COOPERATIVE-LED FOOD SAFETY TECHNOLOGIES AND VALUE CHAIN PERFORMANCE AMONG AGRICULTURAL COOPERATIVES IN ANAMBRA STATE NIGERIA

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Abstract

Food safety technologies can support product quality, reduce post-harvest losses, and strengthen agricultural value-chain performance. This study examined the relationship between cooperative-led food safety technologies and value-chain performance among agricultural cooperatives in Anambra State, Nigeria. Specifically, the study determined the relationship of Safe Storage and Handling Technologies (SSHT), Food Quality Monitoring Technologies (FQMT), and Food-Safety Training (FST) with Value Chain Performance (VCP). A quantitative cross-sectional survey design was adopted. Data from 143 rice farmers were analysed using descriptive statistics, Pearson product-moment correlation, and multiple linear regression at the 5% significance level. The mean scores were 2.991 for SSHT, 2.540 for FQMT, 2.928 for FST, and 2.876 for VCP. Pearson correlations showed positive and statistically significant relationships between SSHT and VCP ($r = .969$, $p < .001$), FQMT and VCP ($r = .933$, $p < .001$), and FST and VCP ($r = .723$, $p < .001$). The regression model was statistically significant, $F(3, 139) = 1617.0$, $p < .001$, with $R^2 = .972$. SSHT had the strongest standardized contribution to VCP ($\beta = .612$, $p < .001$), followed by FQMT ($\beta = .353$, $p < .001$) and FST ($\beta = .069$, $p = .001$). The findings indicate that the three food-safety variables were positively associated with value-chain performance among the sampled rice farmers. However, the exceptionally high R^2 and correlations warrant cautious interpretation because of possible overlap among the construct measures. The study recommends stronger cooperative support for safe storage, quality monitoring, and context-specific food-safety training.

Key words: *Agricultural cooperatives; food safety technologies; value-chain performance; safe storage and handling; food-quality monitoring; food-safety training.*

Introduction

Food safety is an important component of agricultural production and marketing because unsafe handling, storage, processing, and distribution can reduce product quality, increase losses, and expose consumers to health risks. Food safety challenges are particularly important in low- and middle-income countries, where food systems are expanding while food-safety management capacity may remain limited (Jaffee et al., 2018). Globally, foodborne diseases constitute a major public-health burden, with particularly serious implications for vulnerable populations and food systems in developing economies (Havelaar et al., 2015). In sub-Saharan Africa, weaknesses in post-harvest handling, storage, processing, transportation, and market practices further increase food-safety risks (Aworh, 2021).

Food-safety technologies provide opportunities to address some of these challenges. Technologies and practices for safe storage and handling can reduce deterioration, pest infestation, contamination, and post-harvest losses. Food-quality monitoring technologies can support the identification of undesirable changes in food quality and safety. Similarly, food-safety training can improve knowledge and practices relating to hygiene, handling, storage, and quality management. Digital and sensor-based technologies have also expanded the possibilities for monitoring food conditions across supply chains (Fuentes et al., 2023; Uhlig et al., 2022). However, access to such technologies is often constrained by cost, technical capacity, information gaps, and weak institutional support.

Agricultural cooperatives can provide an institutional mechanism for addressing some of these constraints. Cooperatives enable farmers to organize collective activities, share resources, obtain information and training, access inputs and markets, and improve their bargaining position. Evidence from developing-country agriculture indicates that cooperative participation can facilitate access to agricultural technologies and other productive services (Abebaw & Haile, 2013; Ahmed & Mesfin, 2017). Cooperative institutions may therefore provide an appropriate platform for introducing and coordinating food-safety technologies among smallholder farmers. The relevance of food safety extends beyond consumer protection to the performance of agricultural value chains. Value-chain performance reflects the ability of actors and activities within a chain to generate, preserve, and capture value through production, handling, and processing, marketing, and related activities. Poor food-safety practices may result in quality deterioration, post-harvest losses, rejection of products, reduced consumer confidence, and restricted access to higher-value markets. Conversely, improved food-safety practices may support quality assurance and strengthen market performance. Despite the potential importance of food-safety technologies, empirical evidence linking cooperative-led food-safety interventions to agricultural value-chain performance remains limited in the Nigerian context. Existing studies have examined cooperative membership, technology adoption, production efficiency, and value-chain

development, but comparatively less attention has been given to the specific contribution of safe storage and handling, food-quality monitoring, and food-safety training to value-chain performance. This gap is particularly relevant to smallholder rice farmers who depend on cooperatives for information, collective services, and market-related support.

This study therefore examined the relationship between cooperative-led food-safety technologies and value-chain performance among agricultural cooperatives in Anambra State, Nigeria. The study focused on three dimensions: Safe Storage and Handling Technologies (SSHT), Food Quality Monitoring Technologies (FQMT), and Food-Safety Training (FST).

Statement of the Problem

Agricultural cooperatives provide important support to smallholder farmers through collective access to inputs, information, extension services, markets, and other resources. However, many smallholder farmers continue to rely on traditional storage, handling, and quality-management practices. Limited access to appropriate technologies, financial constraints, inadequate technical knowledge, and weak institutional support may expose agricultural products to deterioration, contamination, post-harvest losses, and reduced market competitiveness.

These challenges are important in rice production because value is generated not only through production but also through harvesting, storage, handling, processing, marketing, and maintenance of product quality. Where food-safety practices are inadequate, losses may occur at several points along the value chain. Farmers may also find it difficult to satisfy market requirements associated with product quality and safety.

Agricultural cooperatives have the potential to address these challenges by facilitating collective investment in storage and handling facilities, organizing food-quality monitoring, and providing training to members. Nevertheless, there is limited empirical evidence on whether these cooperative-led food-safety dimensions are associated with improved value-chain performance among rice farmers in Anambra State. The absence of such evidence limits the ability of cooperatives, extension agencies, policymakers, and agricultural development organizations to determine which food-safety interventions deserve greater attention. This study therefore examined the relationship between SSHT, FQMT, FST, and VCP among rice farmers belonging to selected agricultural cooperatives in Awka North Local Government Area of Anambra State.

Objective of the Study

The main objective of the study was to examine the relationship between cooperative-led food-safety technologies and value-chain performance among agricultural cooperatives in Anambra State, Nigeria. The specific objectives were to:

1. determine the relationship between Safe Storage and Handling Technologies (SSHT) and Value Chain Performance (VCP) among agricultural cooperative members;
2. examine the relationship between Food Quality Monitoring Technologies (FQMT) and Value Chain Performance (VCP) among agricultural cooperative members; and
3. assess the relationship between Food-Safety Training (FST) and Value Chain Performance (VCP) among agricultural cooperative members.

Hypotheses of the Study

The following null hypotheses were tested at the 5% level of significance:

H_{01}: Safe Storage and Handling Technologies have no significant relationship with Value Chain Performance among agricultural cooperative members.

H_{02}: Food Quality Monitoring Technologies have no significant relationship with Value Chain Performance among agricultural cooperative members.

H_{03}: Food-Safety Training has no significant relationship with Value Chain Performance among agricultural cooperative members.

Literature Review

Food-Safety Technologies

Food-safety technologies comprise tools, practices, and systems used to prevent contamination, maintain product quality, identify safety risks, and support safer movement of food through production and marketing activities. Their application ranges from improved physical storage and handling systems to monitoring technologies, digital information systems, and training. Recent developments in digital agriculture have expanded the capacity to monitor food and agricultural products using sensors, Internet of Things systems, artificial intelligence, and other digital tools. Sensor-based systems can monitor environmental conditions such as temperature and humidity, while digital technologies can support information management and quality assessment (Uhlig et al., 2022; Fuentes et al., 2023). Artificial intelligence has also been identified as having potential applications in food-quality assessment, contamination detection, risk prediction, and food-safety management (Naseem & Rizwan, 2025; Uzunov & Angeleska, 2026). However, technological sophistication alone does not

guarantee improved food safety. Adoption depends on affordability, accessibility, technical knowledge, infrastructure, institutional support, and users' capacity to integrate technologies into existing practices. For smallholder farmers, cooperative organizations may therefore be important channels through which appropriate food-safety technologies can be introduced and collectively utilized.

Safe Storage and Handling Technologies

Safe Storage and Handling Technologies (SSHT) refer to technologies and practices that protect agricultural products from contamination, deterioration, pest infestation, excessive moisture, and other hazards during storage and handling. For grain-producing farmers, appropriate storage is particularly important because poor storage conditions can lead to quantitative and qualitative losses. Hermetic storage technologies are an example of improved storage practices. Hermetic bags and other sealed storage systems can reduce oxygen availability and restrict insect development, thereby reducing dependence on storage chemicals and helping to maintain grain quality. Improved storage technologies can therefore contribute to both food safety and economic performance by reducing losses and preserving marketable produce.

For cooperative farmers, collective access to storage facilities may reduce the individual cost of adopting improved technologies. Cooperatives can also establish common storage facilities, provide technical guidance, and develop rules for handling and storage. Such collective arrangements are consistent with the broader role of cooperatives in improving farmers' access to technology, information, and productive services (Abebaw & Haile, 2013; Ahmed & Mesfin, 2017).

Food Quality Monitoring Technologies

Food Quality Monitoring Technologies (FQMT) are tools and procedures used to assess conditions that affect food quality and safety. They may include physical inspection, moisture measurement, temperature monitoring, sensors, rapid testing devices, and other technologies capable of detecting changes in food characteristics.

The development of biosensors and other sensing technologies has increased the potential for rapid and non-destructive monitoring of food quality and safety. Biosensors can support the detection of chemical, biological, and other food-related conditions and therefore have applications in food-quality monitoring (Naresh & Lee, 2021). Similarly, IoT-enabled monitoring systems can provide real-time information about environmental conditions that influence food quality during transportation and storage (Uhlig et al., 2022).

For smallholder farmers, access to quality-monitoring technologies may improve

decision-making regarding storage, handling, sorting, marketing, and product quality. However, adoption may be constrained by cost and technical requirements. Cooperative organizations can potentially reduce these constraints through collective acquisition and shared use of monitoring equipment, member training, and coordinated quality-control procedures.

Food-Safety Training

Food-Safety Training (FST) refers to organized educational activities designed to improve farmers' knowledge, skills, attitudes, and practices concerning food safety. Training can address personal hygiene, contamination prevention, handling, storage, sanitation, safe use of inputs, quality control, and other practices relevant to the food chain.

Evidence indicates that food-safety training can improve knowledge and attitudes concerning food-safety practices. Training is particularly useful when it is practical, context-specific, and directed at the actual risks encountered by food handlers and producers (Medeiros et al., 2011; Soon et al., 2012). Research involving farmers' market vendors also identified knowledge gaps and the need for targeted food-safety education (Scheinberg et al., 2013).

Agricultural cooperatives provide a practical institutional platform for delivering such training. Instead of relying solely on individual farmers to obtain information, cooperative-based training can reach several members simultaneously and promote common standards. Regular training may also help members understand and appropriately use storage, handling, and quality-monitoring technologies.

Agricultural Cooperatives and Food-Safety Technology Adoption

Agricultural cooperatives are collective organizations through which farmers pursue economic and social interests. They can facilitate access to markets, agricultural inputs, information, extension services, technology, credit, training, and collective facilities. Evidence from Ethiopia shows that cooperative membership can improve access to agricultural technologies, while other studies have linked cooperative participation with improved farmer welfare and productive outcomes (Abebaw & Haile, 2013; Ahmed & Mesfin, 2017). Cooperatives are particularly relevant to technology adoption because many smallholder farmers face individual constraints relating to finance, information, scale, and technical capacity. Collective action can reduce some of these barriers by spreading costs and making services available to a larger group of farmers.

Recent evidence also shows that cooperative institutions can influence agricultural value-chain performance through training, quality enhancement, market access, and access to inputs. Ahikire et al. (2025), for example, found that cooperative unions

contributed to coffee value-chain performance through mechanisms including training, quality improvement, market access, and input access. The implication is that cooperatives can serve not only as economic organizations but also as channels for food-safety improvement. By organizing training, supporting safe storage, facilitating quality monitoring, and coordinating members' practices, cooperatives may contribute to better outcomes across agricultural value chains.

Value-Chain Performance

Value-chain performance refers to the extent to which activities and relationships within a chain contribute to efficient production, quality maintenance, market access, customer satisfaction, sales, and profitability. In agricultural systems, value is generated through interconnected activities extending from production and harvesting to storage, processing, distribution, and marketing. Food safety is relevant to value-chain performance because quality and safety can influence market acceptance, consumer confidence, losses, and the ability of producers to participate in higher-value markets. Poor storage and handling may reduce product quality, while inadequate monitoring may allow defects or contamination to remain undetected. Training can improve the knowledge needed to maintain safe practices throughout the chain.

In this study, value-chain performance was operationalized using indicators relating to market access, product quality, customer satisfaction, sales growth, and profitability. The focus was therefore on the perceived performance outcomes associated with activities undertaken by cooperative rice farmers.

Empirical Review

Akinola et al. (2023) examined agricultural cooperative membership and the yield of smallholder tomato farmers in Nigeria. The study found that cooperative membership was associated with improved yield and access to extension services and agricultural practices. Although the study demonstrates the productive importance of cooperatives, it did not examine food-safety technologies or value-chain performance.

Ahikire et al. (2025) examined coffee cooperative unions and value-chain performance in Greater Bushenyi. The study reported that training, quality enhancement, market access, and input access contributed to improved coffee value-chain performance. The study is relevant because it demonstrates how cooperative activities can influence quality and market outcomes, although its focus was on coffee rather than rice and did not specifically assess food-safety technologies.

Recent food-safety technology reviews have emphasized the growing role of digital and intelligent technologies in food-safety management. Naseem and Rizwan (2025)

identified applications of artificial intelligence in contamination detection, quality control, supply-chain monitoring, risk assessment, traceability, and pathogen identification.

Uzunov and Angeleska (2026) similarly highlighted the potential of artificial intelligence in food-safety and quality management while identifying implementation barriers such as cost, data limitations, interpretability, and the need for human oversight.

The reviewed studies demonstrate three important points. First, cooperative membership can improve farmers' access to productive resources and information. Second, cooperative activities can influence value-chain performance through training, quality improvement, and market access. Third, technological developments provide new opportunities for food-safety management. However, limited evidence directly connects cooperative-led safe storage and handling, food-quality monitoring, and food-safety training with value-chain performance among rice farmers in Anambra State. This study addresses this gap.

Theoretical Framework

Collective Action Theory

The study is anchored on Collective Action Theory developed by Olson (1965). The theory explains how individuals with common interests can organize and mobilize resources to achieve collective benefits that may be difficult or costly to achieve individually.

Agricultural cooperatives provide an institutional setting in which farmers can coordinate activities and pool resources. Individual farmers may find it difficult to acquire expensive storage facilities, quality-monitoring equipment, technical information, or specialized training. Through collective organization, however, farmers can share costs, obtain services, establish common standards, and coordinate activities.

The theory is particularly relevant to food safety because many food-safety benefits are collective. One farmer's adherence to safe storage and handling procedures may not be sufficient to ensure the safety and quality of a product moving through a chain involving several actors. Collective rules, shared facilities, training, monitoring, and member participation are therefore important.In the present study, the theory provides a basis for understanding how cooperative organization can facilitate the adoption and use of SSHT, FQMT, and FST. Collective access to these resources may improve farmers' capacity to maintain product quality and achieve better value-chain outcomes. The theory consequently links cooperative organization with the three explanatory variables and the expected improvement in value-chain performance.

Methodology

The study was conducted in Awka North Local Government Area (LGA) of Anambra State, Nigeria. Awka North comprises nine communities: Amansea, Isu-Aniocha, Mgbakwu, Urum, Amanuke, Ebenebe, Ugbenu, Ugbene, and Achalla, which serves as the LGA headquarters. Agriculture is an important economic activity, with rice, cassava, maize, and yam among the major crops produced in the area. The study focused on rice farmers belonging to selected agricultural cooperatives. The study population comprised 150 registered members of six selected agricultural cooperatives involved in rice production in Awka North LGA. Because the population was relatively small and identifiable, a total-enumeration approach was adopted. The analysis was based on 143 valid questionnaire returned supplied in the dataset.

Data were collected using a structured questionnaire. The questionnaire measured SSHT, FQMT, FST, and VCP using four items for each construct. Responses were measured on a four-point Likert scale ranging from 1 = Strongly Disagree to 4 = Strongly Agree. Construct scores were computed as the mean of the four corresponding items.

VCP was assessed using indicators relating to market access, product quality, customer satisfaction, sales growth, and profitability. The explanatory constructs represented safe storage and handling practices, food-quality monitoring practices, and food-safety training.

Multiple linear regression was used to estimate the relationship between the three explanatory variables and value-chain performance. The model was specified as:

VCP=β0+β1SSHT+β2FQMT+β3FST+εVCP = beta0 + beta1SSHT + \beta2FQMT + beta3FST+ ε/standard error

where:

VCP = Value Chain Performance;

SSHT = Safe Storage and Handling Technologies;

FQMT = Food Quality Monitoring Technologies;

FST = Food-Safety Training;

β_0 = regression constant;

β_1–β_3 = regression coefficients; andε = error term.

Descriptive statistics, Pearson product-moment correlation, and multiple linear regression were used for data analysis. Statistical decisions were made at the 5% significance level.

Socio-Economic and Institutional Characteristics

Table 1. Selected Socio

				Economic and Institutional Characteristics of Respondents (N = 143)
Variable	**Category**	**Frequency**	**Percentage (%)**	
Gender	Male	79	55.24	
	Female	64	44.76	
Age	18–30 years	24	16.78	
	31–50 years	96	67.13	
	51 years and above	23	16.08	
Rice-farming experience	1–5 years	31	21.68	
	6–10 years	42	29.37	
	11–15 years	45	31.47	
	Above 15 years	25	17.48	
Extension access	Yes	94	65.73	
	No	49	34.27	
Awareness of food-safety technologies	Yes	40	27.97	
	No	103	72.03	

Source: Field Survey, 2026.

Table 1 indicates that males constituted 55.24% of respondents, while 67.13% were aged 31–50 years. Most respondents (78.32%) had more than five years of rice-farming experience. Although 65.73% had access to extension services, only 27.97% were aware of food-safety technologies.

Descriptive Statistics

Table 2. Descriptive Statistics of Study Variables

Variable	Mean	SD	Skewness	Excess Kurtosis
SSHT	2.991	0.573	-0.273	-0.982
FQMT	2.540	0.585	0.222	-0.597
FST	2.928	0.359	-0.032	-0.915
VCP	2.876	0.608	-0.198	-1.071

Source: Computed from Field Survey Data, 2026.

SSHT recorded the highest mean score (M = 2.991, SD = 0.573), followed by FST (M = 2.928, SD = 0.359) and VCP (M = 2.876, SD = 0.608). FQMT had the lowest mean score (M = 2.540, SD = 0.585), indicating comparatively lower reported availability or use of food-quality monitoring technologies. The skewness values ranged from -0.273 to 0.222, while excess kurtosis ranged from -1.071 to -0.597, indicating reasonably balanced distributions.

Pearson Correlation Analysis

Table 3. Pearson Correlation Matrix

Variable	SSHT	FQMT	FST	VCP
SSHT	1.000	.875	.700	.969
FQMT	.875	1.000	.638	.933
FST	.700	.638	1.000	.723
VCP	.969	.933	.723	1.000

Note: p < .001 for reported off-diagonal correlations.

The results indicate positive and statistically significant relationships among all study variables. SSHT had a very strong positive correlation with VCP (r = .969, p < .001), while FQMT also had a very strong positive correlation with VCP (r = .933, p < .001). FST had a strong positive correlation with VCP (r = .723, p < .001).

The explanatory variables were also strongly correlated. SSHT and FQMT recorded r = .875, SSHT and FST r = .700, and FQMT and FST r = .638, all at p < .001. These relationships indicate substantial overlap among some predictors and warrant cautious interpretation of the unique regression coefficients.

Multiple Linear Regression Analysis

Table 4. Multiple Regression Results for Value Chain Performance

Predictor	B	SE	β	t	p	95% CI for B	VIF
Constant	-0.340	0.071	—	-4.765	< .001	[-0.481, -0.199]	—
SSHT	0.649	0.034	.612	19.340	< .001	[0.582, 0.715]	4.994
FQMT	0.367	0.030	.353	12.023	< .001	[0.306, 0.427]	4.295
FST	0.117	0.034	.069	3.489	.001	[0.051, 0.184]	1.971

Model statistics: R = .986; R^2 = .972; Adjusted R^2 = .972; F(3,139) = 1617.0, p < .001.

Source: Computed from Field Survey Data, 2026.

The estimated regression equation was:

VCP^=−0.340+0.649SSHT+0.367FQMT+0.117FST\widehat{VCP} = -0.340 + 0.649SSHT + 0.367FQMT + 0.117FST

The overall regression model was statistically significant, F(3,139) = 1617.0, p < .001.

The R^2 of .972 indicates that the three predictors jointly accounted for 97.2% of the observed variation in VCP within the supplied dataset.

SSHT was the strongest unique predictor of VCP (B = 0.649, β = .612, p < .001). FQMT also had a positive and statistically significant coefficient (B = 0.367, β = .353, p < .001). FST had the smallest standardized coefficient but remained statistically significant (B = 0.117, β = .069, p = .001).

The relative standardized contributions were therefore:

SSHT (β = .612) > FQMT (β = .353) > FST (β = .069).

The VIF values ranged from 1.971 to 4.994. Although none exceeded the commonly used value of 5, the VIF for SSHT was close to that threshold, consistent with the strong correlation between SSHT and FQMT. The regression coefficients should consequently be interpreted as unique statistical contributions after controlling for the other predictors rather than as independent causal effects.

Test of Hypotheses

Table 5. Summary of Hypothesis Decisions

Hypothesis	Relationship	B	p-value	Decision
H01	SSHT → VCP	.612	< .001	Reject H01
H02	FQMT → VCP	.353	< .001	Reject H02
H03	FST → VCP	.069	.001	Reject H03

For H_{01}, SSHT had a positive and statistically significant relationship with VCP (β = .612, p < .001). The null hypothesis was therefore rejected.

For H_{02}, FQMT had a positive and statistically significant relationship with VCP (β = .353, p < .001). The null hypothesis was rejected.

For H_{03}, FST had a positive and statistically significant relationship with VCP (β = .069, p = .001). The null hypothesis was also rejected.

Discussion of Findings

The study found a positive and statistically significant relationship between Safe Storage and Handling Technologies (SSHT) and Value Chain Performance (VCP), with SSHT recording the strongest standardized contribution. This suggests that improved storage and handling may help preserve rice quality, reduce losses, and support marketability. The finding is consistent with evidence that cooperative participation can improve farmers' access to agricultural technologies and productive resources (Abebaw & Haile, 2013; Ahmed & Mesfin, 2017).

Food Quality Monitoring Technologies (FQMT) also had a positive and statistically significant relationship with VCP and recorded the second-largest standardized contribution. This indicates that quality monitoring may support better decisions on storage, sorting, handling, quality assurance, and marketing. The finding agrees with literature emphasizing sensing and digital technologies for food-quality monitoring (Naresh & Lee, 2021; Uhlig et al., 2022; Fuentes et al., 2023). Cooperatives may further facilitate access to shared monitoring equipment and technical support.

Food-Safety Training (FST) had the smallest standardized contribution but remained statistically significant. This indicates that training was positively associated with VCP after controlling for SSHT and FQMT. Its smaller coefficient suggests a weaker unique contribution within the model, although training remains important for enabling farmers to use food-safety technologies effectively. This agrees with evidence that food-safety education can improve knowledge and attitudes (Medeiros et al., 2011; Soon et al., 2012; Scheinberg et al., 2013).

Overall, the results show strong associations between food-safety technologies, training, and perceived value-chain performance and support the relevance of Collective Action Theory in explaining the cooperative role in accessing shared technologies and services.

Conclusion and Recommendations

The study examined the relationship between three cooperative-led food-safety dimensions—Safe Storage and Handling Technologies, Food Quality Monitoring Technologies, and Food-Safety Training—and Value Chain Performance among rice farmers in selected agricultural cooperatives in Awka North Local Government Area of Anambra State. The findings showed that all three explanatory variables had positive and statistically significant relationships with Value Chain Performance. SSHT made the strongest unique contribution, followed by FQMT, while FST had the smallest but statistically significant contribution. The findings indicate that food-safety interventions constitute an important dimension of agricultural value-chain management among the sampled cooperative farmers.The study therefore concludes that strengthening cooperative support for safe storage and handling, food-quality monitoring, and food-safety training may contribute to improved value-chain outcomes. However, the very high R^2 and correlations among the variables require cautious interpretation, and the findings should be understood as statistical associations rather than evidence of causal effects.

Based on the findings, the study recommends that:

1. **Agricultural cooperatives should prioritize safe storage and handling.** Cooperative societies should facilitate collective access to appropriate storage facilities and promote improved handling practices that reduce deterioration, contamination, and post-harvest losses.
2. **Cooperatives should strengthen food-quality monitoring.** Where feasible, cooperatives should provide shared access to appropriate quality-monitoring equipment and establish simple procedures for assessing product quality before storage and marketing.
3. **Food-safety training should be institutionalized.** Cooperative societies should organize regular, practical training covering safe handling, storage, sanitation, quality management, and appropriate use of food-safety technologies.

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