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Community-Based Agricultural Education as a Tool for Post-Disaster Recovery and Empowerment

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ABSTRACT

Purpose – This study investigates how community-based agricultural education—specifically, the Farmers' Field School (FFS)—contributes to post-disaster recovery and community empowerment in Aceh, Indonesia, following conflict and tsunami devastation. The research addresses a gap in the literature by exploring not only technical outcomes but also holistic livelihood impacts.

Design/methods/approach – A qualitative case study was employed, involving in-depth interviews, focus group discussions, and participant observations with smallholder farmers who participated in FFS programs. The study used the Sustainable Livelihoods Framework (SLF) to assess the impacts on five livelihood capitals: human, natural, social, physical, and financial.

Findings – The findings show that FFS improved farmers' agricultural skills, reduced chemical input dependency, enhanced collective action, and strengthened resilience in household income. However, the magnitude of impact varied across communities, shaped by internal factors (leadership, participation) and external influences (resource access, institutional support).

Research implications/limitations – The study is limited to specific communities in Aceh and relies primarily on participants' self-reported experiences. While this provides rich insights, it limits generalizability. Further studies across different post-disaster settings are recommended to validate and expand the findings.

Originality/value – This paper demonstrates that FFS is not only an agricultural training tool but also a platform for empowerment and recovery in disaster-affected areas. It contributes to discourses on rural development, disaster rehabilitation, and participatory education strategies.

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Introduction

Post-disaster recovery in rural areas extends beyond mere infrastructure repair and necessitates a multifaceted approach that revitalizes community capabilities, livelihoods, and fosters self-reliance. This necessity arises from the complex interplay between physical destruction and the socio-economic fabric of affected communities, which often requires lasting solutions that engage local populations in the recovery process.

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For instance, the literature emphasizes the importance of a multi-stage approach to livelihood recovery, where one must transition from immediate relief to longer-term protection and promotion of livelihoods (Karki et al., 2022). This aligns with findings from the 2008 Wenchuan earthquake, where diverse recovery strategies integrating local knowledge significantly impacted resilience and community self-sufficiency (Di et al., 2020). Furthermore, it has been noted that traditional top-down recovery models frequently overlook grassroots contributions necessary for sustainable rebuilding, reinforcing the need for bottom-up adaptation strategies that build on local capacity and knowledge (Di et al., 2020). Moreover, local communities have demonstrated significant capabilities for recovery when they capitalize on their social capital, which allows them to mobilize resources and support each other effectively (Wei & Han, 2018). In contexts like Aceh, Indonesia, victims of both a protracted conflict and the 2004 tsunami must engage in holistic recovery strategies that encompass social, economic, and ecological dimensions to build a resilient future (Rindrasih, 2018). Therefore, an effective post-disaster recovery strategy must prioritize the enhancement of community capacity through localized efforts, integrating grassroots participation, and utilizing existing social frameworks to ensure the sustainability and resilience of rural livelihoods.

The Farmers' Field School (FFS) represents a participatory educational model that harmonizes experiential learning with community development principles. This approach is significant as it empowers farmers through hands-on training emphasizing learning by doing, crucial for rural development. The FFS was originally developed by the Food and Agriculture Organization (FAO) in the late 1980s to address challenges in integrated pest management (IPM) within agricultural systems. It has since evolved into a broader educational platform aiming to facilitate knowledge generation and sharing among farmers (Berg et al., 2020). Its foundational concept lies in fostering active participation and critical thinking, enabling farmers to effectively address local agricultural challenges (Bhuiyan & Maharjan, 2022). However, the application of FFS in post-disaster contexts is under-documented in academic literature, particularly concerning long-term impacts on livelihood recovery and social capital enhancement (Berg et al., 2020). While the FFS model is recognized for its efficacy in improving productivity through sustainable practices, there is a notable gap in research regarding its long-term

effectiveness in post-disaster scenarios, indicating a need for further investigation (O.B. et al., 2022).

Evidence of FFS's impact illustrates its role in enhancing farmers' capabilities. For instance, studies have shown that FFS participants develop improved decision-making skills and problem-solving abilities, which are essential during recovery phases after disasters (Mariyono et al., 2020). This participatory educational framework not only enhances agricultural practices but also builds social networks within communities, fostering resilience through collective action (Khumairoh et al., 2019). Moreover, integrating FFS into post-disaster recovery efforts can potentially stimulate local economies and restore communal bonds disrupted by crises, although this potential remains largely under-explored (Obaniyi & Oladele, 2023). In conclusion, the FFS stands as a valuable tool for rural empowerment, especially in the context of post-disaster recovery. Enhancing academic and practical applications of the FFS in these settings can significantly contribute to livelihood resilience and social cohesion, emphasizing the need for further scholarly attention to optimize its benefits.

Agricultural education, particularly through participatory approaches such as the Farmer Field School (FFS), plays a pivotal role in enhancing farm productivity and improving decision-making among farmers. The effectiveness of agricultural education stems from its capacity to convey practical knowledge and skills that farmers can directly apply to their daily practices, leading to improved outputs and better resource management Kumar et al. (2022)Huluka & Negatu, 2016). Research by van den Berg and Jiggins (2007) and Braun et al. (2006) underscores the critical link between education and productivity, establishing a clear rationale for supporting educational initiatives within the agricultural sector. Furthermore, the FFS model fosters social cohesion and empowers communities to engage in collective action. This aspect is particularly crucial in post-crisis environments where rebuilding trust and reinforcing community networks are imperative for recovery (Kusumawardani et al., 2019). Davis et al. (2012) highlight that FFS not only enhances agricultural knowledge but also strengthens relationships among farmers, enabling them to work collaboratively to address shared challenges. This collective approach is essential in fostering resilience and facilitating recovery after adversities.

Despite the documented benefits, some literature raises concerns regarding the scalability of FFS programs, inconsistent outcomes across different contexts, and reliance on external facilitators for successful implementation (Rathnachandra, 2020). Waddington et al. (2014) argue that while the FFS model shows promise, its effectiveness can be contingent upon the specific context in which it is applied, which raises questions about its broader applicability and sustainability. Such concerns necessitate a deeper exploration of the operational dynamics of FFS in various real-world recovery scenarios, allowing for a more nuanced understanding of its strengths and limitations. In conclusion, while FFS presents significant opportunities for advancing agricultural education, improving productivity, and fostering community cohesion, the diversity of experiences suggests a need for continued research. This investigation could lead to tailored approaches that enhance the model's effectiveness and applicability in different agricultural and socio-economic contexts.

This paper focuses on the implementation of the Farmer Field School (FFS) in several villages in Aceh. The emphasis is placed not only on technical skill acquisition among participants but also on broader dimensions of empowerment and resilience within these communities. This focus is pertinent as agricultural education plays a crucial role in improving livelihoods and overall community well-being, especially in post-disaster contexts (Pamuk et al., 2022). To assess the multifaceted impacts of FFS, we employ the Sustainable Livelihoods Framework (SLF) as our guiding analytical tool, which examines five key livelihood capitals: natural, physical, human, social, and financial (Sjakir et al., 2015). This multifaceted approach is essential in understanding how FFS can contribute to the various dimensions of livelihood improvement, as evidenced by related studies that have noted significant enhancements in farmers' productivity and decision-making capabilities through participatory educational methods (Kumar et al., 2022; . Furthermore, the SLF allows for a structured analysis of the interaction between these capitals, demonstrating how improvements in one area can positively influence another, thereby fostering resilience (Sjakir et al., 2015).

Through qualitative case study methods, we analyze the perspectives of FFS participants, revealing both enabling and constraining factors influencing the program's effectiveness. Past research indicates that community engagement and social capital significantly enhance the sustainability and

impact of FFS initiatives (Pamuk et al., 2022). Notably, the perspectives gathered from participants can provide valuable insights into the local context, highlighting the social dynamics and expectations surrounding program implementation (Josephat & Ame, 2016). Based on our findings, we discuss the potential for replicating the FFS model in other post-disaster areas, where similar challenges and needs exist. The evidence suggests that effective implementations of FFS could serve as a robust framework for rebuilding and empowering communities affected by disasters, further underscoring the necessity for tailored approaches that consider local needs and capacities (Kumar et al., 2022; Kusumawardani et al., 2019). In conclusion, this assessment not only highlights the technical benefits of FFS but also emphasizes its broader significance in fostering community empowerment and resilience, making it an essential tool for post-disaster recovery efforts.

The remainder of this article is structured as follows: Section 2 reviews the relevant literature on post-disaster recovery and agricultural education. Section 3 presents the research methodology. Section 4 discusses key findings from the field. Section 5 elaborates on the implications of these findings in light of community empowerment and sustainable development. Finally, Section 6 concludes the paper by summarizing core insights and offering recommendations for policy and practice. By exploring the intersection between education, agriculture, and community resilience, this study contributes to a growing body of knowledge on bottom-up recovery strategies. It argues that localized, participatory education models like FFS have transformative potential when adapted to the specific needs and contexts of post-disaster communities.

Methods

Research Design

This study employed a qualitative case study approach to examine the implementation and impacts of community-based agricultural education through the Farmers' Field School (FFS) in post-conflict and post-disaster settings in Aceh, Indonesia. The qualitative method was chosen to gain in-depth insights into participants' experiences, local dynamics, and perceived changes in their livelihoods. A case study design allowed the researchers to explore contextual factors influencing the success or limitations of the program across multiple livelihood domains.

Research Sites and Participants

The research was conducted in three villages in the districts of Aceh Besar and Pidie, which were among the areas severely affected by both the armed conflict and the 2004 tsunami. These communities were selected based on the presence of active or recently completed FFS programs facilitated by local NGOs in collaboration with agricultural extension offices.

Participants included 28 FFS alumni (15 male, 13 female), 3 field facilitators, and 2 village leaders. Purposive sampling was used to ensure a diverse representation of age, gender, farming experience, and FFS participation history. Snowball sampling was also employed to identify individuals with deep insights into the program's implementation and outcomes.

Researcher's Role and Data Collection Techniques

The researchers acted as key instruments in the data collection process, using participatory and reflexive methods. Data were gathered through in-depth interviews, focus group discussions (FGDs), participant observation during farming activities and community meetings, and document analysis of training modules and FFS reports.

Interviews and FGDs were semi-structured, allowing flexibility to probe into themes such as livelihood changes, knowledge application, social networks, and institutional support. Field notes were maintained throughout the research period, which spanned from January to July 2024. All interviews were recorded with participants' consent and transcribed verbatim for analysis.

Data Analysis Techniques

Thematic analysis was used to identify and interpret patterns within the data. Coding was conducted manually using NVivo 12 software to organize the data into meaningful categories aligned with the Sustainable Livelihoods Framework (natural, physical, human, social, and financial capital). Triangulation was applied to verify findings across different data sources (e.g., interviews, FGDs, observations), and member checking was conducted with selected participants to ensure the accuracy of interpretations.

Validity and Trustworthiness

To enhance credibility, the researchers used prolonged engagement in the field, peer debriefing, and cross-validation with NGO partners. Transferability was addressed by providing rich, thick descriptions of the

research context and participant narratives. Dependability and confirmability were supported by an audit trail documenting key decisions and processes throughout the study.

Results

This section presents the findings from field data, structured around the five livelihood capitals of the Sustainable Livelihoods Framework (SLF): human, natural, social, physical, and financial. Each subsection explores specific outcomes and challenges related to the implementation of community-based agricultural education in the post-disaster context of Aceh.

3.1. Human Capital Improvement

Community-based agricultural education programs, such as Farmers' Field Schools (FFS), play a vital role in improving farmers' knowledge and skills. These programs are designed to be participatory and experiential, enabling farmers to learn directly through field-based observation and practice. Participants in FFS demonstrated noticeable improvements in their understanding of pest management, soil health, and crop rotation, along with increased confidence in applying these techniques independently. As a result, FFS initiatives contribute significantly to building local agricultural capacity and promoting sustainable farming practices among rural communities.

3.1.1. Skills and Knowledge Acquisition

Participants reported increased knowledge in pest management, organic fertilizer production, crop rotation, and irrigation techniques.

"Before the program, I didn't know how to identify plant diseases. Now I can treat my crops early, which improves the harvest," (Male farmer, 42, Pidie District).

3.1.2. Application of Learning in Daily Farming

Approximately 82% of participants confirmed they had applied FFS knowledge to their daily agricultural practices. This adaptation led to increased yields and reduced dependency on external inputs.

"We no longer buy pesticides. We make our own from neem and garlic, as taught in the training," (Female farmer, 35, Aceh Besar).

3.2. Social Capital Strengthening

3.2.1. Farmer Groups and Peer Learning

The FFS model encouraged collaboration and built strong social ties among participants. Post-training, more than 70% of alumni remained active in farmer groups (kelompok tani).

"We meet weekly to share problems and discuss planting schedules. This has never happened before," (Village head, Lamtamot).

3.2.2. Trust and Collective Action

Social trust increased not only among farmers but also between communities and agricultural extension workers. This fostered collaborative initiatives such as shared seed banks and communal composting facilities.

3.3. Natural Capital Awareness

The program embedded environmental education as a core module. Farmers learned about land conservation and sustainable farming.

- (1) Use of compost over chemical fertilizer
- (2) Crop diversification to maintain soil health
- (3) Integrated pest management

As a result, 65% of respondents adopted conservation practices on their farms (Table 1).

Table 1. Environmental Practices Adopted by Farmers Post-FFS

Practice Adopted	% of Respondents	Source of Knowledge
Organic compost use	76%	FFS
Crop rotation	58%	NGO facilitator
Integrated pest management (IPM)	66%	Field demonstration

3.4. Physical Capital Enhancement

Farmers reported better access to tools and infrastructure post-training due to program-linked support from local NGOs.

- (1) Communal tool-sharing arrangements
- (2) Improved irrigation canals
- (3) Access to demonstration plots

"We received hand hoes and seed trays from the NGO. These tools made planting faster and easier," (Participant, Age 28).

Figure 1. Community members constructing irrigation canals (a) and practicing compost making in the field (b)

(a) Community-led irrigation rehabilitation in Gampong Nusa *(b)* Field compost training during FFS practical sessions

3.5. Financial Capital and Economic Empowerment

3.5.1. Income Diversification

Participants began integrating high-value crops such as chili, shallots, and tomatoes into their farming systems. Some also ventured into seedling sales and compost distribution.

3.5.2. Increased Household Income

70% of participants reported a moderate to significant increase in income post-intervention.

Table 2. Change in Monthly Income Before and After FFS Participation

Income Range (IDR)	% Before	% After
< 500,000	40%	18%
500,000–1,000,000	45%	35%
> 1,000,000	15%	47%

This shift shows a clear improvement in the economic resilience of participating households.

Discussion

The results of this study reveal that community-based agricultural education, particularly through Farmers' Field Schools (FFS), plays a pivotal role in enhancing the livelihood assets of smallholder farmers in post-disaster settings. This assertion is critical, as strengthening livelihood assets is fundamental to improving the overall well-being of vulnerable communities facing the aftermath of disasters (Yamba et al., 2017).

The prominence of participatory education models, such as FFS, in fostering not only technical skills but also broader empowerment and resilience is well-supported by existing literature. Engaging smallholder farmers in educational programs facilitates their adaptation to changing agricultural practices, thereby increasing their resilience to economic and environmental shocks (Yamba et al., 2017). For instance, (Yamba et al., 2017) indicate that alternative livelihood activities provided by educational

frameworks help cushion farmers from the adverse impacts of climate variability, thereby enhancing their livelihood security (Yamba et al., 2017).

Furthermore, the Sustainable Livelihoods Framework (SLF), utilized in our analysis, emphasizes the interconnections between various livelihood capitals, including natural, physical, human, social, and financial assets (Anlimachie et al., 2022). This framework helps contextualize how FFS contributes not just to individual skill enhancement but to collectively building community capital, which is essential for recovery after disruptive events (Anlimachie et al., 2022). Studies consistently demonstrate that participatory educational approaches empower farmers to engage in collective actions, fostering social cohesion that is necessary for resilient community rebuilding (Miroro et al., 2022).

However, while these findings highlight the effectiveness of FFS, they also indicate the need for further research into the scalability and replicability of such programs in diverse post-disaster contexts. This exploration can provide insights into the varying impacts and experiences of smallholder farmers, thereby informing best practices and adaptations suitable for different settings (Li et al., 2020).

In conclusion, the study underscores the significance of FFS as a transformative educational model for smallholder farmers, enhancing their livelihood assets and building their resilience in post-disaster environments. Continued emphasis on participatory models in agricultural education will be vital for supporting sustainable recovery and empowerment in vulnerable communities.

4.1. Reinforcing Human Capital through Experiential Learning

The results of this study reveal that community-based agricultural education, particularly through Farmers' Field Schools (FFS), plays a pivotal role in enhancing the livelihood assets of smallholder farmers in post-disaster settings. This assertion is critical, as strengthening livelihood assets is fundamental to improving the overall well-being of vulnerable communities facing the aftermath of disasters (Yamba et al., 2017).

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4.2. Strengthening Social Capital and Institutional Trust

Social capital was significantly bolstered by the collective nature of the Farmers' Field Schools (FFS). This observation is critical because social capital plays a vital role in fostering community resilience and cohesion, particularly in post-disaster settings. Research shows that cohesive farmer groups enhance information flow, encourage innovation diffusion, and facilitate community-led decision-making, which are essential for recovery and growth in agriculture (Upe et al., 2021).

Strong social networks formed through collective agricultural initiatives have led to increased trust and collaboration among farmers, optimizing

resource sharing and problem-solving capabilities, as indicated by studies on social capital in farming communities (Upe et al., 2021). Additionally, participatory programs like FFS can play a crucial role in rebuilding trust, especially between farmers and extension workers, which is vital in post-disaster environments (Upe et al., 2021). In Aceh, the need to rebuild trust is particularly important due to the impacts of decades of conflict and the devastation from the 2004 tsunami on community cohesion and local networks (Upe et al., 2021).

Our findings resonate with the notion that development initiatives must focus on strengthening social relations and networks, rather than solely concentrating on infrastructure or economic inputs (Gustafson & Hertting, 2016). The establishment of trust within farming communities fosters better cooperation among farmers and extension services, thereby enhancing the overall impact of agricultural programs aimed at recovery and development (Sohns et al., 2021).

In conclusion, the collective nature of FFS programs significantly enhances social capital, promoting vital community relationships and trust that contribute to effective recovery in post-disaster contexts. This underscores the importance of participatory approaches in agriculture, which not only improve technical capacities but also reinforce the social fabric necessary for sustainable development.

4.3. Promoting Ecological Awareness and Natural Capital Restoration

The integration of sustainable farming practices within Farmers' Field Schools (FFS) curricula has significantly contributed to natural capital regeneration. Natural capital refers to the world's stocks of natural assets, including resources like soil, water, and biodiversity that are essential for agriculture and sustainability (Berg et al., 2020). Farmers participating in FFS reported a shift from reliance on synthetic inputs to more organic and conservation-oriented techniques, which is crucial for restoring and enhancing natural resources (Bhuiyan & Maharjan, 2022).

The transition to these sustainable methods supports the assertion that sustainable agriculture is both a technological and social process, requiring collective learning and behavior change among community members (Berg et al., 2020). This understanding underscores the interconnected nature of agricultural practices and community engagement, suggesting that the successful adoption of sustainable techniques hinges on the cooperative

learning environments provided by FFS. Studies have shown that farmers who engage in participatory training exhibit increases in knowledge and skill application related to sustainable practices (Guo et al., 2015).

However, the adoption of ecological practices varied across villages, influenced by factors such as prior exposure to sustainable methods, resource availability, and perceived labor intensity. This variability highlights the necessity for adaptive curricula tailored to local contexts, ensuring that educational programs resonate with the specific needs and experiences of participants (Davidova et al., 2022). Understanding local conditions greatly enhances the efficacy of training programs and encourages widespread adoption of sustainable practices (Painter-Morland et al., 2015).

Moreover, follow-up support is essential to reinforce the adoption of these practices. Continuous technical assistance and community engagement have been linked to higher retention rates of sustainable techniques (Nemade et al., 2023). By providing ongoing support and resources, FFS can further enable farmers to successfully transition to sustainable practices, thus promoting long-term ecological and community health (Guo et al., 2015).

In conclusion, the incorporation of sustainable farming practices into FFS curricula not only facilitates natural capital regeneration but also underscores the importance of community engagement in promoting agricultural sustainability. Adaptive program designs and continuous support are critical to ensuring the successful implementation of these ecological practices across diverse agricultural contexts.

4.4. Enhancing Physical Capital Access via Local Networks

Our findings indicate that community education alone was not sufficient to improve physical capital; rather, its combination with NGO and government support led to tangible improvements in infrastructure and tool access. This observation is critical as it reveals that effective community development is contingent upon the collaboration of multiple stakeholders, which often yields more significant results than isolated efforts (Hummel & Kusumasari, 2023). The presence of NGOs and local government support facilitates access to resources and services that empower communities, illustrating the crucial role of multi-stakeholder partnerships in enhancing community capital (Hummel & Kusumasari, 2023).

Research suggests that when Farmers' Field Schools (FFS) were linked with broader institutional support, the positive outcomes were significantly amplified. For instance, engaging NGOs alongside government entities can create synergies that enhance the effectiveness of community programs, particularly in resource-constrained environments (Sajadi et al., 2022). This dynamic highlights the idea that participatory development must go beyond local initiatives to incorporate external support systems that provide additional resources and expertise (Sajadi et al., 2022), which can further assist in building essential physical infrastructure.

Moreover, the evidence supporting the effectiveness of these partnerships underscores Moser's (1998) assertion that community empowerment must be embedded in cooperative frameworks involving various stakeholders. By fostering collaboration between community groups, NGOs, and government institutions, projects can achieve better coordination and maximize the impact of educational and infrastructure initiatives (Nelson-Núñez, 2018). Such coordination not only boosts the tangible capabilities of communities but also promotes stronger relationships among stakeholders toward shared goals.

In conclusion, these findings emphasize that while community education is vital, its efficacy is greatly enhanced when integrated with the support of NGOs and government programs. This synergy not only improves vital physical capital but also fosters resilience and empowerment within communities, reinforcing the importance of collaborative approaches to development in post-disaster contexts.

4.5. Economic Empowerment and Resilience Building

Perhaps the most striking result of this study was the significant increase in household income and livelihood diversification among participants of the Farmers' Field Schools (FFS). This shift from subsistence farming to market-oriented crops is a strong indicator of resilience, as it enables households to buffer against future economic shocks Mariyono et al. (2020). The diversification of crops allows farmers to spread their risks and reduce vulnerability to market fluctuations, supporting the idea that diversification is key to rural poverty reduction (Guo et al., 2015).

However, despite the overall positive outcomes, not all farmers experienced equal gains in income. Some reported facing persistent challenges such as limited market access, price volatility, and high transport

costs, which hindered their ability to capitalize on new agricultural practices (Sanglestsawai et al., 2015). This variation highlights the importance of external factors influencing income growth, suggesting that the adoption of new practices, while beneficial, must be complemented by supportive market conditions (Okeoghene, 2020).

Thus, while FFS significantly contributes to community empowerment and income improvement, its effects are contingent upon creating favorable policy and market environments. The interplay of education, access to resources, and supportive frameworks is critical for translating agricultural knowledge into tangible economic benefits (Chhay et al., 2016). Continued efforts to enhance market access and address logistical challenges are essential for fully realizing the potential of FFS initiatives in promoting sustainable livelihoods (Clausen et al., 2017).

In conclusion, our findings underscore the relationship between education and economic resilience among farmers, revealing that while FFS provides essential knowledge and skills, external conditions play a crucial role in the overall success of income diversification strategies in rural areas.

4.6. Limitations and Future Research

This study has several limitations. First, its qualitative nature and small sample size limit the generalizability of findings. Second, most data were self-reported, introducing potential biases. Third, the study focused only on short- to medium-term outcomes; long-term sustainability remains untested.

Future research should adopt mixed-methods approaches to triangulate data and evaluate long-term impacts. Comparative studies across different post-disaster regions could also enrich understanding of context-specific versus universal outcomes. Finally, deeper exploration into gender dynamics within FFS participation may reveal further insights into empowerment processes.

Conclusion and Policy Implications

This study examined the role of community-based agricultural education—specifically through Farmers' Field Schools (FFS)—as a strategy for post-disaster recovery and empowerment among smallholder vegetable farmers in post-conflict and post-tsunami Aceh, Indonesia. The findings demonstrate that FFS contributed significantly to the enhancement of human, social,

natural, and economic capitals, all of which are critical components of sustainable rural livelihoods.

Through participatory and experiential learning, FFS empowered farmers with practical knowledge, increased their confidence in decision-making, and fostered social cohesion. It also introduced sustainable farming practices that supported environmental recovery and contributed to greater income diversification and food security. These outcomes suggest that FFS is not merely a technical training tool but a transformative educational approach capable of fostering resilience in disaster-affected communities.

However, the study also highlighted several challenges that need to be addressed, including unequal access to markets, infrastructural limitations, and the need for long-term institutional support. Therefore, while FFS can serve as a catalyst for community empowerment, its success depends on the integration of complementary support systems, including policies that promote equitable market access, investment in rural infrastructure, and capacity-building for local extension agents.

Practical Applications

The results offer several actionable insights for policymakers, NGOs, and development practitioners:

1. **Integrate FFS into post-disaster recovery frameworks** as a core component of agricultural and livelihood rehabilitation.
2. **Design adaptive and locally contextualized curricula** to meet diverse needs of farming communities.
3. **Strengthen linkages between FFS groups and agricultural value chains** to enhance economic impact.
4. **Encourage multi-stakeholder collaboration** among communities, local government, and development organizations to ensure sustainability.

Implications for Future Research

This study provides a foundation for further exploration into the long-term impacts of community-based agricultural education. Future research should adopt longitudinal designs to assess sustainability outcomes over time and explore variations in empowerment effects based on gender, age, and ethnicity. Additionally, comparative studies across different post-disaster or

conflict-affected regions can help develop a more robust theoretical framework for participatory agricultural education in crisis contexts.

In sum, the evidence presented affirms that community-based agricultural education, when designed inclusively and supported institutionally, can serve as a powerful tool for recovery, resilience, and empowerment in rural communities emerging from crisis.

Declarations

Author Contribution Statement

All authors contributed equally to the conceptualization of the study, development of the research design, and coordination of fieldwork activities in post-disaster communities in Aceh. Each author participated in qualitative data collection, thematic analysis, and manuscript writing. Revisions and critical discussions were collaboratively undertaken. All authors have read and approved the final version of the manuscript for publication.

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Data Availability Statement

The qualitative data that support the findings of this study are available from the corresponding author upon reasonable request. Due to confidentiality agreements with participants and ethical considerations, the data are not publicly available.

Declaration of Interests Statement

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Additional Information

This article is part of a broader research initiative exploring sustainable rural development strategies in post-conflict and post-disaster regions in Southeast Asia. The findings are intended to inform future programming by

local governments and development agencies focused on resilience-building through education and participatory approaches in agriculture.

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