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EXPLORING FARMERS' AWARENESS AND KEY DETERMINANTS OF ELECTRIC FENCING ADOPTION IN JERANTUT, PAHANG

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Abstract: *Farmers often encounter challenges when their crops, especially fruit trees, begin to bear fruit. They face significant threats from mammals like cattle, monkeys, and squirrels that feed on fruits. This impacts their financial costs due to early-season losses and necessitates effective mitigation strategies. Consequently, many farmers have turned to electric fencing to protect their crops from mammalian attacks. A study conducted among farmers in Jerantut, Pahang, surveyed 42 respondents to assess their awareness and adoption of electric fencing. It found that farmers in the region displayed a high awareness of electric fencing as a solution to mitigate mammal-related crop damage. The study identified several influential factors affecting the adoption of electric fencing, including geographical location, promotion by extension agents, peer reviews, and environmental benefits. Statistical analyses revealed strong positive correlations between farmers' awareness of electric fencing benefits, environmental concerns, and promotional efforts from agricultural extension services and agribusiness companies. These findings underscore the importance of targeted interventions by policymakers and agricultural educators to enhance the adoption of electric fencing among smallholder farmers, particularly in rural areas. Future research should further investigate the efficacy of electric fencing in improving crop production and reducing mammalian threats in agricultural settings, aiming to support sustainable farming practices and enhance overall agricultural productivity.*

Keywords: *Crop Protection, Electric Fencing, Farmers' Awareness, Mammalian Threats*

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Introduction

Agriculture is a vital part of Malaysia's economy, contributing significantly to the nation's GDP (7.79% in 2023, according to Statista, 2024). The Malaysian community needs to recognize and support this sector. However, farming faces significant challenges, notably the intrusion of wild mammals. These animals can cause extensive crop damage, leading to substantial financial losses for farmers. For example, Kamaruddin (2020) reported losses of RM2.6 million for farmers in Terengganu over three years due to wildlife attacks. Beyond crop damage, animals like elephants and tigers can also destroy farm infrastructure, wasting farmers' time, energy, and resources. While various control measures such as ditches and barbed wire fences have been implemented, these solutions often lack effectiveness and are not cost-efficient (Amin, 2023). Consequently, many farmers have turned to electric fencing as a more reliable method for protecting agricultural land and nearby residential areas from wildlife intrusion. Despite the growing use of electric fencing, there is limited empirical evidence to support its effectiveness or assess farmers' awareness of its benefits. Therefore, this study aims to explore the level of awareness among farmers in Jerantut, Pahang, regarding the adoption of electric fencing and to identify the key factors influencing its adoption as a strategy to mitigate wildlife-related challenges.

Literature Review

Globally, wild mammal attacks pose a significant challenge for farmers, leading to increased crop damage and wildlife-induced losses (Ghimire et al., 2022). Animals like deer, wild pigs, and elephants can severely damage crops, causing substantial yield reductions and financial burdens. Farmers utilise various control methods, including chemical, mechanical, and physical barriers. Among these, electric fences are recognized as a highly effective solution for mitigating human-wildlife conflicts (Conover, 2001). Electric fencing has demonstrated its effectiveness in deterring wild animal intrusions, thereby protecting farmers' crops from damage. A study in Kelantan, Malaysia (Hassan et al., 2017), evaluating strategies for managing human-wildlife conflict, found that while several measures were recommended to authorities, only the implementation of electric fencing in orchards showed a significant positive impact.

A Japanese study (Honda et al., 2009) demonstrated the effectiveness of new electric fence designs in completely preventing crop damage from medium and large mammals. Animals avoided the fenced areas, seemingly learning from observed shocks, resulting in undamaged crops, higher yields, and reduced losses. These results highlight electric fencing's success in deterring various mammal species. Likewise, Dorjee (2016) found high satisfaction with electric fencing as a human-wildlife conflict mitigation tool in its early years of use, reporting 100% effectiveness against species like sambar deer, barking deer, and leopards. Prior research indicates that conventional livestock fences often fail to deter wild mammals (Negus et al., 2019). However, Laguna et al. (2022) found that consistent weekly maintenance significantly improves the effectiveness of fences in preventing wild boar intrusions, leading to reduced crop damage and enhanced farm productivity.

The application and adoption of electric fencing among farmers are influenced by various interrelated factors that shape decision-making in agricultural practices. Among the key determinants identified are economic considerations, geographical location, types of crops and livestock, technological infrastructure, and peer influence. For example, Sapkota et al. (2014) found that initial setup costs and maintenance expenses significantly affect farmers' cost–benefit assessments of electric fencing in Nepal. The high-value crops, like fruit trees or vulnerable livestock, often justify investment in protective measures due to the greater risk of

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financial loss. Similarly, Feuerbacher et al. (2021) emphasize that the type of crops and land-use patterns directly influence farmers' perceptions of electric fencing's effectiveness and practicality. Recognizing and addressing these factors is essential for promoting the effective adoption of electric fencing, particularly in rural farming communities where appropriate support and informed decision-making can significantly enhance agricultural resilience and productivity.

Methodology

This study used a survey to collect information from 47 registered farmers in Jerantut, Pahang, who had received agricultural assistance from the Department of Agriculture. The number of participants was sufficient for this analysis with a 95% confidence level (Raosoft, 2023). The survey had three main parts. The first part asked about the farmers' backgrounds. The second part assessed how much the farmers knew about using electric fencing. The final part looked at what factors influenced their decision to use electric fencing in their farming. This study analysed the collected data using a statistical software program (SPSS version 28). The analysis included looking at percentages and averages to answer the research questions. This study also used correlation and regression analyses to understand the factors that influence the use of electric fencing and how these factors relate to the farmers' awareness of it.

Results and Discussion

Reliability Analysis

Table 1 presents the reliability analysis, assessing the consistency of the questionnaire items. Farmers' awareness of electric fencing showed high internal consistency (Cronbach's Alpha = 0.89 across six items), indicating the questions reliably measured the same concept. Factors influencing electric fence application demonstrated acceptable reliability (Cronbach's Alpha = 0.73 across five items). Overall, the questionnaire exhibited adequate internal consistency, making it suitable for this research.

Table 1: Reliability Analysis

Variable	Cronbach's Alpha	No. of items
Farmers' awareness of using electric fencing	0.89	6
Factors that influence the electric fences	0.73	5

Demographic Profiles of Farmers

The study population exhibited a significant gender imbalance, with the vast majority (90.5%) being male (Table 2). Most farmers (62%) were between 31 and 50 years old, while smaller groups were younger (19-30) or older (over 60). Moreover, age is a known factor influencing agricultural technology adoption (Melesse, 2018), suggesting it may affect electric fencing decisions. In this study, most of the respondents were Malay (88%), with most having tertiary (54.8%) or secondary (40.4%) education. Higher education levels are linked to increased farm productivity among technology adopters (Paltasingh & Goyari, 2018). Most farms (88.1%) were located near rural villages, and a third held MyGAP certification. Individual ownership was the dominant farm structure (90.5%). In terms of land status, freehold land ownership was the most common (71.4%), which is known to encourage long-term farm investments (Dissanayake et al., 2022). Most farms were medium-sized (2-10 hectares), while smaller farms (<1 hectare) constituted 23.8%. Over half of the farms had a monthly production of under 1 tonne per hectare. Approximately half of the farmers earned a monthly income between

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RM2501 and RM5000, with 28.6% earning less. Consistent with Wu (2022), farms with potentially more arable land may experience greater income benefits from adopting new technologies.

Table 2: Demographic Profiles

Items	Category	Frequency	Percentage (%)
Gender	Male	38	90.5
	Female	4	9.5
Age	< 30	4	9.5
	31 – 50	26	62.0
	> 51	12	28.5
Race/ Ethnicity	Malay	37	88
	Chinese	5	12
Highest educational background	Primary school	2	4.8
	Secondary school	17	40.4
	Tertiary education	23	54.8
Location of the farm area	Near villages (rural area)	37	88.1
	Near forest	5	11.9
Scheme and certification received from the DOA	None	13	31
	MyGAP	14	33.3
	Others	15	35.7
Ownership of agricultural land	Individual ownership	38	90.5
	Tenant entirely (rent)	3	7.1
	Joint tenancy	1	2.4
Types of land ownership	Freehold	30	71.4
	Leasehold	1	2.4
	Bumiputera Lot	8	19.1
	Malay Reserve Land	3	7.1
Agricultural farm size (Ha)	< 1 ha	10	23.8
	2 – 10 ha	30	71.4
	> 11 ha	2	4.8
Yield (tonne) per ha (monthly average)	< 1 Tonne/ha	22	52.4
	1 – 5 Tonne/ha	20	47.6
Average agricultural income per month (RM)	< RM2500	12	28.6
	RM2501 – RM5000	21	50.0
	> RM5001	9	21.4

Farmers' Awareness of the Application of Electric Fencing

Table 3 indicates a high level of awareness regarding electric fencing among farmers in Jerantut, Pahang. All farmers acknowledged mammal attacks on their farms, with 90% exhibiting strong awareness. This underscores the prevalence of human-wildlife conflict, as highlighted by IUCN (2023), which can lead to detrimental actions. Crop damage from wildlife significantly impacts farmer income globally (Raphela & Pillay, 2021; Bolds et al., 2022). A substantial majority (67%) were also moderately aware of the common use of electric fences, consistent with findings in Tanzania (Matata et al., 2022), where farmers recognise their effectiveness. Only a small minority (12%) showed a lack of awareness, potentially due to farm size, fewer animal threats, or reliance on alternative methods.

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A significant majority of farmers (67%) showed modest awareness of electric fencing's effectiveness in deterring mammal attacks. This aligns with studies in Bhutan (Chedup et al., 2023) and Paro Dzongkhag (Tshering et al., 2019), where farmers reported satisfaction and improved yields. Researchers in Guinea-Bissau (Gonzalez et al., 2017) also recommended it for human-wildlife conflict. In this study, most farmers believed that electric fencing improves farm management and is more cost-effective than traditional crop guarding, primarily due to reduced labour requirements (Feuerbacher et al., 2021). Although farmers in this study showed awareness of electric fencing, their low level of agreement with the statement that it increases production may be linked to several demographic and farm-related factors. While 90.5% of farmers had individual ownership and 71.4% held freehold land, which typically encourages long-term investment in improvements like fencing, many still view electric fencing as simply a protective tool rather than a means to actively boost output (Jahangirpour and Zibaei, 2022). Farmers often prioritize investments that deliver immediate, measurable returns, such as fertilizers or irrigation systems, because these directly enhance yield per hectare (Wang et al., 2020).

Table 3: Farmers' Awareness of the Application of Electric Fencing (N=42)

Item No.	Items	Percentage (%)					μ	Std. Dev.	Decision
		NAA	NA	SA	A	VA			
1	Aware of mammal attacks	0	0	0	10	90	4.90	0.297	High awareness
2	Aware that many farmers use electric fences on the farm	10	2	0	21	67	4.33	1.243	Moderate awareness
3	Aware that electric fencing deters mammal attacks	12	2	0	19	67	4.26	1.345	Moderate awareness
4	Aware of the benefits of using electric fences	12	2	0	19	67	4.26	1.345	Moderate awareness
5	Aware that electric fences improve farm management	17	2	5	17	59	4.00	1.514	Moderate awareness
6	Aware that electric fences increase production	17	2	5	19	57	3.98	1.506	Less awareness

NAA = Not at all aware, NA = Not aware, SA = Somewhat aware, A = Aware, VA = Very aware, μ = sample mean, Std. Dev. = standard deviation. Decision – weightage average = 25.73/6 = **4.29**

Factors that Influence the Application of Electric Fencing

Table 4 shows that geographic location (74%) and peer reviews (69%) significantly influence electric fence adoption among farmers in Jerantut, Pahang. The prevalence of local wildlife, such as deer and wild boar, often necessitates electric fencing, which has proven effective in preventing interactions (Khouri et al., 2022) and mitigating economic damage (Wang et al., 2023). Positive experiences shared by peers also encourage adoption. Furthermore, educational initiatives, like videos (Walsh et al., 2023), can significantly increase farmers' support for electric fencing, highlighting its potential for improving welfare, conservation, and livelihoods.

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Extension services (μ = 4.52) and environmental concerns (μ = 4.38) were also key factors influencing electric fencing adoption. Extension services play a vital role in educating farmers about new technologies (Dendup et al., 2023). Active promotion of electric fencing through workshops and support from extension services can moderately increase its adoption rates. Additionally, the environmentally conscious farmers may choose electric fencing to protect crops and livestock without harming wildlife or the ecosystem, offering a non-chemical alternative for pest deterrence. However, government initiatives have the least influence on the adoption of electric fencing, as reflected by a low mean score of 2.14, indicating farmers' dissatisfaction. Without sufficient support from government or agency programs, the resources or motivation to invest in new technologies may be lacking among farmers

Table 4: Factors Influencing the Application of Electric Fencing (N=42)

Item No.	Items	Percentage (%)					μ	Std. Dev.	Decision
		SD	D	N	A	SA			
1	Geographic location and severity of attacks	5	0	0	21	74	4.59	0.912	High influence
2	Peer-reviewed effectiveness	5	0	0	26	69	4.55	0.916	High influence
3	Government support for technology adoption	57	12	5	12	14	2.14	1.556	Less influence
4	Promotion by extension services and agribusinesses	7	0	0	19	74	4.52	1.064	High influence
5	Environmental benefits from reduced chemical use	10	2	0	21	67	4.38	1.103	High influence

SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree, μ = sample mean, Std. Dev. = standard deviation. Decision – weightage average = 16.18/5 = **3.24**

Correlation Analysis

Farmers more aware of electric fencing also show significantly greater concern for the environment (r=.901, p<.001), as shown in Table 5. This is likely because electric fences help lower the need for harmful chemicals like pesticides, thus reducing pollution and safeguarding wildlife. Furthermore, a strong link exists between environmental concerns and the promotion of electric fencing by agricultural support services and businesses (r=.906, p<.001). This indicates that as people become more environmentally conscious, these organisations are more inclined to advocate for electric fencing. Research in eastern Bhutan's Pemagatshel District, where farmers often face issues with wildlife and crop damage and rely on extension services for farming information (Dendup et al., 2023), highlights the need for comprehensive agricultural information. This includes details on government initiatives, market opportunities, and the latest farming technologies and innovations. Farmers who are more aware that electric fences can stop mammal attacks are also more likely to see these fences promoted by agricultural support services and businesses (r=.737, p<.001). This suggests that when farmers understand the benefits of electric fencing, these organisations increase their efforts to promote it. Previous studies support this idea. For example, research by Saifan et al. (2021) and He et al. (2020) showed that farmers who have access to extension services are more likely to adopt new farming technologies. All the relationships observed in our study were strong and reliable (p<.01). Based on these findings, the hypothesis proposed in this study has been confirmed.

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H1: A significant relationship exists between farmers' awareness level and the factors influencing the electric fencing application.

Table 5: Correlation Analysis Between Awareness and Factors Influencing the Application of Electric Fencing

Variable		Awareness of the use of electric fences can deter mammal attacks	Environmental concerns as electric fences, can minimise the use of chemicals	Promotion of electric fencing by extension services and agribusiness companies
Awareness of the use of electric fences can deter mammal attacks	Pearson Correlation Sig. (2-tailed) N	1 42	.901** <.001 42	.737** <.001 42
Environmental concerns as electric fences, can minimise the use of chemicals	Pearson Correlation Sig. (2-tailed) N	.901** <.001 42	1 42	.906** <.001 42
Promotion of electric fencing by extension services and agribusiness companies	Pearson Correlation Sig. (2-tailed) N	.737** <.001 42	.906** <.001 42	1 42

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

Regression Analysis

Table 6 shows a strong positive relationship between the predictors (environmental concerns and promotion of electric fencing) and the outcome variable, with R = .921 and R^2 = .847. This means that about 84.7% of the variance in farmers' awareness of electric fences deterring mammal attacks can be explained by these two factors. Table 7 further supports this with a high F-statistic value of 108.251, which is statistically significant at the 0.05 level ($p < .001$), indicating that the predictors meaningfully contribute to explaining the variance in farmers' awareness of electric fence effectiveness. Moreover, Table 8 shows that farmers with stronger environmental concerns tend to be less aware of electric fencing (B=-0.559, p=0.005). Specifically, for every step up in environmental concern, awareness of electric fencing goes down by about half a step. This is a statistically significant trend, indicating a moderate negative link (Beta = -0.443). On the other hand, actively promoting electric fencing has a significant positive impact on farmers' awareness (B 1.587, Beta = 1.302, p<0.001). For each unit increase in promotion efforts, awareness of electric fencing jumps up by nearly one and a half units. This strong and highly significant relationship underscores the crucial role that promotion plays in making farmers more knowledgeable about the benefits of electric fencing

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Table 6: Model Summary (b)

Model	R	R Square	Adjusted R Square	Std error of the Estimate
1	.921[a]	.847	.840	.53860

a. Predictors: (Constant), Environmental concerns as electric fences can minimise the use of chemicals, Promotion of electric fencing by extension services and agribusiness companies

Table 7: ANOVA Table

Model		Sum of Square	df	Mean Square	F	Sig.
1	Regression	62.806	2	31.403	108.251	<.001[b]
	Residual	11.314	39	.290		
	Total	74.119	41			

a. Dependent Variable: Awareness of electric fences can deter mammal attacks
b. Predictors: (Constant), Environmental concerns as electric fences can minimise the use of chemicals, Promotion of electric fencing by extension services and agribusiness companies

Table 8: Coefficients

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std Error	Beta	t	Sig.
1	(Constant)	-.161	.368		-.439	.663
	Environmental concerns as electric fences can minimise the use of chemicals	-.559	.186	-.443	-2.999	.005
	Promotion of electric fencing by extension services and agribusiness companies	1.587	.180	1.302	8.823	<.001

a. Dependent Variable: Awareness of electric fences can deter mammal attacks

Conclusion and Recommendation

The study found that farmers in Jerantut, Pahang, are generally aware of the effectiveness of electric fencing in preventing mammal attacks, as reflected by the highest mean score (μ = 4.90). This suggests a strong understanding among farmers regarding the application and benefits of electric fencing, particularly in improving farm management. However, responses to item 6 showed a lower level of agreement (μ = 3.98) regarding the belief that electric fencing increases farm production. This perception may be influenced by the farmers' demographics and farm characteristics, as most earn below RM5,000 per month and report relatively low production levels. As a result, they may prioritise cost-saving measures over investing in technologies they do not directly associate with yield improvement. This study found that several factors influence the adoption of electric fencing among farmers in Jerantut, Pahang. The most influential factors included geographic location, peer testimonials, promotion by extension agents, and environmental benefits, with mean scores of 4.59, 4.55, 4.52, and 4.38, respectively. The installation and effectiveness of electric fencing may vary depending on the farm's topography, with undulating terrain posing more challenges than flat land. Additionally, farmers often depend on peer experiences, and positive feedback from those who have successfully used electric fencing can strongly encourage its adoption. The Pearson analysis revealed a strong positive correlation between farmers' awareness of electric fencing and their environmental concerns ($r = .901$, $p < .001$), suggesting that many perceive electric fencing as

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an environmentally friendly farming solution. Additionally, a significant relationship was found between environmental concerns and promotional efforts ($r = .906$, $p < .001$), indicating that higher environmental awareness corresponds with increased promotion by extension services and agribusinesses. Farmers' awareness was also positively associated with promotional activities ($r = .737$, $p < .001$). Overall, the findings suggest that awareness of electric fencing as a deterrent for mammal attacks is strongly associated with both environmental concerns and targeted promotional initiatives ($R = .921$, $R^2 = .847$). Supporting this, Danso-Abbeam (2018) emphasised that government-led initiatives play a crucial role in boosting the adoption of new technologies. These insights reflect farmers' understanding of electric fencing as both a protective and environmentally conscious farming practice, shaped by the influence of effective promotion. Therefore, policymakers and educators must formulate targeted interventions that promote the adoption of electric fencing as a strategy for mitigating mammal attacks and enhancing agricultural productivity. It is also recommended that the Malaysian government prioritise investments in advanced agricultural education initiatives and the provision of systematic training programs focused on the practical application of electric fencing. Subsequent research endeavours should focus on evaluating the efficacy of electric fencing among smallholder farmers within rural agricultural regions.

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