

Risks Monitoring Framework for Sustainability of Externally Funded Food Security Projects in Arid and Semi-Arid Lands

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Abstract

Climate-related risks such as droughts, floods, pest and disease outbreaks have been causing severe disruptions to food security projects, posing significant project risks. The study examined how risk monitoring (tracking Key Performance Indicators- KPIs, conducting trend analysis, and implementing risk reporting) influence sustainability of food security projects in Kenya's ASALs, focusing on crop and livestock production. Using Prospect theory and Theory of change, the study employed a correlational research design with 347 targeted respondents from 11 ASAL counties and a final sample of 182 from 6 counties: Tana River, Makueni, Kitui, Kilifi, Kwale, and Narok. Data collection methods included key informant interviews, surveys, observations, and photography. Findings reveal frequent risks including delayed project fund disbursements, low technology adoption, climatic variability (low rainfall, pests and diseases), poor farming skills and high production costs. The findings revealed that tracking KPIs ($M = 4.548$, $SD = 0.655$), analyzing trend analysis ($M = 4.096$, $SD = 0.800$), and implementing risk plans ($M = 4.163$, $SD = 0.891$) significantly enhanced project sustainability. The study also highlighted that risk monitoring reduces project costs, improves timely implementation ($M = 4.370$, $SD = 0.595$), increases agricultural productivity ($M = 4.563$, $SD = 0.568$), and increases stakeholder satisfaction ($M = 4.430$, $SD = 0.641$). Correlation analysis confirmed a strong positive relationship between risk monitoring and project sustainability ($r = 0.873$, $p = 0.000$), while regression analysis (adjusted R-squared = 0.578), supported by suggesting that 57.8% of the variance in Project sustainability was explained by risk monitoring. Value chains included livestock (e.g. dairy cows, local chicken, apiculture), and high-value crops like green grams, cashew nuts and mangoes. The study recommended adoption of structured KPI tracking, digital tools for trend analysis, and risk reporting systems, supported by robust M&E frameworks, policy reforms, stakeholder participation, and capacity building to enhance sustainability.

Key words: Risk Monitoring, Project Sustainability, Arid and Semi-Arid Lands (ASALs), Monitoring and Evaluation (M&E).

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1. Introduction

Drylands in developing countries, particularly in Africa, are characterized by low agricultural productivity, weak infrastructure, and high vulnerability to climate change risks such as droughts and floods (Begizew, 2021). Sustainable food production in these areas requires proactive risk management to minimize crop losses and improve resource efficiency. Climate-related hazards and technological disruptions are increasingly recognized as "threat multipliers" that intensify existing vulnerabilities (Tucci, 2021). The COVID-19 pandemic further exposed these vulnerabilities, reinforcing the need for resilient and integrated risk management systems. Sustainable Development Goals (SDGs) 1, 2 and 13 require global efforts to end poverty; to end hunger, realize food security and sustainable agriculture; and, to strengthen adaptive capacity on risk management on climate-related hazards and natural disasters, respectively (UN, 2023).

Africa is especially susceptible to climate risks due to its dependence on rain-fed agriculture. Extreme weather events like droughts and floods continue to disrupt food security and rural livelihoods (Nthambi & Ijioma-Uche, 2021). In Kenya, agriculture contributes 25% of GDP directly and 27% indirectly, and over 80% of the rural population depends on it for survival (GOK, 2018). However, Kenya's arid and semi-arid lands (ASALs), which cover 88% of the country, suffer from chronic food insecurity, natural resource-based conflicts, and low economic productivity (Nyuma & Churu, 2022). To address these challenges, Kenya has implemented several externally funded projects. The National Agricultural Value Chain Development Project (NAVCDP), launched in 2022 with World Bank support and running through 2027, aims to improve market participation and value addition for small-scale farmers in 26 counties. It builds on the Kenya Climate Smart Agriculture Project (KCSAP), launched in 2017 in 24 counties to enhance resilience through productivity gains, climate adaptation,

and greenhouse gas reduction, and the National Agricultural and Rural Inclusive Growth Project (NARIGP), which targets improved productivity and profitability in 21 counties. These projects align with Kenya's National Climate Change Response Strategy, emphasizing sustainable agriculture and resilience building.

Despite these interventions, productivity in ASALs remains low due to irregular rainfall, market instability, and inadequate risk monitoring. These counties contribute only 5% of GDP, yet they support 30% of the population and 70% of livestock (Djurfeldt, 2020). With global food demand projected to rise by 50% by 2050, effective risk management becomes increasingly vital (FAO, 2017). Agricultural sustainability is further threatened by pests, policy uncertainties, and weak risk monitoring frameworks (Prashanth *et al.*, 2024). These challenges often result in delayed implementation, cost overruns, and unsustainable project outcomes. Strengthening risk monitoring can enhance productivity, stabilize food systems, and improve resilience (Wang *et al.*, 2022).

Droughts, floods, and pest outbreaks weaken traditional coping mechanisms in ASALs, worsening poverty and food insecurity. Kenya's Global Hunger Index score of 23.7 places it in the 'serious' category (GHI, 2019), highlighting the urgent need for improved risk management in agriculture.

1.1 Statement of the Problem

The ASALs of Kenya face chronic development challenges despite hosting over 30% of the population, 70% of the national livestock herd, and covering 88% of the country's landmass. These regions contribute only about 5% to the national GDP, largely due to low agricultural productivity, unreliable rainfall, poor infrastructure, and frequent climate-induced disasters (Djurfeldt, 2020; Nyuma & Churu, 2022). As global food demand is projected to rise by 50% by 2050 (FAO, 2017), enhancing the sustainability of agricultural systems in ASALs becomes a strategic necessity.

While the government and development partners have initiated externally funded agricultural projects, such as NAVCDP, KCSAP, and NARIGP, to build resilience and promote sustainable agriculture, these initiatives are often disrupted by droughts, floods, pest outbreaks, market shocks, and institutional capacity gaps (Prashanth *et al.*, 2024). Poor risk identification and weak monitoring systems lead to delays, cost overruns, and compromised outcomes, undermining project sustainability and the achievement of SDGs 1, 2, and 3, on no poverty, zero hunger, and climate action, respectively (UN, 2023). Livelihoods in ASALs depend heavily on extensive livestock systems and rain-fed agriculture, making them highly sensitive to environmental and socio-economic risks (D'Alessandro *et al.*, 2015). Current interventions have not adequately integrated proactive risk monitoring frameworks to guide adaptive management and ensure long-term project viability. Inaccessibility to sufficient and nutritious food persists, reflecting deeper issues in project sustainability and resilience.

Despite growing awareness of the importance of risk management, literature remains limited on its direct link to the sustainability of externally funded food security projects in Kenya's ASALs. This study responds to this gap by proposing a structured risk monitoring framework to enhance project resilience, accountability, and sustainability in these vulnerable regions.

1.2 Objectives of the Study

The general objective of this study was to analyse risks monitoring on sustainability of externally funded food security projects in Arid and Semi-Arid Lands in Kenya. The study was directed by the following specific objectives: (i) To examine the role of tracking key performance indicators (KPIs) on sustainability of food security projects in Kenya's ASALs; (ii) To analyze trend analysis on sustainability of food security projects in Kenya's ASALs; and, (iii) To assess risk reporting mechanisms on sustainability of food security projects in Kenya's ASALs.

1.3 Justification of the Study

This study sought to establish risk monitoring strategies for ensuring the sustainability of externally funded food security projects in Kenya's ASALs. Given the vast land area occupied by ASALs and their significance to national food security, effective risk management is crucial. This research contributed to achieving SDGs by addressing poverty (SDG 1), enhancing food productivity (SDG 2), fostering economic growth (SDG 8), and strengthening resilience against climate risks (SDG 13). The findings would benefit policymakers, project managers, and stakeholders in developing more effective agricultural risk management strategies. By identifying key risks and their implications, this study aimed to enhance agricultural productivity, improve resilience, and ensure the long-term sustainability of externally funded food security initiatives in ASALs within focus areas of two main sectors of crop production and livestock production.

2. Literature Review

2.1 Theoretical Review

The study applied Prospect Theory and the Theory of Change to analyze risk monitoring and project sustainability, respectively.

2.2.1 Prospect theory

Prospect Theory, introduced by Tversky and Kahneman (1979), assumes that individuals assess gains and losses differently, favoring decisions that are framed as potential gains rather than losses. This “loss aversion” principle suggests that risk monitoring plays a crucial role in decision-making (Liberto, 2022). However, the theory has been criticized for discontinuities at the reference point, limiting its application in nonlinear risk assessments (Chadee *et al.*, 2022). Despite these limitations, the theory is applicable to the independent variable, risk monitoring (i.e. tracking Key Performance Indicators- KPIs, conducting trend analysis, and implementing risk reporting), of this study.

2.2.2 Theory of change

The Theory of Change explains how interventions lead to specific development outcomes based on causal analysis (Stein & Valters, 2012). It identifies assumptions and risks to guide evidence-based program strategies (Weiss, 1995). However, it may be over-simplified, misunderstood by funders, or flawed due to incorrect assumptions (Rogers, 2014). Despite these challenges, the Theory of Change is applicable to the dependent variable of this study, Project Sustainability, in demonstrating how risk management processes enhance agricultural productivity through risk identification and monitoring.

2.2 Econometric Model

The Econometric model illustrates how independent variable, risk monitoring, influences the dependent variable, food security project sustainability in ASAL regions.

The relationship between Risk Monitoring (RM) and Project Sustainability (PS) was expressed as:

$$PS = \beta_0 + \beta_1 KPI + \beta_2 TA + \beta_3 RR + \varepsilon \quad (1)$$

Where:

PS = Project Sustainability (Economic, Environmental, Social)

KPI = Tracking Key Performance Indicators

TA = Trend Analysis

RR = Risk Reporting

β_0 = Constant (Intercept)

$\beta_1, \beta_2, \beta_3$ = Coefficients representing the impact of each risk monitoring component on project sustainability

ε = Error term accounting for unexplained variability

In this study, the independent variable, risk monitoring, is operationalized as a continuous process involving the tracking of Key Performance Indicators (Olubode-Awosola *et al.*, 2008), conducting trend analysis to anticipate risks based on past patterns (Hayes, 2023), and compiling formal risk reports for informed decision-making (Kelly, 2020). It begins at project initiation and continues throughout, ensuring that both known and emerging risks are identified, monitored, and managed effectively (Project Management Institute, 2000), thereby enhancing the sustainability of food security projects in ASAL regions. Risk monitoring is operationalized by three sub-constructs: Tracking Key Performance Indicators (KPIs), Trend analysis, and Risk reporting, as defined herewith.

- i. Tracking KPIs involves the systematic monitoring, measurement, and analysis of specific metrics that demonstrate the success and impact of projects (World Bank, 2017) that are externally funded in ASALs. According to Olubode-Awosola *et al.* (2008), KPIs should be tailored to track inputs, outputs, and outcomes.
- ii. Trend analysis refers to the examination of historical risk data to forecast future project risks across different time horizons; short, intermediate, and long-term (Hayes, 2023). This analysis helps project implementers to anticipate potential future risks based on past patterns.

- iii. Risk reporting is the formal documentation and communication of identified project risks to senior or relevant management teams. According to Kelly (2020), a good risk report should not only list existing risks but also evaluate the effectiveness of current risk mitigation measures, thereby guiding management actions and decision-making on whether risk levels are acceptable or require intervention.

On the other hand, the dependent variable, Project sustainability, in this study refers to the ability of food security projects to ensure long-term economic viability, environmental protection, and social well-being, especially in ASALs (Setsoafia *et al.*, 2022; Begizew, 2021). It is measured through three dimensions: (i) economic sustainability (e.g., productivity, market availability, and financial viability) (Li *et al.*, 2016; Mbatha *et al.*, 2021); (ii) environmental sustainability (e.g., climate adaptation, water access, soil health, and crop diversity) (Lichtfouse *et al.*, 2009); and (iii) social sustainability (e.g., access to food, education and healthcare affordability, and employment opportunities) (FAO, 2011; Desha & Hargroves, 2014). Without effective risk management, agricultural sustainability cannot be achieved (Matei & Onofrei, 2022).

2.3 Research Gaps

A review of existing literature reveals limited research focused specifically on the risk monitoring of externally funded food security projects in Kenya's ASALs. While Otieno and Mutiso (2021) established the significance of risk identification in food project sustainability, their study did not explore risk monitoring which is a key pillar in risk management. Kinyua *et al.* (2015) also demonstrated a positive relationship between risk management and project performance, but their focus on ICT enterprises makes their findings less applicable to the agricultural sector in ASALs. Studies by Handore *et al.* (2023) and Županić *et al.* (2021) underscored the impacts of climate variability and proposed broad strategies for climate adaptation and risk mitigation but lacked a structured approach to managing project-specific risks using tools such as risk checklists or monitoring frameworks. Likewise, Kumar and Bhatia (2023) and Kwiatkowski *et al.* (2023) emphasized carbon farming and climate-smart practices, which, while useful, avoided core project risk management processes. Moreover, reviews such as Nyuma and Churu (2022) and Begizew (2021) acknowledged environmental and production challenges in ASALs, yet failed to integrate scientific risk management methodologies. The need for comprehensive and participatory risk assessment approaches was also emphasized by Bertolozzi-Caredio *et al.* (2021) and Komarek *et al.* (2020), who called for multi-stakeholder and multi-risk frameworks.

Therefore, a gap remained in designing a structured risk monitoring framework tailored to ASAL food security projects. This study sought to bridge this gap by developing a risk monitoring framework that incorporated risk identification and monitoring processes to enhance project sustainability in Kenya's ASAL counties.

3. Materials and Methods

3.1 Research Design

This study applied a *correlational research design*. According to Bhandari (2020), a correlational research design investigates relationships between variables without the researcher controlling or manipulating any of them. A correlation reflects the strength and/or direction of the relationship between two (or more) variables. The direction of a correlation can be either positive or negative. Correlational research design can provide insights into complex real-world relationships, helping researchers in developing theories and make predictions. To test the importance of the correlation between the variables of this study, some statistics on correlation matrix and multiple regression analysis were applied.

3.2 Sampling Framework

The target population consisted of 347 respondents, including officials from three externally funded food security projects (NAVCDP, KCSAP, and NARIGP) that are funded by the World Bank in 11 ASAL counties in Kenya. It comprised of two key officers per county (Project Coordinators and M&E Officers) and one elected Community Driven Development Committee (CDDC) Chairperson per ward across 325 administrative wards. The study employed purposive sampling for the county project management team and stratified sampling for the community-level respondents. Using the Krejcie & Morgan (1970) model, a sample size of 182 respondents was determined based on a 95% confidence level and a 0.05 margin of error. For the sampling strategy, six counties (Tana River, Makueni, Kitui, Kilifi, Kwale, and Narok) were purposefully selected due to their significant ASAL characteristics. Five counties (Taita Taveta, Nyeri, Embu, Meru, and Machakos) were excluded because of their higher agricultural potential or urban influence. The final sample distribution included 12 respondents at the county level (2 from each of the 6 selected counties) and 170 respondents at the community level (one elected

This study applied Descriptive and Correlational research models. The correlational research design, which reflected the strength and direction of the relationship between the variables, investigated relationships between the variables without the researcher controlling or manipulating any of them, as guided by Bhandari (2023). The variables were only identified, observed, and measured.

4. Results and Discussions

4.1 Identified Risks

The study sought to identify the main risks, both internal and external, negatively impacting the food security sector in the Arid and Semi-Arid Lands (ASALs) of Kenya, with respondents indicating their likelihood of occurrence as frequently (F), moderately (M), or rarely (R). The findings on the main risks negatively impacting the food security sector in the Arid and Semi-Arid Lands (ASALs) of Kenya revealed a wide range of internal and external challenges, with varying likelihoods of occurrence. The risks identified as occurring frequently (F) include delayed disbursement of project funds, low adoption of agricultural technologies, climatic variability (mainly low rainfall, pests and diseases), poor modern farming skills, and high cost of production inputs. Risks occurring moderately (M) include political influence, low staff capacity, market challenges, and institutional risks. A few risks were noted to occur rarely (R), such as human-wildlife conflicts and government intervention issues.

These findings suggest that the agricultural sector in ASALs faces significant challenges related to environmental conditions, financial constraints, and technical capacity. The high frequency of risks like low rainfall and climate change highlights the vulnerability of this region to environmental fluctuations, which is consistent with literature emphasizing the impacts of climate variability on agriculture (FAO, 2021). Additionally, the frequent mention of high production costs and pests and diseases aligns with studies by Harrison & Johnson (2019), which underline the economic and biological pressures on agricultural productivity in similar contexts. The moderate occurrence of risks such as political influence and low staff capacity indicates structural and governance issues that further complicate effective agricultural management. Overall, the findings underscore the need for comprehensive risk management strategies that address both environmental and institutional challenges to improve sustainability of food security projects in ASALs.

4.2 Tracking Key Performance Indicators (KPIs)

Tracking KPIs emerged as a critical practice in risk monitoring, providing a structured approach for assessing the progress and success of food security interventions. Respondents emphasized the importance of defining and using performance indicators to monitor the effectiveness of risk mitigation measures. A high level of agreement was recorded regarding the development of such indicators (Mean = 4.548, SD = 0.655), which were seen as essential for linking risk monitoring efforts to measurable project outcomes. The implementation of risk plans also received strong support (Mean = 4.163, SD = 0.891), indicating that beyond identifying risks, action plans are necessary to manage them proactively. Furthermore, monitoring of residual risks was underscored (Mean = 4.200, SD = 0.780), ensuring that secondary or lingering risks are also addressed. (See Table 1).

Table 1: Descriptive Statistics on Risks Monitoring

<i>The following risks monitoring practices have played a significant role in sustainability of food security projects</i>	SD	D	U	A	SA	Mean	Std. Dev.
	1	2	3 %	4 %	5 %		
	%	%					
Development of Key Performance Indicators	0	0.7	6.7	29.6	63	4.548	0.655
Risk plan(s) are implemented	0.7	5.2	12.6	40	41.5	4.163	0.891
Risk trends are analysed	0.7	3	14.1	50.4	31.9	4.096	0.800
Monitoring & evaluation of residual risks	0	3.7	11.1	46.7	38.5	4.200	0.780
Regular reporting of risks to management	0.7	1.5	14.8	35.6	47.4	4.274	0.823
Aggregate Score						4.256	0.790

In the context of value chains, performance indicators were reflected through various activities in specific counties. For example, Kwale focused on local chicken, cashew nut, and beekeeping; Kilifi supported dairy, mango and conservation agriculture; while Tana River promoted beef, poultry, apiculture, and rice. Makueni and Kitui emphasized poultry, green grams, apiculture, and climate-smart agricultural practices like pasture production. Narok focused on local chicken and dairy, integrating improved pastures and livestock vaccinations (see Figure 1). These activities served as project-specific KPIs that allowed stakeholders to monitor progress and adapt interventions accordingly.



Figure 1: Ann Reteti inspecting and stocking her first batch of eggs for incubation in Kilgoris central ward, Narok County.

Expected outcomes cited by respondents also reflect key performance metrics. These included increased productivity, improved household incomes, higher volumes of agricultural sales, and enhanced job opportunities. Improved soil and water conservation practices, better food security, and resilience to climate change shocks were also listed. These anticipated results align with literature by the FAO (2017) and Asfaw *et al.* (2019), which highlight that well-structured risk monitoring, anchored in KPIs, enhances the profitability, sustainability, and resilience of agricultural initiatives.

4.3 Trend Analysis

Trend analysis played a crucial role in strengthening risk monitoring, helping project stakeholders detect and respond to patterns over time. Respondents widely supported the analysis of risk trends (Mean = 4.096, SD = 0.800), acknowledging that understanding recurring risks, such as droughts, pests, or diseases, provides a foundation for proactive planning (See Table 1). By continuously examining past and current data, stakeholders can make informed decisions about which strategies are most effective and which areas require adjustment.

To support trend analysis, the use of digital and technological tools was widely endorsed. These included wireless sensors, weather-monitoring technologies, digital agro-weather observatories, and applications that provide real-time market and advisory services. Technologies such as “Technologies, Innovations, and Management Practices” (TIMPs), GIS, GPS, and artificial intelligence were identified as enablers of timely and accurate risk forecasting. These innovations help track seasonal patterns and emerging threats that could undermine sustainability of food security. Participatory approaches to monitoring and evaluation further enhanced trend analysis. Engaging farmers, extension officers, and community representatives in regular field observations and discussions ensured that the data collected reflected local realities and was contextually relevant. Moreover, the integration of climate-smart agricultural practices, such as minimum tillage, integrated pest management, and the use of drought-tolerant seeds, served as a strategic response to long-term environmental risks.

These findings align with scholarly insights by Ramachandran *et al.* (2022) and Delgado *et al.* (2019), who argue that the integration of digital agriculture technologies and stakeholder-led data collection is essential for building resilience and increasing agricultural productivity in ASALs.

4.4 Risk Reporting

Effective risk reporting mechanisms were highlighted as vital for timely response and coordination among stakeholders. A high mean score (Mean = 4.274, SD = 0.823) was recorded in support of regular reporting of risks to management, emphasizing the need for consistent communication channels to share insights, warnings, and updates (See Table 1). Timely reporting allows for rapid decision-making and ensures that emerging risks are not overlooked or under-prioritized. Respondents suggested the establishment of formal structures to enhance reporting, including the creation of community and county-level risk management committees. These committees would be responsible for overseeing risk surveillance, validating information, and ensuring that follow-up actions are implemented. Regular quarterly meetings and field visits were also recommended as opportunities for collective review and decision-making.

Assigning responsibility for risk management, particularly to trained environmental safeguard teams and agricultural extension officers, was seen as a way to improve the accuracy and accountability of reporting processes. Investing in the capacity of these teams was considered essential for building institutional readiness and responsiveness to evolving challenges. The outcomes associated with improved risk reporting were far-reaching. Respondents anticipated that better reporting would result in improved livelihoods, higher academic performance due to increased household stability, and more sustainable resource use through enhanced soil and water conservation. Additionally, improved communication would encourage wider adoption of agricultural innovations, particularly among women and youth, and facilitate increased participation in local and regional markets. These findings agree with existing literature which affirms that transparent and timely risk communication, backed by training and institutional frameworks, leading to greater project resilience and stakeholder trust.

4.5 Sustainability of Food Security Projects

The study sought to examine how risk monitoring influences the sustainability of externally funded food security projects in Kenya's ASALs. The findings reveal a diverse and region-specific set of value chains and practices that contribute to sustainability outcomes, categorized under the economic, environmental, and social dimensions.

4.5.1 Economic sustainability

The findings strongly indicate that effective risk monitoring enhances the economic sustainability of food security projects across ASAL counties. Respondents consistently associated risk mitigation with increased productivity and profitability, improved household incomes, and expanded sales volumes for agricultural products. For instance, some respondents remarked that risk management leads to "increased productivity and profitability," while others noted its role in facilitating higher agricultural production, household income growth, and expanded market sales. These outcomes reflect the economic strength derived from well-structured agricultural value chains.

Counties such as Kilifi and Kitui have adopted modern farming technologies like drip irrigation, digital market advisory applications, and mechanized tools (e.g., walking tractors), which help reduce production risks and operational inefficiencies. Moreover, the introduction of climate-resilient crop varieties and improved livestock breeds in counties such as Kitui and Tana River, respectively, has further contributed to productivity gains. The descriptive statistics corroborate these insights. Respondents reported a high level of agreement that risk management results in cost savings (Mean = 4.400, SD = 0.803), timely project implementation (Mean = 4.370, SD = 0.595), and increased crop and livestock productivity (Mean = 4.563, SD = 0.568) (See Table 2). These outcomes confirm the assertions by Asfaw *et al.* (2019), who found that advanced risk management practices significantly enhance agricultural income and productivity.

4.5.2 Environmental sustainability

The study also identified several risk monitoring practices that contribute to environmental sustainability. A strong emphasis was placed on conservation agriculture, such as minimum tillage, integrated pest management, and soil conservation practices, which has been widely adopted in Kitui, Makeni, and Kilifi counties. These techniques help maintain soil health and reduce degradation, ensuring long-term agricultural viability in environmentally fragile ASAL ecosystems. Moreover, the use of certified drought-resistant seeds, improved pasture, and sustainable water management technologies like drip irrigation were commonly mentioned by respondents. Such technologies not only stabilize production in the face of climatic uncertainty but also promote long-term environmental stewardship. Some participants noted that effective risk management leads to "better soil and water conservation," while others emphasized its role in enhancing resilience to climate change shocks. These findings are in agreement with the observations by Ramachandran *et al.* (2022), who emphasized the potential of digital and climate-smart technologies to improve environmental outcomes while mitigating risks in agriculture.

4.5.3 Social sustainability

Social sustainability outcomes were also prominent in the responses. Effective risk monitoring was seen to improve community well-being through job creation, better education, improved health outcomes, and strengthened food security. Respondents stated that food security projects, when well-managed, result in "well-improved community livelihood," "good academic sustainability," and "good health." Such outcomes not only ensure the continuity of projects but also promote inclusivity and equity among local populations.

Importantly, the study found that risk monitoring practices foster social inclusion by increasing market participation among marginalized groups, particularly women and youth. In several counties, respondents highlighted improved access to resources and decision-making spaces for these groups, which is essential for building resilient agricultural communities. The study also recorded high stakeholder satisfaction due to enhanced project sustainability (Mean = 4.430, SD = 0.641) (See Table 2). This resonates with the findings by the Food and Agriculture Organization (FAO, 2015), which underscores that effective risk management contributes significantly to stakeholder trust, project durability, and broader development outcomes.

Table 2: Descriptive Statistics on Project Sustainability

<i>The risks monitoring practices have influenced significantly in sustainability of food security projects</i>	SD	D	U	A	SA	Mean	Std. Dev.
	1	2	3	4 %	5 %		
	%	%	%				
Saving of costs due to reduction in risks	0.7	3.7	4.4	37	54.1	4.400	0.803
Timely project implementation due to risk management	0	0.7	3.7	53.3	42.2	4.370	0.595
Increased agricultural productivity (crops & livestock) due to reduction on risks	0	0.7	1.5	38.5	59.3	4.563	0.568
Stakeholder satisfaction due to good project sustainability	0	0.7	5.9	43	50.4	4.430	0.641
Aggregate Score						4.441	0.652

4.6 Correlation Analysis

The correlation analysis examined the relationships between the dependent variable, Project sustainability, and the independent variable, Risk monitoring (Tracking KPIs, Trend analysis, Risk reporting). Pearson's correlation coefficient (r) was used to determine the strength and direction of these relationships, where values close to +1 or -1 indicate strong correlations, while values close to 0 suggest weak or no correlations. Significance was tested at the 0.01 level (2-tailed). Correlation values between ± 0.1 and ± 0.29 indicate a small relationship, values between ± 0.3 and ± 0.49 indicate a medium relationship, and values of ± 0.5 and above indicate a strong relationship. Table 3 presents the results of the correlation analysis.

Table 3: Correlations Analysis

		Project sustainability	Risks monitoring
Project sustainability	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	135	
Risks monitoring	Pearson Correlation	.873**	1
	Sig. (2-tailed)	.000	
	N	135	135

** . Correlation is significant at the 0.05 level (2-tailed).

The correlation between Project sustainability and Risks monitoring was significant, with a Pearson correlation coefficient of 0.873 ($p = 0.001$), indicating a very strong positive relationship. This indicates that consistent and proactive monitoring of risks throughout the project lifecycle is very important to maintaining high project sustainability. Risks monitoring involves continuous assessment of risk triggers and the effectiveness of mitigation plans, allowing project managers to adjust strategies in real time (Roseke, 2018). The significant relationship found in this study supports the literature that identifies risks monitoring as one of the most vital components of effective risk management (Kinyua *et al.*, 2015). By consistently tracking risks, project teams can anticipate potential issues before they escalate, ensuring the project stays on track.

4.7 Regression Analysis

The study tested the null hypotheses related to the independent variable's effect on Project sustainability. The hypothesis was tested using simple regression analysis at a 95% confidence interval, with significance determined at $p < 0.05$. The hypothesis tested whether Risks Monitoring significantly affects Project sustainability. The null hypothesis stated that Risks Monitoring does not influence Project sustainability.

The results of the model summary, as shown in Table 4, indicate that the adjusted R-squared value is 0.578, suggesting that 57.8% of the variance in Project sustainability could be attributed to Risks Monitoring.

Table 4: Model Summary for Risks Monitoring and Project sustainability

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.873 ^a	0.578	0.574	0.387

a. Predictors: (Constant), Risks Monitoring

This high R-squared value in Table 4 demonstrates that risk monitoring plays a critical role in determining project success and sustainability. Risks monitoring allows project managers to track the status of risks throughout the project lifecycle, ensuring that any emerging risks are identified and managed early. Kinyua *et al.* (2015) echoed this finding in their study, stating that continuous monitoring of risks, including regular reporting to management and evaluation of risk management strategies, is vital for maintaining project control and enhancing sustainability. This supports the idea that proactive risk monitoring provides the project team with the necessary insights to adapt to changing conditions and prevent risks from escalating, hence improving overall project outcomes.

The ANOVA results in Table 5 further supported the significance of this relationship, with an F-calculated value of 68.446, which far exceeds the F-critical value of 3.912. The p-value of 0.000 confirms that the relationship between Risks monitoring and Project sustainability is statistically significant.

Table 5: ANOVA for Risks Monitoring and Project sustainability

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	16.564	1	16.564	68.446	0.000 ^b
Residual	12.100	133	0.242		
Total	28.664	134			

This significance implies that the model does not occur by random chance, reinforcing the critical role that ongoing risk monitoring plays in achieving successful project outcomes. These findings are in agreement with the literature, such as the work of Roseke (2018), who emphasized that monitoring project risks continuously ensures that risk priorities are regularly reassessed and emerging risks are quickly mitigated. By doing so, project managers can adjust their strategies in response to changes, thus ensuring projects stay on track to meet their objectives.

As indicated by the regression coefficients in Table 6, the beta coefficient for Risks Monitoring is 0.873, with a p-value of 0.000. This demonstrates that Risks Monitoring has a statistically significant and strong positive impact on Project sustainability.

Table 6: Coefficients for Risks Monitoring and Project sustainability

Model	Unstandardized	Standardized Coefficients		t	Sig.
	Coefficients	B	Beta		
(Constant)	0.591	0.591		3.629	0.000
Risks Monitoring	0.873	0.873	0.873	6.232	0.000

The regression model for Risks Monitoring is:

$$Y = 0.591 + 0.873X_1 \quad (3)$$

Where, Y = Project sustainability and X_1 = Risks Monitoring.

The coefficient indicates that for every one-unit increase in effective Risks Monitoring, Project sustainability improves by 0.873 units. These findings reject the null hypothesis and confirm that continuous risk monitoring significantly enhances project outcomes.

This conclusion aligns with Chapman and Ward's (2011) work, which emphasized that ongoing monitoring of project risks ensures that project teams can react swiftly to emerging threats, in order to prevent small issues from growing into major project disruptions. Similarly, Roseke (2018) highlights that continuous monitoring of risk triggers allows for early detection and mitigation, helping projects avoid costly delays and budget overruns.

The findings confirm that Risks Monitoring has a significant and positive impact on Project sustainability. The results show that effective and continuous risk monitoring is essential for project success. By rejecting the null hypothesis, this study provides empirical support for the argument that ongoing risk monitoring ensures emerging risks are promptly identified and addressed, improving Project sustainability. These findings align with Kinyua *et al.* (2015) and Roseke (2018), who suggest that continuous risk monitoring allows project managers to maintain control over project risks, ultimately leading to better project outcomes. By closely tracking risk triggers and responses, project teams can mitigate potential issues early, ensuring projects are completed on time, within budget, and to the desired quality standards.

5. Conclusion and Recommendations

5.1 Conclusion

This study underlines the critical role of risk monitoring in ensuring the sustainability of food security projects in Kenya's ASALs. The findings reveal that key risk monitoring components, such as developing key performance indicators ($M = 4.548$, $SD = 0.655$), implementing risk plans ($M = 4.163$, $SD = 0.891$), and analyzing risk trends ($M = 4.096$, $SD = 0.800$), significantly enhance project sustainability. The study also observed that comprehensive risk monitoring reduces project costs, improves timely implementation as evidenced by the scores, $M = 4.370$, $SD = 0.595$, and increases agricultural productivity as evidenced by the scores, $M = 4.563$, $SD = 0.568$. Stakeholder satisfaction is also positively impacted by effective risk monitoring as evidenced by the scores, $M = 4.430$, $SD = 0.641$.

The correlation analysis confirms a strong positive relationship between risk monitoring and project sustainability, with a Pearson correlation coefficient of 0.873 ($p = 0.000$). Regression analysis further supports this, with adjusted R-squared value at 0.578, suggesting that 57.8% of the variance in Project sustainability is explained by risk monitoring. Therefore, the findings reject the null hypothesis and affirm that continuous risk monitoring is essential for long-term project success. Additionally, the study highlights the diversity of agricultural value chains supported in ASAL counties, including livestock (e.g., dairy, poultry and beekeeping), high-value crops (e.g., green grams, cashew nuts, and tomatoes), and climate-smart technologies such as conservation agriculture and digital agro-weather observatories. These findings align with existing literature that emphasizes the role of risk monitoring in mitigating agricultural uncertainties, improving productivity, and ensuring project resilience.

Overall, the study concludes that integrating structured risk monitoring frameworks into food security projects is paramount for enhancing sustainability. Strengthening institutional policies, leveraging digital technologies, and promoting stakeholder engagement are key to improving risk management and driving sustainable food security development in ASALs.

5.2 Policy Recommendations

(i) Tracking Key Performance Indicators (KPIs)

- Develop and institutionalize national and county-level policy frameworks with robust Monitoring and Evaluation (M&E) systems that track project performance, risk exposure, and sustainability outcomes.
- Enforce periodic risk audits and performance reviews to ensure early detection of emerging risks and timely corrective actions.
- Integrate risk management indicators into project funding agreements to enhance accountability among donors and implementing partners.

(ii) Trend Analysis

- Establish policies that support real-time data collection and analysis systems to track climate variability, pest outbreaks, and market dynamics.
- Encourage the integration of indigenous knowledge systems with scientific data to improve prediction and response to emerging risks.

- Support capacity building for stakeholders on risk trend analysis and data-driven decision-making to enhance adaptive management.

(iii) Risk Reporting

- Develop and enforce standardized risk reporting protocols requiring regular (monthly/ quarterly) reporting to management, donors, and relevant government agencies.
- Institutionalize the use of digital reporting platforms (e.g., mobile-based systems and data dashboards) to ensure timely and transparent communication of risks.
- Establish and strengthen community and county-level risk management committees to facilitate localized risk identification, reporting, and response.
- Promote participatory monitoring and reporting approaches by involving farmers, extension officers, and local stakeholders in risk tracking processes.
- Build capacity of project staff and stakeholders on risk communication, documentation, and reporting systems.

(iv) Cross-Cutting Policy Recommendation

- Develop supportive policies for climate risk financing and agricultural insurance schemes to buffer against risks identified through monitoring systems and enhance long-term project resilience.

5.3 Operational Recommendations

(i) Tracking KPIs

- Develop and implement project-specific KPI dashboards integrating risk indicators such as yield variability, input costs, and climate exposure, with clearly assigned risk monitoring roles among project team members.
- Conduct regular performance tracking (monthly/ quarterly) to monitor sustainability and risk indicators.

(ii) Trend Analysis

- Promote the adoption of digital and climate-smart technologies such as Geographic Information Systems (GIS), mobile applications, agro-weather observatories, and remote sensing tools for continuous monitoring of environmental and production trends.
- Integrate scientific data with indigenous knowledge to improve prediction of risks such as drought and pest outbreaks.
- Conduct periodic trend reviews and scenario analysis to support adaptive planning.

(iii) Risk Reporting

- Establish standardized internal reporting systems for documenting risks, impacts, and response actions, ensuring timely communication through structured reporting cycles (weekly, monthly, quarterly).
- Use digital platforms (e.g., KoboToolbox, dashboards) for real-time reporting and decision support.
- Promote participatory reporting by involving farmers, extension officers, and community stakeholders.

(iv) Cross-Cutting Operational Actions

- Provide continuous training on risk monitoring tools and systems.
- Conduct regular field verification visits to validate reported risks.
- Integrate risk monitoring into routine project management practices.

6. Risk Monitoring & Evaluation (M&E) Plan

Objective	Indicators	Baseline	Target	Means of Verification	Frequency	Responsibility	Data Collection Method
1. Tracking Key Performance Indicators (KPIs)							
a. Water use efficiency	Volume of water used per unit area under project-supported irrigation	To be established	15% reduction in water use	Water use reports from Water Resource Authority (WRA), field visit records	Quarterly	Project M&E Officer, Field Officers	Field measurements, Farmer logs
b. Crop productivity	Crop yields (tons/ha) under project-supported interventions	To be established	20% increase in yields	Harvest reports, yield survey data	Semi-Annually	County Agricultural Officers	Farm records, Agricultural extension reports
c. Household income levels	% change in average household income of project beneficiaries	Baseline income data	25% increase in household income	Household survey reports from Kenya Bureau of Statistics, financial records	Annually	M&E Specialist	Household surveys, Income assessments
d. Adoption of Climate-Smart Practices	% of farmers adopting at least one climate-smart technology	To be established	60% adoption rate	Adoption tracking forms, photo documentation	Bi-Annually	Project Agronomist	Observations, Farmer interviews
e. Community engagement	Number of community members participating in project activities	To be established	80% participation rate	Meeting minutes, attendance sheets	Quarterly	Field Officers	Attendance records, Community meeting reports
2. Trend Analysis							
a. Seasonal risk patterns	Historical data on droughts, pests, or floods impacting project outcomes	Historical data	Annual risk trend report	Risk maps, trend charts from Kenya Meteorological Department	Annually	M&E Team, Meteorology Department	Secondary data, Meteorological reports
b. Recurrence of identified risks	Frequency of recurring risks over project duration	Existing risk data	30% reduction in recurrence	Updated risk register, trend graphs	Quarterly	Risk Management Team	Risk register analysis
c. Learning from past interventions	Number of documented lessons and adaptations	To be established	At least 5 key lessons/year	Lessons learned logs, adaptation plans	Bi-Annually	Project Coordinator	Project reports, Staff reflection sessions
3. Risk Reporting							
a. Risk register updates	Frequency & completeness of updates to the risk	Existing update cycle	100% quarterly updates	Updated risk register	Quarterly	Risk Focal Person	Document review

Objective	Indicators	Baseline	Target	Means of Verification	Frequency	Responsibility	Data Collection Method
	register						
b. Risk communication to stakeholders	Timeliness & clarity of risk reports shared with stakeholders	To be established	90% timely communication	Stakeholder communication logs, shared reports	Quarterly or As needed	Project Manager	Email records, Meeting minutes
c. Effectiveness of mitigation actions	Number of mitigated versus unmanaged risks identified	Baseline mitigation data	70% of risks mitigated	Risk audit reports	Quarterly	M&E and Risk Management Teams	Risk register review, Follow-up assessments

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