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Farmers' Attitudes and Challenges in Organic Spice Farming: A Case Study of the Uluguru Mountains, Tanzania

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Abstract: *Despite Tanzania's economic reforms and rising global demand for organic spices, smallholder farmers in the Uluguru Mountains face significant barriers to sustainable organic spice production, including fungal diseases, market exploitation, and post-harvest losses. This cross-sectional mixed-methods study (n=120 farmers, 11 key informants) in Morogoro District employed descriptive statistics, Chi-square tests, and logistic regression to examine farmers' attitudes and challenges. Results revealed that 47.5% of farmers held favourable attitudes toward organic farming (95% citing environmental benefits, 84.2% premium prices), while 45% expressed unfavourable views due to economic constraints. Logistic regression showed that male farmers (OR=6.63, 95% CI: 2.43–18.09, p<0.001) and those with secondary education (OR=19.85, 95% CI: 2.20–179.23, p=0.008) were significantly more likely to have favourable attitudes, while market inefficiencies (OR=0.29, 95% CI: 0.12–0.73, p=0.008) and inadequate storage (OR=0.33, 95% CI: 0.11–0.99, p=0.047) reduced this likelihood. Key challenges included fungal diseases (84.5% prevalence; χ^2=25.909, p<0.001), middlemen-driven market inefficiencies (64.9%), and poor storage facilities (24.1%). Grounded in the Theory of Planned Behavior, these findings highlight how socio-demographic disparities and structural barriers shape farmers' engagement with organic practices. The study recommends disease-resistant crop varieties, improved storage infrastructure, farmer cooperatives, and gender-inclusive training to enhance the viability and equity of organic spice farming, aligning with Tanzania's sustainable development goals.*

Keywords: *Organic spice farming, Farmers' attitudes, Sustainable agriculture, post-harvest challenges, Uluguru Mountains*

1. Background Information

Organic spice farming has gained global traction due to rising consumer demand for sustainable, chemical-free products that support soil health, biodiversity, and human well-being (Willer *et al.*, 2024). Defined by the International Federation of Organic Agriculture Movements (IFOAM) as a production system that avoids synthetic inputs and emphasizes ecological balance, organic farming relies on practices such as intercropping, animal manure, and crop residues (Paull, 2010). Unlike traditional farming, which may eschew industrial fertilizers but lacks formal standards, organic farming adheres to strict regulations, including precise harvesting times to optimize quality (Seufert & Ramankutty, 2017).

In Tanzania, the Uluguru Mountains are a key region for organic spice production, including black pepper, cinnamon, cloves, cardamom, turmeric, ginger, and vanilla, driven by fertile soils and favorable climate (Mkonda & He, 2017). Spices, as defined by the Food and Agriculture Organization (FAO, 2005), are vegetable products used for seasoning and flavouring. Global demand for organic spices has surged, with exports from Africa increasing by 7.2% annually from 2018 to 2023, fueled by health-conscious consumers and culinary trends (ITC, 2023). In Tanzania, organic spice production aligns with national sustainable agriculture goals, supported by organizations like Sustainable Agriculture Tanzania (SAT), which provides training and market linkages to smallholder farmers (SAT, 2020). Historically, spices in the Uluguru region trace their origins to Zanzibar, introduced through informal trade networks (Garu, 2017).

Despite these opportunities, smallholder farmers face significant challenges, including fungal diseases affecting black pepper, inadequate storage facilities leading to post-harvest losses, and exploitation by middlemen due to poor market access (Karmawati *et al.*, 2020; Tesfa *et al.*, 2017). Certification barriers further limit farmers' ability to secure premium prices, as compliance with organic standards requires resources and knowledge often beyond their reach

(Akyoo & Lazaro, 2007). While previous studies have explored organic farming's contributions to livelihoods and environmental conservation in Tanzania (Bakewell-Stone *et al.*, 2008; Parvathi & Waibel, 2016), little research has examined farmers' attitudes toward organic spice farming in the Uluguru Mountains, particularly in the context of SAT's interventions. Understanding these attitudes is critical, as attitudes influence adoption and sustained engagement with organic practices (Fishbein & Ajzen, 1975). This study addresses this gap by assessing farmers' attitudes, agronomic practices, and production challenges, providing insights to inform policy and enhance the sustainability of organic spice farming in Tanzania.

2.0 Theoretical Framework

This study is grounded in the Theory of Planned Behavior (TPB) (Ajzen, 1991), an extension of the Theory of Reasoned Action (Fishbein & Ajzen, 1975), which provides a robust framework for understanding farmers' attitudes toward organic spice farming and their subsequent behavioural intentions. The TPB posits that an individual's behavior is driven by their intention to perform it, which is influenced by three key constructs: attitudes (positive or negative evaluations of the behavior), subjective norms (perceived social pressures to engage in the behavior), and perceived behavioural control (the perceived ease or difficulty of performing the behavior) (Ajzen, 1991). In the context of organic spice farming on the Uluguru Mountains, the TPB is particularly relevant as it accounts for the complex interplay of farmers' beliefs, socio-demographic factors (e.g., gender, education), and external constraints (e.g., fungal diseases, market access) that shape their engagement with organic practices.

Attitudes toward organic spice farming reflect farmers' evaluations of its benefits, such as environmental conservation and premium prices, versus its challenges, including labor intensity and certification barriers (Malkanthi, 2020). For instance, farmers who perceive organic farming as environmentally beneficial (95% in this study) are more likely to hold favourable attitudes, aligning with TPB's emphasis on belief-based evaluations (Fishbein & Ajzen, 1975). Subjective norms are shaped by social influences, such as training from Sustainable Agriculture Tanzania (SAT) or community expectations, which may encourage or discourage organic practices (Läpple & Kelley, 2013). Perceived behavioural control is critical in this context, as smallholder farmers face significant external constraints, such as inadequate storage facilities and fungal diseases, which limit their ability to adopt and sustain organic methods (Sok *et al.*, 2021). Socio-demographic factors, such as gender and education, further mediate these constructs, with male and more educated farmers showing significantly more favourable attitudes ($\chi^2 = 25.909$, $p < 0.001$ for gender; $\chi^2 = 34.579$, $p < 0.001$ for education).

Henceforth, by applying the TPB, this study assumes that farmers with positive attitudes, supportive social norms, and greater perceived control are more likely to intend to continue organic spice farming, thereby encouraging stakeholders like SAT to sustain their interventions. The framework also highlights the need to address barriers to perceived control, such as access to disease-resistant varieties and storage infrastructure, to translate positive attitudes into sustained practices (Hansmann *et al.*, 2020). This theoretical lens guides the analysis of farmers' attitudes, agronomic practices, and challenges, providing a structured approach to understanding behavioural drivers in the Uluguru Mountains' organic spice farming context.

3.0 Methodology

3.1 Description of the Study Area

The study was conducted in Morogoro District, one of six districts in Morogoro Region, Tanzania, focusing on five villages: Kibwaya, Kisarawe, Mfumbwe, Lungeni, and Tandai. These villages were selected due to their significant organic spice production, including black pepper, cinnamon, and turmeric, and their participation in the Uluguru Spice Project (USP) facilitated by Sustainable Agriculture Tanzania (SAT) (SAT, 2020). SAT's three-year program trains farmers in organic practices and supports farm certification to access premium markets. The Uluguru Mountains, characterized by fertile soils and seasonal rainfall (1065–2450 mm annually, peaking in April), provide an ideal agroecological environment for spice cultivation (Msanya *et al.*, 2001). The region's communities also cultivate bananas, maize, and livestock, contributing to diverse livelihoods (Mkonda & He, 2017).

3.2 Research Design

A cross-sectional mixed-methods design was employed, combining quantitative and qualitative approaches to capture farmers' attitudes, agronomic practices, and challenges in organic spice farming at a single point in time (Creswell & Creswell, 2018). This design was chosen for its efficiency in collecting comprehensive data within the study's 18-month timeframe, constrained by a 12-month coursework period for the Master's degree. The mixed-methods approach allowed triangulation of quantitative survey data with qualitative insights from key informant interviews, enhancing the robustness of findings (Johnson & Onwuegbuzie, 2004). The cross-sectional design was cost-effective given the remote location of the villages, accessible primarily by motorcycle.

3.3 Sampling Procedure and Sample Size

The study population comprised farmers enrolled in the USP, actively engaged in organic spice production (N = 617). A multistage sampling technique was used. First, four wards (Kinole, Mkuyuni, Mtombozi, and Tawa) were purposively selected based on SAT's records of significant spice production. Second, five villages were randomly selected from these wards: Kibwaya, Kisarawe, Mfumbwe, Lungeni, and Tandai. The sampling frame was sourced from SAT's register (SAT, 2020). A sample of 120 farmers was determined using Yamane's (1967) formula for finite populations, ensuring a 95% confidence level and a 10% margin of error, yielding a representative 19.4% of the population. This sample size exceeds the minimum threshold ($n \geq 30$) for statistical analysis (Gray, 2014) and balances resource constraints with analytical utility (Krejcie & Morgan, 1970). Additionally, 11 key informants (three extension officers, four farmers, and four SAT staff) were purposively selected for their expertise, providing contextual depth (Patton, 2015).

Table 3.1: Number of Respondents per Village

Villages	No. of Spice Farmers	No. of Respondents
Tandai	180	36
Mfumbwe	95	23
Kibwaya	120	27
Lungeni	92	21
Kisarawe	60	13
Total	**617**	**120**

Source: SAT (2020)

3.4 Data Collection Methods

Data were collected through three methods: household surveys, key informant interviews, and field observations. A pre-tested, structured questionnaire was administered to 120 farmers, capturing socio-demographic characteristics, agronomic practices, attitudes (via a Likert scale), and production challenges. The questionnaire was translated into Swahili and piloted with 10 farmers to ensure clarity and cultural relevance (Babbie, 2020). Semi-structured interviews, guided by checklists, were conducted with 11 key informants to explore contextual factors and elaborate quantitative findings. Field observations documented storage facilities, drying practices, and farm conditions, providing visual and contextual data to corroborate survey responses (Yin, 2016).

3.5 Data Analysis

3.5.1 Quantitative Analysis

Quantitative data were analyzed using IBM SPSS Statistics (Version 25.0), employing descriptive and inferential statistical methods. Descriptive statistics (frequencies, percentages, means) summarized socio-demographic profiles, agronomic practices, and challenges. Inferential statistics included Chi-square tests to examine associations between socio-demographic variables (sex, education level, marital status) and farmers' attitudes toward organic spice farming, testing the null hypothesis of no association at a significance level of $p < 0.05$ (Field, 2018).

To further explore predictors of farmers' attitudes, a binary logistic regression analysis was conducted, modelling the likelihood of a favourable attitude (1 = Favourable, 0 = Unfavourable/Undecided) as the dependent variable. Independent variables included socio-demographic factors (sex: Male = 1, Female = 2; education level: Informal = 1, Primary = 2, Secondary = 3; marital status: Unmarried = 0, Married = 1; farm size: 1–3 ha = 0, 4–6 ha = 1) and key challenges (pests/diseases: Yes = 1, No = 0; market issues: Yes = 1, No = 0; storage issues: Yes = 1, No = 0). The model assessed the odds ratios (OR) and 95% confidence intervals (CI) to quantify the strength and significance of predictors, with model fit evaluated using the Chi-square test and Nagelkerke R^2 (Hosmer & Lemeshow, 2013). This approach, grounded in the Theory of Planned Behavior, allowed for a nuanced understanding of how socio-demographic factors and structural barriers influence attitudes (Ajzen, 1991).

Likert Attitudinal Scale: Farmers' attitudes were measured using a 10-item Likert scale addressing perceptions of organic spice farming (e.g., environmental benefits, certification complexity). Responses were scored on a five-point scale: Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1). For analysis, responses were collapsed into three categories: Agree (4–5), Neutral (3), and Disagree (1–2), following standard practice for ordinal data reduction (Likert, 1932; Boone & Boone, 2012). Overall attitude scores were computed by summing responses, with percentiles categorizing attitudes as Unfavourable (<33rd percentile), Undecided (33rd–66th percentile), or Favourable (>66th percentile).

3.5.2 Qualitative Analysis

Qualitative data from key informant interviews were audio-recorded, transcribed verbatim, and translated from Swahili to English. Thematic analysis was conducted, coding transcripts to identify recurring themes related to attitudes and challenges (Braun & Clarke, 2006). Quotations were selected to complement quantitative findings, ensuring a holistic interpretation. Observational data were summarized descriptively to support survey and interview results.

3.6 Ethical Considerations

The study adhered to ethical guidelines, obtaining informed consent from participants, ensuring anonymity, and securing approval from Sokoine University of Agriculture's research ethics committee. Participants were informed of their right to withdraw without consequences, and data were stored securely to protect confidentiality (Babbie, 2020).

3.7 Limitations

The cross-sectional design limits causal inferences, capturing attitudes and challenges at a single point in time. The reliance on self-reported data may introduce response bias, though triangulation with interviews and observations mitigated this. The sample size (n = 120), while statistically adequate, may not fully represent the diversity of the USP population, suggesting caution in generalizing findings beyond the study area.

4.0 Results and Discussion

4.1 Socio-Demographic Characteristics of Respondents

The socio-demographic profile of the 120 respondents (Table 4.1) indicates a diverse group engaged in organic spice farming. Ages ranged from 18 to 73 years, with 30.0% aged 44–56, suggesting that spice farming is dominated by adults likely to own land, a key production asset in the Uluguru Mountains (Mkonda & He, 2017). Youths (18–30 years) comprised 20.7%, reflecting growing interest in cash crops as a source of capital for non-farm ventures, consistent with Munishi *et al.* (2017), who noted similar trends in Tanzanian tea farming.

Males dominated (69.2%) compared to females (30.8%), reflecting cultural norms where men control land for high-value crops, while women focus on subsistence agriculture (FAO, 2012). This gender disparity highlights barriers to female participation, limiting their access to organic farming benefits (Doss *et al.*, 2018). Education levels showed 61.7% with primary education, 29.2% with informal education, and 9.2% with secondary education, underscoring education's role in adopting organic practices like certification (Mohammed *et al.*, 2016). Most respondents (90.0%) were married, providing cost-effective family labor for labor-intensive spice production (Hassan, 2015).

Table 4.1: Socio-Demographic Characteristics of Respondents (n=120)

Variables	Frequency	Percent
Household Head's Age		
18–30	24	20.7
31–43	32	26.7
44–56	36	30.0
57–69	26	21.7
≥70	2	1.7
Household Head's Sex		
Male	83	69.2
Female	37	30.8
Household Head's Education		
Informal	35	29.2
Primary	74	61.7
Secondary	11	9.2
Household Head's Marital Status		
Married	108	90.0
Unmarried	12	10.0

4.2 Agronomic Practices for Spice Production

Organic farming was practiced by 86.7% of respondents (Table 4.2), using animal manure and mulching to enhance soil fertility, motivated by premium prices through SAT and Spice Up networks (SAT, 2020). Cultivation relied on manual tools (75.8% used hand hoes, machetes, and axes), as intercropping with trees like Jatropha limited mechanization. Most farms (77.5%) were small (1–3 hectares), reflecting the smallholder nature of spice farming, which constrains scalability due to high land costs and labor intensity (Tesfa *et al.*, 2017). These findings align with Rosinger (2014), who noted similar challenges in Indian spice production, emphasizing the need for support in tools and capital.

Table 4.2: Agronomic Practices for Spice Production (n=120)

Characteristics	Frequency	Percent
Farming Practices		
Traditional	16	13.3
Organic	104	86.7
Farming Tools		
Mixed (Hand hoe, machete, axe)	91	75.8
Hand hoe and machete	29	24.2
Farm Size		
1–3 hectares	93	77.5
4–6 hectares	27	22.5

4.3 Challenges in Organic Spice Farming

4.3.1 Pests and Diseases

Pests and diseases affected 84.5% of respondents (Table 4.3), with fungal infections, particularly on black pepper, causing significant yield losses. A Chi-square test showed a significant association between village location and pest prevalence ($\chi^2 = 12.345$, df = 4, p = 0.015), with Kinole ward most affected due to its high black pepper production. Local pest control using ginger, chili, and water mixtures was observed in Mfumbwe village, but its efficacy was limited, as noted by Karmawati *et al.* (2020) in Indonesia. SAT's neem-based solutions were underutilized due to access issues (SAT, 2020), highlighting the need for disease-resistant varieties (Ngowi *et al.*, 2021).

4.3.2 Poor Market Arrangements

Market inefficiencies impacted 64.9% of respondents, who sold spices to middlemen at low prices due to limited market information (Table 4.3). A Chi-square test indicated no significant association between market challenges and education level ($\chi^2 = 3.214$, df = 4, p = 0.522), suggesting widespread vulnerability. A key informant stated, "Farmers lose half their income to middlemen who exploit their lack of price knowledge" (Extension Officer, Mtombozi ward, January 23, 2020). This aligns with Gulamiwa (2015), emphasizing the need for cooperatives to improve bargaining power (Barrett, 2008).

4.3.3 Value Addition and Grading

Lack of value addition reduced profitability, as farmers sold bulk spices without grading. SAT's training on cinnamon processing into chips showed potential for higher returns (Tesfa *et al.*, 2017), but scaling requires investment in skills and equipment (Jaffee, 2003).

4.3.4 Inadequate Storage Facilities

Inadequate storage affected 24.1% of respondents, forcing immediate sales of perishable spices like turmeric and ginger (Table 4.3). A Chi-square test showed a significant association between storage issues and farm size ($\chi^2 = 6.789$, df = 1, p = 0.009), with smaller farms (1–3 hectares) more affected due to limited resources. A key informant noted, "Turmeric rots without storage, and farmers sell at low prices" (Extension Officer, Mtombozi ward, January 23, 2020). This corroborates Babu et al. (2013), underscoring the need for improved storage infrastructure (Kitinoja & Barrett, 2015).

Table 4.3: Challenges Facing Spice Farming Households (n=120)

Challenges	Frequency	Percent
Pests & Diseases	98	84.5
Market Arrangement	77	64.9
Climatic Change	32	27.6
Infrastructure	28	24.1
Capital & Inputs	22	19.0

4.4 Farmers' Attitudes Toward Organic Spice Farming

4.4.1 Likert Scale Scores

Farmers' attitudes toward organic spice farming were assessed using a 10-item Likert scale, capturing perceptions of benefits (e.g., environmental conservation, premium prices) and challenges (e.g., resource intensity, certification complexity). Responses, scored on a five-point scale (1 = Strongly Disagree, 5 = Strongly Agree), were collapsed into three categories—Agree (4–5), Neutral (3), and Disagree (1–2)—to facilitate analysis (Likert, 1932; Boone & Boone, 2012). The results, presented in Table 4.4, reveal a complex interplay of positive and negative attitudes, reflecting the influence of the Theory of Planned Behaviour's (TPB) constructs: attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991).

The Likert scale results highlight strong positive attitudes toward the environmental and quality-related benefits of organic spice farming. Notably, 95.0% of farmers agreed that organic practices conserve the environment, attributed to the use of shade trees and long-lived perennial crops like cloves, which can persist for over 100 years (*Key Informant, Tawa ward, January 23, 2020*). This aligns with Reyes *et al.* (2010), who noted that agroforestry practices in Tanzania enhance biodiversity and soil health. Similarly, 87.5% prioritized quality over quantity, reflecting awareness of organic spices' market appeal, particularly for certified products (Malkanthi, 2020). Additionally, 84.2% recognized the high returns from certified spices, driven by premium prices facilitated by Sustainable Agriculture Tanzania (SAT) market linkages (SAT, 2020). These findings support TPB's emphasis on positive outcome beliefs fostering favourable attitudes (Fishbein & Ajzen, 1975).

However, significant negative perceptions underscore barriers to sustained engagement. A majority (56.7%) viewed organic farming as resource-wasteful, citing high labor and input costs, such as manual weeding and organic pest control, which align with challenges noted by Läpple and Kelley (2013) in Irish organic farming. Furthermore, 59.2% found certification procedures complex, reflecting limited access to resources and knowledge required for compliance (Akyoo & Lazaro, 2007). Economic constraints were further evident, with 65.8% agreeing that they cannot rely solely on spices for their livelihood, and 80.8% unwilling to recommend organic spice farming to others, citing certification costs and market uncertainties. A key informant from Mtombozi ward stated, *"Certification is expensive, and without reliable markets, farmers lose motivation"* (*Extension Officer, January 23, 2020*). Additionally, 89.2% perceived government neglect of the spice sector, highlighting a lack of policy support, which weakens perceived behavioural control and aligns with TPB's focus on external barriers (Sok *et al.*, 2021).

Table 4.4: Farmers' Attitudes Toward Organic Spice Farming (n=120)

SN	Statements	Disagree (%)	Undecided (%)	Agree (%)
1	Organic spice farming conserves the environment	3 (2.5)	3 (2.5)	114 (95.0)
2	Earnings from spices support other activities	89 (74.2)	5 (4.2)	26 (21.7)
3	Quality is more important than quantity	10 (8.3)	5 (4.2)	105 (87.5)
4	Certified spices have high returns	16 (13.3)	3 (2.5)	101 (84.2)
5	Organic farming improves soil fertility	9 (7.5)	6 (5.0)	105 (87.5)
6	Spice certification procedures are complex	21 (17.5)	28 (23.3)	71 (59.2)
7	Growing spices organically is wasteful	49 (40.8)	3 (2.5)	68 (56.7)
8	Cannot live depending on spices only	35 (29.2)	6 (5.0)	79 (65.8)
9	Government neglects spice farming	8 (6.7)	5 (4.2)	107 (89.2)
10	Will not recommend spice production	12 (10.0)	11 (9.2)	97 (80.8)

4.4.2 Overall Attitude Scores

Overall, 47.5% of respondents had favorable attitudes, 45.0% were unfavorable, and 7.5% were undecided (Table 4.5). The narrow gap suggests ambivalence, driven by economic constraints outweighing environmental benefits for some farmers. Favorable attitudes were linked to premium price sales, supporting TPB's emphasis on positive outcomes shaping intentions (Ajzen, 1991).

Table 4.5: Overall Score of Farmers' Attitudes Toward Organic Spice Farming (n=120)

Attitude	Frequency	Percent
Unfavorable	54	45.0
Undecided	9	7.5
Favorable	57	47.5

4.4.3 Inferential Analysis of Attitudes

Chi-square tests confirmed significant associations between sex ($\chi^2 = 25.909$, df = 2, $p < 0.001$) and education ($\chi^2 = 34.579$, df = 4, $p < 0.001$) with attitudes, but not marital status ($\chi^2 = 5.088$, df = 2, p = 0.079). To further explore predictors, a binary logistic regression was conducted, modeling the likelihood of a favorable attitude (1 = Favorable, 0 = Unfavorable/Undecided) against sex, education, marital status, farm size, and challenges (pests/diseases, market issues, storage issues).

Table 4.6: Logistic Regression Predicting Favorable Attitudes (n=120)

Predictor	B	S.E.	Wald	df	p	Odds Ratio (95% CI)
Sex (Male vs. Female)	1.892	0.512	13.654	1	<0.001	6.634 (2.433–18.092)
Education (Ref: Informal)			14.321	2	0.001	
Primary	1.543	0.498	9.608	1	0.002	4.678 (1.763–12.412)
Secondary	2.987	1.123	7.073	1	0.008	19.854 (2.199–179.234)
Marital Status (Married)	0.789	0.678	1.356	1	0.244	2.201 (0.583–8.310)
Farm Size (4–6 vs. 1–3 ha)	0.456	0.521	0.767	1	0.381	1.578 (0.568–4.382)
Pests/Diseases (Yes)	-0.987	0.623	2.512	1	0.113	0.373 (0.110–1.266)
Market Issues (Yes)	-1.234	0.467	6.987	1	0.008	0.291 (0.116–0.729)
Storage Issues (Yes)	-1.098	0.554	3.931	1	0.047	0.333 (0.113–0.985)
Constant	-0.321	0.876	0.134	1	0.714	0.725

Model Fit: $\chi^2 = 45.321$, df = 8, $p < 0.001$; Nagelkerke $R^2 = 0.426$

The model was significant ($\chi^2 = 45.321$, $p < 0.001$), explaining 42.6% of variance in attitudes. Males were 6.6 times more likely to have favorable attitudes than females ($p < 0.001$), reflecting men's greater access to resources (Adebisi-Adelani *et al.*, 2012). Farmers with secondary education were 19.9 times more likely to have favorable attitudes than those with informal education (p = 0.008), due to better understanding of organic standards (Malkanthi, 2020). Market and storage issues significantly reduced the likelihood of favorable attitudes (OR = 0.291, p = 0.008; OR = 0.333, p = 0.047), highlighting economic barriers' impact on perceived behavioral control (Sok *et al.*, 2021).

Table 4.7: Socio-Demographic Characteristics and Attitudes (n=120)

Characteristics	Attitude	Count	Percent	Chi-Square Test
Sex				$\chi^2 = 25.909$, df = 2, $p < 0.001$
Male	Unfavorable	32	38.6	
	Undecided	1	1.2	
	Favorable	50	60.2	
Female	Unfavorable	22	59.5	
	Undecided	8	21.6	
	Favorable	7	18.9	
Education Level				$\chi^2 = 34.579$, df = 4, $p < 0.001$
Informal	Unfavorable	25	71.4	
	Undecided	6	17.1	
	Favorable	4	11.4	
Primary	Unfavorable	29	39.2	
	Undecided	3	4.1	
	Favorable	42	56.8	
Secondary	Unfavorable	0	0.0	
	Undecided	0	0.0	
	Favorable	11	100.0	
Marital Status				$\chi^2 = 5.088$, df = 2, p = 0.079
Unmarried	Unfavorable	9	75.0	
	Undecided	0	0.0	
	Favorable	3	25.0	
Married	Unfavorable	45	41.7	
	Undecided	9	8.3	
	Favorable	54	50.0	

4.5 Discussion

The findings of this study illuminate both the potential and the persistent challenges of organic spice farming in the Uluguru Mountains, offering critical insights into farmers' attitudes, practices, and barriers within the framework of the Theory of Planned Behavior (TPB) (Ajzen, 1991). The high adoption rate of organic practices (86.7%) underscores the effectiveness of Sustainable Agriculture Tanzania's (SAT) training and market linkage programs, which have fostered awareness of organic farming's environmental and economic benefits (SAT, 2020). Notably, 95.0% of farmers recognized environmental benefits, such as enhanced soil fertility and biodiversity through shade trees and perennial crops like cloves, aligning with global organic agriculture trends that emphasize ecological sustainability (Willer *et al.*, 2024). Similarly, 84.2% acknowledged the premium prices associated with certified spices, reflecting positive outcome beliefs that, per TPB, drive favourable attitudes and behavioural intentions (Fishbein & Ajzen, 1975).

Despite these opportunities, the near-equal split between favourable (47.5%) and unfavourable (45.0%) attitudes reveals significant ambivalence among farmers, driven by structural and economic barriers that undermine perceived behavioural control, a core TPB construct (Ajzen, 1991). Logistic regression analysis provides deeper insights into these dynamics, identifying sex, education, market inefficiencies, and storage issues as significant predictors of attitudes (χ^2 = 45.321, df = 8, p < 0.001; Nagelkerke R^2 = 0.426). Male farmers were 6.6 times more likely to hold favourable attitudes than female farmers (OR = 6.634, 95% CI: 2.433–18.092, p < 0.001), reflecting gender disparities in access to land, resources, and training, consistent with broader agricultural gender gaps in Tanzania (Doss et al., 2018). Farmers with secondary education were 19.9 times more likely to have favourable attitudes compared to those with informal education (OR = 19.854, 95% CI: 2.199–179.234, p = 0.008), highlighting education's role in understanding complex organic standards and certification processes (Malkanthi, 2020). Conversely, market inefficiencies (OR = 0.291, 95% CI: 0.116–0.729, p = 0.008) and inadequate storage (OR = 0.333, 95% CI: 0.113–0.985, p = 0.047) significantly reduced the likelihood of favourable attitudes, underscoring how external constraints erode farmers' confidence in organic farming's viability (Sok *et al.*, 2021).

Key challenges further contextualize these attitudinal patterns. Fungal diseases, affecting 84.5% of farmers (χ^2 = 12.345, df = 4, p = 0.015), particularly on black pepper, were a major barrier, leading to significant yield losses and reinforcing perceptions of organic farming as resource-intensive (Karmawati *et al.*, 2020). Qualitative data from key informants highlighted limited access to effective organic pest control, such as SAT's neem-based solutions, exacerbating these challenges. A farmer from Mfumbwe village noted, *"Fungal diseases destroy our pepper crops, and we lack affordable solutions to protect our yields" (Farmer, January 25, 2020).* Market inefficiencies, impacting 64.9% of farmers, were driven by middlemen exploitation, with farmers receiving low prices due to limited market information and bargaining power. This aligns with Barrett (2008), who emphasizes the role of cooperatives in improving smallholder market access. Inadequate storage facilities, affecting 24.1% of farmers (χ^2 = 6.789, df = 1, p = 0.009), forced premature sales of perishable spices like turmeric and ginger, further reducing profitability. An extension officer from Mtombozi ward stated, *"Without proper storage, farmers sell at a loss, which discourages them from continuing organic practices" (Extension Officer, January 23, 2020).*

The TPB framework elucidates how these challenges shape farmers' attitudes and intentions. Positive attitudes toward environmental benefits and premium prices reflect strong belief-based evaluations, but low perceived behavioural control, due to fungal diseases, market barriers, and storage limitations, hinders sustained engagement (Sok *et al.*, 2021). The high agreement (89.2%) on perceived government neglect of the spice sector further weakens subjective norms, as farmers feel unsupported by policy frameworks, reducing their motivation to adopt organic practices (Läpple & Kelley, 2013). The logistic regression findings highlight socio-demographic disparities, with women and less-educated farmers facing greater barriers, likely due to limited access to land, training, and financial resources (Adebisi-Adelani *et al.*, 2012). For instance, only 18.9% of female farmers held favourable attitudes compared to 60.2% of male farmers, underscoring the need for gender-inclusive interventions to address inequities (FAO, 2012).

These findings have significant implications for sustainable organic spice farming in the Uluguru Mountains. The high adoption rate and recognition of environmental benefits suggest a strong foundation for scaling organic practices, but addressing structural barriers is critical to translating positive attitudes into sustained behaviours. Interventions should prioritize developing disease-resistant crop varieties to combat fungal infections, as recommended by Ngowi et al. (2021). Establishing farmer cooperatives could mitigate market inefficiencies by enhancing bargaining power and access to price information (Barrett, 2008). Investments in cost-effective storage solutions, such as solar dryers, would reduce post-harvest losses and improve profitability (Kitinoja & Barrett, 2015). Gender-focused training programs, targeting women and less-educated farmers, could bridge disparities in knowledge and resource access, fostering more equitable participation (Doss et al., 2018). Finally, integrating organic spice farming into national agricultural policies with incentives like subsidies could strengthen subjective norms and perceived behavioural control, aligning with Tanzania's sustainable development goals (Willer *et al.*, 2024).

In conclusion, while SAT's interventions have fostered high organic adoption and positive attitudes, economic and structural barriers create ambivalence that limits the sustainability of organic spice farming. The logistic regression results underscore the need for targeted interventions to address gender and education disparities, market inefficiencies, and storage challenges. By aligning solutions with TPB's constructs, stakeholders can enhance farmers' intentions to sustain organic practices, contributing to environmental conservation and equitable livelihoods in the Uluguru Mountains.

5.0 Conclusions and Recommendations

5.1 Conclusions

This study examined agronomic practices, challenges, and attitudes toward organic spice farming among smallholder farmers on the Uluguru Mountains' slopes, uncovering both potential and significant barriers. Most farmers (86.7%) adopted organic methods, valuing environmental benefits (95.0% agreement) and premium prices for certified spices (84.2% agreement), supported by training from Sustainable Agriculture Tanzania. However, profitability is constrained by fungal diseases affecting 84.5% of farmers (χ^2 = 12.345, df = 4, p = 0.015), middlemen-driven market exploitation impacting 64.6%, and inadequate storage forcing 19.0% to sell at low prices ($\chi^2 = 6.723$, df = 1, p = These factors foster mixed attitudes, with 47.5% of farmers holding favorable views and 45.0% unfavorable, reflecting economic challenges that weaken confidence in sustained engagement.

Socio-demographic disparities further shape perceptions. Male farmers (60.2%) and those with secondary education (82%) were significantly more likely to favor organic practices ($\chi^2 = 25.909$, df = 2, $p < 0.001$; $\chi^2 = 34.579$, df = 4, $p < 0.001$), highlighting inequities in access to land, training, and market opportunities. Women and less-educated individuals face greater obstacles, limiting their participation. Smallholder farms (77.5% with 1–3 hectares) and labor-intensive methods hinder scalability, reducing economic returns. Despite these challenges, organic spice farming is widely accepted and holds promise for sustainable livelihoods and environmental conservation if structural barriers are addressed.

5.2 Recommendations

To enhance the viability and inclusivity of organic spice farming, the following targeted actions are recommended:

i. ***Develop Disease-Resistant Crops***: Agricultural research institutions should breed and distribute fungal-resistant black pepper varieties to combat the 84.5% pest prevalence, ensuring smallholders can access these through affordable programs.

ii. ***Improve Storage Solutions***: Provide farmers with cost-effective solar dryers and ventilated storage units for turmeric and ginger to reduce post-harvest losses (19.0% affected), enabling better price negotiation.

iii. ***Form Farmer Cooperatives***: Establish cooperatives to improve market access, reduce reliance on middlemen (64.6% prevalence), and ensure fair pricing through collective bargaining and transparent price information.

iv. ***Offer Gender-Focused Training***: Develop training programs for women on certification, grading, and value addition to bridge the gender gap (30.8% female participation) and empower female farmers.

v. ***Promote Policy Support***: Integrate organic spice farming into national environmental and agricultural policies, offering incentives like subsidies to support sustainable practices.

vi. ***Enhance Infrastructure***: Upgrade rural roads and bridges in spice-producing areas to ensure reliable market access, especially during rainy seasons.

vii. ***Expand Extension Services***: Increase access to ongoing training on organic methods and market literacy, targeting less-educated farmers to foster positive attitudes and skills.

Declaration of Conflict of Interest

We hereby declare that there are no known competing financial interests or personal relationships that could have influenced the research and findings presented in this paper.

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