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CONTRACT FARMING PRACTICES AND ECONOMIC SUSTAINABILITY IN PYRETHRUM FARMING

Imani Stanley Matonya[1], Fulgence J. Mishili[2], Lutengano Mwinuka[3]

[1] *PhD. The University of Dodoma, P.O.Box 41218 Iyumbu, Dodoma, Tanzania, E-mail address: matonya1@gmail.com*

[2] *Senior Lecturer, Sokoine University of Agriculture, Morogoro, Tanzania, E-mail address: fmishili@sua.ac.tz*

[3] *Senior Lecturer, The University of Dodoma, P.O.Box 41218 Iyumbu, Dodoma, Tanzania, E-mail address: mwinuka.lutengano@gmail.com*

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Abstract
Contract farming is increasingly promoted as a means to enhance agricultural productivity and improve farmers' livelihoods, particularly for small and medium-scale producers. However, the extent to which existing contract farming practices influence the economic sustainability of pyrethrum farming remains underexplored in Tanzania. This study investigates how contractual arrangements affect the sustainability of pyrethrum farming with a focus on key practices of contract farming. A cross-sectional survey design was employed, targeting 179 randomly selected small- and medium-scale farmers engaged in contract farming. Data were collected using structured questionnaires and analysed through descriptive statistics, regression models, and ANOVA to evaluate the relationship between contract farming practices and economic sustainability. The findings reveal that stable pricing (95.0%), access to extension services (98.9%), and assured market access (99.4%) significantly contribute to economic sustainability, followed by other factors such as stable pricing, extension services, equity in contracts, and technology adoption with B = 12.79, $p < 0.001$, B = 14.699, $p < 0.001$, B = 10.505, $p < 0.001$, B = 8.859, $p < 0.001$ and R^2 of 0.858. These results underscore the importance of inclusive and supportive contract structure arrangements in enhancing farmers' economic growth; hence, it assures the contract farming system's sustainability.

Keywords: *Contract farming, economic sustainability, extension services, pyrethrum farming, smallholder farmers, Tanzania.*
JEL Codes: *Q12, Q13, L14.*

Introduction

Pyrethrum farming is a significant agricultural activity for small- and medium-scale farmers, particularly in regions with favourable climatic conditions (TARI, 2025) (Malimbwi et al., 2013; Shimira et al., 2021). However, its economic sustainability is highly dependent on existing contract farming arrangements (Malimbwi et al., 2013; Shimira et al., 2021). Contract farming has been widely studied as a mechanism for improving agricultural productivity and farmer incomes (Pultrone et al., 2017; Smalley, 2013; VERVE Financial Services Private Limited, 2021). Scholars such as George (2017); Giovannucci et al. (2012); Hoang (2021); Kozhaya (2020); and Warsanga & Evans (2018) highlight contract farming as a model that provides farmers with stable markets, financial resources, and technical support. Pham et al. (2021) and Rachmasari Putri & Rondhi (2020) further emphasise that contract farming enhances agricultural efficiency by reducing production risks and improving access to quality inputs.

Despite these advantages, other studies, including that of Adamset al. (2019), Minot & Swayer (2014), Simmons et al. (2005) and Singh (2002), caution that, contract farming may also create power imbalances between farmers and contractors, potentially leading to unfair pricing, delays in payments and dependency on a limited number of buyers. However, Gabagambi (2014) comments that, whether contract farming is

beneficial or not, it highly depends on various factors because it is not the contract per se which is harmful, but how it is implemented in a given context (the practices), including the way farmers perceive contract farming, which in other ways means contract farming works if its advantages outweigh the disadvantages.

According to the Tanzania Pyrethrum Board (2025), in a range of five years, pyrethrum production has been increasing year after year, although it has not yet reached the estimated annual demand of 10,000 tonnes per year. Hence, this signifies the need to look into its production system and comment on the good practices that made the production grow in a row for the last five years and what can be done to ensure the sustainability of the production. That being the case, studying the economic sustainability of the contract farming practices becomes crucial, as it has been commended as one of the best ways that has contributed to such improvement.

The problem of economic sustainability in pyrethrum farming is of particular interest because it directly affects rural livelihoods, agricultural productivity, and the overall stability of the sector. Given that pyrethrum is a high-value crop with global market demand, ensuring that small-scale farmers benefit from contract farming arrangements is essential for fostering economic resilience. The scientific problem addressed in this study is whether the existing contract farming practices contribute positively to the long-term economic sustainability of small- and medium-scale pyrethrum farmers.

The purpose of this study is to conduct an assessment of existing contract farming practices in pyrethrum and its economic sustainability and hence contribute to the body of knowledge for policymakers and industry in general in a way that triggers better strategies for enhancing farmer benefits and sustainable contract farming systems.

The theoretical and methodological foundations of contract farming studies are reflected in many studies. Prowse (2012) explains the concept of contract farming in relation to transaction cost theory by bringing in the concepts of uncertainty, asset specificity, and the frequency of exchange as crucial factors that play a notable role in shaping the contract farming system. Bijman et al. (2020), Prowse (2012) and Tonne et al. (2018) comment that, in agricultural markets, smallholder farmers often experience information deficiencies due to limited access to market intelligence, pricing data, and contracts; in return, contracting firms mostly have powerful market information, which leads to a high possibility of opportunistic behaviour occurring whereby firms use these knowledge gaps for economic gain. Therefore, such asymmetries in the contractual relations can increase transaction costs, lead to a power imbalance, and undermine the sustainability of contract farming systems, as supported by Mwandilawa (2018), Warsanga & Evans (2018), and Williamson (2008).

The literature guides this study with valuable methodological insights and lessons that help in shaping its design and analytical approach. The studies from Adnan et al. (2018); Debela & Qaim (2021); Dubbert et al. (2023); Gabagambi (2014); George (2017); Hoang (2021); Meemken & Bellemare (2019); and Uzunoz & Akcay (2012) show various research designs, sampling techniques, data collection methods, and analytical models as employed in contract farming and sustainability studies. Therefore, this cross-sectional designed study used a multistage sampling technique, whereby the selected sample provided insightful data through well-structured questionnaires. The collected data were statistically analysed descriptively and by using regression analysis as well as ANOVA to evaluate the relationship between contract farming practices and economic sustainability.

Research Methods

The study was conducted for a period of eight months of data collection, analysis, and validation, which was preceded by three months of preparations and tools development. A fruitful work of a researcher and team of experts led to well-collected data from Mbulu and Makete districts, which are prominent areas for pyrethrum farming. A multistage sampling design involving both probabilistic and non-probabilistic methods at different stages was used whereby the regions and

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districts were purposefully sampled due to their prominence in pyrethrum farming and followed by random sampling techniques to get representative farmers with consideration that they all have an equal opportunity to participate, which reduced the selection bias and improved the validity of the study's findings.

The sampling frame consisted of 179 identified small- and medium-scale pyrethrum farmers from a total population of 404 farmers from both districts. By using the Yamane's formula ($n = \frac{N}{1+N(e)^2}$) the calculated sample was 201 respondents using an error tolerance of 5%. However, due to logistical and resource constraints during fieldwork, a slightly reduced but still statistically valid sample of 179 respondents was used. This sample represents approximately 44% of the total population and was considered sufficient to provide reliable and insightful results for the study objective, whereby there were 100 farmers from Makete district and 79 farmers from Mbulu district.

Well-structured questionnaires were used to capture quantitative insights, while an interview guide was used to capture key informative information from key informants. Hence, the collected data were assessed using descriptive and inferential statistical methods for the quantitative data, and the qualitative data were narratively analysed, considering the power of the narrative method in capturing respondent experience and its emphasis on the freedom of expression.

The reliability of the questionnaire was tested using Cronbach's alpha, and its validity was ensured through expert review and pilot testing before full-scale data collection. During the analysis stage, SPSS and the visualisations were generated using R and Excel software. In this whole process of the study, ethical practices were considered. The researcher applied for approval to conduct a study from the relevant governing bodies and also asked for consent from the respondents before they were asked questions. All the actions were guided by high confidentiality, and the declaration for the use of data was shared, whereby the data obtained were for academic purpose use only.

Results

The descriptive results of the study show that the respondents from Makete District were drawn from Iniho, Ipelele, and Bulongwa wards by 38.0%, 36.0%, and 26.0%, respectively, due to its prominence in pyrethrum production, while Mbulu District had respondents exclusively from Nambis Ward. The diversified ward selection within Makete District, which is known for active contract farming practices, allowed the study to explore intra-district variations in economic outcomes and exposure to institutional support structures, while the single ward concentration in Mbulu, which is the leading ward in pyrethrum contract farming, provided the best benchmark to other areas that are mostly covered with non-contract farmers. Such ward-level targeting aligns with methodological approaches in agricultural studies where spatial proximity to institutional interventions is considered critical in shaping economic and behavioural outcomes (Stein et al., 2021).

Out of the total 179 respondents in this subset, 105 (58.7%) were male, while 74 (41.3%) were female, indicating higher male representation. Regarding age, most respondents were in the 45–64-year age group (90; 50.3%), followed by 25–44 years (79; 44.1%). Only 10 respondents (5.6%) were above 64 years, and none were below the age of 25. The age and sex distribution of the respondents suggests that pyrethrum farming is largely maintained by middle-aged farmers, likely due to their accumulated farming experience and land ownership status. The absence of farmers under 25 years points to a generational shift where youth may be less involved in farming, possibly due to rural-urban migration or a preference for non-agricultural livelihoods. Meanwhile, the notable representation of women (over 40%) reflects their meaningful role in agricultural activities, though men still dominate participation. Given that involvement may be impacted by age, gender, and responsibilities in household decision-making,

these demographic factors are crucial for assessing the efficacy and breach of contract farming agreements (Bjornlundet al., 2019; Muriithi & Kabubo-Mariara, 2022).

In terms of education, among the respondents, the majority had attained primary education (124; 69.3%), followed by secondary education (25; 14.0%), and smaller proportions held certificate (16; 8.9%) and diploma qualifications (10; 5.6%). Only two respondents (1.1%) had no formal education, and another two (1.1%) held bachelor's degrees. Regarding marital status, most respondents were married (157; 87.7%), while 7 respondents each were either single or divorced (3.9% each), and 8 respondents (4.5%) were widowed or widowers. The high prevalence of primary-level education among respondents indicates that while most farmers are literate and capable of engaging with basic agricultural extension materials, relatively few have advanced training or formal qualifications that could enhance their ability to navigate contract farming schemes. Limited higher education could impact awareness of market opportunities, record-keeping practices, or negotiation power with contracting firms. The overwhelmingly married demographic also reflects the household-orientated nature of small-scale farming, where family labour and joint decision-making are common. This socio-educational profile is crucial when assessing economic sustainability, as education and household composition directly influence farmers' capacity to adapt to institutional arrangements like contract farming (Huyse, 2021; Rosin, 2024).

Apart from pyrethrum farming, the vast majority (89.9%) reported practising livestock keeping, indicating its importance as a supplementary activity to crop farming. About 31.3% were engaged in small businesses, while formal employment accounted for 11.7% of respondents. Very few participants identified as traders (0.6%) or beekeepers (0.6%). All respondents (100%) reported agriculture as their main occupation, underlining its central role in household income and subsistence. The dominance of agriculture as a primary occupation reflects the rural, agrarian context of the study area, where farming remains the backbone of household livelihoods. The high engagement in livestock keeping complements crop production and likely enhances income stability and food security. Although the percentage of respondents involved in small businesses is modest (31.3%), it indicates efforts toward diversification, which is often linked to increased economic resilience. The minimal involvement in formal employment, trade, or beekeeping suggests either limited opportunities or barriers to entry in those sectors. Understanding these livelihood patterns is essential when evaluating how contract farming might contribute to or influence economic sustainability, particularly if it enables or limits the expansion of alternative income streams (Mohammed et al., 2021; Williams et al., 2020).

Influence of existing contract farming practices on the economic sustainability of pyrethrum contract farming for small and medium-scale farmers.

The findings show that various contract farming practices significantly contribute to the economic sustainability of pyrethrum farming among small and medium-scale farmers. Key factors such as stable pricing (95.0%), access to extension services (98.9%), assurance of market access (99.4%), and participation in decision-making (82.1%) are widely presented as practices that positively impact farmers' economic stability and hence assure sustainability, as suggested by Hoang & Nguyen (2023). However, insurance services are largely absent (96.6%), and access to credit remains a challenge, with only 10.1% of farmers having credit access. In terms of the economic benefit of the contract farming system, 91.1% of farmers under study have improved their ability to invest, and 93.9% are able to manage health-related expenses. While 45.8% of farmers could save money, a notable proportion (54.2%) struggled to do so. The near-universal agreement on the economic benefits of contract farming suggests that structured agreements provide financial security and reduce market risks, as suggested by Cole (2022). This is supported by the findings related to the ability of farmers to invest and cover health-related services, which highlights the

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economic empowerment that contract farming offers and reinforces its role in improving livelihoods as per Wang et al. (2022). However, the limited access to credit and insurance services poses a challenge, potentially restricting farmers' ability to expand operations and manage financial risks. (Balana & Oyeyemi, 2022).

Table 1. Influence of Contract Farming Practices on Economic Sustainability of Pyrethrum Farming

Variable	No	Yes.
Are there insurance services in your contract farming program?	173 (96.6%)	6 (3.4%)
Does the presence of insurance in your contract farming program positively influence your economic sustainability?	0 (0.0%)	6 (100.0%)
Are there stable prices in your contract farming program?	9 (5.0%)	170 (95.0%)
Does the stable pricing structure in your contract farming program contribute to your economic sustainability?	1 (0.6%)	169 (99.4%)
Does your contract farming program enable you to hire labour for your farming activities?	44 (24.6%)	135 (75.4%)
Does the utilisation of hired labour in your contract farming have any positive economic impact?	4 (3.0%)	131 (97.0%)
Is there equity (meaning it is fair to both parties) and justice (meaning that decisions are based on the true cause) in the contractor-contracted relationship of your contract farming program?	30 (16.8%)	149 (83.2%)
Does the fair and just relationship between contractors and contracted farmers in your contract farming program positively influence your economic sustainability for small- and medium-scale farmers?	16 (10.7%)	133 (89.3%)
Are there extension services in your contract farming program?	2 (1.1%)	177 (98.9%)
Do the extension services provided in your contract farming contribute significantly to your economic sustainability?	6 (3.4%)	171 (96.6%)
Do farmers have rights to own properties in relation to farming activities on your contract farming program?	15 (8.4%)	164 (91.6%)
Do the rights to secure properties in your contract farming significantly contribute to the programme's economic sustainability?	5 (3.00%)	159 (97.0%)
Is there any opportunity of accessing credit in your contract farming program?	161 (89.9%)	18 (10.11%)
Does the access to credit in your contract farming program have any substantial impact on your economic sustainability?	3 (16.7%)	15 (83.33%)
Do farmers participate in decision-making in your contract farming program?	32 (17.9%)	147 (82.11%)
Does your participation in decision-making processes as small and medium-scale farmers positively contribute to your economic sustainability?	6 (4.1%)	141 (95.99%)
Does your contract farming program provide an assurance of market access?	1 (0.6%)	178 (99.44%)
Does access to a reliable market significantly influence your economic sustainability?	1 (0.6%)	177 (99.44%)
Does your contract farming program emphasise the use of technology and modern farming methods like the use of tractors and online reporting and marketing sharing systems?	66 (36.9%)	113 (63.11%)
Does the integration of technology and innovation in contract farming have any positive economic impact for you?	4 (3.5%)	109 (96.5%)
Do you think being in contract farming is economically beneficial?	0 (0.00%)	179 (100.0%)
Do particular benefits of contract farming assure the sustainability of the contract farming system?	2 (1.1%)	177 (98.99%)

Did you have an ability to save a certain amount of money gained from products in contract farming activities?	97 (54.2%)	82 (45.88%)
Did you have an ability to invest a certain amount of gained money after being in contract farming?	16 (8.9%)	163 (91.11%)
Did you have an ability to cover health-associated shock expenses after being in contract farming?	11 (6.1%)	168 (93.99%)
Is the contract farming program directly benefiting other core-residing members of the household as well?	2 (1.1%)	176 (98.9%)

On the other hand, regression analysis results show that contract farming practices significantly influence the economic sustainability of pyrethrum farming. The model explains 85.8% of the variation in economic sustainability ($R^2 = 0.858$), indicating a strong predictive power. The ANOVA results confirm that the model is statistically significant ($p < 0.001$), meaning the independent variables collectively impact economic sustainability. Among the key predictors, stable pricing ($B = 12.79$, $p < 0.001$), access to extension services ($B = 14.699$, $p < 0.001$), equity and justice in contract relationships ($B = 10.505$, $p < 0.001$), and technological adoption ($B = 8.859$, $p < 0.001$) have the most substantial positive effects. However, variables such as market access assurance ($p = 0.121$), savings ability ($p = 0.739$), investment ability ($p = 0.757$), and health shock coverage ($p = 0.31$) are not statistically significant, implying limited influence on economic sustainability. These highlight the critical role of stable pricing, fair contractual relationships, technological adoption and access to extension services in ensuring the economic sustainability of contract farming as suggested in literature (Hung Anh et al., 2019). Stable pricing provides income predictability, allowing farmers to plan and invest in their farming activities (Boyd & Bellemare, 2020). The strong impact of extension services suggests that knowledge dissemination and technical support significantly enhance farmers' productivity and profitability (Norton & Alwang, 2020). Furthermore, the emphasis on fairness and justice in contractual relationships ensures trust and long-term engagement, which are programmes for sustaining contract farming programmes (Khalili et al., 2024). The positive influence of technology adoption reinforces the importance of modern farming methods in improving efficiency and profitability (Takahashi et al., 2020). However, the non-significant effect of savings and investment ability raises concerns about whether farmers generate enough surplus income to secure long-term financial stability. Additionally, the weak relationship between market access assurance and economic sustainability suggests that while contracts guarantee markets, other factors such as pricing, cost structures, and production efficiency may have a more direct impact on financial well-being (Ali et al., 2021).

Table 2. Regression Coefficients Explaining Economic Sustainability in Pyrethrum Contract Farming

Model	Unstandardized Coefficients		t	Sig.
	B	Std. Error		
(Constant)	-2.598	7.298	-0.356	0.722
Are there insurance services in your contract farming program	10.633	2.163	4.915	<0.001
Are there stable prices in your contract farming program	12.79	1.798	7.114	<0.001
Does your contract farming program enable you to hire labour for your farming activities	6.566	0.935	7.018	<0.001
Is there equity (meaning it is fair to both parties) and justice (meaning that decisions are done based on the true cause) in the contractor-contracted relationship of your contract farming program	10.505	1.132	9.283	<0.001

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Are there extension services in your contract farming program	14.699	3.362	4.373	<0.001
Do farmers have rights to own properties in relation to farming activities on your contract farming program?	9.286	1.317	7.051	<0.001
Is there any opportunity of accessing credit in your contract farming program	6.895	1.247	5.529	<0.001
Do farmers participate on decision-making in your contract farming program	9.235	1.085	8.513	<0.001
Does your contract farming program provide an assurance to market access?	7.995	5.125	1.56	0.121
Does your contract farming program emphasize the use of technology and modern farming methods like the use of tractors and online reporting and marketing sharing system	8.859	0.778	11.39	<0.001
Did you have an ability to save a certain amount of money gained from products in contract farming activities	0.274	0.823	0.334	0.739
Did you have an ability to invest a certain amount of gained money after being in contract farming	0.492	1.588	0.31	0.757
Did you have an ability to cover health associated shocks expenses after being in contract farming	-2.06	2.023	-1.018	0.31
Is the contract farming program directly benefiting other core-residing members of the household as well	3.412	3.567	0.957	0.34

Contribution of the Study

This study has provided a new perspective on the economic sustainability concept in the pyrethrum contract farming sector. Through its triangulation of field data contextually and quantitatively with an $R^2 = 0.858$, it gives an improved understanding of the influence of contract farming practices in relation to the economic sustainability of pyrethrum contract farming, specifically in the areas of Manyara and Mbulu districts. With a base of empirical findings, this study introduces a localised assessment framework that connects farmers' experiences and statistically validated indicators to assess the impact of contract arrangements. This study fills a critical knowledge gap in economically sustainable agricultural systems as empirically evidenced in more generalised studies of contract farming, such as that of Nurjati & Wiryawan (2023).

This study sets itself apart by focusing on analysing the significance of practical variables in contract farming systems, such as fairness in the contract relations and the presence of extension services, as well as the use of technology in farming activities. At the same time the study has revealed contract farming weaknesses, including the limited access to credit and insurance as well, which in return provides a basis for rethinking how contract farming systems can be designed better to enhance equity, financial security, and long-term viability of the system for small and medium-scale farmers. In such a case, these findings become useful to academia in terms of literature that informs future studies; to policymakers by clearly revealing important variables that impact contract farming sustainability; and to agribusiness stakeholders in a way that it directs their decision on areas that they can consider working on in order to improve agricultural value chains.

Conclusion

This study was set out to examine whether the existing contract farming practices contribute positively to the long-term economic sustainability of small and medium-scale pyrethrum farmers in Tanzania. The findings confirm that the existing contract farming practices significantly influence the economic sustainability of pyrethrum farming among small and medium-scale farmers in Tanzania. The core components, such as stable pricing ($B = 12.79$, $p < 0.001$) and access to extension services ($B = 14.699$, $p < 0.001$), both with 95.0% and 98.9% influence on economic

sustainability, respectively; fair and equitable contractual arrangements (B = 10.505, p < 0.001); and technological adoption (B = 8.859, p < 0.001), were found to have strong positive effects on farmers' economic outcomes. These mean that income predictability due to price stability allows farmers to plan and invest in their farming activities, while at the same time knowledge dissemination and technical support from extension officers significantly enhance farmers' productivity and profitability. At the same time, the emphasis on fairness and justice in contractual relationships ensures trust and long-term engagement, which are essential for sustaining contract farming programmes, and the positive influence of technology adoption reinforces the importance of modern farming methods in improving efficiency and profitability. This suggests that there is a high need to invest in service delivery and fairness, both in price and contractual relationships, as well as digital agriculture so as to ensure the system is economically sustainable.

Nevertheless, the non-significant variables, such as the effect of savings with P = 0.739 and investment ability with P = 0.757, raise concerns about whether farmers generate enough surplus income to secure long-term financial stability. In addition to that, the weak relationship between market access assurance, with an influence of 99.4% on economic sustainability, and statistical significance of P = 0.121 suggests that while contracts guarantee markets, other factors such as pricing, cost structures, and production efficiency may have a more direct impact on economic sustainability. Also, other variables such as investment ability (p = 0.757), savings capacity (p = 0.739), and health shock preparedness (p = 0.31) suggest that while contract farming improves income flow and short-term stability, it does not always result in long-term financial resilience or wealth accumulation for all farmers.

Therefore, despite the fact that the study shows the existing contract farming practices significantly influence the economic sustainability of pyrethrum farming among small and medium-scale farmers in Tanzania, contract farming stakeholders should consider all variables of contract farming sustainability rather than focusing on the most advocated variable, such as market access. Hence, the evidence from this study underscores the importance of designing contract farming systems that not only provide technical and market support but also ensure equitable treatment, financial safeguards, and long-term capacity-building for farmers. On the other hand, it is important to consider that these findings are specific to the case of pyrethrum contract farming in Makete and Mbulu districts and are shaped by the local institutional context as well as the type of contract farming in particular areas. Therefore, the generalisations to other crops, regions, or farming systems should be made with consideration to the local context, nature of the crop and the type of the contract farming system engaged.

Recommendation

To further enhance the economic sustainability of pyrethrum farming through contract farming, several strategic actions are recommended. There is a critical need to strengthen access to financial services, such as partnerships between farmers and financial institutions to provide affordable credit and also introduce insurance products tailored to agricultural needs. Apart from that, the continuation and expansion of agricultural extension services are essential, as these services equip farmers with the technical knowledge necessary for productivity and profitability. Also, the promotion of fair and transparent contract arrangements is vital to ensure that farmers are not exploited and that mutual trust is maintained, thus fostering long-term commitment. Furthermore, encouraging the adoption of modern agricultural technologies through training, subsidies, and demonstration projects that can further enhance productivity and income, as well as financial literacy and savings programmes which will help farmers to manage their finances better and improve their resilience to income shocks and accumulate capital for investment, is very crucial in ensuring the sustainability of the pyrethrum contract farming system.

Also, this study opens avenues for further research in several key areas, such as

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intergenerational sustainability of livelihoods and wealth accumulation among smallholder farmers and a comparative study across various crops and regions to find out if the observed benefits and challenges are specific to pyrethrum or reflect broader trends in contract farming. Additionally, research into the integration of digital technologies in contract farming could uncover new ways to improve transparency, efficiency, and trust among stakeholders. Also, since this was geographically confined to Makete and Mbulu districts, which may limit the generalisation of the findings to other pyrethrum-growing regions, a study may be done covering a wider area cultivating pyrethrum theory and hence test the findings in this study versus that from a more covered area.

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