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Cashew nut Business Performance and Smallholders' Farmers Welfare: Exploring the Nexus in Southern Regions of Tanzania

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Abstract

Despite a significant increase in foreign exchange earnings from cashew nut exports in Tanzania over the past ten years, it remains unclear whether smallholder farmers have benefited from participating in the cashew nut business. This study bridges the research gap by assessing the impact of cashew nut business performance on smallholder farmers' welfare in Mtwara and Lindi regions. A quasi-experimental design using cross-sectional data was employed, involving 384 respondents, 128 cashew nut farmers and 256 non-participants. Data were collected through structured questionnaires and Focus Group Discussions (FGDs), and analysed using Propensity Score Matching (PSM) and content analysis.The findings show that participation in the cashew nut business had a statistically significant positive impact on farmers' welfare (t-value > 2). Participants reported higher food expenditure (TZS 58,687–58,829), non-food expenditure (TZS 52,312–55,385), income (TZS 1,763,592–1,786,650), and annual savings (TZS 697,232–701,714). They also owned more consumer durables, valued between TZS 13.9- TZS 14 million. As the study confirms the positive impact of cashew nut business on farmers' welfare, local governments should encourage non-members to engage in the sector through sensitisation on its benefits. The Cashew Nut Board of Tanzania should continue regulating and promoting the quality, marketing, and export of both raw and processed cashew nuts. The central government should strengthen trade regimes and institutions that enhance positive and mitigate negative trade impacts on sustainable development. Lastly, smallholder farmers should

improve their socioeconomic status through capacity-building programmes and adopt sustainable farming practices.

Keywords: Agribusiness, Cashew nut business, Smallholder farmers, welfare

1.0 Introduction

Business performance is a fundamental aspect of any enterprise, as it helps predict future outcomes (Mashenene & Kumburu, 2020). Traditionally, performance measures have been used to determine enterprise success through accounting and financial indicators (Tudose et al., 2022). Business performance refers to the ultimate achievements of business operations and typically covers three dimensions of organisational results: (1) financial outcomes (such as profits, asset returns, and investment returns), (2) market outcomes (including sales and market share), and (3) returns to shareholders (such as total shareholder returns and economic value added) (Sitharam & Hoque, 2016).

The cashew nut business entails the production and sale of cashew nut to generate profit. It is widely considered one of the most effective means of addressing poverty and improving welfare in developing countries (Mashenene & Kumburu, 2020; Dimoso et al., 2024; Léonard et al., 2023). It is projected that increasing agricultural productivity and sales could reduce the proportion of people living on less than $1 a day by between 0.6% and 2% (Léonard et al., 2023). Smallholder participation in the cashew nut business exposes farmers to diverse market prices and services, which directly influence their income and welfare outcomes (Tudose et al., 2022). Enhancing the profitability of cashew nut farming can stimulate investments in productive assets, adoption of modern agricultural technologies, and improvements in household welfare (Jensen, 2010). The cashew nut industry in Tanzania generates over USD 356.5 million annually, ranking it third globally after Côte d'Ivoire and India, which earn approximately USD 800 million and USD 452 million respectively (Lukurugu, 2022; CBT, 2024).

Moreover, the global demand for cashew nuts has increased by 9% annually, and the percentage increase in cashew nut prices from TZS 2,047–2,857/kg in 2015/2016 to the TZS 4,035–4,120/kg in 2024/2025 an increase of 44.2% indicating robust market potential (Lukurugu, 2022; CBT, 2024). The business potential is particularly significant in the Lindi and Mtwara regions, where approximately 65% of the rural population relies on cashew nuts as their primary source of income, followed by sesame (Bezu & Villanger, 2019). Despite growth in cashew nut production and market expansion, smallholder farmers in these regions continue to face poor welfare outcomes (NBS, 2023). This underscores the need to ensure that increased business returns translate into tangible welfare improvements through enhanced income, savings, asset ownership, and resilience to shocks.

Welfare is conceptualised as the level of utility attained by individuals, determined by access to goods and services such as food, education, healthcare, housing, and clean water. The Lindi and Mtwara regions exhibit poor livelihood indicators (Tanzania Human Development Report, 2023). Both regions fall within the middle poverty tercile, with 47% and 49% of their populations, respectively, classified as multidimensionally poor (URT, 2022). The incidence of basic needs poverty in these regions stands at 26.4%, surpassing the national average, with higher vulnerability observed among youth, women, and the elderly (URT, 2021). The average annual regional GDP per capita from 2013 to 2017 was TZS 1,737,881 for Lindi and TZS 2,700,027 for Mtwara (URT, 2022), reflecting relatively low levels of economic development.

In response, the Government of Tanzania (GoT) has implemented several policies and established institutions to promote the cashew nut sub-sector. Key initiatives include the establishment of the Naliendele Agricultural Research Institute (NARI) in 1970 to enhance crop

yields and quality; the formation of the Cashew Nut Board of Tanzania (CBT) in 1993 to oversee quality and trade; and regulatory frameworks such as the Cashewnut Industry Act of 2009 and the Warehouse Receipt Act No. 10 of 2005 (Lukurugu, 2022). The government has also supported cooperatives to facilitate access to inputs, markets, and fair prices. These interventions have contributed to an increase in cashew nut yields from 232,700 Mt in 2021 to a projected 1,000,000 Mt by 2025 (CBT, 2024).

Research on the impact of the cashew nut business on smallholder farmers' welfare presents mixed findings. Studies by Yeboah et al. (2023), Mariwah et al. (2017), and Léonard et al. (2023) highlight positive welfare impacts, such as increased income and reduced hunger. In contrast, Mahadewi et al. (2022) and Wittern et al. (2023) report insignificant effects. These discrepancies may arise from differences in geographical focus, sample sizes, and analytical methods used. Furthermore, many studies rely solely on income as a proxy for welfare, neglecting broader indicators such as savings, assets, and expenditure patterns.

This study makes a novel contribution by adopting a comprehensive welfare framework that includes income, savings, asset ownership, and expenditure patterns to assess the cashew nut business's impact. It also employs a rigorous quasi-experimental design using Propensity Score Matching (PSM), which addresses selection bias often overlooked in earlier studies. Unlike existing literature that primarily focuses on production or market access, this study bridges a critical gap by empirically analysing how business performance affects multidimensional welfare among smallholder farmers in Tanzania. Additionally, it offers region-specific evidence for Lindi and Mtwara, which are underrepresented in cashew related welfare studies, despite their strategic role in cashew production.

However, notwithstanding the pragmatic contributions, particularly in Lindi and Mtwara regions, it is not known if agriculture has achieved strong growth and meaningful transformation as planned and specifically the impact of cashew nut business (profit) on smallholder farmers' welfare in form of revenue, savings, assets, spending forms, and resilience to tremors (such as drought and floods) remains unclear. This situation suggests that smallholder farmers do not fully benefit from their engagement in the business, partly due to deductions associated with primary societies, unions, district councils, warehouse receipt systems, and the existence of thin markets, which hinder competition (Thangata, 2016). Consequently, farmers' incomes do not adequately reflect their incurred costs, resulting in persistently low welfare among smallholder farmers.

Despite a significant increase in foreign exchange earnings from cashew nut exports in Tanzania over a ten-year period (2015/2016–2024/2025), reaching Sh1.52 trillion ≈ USD 584.6 million from USD 185 million, surpassing earnings from other strategic crops such as coffee and tea, welfare levels in the Lindi and Mtwara regions have remained high, with 33.9% and 30% of the population considered poor, respectively (NBS, 2024). This disparity raises questions about why smallholder farmers remain impoverished despite the prominence of cashew nut exports. These circumstances underscore the need for a comprehensive study to generate empirical data and inform interventions aimed at improving cashew nut business performance and enhancing the welfare of small-scale farmers.

Consequently, this study aims to analyse the nexus between the cashew nut business and smallholder farmers' welfare in Lindi and Mtwara, Tanzania. It is thus hypothesised that:

1. Ho: There is no discernible difference in socio-economic characteristics between smallholder farmers who participate in cashew nut businesses and those who do not participate in the Lindi and Mtwara regions.
2. Ho: There is no discernible difference in welfare between smallholder farmers who engage in business activities and those who do not in the Lindi and Mtwara regions

2.0 Review of the related works

2.1Theoretical Framework

This research utilized a sustainable livelihood approach to envisage the cashewnut business and smallholder farmers' welfare. The Sustainable Livelihoods Framework (SLF) developed by Kumar et al. (2023) provides a structure for understanding the opportunities and constraints affecting the poor's ability to access resources and achieve sustainable livelihoods. Originating from the susceptibility-resiliency narratives in the context of rural progress, the SLF is designed to elucidate the procedure for designing sustainable livelihoods, making it particularly suitable for this study. In the SLF, livelihoods are defined by assets and activities, along with the capacity to access them, which determines an individual 'or household's livelihood (Yanuartati, 2023). Smallholder farmers with more assets have more options (Long, 2023). Assets in this context are akin to embedded resources, encompassing both tangible and intangible elements that smallholder farmers can exchange. The SLF categorizes 'livelihood assets' into human, natural, financial, physical, and social capital (Fig. 1). Human capital includes labor, skills, experience, knowledge, and creativity. Natural capital consists of resources, such as land, water, forests, pastures, and minerals. Physical capital comprises tangible items, such as houses, tools, machinery, food stocks, livestock, jewelry, and farm equipment. Financial capital includes money, savings, loans, and credit. Social capital pertains to the quality of relationships among people. The importance and value of these assets vary by context; for instance, natural capital may be more crucial in rural settings, while shelter and labor (physical and human capital) might be more significant in urban areas. Indeed, smallholder farmers' access to these capital assets is influenced by structures (such as levels of government, private sector, and civil society) and processes (including laws, policies, culture, institutions, and power relations). This is summarized in **Figure 1.**

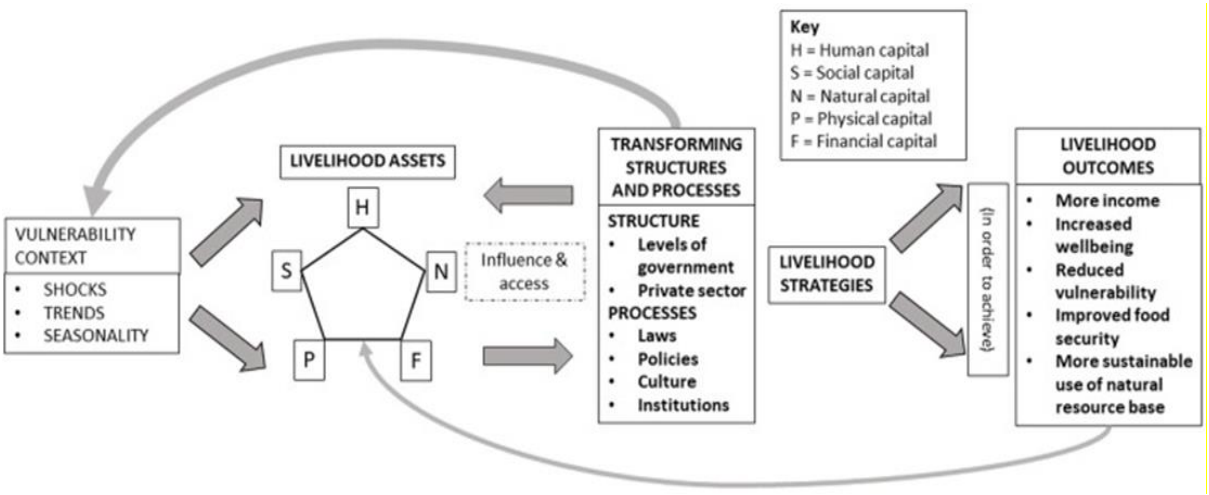

Figure 1: *The Sustainable Livelihood Framework*

Source: *Yanuartati (2023)*

The cashew-nut business encompasses the entire value chain involved in the production, processing, marketing, and distribution of cashew nuts. Thus, cashew nut businesses can bring about economic growth by ensuring that smallholder farmers acquire various resources along with the capacity to access them, which determines an individual or household's welfare in terms of ensuring food security, closing the nutritional gap, and enhancing living standards. It also contributes to improving the standard of living and quality of life, conserving resources,

and promoting overall health and economic prosperity. Conversely, society is primarily concerned with how the cashew nut business sector impacts employment, investment, and economic growth, as well as its effects on the standard of living, resource utilization, conservation efforts, and overall health and prosperity of the economy (Yanuartati, 2023). However, the Sustainable Livelihood Approach inadequately addresses structural inequities and behavioral factors in the cashew nut business, necessitating the inclusion of Morris Altman's Behavioral Theory of Economic Welfare, specifically Economic Justice, to fully assess the influence of the cashew nut business on smallholder farmers' welfare.

Grounded in the economic theory espoused by Morris Altman, particularly the behavioral theory of economic livelihood and economic justice (Saturday, 2021). Central to Altman's notion is the belief that individuals' livelihood may not be enhanced when the material well-being of the employed population is diminished, even in the face of overall economic growth. Altman argued that an improvement in welfare is justified only if it benefits at least one individual without worsening the situation for others in society, aligning with Pareto's criterion, which posits that societal improvement occurs when the welfare of at least one person increases without detriment to others. In these studies, welfare is evaluated by comparing the utility functions of various farmers, allowing for personal comparisons of welfare, even if it entails increased costs for certain individuals. While the term "welfare" typically implies that income or profit gains are crucial for the living conditions and well-being of smallholder farmers, they are also vital for a well-functioning economy and the equitable distribution of wealth. According to the Pareto criterion, income redistribution may result in individuals benefiting at the expense of others. In the field of farm production economics, a primary concern is how to achieve greater net farm income, as improvements in smallholder income directly translate into improved smallholder farmer welfare.

The business performance of smallholder farmers is subscribed to differently by producers, consumers, and society. For instance, consumers frequently complain about high and fluctuating prices, quality, and timely availability of products. Producers may assess performance based on a declining number of product buyers, reduced competition for supplies, and buyers of agricultural products with control over price, the failure of retail and farm prices to move together, excessive marketing costs and prices, and lower cost prices. A broad society is more anxious about the agricultural marketing sector playing a crucial role in enhancing employment, opportunities, attracting investment, and fostering economic growth. It also contributes to improving the standard of living and quality of life, conserving resources, and promoting overall health and economic prosperity. Conversely, society is primarily concerned with how the agricultural marketing sector impacts employment, investment, and economic growth, as well as its effects on the standard of living, resource utilization, conservation efforts, and overall health and prosperity of the economy (Pruntseva et al., 2024). Scholars opined that the assessment of cashew nut business performance requires specific measures such as 1) financial indicators (Profits, ROA, ROI, etc.); (2) market indicators (sales, market segment, etc.); and (3) shareholder return (total shareholder return, economic value added, etc.) (Duan et al., 2023). Others such as Ameh et al. (2022) opined that retail prices, the share of consumers' income spent on food, farm retail price spreads, and farmers' share of consumers' food money are popular measures of business performance.

However, these are some indicators that can be utilized as proxy measures of business performance, each of which has value and limits in the assessment of agricultural business performance. Therefore, there is no universal application of business performance measures because of their complexity, and thus, using a single measure might lead to misleading conclusions and recommendations. Therefore, care must be taken when determining the business performance measures. This study applied financial performance (profits, return on assets, return on investment, etc.) as a proxy measure of business performance among cashew nut smallholder farmers because of its objectivity and worldwide recognition. Livelihood is

conceptualized as level of economic and social well-being attained by individuals or households, determined by their ability to secure and utilize resources for sustaining life and improving their quality of living. It encompasses access to essential needs such as adequate food, improved education, healthcare, housing, and clean water. Additionally, livelihood includes aspects such as increasing income, output, and assets (Balogun 2021). In the scope of this research, welfare is operationalized as the value of life, considering factors such as income, cash savings, assets, spending patterns, and the capacity to withstand unexpected distress.

This study applied PSM to assess level of welfare because of participant in cashew nut business among participants and non-participants due to its potential to provide counter factual evidence. Welfare is conceptualized as the level of utility attained by individuals, which is determined by the goods and services they consume. It encompasses access to essential needs such as adequate food, improved education, healthcare, housing, and clean water. Additionally, welfare includes aspects such as increasing income, output, and assets (Yeboha, 2023). In the scope of this research, welfare is operationalized as the value of life, considering factors such as food, non-food, assets, savings, and consumer durables. By leveraging the assets categorized in the sustainable livelihood framework, the cashew-nut business can significantly enhance smallholder farmers' welfare across various dimensions. Improved access to and management of these assets leads to better food security, fulfillment of non-food needs, accumulation of assets, increased savings, and acquisition of consumer durables, ultimately fostering sustainable livelihood and resilience among smallholder farmers.

2.2 Empirical Debate on Cashew nut business and small holder farmers welfare

Léonard et al. (2023) assessed the impact of cashew grafted plants adoption on productivity and household welfare in benin. Propensity Score Matching (PSM) method was applied, dada were collected from 200 cashew farmers, including 57 adopters and 143 non-adopters of grafted plants. The results revealed that the improvement in cashew nut yield due to adopting grafted cashew plants varies between 231 and 242 kg/ha respectively for Nearest Neighbor and Kernel matching algorithm. Nevertheless, this adoption requires important investments that contribute to increasing agricultural expenses. It was also noted that grafted plants positively & significantly influence cashew income. Grafted cashew plants adopters have an additional 73 755 CFA per hectare cashew income. Total household income also improved by 110 000 CFA per hectare. Yet, the increase in income ought to be large to reduce the proportion of poor among adopters significantly. Thus, increasing cashew nut farmers' welfare will require developing cashew nut planting materials capable of boosting cashew nut productivity. Implementing and diffusing grafted cashew plants needs substantial investments to improve cashew productivity and farmers welfare.

Yeboah et al. (2023) examined the influence of smallholder cashew production and household livelihoods in the transition zone of Ghana. It is still unclear if cashew farmers are better off or worst off from cashew farming in Sub-Saharan Africa. The study investigated the overall effects of cashew production on household livelihoods among smallholder farmers in the Transitional Zone of Ghana. Mixed research design was applied for data collection and analysis. Furthermore 239 cashew-farming households were surveyed. The results revealed both mixed outcomes for farmers and their households. The positive outcomes comprised of increased income, enhanced social status, improved food and nutrition, housing and education. While the negative results included augmented theft, high cost of goods and services, high cost of living, and a rise in physical health problems among farmers. Generally, cashew farmers and their households experienced improved livelihoods despite the negative effects arising from cashew farming. It was recommended that a multi-stakeholder approach to development planning that promotes innovations in training, extension support, and sound financial and business management should be improved.

Mahadewi et al. (2022). analyzed the impact of the cashew industry on the socio-economic conditions of cashew farmers in Ban Village. The study employed descriptive mixed approached of qualitative and quantitative and before after, KII and questionnaires were the main data collection methods. It was revealed that cashew industry had impact on the economic conditions (increase in income) of farmers in Ban Village. Increased income has an impact on the ability of farmers to improve housing conditions so that they become more feasible and comfortable, and are able to create business opportunities so that they can provide other financial benefits. Even though social conditions show that social interaction is established. Nonetheless, there is a decrease in the intensity of meeting within the family because more interactions are carried out at night after work. Concerning consumption, ownership of household facilities, knowledge and skills of farmers has increased. Farmers are recommended to pay more attention to their agriculture so that they can produce superior quality cashew nuts and the industry to pay attention to the comfort of the community to avoid conflicts.

Nangameta (2022) assessed the effect of Warehouse Receipts System for Economic Welfare of Smallholder Cashew nut Farmers in Mtwara District, Tanzania. Specifically, the study with determined the impact of Warehouse Receipts System on farmer's income improvement, accessibility to markets and on the improvements of quality cashew nut produced. The study employed cross-section design and a sample size of 302 farmers was employed. Systematic multi stage sampling technique was employed to select five wards where both quantitative and qualitative data were obtained. Multiple regression models were also used in data analysis. The study revealed that WRS brought improvement to farmers income through accessing financial institutions and insurance services. This eventually improved their welfare. It was also found that the key and vital role played by WRS such as accessing farmers to advanced storage facilities, well packaging materials had improved the quality of cashew nut produced and thus income. It was also revealed that delaying in payments and being paid for instalment was not satisfied the farmers. Age of the respondents, family size and the land size owned was found to have significant impacts to farmer's economic welfare. It was also concluded that farmers value WRS in its role which ultimately benefits farmers by increasing income that leads to improve living standard, but the unethical behaviour of operators reduces the trust of WRS. The study recommended to policy makers including stakeholders like farmers, AMCOS and CBT to deal with the aspects of markets, price setting, post-harvest losses and challenges facing farmers accordingly.

Although the existing body of research on cashew farming and smallholder welfare provides important insights, several critical gaps remain. A common limitation in many of these studies is their narrow focus on income or productivity, often overlooking broader aspects of welfare such as housing conditions, access to healthcare, food security, and education. This narrow lens does not fully capture the everyday realities and needs of smallholder farmers. In addition, while some researchers, such as Léonard et al. (2023), have adopted more rigorous approaches like quasi-experimental designs, many others rely on basic descriptive or cross-sectional analyses. These approaches fall short in establishing cause-and-effect relationships, making it difficult to determine whether improvements in welfare are truly attributable to cashew farming. Furthermore, the findings across different studies are not always consistent. For example, Yeboah et al. (2023) reported both positive and negative impacts of cashew farming, pointing to the importance of context and the role of supporting policies and institutions. Another issue is the limited scale of these investigations many rely on relatively small, localised samples, often fewer than 200 respondents. As Kyriazos (2018) notes, such small sample sizes can compromise the accuracy and generalisability of research findings. Most notably, there is a striking lack of empirical evidence from Tanzania, despite its significance as one of Africa's leading cashew producers. This underrepresentation leaves an important gap in understanding how the cashew sector affects smallholder farmers in the Tanzanian context.

In response to these shortcomings, the present study seeks to provide a more comprehensive understanding by incorporating a multidimensional view of welfare that goes beyond income and productivity alone. It also employs a larger and more statistically robust sample to improve the credibility and applicability of the results. Advanced analytical tools will be used to uncover potential causal links between cashew farming and smallholder welfare. Importantly, the study is grounded in the Tanzanian context, offering context-specific evidence that can help shape more effective policies and practices within the cashew value chain

2.2 Conceptual Framework

This study is anchored in the premise that the cashew nut business, as the independent variable, plays a vital role in shaping the welfare of smallholder farmers, which is the dependent variable. Cashew nut business performance is a mediating variable, connecting structural & operational elements of the business to tangible welfare outcomes. Performance of cashew nut business is influenced by several drivers and determinants such as land size, labour, farm inputs access, capital, extension services, and market accessibility. These inputs influence the volume of output, income earned, net profits, and return on investment (RORI) the key indicators of business performance. Enhanced business performance resulted to improved household income. Household income is used by farmers in meeting basic needs, such as education, healthcare, acquire assets, and savings. Consequently, Consequently welfare which was operationalized through monthly food and non-food expenditure, asset ownership, and household savings (in TZS)

Cashew nut business (independent variable) → Business performance (mediating variable) → Smallholder farmers' welfare (dependent variable).

It is also assumed that, relationship between business performance and welfare is not linear or uniform all the time and across households. This is because is influenced by socioeconomic characteristics like education level, household size, farming experience as well as gender of the household head. These characteristics act as moderating variables, affecting how much of the income derived from the cashew nut business translates into improved welfare. Further, cashew nut business can contribute to welfare by creating jobs. Increased engagement in the cashew business increase demand for labour and farming inputs which in turn leads to spill over effects. Through this process smallholder farmers transit from to more market led production systems through which they earn higher income and enhancing their capacity to invest in long term livelihood improvements.

Despite numerous empirical studies that explore the link between cashewnut business and rural welfare, scant attention has been given to the specific contribution of business performance to the welfare of farmers. This study seeks to address this gap by focusing on the cashew nut business in the Lindi and Mtwara regions of Tanzania, where the crop is a major economic driver. By linking cashew nut business as the independent variable and welfare as outcome variable, this framework offers a structured approach to understanding the economic significance of this relationship to smallholder farmers welfare. This is summarized in **Figure 2**.

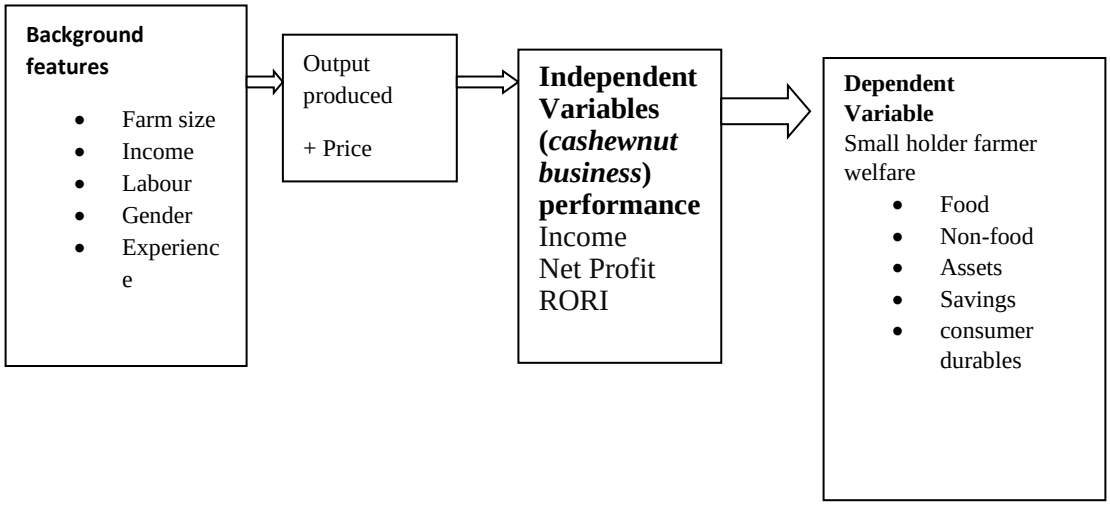

Figure 2: *Conceptual Framework*

Source: *Authors own Construction*

3.0 Methodology

3.1 Research Design

The quasi-experimental design relating to cross-sectional data was employed rather than a Randomized Control Trial (RCT) because in this case it is difficult to meet the three conditions for RCT, which are first randomization whereby subjects are randomly assigned to control and experimental groups and each subject has equal chance of being assigned to either group, second manipulation/intervention whereby experiment is done to selected group(s) of subjects in study and not to other (s), and finally control whereby one or more control group(s) are compared with experimental group(s) (Léonard et al. (2023). This allowed data of concern (nexus cashewnut business and welfare) to be gathered and investigated at once, unlike other techniques such as experimental design (Msuya, 2020). Data for this study were collected from August to December 2021. A mixed-methods approach that utilizes quantitative and qualitative techniques was employed in data collection for triangulation purposes (Saunders, Lewis & Thornhill, 2012).) Information was gathered from both participating and non-participating smallholder farmers in cashew nut production.

3.2 Description of Study area

The study was conducted in the Mtwara and Lindi regions in southern Tanzania, as shown in the map. Mtwara is the southernmost region of the country, bordered by Lindi to the north, the Indian Ocean to the east, and Mozambique to the south, separated by the Ruvuma River. To the west, it shares a boundary with Ruvuma region (URT, 2025). The region covers an area of 16,720 square kilometres and is divided into five districts and 98 wards. According to the 2022 National Population and Housing Census, Mtwara had a population of 1,270,854 (URT, 2025). Agriculture forms the backbone of the local economy, with about 92% of the population engaged in it over 65% of whom are involved in cashew nut farming. Other notable activities include fishing, beekeeping, small-scale industries, and extraction. Lindi region, located just north of Mtwara, borders Morogoro and Pwani to the west, Ruvuma to the east, Mtwara to the south, and also fronts the Indian Ocean to the east (URT, 2019). It spans roughly 67,000 square kilometres and is administratively divided into five districts and 142 wards. As of 2022, the region's population stood at 1,004,439 (NBS, 2019). Like Mtwara, Lindi's economy is largely agricultural, with cashew farming being the dominant activity. Other economic pursuits include

general trade, office-based work, construction, manufacturing, mining, and livestock keeping. These two regions were purposively selected for the study because they are the country's main cashew producers, contributing an estimated 80% to 90% of Tanzania's marketed cashew crop (CBT, 2025). See **figure 3** for the details.

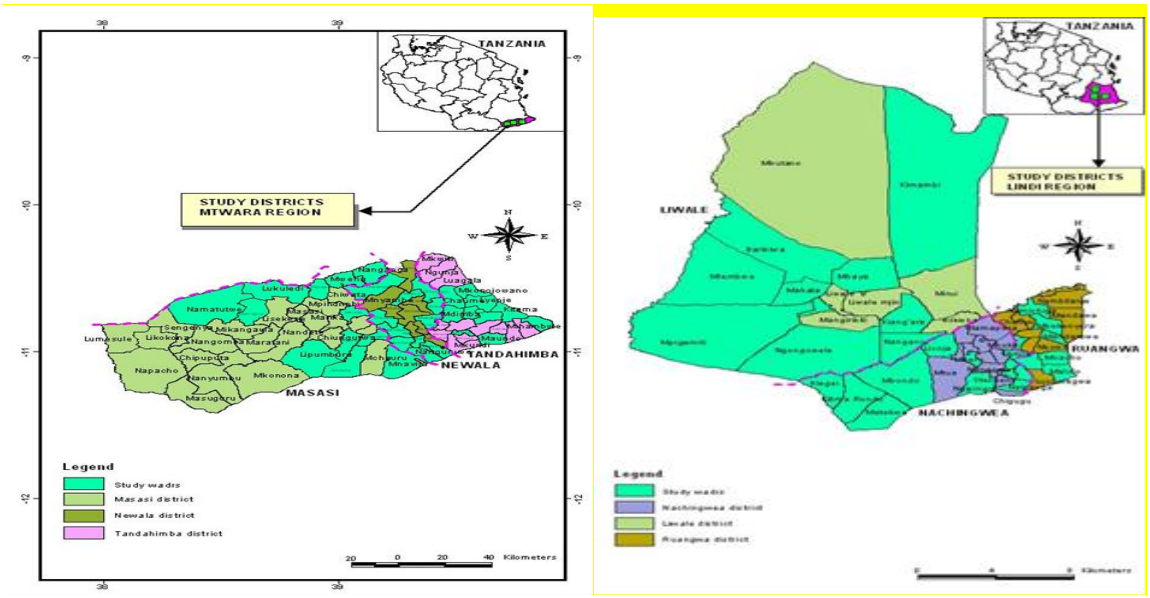

Figure 3: *Description of study areas*

Source: *Field survey, 2021*

3.3 Sample Size and Sampling Procedures

A total of 384 respondents were included in this study. The sample size was estimated using Daniel's (2009) formula because it accommodates participants (p) and non-participants (1-p) for sample size calculation to generate counterfactual evidence. The details of this process are provided below.

$$\text{Sample Size (n)} = \frac{z^2 \text{x (p) x (q)}}{d^2}$$

Where;
Z= degree of confidence (95%, which yielded 1.96).
p= Percentage of the target population estimated to have characteristics (50%)
q= 1.0-p (population estimated to have 50% characteristics)
d= Margin of error set to 0.05 capture

Out of 384 accessed sample participants (cashew nut smallholder farmers =128) and non-participants (non-cashew nut smallholder farmers =256), only 128 participants were studied. The size of the respondents is a suggestion from preceding quasi-experimental inquiries (Wan, 2025). The large size of non-participants confined large variances among non-participants with respect to diverse welfare parameters among smallholder farmers. A ration 2-to-3 ratio of participants to non-match the prerequisite of the PSM model (Msuya, 2020).

The response rate was equal to 100%, which was reasonable, as remarked by Babbie (2010) that a response rate of 70% and above is very good. Multistage sampling was then performed. First, in Mtwara, Tandahimba, 12 out of 22 wards were selected; in Newala, 12 out of 20 wards were selected; and in Masasi out of 28 wards 15were selected. In Lindi, Nachingwea out of 32, 15 were selected; in Ruagwa out of 21 wards, 11 were selected, in Liwale out of 20 wards, 11

were selected. Second, within each ward, a total of 152 hamlets were selected hamlets were chosen randomly from the Ward Executive Officer list, employing random numbers. households within each hamlet were selected. Third, smallholder farmers within the hamlets were systematically chosen based on household lists provided by the WEOs. The initial household was randomly selected, and the subsequent smallholder farmers/households were acquired by selecting each 10th household (Lukurugu et al. 2022; Kumburu, et al., 2019). Second, in the fourth phase, heads of every household were purposively chosen, focusing on both participants and non-participants. Thus 76 wards were selected, with each ward contributing 5 respondents. in each ward, 2 hamlets were selected, amounting to total of 152 hamlets. Consequently, the distribution of respondents per hamlet averaged between 2 and 3 household and in each household one person was selected.

3.4 Methods and Tools of Data Collections

Data were collected via a semi-structured questionnaire to capture both qualitative and quantitative information. The questionnaire included both closed and open-ended questions. The questionnaire was administered face-to-face. This was expected to lead to a higher response rate and more accurate data. It was also easier for the enumerators to rectify the questions where necessary. The first section of the questionnaire intended to capture consisted of the socio-demographic characteristics of respondents, such as their age, education, income, cashew tree number, farm size, outreach program, landholding situation, application of fertilizers and agrochemicals, cashew nut price, and cashew nut quality. Other sections aim to collect specific information on welfare (income earned and costs involved in covering all expenses associated with food items, non-food items, consumer durables, and savings). To ensure reliability and validity, the study instrument was pretested with 40 respondents. The aim was to ensure that the questions were well understood and answered within the time frame. Qualitative information was obtained through Key Informant Interviews (KIIs) and focus-group discussions (FGDs). A total of six KIIs were organized in each district, containing purposively technical official personnel due to their acquaintance with cashew nuts and welfare matters. Furthermore, six FGDs constituting eight randomly selected farmers were arranged in each district, and household position, gender, and age were among the criteria in selecting participants to reflect diverse opinions.

3.5 Analytical Model

Qualitative data from Key Informant Interviews were analysed using the Content Analysis (CA) method. Several systematic procedures were conducted, first, the interviews were transcribed into word documents. Key themes, concepts, and phrases related to the business performance and smallholder farmers welfare were transcribed into word document to enable comprehensive scrutinization of all responses. In this study, smallholder farmers' welfare was operationalized using five key indicators: food expenditure, non-food expenditure, value of assets, income, and consumer durables. The extracted information was organised into common themes that emerged in response to these indicators. These themes were subsequently categorised into coherent groups to provide a structured summary of the key findings. Finally, the qualitative information was integrated with the quantitative data to provide a comprehensive understanding.

Quantitatively, first, welfare positions among participants and non-participants were sought. In this item, parameters measuring parametors (such as income, cash savings, assets, expenditure patterns, and the ability to cope with shocks) were quantified by summarizing the total value in Tanzanian Shillings (TZS). Second, the second-stage Propensity Score Matching (PSM) method was applied to assess the net effect of smallholder farmers' livelihood through participation in the cashew nut business (Warinda et al., 2020) and to address the challenges of selection bias

arising from unequal socioeconomic characteristics of respondents in impact evaluation at the individual level (Stuart et al., 2014).

3.4.1 Propensity Score Estimation

The propensity score, denoted as e(x), represents the conditional probability of assigning the respondent to the regional projects (treatment) given a vector of observed covariates (Pirracchio et al., 2015), and is expressed as

$$e(x_i) = p(z_i = 1 | x_i), \quad (1)$$

where x_i represents the variable predicting participation and outcomes (treatment, $z_i = 1$). These variables included age, education level, income, number of cashew tree cropping systems, labor availability, farm size, access to outreach services, land ownership, fertilizer and pesticide usage, cashew nut price, and cashew nut quality. These variables were chosen based on their relevance to socioeconomic characteristics influencing participation and welfare outcomes. It is presumed that:

$$p\langle z_1,\ldots,z_n \mid x_1,\ldots x_n \rangle = N_i = 1_e(x_i) z_i \{1 - e(x_i)\} 1 - z_i \quad (2)$$

3.4.2 Matching Algorithm Selection and Bandwidth/Caliper Choices

Three matching algorithms were employed: Nearest Neighbor, Radius Kernel, and Stratification. These were chosen based on their strengths: Nearest Neighbor Matching: This pairs each treated unit with the closest control unit in terms of propensity score, minimizing bias while maintaining simplicity. A caliper of 0.05 was used to exclude matches where the propensity score difference exceeded this threshold. Radius Kernel Matching: This approach uses a bandwidth of 0.1, allowing multiple control units to be matched with treated units within a defined radius, providing robust estimates by incorporating more information. Stratification Matching: Respondents were divided into strata based on propensity score intervals to ensure comparability within blocks and robustness in causal inferences.

3.4.3 Balance Diagnostics

Balance diagnostics were conducted to assess whether the matching procedure effectively reduced selection bias. Standardized mean differences (SMDs) for each covariate were calculated before and after the matching. An SMD below 0.1 indicated adequate balance. Visual diagnostics, such as propensity score histograms and kernel density plots, confirmed the overlap between the treated and control groups. The details are shown in **Fig. 4**.

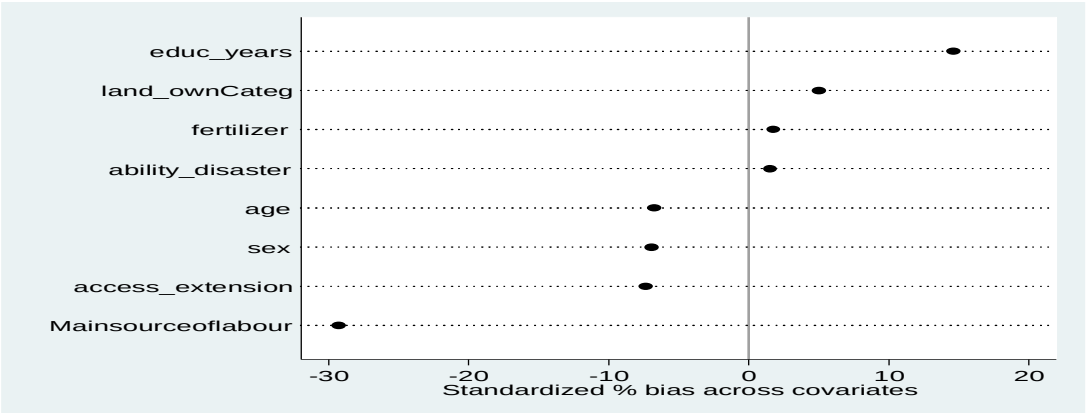

Figure 4: Kernel Density Plots

Source: Analysed from Collected Data

From the above figure, the results suggest that most covariates are relatively well balanced after matching, but some variables like Main source of labor and education years still show imbalance. Despite the possible need to consider improving the matching process or using different matching techniques (e.g., caliper matching) to achieve better balance, these results satisfactorily imply the presence of balancing among covariates, as evidenced by 75% of the study covariates having the minimum %bias. To account for the minor observed bias, different matching techniques were adopted.

3.4.4 Balancing Property and Common Support Option

A total of 237 respondents formed a control group in the common support area, and 19 respondents were disconnected from common support as their feature (socio-economic characteristics) did not match the requirements of the region. The matching techniques include nearest neighbor, Radius Kernel and Stratification. These matching techniques are preferred because of their advantages in terms of simplicity, precision, robustness, and use of information, leading to more accurate and credible causal inferences. The results indicated that alignment qualities were satisfied in all blocks, and there was no distinction between the propensity scores of the control and treated groups. This step mitigates potential biases arising from unmatched observations. Details are provided in **Table 1 and figure 5**.

Table 1: *Testing of balancing property and common support option*

Inferior of blocks of propensity score	Type of respondent		Total
	Nonparticipant	Participant	
0.01	96	5	101
0.1	49	8	57
0.2	55	19	74
0.4	17	14	31
0.6	15	44	59
0.8	5	38	43
Total	237	128	365

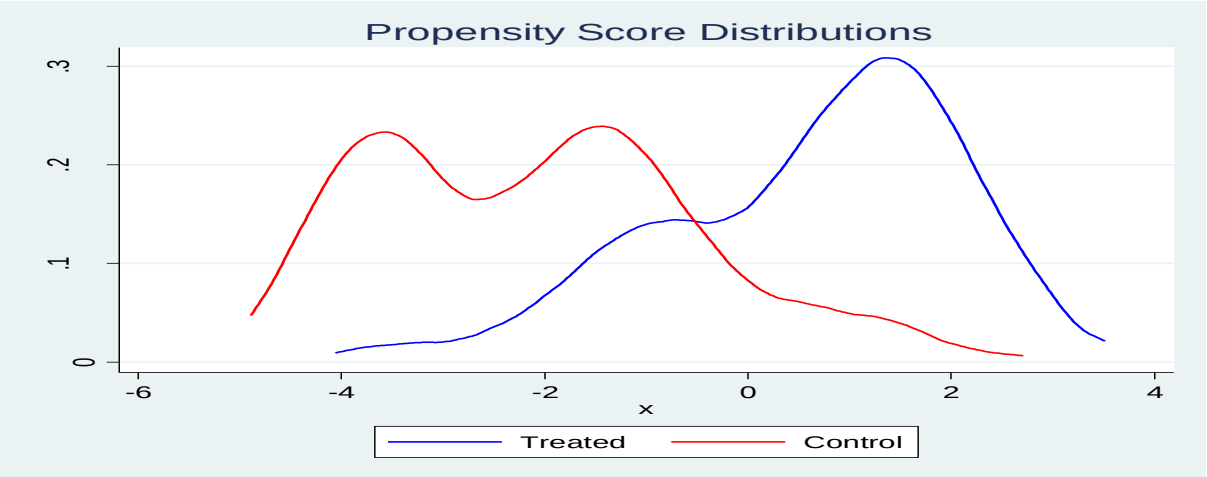

Figure 5: *Propensity Score Distribution*

Source: *Analysed from Collected Data*

The figure above shows a graphical representation of the common support. The region where both the blue and red curves overlap shows a common support. This overlap suggests that the treated and control groups had comparable units for matching.

3.5 Sensitivity Analysis

Benimana (2021) asserts that the treatment group can contain unobservable qualities that might influence the treatment results of the intrusion. Thus, sensitivity analysis was carried out following PSM to investigate whether unnoticeable parameters affect outcomes and treatment effects, given that PSM results are based on observable descriptions alone. The Stata program (sensatt), which analyzes the sensitivity of matching estimators projected by Ichino *et al.* (2008), was utilized in this study. A contrast of ATT with unobservable factors U (confounders) is weighted against ATT devoid of confounders, which is referred to as ATT (target) after the effects of confounders on the result are approximated. Estimators are regarded as vigorous when ATT (conf) does not diverge significantly from the original ATT (target). Consequently, the covariates were well-balanced to imitate a randomized control trial.

The sensitivity analysis was ideal for this study because it lodged the linear outcome parameters utilized in this study, different from *mhbound* and *rbound* sensitivity analysis matching binary outcome parameters only. The percentage of confounders transversely welfare outcomes differs from -0.43% to 60.96%, with a mean percentage of − -1.16%. This indicates that the total unobserved parameters in the outcome variables were below 5%; hence, PSM outcomes rely on observable characteristics for more than 95%. Thus, unobservable factors exempt the variable of the inquiry. Further details are provided in Table 2.

Table 2: *Sensitivity Analysis Outputs for welfare Outcome(s)*

Livelihood Outcome(s)	TARGET		With confounder U		% of confounder (ATT)
	ATT	**S.E**	**ATT**	**S.E**	
Food	58656.641	3423.765	62868.109	3755.823	-7.17987
Non-food	52427.227	7263.890	54033.547	2112.182	-3.0639
Assets	433000	1150000	169000	619000	60.96998
Income	1790000	119000	1760000	24323.085	1.6759
Savings	697000	47094.942	700000	31949.494	-0.43
consumer durables	3030000	1180000	2390000	488000	21.122

4.0 Findings and Discussion

4.1 Socio-economic Characteristics

In terms of age, the mean ages of cashew nut and sesame farmers were 39 and 47 years, respectively, indicating that both groups consisted of adults, potentially driven by increased responsibilities and the labor-intensive nature of cashew nut production. However, this age is above the national median age of 18 years (NBS, 2023). The reason for this discrepancy is that the national census normally involves all people regardless of their age. This aligns with the findings of Lukurugu et al. (2022) for the common age group in cashew production. Regarding marital status, marriage is a common practice in the study area as the majority (55% for sesame (non-participants) and 68% for cashew nut participants) were married, implying there is a strong urge to engage in either cashew nut or sesame production so that they can provide for their families.

The results again show that the majority (69% for sesame and 66% for cashew nuts) grow crops on their own land acquired through various means, implying that they have the freedom to choose what crops to plant, what agricultural practices to employ, and how to manage their land, which can significantly impact their welfare. The results further showed that most cashew nut growers (80%) employed fertilizers and pesticides compared to their counterparts (34%).

It was also of interest to note that the household source is mostly utilized by cashew nut growers compared to their counterparts. The mean household sizes for participants and non-participants were five and four, respectively, with cashew nut production relying on labor from relatives residing with the farm owner. The utilization of extension services is also a common practice among cashew nut growers because of the nature of the crop and the availability of services in the study area. The results further showed statistically significant differences for all parameters studied, except for sex and land ownership. Further details are provided in **Table 3**.

Table 3: *Socio-economic Characteristics*

Variable(s)	Participation status		Chi-square (p-value)
	Non-participant n (%)	Participants n (%)	
Sex			
Male	73 (28.5)	35 (27.34)	
Female	183 (71.48)	93 (72.66)	0.058 (0.81)
Marital status			
Not married	115 (44.92)	40 (31.25)	
Married	141 (55.08)	88 (68.75)	6.626 (0.010)
Land ownership			
No	79 (30.86)	43 (33.59)	
Yes	177 (69.14)	85 (66.41)	0.2943 (0.587)
Received fertilizers and pesticides			
No	173 (67.58)	25 (19.53)	
Yes	83 (34.42)	103 (80.47)	78.874 (< 0.001)
Source of labour			
Hired	67 (26.17)	19 (14.84)	
Family	92 (35.94)	74 (57.81)	17.097 (< 0.001)
Both hired and family	97 (37.89)	35 (27.34)	
Access extension services			
No	177 (69.14)	23 (17.97)	
Yes	79 (30.86)	105 (82.03)	89.535 (< 0.001)
Age (mean ± SD)	39.9 ± 11.87	47.34 ± 11.67	
Farm size (mean ± SD)	2.98 ± 1.37	5.68 ± 2.44	

4.1 Welfare outcome between participants and non-participants

An independent sample t-test was employed prior to PSM to examine if there is a difference in welfare among smallholder farmers who participate in the cashewnut business and those who do not. Six welfare outcomes, including food expenditure in TZS, non-food expenditure in TZS, value of assets in TZS, income in TZS, and consumer durables in TZS, were analyzed. The results were highly statistically significant ($p<0.01$), except for assets. Small-holder farmers who participate in cashewnut businesses have a higher mean value than those who do not participate. The results show that participants spent more TZS, 59 344, 57 883, 1 040 254, and 13937136 on food, non-food and assets, and consumer durables, respectively, than their counterparts. Furthermore, participants had a higher income TZS 1 785 004, saving more TZS 704 570 (Table 4). A possible explanation is that participation in cashewnut businesses enables farmers to generate higher profits. The generated profit is expected to contribute to efforts to improve smallholder farmers' welfare, as the income earned enables farmers to cover all expenses associated with food items, non-food items, consumer durable assets, and savings.

This study is also supported by the findings of Léonard et al. (2023). who noted that participation has a positive and significant impact on the welfare of rural households. Results from FGD also noted that one participant from Tandahimba expressed that:

"*Engagement in this business is genuinely beneficial as it provides us with income to support our family's needs such as food, healthcare, clothing, and school fees. However, the income earned is not sufficient compared to the efforts and resources invested due to the involvement of various actors. Each actor, such as the Local Government Authority (LGA), the National Agricultural Research Institute (NARI), and the Cashewnut Board of Tanzania (CBT), deducts a certain amount of money. For instance, the Agricultural Marketing Co-operative Society (AMCOS) deducts 70 Tanzanian Shillings per kilogram sold, while CBT and NARI deduct 15 Tanzanian Shillings each*"(*FGD Tandahimba, July 2021*).

Additionally, another participant from Ruangwa highlighted that the "*transportation system is severely deficient, with poor road quality often forcing them to transport cashew nuts by bicycle. This leads to delays and sometimes compromises the quality of the cashew nuts, especially during rainy or dusty conditions*' (*FGD Ruangwa, August 2021).*

Table 4: Welfare outcome between participants and non-participants

Outcome variable	Participant (n=128)	Non-participant (n=256)	Mean difference	S. E	t-statistic	P-value
Food	127630.9	68286.64	59344.3	1743.28	34.0417	<0.001
Non-food	160044.4	102160.6	57883.75	3909.13	14.8073	<0.001
Assets	4412509	3372255	1040254	560267	1.8567	<0.032
Income	4087566	2302562	1785004	71253.4	25.0515	<0.001
Savings	1576443	871872.3	704570.2	25951.61	27.1494	<0.001
consumer durables	14606214.8	669078.48	13937136.36	348097.1	40.0381	<0.001
Welfare	25000000	7310211	17689789	669436.3	26.3807	<0.001

4.2 Estimation of Influence of Cashew nut Business Performance on Smallholder Farmers Welfare

The results revealed that the mean welfare value for participants surpassed that of their counterparts (non-participants) and was statistically significant. PSM was utilized to test whether differences were attributed to involvement in the cashewnut business. Table 5 presents the findings.

Table 5: *Estimation of ATT using different PSM estimators*

Outcome variable	Matching estimator	ATT		Difference	S.E	T-stat
		Participant	Non-participant			
Food	Nearest neighbour	127302.4	68604	58698.4	3391.76	17.31
	Radius	127630.938	68943.75	58687.19	3406.63	17.23
	Kernel	127630.938	68802.29	58828.64	2970.92	19.80
	Stratification	127302.4	68604	58698.4	3391.75	17.31
Non food	Nearest neighbour	160300.72	107532.56	52768.16	6809.81	7.75
	Radius	160044.37	107732.19	52312.19	6786.1	7.71
	Kernel	160044.37	104659.27	55385.1	6510.3	8.51
	Stratification	160300.72	107532.56	52768.16	6809.81	7.75
Assets	Nearest neighbour	4486342.08	3622754.56	863587.52	992449.2	0.87
	Radius	4412509.22	3764865.63	647643.59	990604.8	0.65
	Kernel	4412509.22	4019680.12	392829.1	921810.1	0.43
	Stratification	4486342.08	3622754.56	863587.52	992449.15	0.87
Income	Nearest neighbour	4074117.6	2310524.8	1763592.8	131472.6	13.41
	Radius	4087565.63	2300914.84	1786650.78	132006.1	13.53
	Kernel	4087565.63	2308115.45	1779450.17	120614.13	14.75
	Stratification	4074117.6	2310524.8	1763592.8	131472.6	13.41

Savings	Nearest neighbour	1582079.6	883170.6	698908.96	44425.89	15.73
	Radius	1576442.58	879209.688	697232.891	44467.08	15.68
	Kernel	1576442.58	874728.526	701714.05	43064.7	16.29
	Stratification	1582079.6	883170.64	698908.96	44425.89	15.73
consumer durables	Nearest neighbor	14606214.8	613237.5	13992977.3	474853.423	29.47
	Radius	14606214.8	613237.5	13992977.3	474853.423	29.47
	Kernel	14606214.8	651162.12	13955052.7	474550.68	29.41
	Stratification	14646684	613377.6	14033306.4	483242.987	29.04
Welfare	Nearest neighbour	24970407.5	7984020.63	16986386.9	1112154.61	15.27
	Radius	24970407.5	7984020.63	16986386.9	1112154.61	15.27
	Kernel	24970407.5	8023480.84	16946926.7	1064489.58	15.92
	Stratification	25076826.4	7861060	17215766.4	1117571.58	15.40

The results table 5 shows that the mean value of expenditure in food for participants were significant (t-value > 2) higher than their counterpart non-participants by value scale of TZS 58 687.19 to 58 828.64 in all matching methods. This results is similar to those obtained during Focus Group Discussion (FGD) where on participant reported that "we *are capable of affording three meals per day and we even have balanced diet.....this is not because of anything but money earned during cashewnut season is adequate enough to afford meals without any skipping or shortage (FGD Nachingwea September 2021)*. This reflects the practical realities faced by smallholder farmers and illustrates how income from cashew farming translates directly into improved food security at the household level. This corroborates the findings of Yeboah et al. (2023), who noted that smallholder farms earn adequate income to purchase food items through participation.

Concerning expenditure on non-food items, it was revealed that participants spent more, and these results were highly statistically significant (t-value > 2) compared with their counterparts, confirming the robustness of the difference. The value ranges from 52 312.19 to 55 385.1 in all matching methods. This implies that the participants have better welfare than their counterparts. These figures suggest that households engaged in the cashew nut business experience improved economic capacity, enabling them to invest in non-food essentials. This is consistent with the broader understanding of welfare, which includes not only food security but also access to clothing, education, housing, health care, and other necessary services. This collaborate the findings of Léonard et al. (2023) who noted positively & significantly influence cashew income on smallholder farmers welfare.

The statistical findings are further substantiated by qualitative evidence where it was opined by one participant during FGD that "*in cashewnut farmers have always been blessed with more income as a result of participation in cashewnut because no wonder their life style including dressing and other expenditure is higher compared to those who do not involved in cashewnut business".*

Another participant reported that

"*Income levels has increased due to cashewnut business. The income gained used for paying school fees, buying food, assets, building houses, buying farms and paying for medical services and hence improved household welfare". Generally, life improvement for group members is mainly contributed by cashewnut business.*

A male participant from Nachingwea on December 2021 added that *'…now it is evident that, most cashewnut farmers are capable to meet basic needs such as food, health care and clothes, …this is mainly steered by increased income at household level.*

This is supported by Bojang and Emang (2024), who noted that smallholder cashew nut farmers are better able to absorb the dynamics of the food system, thereby promoting food security and sustainable rural development compared to their counterparts.

These testimonies add context to the numerical findings and demonstrate the tangible impact of cashew nut farming on broader aspects of welfare. A male participant from Nachingwea in December 2021 added, "Now it is evident that most cashew nut farmers are capable of meeting basic needs such as food, health care, and clothing. This is mainly steered by increased income at the household level." This convergence between statistical data and lived experience offers compelling evidence that cashew nut participation contributes meaningfully to improved living standards.

It was also necessary to establish whether there was a difference in asset ownership between participants and nonparticipants. The amount ranged from 392,829 to 863 578, however the results were not significant, implying that participation in cashewnut business does not influence asset ownership in all matching technique results were < 2. During FGD one participant attested that

"Despite *the fact that I'm earning a lot of money from cashewnut farming we don't show off in terms of buying asset because this will attract witchcraft. We don't want to die early so we normally keep low profile, and this makes everyone safe and happy*"

Despite the fact that participants save TZS 700,000 per month, the money is just kept in the bank or spent on luxury such as (Ngoma). These findings shed light on a unique cultural aspect among cashewnut farmers, revealing that, despite experiencing financial success, individuals within this community refrain from showcasing their wealth through the acquisition of assets, building modern houses, or buying cars. The aversion to displaying affluence is driven by the fear of attracting negative spiritual influences, particularly witchcraft. This finding contradicts the assumptions of the SLA that the cashewnut business can bring about economic growth by ensuring that smallholder farmers acquire various resources and, along with the capacity to access them, that determine an individual or household's welfare in terms of food security, bridging the nutritional gap, acquisition of assets, and improvement in the standards of living.

In all matching estimators, income was higher for those who participated than for their counterparts. This result was statistically significant (t-value > 2), ranging between TZS 1 763 592 and 1 786 650. A possible explanation for this is that the price offered for cashew nut is always higher than that of other common crops in the study area, such as sesame, and those who participate in the cashew nut business always have higher income to enable them to improve their welfare. These results are in line with those of Fasakin et al. (2022); if properly harnessed, cashew nut production plays a major role in providing sustainable employment and income. This is also similar to the assertion that SLA increase in income among participants can lead to more resilient and sustainable welfare, for example, by investing in diverse assets and ensuring sustainable practices, as participants can build a robust welfare system that not only increases current income but also secures future income against various shocks and stresses.

The findings also indicate that annual savings for participants were higher than for non-participants by estimated amounts ranging from 697 232 to 701 714 The variation was highly statistically significant (t-value > 2) across all matching estimators. This means that participants were capable of saving more than their counterparts. As outlined in SLA, participants who save a portion of their earnings often invest in diversifying crops, irrigation, and accessing better markets through cooperatives. These investments lead to higher and more stable incomes, better health and educational outcomes, and increased resilience to market and environmental shocks. This was supported by FGD results, where one participant reported that

"Previously saving money for future use and unforeseen events was not part of our culture but after engaging in cashewnut business, I know the importance of saving. Currently I do save not less than TZS 600,000 every month at our SACCOS. The saving culture has improved my financial resilience capacity and therefore I, am not much worried about my tomorrow (FGD, Liwale December 2021*).*

This is supported by another participant who said "…..cashewnut business helped us to boost our saving culture……most of the members are loanable within our SACCOS and able to absorb financial shocks…."

The results show that the mean value for consumer durables of participants was significantly (t-value > 2) higher than non-participants, as the amount fluctuated from 13955052 to 14033306 in all matching methods. This implies that consumer durables positively influence participants' welfare by improving their quality of life, providing economic benefits, enhancing productivity, improving health and safety, boosting social status and psychological well-being, and offering better access to information and connectivity. Non-participants who lack these benefits may experience lower levels of welfare. This is in line with the findings of Abdullahi et al. (2024), who observed that cashew nut production and business improve income, asset ownership, savings, and, ultimately, welfare levels. The results also indicate a positive relationship between access to credit and farm size, although their effects on welfare were not statistically significant. These findings underscore the importance of promoting the cashew business as a viable strategy for improving welfare and addressing factors that can enhance the productivity and profitability of this agricultural activity.

Table 6 analyzes the treatment effect on welfare using four matching techniques to balance the participants and non-participants. Unmatched samples show a large welfare difference (1.77×1071.77×107), which is consistently reduced after matching, with ATT estimates ranging from 1.69×1071.69×107 (Kernel) to 1.73×1071.73×107 (Common Support).

Table 6: *Treatment effect on welfare based on different matching techniques*

Matching method	Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
Common support	welfare	Unmatched	2.50e+07	7.31e+06	1.77e+07	6.69e+05	26.380
	ATT		2.51e+07	7.81e+06	1.73e+07	1.11e+06	15.540
Caliper	welfare	Unmatched	2.50e+07	7.31e+06	1.77e+07	6.69e+05	26.380
	ATT		2.50e+07	7.93e+06	1.70e+07	1.11e+06	15.410
Kernel	welfare	Unmatched	2.50e+07	7.31e+06	1.77e+07	6.69e+05	26.380
	ATT		2.50e+07	8.02e+06	1.69e+07	1.06e+06	15.920
Neighborhood	welfare	Unmatched	2.50e+07	7.31e+06	1.77e+07	6.69e+05	26.380
	ATT		2.50e+07	7.93e+06	1.70e+07	1.11e+06	15.410

Kernel matching demonstrates the highest precision with the lowest standard error (1.06×1061.06×106) and highest T-statistic (15.920), while Caliper and Neighborhood methods yield identical results (1.70×1071.70×107). Matching improves comparability and provides robust treatment effect estimates, with the kernel emerging as the most reliable method.

5.0 Conclusion and Practical Implications

5.1 Conclusion

This study sought to assess the impact of cashew nut business performance on the welfare of smallholder farmers in the Lindi and Mtwara regions of Tanzania. Using Propensity Score Matching (PSM) and a robust quasi-experimental design, the findings provide compelling evidence that participation in the cashew nut business significantly enhances farmers' welfare. Participants exhibited higher food and non-food expenditures, incomes, savings, and ownership of consumer durables, all of which are key indicators of improved living standards. These results substantiate the rejection of null hypotheses concerning income, expenditures, and savings, though asset ownership remained statistically insignificant, largely due to cultural norms around wealth display.

Overall, the findings affirm that the cashew nut sector holds strong potential to contribute to rural economic transformation and poverty alleviation. However, realizing its full welfare potential requires not only enhancing production and market access but also addressing structural bottlenecks and socio-cultural constraints. It is recommended that the local government in the study area should encourage participants and non-participants to increase production and engage in cashew nut business to boost spending on non-food. The Cashew nut Board of Tanzania should continue to regulate and promote the quality, price, marketing, and export of raw and processed cashew nuts to enable farmers to earn adequate income that can be spent on food items. These insights are valuable for informing targeted policies and interventions to support inclusive and sustainable agricultural development in Tanzania.

5.2 Practical and Policy Implications of the Study

There is a dire need to improve the functioning of agricultural markets by facilitating market access and reducing transaction costs to enable farmers to fully participate and benefit from cashew nut business in rural Tanzania, Despite existence of the Southern Agricultural Growth Corridor of Tanzania (“SAGCOT, the country still faces challenges with poor road infrastructure, which hampers farmers' access to profitable markets, unequal power distribution among actor, lower price as well as over regulations thereby perpetuating in poverty. Hence, development programs and policies aimed at reducing transport and transaction costs, as well as decreasing travel time to profitable markets through road network improvement in rural communities, are necessary for smallholder farmers to avoid market and economic isolation and improve livelihood.

6.0 Declarations

Availability of data and materials

Data relevant to this manuscript will be provided upon reasonable request from the main and corresponding author, Ahadiel Elirehema Mmbughu (Email: ahadim48@gmail.com).

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Authors contributions

AM is the main author of this manuscript, and he is basically a PhD Candidate at Moshi Cooperative University. MK was the main supervisor who guided the entire process and conceptualization, methodology, resources, writing original draft, writing review & editing. MT is the co-supervisor who assisted conceptualization, methodology, resources, writing original draft, writing review & editing. all authors have approved the final version of the manuscript.

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Ethics statement

The study protocol was approved by the Vice Chancellor of Moshi Co-operative University on behalf of the Tanzania Commission for Science and Technology (COSTECH) (MoCU/UGS/3/41). This study strictly followed the guidelines for writing concept notes, proposals, research reports, dissertations, and the fourth edition of July 2020.

Informed consent to participate

Written informed consent was obtained from all the participants. They were reassured that their participation was voluntary, and that they were free to withdraw at any time. In addition, all the information was gathered anonymously and handled confidentially.

Limitations and recommendations for further studies

The study is confined to a single country and employs a quasi-experimental design. Future studies should extend their scope to a comparative analysis between countries and employ randomized control trials and true experimental designs.

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