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The Role of Farmer Field and Business School (FFBS) in Improving Access to Agricultural Extension Services to Smallholder Farmers in Iringa Rural District, Tanzania

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Innovative and holistic approaches, such as the Farmers Field and Business School (FFBS), are essential for advancing agricultural practices and improving smallholder farmer livelihoods. In Tanzania, while evidence suggests that FFBS enhances access to extension services, its specific role remains undocumented. This study used an exploratory sequential mixed method to explore FFBS's role in improving smallholder farmers' access to extension services. The study involved 43

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FFBS beneficiaries from CARE International's FFBS scale-up project, selected through snowball sampling until data were saturated. This approach was chosen due to the challenges of accessing a comprehensive list of active participants and of ensuring that diverse perspectives are included. Data were collected using in-depth interviews, key informant interviews, focus group discussions (FGD), document review, and observation. Findings suggest that FFBS significantly enhances access to extension services through capacity-building in agronomy, climate resilience through sustainable agricultural practices, market linkages, gender empowerment, and information dissemination. The FFBS programme utilizes innovative experiential learning techniques, including hands-on training in sustainable agricultural practices, to equip farmers with practical knowledge and skills. Despite the positive outcomes, FFBS has not fully facilitated the transition of smallholder farming into large-scale commercial agriculture, highlighting challenges in scaling up production. The study suggests that all FFBS elements need to be fully applied to realize their innovative benefits. Policy implications include the need to improve resource access, particularly capital, technology, and markets for smallholder farmers, integrate FFBS into national extension programs, and promote gender-inclusive capacity-building to scale up agricultural productivity and sustainability.

Keywords: *Farmers business school (FFBS); field and agricultural extension services; smallholder farmers; access improvement.*

1. INTRODUCTION

1.1 Background Information

Agricultural extension services are vital for bridging the gap between scientific research and practical farming, facilitating the dissemination of innovations that improve agricultural productivity and sustainability (Zwane, 2020). The Farmers Field and Business School (FFBS), an evolution of the Farmer Field School (FFS), integrates agricultural training with business management to enhance farming practices and improve financial outcomes (Tham-Agyekuma *et al.*, 2021). While FFBS has been promising in improving farming techniques, its effectiveness has been limited by inadequate market information, thus constraining farmers' ability to make informed economic decisions, despite the adoption of improved agricultural practices (Zwane, 2020). Often, smallholder farmers face persistent challenges such as limited market access, price fluctuations, and inadequate financial support, all of which undermine the full potential of FFBS (Giannini *et al.*, 2022).

FFBS attempts to address these challenges by combining practical agricultural methods with business skills. However, market integration remains a significant barrier, especially in developing countries. While FFBS improves access to market information (e.g., price trends, market demand), smallholder farmers experience difficulties connecting with viable markets where they can sell their produce at competitive prices. This constraint underscores the difference

between having knowledge of market conditions and having the ability to participate in and benefit from these markets (Meludu, 2022). The model, which originated in Southeast Asia in the 1980s, expanded to Africa in the 1990s to address low agricultural productivity and poor market access (Yadav *et al.*, 2021; van den Berg *et al.*, 2020). Through experiential learning, FFBS trains farmers on the adoption of sustainable agricultural practices, such as pest management, soil conservation, and efficient crop management (Charasari *et al.*, 2022). Despite its success in improving yields and livelihoods globally, FFBS needs to further integrate commercial opportunities and market participation to ensure that financial outcomes match improvements in agricultural practices (Meludu, 2022).

In Tanzania, FFBS has been implemented by CARE International since 2012 and has reached over 5.3 million smallholder farmers across 41 countries, including 8,031 farmers in Iringa District (CARE International, 2024). The program has contributed to a 20.1 per cent increase in soybean yields and an 18 per cent rise in farmer incomes, primarily through the adoption of climate-resilient practices such as crop rotation and composting (CARE International, 2024). Additionally, FFBS has empowered women farmers by enhancing their self-confidence, autonomy, and economic participation (CARE International, 2024). However, despite these improvements, agricultural productivity in Tanzania remains low, partly due to insufficient adoption of innovative extension methods and challenges in scaling up these innovations.

Moreover, there is limited scholarly documentation of FFBS's role in delivering extension services (Singh *et al.*, 2022; Ojijo, 2021).

While FFBS has proven effective in enhancing farmers' knowledge and skills, its role in providing sustained agricultural extension services remains underexplored (Chilemba & Ragasa, 2020; Meludu, 2022). The current study therefore explores FFBS's role in improving smallholder farmers' access to agricultural extension services in Iringa District, Tanzania. By addressing this gap, the study aims to provide insights into how FFBS can better support smallholder farmers and contribute to sustainable agricultural development and economic resilience in Tanzania. This examines a significant topic pertaining to Tanzanian smallholder farmers and agricultural extension services. The study offers actual proof of the efficacy of FFBS in enhancing access to extension services, making it extremely pertinent to the scientific community. In order to improve rural livelihoods, agricultural production, and poverty reduction, these services are essential. Additionally, by shedding light on the real-world implementations of FFBS in Tanzania, this study adds to the body of knowledge and offers useful information for upcoming policy and rural development initiatives.

2. EMPIRICAL LITERATURE REVIEW ON THE DELIVERY OF AGRICULTURAL EXTENSION SERVICES

Agricultural extension refers to an educational system that provides farmers with knowledge and skills to enhance their farming practices. According to Fisher, (2013), agricultural extension services are designed to directly reach farmers on their farms, emphasizing the importance of involving all family members in the planning and implementation of programs. These services aim to transition subsistence farmers to commercial farming, and improving food security and sustainability (Ojeka *et al.*, 2016). However, the effectiveness of Agricultural Extension Services requires critical evaluation. For instance, while farmer training workshops and market linkages are promoted, their real-world impact in regions with infrastructural or political constraints remains uncertain (Alakpa & Ehigie, 2024). Similarly, technological tools such as mobile-based SMS alerts, though innovative, encounter challenges in areas with limited internet access and or digital literacy, raising

questions about their practical impact on smallholder farmers (Singh *et al.*, 2023).

The FFBS integrates agricultural training with business skills; however, its role in improving smallholder farmers' access to agricultural extension services requires further assessment (Mahaarcha & Sirisunhirun, 2023). And despite its participatory approach, understanding how well FFBS enhances farmers' access to extension services, which include both agricultural practices and business skills remains elusive. The quality of extension personnel is critical, as they must address both farming techniques and broader agricultural knowledge (FAO, 2019; Kazeem *et al.*, 2017). However, financial, technological, and socio-cultural barriers continue to hinder equitable access to these services, especially in developing countries.

In Tanzania, FFBS has shown promising results; however, research on its implementation, particularly in Iringa District, remains limited. Studies on FFBS's role in improving access to extension services are lacking, hindering the efforts to evaluate its full potential. Furthermore, impact assessments and feedback mechanisms are scarce, making it difficult to refine extension approaches and assess their long-term outcomes. Addressing these gaps is crucial for enhancing the effectiveness of agricultural extension services in fostering sustainable development and improving smallholder farmers' access to these services.

2.1 Theoretical Framework

The current study employs Kolb's Experiential Learning Theory (ELT) as a theoretical framework, which views learning as a cyclical process involving Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation. These stages align with the Farmer Field and Business School (FFBS) model, which uses experiential learning to enhance farming practices and market linkages among smallholder farmers. In the Concrete Experience phase, farmers engage in hands-on activities such as field demonstrations carried out through interviews and observations. Reflective Observation involves facilitated discussions, where farmers analyse experiences and share insights on agricultural techniques and market information. During Abstract Conceptualization, farmers refine strategies and business concepts, while in the Active Experimentation farmers

implement new approaches, such as cooperative selling and price negotiations to improving market access and income.

The study also integrates social learning theory to emphasize collective learning within FFBS, where group interactions and knowledge sharing enhance market linkages. By combining practical agricultural knowledge with business skills, FFBS empowers farmers in making informed decisions, securing better prices, and expanding market reach. This dual approach highlights how FFBS fosters economic resilience and poverty reduction among smallholder farmers. The research methodology captures these learning stages, demonstrating how FFBS enhances both individual and collective market engagement, ensuring sustainable economic outcomes.

3. METHODOLOGY

3.1 Description of the Study Area

Iringa District, located in the Iringa Region of Tanzania, was selected for this study due to its significance in agricultural production and the potential benefits of implementing the FFBS

approach. According to the 2022 Census (URT, 2022), the district has a population of 315,354 people (153,556 males and 161,798 females), with 82 per cent of households engaged in farming. The study focused on farmers involved in Care International's FFBS scale-up project across 62 villages in 18 wards, benefiting 8,031 small-scale producers, including 5,782 women and 2,249 men. The research aimed to explore the role of FFBS in enhancing agricultural extension services and to provide insights that could inform policy and practice at both local and national levels. A mixed-methods design, using an exploratory sequential approach was employed. The qualitative phase included in-depth interviews, focus group discussions (FGDs), and key informant interviews (KIs), followed by a quantitative phase to validate the findings. Data collection occurred in four purposively selected wards Luhota, Lyamgungwe, Magulilwa, and Mgama were chosen for their high agricultural potential and active participation in FFBS activities. A combination of purposive and snowball sampling methods led to the inclusion of 43 FFBS direct beneficiaries (31 women, 12 men).

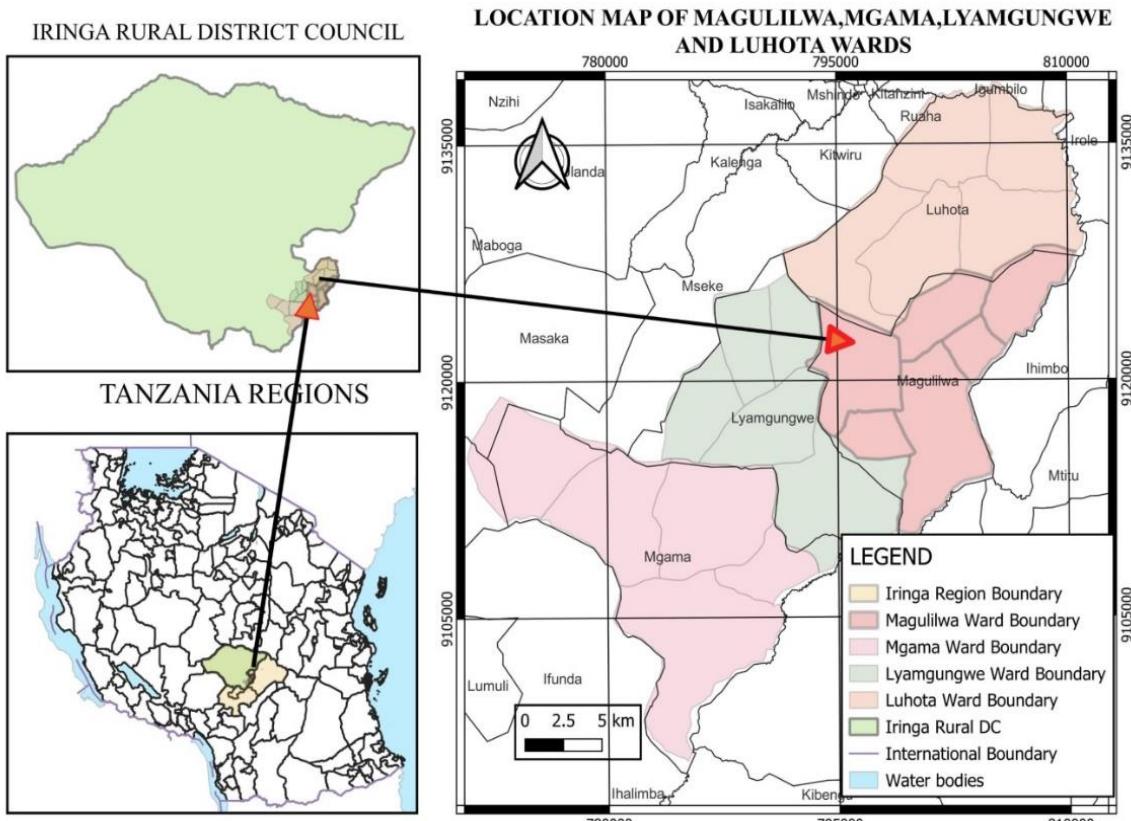


Fig. 1. A map showing the location of the study area, source: GIS, (2024)

The purposive sampling method ensured the study focused on wards with significant agricultural potential and strong FFBS participation, directly aligning with the research objectives and minimizing the inclusion of low-engagement areas. This strategic approach allowed the study to gather data from regions where FFBS was likely to have the greatest impact, ensuring both relevance and applicability of the findings. To further diversify the sample, snowball sampling was employed to reach a broader range of participants, particularly those from marginalized or hard-to-reach groups. While snowball sampling can introduce bias due to reliance on social networks, the researchers minimized this risk by carefully monitoring the referral process, ensuring a balanced representation of gender and varying levels of engagement in FFBS activities. Data saturation was achieved when no new themes emerged, indicating that the sample size was sufficiently comprehensive to capture a diverse range of perspectives. Qualitative data were analysed using a thematic analysis approach, while quantitative data were analysed using descriptive statistics (e.g., frequencies and percentages). The qualitative analysis involved transcription, coding, and identification of key themes. Audio, video, and photo data were transcribed, coded, and categorized to facilitate the interpretation of the study findings. Secondary data (e.g., reports and demographic information) were also reviewed and analysed thematically to support the study's conclusions.

4. RESULTS

4.1 Socio-demographic Characteristics of Participants

In Table 1 The socio-demographic analysis highlights gender-based differences among participants. Male participants are predominantly middle-aged, with 75 per cent in the 35-54 age groups, 16.7per cent in the 55 or above category, and none represented the 18-34 age range. Female participants exhibit a broader age distribution, with 41.9 per cent aged 35-54, 19.4per cent aged 18-34, and 16.1per cent aged 55 or above, illustrating a more age-diversity among females. Education levels show similarities and disparities. Both genders are primarily educated at the primary level, with 75per cent of males and 83.9per cent of females falling into this category. However, 16.7 per cent of males completed post-primary education, while no females reported attaining this level.

Additionally, 8.3per cent of males reported receiving non-formal education, compared to 3.2per cent of females, suggesting that males ranked slightly higher in educational achievement, especially in post-primary education. In terms of marital status, all male participants are married (100%), indicating uniformity in this demographic. Female participants, however, display diversity: 22.6per cent are married, 48.3per cent are separated, 12.9per cent are divorced, 9.7per cent are widowed, and 6.5per cent are single. This reflects a wider range of marital experiences among females. Overall, these findings underscore notable gender-based differences in age, education, and marital status within the sample population.

4.2 FFBS Role in the Access to Agricultural Extension Services

This study reveals that FFBS is a participatory agricultural extension approach that enhances access to essential services. These include market engagement, entrepreneurship, gender equality, nutrition, and climate-resilient agriculture. By promoting experiential learning, capacity building, and community empowerment, FFBS proves to be a versatile tool for agricultural development. However, the approach requires refinement to adapt to diverse contexts, as weaknesses in market engagement, certification, and performance monitoring have been identified. Key findings reveal that FFBS provides training in various areas, such as the production and processing of soybeans, the production and processing of sunflower, nutritious flour, the application of soil testing, the marketing of agricultural produce, and the appropriate use of improved seeds. They also foster collaboration between farmers and Extension Officers, contributing to stronger agricultural practices. They also fosters collaboration between farmers and Extension Officers, contributing to stronger agricultural practices (see Table 2).

Based on data from Ngama, Magulilwa, Lyamungwe, and Luhota Wards, the study demonstrates that FFBS is a comprehensive approach that provides several agricultural extension services, improving farmers' access to extension services. Several key themes emerged from the analysis, highlighting the positive impacts of FFBS on farmers' knowledge, skills, and agricultural practices. The themes include the Role of FFBS in Capacity Building, Gender Empowerment of FFBS, Access to

Market Linkages through FFBS, Access to Climate Resilience through Sustainable Agricultural Practices, and Information Dissemination through FFBS. Each of these themes is discussed in the subsequent sections.

4.2.1 The role of FFBS in capacity building

FFBS, led by groups such as CARE International, equips farmers with skills in agricultural production and marketing through training, field demonstrations, and interactive sessions. It blends traditional knowledge with modern methods, enhancing farming practices, increasing productivity, and improving market navigation, thus fostering sustainable growth and economic resilience.

Participants in one FGD said,

Participants agreed that FFBS significantly improved their agricultural knowledge, business, crop markets, and gender violence education, providing practical skills in agronomic practices, field preparation and innovative methods such as bag gardening (FGD participant, Luhota Ward, 2024).

Secondary data from CARE confirm that FFBS enhances farmers' access to extension services by bridging the gaps between farmers and government officials. Training Community-Based Trainers (CBTs) and Paraprofessionals (PPs) strengthen service provision, especially expertise on markets, gender, and agricultural practices.

A participant made the following remark,

...FFBS training covered improved agronomic practices, smart agriculture, soybean/sunflower production, and sustainable techniques such as bag gardening, composting, and crop rotation to

enhance soil fertility (In-depth interview, Mgama Ward, September 28, 2024).

*Participants in another FGD reported,

...FGD participants highlighted FFBS-taught environmental strategies such as sustainable farming, conservation agriculture, and avoiding deforestation. They learned Climate Smart Agriculture, terracing, and home gardening to combat stunting and reduce costs. Farmers adopted early-maturing crops, weather forecasts, and tree planting, alongside skills in detergent production, batik, and soybean milling (FGD participants, Mlanda Ward, September 27, 2024).

Participants agreed that FFBS enabled value addition by transforming soybeans and sunflower into nutritious flour, boosting income and child nutrition. In 2024, 3,893 farmers trained by 62 paraprofessionals, 47 Village Extension Officers, and 62 community-based trainers learned sustainable practices such as improved seeds, organic fertilizers, crop rotation, and pest control. About 48 per cent of FFBS households adopted climate-resilient methods, increasing soybean yields by 20.1 per cent and incomes by 18 per cent. CARE International's evaluation (September 11, 2024) highlighted training in soil improvement, water conservation, and vegetable cultivation for 317 farmers (221 women, 96 men). Farmers reported that improved techniques reduced workloads and entrepreneurial opportunities, such as retail and livestock. FFBS also promoted market engagement, compost production, and leadership, thus enhancing economic participation and climate resilience. These findings align with the findings in a study by (Odhiambo, 2022), showing that participatory approaches improve sustainable farming adoption, knowledge retention, and productivity.

Box 1: Access to agricultural extension services by NGOs

FFBS partnered with CARE International and Iringa local government staff to train 317 farmers on compost manure preparation, soil improvement, water conservation, and seedbed preparation. This training enabled farmers to grow vegetables with fewer chemicals and reduced women's labour in food sourcing. Farmers also learned entrepreneurship skills, including retail, pig farming, small ruminant rearing, and leadership. Participation in VSLAs enhanced leadership and managerial capabilities. FFBS promotes community empowerment, climate-smart practices, and market engagement through hands-on training, financial literacy, and innovative techniques. These initiatives improve soil health, maternal health, and livelihoods, showcasing FFBS's role in empowering farmers.

Source: CARE International, (2024)

4.2.2 Gender empowerment of FFBS

FFBS has advanced gender equity by empowering women in agriculture, and 58 per cent of 3,893 trained farmers in 2024 were women. The trainees gained skills in crop rotation, composting, improved seeds, and climate-resilient practices, thus enhancing their economic leadership and decision-making roles in farming communities.

Findings from FGDs, Lyamungwe Ward, KIls, Mlanda Ward, and Mgama Ward indicate that FFBS trained farmers in sunflower and soybean production, introducing Hysun sunflower seeds, which outperform local varieties. Training included sustainable techniques such as compost preparation, bag gardening, and crop rotation to enhance soil fertility. Farmers learned value addition, such as processing soybeans into nutrient-dense flour, reducing stunting, and improving child nutrition. These practices boosted profitability and family health, highlighting FFBS's impact (FGDs, Lyamungwe Ward, September 26, 2024; KIls, Mlanda Ward, September 27, 2024; Mgama Ward, September 28, 2024).

FFBS significantly enhances women's social roles, self-esteem, and economic independence. Women trained in FFBS have ventured into entrepreneurial activities, such as processing soybeans and sunflowers into nutrient-dense flour, boosting income and household nutrition. Tools such as scales and soybean milling machines have improved market engagement and fair-trade practices. Safia Madenge, a 39-year-old farmer from Mlanda village, exemplifies this empowerment. Initially reliant on traditional maize farming, she struggled to increase yields and income. As a Community-Based Trainer (CBT), Safia received training in Village Savings and Loan Associations (VSLAs), thus, she improved her financial literacy, which enabled her to inspire other women to achieve financial independence (FGDs and interviews, 2024).

During a Key Informant Interview, it was thus revealed,

“...Safia and her team learned value addition from FFBS, processing soybeans into meat, milk, flour, and tea masala. A soybean processing machine boosted production and quality, improving their financial outcomes. Safia, once reliant on traditional farming, is now a trainer and entrepreneur, inspiring other women in her community through

FFBS (Key informant interview and CARE International review, September 11, 2024).

FFBS has enhanced women's roles through leadership opportunities and increased decision-making in farming. Notably, 35 per cent of female participants now lead in community groups such as VSLAs, thus reflecting broader recognition of their contributions (FGDs, interviews, participant feedback).

During FGDs in Mlanda Ward, it was revealed that Participants learned FFBS-taught environmental strategies like sustainable farming, conservation agriculture, and avoiding deforestation. They gained skills in Climate Smart Agriculture, terracing, and home gardening, reducing stunting and living costs (*FGD participants, Mlanda Ward, September 27, 2024*)

FFBS drives gender empowerment and social-economic transformation, equipping women to address climate challenges through early-maturing crops and weather forecasts. A case study of Amina from Magulilwa Ward highlights her transition from subsistence farming to owning a profitable organic fertilizer business, which enabled her to empower other women. CARE International's review (September 11, 2024) notes, FFBS trained 317 farmers (221 women, 96 men) in soil improvement, water conservation, and vegetable cultivation, thus enabling women to pursue entrepreneurial activities such as retail business and livestock keeping. FFBS also promoted market engagement, compost production, and leadership, thus enhancing economic participation and climate resilience among farmers. Addressing gender inequality and GBV is crucial, as Chiadikaobi et al., (2024) highlight its impact on women's productivity and well-being. FFBS bridges information gaps between information sources and farmers by providing timely updates on pest management, market trends, and best practices, enabling farmers to make informed decisions and fostering stakeholder collaboration, thus improving productivity and income.

During a Key Informant Interview, the following observation was made,

“...FFBS enhances agricultural extension through participatory learning, engaging farmers in tailored education to address their unique challenges. It provides business and agricultural skills, leveraging local experts

and extension workers to share vital information on market trends, crop rotation, and pest control. Peer-to-peer learning fosters innovation, while market orientation teaches value chain strategies. Practical demonstrations ensure real-world application of skills (Key Informant Interview, September 9, 2024).

Local experts in FFBS connect farmers with stakeholders, enhancing NGO-led extension services. This collaboration strengthens community-NGO-government ties, ensuring that farmers receive tailored support to improve practices and yields.

During an In-depth interview, a participant gave the following remark,

“...Village farmers trained by FFBS in sunflower and soybean production learned advanced agronomic techniques, including Hysun sunflower seeds, which outperform local varieties. They gained skills in compost preparation, bag gardening, and crop rotation to enhance soil fertility. Training in value addition, such as processing soybeans into nutrient-dense flour, improved child nutrition and reduced stunting, leading to economic and health benefits (In-depth interview, Mgama Ward, September 28, 2024).

FFBS enhances agricultural extension by fostering collaboration among NGOs, the government, and farmers, ensuring farmers' timely access to innovations and policy decisions based on empirical data. This approach boosts productivity, resilience, and sustainability, with its adaptability benefiting diverse regions. FFBS improves knowledge flow, stakeholder communication, and extension efficiency, aligning with Danjumah et al., (2024) study on effective extension systems. Through partnerships with suppliers, FFBS facilitates access to quality seeds, fertilizers, and pesticides, which are crucial for sustainable farming and increased yields. These linkages empower farmers, thus enhancing their productivity and crop outcomes.

According to Key Informant Interview,

“...FFBS collaborates with local Agro-input dealers to supply farmers with seeds, fertilizers, and pesticides. A dealer noted, Timely access to quality inputs is crucial for FFBS success, but cited challenges such as cost fluctuations and logistics (Key Informant, Agro-Input Dealer, September 28, 2024).

The FFBS model has significantly reduced input costs for smallholder farmers through strategies such as bulk buying and collaboration with suppliers, thus enabling cost-sharing and collective bargaining. By connecting farmers with stakeholders, FFBS ensures affordable access to quality inputs among farmers, fostering improved agricultural practices without excessive expenses. The model also promotes partnerships among local communities, Government Agricultural Officers, and NGOs, thus enhancing farmers' access to comprehensive agricultural extension services, including inputs and sustainable practices.

FFBS engages community-based trainers (CBTs) and local government representatives to provide hands-on training and disseminate agricultural knowledge to farmers, thus strengthening the entire agricultural ecosystem. Despite challenges such as logistical barriers in rural areas and fluctuating costs of agricultural inputs, FFBS collaborates with stakeholders to ensure a sustainable supply chain. Timely access to inputs remains critical for the success of FFBS interventions, enabling smallholder farmers to adopt climate-smart practices, increase productivity, and improve livelihoods.

These findings align with findings in a study by Danjumah et al., (2024), who emphasize that effective agricultural extension systems should provide farmers with information, advice, and support, underscoring FFBS's role in promoting sustainable farming and better outcomes for farming communities.

Box 2: Success story 2 on the role of FFBS

Hussen Mfilinge's life transformed after FFBS training, shifting from traditional farming to adopting gender equality, VSLAs, and modern techniques. This reduced family conflicts, boosted profits, and enabled milestones such as building a house, expanding farmland, and buying livestock. As a Paraprofessional, he now trains over 300 people, inspiring his community with entrepreneurial and agronomic practices.

Source: Documentary review of care international observation date:09/15/2023

Table 1. Basic characteristics of male and female participants

Parameter	Categories	Sex: Male (n=12)				Female (n=31)			Total (%)
					Total (%)				
Age in (years)	18 - 34	0	0	1	1 (8.3%)	0	1	0	2 (19.4%)
	35 – 54	1	5	3	9 (75%)	0	7	3	13 (41.9%)
	55 or above	0	1	1	2 (16.7%)	0	4	1	0 (5 (16.1%))
	Total	1	6	5	12 (100%)	12	4	5	10 (31 (100%))
Educational level	Non-formal education	0	1	0	1 (8.3%)	0	0	0	1 (3.2%)
	Primary education	1	5	3	9 (75%)	12	3	4	7 (83.9%)
	Post-primary education	0	1	1	2 (16.7%)	0	0	0	0
	Total	1	7	4	12 (100%)	12	4	5	10 (31 (100%))
Marital Status	Married	2	5	5	12 (100%)	1	4	0	2 (7 (22.6%))
	Separated	0	0	0	0	1	5	3	6 (48.3%)
	Single	0	0	0	0	2	0	0	2 (6.5%)
	Divorced	0	0	0	0	1	2	1	4 (12.9%)
	Widow/Widower	0	0	0	0	0	1	2	3 (9.7%)
Total		2	5	5	(100%)	4	10	6	11 (31(100%))

Table 2. Role of FFBS in improving access to agricultural extension services

	Ngama Ward (n=12)		Magunliwa Ward (n=10)		Lyamungwe Ward (n=11)		Luhota Ward (n=10)	
	Freq.	Per. (%)	Freq.	Per. (%)	Freq.	Per. (%)	Freq.	Per. (%)
Training on the production and processing of soybeans	12	100	8	80	10	90.91	8	80
Skill to produce and process sunflower	12	100	6	60	9	81.82	9	90
Increase agricultural production	10	83.3	10	100	10	90.91	10	100
Learning to produce nutritious flour	12	100	4	40	9	81.82	10	100
Making use of soil testing knowledge	11	91.7	8	80	7	63.64	7	70
Applying marketing skills for agricultural produce	11	91.7	10	100	11	100	1	10
Training on the appropriate use of improved seeds and planting at the appropriate time	11	91.7	10	100	11	100	7	70
Training on the appropriate application of fertilizer	11	91.7	10	100	11	100	7	70
Training on engaging in farming as a business	12	100	9	90	9	81.82	8	80
Training on African-based bag gardening	12	100	10	100	10	90.91	2	20
Linking to key stakeholders and suppliers of agricultural inputs	9	75	6	60	5	45.45	2	20
Minimizing the prices of fertilizer and other agricultural inputs through bulk purchase	9	75	2	20	2	18.18	7	70
M: Strengthening closeness between farmers and government agricultural extension officers	10	83.3	10	100	9	81.82	7	70
P: Promoting gender empowerment and facilitating associated training introduces us to gender empowerment	11	91.7	10	100	11	100	9	90

4.2.3 Access to market linkages through FFBS

Market access is crucial for smallholder farmers to sell produce competitively, diversify income, and achieve higher economic returns, thus directly improving their livelihoods. The Farmer Field Business School (FFBS) program strengthens connections between farmers and local/regional markets by fostering collaboration among farmers, market actors, and service providers. FFBS equips farmers with skills, resources, and networks to engage effectively in markets, thus enhancing their participation and economic outcomes.

FFBS promotes collective action through producer groups, enhancing farmers' production, marketing, and business skills. Practical training builds confidence, while financial literacy training enables farmers to acquire skills in resource management and knowledge of investments, thus improving financial resilience among farmers. FFBS integrates business education with agricultural training, encouraging best practices and informed decision-making. Market orientation teaches farmers to analyse local markets and align production with demand, enhancing market access and returns. Through community empowerment, FFBS fosters sustainable agricultural practices and improved livelihoods despite challenges (CARE International, 2024).

Participants in FGDs across Lyamungwe, Mlanda, and Mgama Wards highlighted FFBS's role in enhancing market engagement. Farmers in Lyamungwe reported higher revenues from FFBS-arranged market days, while those in Mlanda gained economic stability through steady contracts with local traders, reducing reliance on low-paying intermediaries (FGD participants, September 27, 2024).

Women farmers have significantly benefited from FFBS in gaining access to new markets and launching small enterprises. Training in market participation has enabled women in Mgama Ward to sell value-added products such as soybean flour and sunflower oil in urban markets, boosting their incomes and social status. FFBS promotes sustainable farming, market accessibility, and economic resilience through farmer mobilization, financial literacy, and practical training. Continued innovation and collaboration are essential to overcoming challenges and ensuring long-term success for smallholder farmers. These findings align with

findings in a study by Ragasa et al., (2023), who emphasize that market-oriented extension programmes enhance farm profitability and food security by combining technical and business training.

4.2.4 Access to climate resilience through sustainable agricultural practices

Climate change has heightened smallholder farmers' vulnerability to environmental disruptions such as erratic rainfall, droughts, and floods, thus threatening their livelihoods and food security. The Farmer Field Business School (FFBS) addresses these challenges by equipping farmers with climate-resilient practices through hands-on training in climate-smart agriculture (CSA). FFBS promotes sustainable methods such as crop rotation, intercropping, water conservation, and the use of organic fertilizers to enhance soil health and reduce reliance on chemical inputs. It also emphasizes agroforestry to improve water retention, reduce erosion, and diversify income sources. Additionally, FFBS introduces drought-resistant, early-maturing crop varieties and teaches farmers on compost manure production, thus improving soil fertility and water conservation. These practices enhance farmers' resilience to climate shocks, ensuring sustainable farming systems (CARE International, 2024).

A participant in the FGD reported,

“...Climate change increases smallholder farmers' vulnerability to erratic rainfall, droughts, and floods, threatening livelihoods and food security. FFBS addresses this through climate-smart agriculture (CSA) training, promoting crop rotation, intercropping, water conservation, organic fertilizers, and agroforestry. It also introduces drought-resistant crops and compost production, enhancing soil health and resilience to climate shocks (CARE International, 2024).”

FFBS training emphasizes farmyard manure and compost, reducing reliance on artificial fertilizers. It significantly empowers female farmers, who often manage household food production, by teaching them sustainable practices. For example, women in Mlanda Ward grow vegetables alongside staple crops, thus boosting income and nutrition, and have diversified their economic ventures into soap and batik production, enhancing economic resilience (CARE International, 2024).

During the same FGD, another participant had this to say,

....Farmers in Mgama ward use climate-smart techniques like gully reclamation and terracing to reduce soil erosion, protect farms, and ensure consistent yields despite erratic rainfall (FGDs, Mgama Ward).

Key stakeholders, including local government representatives and Extension Officers, emphasize the importance of training and knowledge sharing in building climate resilience. One Extension Officer noted while climate-smart practices have boosted smallholder farmers' productivity, further investments in infrastructure, such as irrigation and weather forecasting technologies, are essential. Collaboration among FFBS, local governments, and NGOs has equipped farmers with knowledge and resources to adopt these practices effectively. A Local Government Official highlighted the need to integrate climate resilience into national policies and community training, stating, "FFBS has educated farmers on climate resilience, but more efforts are needed to improve infrastructure and access to resources such as drought-resistant seeds and weather information" (Local Government Official, 2024).

Despite progress, challenges persist, including limited access to affordable inputs such as drought-resistant seeds and fertilizers, as well as difficulties in predicting weather patterns for optimal planting. Farmers also face challenges in accessing climate-related information promptly, hindering their ability to implement best practices during changing conditions. FFBS's focus on sustainable methods, such as crop diversification and water management, offers significant potential to enhance climate resilience. However, sustained investments in infrastructure, market access, and climate data are crucial for long-term effectiveness. Strengthening collaboration among NGOs, governments, and communities can further support smallholder farmers in adapting to climate change and ensuring food security. These findings align with findings in other studies by Kassie et al., (2013) and Ngigi et al., (2023), which stress the role of participatory extension services in promoting sustainable agriculture and community resilience.

4.2.5 Information dissemination through FFBS

By sharing up-to-date agricultural information, the FFBS bridges a gap between smallholder

farmers, government bodies, and research institutes. FFBS programs enhance extension services by ensuring timely access to crucial information, aiding farmers in making informed decisions, and fostering stakeholder cooperation. These programs provide updates on pest management, market trends, and best practices, enabling farmers to address issues effectively and adjust their production to meet market demands for better profitability.

During a Key Informant Interview, one participant had this to say,

“...The FFBS uses participatory learning to engage farmers in their education, fostering experience and information sharing tailored to their specific needs. FFBS also focuses on improving farmers' financial management and productivity through essential business and agricultural skills. Local community experts and extension workers expedite access to vital information, allowing farmers to make well-informed decisions”... (Key Informant Interview, September 9, 2024)

Local experts are crucial in disseminating knowledge and helping NGOs provide effective extension services. This partnership improves agricultural extension programs' efficiency. FFBS's information distribution enhances decision-making, productivity, and cooperation, fostering a resilient and sustainable agricultural sector. The FFBS model can be applied in various regions to improve stakeholder communication and knowledge sharing, benefiting the agricultural industry.

A participant in an In-depth interview gave the following remark,

“...Village farmers have been trained in producing and processing sunflower and soybeans using advanced agronomic techniques and smart-agriculture methods. The FFBS initiative introduced the Hysun sunflower seed variety, increasing yields. Training included sustainable agricultural techniques such as compost preparation, bag gardening, crop rotation, and soybean cultivation for home and commercial use. Farmers learned to enhance sunflower production for better revenue and process soybeans into nutrient-dense flour, improving child nutrition and reducing stunting. This comprehensive education has transformed lives, resulting in economic benefits and

better family health..." (In-depth interview, Mgama Ward, September 28, 2024).

These findings align with findings in a study by Danjumah et al., (2024), emphasizing the importance of providing information, advice, and support to farmers for improved practices and yields.

Semi-structured interviews across four wards revealed varying insights on access to agricultural extension services through FFBS. In Ngama Ward, participation in training activities ranged from 33.33 to 100 per cent, with high engagement in soil testing, fertilizer application, and business-focused farming. Magulilwa Ward showed a gap between role recognition and implementation, with six roles achieving 100per cent agreement, but soil testing and bulk purchase of inputs were recognized at 20per cent only. Nutritious flour production was acknowledged at 40per cent (see Table 2).

In Lyamungwe Ward, marketing skills, improved seed use, and farmer-extension officer relationships were highly recognized (100%), while fertilizer application training scored 81.82per cent. Soybean and sunflower production training received 90.91 and 81.82per cent recognition, respectively. However, bulk purchase of inputs (18.18%) and soil testing knowledge (45.45%) were less acknowledged (see Table 2).

Luhota Ward prioritized agricultural production and nutritious flour production (100%), followed by soil testing, gender empowerment, and sunflower training. Business-focused farming and bag gardening were recognized at 80per cent, while marketing skills and fertilizer application scored 70per cent. Bulk purchase of inputs and stakeholder linkages were the least recognized (20%) (see Table 2).

Documentary findings highlight paraprofessionals (PPs) and Community-Based Trainers (CBTs) as key pillars in delivering FFBS extension services (see Box 1, Box 2, Box 3). These results underscore the need to strengthen less-recognized roles, such as bulk purchasing and soil testing, to enhance FFBS effectiveness.

4.3 Challenges in Accessing FFBS Agricultural Extension Services

First, a noteworthy result on market engagement is that agrodealers are unwilling to proceed with the existing arrangements. One of the agro-input dealers had this to say,

"I collaborate with Care International to provide smallholder farmers with essential inputs like seeds, fertilizers, and pest control products. Timely access to quality inputs is crucial for FFBS success, but challenges such as price fluctuations and logistical difficulties in reaching remote areas hinder delivery. Payment delays from farmers also pose issues, requiring Care International's support for smoother transactions. Enhanced coordination with local authorities is needed to ensure a stable and efficient supply chain" (Agro-input Dealer, Sep 28, 2024).

Second, the results also suggest some key challenges in market engagement. Some key informants argued that despite FFBS interventions, soybean production engagement remains low due to market uncertainties. Smallholder farmers struggle to attract buyers, as off-takers demand large quantities, which are often unavailable. Farmers face low prices, unreliable markets, and limited sales opportunities, with soybean products mainly sold during special events. FGD participants and local officials (Sep 28, 2024) echoed these challenges. Additionally, while FFBS relies on Paraprofessionals (PPs) and Community-Based Trainers (CBTs) to sustain agricultural services, research indicates performance issues among these key actors, hindering effective service delivery. Market access remains a significant barrier to FFBS success. A key informant had this to say,

Some PPs and CBTs lack effective communication skills, and older trainers struggle to deliver FFBS knowledge, hindering farmers' learning (Key Informant, local officials, Sep 28, 2024).

FFBS delivery of agricultural extension services lacks uniformity across the four wards, with some participants receiving extra training while others are not. FGDs revealed that only a few beneficiaries were trained in digital record-keeping (CHOMOKA), and even these faced implementation challenges, limiting their benefits. This inconsistency in service provision has led to poor performance among those with limited access to training and resources. One of the key informants said,

FFBS services lack uniformity; some villages receive soybean processing training while others do not, creating inconsistencies in project implementation (Key Informant, local officials, Sep 28, 2024).

Table 3. Challenges in accessing FFBS agricultural extension services

Challenge	Description
Institutional and Coordination Challenges	Insufficient coordination among local governments, CARE International, and stakeholders disrupts FFBS service delivery in Iringa Rural District. Unclear roles and funding gaps further hinder consistent access to agricultural extension services for farmers.
Socioeconomic and Cultural Barriers	Cultural resistance and limited access to land, capital, and inputs impede farmers, especially women and marginalized groups, from adopting new techniques. These barriers reduce the effectiveness of FFBS services.
Gender and Social Inclusion Barriers	Entrenched gender norms and socioeconomic disparities restrict women's access to decision-making and markets, undermining FFBS's gender-sensitive goals and limiting household benefits.
Policy and Political Constraints	Weak policies on market access, resource allocation, and gender inclusion, coupled with political reluctance, hinder FFBS's reach and effectiveness in Iringa Rural District.
Market Engagement and Certification Weaknesses	Weaknesses in market access and certification processes limit farmers' ability to enter lucrative markets, reducing economic incentives to adopt new practices.
Participatory Performance Monitoring and Evaluation	Inadequate monitoring and evaluation mechanisms hinder accurate impact assessment and improvement identification, making it difficult to ensure FFBS meets farmers' needs.

This format organizes the challenges with their corresponding descriptions into a clean, readable table, as you requested. Let me know if you'd like any further adjustments

Fifth, field observations reveal poor implementation and sustainability of FFBS skills. Despite claims of increased home gardens, no visible plots or common crops such as tomatoes or leafy greens were found. Communities lack formal markets; produce is sold informally from homes, limiting economic growth.

Sixth, while FFBS claims to transform farmers into commercial farming, no large-scale production was observed. Fields remain small, with maize cultivation dominant, often processed into local brews. Farmers sustain small-scale, subsistence farming, cooperating with neighbours and relying on traditional practices passed through generations. FFBS beneficiaries continue to prioritize sustenance over commercial expansion.

5. DISCUSSION

This study highlights the significant role of the Farmer Field Business School (FFBS) in improving smallholder farmers' access to agricultural extension services. FFBS has proven to be an innovative and integrated approach, creating a conducive environment for sustainable service delivery. However, the study noted the need for uniformity in implementing FFBS interventions across all areas to maximize its potential. By providing tailored agricultural

extension services, FFBS has empowered farmers, particularly women and marginalized groups, thus enhancing farm management techniques, livelihoods, and climate resilience. These findings align with findings of previous studies, which underscore the importance of effective agricultural extension systems in improving farming practices and crop yields (Danjumah et al., 2024; Alakpa & Ehigie, 2024; Masanja et al., 2023). FFBS serves as a platform for delivering information, advice, and support to farmers, consistent with Danjumah et al., (2024) and Kathula, (2023), who stress the role of extension services in disseminating farm technologies and supporting rural adult learning.

FFBS has positively impacted farmers through enhanced agricultural knowledge, the adoption of improved seed varieties, sustainable practices, value addition, and economic and health benefits. Farmers have gained expertise in soybean and sunflower production, processing, and modern farming techniques, leading to improved yields and sustainability. The introduction of high-yield sunflower varieties, such as Hysun, has boosted productivity, while training in compost preparation, bag gardening, and crop rotation have enhanced soil fertility. Value addition, such as processing soybeans into nutritious flour has increased profits and improved household nutrition, particularly

reducing child stunting. These outcomes align with Okorie & Nkeme, (2024), who advocate for a multifaceted approach to agricultural extension, emphasizing financial support, resource availability, and training.

FFBS integrates gender empowerment, market engagement, and capacity building, distinguishing it from traditional extension systems. By involving women in decision-making and providing skills for managing agricultural initiatives, FFBS enhances their market participation and income generation. This aligns with Wakaba *et al.*, (2022) and Singh *et al.*, (2022), who emphasize the importance of gender-sensitive interventions in promoting women's empowerment and sustainable agriculture. FFBS's focus on market engagement, including pre-harvest agreements and bulk purchasing, reduces market uncertainties and improves financial stability for farmers. This approach resonates with Ragasa *et al.*, (2023), who highlight the benefits of market-oriented extension programs in enhancing farm profitability and food security.

The program's participatory extension models and hands-on training have been instrumental in promoting sustainable agriculture and climate resilience. By engaging farmers in decision-making and leveraging local knowledge, FFBS has increased the adoption of sustainable practices, improved knowledge retention, and boosted productivity (Odhiambo *et al.*, 2022; Mwongera *et al.*, 2017). The experiential learning approach, which allows farmers to apply knowledge directly to their practices, has been particularly effective. This aligns with (Kolb, 1984), who emphasize the importance of active participation and reflection in agricultural extension.

FFBS has also addressed gender-based violence and promoted gender equality, empowering women to confront domestic abuse and harmful practices. This aligns with Chiadikaobi *et al.*, (2024) who highlight the need for comprehensive strategies to address gender-based violence and promote women's empowerment in agriculture. The gender-sensitive training program has improved women's economic independence and social status, reducing the risks of gender-based violence.

The program's focus on nutrition and health has been transformative, particularly through the promotion of nutrient-rich crops such as

soybeans and value-added products such as soy milk and flour. These initiatives have improved food security and dietary diversity, reducing stunting and wasting among children. This aligns with Wossen *et al.*, (2022) and Harris *et al.*, (2022), who emphasize the role of nutrition-sensitive agricultural interventions in enhancing food security and health outcomes.

FFBS has strengthened community resilience by fostering collective action and cooperation among farmers. The participatory nature of the program has enhanced social cohesion and mutual support, enabling communities to adapt to challenges and improve livelihoods. This aligns with Kassie *et al.*, (2013) and Ngigi *et al.*, (2023) who highlight the importance of participatory extension services in building community resilience and promoting sustainable agricultural practices.

FFBS has significantly improved access to agricultural extension services, empowering smallholder farmers through enhanced knowledge, sustainable practices, gender empowerment, and market engagement. The program's participatory and experiential learning approaches have been particularly effective in promoting climate resilience and community development. However, challenges such as inconsistent service delivery, market access, and gender disparities remain. Addressing these issues through integrated and gender-sensitive approaches will be crucial for maximizing the impact of FFBS and ensuring sustainable agricultural development.

6. IMPLICATIONS OF THE STUDY

The findings from this study highlight critical barriers to accessing FFBS agricultural extension services in Iringa Rural District. Addressing these challenges could improve institutional coordination, provide targeted support for marginalized groups and implement gender-sensitive approaches. Enhancing market engagement, certification processes, and participatory performance monitoring can significantly improve service delivery and impact. Additionally, integrating gender equality and social inclusion into agricultural policies and programs is essential for broader societal and economic benefits. Future research should explore the long-term impact of gender-focused training and investigate strategies for better institutional collaboration and sustainable funding mechanisms.

Despite its successes, FFBS's limitations in transitioning farmers into large-scale commercial agriculture must be addressed to fully realize its potential. According to (Ojeka *et al.*, 2016), agricultural extension services have the potential to transform subsistence farmers into modern, commercial agriculture to increase household food security. Despite the many achievements of FFBS, the approach has not been successful in transforming its beneficiaries into large-scale farmers engagement in modern commercial agriculture. The provision of agricultural extension services through the FFBS highlights a significant gap between the recognition of various roles and their actual implementation, particularly in terms of how these roles translate into tangible outcomes.

7. CONCLUSION

Using a comprehensive capacity-building approach, the FFBS is essential to improving agricultural extension services for smallholder farmers. Through the integration of traditional and modern practices, FFBS greatly improves farm management, production, and food security by emphasizing agronomy, nutrition, marketing, and women empowerment. The improvement of dietary diversity, which leads to more varied and nutrient-dense diets for households, and the strengthening of gender relations, where women now hold decision-making positions, are two of FFBS's major achievements. Additionally, FFBS has strengthened ties between extension agents and farmers, lowering operating expenses by enabling bulk purchasing.

Though it has produced favorable results, FFBS has not entirely helped smallholder farmers make the switch to large-scale commercial agriculture. This restriction reveals enduring deficiencies in production scaling, such as difficulties in gaining access to markets, resources, and technology, as well as inadequate extension services. Additionally, despite the high potential for expanding the accessibility of agricultural services, digital instruments such as CHOMOKA have not been completely utilized because of usability problems (Olagunju *et al.*, 2021).

Integrating all of FFBS's elements market participation, entrepreneurship, gender equality, nutrition, and sustainable agriculture is crucial to maximizing its effects. While encouraging entrepreneurship can spur innovation in farming methods, market engagement guarantees farmers fair pricing and opens up new markets. Destroying the institutional and cultural barriers

that prevent women from fully participating in society is essential to achieving gender equality. Furthermore, nutrition education has to keep encouraging resistance against food instability and dietary diversity.

Sustainable agricultural practices, such as agroforestry and conservation agriculture, are vital for the long-term success and climate resilience of FFBS. Uniformity in the implementation of FFBS across different contexts is essential to ensure consistent outcomes, while addressing challenges in market engagement, certification, and participatory monitoring. To optimize the effectiveness of FFBS and improve smallholder farmers' livelihoods, coordinated efforts among policymakers, development organizations, and local communities are necessary. Collaboration is key to refining FFBS and scaling its benefits, ensuring that it continues to empower farmers and contribute to rural development in the long run.

CONSENT

In compliance with global or academic norms, the authors sought and obtained written consent from the respondents.

OR personal relationships that could have appeared to influence the work reported in this paper.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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