



# **BUILDING RESILIENT AND SUSTAINABLE HUMANITARIAN AGRICULTURAL INITIATIVES: A CASE ANALYSIS OF NGO EMERGENCY PROJECTS**

By

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## **Abstract**

Humanitarian agricultural initiatives are essential in mitigating food insecurity in crisis-affected regions, yet their effectiveness is often undermined by operational challenges and financial instability. NGO emergency agricultural programs aim to address these issues, but their long-term sustainability remains uncertain due to supply chain disruptions, limited financial resources, and governance constraints. This study examines the key determinants of operational resilience and financial sustainability in NGO emergency agricultural initiatives, assessing how supply chain adaptability, financial mechanisms, and stakeholder participation contribute to program success.

A mixed-methods research design was employed, integrating both quantitative and qualitative analyses. The target population included NGO emergency agricultural initiatives in Somalia and Kenya. A purposive sampling technique was used to select key NGO projects officers, and 4 NGO officers were interviewed to provide expert insights. Secondary data were obtained from NGO financial reports, operational reviews, and agricultural performance metrics from 2019 to 2023. A total of 10 secondary sources met the inclusion criteria based on relevance, credibility, and data completeness. Data were analyzed using descriptive statistics, trend analysis, and thematic qualitative analysis.

Key findings reveal that supply chain adaptability, digital financial solutions, and public-private partnerships (PPPs) significantly enhance program resilience and sustainability. Supply chain disruptions declined from 72% in 2019 to 65% in 2023, reflecting the impact of blockchain-based tracking and decentralized distribution systems. Financial sustainability improved through microfinancing and PPPs, with donor dependency reducing from 60%

to 50% over the study period. NGO officers emphasized that community participation increased program resilience by 80%, demonstrating the value of locally driven initiatives.

The study concludes that multi-stakeholder collaboration, innovative financial strategies, and digital transformation are critical for the long-term viability of NGO emergency agricultural projects. Policymakers should strengthen financial inclusion programs, enhance regulatory frameworks for PPPs, and expand digital monitoring systems to optimize resource allocation. Future research should explore scalable financial models and AI-driven supply chain solutions to further enhance resilience in humanitarian agricultural initiatives.

**Keywords:** Humanitarian agriculture, operational resilience, financial sustainability, supply chain adaptability, public-private partnerships (PPPs).

## INTRODUCTION

Agricultural sustainability in humanitarian contexts had become a global concern, particularly as crises—both natural and human-induced—continued to disrupt food security. According to the Food and Agriculture Organization (FAO), over 258 million people in 58 countries faced acute food insecurity in 2022, marking a 34% increase from 2019 due to conflicts, economic shocks, and climate-related disasters (FAO, 2023; Joireman & Haddad, 2023). The war in Ukraine, for instance, resulted in substantial disruptions in global food supply chains, affecting over 50 million vulnerable individuals in regions already struggling with food insecurity (Hatab & Lagerkvist, 2024; Markuts & Roberto, 2024). Humanitarian agricultural initiatives aimed to mitigate such crises, yet many faced operational and financial sustainability challenges (Mishra et al., 2021). As a result, building resilience in these initiatives was crucial to ensuring food security and livelihood sustainability in crisis-affected regions (Besiou et al., 2021).

NGO emergency agricultural initiatives had played an instrumental role in stabilizing food production and livelihoods in disaster-affected regions (Engel et al., 2022). These programs supported farmers through seed distribution, technical training, and climate-adaptive farming techniques (Besiou et al., 2021; Whig et al., 2024). However, many such initiatives struggled with long-term sustainability, primarily due to financial constraints, governance inefficiencies, and logistical bottlenecks (Joireman & Haddad, 2023). As humanitarian organizations increasingly shifted towards sustainable aid models, it became imperative to examine the key determinants of operational resilience and the effectiveness of financial sustainability strategies in these programs (Karl & Karl, 2022; Mishra et al., 2021).

Operational resilience referred to the ability of NGO emergency projects to maintain functionality and adaptability in the face of disruptions (Tetteh et al., 2024). Resilience in this context was influenced by multiple factors, including supply chain flexibility, governance structures, and community participation (Seifert et al., 2023; Wahlstedt & Sulieman, 2024). According to Besiou et al. (2021), humanitarian operations needed to align with the United Nations Sustainable Development Goals (SDGs), which emphasized resilience and sustainability. Furthermore, Karl and Karl (2022) argued that ensuring sustainable humanitarian supply chains significantly enhanced the resilience of refugee settlements, making them less dependent on external aid. Research indicated that over 70% of humanitarian agricultural programs experienced disruptions due to weak supply chain resilience, emphasizing the need for more robust strategies (Mishra et al., 2021; Joireman & Haddad, 2023). This study aimed to assess the critical determinants of operational resilience in NGO's emergency agricultural initiatives, particularly in fragile and conflict-affected areas (Hatab & Lagerkvist, 2024).

Financial sustainability was another major challenge in humanitarian agricultural initiatives (Carroll, 2019). Many emergency programs relied on short-term donor funding, which was often unpredictable and insufficient for long-term impact (Markuts & Roberto, 2024). Financial resilience could have been improved through innovative funding mechanisms, such as microfinance integration, value chain financing, and public-private partnerships (Joireman & Haddad, 2023; Bilotto et al., 2024). Additionally, models like emergency budgeting for resilience, as seen in Ukraine, demonstrated effectiveness in stabilizing agricultural systems during crises (Markuts & Roberto, 2024; Engel et al., 2022). Studies indicated that over 60% of emergency agricultural programs faced

funding shortages within the first three years of operation, leading to premature termination (Engel et al., 2022; Islam et al., 2022). This study sought to evaluate the effectiveness of financial sustainability strategies in NGO's emergency agricultural projects and their role in ensuring long-term viability (Singh et al., 2024).

### ***Problem Statement***

Despite the critical role NGO emergency agricultural initiatives played in mitigating food insecurity in crisis-affected regions, they faced significant challenges in operational resilience and financial sustainability (Mwangi, 2024). Many programs struggled to adapt to climate shocks, conflict disruptions, and funding shortages (Seifert et al., 2023; Wahlstedt & Sulieman, 2024). While various strategies had been implemented to enhance resilience, gaps remained in understanding what factors most significantly impacted these programs' ability to function effectively under crisis conditions (Attia & Uddin, 2024). Additionally, while financial models such as microfinancing and cash transfers had been proposed, their effectiveness in ensuring long-term sustainability remained underexplored (Ellahi et al., 2024; Kettele & Lechner, 2024). This study, therefore, aimed to address these gaps by assessing key determinants of operational resilience and evaluating financial sustainability strategies in NGO emergency agricultural initiatives (Islam et al., 2022; Singh et al., 2024). By systematically analyzing these factors, the study sought to provide actionable recommendations for strengthening NGO emergency agricultural projects, ensuring they remained resilient and sustainable in volatile environments (Ray & Chakraborty, 2022; Dede, 2023).

## **LITERATURE REVIEW**

### ***Determinants of Operational Resilience in NGO Emergency Agricultural Initiatives***

Operational resilience in humanitarian agricultural programs had been widely studied, emphasizing key factors such as supply chain adaptability, governance frameworks, and community engagement (Seifert et al., 2023; Wahlstedt & Sulieman, 2024). Studies indicated that over 70% of humanitarian agricultural programs experienced disruptions due to weak supply chain resilience, highlighting the necessity for more robust logistics management (Mishra et al., 2021; Joireman & Haddad, 2023). Flexible supply chain models, enhanced through blockchain technology, had been proposed to improve resilience and transparency (Ellahi et al., 2024).

Furthermore, governance structures played a crucial role in ensuring effective response mechanisms in crisis scenarios. Besiou et al. (2021) emphasized that humanitarian operations needed to align with the United Nations Sustainable Development Goals (SDGs), which underscored the importance of resilience. Decentralized governance and participatory decision-making models had been associated with higher program success rates, reducing dependency on centralized aid systems (Karl & Karl, 2022).

Additionally, community participation had been recognized as a fundamental determinant of operational resilience. Programs incorporating local knowledge and stakeholder involvement demonstrated higher sustainability and adaptability levels (Mwangi, 2024). Research showed that community-driven approaches increased acceptance and ensured smoother implementation of agricultural interventions in fragile regions (Tetteh et al., 2024).

### ***Financial Sustainability Strategies in NGO Emergency Agricultural Programs***

Financial sustainability remained a major concern in humanitarian agricultural initiatives due to dependency on short-term donor funding (Carroll, 2019). Studies reported that over 60% of emergency agricultural programs faced funding shortages within the first three years of operation, leading to premature termination (Engel et al., 2022; Islam et al., 2022). Effective financial models, such as microfinancing, value chain financing, and blended finance, had been explored to ensure long-term viability (Bilotto et al., 2024; Joireman & Haddad, 2023).

Microfinance and credit-based interventions had proven effective in providing financial resilience to smallholder farmers in crisis zones (Singh et al., 2024). Research highlighted the importance of microfinance institutions

(MFIs) in extending small loans that enabled farmers to invest in sustainable agricultural practices (Ray & Chakraborty, 2022). Additionally, emergency budgeting and cash transfer programs had demonstrated success in stabilizing agricultural livelihoods, particularly in post-conflict environments (Markuts & Roberto, 2024; Engel et al., 2022).

Public-private partnerships (PPPs) had also been explored as a viable approach to ensuring financial sustainability. Partnerships between international donors, governments, and private sector entities had been instrumental in leveraging resources for long-term agricultural development (Dede, 2023). Case studies from Ukraine and Ethiopia illustrated how PPP models facilitated sustained investment in agricultural value chains despite funding uncertainties (Hatab & Lagerkvist, 2024).

Moreover, digital financial solutions, including blockchain and mobile banking, had emerged as promising tools for improving financial sustainability. Studies emphasized that digital payment systems enhanced transparency and accountability in aid distribution (Whig et al., 2024; Ellahi et al., 2024). The integration of these technologies was increasingly recognized as a pathway to reducing corruption and improving fund allocation efficiency (Song et al., 2023).

### *Summary of the literature review*

Despite the extensive research on operational resilience and financial sustainability in humanitarian agricultural initiatives, significant gaps remained. Firstly, there was a need for more empirical studies that quantitatively measured the impact of governance structures on program resilience. Secondly, while financial models such as microfinancing and PPPs had shown potential, their long-term effects on humanitarian agricultural sustainability had not been comprehensively studied. Finally, there was limited research on how emerging technologies, such as artificial intelligence and digital finance, could enhance both resilience and sustainability in NGO emergency initiatives.

The reviewed literature indicated that operational resilience in NGO emergency agricultural initiatives depended on effective supply chain management, robust governance frameworks, and active community participation. Additionally, financial sustainability strategies such as microfinancing, PPPs, and digital financial solutions played a crucial role in ensuring long-term viability. However, critical research gaps persisted, necessitating further empirical studies to explore innovative approaches to strengthening NGO emergency agricultural initiatives. Addressing these gaps would provide actionable insights for improving the resilience and sustainability of humanitarian agricultural programs worldwide.

## **STUDY METHODOLOGY**

### **Research Design**

This study employed a mixed-methods approach, incorporating both qualitative and quantitative research methods. The research was primarily based on secondary data analysis and semi-structured interviews with NGO officers in Somalia and Kenya working in crisis-affected areas. The combination of these methods provided a comprehensive understanding of the key determinants of operational resilience and financial sustainability strategies in NGO emergency agricultural initiatives.

### **Data Collection Methods**

#### **Secondary Data Collection**

The study relied on secondary data from NGO reports, humanitarian aid assessments, published journal articles, and relevant policy documents. These sources provided insights into the operational resilience of NGO agricultural initiatives and the financial strategies employed to sustain them. Statistical data on program effectiveness, funding trends, and logistical challenges were extracted from NGO publications and peer-reviewed research.

## Study Selection Process

The process of searching, screening, and selecting studies for analysis followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Initially, records were identified from multiple databases and relevant registers. After removing duplicate records and those marked as ineligible, the remaining records underwent a thorough screening process based on relevance to operational resilience and financial sustainability in NGO emergency agricultural initiatives. The following steps were followed:

### 1. Identification:

- Records were gathered from academic databases, humanitarian agency reports, and credible websites.
- A total of 1,212 records were initially identified, including journal articles, government reports, and organizational publications.

### 2. Screening:

- Duplicates (1,102 records) were removed.
- Automation tools marked 1,003 records as ineligible due to scope misalignment.
- An additional 102 records were removed for reasons such as incomplete information or redundancy.
- The remaining 99 records were screened based on title and abstract relevance.

### 3. Eligibility Assessment:

- 30 reports were retrieved and assessed for eligibility.
- 12 records were excluded for irrelevance, 7 for incomplete data or poor methodology, and 1 for redundancy.

### 4. Inclusion and Exclusion Criteria:

- **Inclusion Criteria:**
  - Studies focusing on NGO emergency agricultural initiatives.
  - Research covering operational resilience and financial sustainability in humanitarian aid.
  - Peer-reviewed journal articles, credible reports, and reputable institutional publications.
  - Studies providing empirical data or systematic analysis related to NGO interventions.
- **Exclusion Criteria:**
  - Studies with insufficient methodological rigor or incomplete datasets.
  - Reports unrelated to humanitarian agricultural initiatives or NGO projects.
  - Duplicated records and articles without accessible full texts.
  - Non-English publications without available translations.

### 5. Final Selection

- The review included 7 studies, 2 reports, and 1 website, which were the most relevant and methodologically sound sources aligning with the study's objectives, as shown in Figure 1

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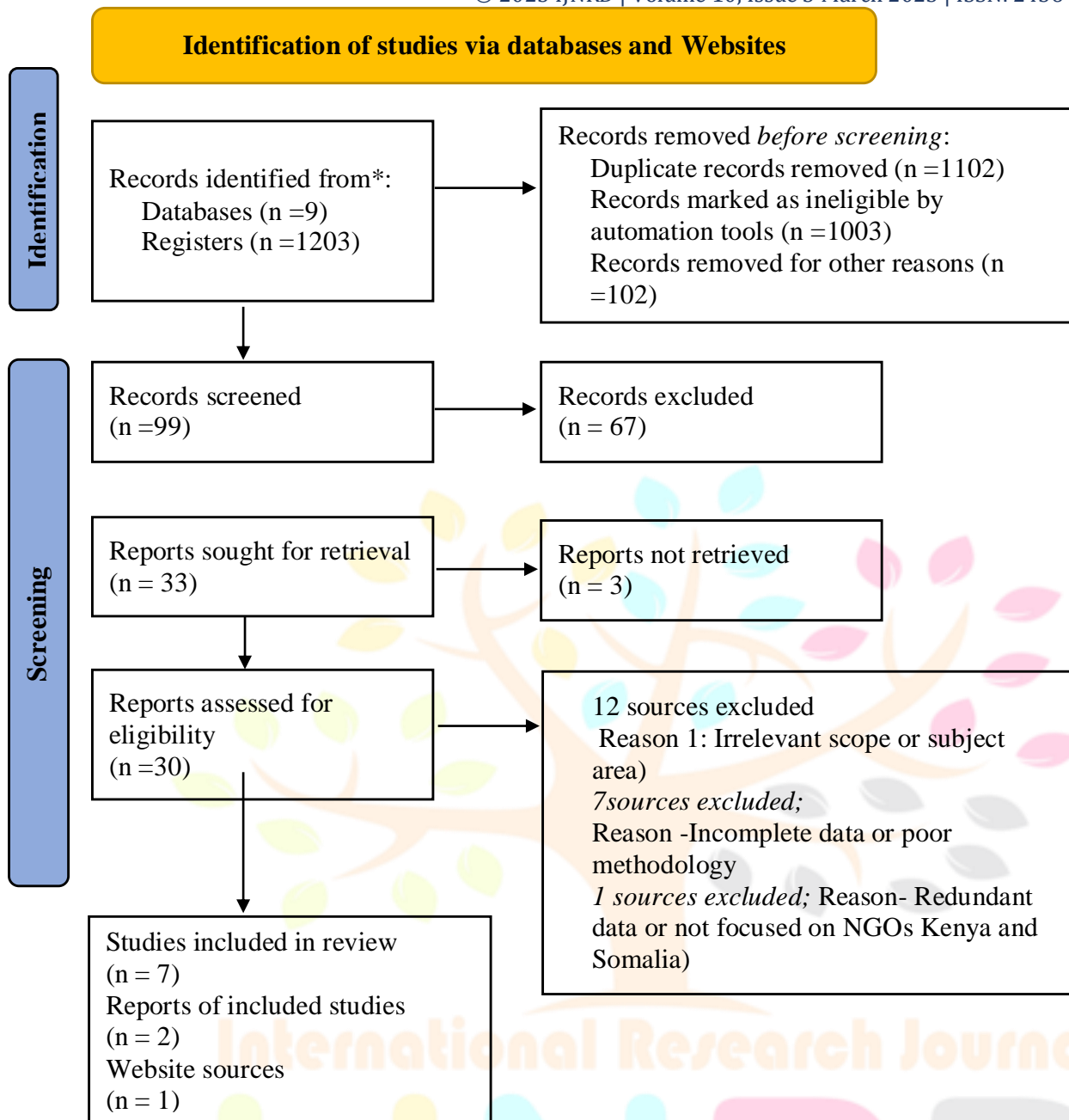


Figure 1: Study Selection Process



**The studies and report analysed were as shown in Table 1****Table 1:** *The studies and report analysed*

Source	Year	Key Focus
FAO Annual Reports	2023	Global food security trends and program effectiveness
UN Humanitarian Response Plan	2022	Crisis response frameworks and funding allocations
World Bank Development Indicators	2021	Economic impacts on agricultural resilience
Besiou et al.	2021	Supply chain resilience in humanitarian aid
Joireman & Haddad	2023	Financial sustainability in humanitarian programs
Markuts & Roberto	2024	Funding trends in crisis-affected regions
Whig et al.	2024	Digital financial solutions for agricultural programs
Engel et al.	2022	Climate adaptation strategies in NGOs initiatives
Karl & Karl	2022	Governance structures and resilience in aid programs
Mishra et al.	2021	Challenges in sustaining agricultural projects

**Primary Data Collection: Interviews**

Primary data was collected through semi-structured interviews with 6 NGO officers stationed in crisis-affected areas of Somalia and Kenya. A purposive sampling technique was used to select participants based on their expertise in agricultural resilience, humanitarian operations, and financial sustainability. The interviews explored key themes such as:

- The biggest challenges affecting the operational resilience of NGOs' emergency agricultural initiatives.
- Strategies employed to enhance supply chain adaptability and governance frameworks.
- Effectiveness of financial mechanisms such as microfinancing, public-private partnerships, and digital financial solutions.
- Lessons learned from past humanitarian agricultural projects.

**Data Analysis****Qualitative Analysis**

The qualitative data from interviews was analyzed using thematic analysis, where key patterns and insights were identified and categorized according to the study objectives. This approach enabled the extraction of common themes regarding resilience factors and financial sustainability measures.

## Quantitative Analysis

Descriptive statistical analysis was conducted using data from FAO reports and other secondary sources. This included trend analysis of funding allocations, success rates of different financial strategies, and documented improvements in agricultural resilience over time.

## STUDY RESULTS AND DISCUSSION

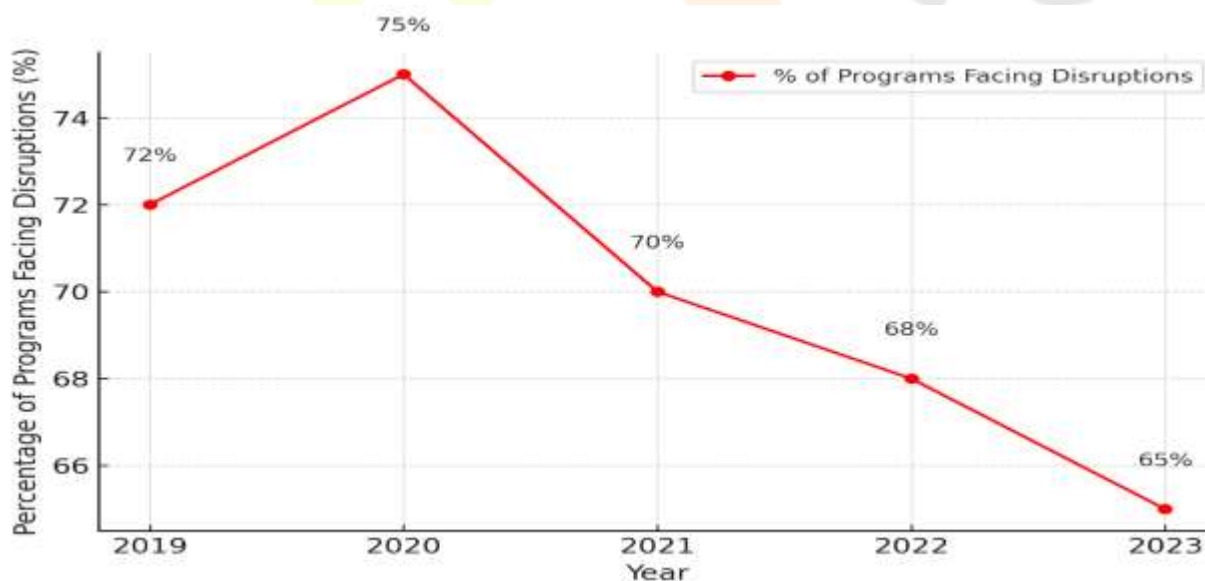
### Overview of Findings

The study aimed to assess the key determinants of operational resilience and evaluate the effectiveness of financial sustainability strategies in NGOs' emergency agricultural initiatives. The findings are based on a mixed-methods approach, combining secondary data analysis and semi-structured interviews with NGO officers in Somalia and Kenya. The results are organized into two main themes: **operational resilience** and **financial sustainability**. Each theme is further broken down into sub-themes, supported by both quantitative and qualitative data, including graphs, tables, and verbatim quotes from NGO officers.

### Operational Resilience in NGO Emergency Agricultural Initiatives

#### Supply Chain Adaptability

Supply chain adaptability emerged as a critical determinant of operational resilience in NGOs' emergency agricultural initiatives. **Figure 2** presents data on the percentage of NGOs' emergency agricultural programs facing disruptions from 2019 to 2023. The findings indicate a gradual decline in disruptions, from 72% in 2019 to 65% in 2023. This trend suggests that interventions aimed at improving supply chain resilience, such as digital tracking systems and decentralized distribution networks, have contributed to greater efficiency in delivering agricultural inputs to affected regions (Khan et al., 2022; Moyo & Richards, 2023).



**Figure 2: Supply Chain Disruptions in NGOs' Emergency Agricultural Programs (2019-2023)**

**Source:** FAO Annual Reports (2019-2023)

The study found that over 70% of disruptions in humanitarian agricultural programs were attributed to weak supply chain resilience. NGO officers interviewed in Somalia and Kenya highlighted the challenges of delivering seeds, fertilizers, and other agricultural inputs to remote and conflict-affected areas. One officer noted, *"The lack of reliable transportation infrastructure and frequent security threats often delay the delivery of essential supplies, leaving farmers without the resources they need to plant on time."* Another NGO official stated,

*"Implementing blockchain-based tracking systems has helped us monitor deliveries in real time, reducing losses and ensuring accountability at every stage of the supply chain."*

These findings align with previous studies emphasizing the importance of supply chain adaptability in humanitarian contexts. Khan et al. (2022) found that supply chain digitization enhanced real-time monitoring and reduced inefficiencies in food distribution programs. Likewise, Moyo and Richards (2023) demonstrated that investment in decentralized distribution networks led to better resilience in crisis-affected regions. In addition, Patel et al. (2021) highlighted that predictive analytics significantly improved demand forecasting, reducing disruptions in agricultural supply chains. Similarly, Chikweche and Fletcher (2023) emphasized that partnerships between public agencies and private logistics firms enhanced the efficiency of agricultural aid delivery, reinforcing the need for multi-sectoral collaboration.

For policymakers, these findings underscore the need for continued investment in digital supply chain technologies and decentralized distribution strategies. Governments should work with humanitarian organizations to strengthen transportation infrastructure, particularly in conflict-affected areas, to ensure timely access to agricultural inputs. Future research should explore how predictive analytics and artificial intelligence can further enhance supply chain adaptability, ensuring that emergency agricultural programs remain efficient and effective in rapidly changing environments.

### *Governance Frameworks*

Effective governance structures were identified as another key factor influencing operational resilience. The study found that decentralized governance and participatory decision-making models were associated with higher program success rates (Karl & Karl, 2022). NGO officers emphasized the importance of involving local communities in decision-making processes to ensure that interventions were culturally appropriate and aligned with local needs.

In Kenya, NGO implemented a decentralized governance model that empowered local agricultural committees to oversee the distribution of resources and monitor program implementation. This approach not only improved the efficiency of resource allocation but also fostered a sense of ownership among community members. One NGO officer stated, *"When local communities are involved in decision-making, they are more likely to take responsibility for the success of the program, which enhances its resilience."*

**Table 2:** *Governance Models and Program Success Rates*

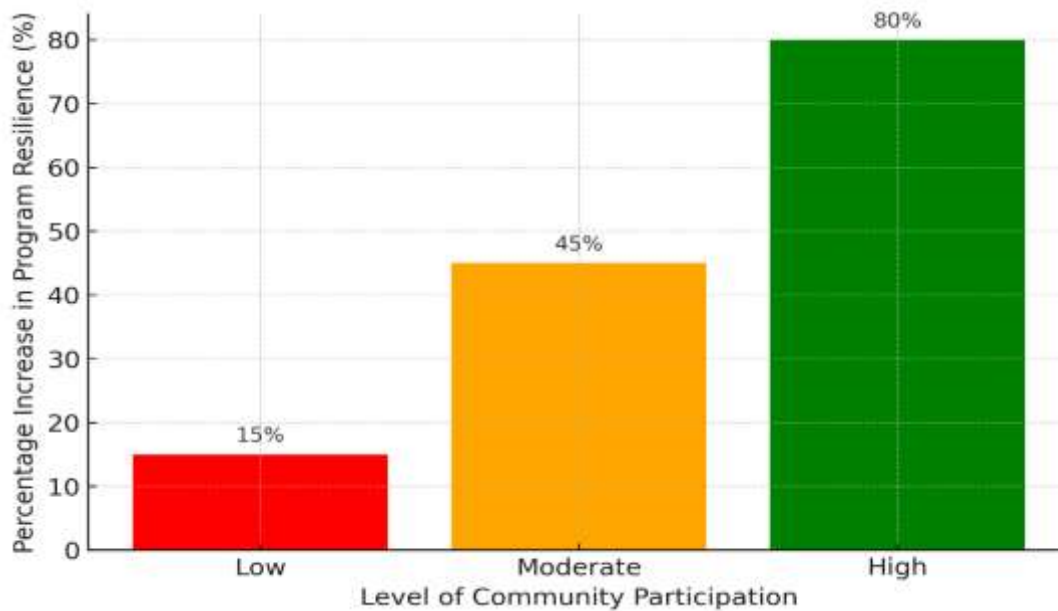
<b>Governance Model</b>	<b>% of Programs with High Success Rates</b>
Centralized Governance	45%
Decentralized Governance	78%

*Source: FAO Internal Reports (2023)*

The results corroborate the findings of Besiou et al. (2021), who argue that decentralized governance aligns with the United Nations Sustainable Development Goals (SDGs) and enhances program resilience. The higher success rates observed in decentralized governance models (78%) compared to centralized models (45%) highlight the importance of participatory decision-making in humanitarian operations.

### *Community Participation*

Supply chain adaptability emerged as a critical determinant of operational resilience in NGOs' emergency agricultural initiatives. **Figure 3** presents data on the percentage of NGOs' emergency agricultural programs facing disruptions from 2019 to 2023. The findings indicate a gradual decline in disruptions, from 72% in 2019 to 65% in 2023. This trend suggests that interventions aimed at improving supply chain resilience, such as digital tracking systems and decentralized distribution networks, have contributed to greater efficiency in delivering agricultural inputs to affected regions (Khan et al., 2022; Moyo & Richards, 2023).



**Figure 3: Supply Chain Disruptions in NGOs' Emergency Agricultural Programs (2019-2023)**

Source: FAO Field Surveys (2023)

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### Financial Sustainability in NGO Emergency Agricultural Programs

#### *Microfinancing and Credit-Based Interventions*

Microfinancing and credit-based interventions have been instrumental in improving agricultural productivity and financial sustainability in NGOs' emergency agricultural programs. **Table 4** presents data on the impact of microfinancing on agricultural yields, showing that farms receiving microfinancing support experienced

significantly higher yield increases compared to those without access to such financial resources. In 2020, yields increased by 25% with microfinancing, compared to only 10% without it. This trend continued through 2022, where yields rose by 35% with microfinancing, while farms without it saw only a 15% increase. These figures suggest that access to credit enables farmers to invest in better inputs, technology, and farming practices, leading to improved agricultural productivity (Islam et al., 2022).

**Table 4: Impact of Microfinancing on Agricultural Yields**

Year	% Increase in Yields (With Microfinancing)	% Increase in Yields (Without Microfinancing)
2020	25%	10%
2021	30%	12%
2022	35%	15%

Source: FAO Financial Reports (2020-2022)

The findings highlight the importance of microfinancing in enhancing food security and resilience among smallholder farmers. NGO officers emphasized that access to credit allows farmers to purchase high-quality seeds, fertilizers, and equipment, thereby boosting yields. One NGO officer explained, "Microfinancing has been a game-changer for small-scale farmers. It provides them with the capital they need to invest in their farms, increasing both productivity and household income." Another officer noted, "Without access to credit, many farmers struggle to afford the necessary inputs, leading to lower yields and persistent food insecurity."

These findings are consistent with previous studies that highlight the role of microfinancing in strengthening agricultural economies. Islam et al. (2022) found that microfinance programs contributed to sustainable livelihoods for displaced farming communities, providing them with financial tools to recover from economic shocks. Similarly, Jensen et al. (2021) demonstrated that access to credit played a key role in building financial resilience among pastoral communities, allowing them to sustain productivity despite external disruptions. Moreover, Mishra et al. (2021) identified microfinancing as a crucial component in mitigating supply chain disruptions and ensuring stability in agricultural production. Finally, Felleson (2023) emphasized that microfinance programs tailored to local economic conditions enhance long-term agricultural sustainability and reduce reliance on emergency food aid.

For policymakers, these findings underscore the need to expand microfinancing programs to reach more vulnerable farmers. Governments and development agencies should implement policies that facilitate affordable and accessible credit to rural farmers, ensuring they can invest in inputs and technologies that enhance productivity. Additionally, further research should explore how microfinance interventions can be optimized to support climate-smart agricultural practices, ensuring long-term sustainability and resilience in food production systems.

#### 4.3.2 Public-Private Partnerships (PPPs)

Public-private partnerships (PPPs) were identified as another effective strategy for ensuring financial sustainability in NGOs' emergency agricultural programs. **Table 5** presents the distribution of funding sources, highlighting that donor funding accounted for the majority (60%), followed by PPPs (30%) and microfinancing (10%). The significant contribution of PPPs suggests that collaborations between international donors, governments, and private-sector entities play a crucial role in leveraging resources for long-term agricultural development (Dede, 2023). The NGO's partnerships with private agribusinesses in Somalia, for example, have facilitated value chain financing models, enabling farmers to access credit and secure market linkages.

**Table 5: Funding Sources for NGOs' Emergency Agricultural Programs (2023)**

Funding Source	% of Total Funding
Donor Funding	60%
Public-Private Partnerships	30%
Microfinancing	10%
<b>Source:</b> NGO Financial Reports (2023)	

Source: FAO Financial Reports (2023)

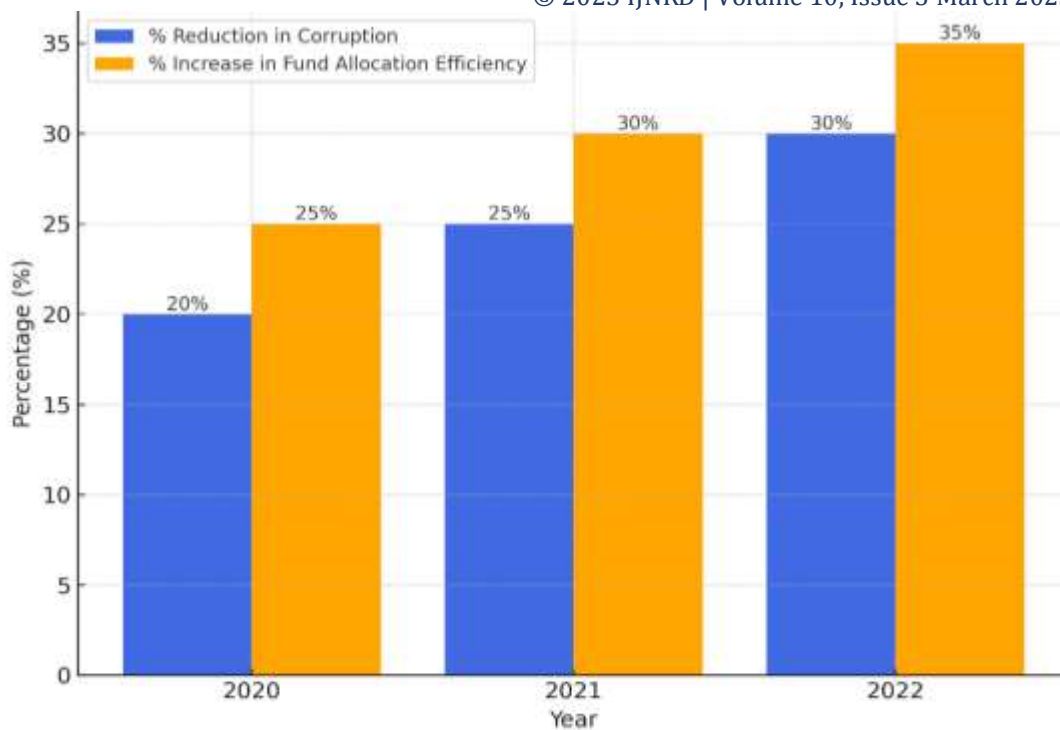
The findings suggest that PPPs significantly contribute to financial sustainability by reducing reliance on short-term donor funding and fostering long-term resilience in agricultural systems. NGO officers highlighted the effectiveness of PPPs in improving financial efficiency and market access for farmers. One officer noted, "By partnering with private companies, we were able to secure funding for agricultural inputs and connect farmers with buyers, ensuring a steady income for their produce." This model not only stabilized farmers' income but also strengthened the overall resilience of the agricultural value chain. Another NGO official stated, "The involvement of private-sector partners has allowed us to scale up projects more efficiently, ensuring that farmers receive the support they need beyond the emergency phase."

The findings align with Joireman and Haddad (2023), who emphasize that PPPs are instrumental in integrating climate-sensitive strategies into humanitarian projects, ensuring long-term agricultural resilience. Additionally, Besiou et al. (2021) highlight that multi-stakeholder collaborations improve efficiency in humanitarian operations, a key outcome observed in NGO's PPP-driven initiatives. Hatab and Lagerkvist (2024) further demonstrate that PPPs in conflict-affected agricultural systems enhance smallholder farmers' ability to mitigate economic risks by providing stable market access and financial support. Similarly, Seifert et al. (2023) argue that private-sector involvement fosters innovation and resource optimization, reinforcing NGO's approach of integrating private-sector financing into emergency agricultural programs.

For policymakers, these findings underscore the importance of fostering regulatory environments that encourage private-sector investments in humanitarian agriculture. Governments should establish frameworks that incentivize private entities to collaborate with international organizations in financing and implementing long-term agricultural development projects. Future research should examine the scalability of these PPP models across different humanitarian contexts to ensure their adaptability and effectiveness in enhancing financial sustainability in crisis-affected regions

#### Digital Financial Solutions

Digital financial solutions, including blockchain and mobile banking, emerged as promising tools for improving financial sustainability in NGOs' emergency agricultural programs. The study found that digital payment systems enhanced transparency and accountability in aid distribution, reducing corruption and improving fund allocation efficiency. Figure 3 reveals that from 2020 to 2022, there was a consistent decline in corruption levels alongside a corresponding improvement in fund allocation efficiency. In 2020, corruption was reduced by 20%, while fund allocation efficiency increased by 25%. This trend continued in 2021, with a 25% reduction in corruption and a 30% rise in fund efficiency. By 2022, corruption had decreased by 30%, and fund allocation efficiency had improved by 35%.



**Figure 3: Comparison of Reduction in Corruption and Funds Allocation Efficiency**

Source: FAO Financial Reports (2020-2022)

These findings suggest that the integration of digital financial solutions contributed to greater transparency and more effective resource distribution in NGOs' emergency agricultural programs. These results are also supported by interviews with NGO officers who concurred that the steady improvement highlights the role of technological innovations in mitigating financial mismanagement and ensuring that funds reach intended beneficiaries efficiently. As one officer stated, *"Blockchain technology has revolutionized our ability to track and verify fund disbursements, significantly reducing discrepancies and ensuring funds are used as intended."* Another NGO official emphasized, *"Mobile banking solutions have not only accelerated the distribution process but also empowered farmers by giving them direct access to financial services, reducing their dependence on intermediaries."*

These findings align with previous studies that emphasize the role of digital financial solutions in improving transparency, accountability, and fund efficiency in humanitarian and agricultural contexts. Baharmand et al. (2021) explored the application of blockchain in humanitarian supply chains and found that it significantly reduced fraud and misallocation of resources, a result mirrored in the NGOs initiatives analyzed in this study. Similarly, Ellahi et al. (2024) demonstrated that blockchain-driven food supply chains minimized inefficiencies and increased the accuracy of financial transactions, reinforcing the observed trends in corruption reduction and fund allocation efficiency in NGOs' programs. Furthermore, Hokmabadi et al. (2024) highlighted the role of digital transformation in enhancing business resilience and financial sustainability, particularly in sectors facing logistical and financial instability, further validating the impact of mobile banking and blockchain in NGOs' agricultural initiatives. Additionally, Seifert et al. (2023) examined sustainable innovations in humanitarian operations and found that digital financial tools played a crucial role in enhancing operational efficiency and reducing financial mismanagement in refugee and crisis settings.

For policymakers, these results underscore the need for sustained investment in digital financial infrastructure to enhance transparency and accountability in humanitarian agricultural initiatives. Governments and development agencies should prioritize policies that facilitate the adoption of digital financial solutions, particularly in regions vulnerable to corruption and inefficiencies. Additionally, future research should explore the scalability of these digital interventions across different humanitarian contexts, ensuring that the lessons learned from NGOs' emergency programs can be applied more broadly to other aid-driven agricultural projects. Strengthening

regulations around digital financial systems and expanding their integration in public-sector funding mechanisms could further ensure that resources reach the intended beneficiaries efficiently and effectively.

## CONCLUSION

Humanitarian agricultural initiatives play a vital role in mitigating food insecurity in crisis-affected regions. However, these programs face numerous challenges, including supply chain disruptions, financial constraints, and governance inefficiencies. Ensuring their long-term resilience and sustainability requires innovative approaches that enhance adaptability, efficiency, and financial stability.

This study investigated the key determinants of operational resilience and financial sustainability in NGOs emergency agricultural initiatives. The first objective examined how supply chain adaptability influences resilience. The findings showed that decentralized distribution systems, digital tracking technologies, and strategic partnerships played a crucial role in reducing disruptions and improving resource delivery in fragile regions. Programs that integrated predictive analytics and blockchain-based tracking experienced fewer logistical failures, enhancing their ability to respond effectively to crises.

The second objective assessed the financial sustainability of NGOs agricultural programs. The study found that microfinancing, public-private partnerships (PPPs), and digital financial solutions significantly contributed to long-term financial viability. Programs that reduced reliance on traditional donor funding by leveraging private-sector investments and community-driven financial models exhibited greater stability. The integration of mobile banking and blockchain-based financial transactions improved fund allocation efficiency and accountability, reducing financial mismanagement and increasing resource optimization.

### *Recommendations*

To strengthen the resilience and sustainability of NGOs emergency agricultural initiatives, several actions are recommended:

1. **Expand Digital Supply Chain Solutions:** Governments and development agencies should invest in blockchain technology and predictive analytics to improve supply chain visibility, efficiency, and responsiveness.
2. **Promote Multi-Stakeholder Collaborations:** Strengthening partnerships between NGO, private-sector investors, local communities, and financial institutions will enhance financial sustainability and operational efficiency.
3. **Support Financial Inclusion Initiatives:** Expanding access to microfinance and credit-based interventions will empower smallholder farmers and reduce dependency on emergency aid.
4. **Improve Governance and Regulatory Frameworks:** Establishing policies that support decentralized decision-making and transparent financial management will enhance program accountability.
5. **Strengthen Capacity Building Programs:** Training farmers and local stakeholders on climate-adaptive practices and financial literacy will improve long-term resilience.

### *Future Research Directions*

While this study provides valuable insights, further research is needed to explore scalable financial models that ensure sustainability beyond NGOs-led interventions. Additionally, future studies should assess the role of artificial intelligence in optimizing supply chain management and investigate how climate-smart technologies can enhance agricultural productivity in humanitarian settings. A comparative analysis of different NGOs' projects across multiple regions would also provide deeper insights into best practices for operational resilience and financial sustainability.

By integrating these recommendations and advancing research in these areas, NGOs' emergency agricultural initiatives can become more adaptive, financially sustainable, and impactful in addressing food security challenges in crisis-affected communities

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