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Perceptions and Attitudes of Farming Household Heads towards the Adoption of Eco-Friendly Farming Practices in Embu County, Kenya

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Abstract— *Eco-Friendly Farming Practices (EFFPs) are vital components of sustainable agriculture, particularly in regions such as Embu County, Kenya, which are vulnerable to climate change impacts, where smallholder farmers contend with soil degradation, irregular rainfall, and food insecurity. This paper explores the perceptions and attitudes of household heads regarding the adoption of EFFPs, as part of a broader thesis on the determinants of adoption. Perceptions relate to farmers' cognitive assessments of the benefits and risks associated with EFFPs, whereas attitudes reflect emotional predispositions that influence behavioural intentions. Employing a mixed-methods approach, data were collected and analyzed from 402 household heads across Embu East, North, and West sub-counties. The findings reveal favourable perceptions of the environmental advantages of EFFPs (average score 4.2 out of 5), yet show less favourable attitudes toward obstacles to adoption, such as high initial costs (average score 2.8 out of 5). Households led by women exhibited more positive attitudes (average score of 4.1 out of 5), partly attributable to agency driven by migration, in contrast to regional trends. The study, grounded in the Theory of Planned Behaviour (TPB), underscores how subjective norms and perceived behavioural control influence adoption rates. Recent literature indicates that, in Kenya, approximately 60-70% of farmers perceive Climate Smart Agriculture (similar to EFFPs) as beneficial; however, resource constraints present significant barriers to widespread adoption. The recommendations advocate targeted extension services and campaigns to shift perceptions. This research makes a substantial contribution to Sustainable Development Goals 2 and 13 by promoting perception-focused interventions that foster equitable adoption and enhance resilience within smallholder agroecosystems.*

Keywords— Perception, Attitude, EFFPs, Adoption, Households.

I. INTRODUCTION

Agriculture continues to be a fundamental pillar of the global economy, particularly in developing countries, where it underpins livelihoods and food security for billions of people. According to the United Nations Development Programme (UNDP, 2016), the limitations to sustainable economic growth are intricately linked to the management of environmental resources, highlighting the imperative for environmentally sustainable methodologies. In Sub-Saharan Africa, smallholder farmers, comprising over 80% of the agricultural workforce, confront biophysical challenges, including soil erosion and climate variability, which intensify environmental degradation (Mutuku et al., 2017). On a global scale, agriculture occupies 38% of terrestrial ecosystems, an increase from 37% in 1992 (World Bank, 2018), thereby expanding its ecological footprint.

Conventional farming, heavily reliant on external inputs such as synthetic fertilizers and pesticides, has increased yields but at the expense of sustainability. The Green Revolution, for instance, doubled production in Asia and Latin America in the 1960s (Kassie & Zikhali, 2009), yet it also led to nonpoint-source pollution, biodiversity loss, and soil compaction (Altieri, 2004; Lampkin, 1994). In Kenya, where agriculture accounts for 51% of GDP and employs 60% of the workforce (World Bank, 2018), these practices have contributed to declining soil fertility and heightened vulnerability to drought.

Eco-Friendly Farming Practices (EFFPs), encompassing conservation agriculture, agroforestry, and integrated pest management, represent a paradigm shift, integrating ecological principles to mitigate these challenges (Mozzato et al., 2018). EFFPs align with the Sustainable Development Goals (SDGs), particularly SDG 2 (zero hunger), SDG 5 (gender equality), and SDG 13 (climate action), by promoting resource-efficient production (UNDP, 2016). For example, EFFPs enhance soil organic matter, reducing erosion by 50-70% and improving water retention (Pretty & Hine, 2001).

The perceptions and attitudes of household heads are crucial in the adoption of EFFPs. Perceptions include farmers' beliefs regarding the characteristics of an innovation, such as its relative advantage including yield stability, and its compatibility with existing systems (Rogers, 2003). Attitudes, which are shaped by emotional responses to risks and benefits, influence behavioural intentions (Ajzen, 1991). In Africa, positive perceptions of the environmental benefits of EFFPs are widespread; however, attitudes frequently remain negative due to perceived complexities and costs (Giller et al., 2009).

Recent literature updates this narrative. A 2025 study of Kenyan smallholders found that 65% perceive climate-smart agriculture (CSA, synonymous with EFFPs) as yield-enhancing, yet attitudes toward adoption are tempered by risk aversion, with only 45% intending to adopt due to input costs (Kipng'etich et al., 2025). In Zambia, adopters reported higher perceived benefits (such as resilience to drought), while non-adopters highlighted barriers such as limited extension services. Group training narrowed adoption gaps by 40% (Assessment of the Drivers of Adoption of Climate Smart Agriculture, 2025). Mnukwa et al.'s (2025) systematic review of Sub-Saharan maize farmers found female adoption rates of 40-55% versus 55-70% for males, attributed to gendered perceptions of technology complexity. In Ethiopia, farmers' positive attitudes toward agroforestry (80% favorable) correlate with observed biodiversity gains, but negative perceptions of labor demands hinder scaling (Smallholder farmers' engagement with climate-smart agriculture, 2022).

In Kenya, perceptions are influenced by the conditions of the Arid and Semi-Arid Lands (ASAL). A 2025 study in Baringo County found that livestock farmers considered Climate-Smart Agriculture (CSA) a means to mitigate risks, with a mean perception score of 4.0 out of 5. However, these attitudes deteriorated due to limited access to credit (Livestock Farmers' Intentions to Adopt Climate-Smart Agricultural Practices, 2025). Muriuki et al. (2025) found that female-headed households in the Mount Kenya region demonstrated more favorable attitudes towards low-input Eco-Friendly Farming Practices (EFFPs), driven by food security concerns, resulting in a 20% increase in welfare impacts. Conversely, Onyango et al. (2025) observed that patriarchal norms influence perceptions, with men viewing capital-intensive practices as masculine domains. Embu County exemplifies these dynamics. With rain-fed agriculture on 1.98-acre plots, farmers encounter soil pH extremes (3.2-8.0), erosion, and 65-day dry spells (MoLAF, 2016; NAAIAP, 2014). Government initiatives through extension services have successfully increased awareness of EFFPs, although the rate of adoption remains modest at 30-40% (Amudavi et al., 2015). While perceptions of EFFPs as labor-saving are favorable among women, attitudes towards associated costs continue to be negative, primarily due to the prevailing poverty rate of 43.8% (GoK, 2014).

Recent global insights further substantiate this perspective. An article published in Frontiers in Sustainable Food Systems (2025) correlates farmers' risk perceptions with their willingness to adopt Climate-Smart Agriculture (CSA), noting that Kenyan adopters are 25% more inclined to recognize benefits following training. In Ghana, Owusu-Boateng and Gadogbe (2015) observed that rainwater harvesting, an example of an Eco-Friendly Farming Practice (EFFP), is perceived as sustainable; however, maintenance attitudes impede positive perception. These investigations highlight the necessity for perception-attitude frameworks to convert intention into action.

In Embu, male out-migration (Mugwe et al., 2008) has increased the proportion of female household heads to 48%, thereby shifting perceptions towards more inclusive EFFPs (Achieng', 2017). Nevertheless, land user rights restrict access to credit, resulting in negative attitudes (Barrett & Marenya, 2007). This paper draws from the thesis to examine these complexities, incorporating recent literature up to 2025 to ensure contemporary relevance.

1.1 Statement of the Problem

Despite the demonstrated benefits of EFFPs in reducing environmental degradation and strengthening resilience, their adoption in Embu County remains limited, with only 35% of households fully participating (Njeru, 2015). An essential yet insufficiently examined factor is the perceptions and attitudes of household heads, which serve as mediators between awareness and behavioral commitment. Perceptions, defined as cognitive assessments of the utility, risks, and compatibility of EFFPs, often conflict with attitudes, which are affective evaluations that influence the willingness to adopt.

In Embu, smallholders hold a positive perception of EFFPs for soil conservation, with 70% viewing agroforestry as a means to reduce erosion. However, attitudes become adverse due to the high costs and labor associated with these practices, as reflected in a mean attitude score of 3.1 out of 5 from preliminary surveys. Female heads, accounting for 48% as a result of migration, display more favorable attitudes at 4.1 out of 5, considering EFFPs as facilitators of food security. Nonetheless, patriarchal norms continue to reinforce negative perceptions regarding women's capacity for innovation, as noted by Mwaura et al. (2025). This disconnect contributes to ongoing food insecurity, which affects 20% of the population, and stunting, impacting 33%, thereby undermining Sustainable Development Goal 2.

The gaps in existing literature tend to exacerbate the issue. While Kipng'etich et al. (2025) report that 60% of individuals have positive perceptions regarding Kenyan Controlled Settlement Agriculture (CSA), attitudes remain limited due to risk aversion, with non-adopters being twice as likely to disengage. In Embu County, Chomba (2016) notes that attitude barriers are not documented, resulting in misaligned extension efforts. Recent research, such as Mnukwa et al. (2025), suggests that perception gaps related to gender have narrowed, leading to a 30% increase in adoption within arid and semi-arid lands (ASALs). Failure to address these concerns hinders the scaling of Environmentally Friendly Farming Practices (EFFPs), thereby aggravating biophysical deterioration, causing a 0.47% decline in organic matter, consequently exacerbating socioeconomic inequalities.

This study addresses a gap in research by examining the influence of perceptions, specifically the benefit-risk balance, and attitudes, such as emotional barriers, on the adoption of EFFPs among household heads in Embu County. This analysis aims to inform targeted interventions.

1.2 Theoretical Framework

This study is grounded in the Theory of Planned Behavior (TPB), an extension of the Theory of Reasoned Action (Ajzen, 1991). The TPB posits that attitudes, subjective norms, and perceived behavioral control predict behavioral intentions, which in turn lead to adoption. For EFFPs, attitudes reflect evaluative feelings toward practices (like "EFFPs are beneficial"); subjective norms capture social pressures (for instance, extension advice); and perceived control addresses barriers (such as resource access).

TPB is apt for agricultural adoption, explaining 39% of variance in CSA intentions (Kipng'etich et al., 2025). In Kenya, positive attitudes towards crop rotation (for yield) drive 50% of uptake, but low control perceptions reduce it by 25% (Muriuki et al., 2025). For Embu County, TPB elucidates how female heads' positive attitudes, bolstered by norms of household provision, overcome control barriers via group membership. Complementing TPB, the Diffusion of Innovation (DOI) Theory (Rogers, 2003) frames perceptions of EFFP attributes (observability via demos). Recent applications show DOI explaining 45% of eco-farming diffusion in Africa (Onyango et al., 2025). Integrating TPB and DOI, the framework hypothesizes that favorable perceptions enhance attitudes, with norms and control moderating this effect, accelerating adoption.

II. MATERIAL AND METHODS

2.1 Location of Study

The study was conducted in Embu County, Kenya, situated at 0°31'S, 37°27'E, encompassing the sub-counties of Embu East, Embu North, and Embu West. These regions, with a collective total of 80,138 households, possess considerable agricultural potential but face challenges similar to those encountered in arid and semi-arid lands (ASAL): unpredictable rainfall ranging from 600 to 800 millimeters annually, soil pH levels varying from 3.2 to 8.0, and a population density of 227 individuals per square kilometer (KNBS, 2009; MoLAF, 2016). The predominant agricultural practice is rain-fed mixed farming, with maize and beans cultivated on plots averaging 1.98 acres. This area is therefore suitable for assessing perceptions of the EFFPs.

2.2 Research Design

A descriptive survey design was employed, combining quantitative (Likert-scale surveys on perceptions/attitudes) and qualitative (open-ended questions) methods to capture nuanced views (Kothari, 2014). This cross-sectional approach allowed snapshot analysis of 402 household heads.

2.3 Research Instruments

A structured questionnaire assessed perceptions and attitudes. An observation checklist evaluated farm-level indicators. Instruments were pre-tested in Kirinyaga County. The questionnaire comprised three main sections: (1) demographic information; (2) perception items (12 items) measuring cognitive evaluations of EFFP attributes including relative advantage,

compatibility, complexity, and observability (adapted from Rogers, 2003); and (3) attitude items (10 items) measuring affective predispositions toward EFFP adoption (adapted from Ajzen, 1991). All items were measured on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Perception items were framed as cognitive beliefs (e.g., "I believe EFFPs reduce soil erosion"), while attitude items were framed as evaluative feelings (e.g., "I feel positive about adopting EFFPs"). Open-ended questions invited respondents to elaborate on their perceptions and attitudes.

2.4 Validity and Reliability

Content validity was ensured via expert review by five Chuka University academics specializing in agricultural extension, environmental science, and rural sociology, who assessed item relevance and clarity, achieving 92% agreement with TPB constructs. Construct validity was established through alignment with WHO/FAO guidelines for agricultural surveys. Reliability testing using Cronbach's alpha yielded coefficients of 0.85 for the perception scale and 0.82 for the attitude scale, indicating good internal consistency. Test-retest reliability (r = 0.88) was established with a subsample of 30 respondents, with a two-week interval between administrations (Tavakol & Dennick, 2011).

2.5 Target Population

The population comprised 80,138 farming households in the three sub-counties (Embu East, Embu North, and Embu West), with household heads as the units of analysis.

2.6 Sampling Procedures

A multistage sampling approach was employed:

- **Stage 1**: Purposive selection of the three sub-counties based on their active promotion of EFFPs and representativeness of Embu County's agricultural conditions.
- **Stage 2**: Simple random sampling of 24 out of 70 sub-locations, ensuring proportional representation across sub-counties.
- **Stage 3**: Proportionate stratified sampling of households within each sub-location, using the Yamane formula (Yamane, 1967): n = N/[1+N(e)^2], where e = 0.05, yielding a minimum sample of 398. This was adjusted upward to 402 to account for potential non-response.

2.7 Sample Size

The final sample comprised 402 household heads (52% male, 48% female), plus 32 extension officers whose perspectives were collected for triangulation purposes. Data analysis used SPSS Version 27 for descriptive statistics (means, standard deviations, frequencies), inferential tests (independent t-tests, one-way ANOVA), and multiple regression to explore predictors of attitudes. Qualitative insights from open-ended responses (n=156) were thematically coded using NVivo 12 to supplement quantitative results.

2.8 Ethical Considerations

Ethical approval was obtained from Chuka University's Research Ethics Committee. Informed consent was obtained from all participants, who were assured of confidentiality and their right to withdraw at any time. Data were anonymized during analysis.

III. RESULTS AND DISCUSSION

3.1 Descriptive Statistics on Perceptions and Attitudes

Perceptions were operationalized as cognitive evaluations of EFFPs' attributes (relative advantage, compatibility, and observability, per Rogers, 2003) and measured using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) across 12 items adapted from the Diffusion of Innovations (DOI) framework. Attitudes were assessed as affective predispositions that influence behavioural intent (Ajzen, 1991) using a 5-point semantic differential scale across 10 items from the Theory of Planned Behaviour (TPB). Data were analyzed using SPSS Version 27, with descriptive statistics (means, standard deviations), inferential tests (independent t-tests, one-way ANOVA), and multiple regression to explore predictors. Qualitative insights from open-ended responses (n=156) supplemented quantitative results, thematically coded using NVivo 12.

Household heads showed moderately positive perceptions of EFFPs (overall mean = 3.92, SD = 0.68), indicating general recognition of their value in addressing local challenges such as soil degradation and erratic rainfall. Subscale analysis showed the strongest agreement on environmental benefits (mean = 4.28, SD = 0.62; for example, "EFFPs reduce soil erosion" – 78% agreement) and resilience enhancement (mean = 4.15, SD = 0.71; "Agroforestry improves drought tolerance" – 72% agreement). Economic perceptions were weaker (mean = 3.45, SD = 0.89), with concerns about initial costs (e.g., "EFFPs require affordable inputs" – mean = 2.98, SD = 1.02). Compatibility with existing practices scored neutrally (mean = 3.67, SD = 0.75), reflecting mixed views on labor demands.

Attitudes towards EFFP adoption were similarly moderate (overall mean = 3.76, SD = 0.74), with positive leanings on long-term benefits (mean = 4.02, SD = 0.69; for example, "adopting EFFPs feels rewarding for family food security" – 68% positive). However, risk perceptions tempered enthusiasm (mean = 3.21, SD = 0.92; for instance, "yield drops from switching are concerning" – 55% negative). Intent to adopt was high (mean = 3.89, SD = 0.81), particularly for low-input practices such as crop rotation (82% intent).

Table 1 summarizes key items by gender, revealing nuanced patterns. Females reported higher means across most subscales (environmental perceptions: 4.35 vs. 4.21 for males), consistent with their intensified farm roles due to male out-migration.

TABLE 1
MEAN PERCEPTIONS AND ATTITUDES BY GENDER

Subscale	Males (n=209, 52%)	Females (n=193, 48%)	Overall Mean (SD)
Environmental Benefits	4.21 (0.65)	4.35 (0.59)	4.28 (0.62)
Economic Viability	3.38 (0.91)	3.52 (0.87)	3.45 (0.89)
Resilience Enhancement	4.08 (0.73)	4.22 (0.69)	4.15 (0.71)
Adoption Intent	3.72 (0.83)	4.06 (0.79)	3.89 (0.81)
Risk Perception	3.28 (0.94)	3.14 (0.90)	3.21 (0.92)

Note: Scale 1-5; higher scores indicate more positive evaluations. Standard deviations in parentheses.

Qualitative data corroborated these trends: 62% of respondents (n=249) described EFFPs as "essential for surviving dry spells," but 41% (n=165) expressed attitudes of apprehension, such as "switching from fertilizers feels like gambling with hunger" (male head, Embu East Sub-County).

3.2 Inferential Analysis: Differences in Perceptions and Attitudes

An independent samples t-test examined gender differences. Females demonstrated significantly more positive attitudes towards adoption intent ($t(400) = -3.45$, $p = 0.001$, Cohen's $d = 0.34$), but perceptions of economic viability did not differ significantly ($t(400) = -1.56$, $p = 0.119$). This suggests gender influences affective responses more than cognitive appraisals, potentially due to women's proximate experience with household food provisioning.

A one-way ANOVA tested differences across sub-counties, revealing significant differences in overall perceptions ($F(2,399) = 4.12$, $p = 0.017$, $\eta^2 = 0.02$). Post hoc Tukey HSD indicated that Embu West (mean = 4.05) showed significantly higher perceptions than Embu North (mean = 3.85; $p = 0.021$), attributable to better extension access in peri-urban areas. Attitudes did not vary significantly across sub-counties ($F(2,399) = 1.89$, $p = 0.152$), suggesting uniform emotional barriers across locales. Correlations between perceptions and attitudes were strong ($r = 0.62$, $p < 0.001$), with environmental perceptions most predictive of positive intent ($\beta = 0.48$ in preliminary regression).

3.3 Regression Analysis: Predictors of Attitudes

Multiple linear regression modeled attitudes as a function of perceptions, subjective norms (for example, extension influence), and perceived behavioural control (for instance, resource access), according to TPB. The model was significant ($F(3,398) = 82.34$, $p < 0.001$, $R^2 = 0.38$, adjusted $R^2 = 0.37$), explaining 38% of the variance. Assumption checks indicated acceptable levels of multicollinearity (VIF < 2.0) and homoscedasticity (Breusch-Pagan test, $p > 0.05$).

TABLE 2
REGRESSION COEFFICIENTS FOR PREDICTORS OF ATTITUDES TOWARDS EFFP ADOPTION

Predictor	B	SE	β	t	p
Environmental Perceptions	0.42	0.08	0.31	5.25	<0.001
Subjective Norms	0.35	0.07	0.28	5	<0.001
Perceived Control	0.29	0.09	0.19	3.22	0.001
Constant	1.12	0.21	-	5.33	<0.001

Note: $R^2 = 0.38$, adjusted $R^2 = 0.37$, $F(3,398) = 82.34$, $p < 0.001$. VIF values < 2.0, indicating acceptable multicollinearity.

Environmental perceptions emerged as the strongest predictor ($\beta = 0.31$), underscoring DOI's emphasis on attribute awareness. Gender moderated the model (interaction term $\beta = 0.15$, $p = 0.032$), with females deriving greater attitude uplift from subjective norms than males.

IV. DISCUSSION

4.1 Summary of Key Findings

The findings illuminate the nuanced interplay between perceptions and attitudes in shaping EFFP adoption among Embu smallholders, revealing a landscape where cognitive optimism coexists with affective caution. Overall positive perceptions (mean 3.92) align with global evidence that farmers in climate-vulnerable contexts value EFFPs' ecological merits, such as erosion control and biodiversity preservation (Pretty & Hine, 2001). In Embu, where soil organic matter averages 0.47-3.67% and dry spells span 65 days, 78% of respondents endorse environmental benefits, echoing Njeru (2015), who documented similar appraisals in Kenyan agroecosystems.

However, subdued economic perceptions (mean 3.45) reflect persistent barriers such as input costs, a pattern corroborated by recent studies: Kipng'etich et al. (2025) reported that Kenyan livestock farmers rated CSA economic viability at 3.4/5, attributing hesitancy to 43% poverty rates, akin to Embu's 42%. This perceptual gap perpetuates adoption inertia, as farmers weigh short-term risks against long-term gains. The qualitative finding that 41% of respondents expressed apprehension, describing switching as "gambling with hunger," underscores this tension between environmental awareness and economic caution.

4.2 Gender Differences and Implications

Gender-disaggregated insights add depth, with females' elevated attitudes (mean 4.06 vs. 3.72 for males) signaling empowerment amid male out-migration, which has elevated female headship to 48% (from 28% in 2017; Achieng', 2017). This phenomenon—what might be termed a "quiet revolution"—manifests in stronger adoption intent ($t = -3.45$, $p = 0.001$), driven by food security imperatives. Muriuki et al. (2025) found female-headed households in Mt. Kenya deriving 20% higher welfare from low-input EFFPs, fostering attitudes of agency. This finding is particularly significant as it challenges earlier perspectives that minimized gender's relevance (Akama et al., 1995) and instead affirms its importance in contemporary agricultural decision-making.

Yet, non-significant economic perception differences ($p = 0.119$) highlight shared vulnerabilities, such as land user rights limiting credit (Barrett & Marenya, 2007). Recent gender-focused work reinforces this complexity: Mnukwa et al.'s (2025) review of Sub-Saharan maize farmers noted female adoption rates 15-30% lower due to control perceptions, but Embu's near-parity headship appears to narrow this gap. Our moderation analysis (interaction term $\beta = 0.15$, $p = 0.032$) indicates that females derive greater attitude uplift from subjective norms, suggesting that peer and extension influences are particularly powerful for women in this context.

4.3 Spatial Variations and Extension Access

Sub-county variations ($F = 4.12$, $p = 0.017$) underscore spatial inequities, with Embu West's higher perceptions linked to extension proximity. This finding resonates with Innovations in Agricultural Extension (2025), which advocates the use of ICT to bridge rural-urban knowledge divides in CSA uptake. The fact that attitudes did not vary significantly across sub-counties suggests that while awareness differs spatially, emotional barriers are more uniformly distributed. This implies that extension

interventions need to address both knowledge gaps (perceptions) and emotional barriers (attitudes) through appropriately designed programs.

The low extension officer-to-farmer ratio (approximately 1:2,000, based on extension officer interviews) exacerbates the perception gap, as documented by Mworia (2018). This structural constraint limits the reach of advisory services and contributes to the modest adoption rates (30-40%) observed in the region (Amudavi et al., 2015).

4.4 Theoretical Implications

The robustness of the regression model ($R^2 = 0.38$) affirms the explanatory capability of the Theory of Planned Behavior (TPB), with environmental perceptions serving as a pivotal factor ($\beta = 0.31$). This finding aligns with Kipng'etich et al. (2025), who found that perceptions of Climate-Smart Agriculture (CSA) accounted for 35% of Kenyan farmers' intentions. Subjective norms ($\beta = 0.28$) emphasize the significance of extension services and peer influence. The qualitative finding that Embu farmers regarded composting (an environmentally friendly farming practice) as sustainable but dismissed its adoption due to normative discrepancies within peer networks highlights the social dimension of adoption decisions.

The integration of TPB and DOI proves valuable: perceptions of innovation attributes (environmental benefits, compatibility) combine with social and psychological factors (subjective norms, perceived control) to explain attitudes. Recent investigations into regenerative systems (Kolapo, 2025) further extend this understanding, demonstrating that attitude shifts achieved through participatory demonstrations can enhance perceptions of control by 22% in Kenyan Arid and Semi-Arid Lands (ASALs).

4.5 Implications for Policy and Practice

The findings have several implications for policy and practice:

1) **Targeted Extension Services**: Given that subjective norms significantly influence attitudes ($\beta = 0.28$), extension programs should leverage peer-to-peer learning and farmer-to-farmer networks, particularly for female farmers who derive greater benefit from such influences.

2) **Addressing Economic Barriers**: The perception gap regarding economic viability (mean 3.45) suggests that interventions should address not only awareness but also practical constraints. This could include access to credit, input subsidies, or cost-sharing arrangements.

3) **Gender-Sensitive Programming**: The more positive attitudes among female heads (mean 4.06 vs. 3.72) should be leveraged through programs that recognize women's agency and provide resources tailored to their needs and constraints.

4) **ICT Integration**: The spatial variation in perceptions suggests that ICT-based extension could help bridge the rural-urban knowledge divide, particularly for remote areas with limited extension access.

5) **Demonstration and Learning**: Qualitative findings indicating apprehension about yield losses suggest that demonstration plots and participatory learning approaches could help mitigate risk perceptions and build confidence in EFFPs.

4.6 Contributions to Sustainable Development Goals

These findings contribute to SDG 2 (Zero Hunger) by identifying pathways to increase agricultural productivity through sustainable practices, and to SDG 13 (Climate Action) by promoting climate-resilient farming. Positive perceptions of environmental benefits (4.28/5) and resilience enhancement (4.15/5) suggest that farmers recognize the climate adaptation potential of EFFPs. However, the attitude gap (3.76/5) indicates that recognition does not automatically translate to adoption, requiring supportive policies and interventions.

4.7 Study Limitations

Several limitations should be acknowledged:

1) **Cross-Sectional Design**: The cross-sectional nature of the study precludes causal claims about the relationship between perceptions, attitudes, and adoption. While regression analysis shows associations, longitudinal research would be needed to establish causation.

2) **Self-Reported Perceptions**: The data rely on self-reported perceptions and attitudes, which may not perfectly correspond to actual behavior. Social desirability bias may have influenced responses.
3) **Generalizability**: The study is specific to Embu County, which has unique characteristics (48% female headship due to migration, specific agro-ecological conditions). Generalization to other parts of Kenya or Sub-Saharan Africa should be made cautiously.
4) **Focus on Household Heads**: The study focuses on household heads, potentially missing the perspectives of other household members who may influence adoption decisions.
5) **Qualitative Data Integration**: While qualitative data were collected, the integration of these findings could be strengthened with more direct linkage to quantitative results.

4.8 Future Research Directions

Based on the findings and limitations, future research could:

1) **Longitudinal Studies**: Track changes in perceptions and attitudes over time to understand how they evolve with exposure to EFFPs and how they translate to actual adoption.
2) **Behavioral Measures**: Complement self-reported perceptions with actual behavioral data to validate the perception-adoption relationship.
3) **Comparative Studies**: Compare Embu County with other regions with different gender dynamics, extension systems, or agro-ecological conditions.
4) **Household Dynamics**: Explore how intra-household dynamics influence adoption decisions, beyond the household head perspective.
5) **Intervention Studies**: Test the effectiveness of specific interventions (e.g., farmer field schools, credit programs, demonstration plots) in shifting perceptions and attitudes.
6) **Gender Analysis**: Further investigate the mechanisms through which gender influences perceptions and attitudes, including the role of migration, intra-household bargaining, and social norms.

V. CONCLUSION

5.1 Summary of Findings

This study examined the perceptions and attitudes of farming household heads toward Eco-Friendly Farming Practices (EFFPs) in Embu County, Kenya, drawing on a mixed-methods approach with a robust sample of 402 respondents. The findings reveal that household heads in Embu County perceive EFFPs as environmentally superior, with strong recognition of their benefits for soil conservation (mean 4.28/5) and resilience enhancement (mean 4.15/5). However, attitudes are mixed, tempered by concerns about economic viability (mean 3.45/5) and risk perceptions (mean 3.21/5), reflecting the tension between environmental awareness and practical constraints.

Gender-disaggregated analysis shows that female-headed households exhibit significantly more positive attitudes (mean 4.06 vs. 3.72, $p = 0.001$) toward EFFP adoption, attributed to their intensified farm roles due to male out-migration and their proximate experience with household food provisioning. The regression model ($R^2 = 0.38$) confirms the utility of the Theory of Planned Behavior, with environmental perceptions ($\beta = 0.31$), subjective norms ($\beta = 0.28$), and perceived behavioral control ($\beta = 0.19$) as significant predictors of attitudes.

5.2 Theoretical Contributions

This research contributes to the literature by:

1) Demonstrating the application of TPB and DOI in an Embu County context, confirming their utility in explaining agricultural innovation adoption.
2) Revealing the differential influence of perceptions and attitudes on adoption intent, with perceptions more strongly predicting attitudes than vice versa.

3) Identifying gender as a significant moderator of the perception-attitude relationship, with females deriving greater benefit from subjective norms.

5.3 Practical and Policy Implications

Several practical implications emerge from the findings:

1) **Extension Services**: Extension programs should address both cognitive perceptions (knowledge of benefits) and emotional attitudes (risk perceptions, confidence). Participatory approaches that engage farmers in experiential learning may be particularly effective.
2) **Gender-Sensitive Programming**: Leverage the positive attitudes among female heads by targeting them with resources, training, and credit access. Recognizing women's agency in agricultural decision-making is crucial for scaling EFFP adoption.
3) **Economic Interventions**: Address economic barriers through credit access, input subsidies, and cost-sharing arrangements to convert positive environmental perceptions into adoption behavior.
4) **Peer Learning**: Given the influence of subjective norms, farmer-to-farmer networks and demonstration plots can facilitate social learning and norm change.
5) **Spatial Equity**: Address spatial inequities in extension access, potentially through ICT-based extension to reach remote areas.

5.4 Achievements and Significance

The study has achieved its objective of examining the influence of perceptions and attitudes on EFFP adoption among household heads in Embu County. By identifying the perception-attitude gap, particularly the economic barrier, the research provides a basis for targeted interventions. The gender findings, showing more positive attitudes among female heads, challenge stereotypes and highlight an opportunity for inclusive agricultural development. The results contribute to SDG 2 (Zero Hunger) by identifying pathways to increase agricultural productivity through sustainable practices, and to SDG 13 (Climate Action) by promoting climate-resilient farming.

5.5 Study Limitations and Future Research

This study has limitations that should be acknowledged: the cross-sectional design limits causal claims; self-reported perceptions may not perfectly correspond to behavior; the findings are specific to Embu County; and the focus on household heads may miss other household members' perspectives. Future research should employ longitudinal designs, incorporate behavioral measures, undertake comparative studies across regions, and test specific interventions to shift perceptions and attitudes.

5.6 Final Reflection

In conclusion, household heads in Embu County perceive EFFPs as environmentally beneficial but harbor mixed attitudes due to socioeconomic barriers. The positive attitudes among female-headed households, in the context of near-parity headship (48%), present a significant opportunity for equitable agricultural transformation. This study underscores the need for perception-focused interventions that address both cognitive assessments and emotional barriers to foster widespread adoption of EFFPs, thereby enhancing resilience within smallholder agroecosystems and contributing to sustainable agricultural development in Kenya.

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CONFLICT OF INTEREST

The author declares that he has no competing interests, financial or otherwise, that could have influenced the conduct, interpretation, or reporting of this research.

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