ECONOMIC AND CONSERVATION IMPACTS OF SEASONAL PADDY FENCES AS A HUMAN-ELEPHANT CONFLICT MITIGATION STRATEGY

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Abstract

This study evaluated the viability of Seasonal Paddy Fences (SPFs) as a Human-Elephant Conflict (HEC) mitigation strategy in rural Sri Lanka. Using primary data from two paddy tracts in the North Central Province, the study employed both a benefit-cost analysis and thematic analysis to assess the financial and conservation impacts of SPFs. The findings enabled the conclusions that the SPFs could significantly enhance farmers' economic outcomes through the reduction of crop damage and labour costs, while they also would foster peaceful coexistence between farmers and elephants by allowing safe access to fallow lands for wild elephants. The study also found that the adoption of SPFs faces, however, could face challenges, including high initial installation costs, negative public perceptions of elephants, and inadequate institutional support. Recommendations that stemmed from the research include improving access to materials, enhancing government emphasis on resource allocation for the initiative and for monitoring its implementation, addressing public attitudes toward elephants, and promoting long-term sustainability through community engagement. The outcomes of the study also call for policy reforms to overcome the barriers hindering the widespread adoption of SPFs, thereby enabling valuable insights to the discourse on sustainable human-wildlife coexistence.

JEL: *Q57, Q15, Q58, D61, Q56*

Keywords*: Wild Elephants; Conservation; Crop raiding; Human-Elephant Conflict; Seasonal Paddy Fences*

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INTRODUCTION

The reduction in elephant habitats has precipitated one of the most long-standing biodiversity issues in Sri Lanka; the Human-Elephant Conflict (HEC), characterised by crop raids, property destruction, human as well as elephant fatalities, and injuries (Shaffer et al., 2019). In rural Sri Lanka, where paddy farming is the primary livelihood for the majority, HEC remains an obstacle to the economic prosperity of farmers, contributing significantly to rural poverty. Crop raiding by elephants stands as the biggest concern for these farmers, and traditional solutions often involve the use of permanent electric fences that are erupted around forest reserves, which serve as "protected areas" for elephants. Despite these efforts to separate elephants from humans, recent studies have revealed that this mechanism has failed to mitigate the conflict sustainably primarily due to the "protected areas" being at or near their carrying capacity (Gunaratne & Premarathne, 2006).

Moreover, the use of trenches, translocation of elephants, use of firearms, and other lethal mechanisms are used to mitigate the conflict. Nevertheless, none of the mitigation mechanisms have been able to provide a sustainable and effective strategy that would pacify both elephants and humans. Instead, the traditional methods of HEC mitigation have intensified the conflict (Fernando et al., 2012).

Alternatively, the construction of permanent electric fences around paddy fields creates challenges primarily in terms of fence guarding during fallow periods and maintenance as well as raises concerns about its impact on elephants (Sajla & Famees, 2022). Also, an unmanned fence during the fallow period will be a "training ground" for elephants to learn to break fences. On the other hand, these fallow lands are essential for elephant survival as the leftover harvest and herbs provide important nutritional values, and the land can be used for foraging (Centre for Conservation and Research - Sri Lanka, n.d.). Therefore, there is a constant tug-of-war between elephants and paddy farmers to fulfil their spatial requirements.

Identifying this friction, the Centre for Conservation and Research (CCR) has introduced the concept of Seasonal Paddy Fences (SPFs). These are a type of seasonal, temporary community-based fence; made up of GI tube posts energised through solar energy. Farmers can set up these fences when cultivation begins, remove them immediately after the harvest, and store them for the next growing season. Between each paddy cultivation season (Yala and Maha), the paddy fields remain fallow for 2-3 months without being used by the farmers. The main goal of this mechanism is not only to protect paddy fields during cultivation but also to enable elephants to access fallow fields without conflict. The Centre for Conservation and Research has implemented this initiative in over 40 paddy tracts adjacent to several villages in Sri Lanka as pilot projects. The smooth functioning of these projects is ensured through 'fence committees comprising of farmers' that are set up to manage the fences.

According to the CCR, Seasonal Paddy Fences appear to have the capacity to mitigate HEC and promote community engagement in elephant conservation efforts, while also creating coexistence between paddy farmers and elephants, as this mechanism allows elephants and paddy farmers to share the land (Centre for Conservation and Research - Sri Lanka, n.d.). Based on that scientific premise, the major objective of this study is to examine the impacts of Seasonal Paddy Fences in the context of Sri Lanka.

The authors have identified two major channels of using SPF; the financial and economic implications for paddy farmers. Therefore, this study will consider comparable paddy tracts of two villages affected by HEC to evaluate the financial and economic viability of implementing SPF in the context of Sri Lanka and the stakeholder's perception regarding the mechanism. The study acknowledges the need for sustainable and effective strategies that promote peaceful coexistence between paddy farmers and elephants. Thus, the research seeks to contribute valuable insights to the broader discourse on elephant conservation and the sustainability of community livelihood.

LITERATURE REVIEW

Over the past few decades, a substantial number of studies have been conducted on various facets of elephant biology, conservation, and ecology. However, the exploration of economic aspects within the realm of elephant conservation in the context of paddy cultivation, especially on Seasonal Paddy Fences or community-based electric fences has been significantly limited. The existing body of literature on elephant conservation primarily revolves around studies related to ivory trade issues or the economic dimensions of ecotourism, with a predominant focus on linear electric fences or translocation of elephants. While crop raiding and the resulting Human-Elephant Conflict (HEC) are acknowledged as major challenges in paddy cultivation, the economic aspects of elephant conservation efforts—and their implications for HEC in paddy cultivation—have received comparatively less attention.

Several studies have identified the extent of the damages caused by HEC in Sri Lanka. According to Gunawansa et al., (2023), in HEC-affected areas of Sri Lanka, it has been estimated that a farmer faces annual losses exceeding USD 200 due to crop damage. The same study reports that 125 people and 370 elephants have been killed annually on average since 2019, due to the conflict. Also, Sri Lanka has recorded the highest annual elephant deaths and second-highest human deaths due to HEC in the world (Gunawansa et al., 2023). The intensity of the conflict varies according to food availability, size of protected areas, agricultural practices, human density, seasonal climate variations, and socio-cultural beliefs.

The continuity of the vast extent of crop damage and human deaths results in creating a social perception of elephants as an ‘agricultural pest’, ‘a nuisance’, and a significant threat to human survival and livelihood (Gunawansa et al., 2023). These negative

perceptions tend to strongly undermine conservation efforts for elephant populations (Vibha et al., 2021). Bandara & Tisdell (2003) highlight the importance of fostering an attitudinal shift among farmers through HEC mitigation mechanisms to promote coexistence. However, their study reveals a deeply rooted negative perception of elephants among farmers in HEC-affected areas, and an effective mitigation mechanism capable of facilitating this change has yet to be identified.

In Sri Lanka, the main HEC mitigation strategy is to confine elephants within protected areas and relocate problematic elephants to national parks away from their original habitat later. These protected areas and parks are then surrounded by electric fences to restrict elephant movement. Thereby, in 2019 and 2020, Sri Lanka spent USD 2.74 million to construct 4,756 Km of linear electric fences (Parliament of Sri Lanka, 2021). Yet, research shows that 80% of translocated elephants return to their original areas, while the remaining 20% end up causing similar issues in new locations (Fernando et al., 2012)

Elephants thrive in diverse settings, such as regenerating forests and open spaces, and therefore, retaliatory measures against elephants result in habitat destruction, endangering biodiversity conservation efforts. The approach of translocating elephants intensifies conflicts, as displaced groups of female and young elephants, suffer high mortality rates. Additionally, disruptions in the natural migration patterns of elephants can lead to ecological imbalances (Fernando et al., 2012).

Several studies have highlighted various limitations in current Human-Elephant Conflict (HEC) mitigation strategies and examined the feasibility of adopting innovative approaches. Although the economic and practical benefits of Seasonal Paddy Fences remain unexplored due to their early-stage pilot implementation, studies on permanent electric fencing offer valuable insights. For instance, Sapkota et al., (2014) have conducted a cost-benefit analysis of electric fencing as a tool for managing Human-Wildlife Conflict (HWC) in agricultural settings in Nepal. This study assessed the impact of electric fencing both before and after installation, identifying multiple economic advantages such as reclaiming previously abandoned land for cultivation, reducing the necessity for watchtower construction, and saving time previously devoted to monitoring. The study concluded that electric fencing is highly cost-effective in mitigating HWC, underscoring its economic viability as an alternative strategy in conflict-prone agricultural areas. These findings suggest that electric fencing—and potentially Seasonal Paddy Fences—could play a key role in reducing HEC if similar results can be achieved.

Additionally, an experimental study by Samaranayake et. al (2023) evaluated the effectiveness of privately funded electric fencing in mitigating Human-Elephant Conflict (HEC) in paddy cultivation and nearby human settlements in the form of a “With-and-Without comparison”. The findings reveal that private investment in electric fencing enhances sustainability, as the responsibility for maintenance falls on the beneficiaries themselves rather than the government. Although the study failed to quantify the benefits

of private fencing, they identified that this arrangement ensures consistent maintenance and minimizes the financial burden on public resources, indicating that private fencing may be a viable, community-driven approach to managing HEC in agricultural and residential areas.

While permanent electric fences have shown some progress in HEC mitigation, the mechanisms receive criticism for disregarding the well-being of elephants. Hart & O'Connell-Rodwell (2000) argue that, because farmers lose potential earnings as a result of crop depredation by elephants, they should be provided with some economic benefits from elephant conservation. In other words, there should be a balance between the need for elephant conservation and fulfilling human interests. The same study demonstrates that farmers take the law into their own hands and go to the extent of harming elephants because they suffer from the constant crop depredation of elephants and this in turn leads to the destruction of elephant populations. Therefore, any HEC mitigation method should be beneficial for both parties.

Owing to the above-mentioned biodiversity complexities and the need to foster coexistence, SPF needs to be evaluated in terms of its financial viability and the impact it creates in HEC mitigation. Acknowledging these aspects and the research gap related to SPF as a possible HEC mitigation mechanism, this study will assess the economic and conservation impacts of SPF as a sustainable mitigation strategy for HEC.

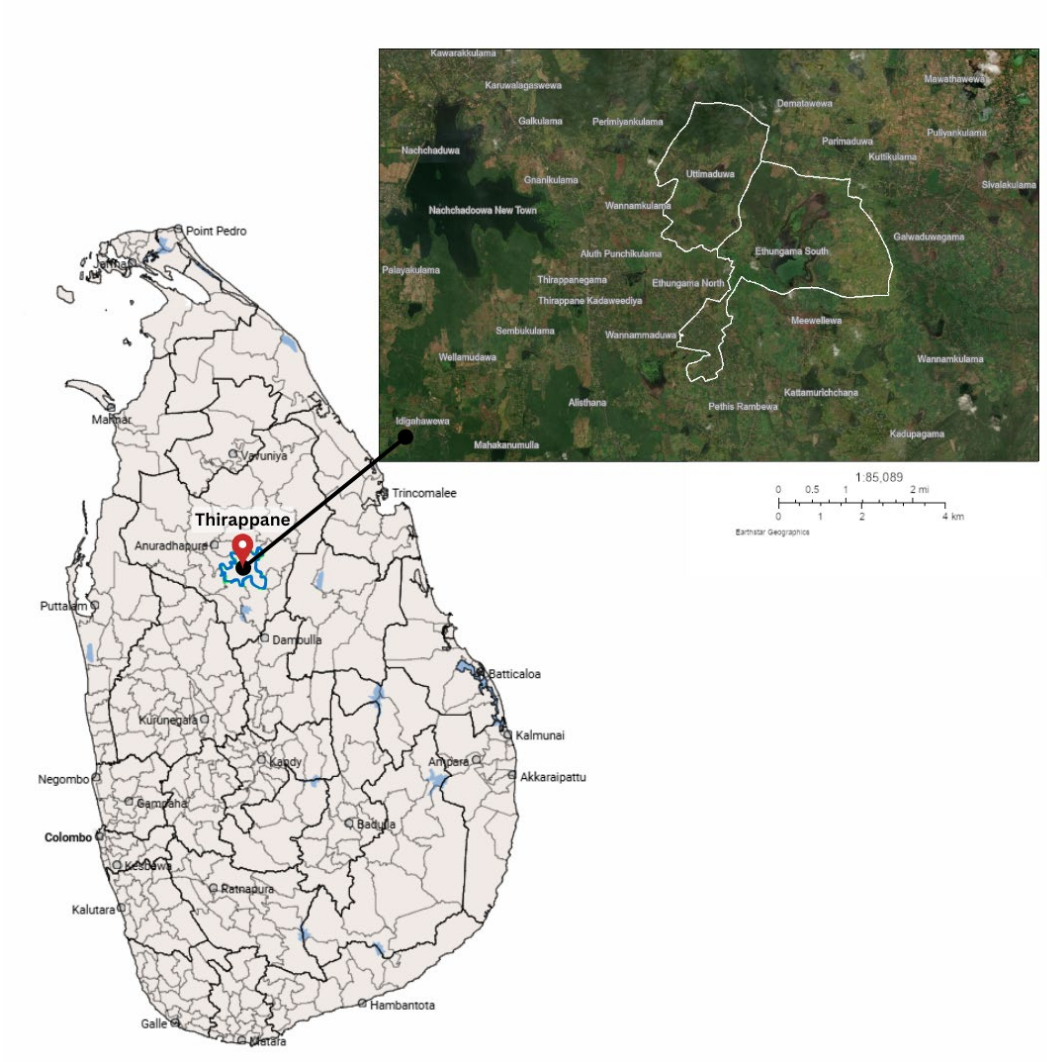
METHODOLOGY

Given the very limited use of SPF in Sri Lanka, the research adopted the case study approach, by selecting two comparable paddy tracts of two villages affected by HEC; one having implemented SPF as a pilot project and the other with no SPF, enabling "with-and-without" comparison (Gunaratne & Premarathne, 2006). Paddy tracts of Eruwewa, Ethungama South village (with SPF), and Uttimaduwa village (without SPF) were therefore selected for stakeholder interviews. These adjacent villages, both located within the Thirappane Divisional Secretariat area, in the Anuradhapura district of the North Central Province, Sri Lanka, have been notably affected by the escalating issue of HEC and have paddy tracts adjacent to the village.

Eruwewa, situated in the 522 Ethungama-South administrative area (Figure 01), houses a population of 208 residents. Notably, the paddy land by this village has been utilizing Seasonal Paddy Fences around their paddy tract since 2018 November (Maha season). On the other hand, the paddy stretch at the border of 520 Uttimaduwa administrative area, does not rely on Seasonal Paddy Fences and has a population of 573 residents. Both of these villages have adjacent paddy tracts in which, paddy is cultivated in both seasons of Yala and Maha. The villages also share similarities in terms of religious and cultural backgrounds, and the two villages are much similar in socio-demographic aspects as well

as geographic and ecological aspects. Therefore, no issues were identified in comparing the impact of HEC on the two paddy tracts.

Figure 01: Map of the two GN divisions; Uttimaduwa and Eruwewa, Ethungama South



Source: Author generated using ArcGIS software and citypopulation.de

Considering the overall similarities between the two villages and their farming practices, a stakeholder interview was conducted with 25 farmers from each village to obtain information on human-elephant conflict with and without fence installation and its effectiveness. Additionally, Key Informant Interviews (KIIs) in the form of semi-structured interviews were also conducted with some of the professionals of the subject matter at hand, for a more in-depth analysis.

This study was two-fold, employing both qualitative and quantitative approaches to explore the impacts of SPF in Sri Lanka. As the first phase of the study, a financial viability analysis was conducted to assess the financial and economic implications for paddy farmers through a comparative Benefit-Cost Analysis (Sapkota et al., 2014). The analysis delved into factors such as reduction in the crop guarding time, expenditure on elephant deterring mechanisms, the cost of installation, efficiency gains in labour, and other tangible and intangible benefits derived from these fences sourced from the stakeholder interviews. Secondly, the thematic analysis aimed at capturing both the qualitative insights gathered from Key Informant Interviews as well as the hybrid data obtained through the stakeholder questionnaire.

Thus, the study assessed the overall effectiveness of Seasonal Paddy Fences in addressing human-elephant conflict and influencing a change in the local attitudes towards elephants.

Financial and economic implications of Seasonal Paddy Fences on paddy farmers

The study focused on the Seasonal Paddy Fence (SPF) used in Eruwewa; a 7 km enclosure erected around a 228-acre paddy tract during each paddy season. The analysis covered the entire 7 km SPF, assuming a 15-year lifespan. The initial installation cost was sourced from the Centre for Conservation and Research, while maintenance and implementation costs were estimated through interviews with the farmers' organization leaders in Eruwewa.

A comprehensive financial analysis was conducted to evaluate the economic implications of the investment towards farmers. The primary methodology employed involved an NPV analysis, taking into consideration the time value of money over the project's lifespan. Despite implementing Seasonal Paddy Fences in Eruwewa in 2018, this study incorporated present investment costs, assuming benefits and costs from the previous cultivating season would persist throughout the investment's life. This approach was adopted in consideration of accommodating the unpredictability of factors such as changes in wages, prices, and import/export regulations over the 15-year investment period.

Furthermore, three key benefit variables were studied in the analysis including the benefit gained from saved paddy, the reduction of expenditure on fireworks, and the value of labour saved per season from the reduction in crop guarding. The cost variables, on the other hand, included 4 factors; the cost of petrol and weedicide for fence maintenance, and the opportunity costs of fence maintenance and fixing the fence.

This quantitative approach was expected to ensure a rigorous examination of the financial prospects of SPF, offering a basis for strategic decision-making and investment planning. Further details on the specific assumptions, calculations, and parameters used in the analysis are outlined in the subsequent sections.

RESULTS AND DISCUSSION

Financial viability analysis

Table 01: Benefit-Cost Analysis of SPF for Full Acreage of Eruwewa

Benefits and Costs	(LKR / Season)
Investment [a]	3,169,580
Summary of Benefits per Season	
Benefit of paddy saved [b]	2,380,320
Benefit from saved firecrackers	13,224
Value of labour saved from reduction in crop guarding[d]	1,890,000
Total Benefits per Season	**4,283,544**
Summary of Costs per Season	
Cost of Petrol for fence maintenance [c]	547,200
Cost for weedicide for fence maintenance [c]	364,800
Opportunity cost of fence maintenance	315,000
Opportunity cost of labour for fixing and removing the fence [d]	420,000
Total Costs per Season	**1,647,000**
Net Present Value with the value of labour saved on crop guarding[e]	24,667,742
Net Present Value without the value of labour saved on crop guarding[e]	4,542,314.4

Source: Author calculations based on stakeholder interview responses and current market prices. Actual costs of erection, maintenance, and removal of Seasonal Paddy Fences were obtained from the Centre for Conservation and Research.

Notes:

(a) The proxy that was taken for the Investment was the cost of material used for fence erection in their current market prices. However, a one-time payment of LKR 3000 was collected for 54 acres of registered paddy fields in Eruwewa to finance the investment by the CCR.

(b) The average yields per acre in the two villages were estimated based on the primary data and its value was estimated through the average current market price of rice. The yields were cross-checked with the data from the Department of Census and Statistics (n.d.) average paddy yield of Anuradhapura District to ensure the reliability of the collected data. Because of the overall similarities between the two villages, the difference in yield per acre was attributed to HEC.

(c) The current market price of petrol and weedicide was taken when doing the analysis.

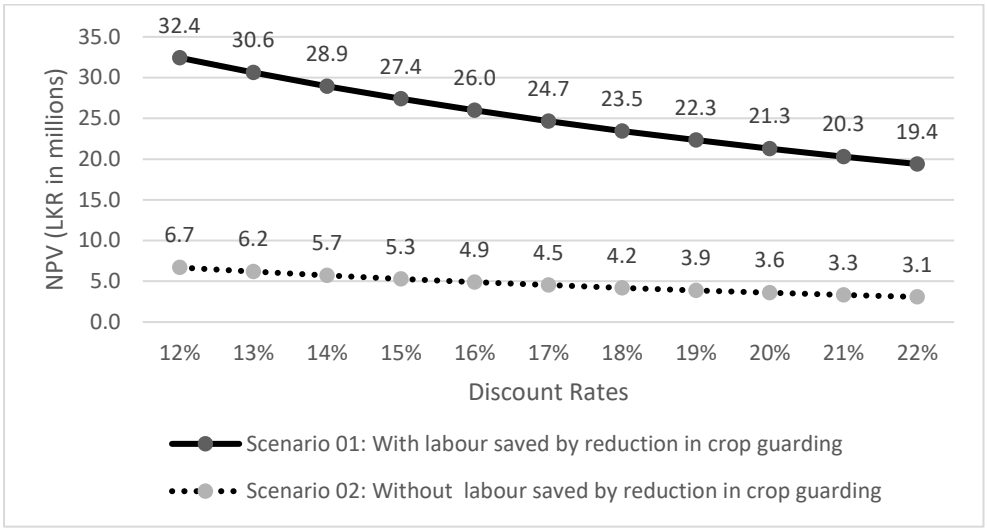
(d) An average daily wage of LKR 2,500 was taken into consideration when estimating the opportunity costs of time and the value of labour following the methodology mentioned by Jenkins (1995).

(e) A financial discount rate of 17% per annum was adopted, and an effective life of 15 years for the capital investment was considered.

The financial viability analysis, as outlined in Table 01 (above), encompassed a range of benefit and cost variables. A main assumption in this analysis pertained to the factors affecting the variance in paddy yield with and without the Seasonal Paddy Fence. Considering the uniformity in soil type, weather conditions, and cultivation practices in both villages, it was assumed that differences in harvest quantity were predominantly linked to damage inflicted by elephants. This assumption guided the calculation of yield per acre, derived from stakeholder questionnaire responses, which indicated a notable variance of 87 kg higher in Eruwewa. By attributing this difference to elephant damage in Uttimaduwa, the subsequent estimation revealed that 19,836 kg of paddy were preserved across the entire 228 acres of paddy land in Eruwewa during 2023 Yala cultivation season, which would have otherwise been lost if Eruwewa had been subjected to the same level of elephant related threats as Uttimaduwa. This finding underscored the effectiveness of the SPF in mitigating crop damage by wild elephants.

To conduct a more in-depth evaluation of the financial viability on the part of the farmer, the NPV analysis was conducted under two scenarios; one, taking the value of labour saved per season from the reduction of the crop guarding time and second, without taking the value of labour saved per season from the reduction of the crop guarding time.[1] The outcomes of the analysis are depicted in Figure 02.

Figure 02: Comparison of NPV under the spectrum of discount rates



Source: Calculations by the authors

[1] The introduction of SPF in Eruwewa reduced the need for manual crop guarding, saving LKR 1.89 Mn in labour cost per season, and significantly decreasing nighttime monitoring of animal raids. While some studies have excluded time saved on crop guarding as a benefit (Sapkota et al., 2014), some others (Feuerbacher et al., 2021) have included it, reflecting differing views on its economic value.

Each of the above-mentioned scenarios was evaluated under a spectrum of discount rates setting 17% as the benchmark.[2] At each of these discount rates, in both scenarios, the NPV were found to be high, suggesting that the use of Seasonal Paddy Fences would be financially viable in the long-term; and thus, farmers could be having a financial incentive to resort to Seasonal Paddy Fences. Since Sri Lanka has been experiencing a severe economic downfall since 2020, the commercial lending rates have been high in the subsequent years. However, this spectrum of discount rates will provide a distinct picture of the financial incentives received by individual farmers based on whether the economy will recover or not.

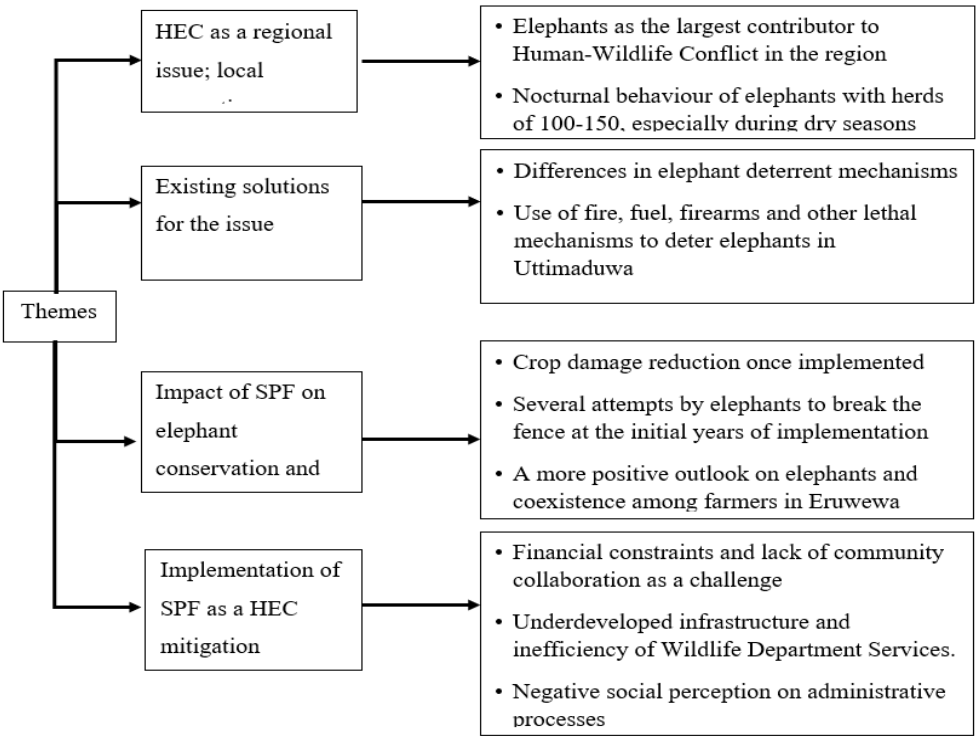
Thematic Analysis

The thematic analysis in this study explored the role of SPFs in mitigating HEC, fostering positive local attitudes toward elephants, and stakeholders' perceptions of its potential as a long-term HEC mitigation strategy in paddy cultivation. This analysis followed a systematic process, specifically the approach outlined by Braun and Clarke (2006), which is widely used for its flexibility and rigour in qualitative research. Data from stakeholder interviews and KIIs were transcribed and thoroughly reviewed to ensure familiarity with the material. Recurring ideas and significant observations were then coded, and these codes were organized into broader categories. Through iterative refinement, four key themes were identified by the authors, as in Figure 03.

The findings discovered elephants to be the primary contributors to Human-Wildlife Conflict, indicating pervasive and regionally prominent challenges imposed by elephants in paddy farming. The compensation value for damages caused by elephants amounted to LKR 1,225,498.50 in 2023. Although there was no crop damage in Eruwewa, an average of 35 complaints of crop damage have been reported to the Department of Wildlife Conservation by the local farmers in Uttimaduwa from 2021 to 2023. Although the crops in Eruwewa remained protected by SPF, the farmers in Uttimaduwa have to spend 2-3 nights per week in their paddy fields guarding their crops from elephants. Furthermore, these farmers tend to use firearms against wild elephants and even use other methods of physically damaging elephants such as shooting with razor blades, using fire and fuel to burn elephants, or creating illegal trenches to deter elephants. However, according to the Wildlife Department officials, it is very rare that these cases get reported and it is challenging to identify the exact perpetrators since injured elephants may relocate to a different region.

[2] As per instructed by several commercial banks in Sri Lanka, the average commercial interest rate amounted to 22% as at November 2023 and this lending rate was adjusted to the average CCPI inflation rate of the past 6 months which was computed to be 4.35%. Thus, a discount rate of 17% was taken into consideration as the benchmark discount rate.

Figure 03: Summary of the thematic analysis



Source: Constructed by the authors

Note: The flowchart provides a general summary of the analysis based on (Penn et al., 2019)

One of the key achievements of the Seasonal Paddy Fences (SPF), as identified in the analysis, is the significant shift in farmers' attitudes toward wild elephants following the installation of fences in Eruwewa. In 2018, before the fences were introduced, elephants affected 37 of the 149 acres of paddy cultivated by the 25 respondents in Eruwewa. Since the installation, crop damage has dropped to zero and has remained so in subsequent seasons. Consequently, while farmers viewed elephants as a major threat to paddy farming before 2018, all respondents in Eruwewa now report that wild elephants no longer pose a problem, provided they do not breach the fence. From the point of view of Wildlife Department officers, SPF functions as a 'psychological barrier' for the elephants that habituate them to remain in the wilderness till access is granted for crop residue in the fallow lands. Consequently, in Eruwewa, a reduction in the use of lethal elephant deterrent mechanisms has been observed by the authorities. Although the elephants are unable to damage the crop, after the harvest is done, the fallow lands are open for elephants to get nutrients and enjoy the land.

Despite the positive perception regarding SPF by the local farmers in Eruwewa and the success of the mechanism in reducing crop damage, a reluctance to privately fund a seasonal paddy fence by farmers was observed in both villages. Several issues were

identified as the causes for this hesitancy. First and foremost, financial constraints were found to be the main obstacle to farmers' willingness to invest in SPF. They further cited that current inflationary situations and the low prices at which the paddy is being purchased by the intermediary parties result in this inability to bear substantial costs. Second, it was also identified that the potential success of SPF can be jeopardized due to underlying conflicts between the individuals of the community. Therefore, addressing these financial and communal challenges could be crucial for the effective implementation of SPF as an HEC mitigation mechanism. Third, the understaffing and resource limitations at the institutional and infrastructural framework were also recognised as a constraint. The Wildlife Department of Sri Lanka operates an office in Thirappane, actively monitoring Human-Wildlife Conflicts across 43 administrative areas; but, the office consists of only five officers, one jeep, and a motorbike. This inadequacy of resources was felt as a potential hindrance of the Department's ability to promptly respond to incidents, gather comprehensive data, and implement proactive measures. These structural issues have caused public dissatisfaction regarding the authorities making farmers reluctant to make complaints to the office of the Department of Wildlife Conservation about crop damage caused by wild elephants.

The financial viability analysis and the thematic analysis were able to evaluate the impacts of Seasonal Paddy Fences in the context of Sri Lanka and the summary of the analytical findings is presented in Table 02.

Table 02: Summary of Findings

Aspect	Findings
The comparative Benefit-Cost Analysis	The results of the analysis indicated the long-term financial viability for farmers with SPF, especially with reduced crop guarding labour costs.
Impact on paddy yield	87 kg higher yield per acre in Eruwewa attributed to reduced elephant damage due to SPF, saving 19,836 kg of paddy overall in the 2023 Yala cultivation season.
Farmers' perception	Positive shift of attitudes in Eruwewa; elephants not perceived as a problem post-SPF installation, with reduced use of lethal deterrents.
Professional's perception	SPF functions as a psychological barrier that habituates them to remain in the wilderness till access is granted for crop residue in the fallow lands.
HEC mitigation	SPF mitigated HEC effectively in Eruwewa; Uttimaduwa continued to experience significant crop damage and HEC issues.
Challenges to SPF adoption	Financial constraints, inflation, low paddy prices, and community conflicts hinder willingness to fund SPF privately.
Structural barriers to long term SPF implementation	The Wildlife Department is understaffed with limited resources, reducing responsiveness and farmer satisfaction.

Source: Authors generated

CONCLUSIONS & RECOMMENDATIONS

The study has critically examined the viability of implementing Seasonal Paddy Fences as a Human-Elephant Conflict (HEC) mitigation mechanism while creating space for coexistence. The findings suggest that Seasonal Paddy Fences are financially viable for the farmers and, therefore, have the potential to be implemented without any third-party intervention. The mechanism not only protects paddy fields during cultivation but also provides a practical solution for preserving fallow periods crucial for elephant foraging and movement. One of the most notable findings is the attitudinal change in paddy farmers towards elephants as a result of SPF, which is crucial to creating coexistence among paddy farmers and elephants but has not been successfully achieved through other HEC mitigation strategies. While the economic and practical feasibility of these fences emerges as a key consideration influencing their acceptability and adoption by farmers, the research identifies several issues that act as barriers to promoting SPF as a mitigation strategy for HEC. Such issues include financial constraints, lack of support by the authorities, hardships in uniting communities, and underdeveloped infrastructure. Therefore, even though, Seasonal Paddy Fences hold promise for transforming the dynamics of coexistence between paddy farmers and elephants, policy interventions should be made to overcome the identified obstacles and to increase the opportunity to harness broader economic and environmental benefits. Moving forward, further research and widespread implementation could contribute to a more sustainable and harmonious relationship between paddy farming communities and elephants in regions prone to human-elephant conflicts.

To improve the financial efficiency of Human-Elephant Conflict (HEC) mitigation efforts, it is recommended that the government focus on reducing maintenance costs related to interventions. This can be achieved by providing subsidies for cost-effective alternatives, such as petrol and weedicide, and implementing efficient maintenance strategies. Additionally, raising awareness among farmers on the advantages of HEC interventions can encourage them to invest saved time in other economic activities, enhancing overall benefits. Community engagement programs are also crucial, as they can foster unity and enable future community-based HEC mitigation efforts. Addressing logistical and staffing shortages at the Wildlife Department Office in Thirappane through better facilities and standardized training for officers will further strengthen local capacity. Infrastructural support should be prioritized for HEC-affected areas to provide necessary resources for these interventions. Finally, a longitudinal study is recommended to assess the sustainability of the intervention, exploring both its economic and biodiversity impacts over time and ideally using a larger sample size.

LIMITATIONS

It should be noted that the long-term outcomes of Seasonal Paddy Fence installation are not yet apparent. According to Wildlife Department Officials, monitoring elephant

injuries and fatalities presents a formidable challenge, as injured elephants might move to different regions, complicating the identification of the specific circumstances and individuals responsible for the injuries. As a result, the study does not encompass the long-term impacts of elephant and human life losses, as well as other economic implications. A more detailed economic analysis in the future should include an evaluation of the economic value associated with human and elephant casualties, the overall economic benefits to the nation, and the potential expansion of agricultural land facilitated by the implementation of Seasonal Paddy Fences.

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