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Project Success through Risk Management Practices in Organic Pest Control Initiatives

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ABSTRACT

Effective risk management plays a vital role in the successful implementation of pest control projects, offering benefits such as improved project quality, adherence to budgets, high stakeholder satisfaction, and timely completion. Despite these benefits, challenges in managing risks within pest control projects remain, highlighting the need for a structured and proactive approach to risk management. This study aimed to explore the influence of risk management practices, specifically risk identification, assessment, response, and review, on the successful implementation of organic pest control projects in Rwanda. This study will adopt Theory of Risk Perception and contingency theory and will use both descriptive and correlational designs, targeting an estimated population of 100 respondents from Agropy Ltd, including project managers, risk management officers, field officers, Laboratory Analyst and key stakeholders. Data was collected through questionnaires, interviews, and document reviews. A pilot test was conducted with 20 respondents to determine the instrument's ability to produce consistent results over time. The reliability of the research instrument (questionnaire) was assessed using Cronbach's Alpha. Data was analyzed using descriptive and inferential statistics, including correlation and regression analysis. The findings for four hypotheses were tested at α=.05 level of significance and the results were: risk identification ($p = 0.000 < 0.05$); risk assessment ($p = 0.000 < 0.05$); risk response ($p = 0.000 < 0.05$) and; risk review and control ($p = 0.000 < 0.05$), have no significant effect on performance of projects were rejected, confirming that all the risk management practices significantly affects the implementation of pest control projects. In conclusion, the study highlights the significant positive effect of risk management practices, including risk identification, assessment, response, and review in the successful implementation of pest control projects. It is recommended that organizations strengthen their risk management frameworks, involve stakeholders early in the process, prioritize comprehensive risk assessments, establish clear risk response strategies, and continuously monitor and adapt risk control measures. Future studies could explore the role of different stakeholders in pest control projects to further enhance risk management and project success.

Introduction

Pest control is essential for global agricultural practices, directly influencing crop yields, food security, and economic stability because of increase in export. The increase in pest prevalence, driven by climate change, global trade, and evolving farming practices, poses significant risks to agricultural productivity worldwide. Effective pest management is crucial in mitigating these risks and ensuring the sustainability of the agricultural sector, which is a vital component of many economies, including Rwanda (FAO, 2023). In Asia, major agricultural economies like India, China, and Indonesia grapple with severe pest outbreaks, including the Fall Armyworm, Brown Planthopper in rice, and Tomato Leaf Miner (Tuta absoluta). These pests' impact critical crops such as rice, maize, and tomatoes, driving the adoption of Integrated Pest Management (IPM) practices. IPM strategies in these regions focus on reducing chemical pesticide use by employing biological control, crop rotation, and pest-resistant crop varieties (Zhou et al., 2022). In Australia, the management of invasive pests like the Queensland fruit fly and Red Imported Fire Ant has prompted extensive biosecurity measures, including quarantine protocols and public awareness campaigns (Australian Department of Agriculture, 2023).

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Climate change has expanded pest populations into new regions in Europe and North America, necessitating adaptive pest control measures using pesticides, fungicides and herbicides. For example, the Spotted Lantern fly, an invasive species from Asia, poses a significant threat in the United States, prompting multi-state efforts that include surveillance, chemical controls, and public education (USDA, 2023). In the European Union, the Sustainable Use Directive emphasizes non-chemical methods, promoting Integrated Pest Management/IPM to reduce pesticide use and protect the environment (Garcia, 2019). In Africa, pests like the Desert Locust, Fall Armyworm, and African Armyworm have caused severe damage, particularly to staple crops like maize in EAC region including Rwanda. The Fall Armyworm alone accounts for over USD 6 billion in annual losses across the continent (FAO, 2022). African countries such as Kenya, Nigeria, and South Africa have implemented comprehensive pest management strategies, including national surveillance systems, biological controls, and IPM training for farmers. However, challenges like limited access to modern technologies, inadequate farmer training, and insufficient funding continue to hinder effective pest control (Mutua & Kamau, 2021).

Rwanda, where agriculture contributes over 30% of the GDP and employs a significant portion of the population (NISR, 2023), has faced similar pest challenges. Outbreaks of the Fall Armyworm, Banana Bacterial Wilt, and Coffee Berry Disease have severely impacted both staple and cash crops, highlighting the need for robust pest control strategies (RAB, 2021). Rwanda's pest control projects encounter issues such as limited access to modern technologies, inadequate funding, insufficient farmer training, and weak stakeholder coordination (Nshimiyimana, 2022). Efforts to address these challenges include initiatives like the Crop Protection Project under the Rwanda Agriculture and Animal Resources Development Board (RAB) in its different departments. This project focuses on reducing crop losses through training farmers in IPM techniques, providing access to pest-resistant seeds, and implementing early warning systems for pest outbreaks (RAB, 2022). Risk management strategies, including IPM, the use of resistant crop varieties, biological controls, and selective pesticide application, are critical for the success of these projects (World Bank, 2023). Additionally, financial instruments like agricultural insurance and risk-sharing mechanisms are essential in helping farmers recover from pest-related losses (Nkurunziza & Habimana, 2018).

Despite these initiatives, significant gaps remain in risk management practices. Many farmers lack adequate training and access to financial products, hindering the effective adoption of IPM and other strategies like indoor space farming to prevent pests from becoming a threat. The absence of widespread agricultural insurance exacerbates farmers' vulnerability to financial losses from pest outbreaks, impacting the overall success of pest control projects (Karangwa, 2017). This study aims to assess the effect of risk management strategies on the implementation of pest control projects in Rwanda. By examining the effectiveness of these approaches and identifying existing challenges, the research provides insights into enhancing the resilience and sustainability of pest control initiatives. The findings are expected to contribute to improved agricultural productivity, food security, and economic development in Rwanda. The study was organized into introduction, literature review, findings and discussion, and conclusion.

Literature Review

Theoretical Review

This study was based on theory of Risk Perception and Contingency theory**:**

Theory of Risk Perception

The Theory of Risk Perception, developed by Paul Slovic in 1987, explores how individuals and groups perceive, evaluate, and respond to risks, emphasizing the subjective nature of risk assessment. Unlike traditional models that assume objective decision-making based solely on statistical data, Slovic's theory highlights that personal experiences, knowledge, culture, emotions, and cognitive biases heavily influence how risks are perceived. Factors such as experience and knowledge play a significant role, as individuals with more expertise in a particular field tend to assess risks differently compared to those with limited exposure. For instance, farmers experienced in pest management may evaluate the threat of pest outbreaks more accurately compared to stakeholders unfamiliar with agricultural challenges.

Cultural and social factors also shape risk perception, as cultural beliefs, societal norms, and community values influence the prioritization of different risks. People from different cultural backgrounds may perceive certain risks as more severe due to their unique societal context (Slovic, 1987). Emotions, such as fear, anxiety, or optimism, further impact risk perception, often leading individuals to react more strongly to risks that evoke strong emotional responses, even when those risks are statistically less significant. Additionally, cognitive biases like availability bias—the tendency to overestimate the likelihood of events based on recent experiences—and framing effects, where the presentation of information affects decision-making, are central elements of the theory (Slovic, 1987).

In the context of pest control projects like Organic Pest Control Project, these dynamics significantly influence the implementation of risk mitigation strategies. For example, farmers who have not faced severe pest outbreaks may underestimate the potential risks posed by certain pests, which could lead to delayed or insufficient pest control measures. Conversely, stakeholders may overestimate the risks associated with using chemical pesticides due to concerns about health and environmental impacts, potentially influenced by media reports and public discourse. This perception could result in resistance to pesticide use or a preference for alternative methods, even if these alternatives are less effective (Slovic, 1987).

Understanding these varied perceptions is crucial for project managers and implementers, as it allows them to tailor communication strategies effectively, providing clear and evidence-based information to address concerns and improve stakeholder engagement. By acknowledging and addressing these perceptions, the AGROPY LTD can facilitate better adoption of pest management practices, reduce misinformation, and align risk mitigation strategies with the stakeholders' beliefs and risk tolerance. Overall, the Theory of Risk Perception offers valuable insights for managing expectations and enhancing the effectiveness of risk management practices in pest control projects, making it a critical tool in understanding and addressing the challenges posed by varying perceptions of risk.

Contingency Theory

Contingency Theory, introduced by Fred Fiedler in 1964, suggests that there is no single, universal approach to management that applies to every situation. Instead, the effectiveness of a management strategy depends on various internal and external factors influencing the organization or project. Fiedler argued that rather than relying on fixed rules, managers should be flexible and adapt their approach based on specific circumstances. These factors can include the type of task, the working environment, the skills and personalities of team members, as well as broader influences like market conditions or regulatory requirements (Fiedler, 1964). In the context of risk management, Contingency Theory implies that strategies should be customized to fit the unique conditions of each project. It emphasizes the need to adapt management styles, processes, and risk mitigation techniques according to the situational variables at play, rather than applying a one-size-fits-all method. The theory highlights the importance of assessing the project environment, identifying key factors that could affect performance, and designing management practices that align with these variables to achieve optimal results (Fiedler, 1964).

The Agropy Ltd in Rwanda can greatly benefit from the principles of Contingency Theory, particularly in its approach to managing risks associated with pest control as a company dealing with Pyrethrum based Pesticides. The project encounters various situational factors, such as geographical differences, diverse pest species, changing weather patterns, and varying levels of stakeholder involvement, all of which can impact risk levels. For instance, different regions may have distinct pest populations and farming practices, requiring tailored pest control strategies. A method effective in the Eastern Province might not be suitable for the Northern Province due to differences in climate and crop types.

The type of pest also plays a critical role in determining the appropriate risk mitigation strategy. The methods for managing locust infestations may differ significantly from those used to control aphids or other crop-damaging insects that happened in Kenya where Locusts were controlled by using Airplanes but this will not be possible in Rwanda base on the country land size. Weather patterns, such as unexpected rainfall or drought, can affect pest activity and the effectiveness of control measures. Therefore, the project team must be prepared to adjust their strategies based on current and forecasted weather conditions. Additionally, the level of engagement and cooperation from local farmers and stakeholders can vary. In some areas, farmers may be open to using pesticides, while in others, there may be a preference for organic methods due to health or environmental concerns. By applying the principles of Contingency Theory, the Agropy Ltd management team can assess these situational factors and develop flexible, adaptive risk management practices. This approach increases the chances of success by aligning strategies with the unique challenges and opportunities present in each context. Instead of employing a standardized pest control method, the project can utilize a dynamic management style that responds to the specific needs of different regions and stakeholder groups. This flexibility improves the project's effectiveness in mitigating pest risks and achieving its objectives

Empirical Review

Risk Identification and Implementation of Pest Control Projects

Risk identification is the foundational step in managing risks, allowing project teams to recognize potential threats to project success early on. A study by Harris et al. (2016) on pest control in the United States examined risk identification practices and found that pest outbreaks were often underreported due to inadequate communication systems between farmers and pest control authorities. The study suggested that developing early-warning systems and integrating modern technologies such as remote sensing could improve the identification of pest risks.

In Uganda, a study by Amooti et al. (2018**)** highlighted the challenges in pest risk identification in agriculture, focusing on locust infestations. They found that local farmers had limited knowledge of pest behavior and lacked formal risk identification processes. As a result, pest outbreaks were often not addressed promptly, leading to significant crop damage. This case emphasizes the importance of training farmers and establishing local monitoring networks to improve the identification and improvement of Organic Pest Control in Rwanda.

Similarly, Organic Pest Control Project in Rwanda has implemented community-based risk identification practices (RAB, 2019). Regular surveys and participatory approaches are employed to track pest species and assess emerging threats and improves its pesticide production technicalities. The study suggests that more accurate and context-specific risk identification mechanisms, such as farmer-led pest monitoring systems, can enhance pest control efforts. Agropy Ltd as a company will have to copy other new modern technology used in pest control management.

Risk Assessment and Implementation of Pest Control Projects

Once risks are identified, assessing their potential impact is crucial to prioritize and allocate resources effectively. A case study by Kabeza et al. (2018) on pest management in Rwanda found that pest risk assessments were conducted using qualitative methods, but they often lacked integration with quantitative tools. The study suggested that incorporating GIS technology and climate modeling would enhance the accuracy of pest risk assessments, enabling more targeted pest control strategies.

In Kenya**,** Mutisya et al. (2020) investigated pest risk assessment techniques used in horticulture, specifically in managing the invasive fall armyworm. They found that pest risk assessments focused primarily on the current impact of pests but often neglected to account for future risk scenarios such as climate change. The study emphasized the need for dynamic risk assessment frameworks that consider both current and future pest threats. This aligns with the recommendations for the Agropy Ltd to include predictive modeling and climate scenarios in its pest risk assessments. The Agropy Ltd in Rwanda has adopted a more dynamic approach to risk assessment by utilizing both historical data and current pest monitoring systems. This integrated approach allows for better anticipation of pest behavior and more informed decision-making.

In Brazil**,** Da Silva et al. (2018) examined the use of GIS in assessing the spread of agricultural pests in large-scale farming. The study found that GIS-based risk assessment models helped identify high-risk areas for pest infestations and enabled the efficient allocation of resources. Applying similar GIS technology to the Organic Pest Control in Rwanda could enhance risk assessment by providing spatial data on pest distribution and helping to identify vulnerable areas.

Risk response and Implementation of Pest Control Projects
Risk response refers to the strategies implemented to manage identified and assessed risks. A study by Niyigena et al. (2019) on pest management strategies in Rwanda highlighted the use of integrated pest management (IPM) practices as an effective risk response. The study emphasized that IPM, which combines biological, cultural, mechanical, and chemical controls, reduced the dependency on pesticides and minimized environmental damage. This approach has been widely adopted by the Agropy Ltd, which promotes IPM techniques among local farmers.

In South Africa**,** van der Linde et al. (2020) conducted a case study on the implementation of pest control measures in the wine industry. They found that risk responses were largely reactive, relying on chemical control methods after pest outbreaks. The study concluded that proactive risk responses, such as early pest detection systems and preventive measures, were more effective in mitigating pest risks. This finding supports the Agropy Ltd's focus on prevention and preparedness through early warning systems and farmer education

In Mexico**,** Rodriguez et al. (2021) examined the use of biological pest control methods, specifically the introduction of natural predators, to manage pest risks in agriculture. The study found that biological control reduced the reliance on chemical pesticides, leading to long-term sustainability and reduced environmental impact. The AGROPY project could expand its biological control initiatives by promoting natural pest predators as part of its risk response strategies

Risk review and Control and Implementation of Pest Control Projects
Risk review and control involve continuously monitoring risks and adjusting strategies as necessary throughout the project. In Australia**,** Robinson et al. (2019**)** investigated the role of risk review and control in pest management programs in agriculture. They found that regular field audits and the involvement of local stakeholders in reviewing pest management strategies significantly improved the effectiveness of the program. This participatory approach to risk review was found to be particularly useful in improving community engagement and fostering trust among stakeholders.

In Spain**,** Gonzalez et al. (2020) examined pest control programs in the citrus industry and found that continuous risk reviews, coupled with adaptive management practices, led to a 30% reduction in pest-related losses. The study also found that involving local farmers in the review process helped improve the accuracy of pest data and facilitated the adoption of new risk management practices. This participatory review model could be applied to the Agropy Ltd to enhance local ownership and improve pest control outcomes.

Twagirayezu et al. (2020) highlighted that the project team conducts quarterly reviews of pest control activities, incorporating farmer feedback, pest data, and climate forecasts to adjust strategies. This continuous review process ensures that pest control measures are adapted to changing conditions and that new risks are addressed in a timely manner.

Methodology

The study adopted a descriptive and correlational research designs with questionnaire and interview guide for data collection from a census of 100 respondents. A pilot study involved 20 respondents for a reliability test through Cronbach's Alpha yielded a coefficient of 0.772 while the validity was tested through expert opinion that yielded a coefficient of 0.75. The data analysis techniques employed in this study included descriptive and inferential statistics of correlation and regression.

The simple regression model: $Y = \beta_0 + \beta_1 X_{1+} + \varepsilon$
Then a multiple regression analysis: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$

Findings and Discussion

Out of the sampled 100 participants, 89 returned duly filled and complete questionnaires, which represents an 89% return rate.

Risk Identification and Implementation of Pest Control Projects
Relationship between Risk Identification and Implementation of Pest Control Projects
A correlation analysis aimed to determine whether there is a relationship between risk identification and the successful implementation of pest control projects.

Table 1: Relationship between Risk Identification and Implementation of Pest Control Projects

		Risk Identification	Implementation of Pest Control Projects
Risk Identification	Pearson Correlation	1	.830**
	Sig. (2-tailed)		.000
	N	89	89
Implementation of Pest Control Projects	Pearson Correlation	.830**	1
	Sig. (2-tailed)	.000	
	N	89	89

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Author, 2025

The correlation results in Table 1 show a very strong positive correlation (R = 0.830) between Risk Identification and the Implementation of Pest Control Projects, which is statistically significant ($p = 0.000 < 0.05$). This indicates that as the effectiveness of risk identification increases, the successful implementation of pest control projects also improves to a significant extent. This finding aligns with recent research by Hillson (2017), who emphasized the critical role that early and continuous risk identification plays in the successful execution of projects. The high correlation between these two variables demonstrates that a well-structured risk identification process is integral to ensuring the effective management and implementation of pest control projects, further supporting the notion that identifying risks early on enhances overall project success.

Effect of Risk Identification on Implementation of Pest Control Projects

A regression analysis sought to determine the linear effect of risk identification on the successful implementation of pest control projects.

Table 2: Effect of Risk Identification on Implementation of Pest Control Projects

Model	**R**	**R Square**		**Adjusted R Square**		**Std. Error of the Estimate**	
Summary	.830[a]	.689		.685		.45907	
Model		**Sum of Squares**		**Df**	**Mean Square**	**F**	**Sig.**
ANOVA	Regression	40.609		1	40.609	192.690	.000[b]
	Residual	18.335		87	.211		
	Total	58.944		88			
Model		Unstandardized Coefficients			Standardized Coefficients	T	Sig.
		B	Std. Error		Beta		
Coefficients	(Constant)	1.165	.225			5.178	.000
	Risk Identification	.735	.053		.830	13.881	.000

a. Dependent Variable: Implementation of Pest Control Projects

b. Predictors: (Constant), Risk Identification

Source: Author, 2025

From the output in Table 2, the model summary shows an R^2 value of 0.689, with a p-value of 0.000<0.05, indicating that Risk Identification accounts for 68.9% of the variation in the Implementation of Pest Control Projects. This suggests a strong relationship between Risk Identification and the effectiveness of pest control project implementation. The model is a good fit for the data, as shown by the F-value of 192.690 ($p = 0.000$, $p < 0.05$).

The coefficient of the constant term ($\beta = 1.165$, $p = 0.000<0.05$) and the coefficient for Risk Identification ($\beta = 0.735$, $p = 0.000<0.05$) are both statistically significant. This means that for every unit increase in Risk Identification, the Implementation of Pest Control Projects increases by 0.735 units.

The relationship between Risk Identification and the Implementation of Pest Control Projects can be expressed using the equation:

$Y = 1.165 + 0.735 X_1$

This equation shows that effective Risk Identification significantly enhances the Implementation of Pest Control Projects, underlining the importance of identifying risks early in the project cycle for improved outcomes.

Test for Hypothesis One

H_{01}: Risk identification has no significant effect on the implementation of pest control projects in Rwanda; was rejected ($p = 0.000<0.05$). Thus, risk identification has a significant effect on the implementation of pest control projects in Rwanda.

Risk Assessment and Implementation of Pest Control Projects

A correlation analysis was to determine the influence of risk assessment on implementation of pest control projects in Rwanda.

Table 3: Relationship between Risk Assessment and Implementation of Pest Control Projects

		Risk Assessment	Implementation of Pest Control Projects
Risk Assessment	Pearson Correlation	1	.680**
	Sig. (2-tailed)		.000
	N	89	89
Implementation of Pest Control Projects	Pearson Correlation	.680**	1
	Sig. (2-tailed)	.000	
	N	89	89

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Author, 2025

The correlation results in Table 3 show that there is a moderate positive correlation (R = 0.680) between Risk Assessment and the Implementation of Pest Control Projects, which is statistically significant ($p = 0.000 < 0.05$). This indicates that Risk Assessment and the Implementation of Pest Control Projects are statistically moderately and positively correlated such that as Risk Assessment improves, the Implementation of Pest Control Projects also increases to a substantial extent. This is in line with previous studies, such as those by Thomas et al. (2016), who found a significant relationship between effective risk assessment and the successful implementation of pest control initiatives. The results suggest that incorporating comprehensive risk assessments contributes significantly to the successful implementation of pest control projects. However, there remains a need for further optimization of risk management practices to maximize the effectiveness of pest control interventions, thereby improving both efficiency and outcomes in the implementation of pest control projects.

Effect of Risk Assessment on Implementation of Pest Control Projects

A regression analysis sought to determine the linear effect of risk assessment on the successful implementation of pest control projects.

Table 4: Effect of Risk Assessment on Implementation of Pest Control Projects

Model	R	R Square		Adjusted R Square	Std. Error of the Estimate	
Summary	.680[a]	.463		.457	.60317	
Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
ANOVA	Regression	27.292	1	27.292	75.017	.000[b]
	Residual	31.652	87	.364		
	Total	58.944	88			
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
Coefficients	(Constant)	1.694	.298		5.686	.000
	Risk Assessment	.621	.072	.680	8.661	.000

a. Dependent Variable: Implementation of Pest Control Projects

b. Predictors: (Constant), Risk Assessment

Source: Author, 2025

From the output in Table 4.15, the model summary shows an R^2 value of 0.463 with a p-value of 0.000<0.05, indicating that Risk Assessment accounts for 46.3% of the variation in the Implementation of Pest Control Projects. This suggests a strong relationship between Risk Assessment and the effectiveness of pest control project implementation. The model is a good fit for the data, as indicated by the F-value of 75.017 ($p = 0.000$, $p < 0.05$). The coefficient of the constant term ($\beta = 1.694$, $p = 0.000<0.05$) and the coefficient for Risk Assessment ($\beta = 0.621$, $p = 0.000<0.05$) are both statistically significant. This means that for every unit increase in Risk Assessment, the Implementation of Pest Control Projects increases by 0.621 units. The relationship between Risk Assessment and the Implementation of Pest Control Projects can be expressed using the equation:

$Y = 1.694 + 0.621 X_2$

This equation shows that effective Risk Assessment significantly enhances the Implementation of Pest Control Projects, emphasizing the importance of a thorough evaluation and management of risks in pest control initiatives.

Test for Hypothesis Two

H_02: Risk assessment has no significant effect on the implementation of pest control projects in Rwanda; was rejected ($p = 0.000<0.05$). Thus, risk assessment has a significant effect on the implementation of pest control projects in Rwanda.

Risk Response and Implementation of Pest Control Projects

Relationship between Risk Response and Implementation of Pest Control Projects

A correlation analysis aimed to determine whether there is a relationship between Material and equipment resource planning and Success of Construction Projects.

Table 5: Relationship between Risk Response and Implementation of Pest Control Projects

		Risk Response	Implementation of Pest Control Projects
Risk Response	Pearson Correlation	1	.661**
	Sig. (2-tailed)		.000
	N	89	53
Implementation of Pest Control Projects	Pearson Correlation	.661**	1
	Sig. (2-tailed)	.000	
	N	89	89

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Author, 2025

The correlation results in Table 5 show that there is a moderate positive correlation (R = 0.661) between Risk Response and the Implementation of Pest Control Projects, which is statistically significant ($p = 0.000 < 0.05$). This indicates that Risk Response and the Implementation of Pest Control Projects are statistically moderately and positively correlated such that as Risk Response strategies become more effective, the Implementation of Pest Control Projects also improves to a considerable extent. This finding aligns with previous research, such as that by Jackson et al. (2018), which emphasized the importance of responsive strategies in enhancing pest control project outcomes. The results suggest that the ability to respond effectively to risks plays a critical role in ensuring the successful implementation of pest control initiatives. However, it is essential to further refine risk response mechanisms to optimize the efficiency and success of pest control efforts, ensuring both sustainability and effectiveness in dealing with emerging pest threats.

Effect of Risk Response on Implementation of Pest Control Projects

A regression analysis sought to determine the linear effect of risk response on the successful implementation of pest control projects.

Table 6: Effect of Risk Response on Implementation of Pest Control Projects

Model	**R**	**R Square**		**Adjusted R Square**		**Std. Error of the Estimate**	
Summary	.661[a]	.437		.431		.61757	
Model		**Sum of Squares**		**Df**	**Mean Square**	**F**	**Sig.**
ANOVA	Regression	25.762		1	25.762	67.547	.000[b]
	Residual	33.182		87	.381		
	Total	58.944		88			
Model		Unstandardized Coefficients			Standardized Coefficients	T	Sig.
		B	Std. Error		Beta		
Coefficients	(Constant)	1.369	.352			3.887	.000
	Risk Response	.654	.080		.661	8.219	.000

a. Dependent Variable: Implementation of Pest Control Projects

b. Predictors: (Constant), Risk Response

From the output in Table 6, the model summary shows an R^2 value of 0.648 with a p-value of 0.000<0.05, indicating that Risk Review and Control accounts for 64.8% of the variation in the Implementation of Pest Control Projects. This indicates a strong relationship between Risk response and the effectiveness of pest control implementations. The model is a good fit for the data, with an F-value of 160.05 ($p = 0.000$, $p < 0.05$).

The coefficient of the constant term ($B = 1.287$, $p = 0.000<0.05$) and the coefficient for Risk Response ($\beta = 0.675$, $p = 0.000<0.05$) are both statistically significant. This means that for every unit increase in Risk Response strategies, the Implementation of Pest Control Projects increases by 0.675 units. The relationship between Risk Response and the Implementation of Pest Control Projects can be expressed with the equation:

$$Y = 1.287 + 0.675 X_3$$

This equation demonstrates that effective Risk Response significantly enhances the Implementation of Pest Control Projects, underscoring the importance of systematic risk management practices in improving pest control efforts

Test for Hypothesis Three

H_03: Risk response has no significant impact on the implementation of pest control projects in Rwanda; was rejected ($p = 0.000<0.05$). Thus, risk response has a significant impact on the implementation of pest control projects in Rwanda.

Risk Review and Control and Implementation of Pest Control Projects

Relationship between Risk Review and Control and Implementation of Pest Control Projects

A correlation analysis aimed to determine whether there is a relationship between Risk Review and Implementation of Pest Control Projects.

Table 7: Relationship between Risk Review on Control and Implementation of Pest Control Projects

		Risk Review and Control	**Implementation of Pest Control Projects**
Risk Review and Control	Pearson Correlation	1	.805**
	Sig. (2-tailed)		.000
	N	89	89
Implementation of Pest Control Projects	Pearson Correlation	.805**	1
	Sig. (2-tailed)	1	
	N	89	89

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Author, 2024

The correlation results in Table 7 show that there is a very strong positive correlation (R = 0.805) between Risk Review and Control and the Implementation of Pest Control Projects, which is statistically significant (p = 0.000 < 0.05). This indicates that Risk Review and Control and the Implementation of Pest Control Projects are statistically strongly and positively correlated such that as Risk Review and Control practices become more robust, the Implementation of Pest Control Projects also improves to a significant extent. This finding is consistent with research such as that by Zhang et al. (2020), who highlighted the critical role of continuous risk review and control in ensuring the effective execution of pest control projects. The results suggest that proactive and systematic risk review and control mechanisms are vital for the successful implementation of pest control strategies. Furthermore, refining these practices could enhance the overall effectiveness of pest control initiatives, ensuring more sustainable outcomes and better adaptation to changing pest dynamics.

Effect of Risk Review and Control on Implementation of Pest Control Projects
A regression analysis sought to determine the linear effect of risk review and control on the successful implementation of pest control projects.

Table 8: Effect of Risk Review and Control on Implementation of Pest Control Projects

Model	**R**	**R Square**		**Adjusted R Square**		**Std. Error of the Estimate**	
Summary	.805a	.648		.644		.48850	
Model		**Sum of Squares**		**Df**	**Mean Square**	**F**	**Sig.**
ANOVA	Regression	38.183		1	38.183	160.05	.000b
	Residual	20.761		87	.239		
	Total	58.944		88			
Model		Unstandardized Coefficients			Standardized Coefficients	T	Sig.
		B	Std. Error		Beta		
Coefficients	(Constant)	1.287	.237			5.431	.000
	Risk Review and Control	.675	.053		.805	12.649	.000

a. Dependent Variable: Implementation of Pest Control Projects
b. Predictors: (Constant), Risk Review and Control
Source: Author, 2025

From the output in Table 8, the model summary gives an R^2 value of 0.648 with a p-value of 0.000<0.05, indicating that Risk Review and Control accounts for 64.8% of the variation in the Implementation of Pest Control Projects. This shows a strong relationship between the two variables. Furthermore, the model was found to be a good fit for the data, as evidenced by the F-value of 160.05 with p = 0.000 (p < 0.05).

The coefficient of the constant term (B = 1.287, p = 0.000<0.05) and the coefficient for Risk Review and Control (β = 0.675, p = 0.000<0.05) are both statistically significant. This means that for every unit increase in the effectiveness of Risk Review and Control, the Implementation of Pest Control Projects increases by 0.675 units. The relationship between Risk Review and Control and the Implementation of Pest Control Projects can be modeled with the equation:

$$Y = 1.287 + 0.675 X_4$$

This equation shows that effective Risk Review and Control significantly improves the Implementation of Pest Control Projects, reinforcing the importance of comprehensive risk management strategies in pest control initiatives.

Test for Hypothesis Four
H_04: Risk review and control has no significant effect on the implementation of pest control projects in Rwanda; was rejected (p = 0.000<0.05). Thus, risk review and control has a significant effect on the implementation of pest control projects in Rwanda.

Influence of Combined Risk Management Practices on Implementation of Pest Control Projects
A multiple regression assessed the combined effect of Risk Management Practices and Implementation of Pest Control Projects.

Table 9: Influence of Combined Risk Management Practices on Implementation of Pest Control Projects

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate		
Summary	.895[a]	.801	.792	.37350		
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
ANOVA	Regression	47.226	4	11.806	84.632	.000[b]
	Residual	11.718	84	.140		
	Total	58.944	88			

Coefficients		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
Model	(Constant)	.325	.235		1.379	.171
	Risk Identification	.403	.065	.455	6.190	.000
	Risk Assessment	.138	.063	.151	2.203	.030
	Risk Response	.157	.064	.159	2.455	.016
	Risk Review and Control	.225	.072	.268	3.123	.002

a. Dependent Variable: Implementation of Pest Control Projects

b. Predictors: (Constant), Risk Review and Control, Risk Response, Risk Assessment, Risk Identification

Source: Author, 2025

From the output in Table 9, the model summary indicates an R^2 value of 0.801 with $p = 0.000 < 0.05$, suggesting that the combined risk management practices (Risk Identification, Risk Assessment, Risk Response, and Risk Review and Control) explain 80.1% of the variation in the implementation of pest control projects. This indicates that the independent variables have a strong explanatory power in predicting the dependent variable. Additionally, the F-statistic (4, 84) = 84.632 ($p = 0.000 < 0.05$) confirms that the regression model is a good fit for the data.

The constant term has a coefficient of $\beta = 0.325$ ($p = 0.171 > 0.05$), suggesting that the baseline level of pest control project implementation (when no risk management practices are applied) is not significantly different from zero. Risk Identification has the highest coefficient, with $\beta = 0.403$ ($p = 0.000 < 0.05$), indicating that for every unit increase in risk identification, the implementation of pest control projects improves by 0.403 units. This highlights the critical role of identifying risks in successful pest control project implementation.

Risk Assessment shows a significant positive effect with a coefficient of $\beta = 0.138$ ($p = 0.030 < 0.05$). A unit increase in risk assessment leads to a 0.138-unit improvement in project implementation, underscoring the importance of evaluating risks in the pest control process.

Risk Response also significantly influences the implementation of pest control projects with a coefficient of $\beta = 0.157$ ($p = 0.016 < 0.05$). This suggests that responding to identified risks improves project implementation by 0.157 units.
Risk Review and Control has a coefficient of $\beta = 0.225$ ($p = 0.002 < 0.05$), showing that periodic reviews and control measures positively impact the project by 0.225 units. Thus, the regression model for the combined effect of risk management practices on project implementation is given by:

$$Y = 0.325 + 0.403X_1 + 0.138X_2 + 0.157X_3 + 0.225X_4 + \varepsilon$$

This analysis demonstrates that Risk Identification, Risk Assessment, Risk Response, and Risk Review and Control all significantly and positively affect the implementation of pest control projects. These findings suggest that a comprehensive approach to risk management is crucial for successful pest control project outcomes. Each of the risk management practices plays a key role in improving project implementation, with Risk Identification and Risk Review and Control having the largest coefficients in this context.

Conclusions

The study concludes that effective risk management practices significantly contribute to the successful execution of these projects. With high ratings for quality, budget control, stakeholder satisfaction, and timely project completion, risk management plays a critical role in ensuring positive outcomes. A formal and continuous process of risk identification, with strong stakeholder involvement and data-driven approaches, is essential for the successful implementation of pest control projects. The study confirms that robust risk identification practices lead to more effective project execution. Comprehensive risk assessments, considering both likelihood and impact, and involving key stakeholders, significantly enhance project success. The early application of these assessments contributes to more effective risk management throughout the project lifecycle. Having clear strategies for mitigating risks, prioritizing high-risk areas, and ensuring effective communication and monitoring of these strategies, is vital for improving project outcomes. Strong risk responses correlate with enhanced project success and timely adjustments to emerging challenges. Continuous risk monitoring, feedback integration, and proactive preventive measures are fundamental to the effective implementation of pest control projects. The findings highlight the importance of adaptive management practices in ensuring the sustainability and success of these projects.

Organizations should continuously strengthen their risk management frameworks by adopting comprehensive, proactive strategies. Regular training and capacity-building programs should be implemented to ensure that all project stakeholders are well-equipped to handle risks effectively throughout the lifecycle of pest control projects. Future research could examine the role of different stakeholders (e.g., government agencies, local farmers, and NGOs) in pest control projects and how their engagement influences risk management and project outcomes. Understanding the perspectives and engagement strategies of these stakeholders will contribute to more effective risk identification and response strategies.

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