Eastern African Journal of Humanities and Social Sciences
Vol. 5 No. 2 (2026): ISSN (Online): 2958-4558
DOI: https://doi.org/10.58721/ndbky252
Smallholder farmers Adoption of Integrated Pest Management Practices under Changing Climate in Morogoro District Council, Tanzania

Smallholder farmers Adoption of Integrated Pest Management Practices under Changing Climate in Morogoro District Council, Tanzania

Isdory Mligo
The Mwalimu Nyerere Memorial Academy, Tanzania

Article History
Received: 2025-01-28
Revised: 2026-07-14
Accepted: 2026-07-28
Published: 2026-08-02

Keywords
Crop farming
Climate
Pest management
Smallholder farmers

How to cite:
Mligo, I. (2026). Smallholder farmers Adoption of Integrated Pest Management Practices under Changing Climate in Morogoro District Council, Tanzania. *Eastern African Journal of Humanities and Social Sciences*, *5*(2), 415-428.

Copyright © 2026

Abstract
Climate variability in Morogoro District has increased pest occurrence and reduced crop productivity. Despite government efforts to promote integrated pest management (IPM), adoption among farmers remains constrained. This study aimed to understand smallholder farmers adoption of IPM practices under changing climate in Morogoro District, Tanzania. A convergent parallel mixed-methods research design was employed. Simple random sampling was used to select 387 household heads engaged in crop farming. Purposive sampling was used to select 8 key informants for in-depth interviews and 24 participants for focus group discussions. The in-depth interview with key informants, focus group discussions and a household questionnaire survey were used to collect data. Descriptive and inferential statistical techniques were used to analyses quantitative data on farmers' perceptions of IPM and factors influencing IPM adoption using the IBM SPSS Statistics Version 20, while qualitative data were analysed using content analysis through NVivo Version 11. The results indicated that respondents had a moderate perception of IPM practices, with an overall mean score of 3.04. The most adopted IPM practices among farmers included crop rotation, resistant crop varieties, intercropping, and careful pesticide use. The binary logistic regression model results show that education, sex, access to extension services, membership in farmer groups, and access to financial support significantly ($p < 0.05$) influenced the adoption of IPM practices. The study concludes that farmers in Morogoro District had moderate perceptions and adoption of IPM practices. It recommends that the government strengthen extension services, financial support, and climate-responsive interventions to enhance farmers' IPM adoption.

Introduction

Agriculture is central to global food security and rural livelihoods, yet climate change and variability have altered rainfall patterns and increased temperatures, creating favourable conditions for pest outbreaks that reduce crop productivity (Sekabira et al., 2022). Most farmers continue to rely on chemical pesticides, despite their adverse effects on the environment, human health, and pest resistance. Recently, Integrated Pest Management (IPM) has gained global recognition as a sustainable approach that combines cultural, mechanical, biological, and chemical methods to manage pest populations. Brown (2024) found that IPM adoption improves crop productivity while reducing environmental impacts, particularly under changing climatic conditions.

In Africa, agriculture supports over 60% of the population and contributes significantly to national economies. However, climate change and variability, characterised by shifting rainfall patterns, rising temperatures, and extreme weather events, have increased pest outbreaks and reduced crop yields. African farmers also rely primarily on chemical pesticides to control pests, leading to environmental degradation and threats to human health. Although IPM has improved pest control and reduced chemical use in some African countries, adoption remains low because of limited awareness, weak extension services, and socio-economic constraints (Richard1 & Kobusingye, 2025).

In Tanzania, agriculture remains a backbone of the economy, contributing significantly to both national food security and rural livelihoods (Mafie, 2022). Morogoro District is an important food-producing area, but climate variability has increased pest occurrence and reduced crop yields (George, 2024). Despite efforts by the government and development partners to promote IPM, its adoption remains constrained. This study examined farmers' perceptions of IPM, the IPM practices adopted by smallholder farmers, and the socio-economic and institutional factors influencing adoption in Morogoro District.

Theoretical Framework

The study was guided by the Diffusion of Innovations (DOI) Theory, which explains how innovations are communicated and adopted within a social system (Backer & Rogers, 1998). According to the theory, the adoption of an innovation is influenced by its perceived relative advantage, compatibility with existing farming practices, complexity, trialability, and observability. Farmers are more likely to adopt an innovation when they perceive it as beneficial, compatible with their needs and farming systems, easy to understand and implement, testable on a small scale, and capable of producing visible results. In this study, IPM is considered an innovation whose adoption is influenced by farmers' perceptions, socio-economic characteristics, and institutional factors.

Conceptual Framework

In this study, the conceptual framework assumes that changing climatic conditions influence the emergence and distribution of crop pests and diseases. These changes shape farmers' perceptions of Integrated Pest Management (IPM) as a sustainable approach to pest control. The adoption of IPM practices such as is determined by farmers' socio-economic characteristics (such as education and farm size) and institutional factors (such as access to extension services, credit, and membership in farmer groups). The interaction of these factors determines the extent to which smallholder farmers adopt IPM practices under changing climatic conditions.

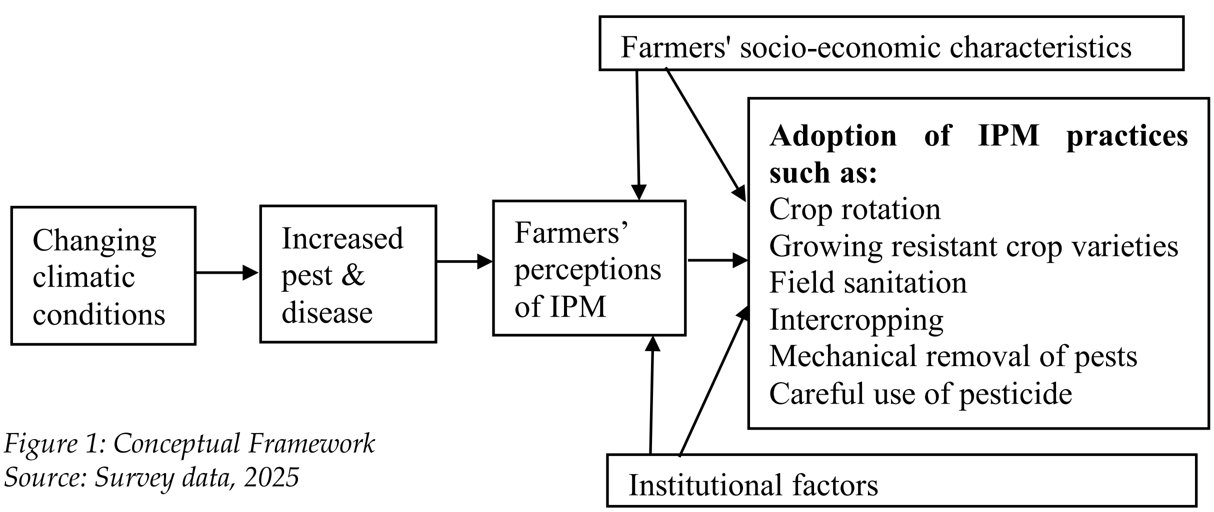

Figure 1: Conceptual Framework
Source: Survey data, 2025

Eastern African Journal of Humanities and Social Sciences
Vol. 5 No. 2 (2026): ISSN (Online): 2958-4558
DOI: https://doi.org/10.58721/ndbky252

Methodology

This study employed a convergent parallel mixed-methods research design to investigate the adoption of Integrated Pest Management (IPM) practices among smallholder farmers in Morogoro District Council under changing climate conditions. The design was appropriate because it enabled the concurrent collection and analysis of quantitative and qualitative data on farmers' perceptions of IPM practices, their level of adoption, and the factors influencing adoption.

The research was conducted in the Morogoro District Council, specifically in the Mkambalani and Mikese wards. The district is located between latitudes 6^{0}00′00′′ and 8^{0}00′00′′ south of the Equator, and between longitudes 37^{0}00′00′′ and 39^{0}00′00′′ east of the Greenwich Meridian. The district is predominantly rural, with crop production being a major livelihood activity. Climate variability in the area, including irregular rainfall and rising temperatures, has affected pest prevalence and crop productivity, making it a suitable context for studying IPM adoption.

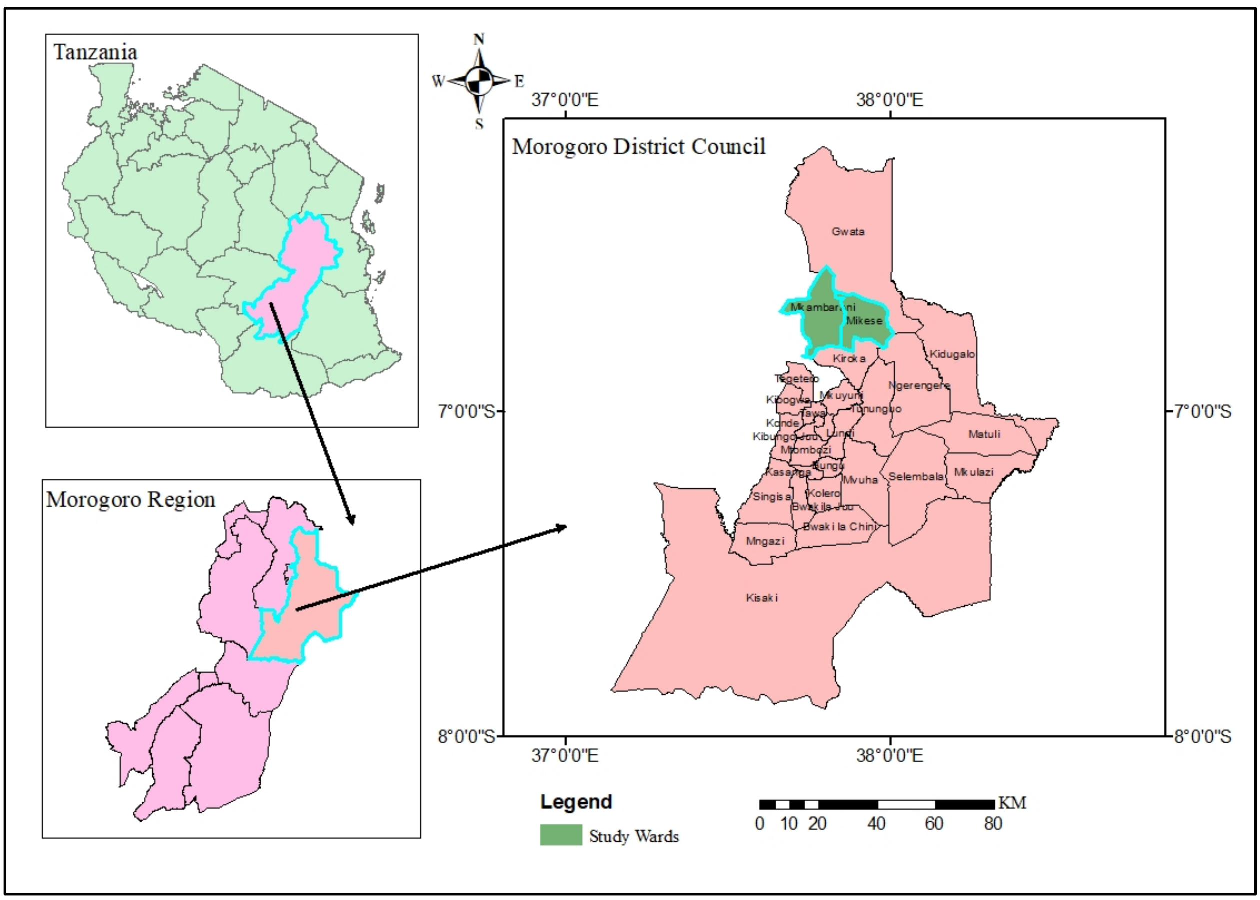

Figure 2: Location of the study area
Source: Survey data, 2025

The target population were the smallholder farmers (11,577) involved in crop production in Morogoro District (The United Republic of Tanzania, 2022). Key informants, including agricultural extension officers, local government officials, and farmer group representatives, were included to provide insights into institutional support for IPM adoption.

The study used a sample size of 387 respondents that was determined by Yamane (1967) formula, and expressed as: $n = \frac{N}{1+N(e)^2}$

Where n = sample size, N = population size and e = the level of precision (5%).

Therefore $n = \frac{11,577}{1+11,577(0.05)^2}$ =

$$n = \frac{11,577}{1 + 11,577(0.0025)} = 387\ respondents$$

The proportional allocation formula by Kothari (2004) was used to determine the number of respondents for the study wards. The formula is expressed as: $ni = \frac{Ni}{N} x\ n$

Where *ni* represents the sample size for the i^{th} ward, *Ni* is the population of the i^{th} ward, *N* is the total population of all selected wards, and *n* is the overall sample size for the study (Table 1).

Table 1: Population and sample size for the study

Wards	Population	Households	Sample ($ni = \frac{Ni}{N} x\ n$)	(%)
Mkambalani	18,388	5,267	176	45
Mikese	23,637	6,310	211	55
Total	**42,025**	**11,577**	**387**	**100**

Source: The United Republic of Tanzania, 2022

The study employed purposive sampling to select two wards and four villages, with two villages from each ward. In addition, simple random sampling was used to select 387 household heads engaged in crop farming for the study. Furthermore, purposive sampling was used to select 8 key informants for in-depth interviews and 24 participants for focus group discussions based on their knowledge and experience in IPM practices. The sample size was adequate to provide rich information relevant to the study objectives. This study collected both primary and secondary data. The extension officers, local government officials, household heads, and farmer group leaders were the primary data sources. The published and unpublished documents were the sources of secondary data. The primary data on farmers' perceptions and adoption of IPM practices were collected through in-depth interviews with key informants, focus group discussions and a household questionnaire survey. The questionnaire was pre-tested among a small group of farmers in an area with characteristics similar to, but outside, the study area. The pre-test assessed the clarity and relevance of questions. Based on feedback, revisions were made to improve the questionnaire's clarity and reliability.

The qualitative data collected through in-depth interviews and focus group discussions were analysed using qualitative content analysis (Graneheim et al., 2017). The analysis involved transcribing the data, generating codes, grouping similar codes into categories, and developing themes through NVivo software Version 11. The quantitative data collected via a household questionnaire survey were analysed using descriptive statistics and a binary logistic regression model in IBM SPSS Statistics version 20. The binary logistic regression model was used to examine the socio-economic and institutional factors influencing IPM adoption. The model was articulated as:

$Y = \beta_0 + \beta_1 (Ag) + \beta_2 (Fs) + \beta_3 (Ed) + \beta_4 (Se) + \beta_5 (Acv) + \beta_6 (Aes) + \beta_7 (Mfg) + \beta_8 (Afs) + \ldots\ldots\ldots\ldots\ldots\ldots\beta_Z.$

Where *Y* = Households implementing IPM practices, B_0 = Constant, B_1-B_z = Coefficient of the explanatory variables, *Ag*= Age of the household head, *Fs* = Farm size, *Ed* = Educational levels of the household head, *Se* = Sex of the household head, *Acv* = Awareness of Climate Variability, *Aes* = Access to extension service, *Mfg* = Membership in Farmer Groups, and *Afs* = Access to Financial Support.

In this model, the dependent variable was whether households implemented IPM practices (Y), with two possible categorical outcomes: Y = 0 when the household does not implement IPM practices and Y = 1 when the household implements IPM practices. The model's independent variables were the socio-economic and institutional factors influencing households' adoption of IPM practices (Table 2).

Table 2: Description of Independent Variables Used in the Binary Logistic Regression Model

Independent variables	**Coding**
Age of the household head	0 = Below or equal to 45 years, 1 = Above 45 years
Farm size	0 = Below or equal to 2 acres, 1 = Above 2 acres
Educational levels	0 = Primary or less, 1 = Secondary & above
Sex of the household head	0 = Female, 1= Male
Awareness of Climate Variability	0 = Not aware, 1= Aware
Access to extension service	0 = No access, 1 = Access
Membership in Farmer Groups	0 = Non-member, 1= Member
Access to Financial Support	0 = No access, 1 = Access

Source: Field data, 2025

Ethical considerations

Permission to conduct the study was obtained from The Mwalimu Nyerere Memorial Academy, Karume Campus, Zanzibar, and relevant authorities in Morogoro Region. Participants were informed about the study purpose, provided informed consent, and assured of confidentiality and anonymity. All collected information was used solely for research purposes.

Findings and Discussion

The demographic characteristics of the respondents

The results in Table 3 show that most respondents (60%) were over 45 years old, suggesting greater experience with IPM practices. Additionally, 60% had secondary education or above, indicating higher knowledge and skills that may support IPM adoption. Other characteristics, including farm size, sex, marital status, and ward of residence, are presented in Table 3.

Table 3: Demographic characteristics of the respondents

Variables	**Categories**	**Total N=387** (%)
Age	≤ 45 years	40
	> 45 years	60
Farm size	≤ 2 Acres	35
	> 2 Acres	65
Education level	≤ Primary	40
	≥ Secondary	60
Sex	Female	52
	Male	48
Marital status	Not married	16
	Married	84
Wards of residence	Mkambalani	45
	Mikese	55

Source: Field data, 2026

Types of food crops grown in the study area

The multiple-response results (Table 4) indicate that there was no statistically significant difference (χ^2 = 4.516, df = 9, p = 0.874) between wards in the types of crops cultivated. Maize and vegetables were the most commonly grown crops in both wards, followed by cassava, rice, pigeon peas, and cowpeas.

Table 4: Types of food crops grown

Food crops	Wards of residence		χ^2 df *P*- Value
	Mkambalani	**Mikese**	
Maize	68%	66%	4.516
Beans	21%	28%	9
Vegetables	59%	63%	0.874
Rice	29%	30%	
Cassava	39%	40%	
Sorghum	26%	27%	
Cowpeas	28%	30%	
Pigeon peas	30%	31%	
Other food crops such as fruits	21%	22%	

**Significant at 5%

***Key:* χ^2*= Chi-square test*
df *= Degrees of freedom*
Source: Survey data, 2026

The results from in-depth interviews with key informants show that most crops grown in the study wards included maize, beans, rice, vegetables, cassava, sorghum, cowpeas, pigeon peas, and other crops such as fruits and bananas. One of the key informants said:

Generally, Morogoro Rural District is blessed with favourable conditions for cultivating a variety of crops. We grow maize, rice, vegetables, cassava, pigeon peas, cowpeas, bananas, and beans. These crops are primarily produced for household consumption. However, in years when harvests are particularly good, we sell the surplus produce to purchase other food items that are not produced locally. Income generated from the sale of surplus crops is also used to meet other household needs, such as paying school fees for children, purchasing plots of land, and constructing houses (Male farmer in Mkambalani ward).

Types of pests and diseases affecting food crops

The multiple-response findings (Table 5) show no statistically significant difference (χ^2 = 1.113, df = 6, p = 0.981) among wards in the types of pests and diseases affected. These results suggest that farmers in both wards face similar challenges posed by insect pests, fungal diseases, and storage pests due to shared agroecological conditions and farming practices.

Table 5: Types of pests and diseases affecting food crops

Types of pests and diseases	Wards of residence		χ^2
			df
	Mkambalani	**Mikese**	***P*- Value**
Insect pests	71%	70%	1.113
Vertebrate Pests	37%	41%	6
Fungal diseases	48%	48%	0.981
Storage pests	80%	79%	
Bacterial disease	48%	51%	
Viral diseases	29%	31%	

***Significant at 5*
***Key:** χ^2= Chi-square test*
***df** = Degrees of freedom*
Source: Survey data, 2026

Insect pests were the most prominent category in both Mkambalani (71%) and Mikese (70%) wards. These pests include fall armyworm, stem borers, aphids, whiteflies, and bean fly. These pests mainly affect maize, rice, sorghum, cassava, beans, and tomatoes. Their dominance reflects the importance of cereal and horticultural production in both wards, particularly maize, which is highly susceptible to fall armyworm and stem borers. These findings corroborate those of Tryphone & Pastory (2023),who reported that most of the insect pests affecting crop farming in Morogoro, Tanzania were cereal stem borers, maize aphids, whiteflies, and armyworm. Furthermore, findings from in-depth interviews with key informants revealed that agricultural production in this area is constrained by pests such as stem borers, aphids, whiteflies, and bean flies. These pests have been causing extensive damage to crops including maize, tomatoes, rice, cassava, and beans. Consequently, farmers experience reduced agricultural productivity, making it difficult for them to achieve their farming goals and expected yields. One of the key informants reported:

In this ward, many farmers have been experiencing challenges such as crop damage caused by pests including stem borers, aphids, whiteflies, and bean flies. These pests attack crops including maize, tomatoes, rice, cassava, and beans while they are still in the field. This problem has resulted in reduced crop yields and hindered farmers from achieving their production goals and improving their livelihoods (Key informant in Mikese ward).

Storage pests were also highly prevalent in both Mkambalani (80%) and Mikese (79%) wards. The main examples are maize weevils and larger grain borers that primarily affect stored maize and other grains. The similar high proportions suggest that post-harvest management constraints are shared between the two wards. Vertebrate pests are moderately reported, with a slightly higher occurrence in Mikese (41%) than in Mkambalani (37%). These pests include rats, mice, monkeys, and wild pigs. The affected crops include rice, sorghum, millet, maize, cassava, and bananas.

Fungal diseases show equal prevalence in both wards (48%). Examples include rice blast and maize leaf blight, affecting rice, maize, tomatoes, beans, and fruits. The uniform distribution of disease indicates that the two wards had identical climatic conditions favouring fungal development. Furthermore, bacterial diseases are also comparable across wards, with a slight increase in Mikese (51%) compared to Mkambalani (48%). Examples of bacterial diseases include bacterial wilt, bacterial leaf blight, and common bacterial blight, affecting tomatoes, rice, and beans. Viral diseases were the least-reported category in both the Mkambalani (29%) and Mikese (31%) wards. Cassava mosaic disease, maize streak disease, and tomato yellow leaf curl disease are the main examples, affecting cassava, maize, and tomatoes.

Smallholder farmers' perceptions of Integrated Pest Management

The results on smallholder farmers' perceptions of Integrated Pest Management, measured on a five-point Likert-scale and summarised as weighted means and standard deviations, are presented. The interpretation of the results was guided by a five-point Likert-scale class-interval approach. In this framework, mean scores ranging from 1.00 to 1.80 represented strongly disagree, 1.81 to 2.61 represented disagree, 2.62 to 3.42 represented neutral or moderate, 3.43 to 4.23 represented agree, and 4.24 to 5.04 represented strongly agree (Alkharusi, 2022). In this study, the weighted mean scores ranging from 1.00 to 2.61 indicate low perception, 2.62 to 3.42 indicate moderate perception, and 3.43 to 5.04 indicate high perception.

The results (Table 6) indicate that respondents had a moderate perception of Integrated Pest Management (IPM) practices, with a mean score of 3.04. This suggests that farmers had a fair understanding of IPM and recognised its importance in pest control. However, these findings differ from Rahman (2022), who found that farmers had low overall knowledge of various IPM practices. This study revealed that farmers strongly believed that chemical pesticides should be used when pest damage becomes severe, that extension services are an important source of IPM knowledge, and that pest-resistant crop varieties reduce crop damage.

On the other hand, farmers had moderate perceptions (Table 6) that crop rotation reduces pest problems, intercropping reduces pest attacks, combining different pest control methods eliminates pests, and that removing crop residues and infected plants prevents pests. In addition, farmers moderately perceived that regular crop inspection helps detect pests early and climate variability influences pest outbreaks. The results from in-depth interviews with key informants revealed that climate change had increased the frequency and unpredictability of pest outbreaks. Accordingly, farmers had adopted various IPM practices, although many continued to rely on chemical pesticides during severe infestations because of their immediate effectiveness. One of the key informants explained:

Climate change has made pest problems more frequent and less predictable. Pest outbreaks now occur unexpectedly, making it difficult for farmers to plan effective control measures. Some have started using crop rotation, field sanitation, and resistant varieties, but many still depend on pesticides because they work faster when the infestation is severe (Key Informant in Mkambalani ward).

Table 6: Smallholder farmers' perceptions of Integrated Pest Management

Items	SD	D	N	A	SA	Mean	σ	Decision
Crop rotation reduces pest problems.	54 (14%)	70 (18%)	39 (10%)	138 (36%)	86 (22%)	3.34	1.37	Moderate
Pest-resistant crop varieties can reduce crop damage.	50 (13%)	38 (10%)	52 (13%)	93 (24%)	154 (40%)	3.68	1.41	High
Biological methods help control pests.	181 (47%)	111 (29%)	32 (8%)	27 (7%)	36 (9%)	2.03	1.29	Low
Removing crop residues and the infected plants prevents pests.	36 (9%)	119 (31%)	77 (20%)	55 (14%)	100 (26%)	3.17	1.35	Moderate
Intercropping reduces pest attacks.	61 (16%)	71 (18%)	55 (14%)	74 (19%)	126 (33%)	3.34	1.48	Moderate
Regular crop inspection helps detect pests early.	88 (23%)	125 (32%)	32 (8%)	70 (18%)	72 (19%)	2.78	1.45	Moderate
Botanical or plant-based pesticides control pests.	170 (44%)	93 (24%)	48 (12%)	36 (9%)	40 (11%)	2.18	1.36	Low
Excessive pesticide use harms the environment and health.	82 (21%)	135 (35%)	94 (24%)	50 (13%)	26 (7%)	2.49	1.16	Low
Chemical pesticides should be used when pest damage is severe.	30 (8%)	40 (10%)	28 (7%)	142 (37%)	147 (38%)	3.87	1.24	High
Combining pest control methods eliminate pests.	66 (17%)	63 (16%)	69 (18%)	115 (30%)	74 (19%)	3.18	1.37	Moderate
Climate variability influence pest outbreaks.	124 (32%)	89 (23%)	51 (13%)	56 (15%)	67 (17%)	2.62	1.49	Moderate
Extension services provide IPM knowledge.	37 (10%)	53 (14%)	30 (8%)	110 (28%)	157 (40%)	3.77	1.36	High
Overall weighted mean						**3.04**		**Moderate**

Key: SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree, and σ = Standard Deviation.

***Source**: Survey data, 2026*

Furthermore, farmers showed low perceptions (Table 6) that biological methods help control pests and that botanical pesticides can control pests. These results indicate that farmers had limited awareness or experience with natural pest control options. In addition, they showed a low perception of the harm excessive use of chemical pesticides causes to the environment and human health. This indicates limited awareness of the risks associated with pesticide overuse among smallholder farmers.

Smallholder farmers' Integrated Pest Management practices

The findings in Table 7 show that 51% of respondents practised crop rotation. Through this practice, respondents were growing different crops sequentially on the same piece of land to break pest and disease cycles. For example, farmers were rotating maize with cassava or pigeon peas. The Chi-square test results indicate that there was no statistically significant difference ($\chi^2 = 2.289$, $p = 0.130$) between the two wards in the practice of crop rotation. The similarity may reflect similar farming systems and awareness of crop rotation in pest control across the two wards. Likewise, Shrestha et al. (2024) found that vegetable growers in Lamjung district, Nepal, adopted IPM practices such as crop rotation, the use of resistant crop varieties, and field sanitation.

Table 7: Smallholder farmers' Integrated Pest Management practices

IPM Practice	Practices	Ward of Residence Mkambalani %	Mikese %	Total %	χ^2 P- Value
Crop rotation	Not practiced	45	53	49	2.289
	Practiced	55	47	51	0.130
Growing of resistant crop varieties	Not practiced	55	37	45	12.651**
	Practiced	45	63	55	0.000
Field sanitation	Not practiced	62	55	58	2.173
	Practiced	38	45	42	0.140
Intercropping	Not practiced	49	32	40	11.752**
	Practiced	51	68	60	0.001
Mechanical removal of pests	Not practiced	67	54	59	6.646**
	Practiced	33	46	41	0.010
Careful use of pesticides	Not practiced	28	46	38	14.100** 0.000
	Practiced	72	54	62	

***Significant at 5%*
Key: *χ^2 = Chi-square test*
Source: Survey data, 2026

Regarding the cultivation of resistant crop varieties, the results show that 55% of respondents practised this. They were developing pest-resistant varieties of maize, cassava, and rice. The Chi-square test results indicate a statistically significant difference (χ^2 = 12.651, p = 0.000) between the two wards in the adoption of resistant crop varieties. The higher adoption in Mikese ward may be due to better access to improved seeds, increased awareness of resistant varieties, and stronger agricultural extension support promoting pest-resistant crops.

Furthermore, the results show that 42% of respondents practised field sanitation. This practice involves removing crop residues or weeds that can harbour pests and diseases. The Chi-square test results indicate no statistically significant difference (χ^2 = 2.173, p = 0.140) between the two wards in the practice of field sanitation. The similarity may be attributed to comparable farming conditions and similar levels of awareness regarding the importance of field sanitation in pest management. Mansaray et al. (2025) reported that most farmers in Sierra Leone relied on physical and traditional pest control methods, such as manual pest removal and field sanitation.

The findings revealed that 60% of respondents practised intercropping. In this practice, respondents were growing two or more crops together on the same farmland. For example, they intercropped maize with cassava or cowpeas to reduce pest infestations and diversify farm output. The Chi-square test results indicate a statistically significant difference (χ^2 = 11.752, p = 0.001) between the two wards in intercropping practices. The higher adoption in Mikese ward may be linked to traditional farming systems, greater awareness of the benefits of crop diversification, and farmers' experiences that intercropping reduces pest infestations and improves productivity.

The findings from the focus group discussions showed that intercropping was one of the Integrated Pest Management practices used by farmers to control pests and diseases. Farmers reported that intercropping cassava with maize and maize with cowpeas helps to control pests by creating a more diverse cropping system that interferes with pest establishment and spread. They further reported that cowpeas can act as an alternative host for some pests and reduce pest pressure on maize. One of the participants said:

Intercropping is one of the most effective methods for controlling pests and diseases. When I intercrop cassava with maize or maize with cowpeas, pests find it more difficult to identify and attack their preferred crops due to increased crop diversity. This practice helps reduce pest infestations and crop damage, leading to healthier crops and improved yields (Female farmer in Mikese ward).

Regarding mechanical pest removal, 41% of respondents reported practising it. This practice was possible on small plots because it involved handpicking pests or removing their eggs or larvae to reduce pest damage. The Chi-square test results indicate a statistically significant difference (χ^2 = 6.646, p = 0.010) between the two wards in the practice of mechanical pest removal. The higher practice in Mikese ward may be associated with higher pest infestation levels or better awareness of environmentally friendly pest control methods.

The findings indicated that 62% of respondents practised careful use of pesticides. The Chi-square test results indicate a statistically significant difference (χ^2 = 14.100, p = 0.000) between the two wards in careful pesticide use. The higher proportion in Mkambalani may be due to better access to extension education. Fundikira, (2023) reported that tomato farmers in Mvomero district relied on the use of Snow Tiger (chlorfenapyr) and Dudumetrin (sumithrin) pesticides to control pests and diseases.

Factors influencing the adoption of integrated pest management (IPM) practices

The results from the binary logistic regression model in examining the factors influencing the adoption of IPM practices are presented. The omnibus test for the binary logistic regression model was statistically significant (χ^2 = 67.620, df = 8, p < 0.000), indicating that the model provides a significant improvement over the intercept-only (null) model. The -2 Log Likelihood value of 458.574 represents the model deviance and is used as a comparative measure of model fit rather than a standalone indicator. The Cox and Snell R^2 (0.160) and Nagelkerke R^2 (0.216) suggest that the predictors explain between 16% and 21.6% of the variation in the dependent variable, indicating a moderate level of explanatory power.

Table 8: Model Summary

Model summary		
-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
458.574[a]	.160	.216

Source: Survey data 2026

The findings revealed that the age of the household head had a statistically significant influence on the adoption of integrated pest management practices (B = .022, p = .015, Exp (B) = 1.022). This indicates that a one-unit increase in respondents' Age increased the odds of adopting integrated pest management practices by 1.022, holding other variables constant. Similar findings were reported by Agulanna et al. (2025) that farmers' age had a significant relationship with the adoption of IPM, suggesting that older farmers possessed greater experience with IPM practices and were more likely to adopt them.

Table 9: The factors influencing the adoption of IPM practices

Variables in the Equation								
	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP(B)	
							Lower	Upper
Ag	.022**	.009	5.904	1	.015	1.022	1.004	1.040
Fs	.081	.099	.669	1	.413	1.085	.893	1.317
Ed (1)	-.558**	.237	5.521	1	.019	.572	.359	.912
Se (1)	-.454**	.229	3.952	1	.047	.635	.406	.994
Acv (1)	-.084	.328	.065	1	.799	.920	.483	1.751
Aes (1)	-.637**	.292	4.756	1	.029	.529	.299	.938
Mgf (1)	-.825**	.310	7.087	1	.008	.438	.239	.805
Afs (1)	-.617**	.298	4.288	1	.038	.540	.301	.968
Constant	.183	.614	.088	1	.766	1.200		

Note: ***Significant at 5%*

Key: *Ag= Age of the household head, Fs = Farm size, Ed = Educational levels of the household head, Se = Sex of the household head, Acv = Awareness of Climate Variability, Aes = Access to extension service, Mfg = Membership in Farmer Groups, and Afs = Access to Financial Support.*

Source: Survey data, 2026

Respondents' education level had a statistically significant negative effect on the adoption of integrated pest management practices (B = -.558, p = .019, Exp (B) = .572). The findings indicate that the odds of adopting integrated pest management practices were 0.572 times lower among respondents with primary or lower education than among those with secondary or higher education. These results corroborate those of Mansaray et al. (2025) who found that the education level of the farmers significantly influenced the adoption of IPM practices.

The sex of the respondents had a statistically significant influence on the adoption of integrated pest management practices (B = -.454, p = .047, Exp (B) = .635). The findings show that the odds of adopting integrated pest management practices were 0.635 times lower among female respondents than among male respondents. These findings are consistent with those of Kihoro et al. 2021) who reported that female farmers were less likely to adopt IPM practices compared to males.

Access to extension services had a statistically significant negative effect on the adoption of integrated pest management practices (B = -.637, p = .029, Exp (B) = .529). The results reveal that the odds of adopting integrated pest management practices were 0.529 times lower among respondents without access to extension services than among those with access. These findings support the Diffusion of Innovations Theory, which highlights the role of information sources, such as extension services, in promoting IPM adoption through technical advice and training. Shrestha et al. (2024) reported similar findings that access to extension services significantly influenced adoption of IPM practices in vegetable cultivation.

Membership in farmer groups had a statistically significant negative effect on the adoption of integrated pest management practices (B = -.825, p = .008, Exp (B) = .438). These results indicate that the odds of adopting integrated pest management practices were 0.438 times lower among respondents who were non-members of farmer groups than among those who were members. These findings agree with the Diffusion of Innovations Theory, which explains that the adoption of new technologies is influenced by communication and social interaction within a community. Also, Garané et al. (2025) found that membership in farmer organisations increased IPM adoption through information sharing and peer learning.

Access to financial support had a statistically significant negative effect on the adoption of integrated pest management practices (B = -.617, p = .038, Exp (B) = .540). This shows that the odds of adopting integrated pest management practices were 0.540 times lower among respondents without access to financial resources than among those with access. According to Olasunkanmi et al. (2022), access to credit significantly influenced the adoption of IPM practices among maize farmers.

Limitations of the study

The study was limited to Morogoro District, which may affect the generalisability of findings. However, the use of both quantitative and qualitative methods provided a comprehensive understanding of the study problem and strengthened the credibility of the findings.

Conclusion

The study concludes that farmers had moderate perceptions of Integrated Pest Management (IPM) practices amid changing climatic conditions, and that these perceptions were influenced by socio-economic and institutional factors. The study contributes to knowledge by showing how socio-economic and institutional factors shape farmers' perceptions and adoption of IPM under changing climatic conditions in Morogoro District. It recommends that the government strengthen extension services, financial support, and climate-responsive interventions to promote IPM adoption among farmers.

References

Agulanna, F. T., Williams, O. A., Adebiyi, S., Rahman, S. B., & Uwagboe, E. O. (2025). Perception and Adoption of Integrated Pest Management for the Enhancement of Cocoa Production and Income among Cocoa Farmers in Osun State, Nigeria. *Journal of Research in Management and Social Sciences*, *11*(1), 162–177.

Alkharusi, H. (2022). A descriptive Analysis and Interpretation of Data from Likert Scales in Educational and Psychological Research Hussain Alkharusi. *Indian Journal of Psychology and Education*, *12*(2), 13–16. https://www.ijpe.co.in/index.php/ijpe/article/view/101

Backer, T. E., & Rogers, E. M. (1998). Diffusion of innovations theory and work-site aids programs. *Journal of Health Communication*, *3*(1), 17–28. https://doi.org/10.1080/108107398127481

Brown, I. (2024). Integrated Pest Management Strategies for Controlling Tuta absoluta. *International Journal of Agronomy*, *5*(1), 1–6. https://iaeme.com/Home/issue/IJAG?Volume=5&Issue=1

Fundikira, S.S., E. S. and S. S. M. (2023). Farmer's Knowledge and Practices on Proper use of Pesticides on Tomato Production to Ensure Safety among Consumers: a Case Study of Mvomero District, Morogoro. *Tanzania Journal of Agricultural Sciences*, *22*(02), 322–332.

Garané, M., Ouédraogo, S., Gaspart, F., Toé, P., Leener, P. De, & Legrève, A. (2025). Determinants of integrated pest management adoption in tomato farming : A study from Burkina Faso. *Journal of Development and Agricultural Economics*, *17*(3), 98–108.

George, W. (2024). Economics of On-Farm Climate Smart Agricultural Practices in Crop-Based Farming Systems in Morogoro Rural District. *Journal of African Economic Perspectives*, *2*(1), 14–20. https://doi.org/10.58548/2024jaep21.1420

Graneheim, U. H., Lindgren, B. M., & Lundman, B. (2017). Methodological challenges in qualitative content analysis: A discussion paper. *Nurse Education Today*, *56*(June), 29–34. https://doi.org/10.1016/j.nedt.2017.06.002

Kihoro, D. M., Micheni, P. K., & Ng'ang'a, F. W. (2021). Analysis of Socioeconomic Factors Influencing Adoption of Integrated Pest Management (IPM) among Smallholder Tomato Farmers in Buuri Sub-County, Meru County, Kenya. *Asian Journal of Agricultural Extension, Economics & Sociology*, *39*(7), 122–129. https://doi.org/10.9734/ajaees/2021/v39i730616

Kothari, R. (2004). *Researc Methodology; Methods and Techniques* (Second Edi). New Age International

Publishers.

Mafie, G. K. (2022). The Impact of Climate Change on Agricultural Productivity in Tanzania. *International Economic Journal*, *36*(1), 129–145. https://doi.org/10.1080/10168737.2021.2010229

Mansaray, A. H. D., Samura, A. E., Amara, V., & Quee, D. D. (2025). Assessing Farmers Perception and Knowledge in the Management of Economically Important Insect Pests of Rice in Seirra Leone. *Asian Journal of Advanced Research and Reports*, *19*(7), 72–83. https://doi.org/10.9734/ajarr/2025/v19i71082

Olasunkanmi, N. O., Ogunwande, I. O., Thompson, O. A., Afolabi, J. A., & Sofoluwe, N. A. (2022). Determinants of Adoption of Integrated Pest Management Practices Among Maize Farmers in Southwest Nigeria. *Contemporary Agriculture*, *71*(1–2), 73–80. https://doi.org/10.2478/contagri-2022-0011

Rahman, M. S. (2022). Farmers' perceptions of integrated pest management (IPM) and determinants of adoption in vegetable production in Bangladesh. *International Journal of Pest Management*, *68*(2), 158–166. https://doi.org/10.1080/09670874.2020.1807653

Richard1, K., & Kobusingye, P. (2025). Integrated Pest Management in Changing Climate Conditions: A Case Study of Makerere University College of Agricultural and Environmental Sciences. *Metropolitan Journal Of Environmental and Health Research*, *4*(5), 734–746.

Sekabira, H., Tepa-Yotto, G. T., Djouaka, R., Clottey, V., Gaitu, C., Tamò, M., Kaweesa, Y., & Ddungu, S. P. (2022). Determinants for Deployment of Climate-Smart Integrated Pest Management Practices: A Meta-Analysis Approach. *Agriculture*, *12*(7), 1–19.

Shrestha, S., Amgain, L. P., Pandey, P., Bhandari, T., & Khatiwada, S. (2024). Adoption status of integrated pest management (IPM) practices among vegetable growers of Lamjung district of Nepal. *Heliyon*, *10*(18), e37999. https://doi.org/10.1016/j.heliyon.2024.e37999

The United Republic of Tanzania. (2022). *The 2022 Population and Housing Census: Administrative Units Population Distribution Report; Tanzania*. https://sensa.nbs.go.tz/publication/volume1a.pdf.Retrieved on 20/4/2023

Tryphone, G. M., & Pastory, S. T. (2023). Evaluating Limitations of Agroecological Practices and Stakeholders' Response: A Case of Uluguru Mountains Landscape in Morogoro Municipality, Tanzania. *East African Journal of Science, Technology and Innovation*, *4*(2), 1–18. https://doi.org/10.37425/eajsti.v4i3.676