrifood-systems/en

Hasan, R., Islam, A. F. M. S., Maleque, M. A., Islam, M. S., & Rahman, M. M. (2023). Effect of Drought Stress on Leaf Productivity and Liquor Quality of Tea: A Review. Asian Journal of Soil Science and Plant Nutrition, 9(4), 1–10. https://doi.org/10.9734/ajsspn/2023/v9i4187

Hilal, & Mubarak. (2013). International tea marketing and need for reviving Sri Lankan tea industry. Journal of Management, 9(1), 25–38. https://doi.org/10.4038/jm.v9i1.7563

IDH. (2021a). Agriconnect improving income and nutrition of smallholder tea farmers in Southern Tanzania: RBTC-JE SDM Case Report. Retrieved August 8, 2023, from https://www.idhsustainabletrade.com/uploaded/2021/12/RBTC-JE-in-Agricon-template_Public-report.pdf

IDH. (2021b). Agriconnect improving income and nutrition of smallholder tea farmers in Southern Tanzania: Ikanga SDM Case Report. Retrieved August 8, 2023, from https://www.idhsustainabletrade.com/uploaded/2021/12/Ikanga-SDM-case.pdf

Kiet, T. H. V. T., Thoa, N.T.K.,& Thai, L.X. (2020). Determinants of Technical Efficiency of Tuong-mango Farmers in Cooperative and Non-cooperative in the Southern Vietnam. Journal of Advanced Research in Dynamical and Control Systems, 12(7), 517–525. https://doi.org/10.5373/jardcs/v12i7/20202034

Knight. (2022). What is a Smallholder Farmer? Heifer International. Retrieved August 13, 2023, from https://www.heifer.org/blog/what-is-a-smallholder-farmer.html

Liang, Y., Bi, W., & Zhang, Y. (2023). Can contract farming improve farmers' technical efficiency and income? Evidence from beef cattle farmers in China. Frontiers in Sustainable Food Systems, 7. https://doi.org/10.3389/fsufs.2023.1179423

Lowder, S. K., Sánchez, M. V., & Bertini, R. (2021). Which farms feed the world and has farmland become more concentrated? World Development, 142, 105455. https://doi.org/10.1016/j.worlddev.2021.105455

Luh, Y. H. (2020). Inclusiveness of Contract Farming along the Modern Food Supply Chain: Empirical Evidence from Taiwan. Agriculture, 10(5), 187. https://doi.org/10.3390/agriculture10050187

Marwa, M. E., & Manda, J. (2022). Do youth farmers benefit from participating in contract farming? Evidence from French beans youth farmers in Arusha, Tanzania. Agrekon, 61(4), 379–398. https://doi.org/10.1080/03031853.2022.2099917

Mazhar, R., Xuehao, B., Dogot, T., Skominas, R., Tanaskovik, V., Azadi, H., & Wei, Z. (2022). Contract Farming and Technical Efficiency: A Case of Export-Oriented Organic Rice Farmers in Pakistan. Land, 11(11), 1953. https://doi.org/10.3390/land11111953

Mpeta, D. (2015). Effects of contract farming on production and income of sunflower farmers in Kongwa district in Central Agricultural Zone of Tanzania . Retrieved August 13, 2023, from http://41.59.85.71/bitstream/handle/11192/2247/PhD-MU_Mpeta-Daniel%20Fabiano_2017.pdf?sequence=1

Muzira, R., Nabasumba, D., Natuha, S., & Okello, J. (2023). Understanding Gendered Tea Production Characteristics and Trends under Smallholder Farming Systems in South-Western Uganda. OALib, 10(04), 1–11. https://doi.org/10.4236/oalib.1109423

Ngango, J., & Kim, S. G. (2019). Assessment of Technical Efficiency and Its Potential Determinants among Small-Scale Coffee Farmers in Rwanda. Agriculture, 9(7), 161. https://doi.org/10.3390/agriculture9070161

Ngeno, V. (2023). Technical efficiency and technology gap in Kenya's tea industry: accounting for farm heterogeneity. Journal of Development Effectiveness, 1–18. https://doi.org/10.1080/19439342.2023.2217177

Orlando, G. (2023). On the Assumptions of the Cobb-Douglas Production Function and Their Assessment in Contemporary Economic Theory. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4439917

Perera, P. (2014). Tea smallholders in Sri Lanka: Issues and challenges in remote areas. International Journal of Business and Social Scienc, 5(12), 108–117. https://ijbssnet.com/journals/vol_5_no_12_november_2014/13.pdf

Rajeswar, K., Saranya. R., & Ambika, V. (2017). Tea Industry in India–Challenges Ahead. Iconic Research and Engineering Journals, 1(7), 39–41. https://www.irejournals.com/formatedpaper/1700155.pdf

Rondhi, M., Bagus Kuntadi, E., Suwandari, A., Yanuarti, R., Fatikhul Khasan, A., Mori, Y., & Kondo, T. (2023). Impact of Contract Farming on the Technical Efficiency of Broiler Farmers in Indonesia. Economia Agro-Alimentare, 25(1), 35–55. https://doi.org/10.3280/ecag2023oa14670

Roser, M. (2023). Employment in Agriculture. Our World in Data. Retrieved August 14, 2023, from https://ourworldindata.org/employment-in-agriculture

Saroj, Paltasingh, K. R., & Jena, P. K. (2023). Does contract farming enhance farm efficiency? A case of wheat growers of Haryana, India. Heliyon, 9(4), e15222. https://doi.org/10.1016/j.heliyon.2023.e15222

Singh, D. K. (2020). Technical efficiency of dairy farmers in Bihar, India: status and determinants. Agricultural Economics Research Review, 33(1), 81. https://doi.org/10.5958/0974-0279.2020.00009.9

Statista. (2023). Global: annual tea consumption 2012-2025 | Statista. Retrieved August 12, 2023, from https://www.statista.com/statistics/940102/global-tea-consumption/

Swain, B. B. (2016). Does Technological linkage in contract farming increase farm productivity and efficiency? The case of hybrid paddy seed cultivation in Undivided Andhra Pradesh. Agricultural Economics Research Review, 29(2), 211. https://doi.org/10.5958/0974-0279.2016.00049.5

TanzaniaInvest. (2016). Smallholder Farmers Archives. Retrieved August 13, 2023, from https://www.tanzaniainvest.com/smallholders

TanzaniaInvest. (2023). Tanzania Agriculture Archives. Retrieved August 13, 2023, from https://www.tanzaniainvest.com/agriculture

URT. (2016). Contract farming schemes in Tanzania: Benefits and challenges Tanzania WP No. 8, January 2016. BoT. Retrieved August 12, 2023, from https://www.sustainableagtanzania.com/_webedit/uploaded-files/All%20Files/machinery/Contract%20Farming%20Schemes%20in%20Tanzania-%20Benefits%20and%20Challenges.pdf

URT. (2019.). Tanzania mainland household budget survey 2017-18: Key indicators report. Dodoma, Tanzania. Available at: https://www.nbs.go.tz/nbs/takwimu/hbs/2017_18_HBS_Key_Indicators_Report_Engl.pdf (Retrieved August 12, 2023).

URT. (2023). Tea industry trend: A report presented at the tea stakeholders meeting held in Iringa Tanzania on 18 January 2023

Wang, X., & Fu, Y. (2013). Some Characterizations of the Cobb-Douglas and CES Production Functions in Microeconomics. Abstract and Applied Analysis, 2013, 1–6. https://doi.org/10.1155/2013/761832.