

Assessment of Agricultural Investment Intensity and its Influence on Food Sufficiency in Tharaka-Nithi County, Kenya

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ABSTRACT

Agricultural investment intensity refers to the extent to which farmers commit financial, physical, human, and technological resources to agricultural activities to improve productivity, income and food sufficiency. However, smallholder farmers in Kenya continue to face constraints related to limited financial resources, high input costs, inadequate extension services, restricted access to credit, and climate variability. The main objective of this study was to assess the intensity of agricultural investments and determine their influence on household food sufficiency among smallholder farmers in Tharaka-Nithi County, Kenya. The study targeted a population of 98,050 farming households, from which a sample of 398 farming households was selected. A mixed-methods research design was adopted, and data were collected using structured questionnaires, complemented by qualitative information from key informants. Quantitative data were analyzed using descriptive statistics, while qualitative data were analyzed thematically. The findings revealed a generally high positive perception of agricultural investment, with all thirteen investment intensity indicators recording mean scores above the neutral midpoint of 3.0, ranging from 3.93 to 4.19. Poor agricultural investment and high input costs recorded the highest mean scores (4.19 each), followed by income as a driver of investment (4.18), indicating that financial capacity and input affordability strongly influence investment decisions. Diversification of agricultural investments was also perceived to improve household food sufficiency. The study recommends improved access to affordable credit, inputs, extension services, irrigation, markets, and appropriate agricultural technologies to strengthen investment intensity and enhance household food sufficiency among smallholder farmers in Tharaka-Nithi County.

Keywords: Agricultural investment; Food sufficiency; Smallholder farmers.

INTRODUCTION

Globally, the agricultural sector continues to play a fundamental role in economic development and food systems. In many developing countries, agriculture remains the backbone of the economy, providing employment, income, and food to a significant proportion of the population. The World Bank (2023), notes that growth in agriculture is two to four times more effective at reducing poverty than growth in other sectors, especially in low-income economies dominated by rural populations. Investments in agriculture therefore contribute not only to food production but also to poverty reduction, employment creation, industrial development, and social stability. Suri and Udry (2022), observed that agricultural investments are increasingly linked to sustainable development goals due to their ability to support inclusive economic growth, environmental conservation, and food system resilience.

Wassie and Assefa (2022) argued that in Pakistan, agricultural investments are multifaceted tools for stimulating economic transformation and enhancing global competitiveness. Investments in agricultural education, extension services, research institutions, and innovation systems enable farmers to adopt improved technologies and management practices. According to World Economic Forum (2023), in many developing countries, extension systems provide farmers with access to information on climate adaptation, pest

management, agronomic practices, post-harvest handling, and market trends. Human capital development through agricultural training institutions and farmer field schools has been recognized as a key strategy for increasing agricultural productivity and improving food sufficiency outcomes

In Sub-Saharan Africa, agricultural investments have produced both positive and negative effects on smallholder welfare. Fitawek and Hendriks (2022), studying Kenya, Madagascar, and Mozambique, found that participation in contract farming linked to large-scale agricultural investments reduced household food insufficiency. Farmers benefited from inputs, extension services, training, and reliable markets, which improved productivity and incomes while reducing reliance on negative coping strategies.

However, large-scale agricultural investments may also create seasonal, insecure, and poorly paid employment, while unequal bargaining power can disadvantage smallholders (Edefe, 2023; Fitawek & Hendriks, 2022). Therefore, agricultural investments should promote inclusive growth, secure land rights, sustainable land management, and equitable benefit-sharing to reduce rural inequalities. Large-scale agricultural investments can also undermine household food sufficiency when they displace local communities or restrict access to land and natural resources. Guyalo et al. (2022) found that such investments in Ethiopia's Gambella region reduced food availability, access, and utilization by limiting access to farmland, grazing areas, forests, and water. These findings highlight the need for community participation, secure land rights, fair compensation, and environmentally sustainable investment practices to protect smallholder livelihoods. In Kenya, agricultural investments have created both opportunities and challenges for rural households. Masola (2022) found that contract farming improved food sufficiency, income, dietary diversity, and asset accumulation by providing farmers with inputs, credit, extension services, and reliable markets. However, seasonal employment, price fluctuations, and gender inequalities sometimes reduced these benefits. Similarly, Mujenja and Wonani (2019) emphasized that food sufficiency depends not only on food availability but also on stable incomes and access to resources.

Theoretical Framework

The study is based on the Theory of Food Sufficiency advanced by Theodore W. Schultz. It provides a foundational explanation for persistent food insufficiency and low agricultural productivity in developing economies. The theory stipulates that smallholder farmers are rational and economically efficient within the constraints imposed by their environments. Schultz argued that traditional farmers do not suffer from ignorance or resistance to innovation, but rather from limited access to agricultural investments, modern technologies, education, and supportive institutions. Consequently, low productivity and food insufficiency arise not from inefficiency, but from structural constraints that prevent farmers from exploiting profitable opportunities (Schultz, 1964). This perspective reframes agricultural underperformance as an investment and institutional problem rather than a behavioral one.

Conceptual Framework

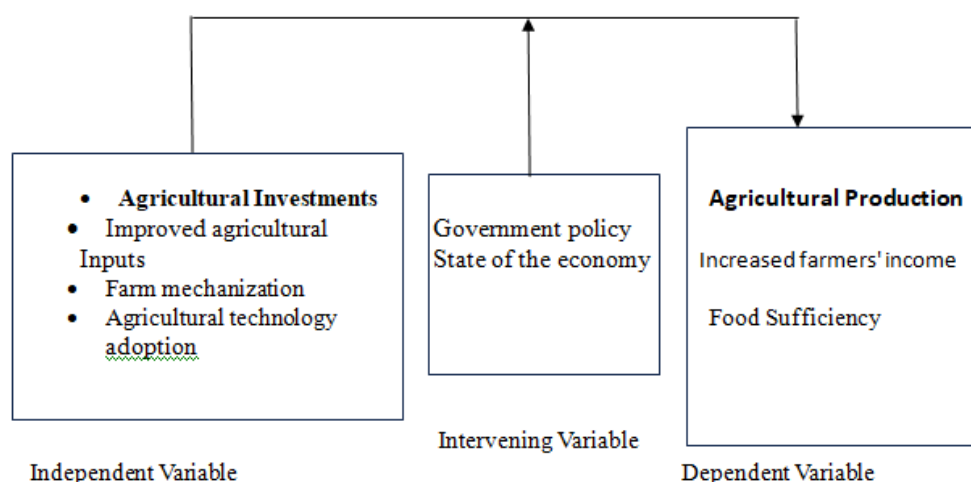


Figure 1: Influence of Agricultural Investments on Agricultural Production

The conceptual framework illustrates the relationship between agricultural investments and agricultural production, based on Schultz's (1964) theory of transforming traditional agriculture. The framework assumes that investment in productive resources such as improved inputs, irrigation, mechanization, technology, land improvement, livestock, and farmer skills enhances farmers' capacity to increase agricultural production. These investments improve the efficiency and productivity of land, labour, and other farm resources, resulting in increased crop and livestock output, productivity, production diversification, and marketable surplus. The framework therefore suggests that higher levels of agricultural investment are likely to contribute to improved agricultural production, which can subsequently enhance household food sufficiency and income.

METHODOLOGY

Study Area

This study was carried out in Tharaka Nithi County, Kenya. It lies on the Eastern slopes of Mount Kenya with a population of 393,177 according to the 2019 census. It's located between longitude 37° 18' 37" and 37° 28' 33" East and latitudes 0° 07' 23" and 0° 26' 19" South. The bordering counties are Meru County to the east, Kitui County to the south, and Embu County to the west.

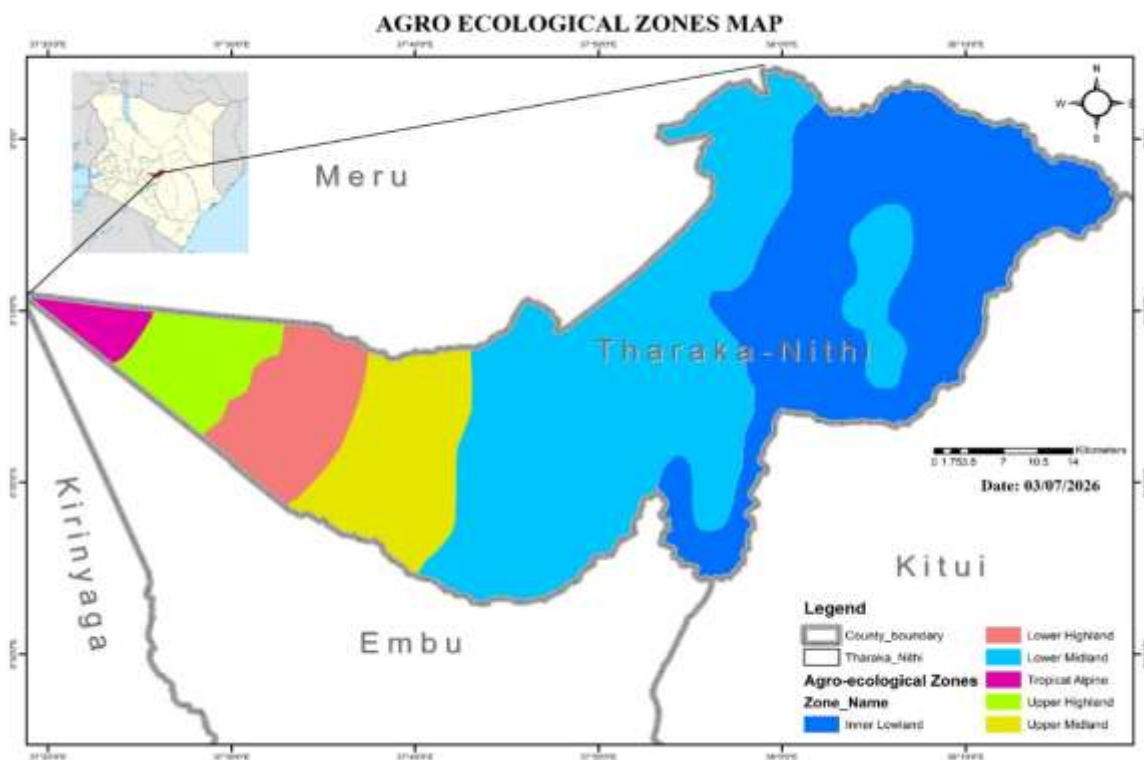


Figure 2: Map of Tharaka Nithi County Showing Agro-climatic Zones (Author 2026)

The area experiences a bimodal rainfall pattern, with long rains occurring between March and June and short rains between October and December. Tharaka Nithi County exhibits diverse soil types influenced by its varied topography and agro-ecological zones. The county spans

elevations ranging from approximately 600 meters in the lowlands to about 5,200 meters in the upper highland areas. This wide altitudinal range results in distinct soil characteristics across different ecological zones (Odour, 2021).

Study Design

This study adopted a mixed-methods research design, which integrates both quantitative and qualitative approaches within a single study to provide a comprehensive understanding of the research problem. The design enabled the researcher to combine numerical data on agricultural investments and food sufficiency with

qualitative insights from farmers and key informants. By integrating these approaches, the study was able to capture not only measurable patterns and relationships but also the underlying perceptions, experiences, and contextual factors influencing agricultural practices and investment decisions (Kothari, 2017).

Target Population

The target Population of this study was the 98,050 farming households in Tharaka Nithi County, KNBS (2021). A random stratified sampling technique was used for the selection of the study respondents. The number of respondents was proportional to the total population of the study area.

Sampling Procedures and Sample Size

Tharaka Nithi County has 106,000 households, out of which 92.% are farming households, equivalent to 98,050 units based on KNBS (Kenya National Bureau of Statistics, 2021). The sample size was determined using a formula by Yamane et al (1967): $n = \frac{N}{1 + N(e)^2}$

Where $N = 98,050$ households

$e =$ margin of acceptable error (0.05)

$$n = 98050 / 1 + 98050(0.05)^2$$

$$n = 398 \text{ Households}$$

The 398 households were randomly sampled from the three sub-counties. The number of households in each sub-county was then computed proportionately using:

$$n = (n \times N_i) / N$$

Where:

$n =$ total sample size;

$N_i =$ population in strata;

$N =$ total population

Table 1: Number of Respondents in the Study Area

Sub county	Farming Households	Proportionate Sample
Chuka/Igamba Ngombe	38,950	158
Maara	30,200	123
Tharaka	28,900	117
Total	98,050	398

Research Instruments

The study employed both quantitative and qualitative data collection instruments to address the research questions. Quantitative data were collected from farmers using structured questionnaires containing closed-ended questions and five-point Likert-scale items. The questionnaire captured information on agricultural investments, institutional factors, access to agricultural technologies, technology adoption, and household food security. Qualitative data were collected through structured and semi-structured Key Informant Interviews (KIIs) with selected extension officers, agricultural agency officials, and other relevant institutional stakeholders. The interviews explored institutional support, extension services, access to credit and markets, government programmes, technology adoption, and challenges affecting agricultural investment and food security. The combination of questionnaires and key informant interviews enabled the study to obtain

measurable data from farmers while also capturing detailed institutional perspectives and contextual explanations related to the research questions.

Reliability

In the present study, the research questionnaire was pretested in Embu County. The choice of Embu County was based on the fact that it has similar ecoclimatic zones. Pretesting helped to identify ambiguities and misunderstandings of test items. The reliability of the questionnaire was computed using Cronbach's Alpha. A coefficient of 0.79 was obtained. This is higher than the recommended 0.7, indicating that the questionnaire was reliable for collecting data (Fraenkel & Wallen, 2003).

Validity

Validity of the test questionnaire was obtained by subjecting the same to peer review to assess its adequacy in collecting the desired information. Furthermore, the questionnaire was scrutinized by experts in the field of geography and social sciences to assess its efficiency in obtaining desired information. Issues raised by peers and experts were used for improvement of the research tools.

RESULTS AND DISCUSSIONS

Influence of Agricultural Investment Intensity on Food Sufficiency

To arrive at the findings, data were collected from the sampled farming households using a structured questionnaire designed to assess the respondents' perceptions of agricultural investment intensity. In this study, food sufficiency was operationalized as the household's ability to produce, obtain, or purchase adequate food for regular household consumption without experiencing food shortages. The responses were measured using a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The mean scores were then used to determine the overall level of agreement among respondents regarding the contribution and intensity of agricultural investments. The results were presented in Figure 2.

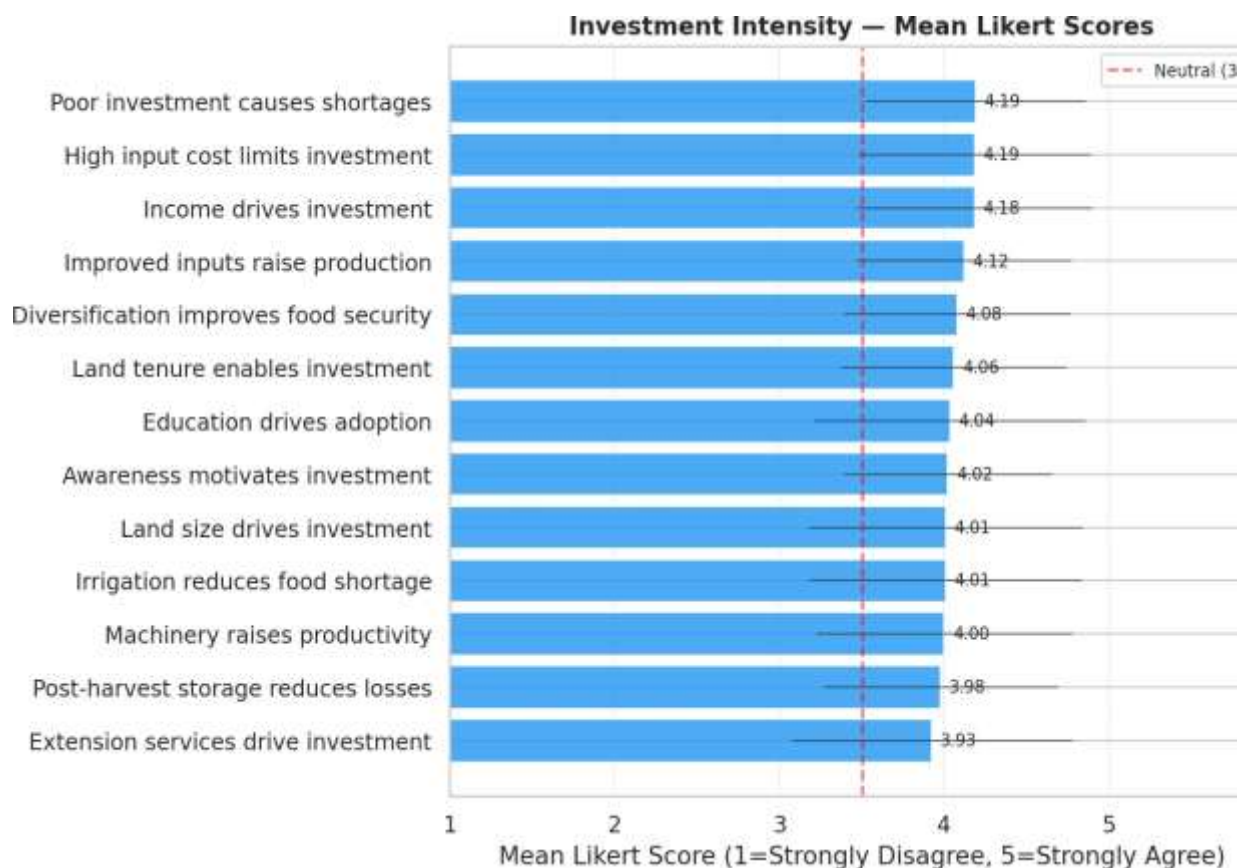


Figure 3: Investment Intensity – Mean Likert Scores

The mean score of 4.19 implies a high level of consensus among the respondents regarding the contribution of inadequate investment in agriculture to food shortages. Limited investment may prevent farmers from acquiring key inputs such as quality seeds, fertilizers, pesticides, irrigation equipment and appropriate farm machinery. This means that low investment can contribute to low agricultural productivity and limited capacity of households to produce enough food for their consumption and income needs. This finding emphasizes the necessity of improving agricultural investment as a means of increasing household food self-sufficiency and reducing vulnerability to food shortages (FAO, 2023; Government of Kenya, 2026).

The average score of 4.19 indicates that the high input costs are severely constraining the farmers' ability to purchase seeds, fertilizers, chemicals, machinery and other production inputs. If the price of inputs is high relative to household income, farmers may use less quantity or quality of inputs, resulting in lower farm productivity and less food available. Hence, the finding suggests that reducing the cost of agricultural inputs through subsidies, improved market systems, and targeted financial support could enhance investment and strengthen household food sufficiency (FAO, 2023; Government of Kenya, 2026).

The average score of 4.18 indicates strong agreement that a higher household income allows farmers to invest in agricultural technologies and productive farm activities. The more resourceful the farmer, the better the inputs, equipment, irrigation facilities and other technologies he can afford and the greater his ability to plow the returns back into agricultural production. This demonstrates that an increase in household income can improve farmers' capacity to adopt productivity-raising technologies and sustain agricultural investment over time (FAO, 2024; Government of Kenya, 2019).

The average score of 4.12 shows that the respondents are aware of the role of improved agricultural inputs in enhanced farm productivity. Better seeds, fertilizers, livestock breeds, and sound pest-management practices can increase farm efficiency and yields for farmers who have the right access, knowledge, and financial means. In turn, increased productivity can increase the quantity of food available to households and generate additional income for purchasing food and reinvesting in agricultural activities (FAO, 2023; World Bank, 2019).

The mean score of 4.08 indicates that respondents strongly agree that agricultural diversification improves household food sufficiency. Investing in a combination of crops, livestock and other farming businesses reduces reliance on a single source of food or income and offers alternative sources of livelihood when one business does badly. Thus, diversification can enhance household resilience to climatic, market and production related shocks and improve the stability of food and income supplies (Government of Kenya, 2019).

The average score of 4.06 shows that secure land tenure is perceived as an important determinant of agricultural investment decisions. Farmers who are secure in their control and use of their land are more likely to make long-term investments such as irrigation systems, soil fertility improvement, tree planting, and permanent farm infrastructure. Secure tenure can therefore provide farmers with greater incentives to engage in activities whose benefits may not be realized for many seasons, thus enhancing sustainable agricultural productivity and food sufficiency (Government of Kenya, 2026). The mean score of 4.04 shows that respondents are aware of the importance of education and training in influencing agricultural investment decisions. Education and farmer training can enhance knowledge of modern production practices, financial management, input use and agricultural technologies, thus enabling farmers to make better investment decisions. Better-informed farmers are also more likely to appreciate the potential benefits and appropriate use of technologies that can contribute to increased productivity and improved household food availability (FAO, 2023). The average score of 4.02 suggests that farmers' knowledge of advantages, costs and risks connected with agricultural technologies influence their readiness to invest and adopt. Farmers aware of how technologies might help boost productivity, minimize losses or increase resilience are more willing to consider investing in them. This result underlines the need of dissemination of information, demonstrations, farmer training and extension support to increase knowledge and adoption of appropriate technology (FAO, 2023; Government of Kenya, 2023).

Farm size is a significant factor in agricultural investment decisions, according to the mean score of 4.01. Due to the possibility of achieving economies of scale, larger or more profitable farms may offer more chances for

investment in mechanization, irrigation, enhanced infrastructure, and increased productivity. The result also suggests that farmers with small, dispersed holdings would find it difficult to make significant investments. Therefore, the possibility for profitable agricultural investment could be increased by addressing issues related to small farm sizes and land fragmentation.

Strong agreement that irrigation increases agricultural productivity and household food sufficiency is indicated by the mean score of 4.01. By enabling crop production during dry spells and lowering farmers' reliance on erratic rainfall, irrigation increases the likelihood of obtaining food from farming all year round. Investing in suitable irrigation systems can thereby increase family food security, build resistance to climate-related shocks, and improve production stability in regions impacted by rainfall variability (FAO, 2024; State Department for Irrigation, 2026).

The average score of 4.00 indicates that respondents saw automation as a crucial agricultural investment for raising farm productivity. Agricultural machinery can help farmers manage greater areas more effectively, minimize reliance on manual labor, and expedite soil preparation and other farm operations. However, adoption among smallholder farmers may be hampered by the comparatively high cost of machinery and the restricted availability of financing. Therefore, increasing the availability of reasonably priced mechanization services and suitable funding sources could enhance mechanization's contribution to agricultural output (Government of Kenya, 2024).

The average score of 3.98 shows that respondents understand how crucial it is to invest in better storage facilities in order to increase food sufficiency. By minimizing spoilage, pest damage, and other post-harvest losses, adequate storage enables households to save a larger percentage of their agricultural output for sale or future consumption. Additionally, better storage can help farmers hold onto goods until the market is more favorable, which might boost farm revenue and increase household food purchasing power (FAO, 2013).

The results show that respondents agree that extension services are crucial for encouraging agricultural investment and technology adoption, despite the fact that they received the lowest mean score of 3.93. Extension agents give farmers productivity advice, technical knowledge, and direction on how to employ agricultural technologies and inputs. The somewhat lower score when compared to the other metrics may indicate that farmers' access to extension services is still restricted or inconsistent. Therefore, farmers' ability to make wise investment decisions and increase agricultural productivity and food sufficiency might be improved by expanding extension coverage and providing farmer training.

The finding that inadequate agricultural investment contributes to food shortages is consistent with the study by Awinda (2018), which found that investment in irrigated smallholder agriculture in Kenya contributes to improved household food security through increased agricultural production and household incomes. This supports the current finding that investment in productive resources such as irrigation, improved inputs, and farm technologies can strengthen household food sufficiency. Similarly, Chege and Wamukota (2024) found that agricultural diversification among smallholder farmers in Kilifi South Sub-County contributes to improved food security by reducing dependence on a single agricultural activity and strengthening household resilience. This finding aligns with the current study, where respondents strongly agreed that diversified agricultural investments improve household food sufficiency.

However, a contrasting finding was reported by Wangu et al. (2021) in Tharaka-Nithi County. Their study of a French bean Agri-investment initiative found that agricultural commercialization did not automatically improve household food and nutrition security. Limited access to land and irrigation excluded many farmers, while replacing food crops with export-oriented crops could potentially weaken local food security. This contrasts with the generally positive perception in the current study and demonstrates that agricultural investment alone may not guarantee food sufficiency unless investments are inclusive, affordable, appropriately targeted, and supported by access to land, water, inputs, markets, and extension services. The contrasting evidence therefore reinforces the importance of considering the quality, accessibility, and distribution of agricultural investments rather than investment intensity alone.

Policy Implications

Farmers' access to affordable financial services and reduction of agricultural input costs should be among the top priorities of the county government of Tharaka Nithi. Therefore, Tharaka Nithi county and national government of Kenya need to develop investment support programs that are focused on the financial and structural limitations of small-scale farmers. Policies mentioned above should also promote investment in diversified and climate-resilient agriculture. This will increase the self-sufficiency of households in food production and their ability to survive adverse effects related to climate and production factors.

RECOMMENDATIONS

The research suggests the need to enhance accessibility of affordable agricultural financing, subsidized and high-quality agricultural inputs. There should be an increase in investment in irrigation facilities in order to minimize farmers' dependence on unpredictable rainfall. Additionally, rural roads, market infrastructure, and storage facilities need to be improved. Moreover, assistance needs to be provided to the farmers in terms of the adoption of viable agricultural technologies including high-yield seeds, mechanization, soil-management practices, digital agriculture technology, and value addition technologies. The focus of these measures should be on smallholder farmers with limited resources and involve diversified agriculture investment leading to food sustainability.

LIMITATIONS OF THE STUDY

The study faced three main limitations: self-reported data could have introduced response bias, which was minimized through clear questionnaires and key informant interviews; the cross-sectional design limited causal interpretation, which was addressed by integrating quantitative and qualitative data; and the findings may have limited generalizability beyond Tharaka-Nithi County, which was addressed through stratified proportional random sampling to ensure adequate representation of the study population.

Author Contributions

Conceptualization: M C, M K, J M; methodology: M C, M K, J M; investigation: M C, M K, J Mu; data collection and analysis: M C, M K, J M; writing—original draft preparation: M C; writing review and editing: M K, J M; visualization: M C, M K, J M. All authors have read and agreed to the published version of the manuscript.

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This research received no external funding.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Conflict Of Interest

The authors declare that they have no conflict of interest.

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