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### RESEARCH ARTICLE

#### HUMAN ANIMAL CONFLICT (HEC) AND ASSOCIATED PROBLEMS: A CASE STUDY IN THIRUKKOVIL DIVISIONAL SECRETARIAT DIVISION, AMPARA DISTRICT

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#### Abstract

Department of Wildlife Conservation reported in 2011 that an Asian elephant (*Elephas maximus*) population of 1573 identified in the Eastern province and which has the second highest population in the country, also created a major Human Elephant conflict (HEC). This study aimed to analyze the HEC and associated problems in the Thirukkivil Divisional Secretariat in the Ampara District. The purposive sampling method was used to collect the primary data through interviews and observations. 40 people including 20 men and 20 women were selected for the study, and affected area data was gathered via observation. Secondary data was obtained from the older literature and Primary and Secondary data were analyzed through SPSS. The Study area has the second-highest Elephant population on the island caused to the high HEC incidents. 9 Grama Niladhari division including Kanchikudiyaru, Sangamam, Thangavelayuthapuram, Thandiyadi, Kanchirankuda, Sangamankiramam, Thirukkivil-04, Thirukkivil-03, and Vinayakapuram are highly affected by the HEC while remaining 13 has the moderate problems. 65% of the elephant attack happened during the December to February Maha season. 2013 to 2020 shows that a totally of 10 human people died and 22 people were injured due to the HEC. Moreover, estimated crop damages within the last seven years in Paddy cultivation, Highland Crops and Chena cultivation, Coconut, Banana, and Vegetables were Rs, 2234550, Rs, 180,500 and Rs.108,000, Rs.145000, Rs.150,000, Rs.125,000 respectively. High property damages occurred during the 2013 period with a cost of Rs.310,000. Human settlement distance from forest is a main cause for HEC and food insecurity, and lack of access to river water and fuelwood are the impacts created by the HEC. Therefore, this study suggests technologies including Bio-fencing, electric-fencing, trip alarms, chili-fences, and watchtowers to minimize the risk associated with HEC. Moreover, conducting awareness Programmes is important to protect the Eco-system and Asian Elephants.

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**Introduction:-**

The International Union for conservation of Nature Red List categorized the Asian Elephant (*Elephas maximus*) as an endangered species. Sri Lanka is home to Asian elephants; the country provides Natural habitats for 10% of Asian elephants. Department of Wildlife Conservation surveyed in 2011 reported an abundant number of elephants reported from the Mahaweli Region. The second highest number of elephants was reported in Eastern with 1573. Wild elephants inhabited both wet and dry zones, even though the majority of the elephant habitats reported in the Dry Sone (Elizabeth & Charles, 2000)

Human Elephant Conflict (HEC) is the most debated issue in Sri Lanka. HEC represents a serious threat to both humans and elephants. This situation creates challenges to the survival of both wild elephants and rural people (Soren et al, 2021). Dry zone forest covers are converted to agricultural landscapes due to monoculture expansion during the colonial period. As a result of large-scale forest clearing for development projects, road construction, human settlements, and agriculture, encroachment on natural habitats, and blockade of elephant migration corridors, the conflict between humans and animals has increased in recent years (Maria et al., 2024). This study analyzes the human-elephant conflict and associated problems in the Thirukovil Divisional Secretariat (DS) division.

**Literature Review:-**

Sri Lanka has the highest elephant and third highest human population within Asia, next to India and Bangladesh. High-density populations lead to a high level of conflict (Prithiviraj & Jennifer, 2011). On the island, almost 250 - 275 elephants and around 90 – 100 humans lose their lives due to HEC every year. Moreover, 14 elephants died due to train hits also in the year of 2008, and 7 elephants' deaths in 2017 caused due to train accidents (Elizabeth & Charles, 2006). Sri Lanka has recorded the highest elephant death cases and second highest human deaths in Asian countries due to the HEC. The human death rate has increased by 42% compared with the past 3 decades. (Thakshila et al, 2023)

Ampara is one of the most HEC conflict reported district in Sri Lanka, between the years of 2005 to 2016 53% of paddy crops, 13% of coconut trees, and 13% of home gardens were destroyed by the wild elephants in the study area. In addition, 12 humans' life losses and 5 elephants' deaths were recorded within the same duration in the Sammanthurai DS division (Ahamad & Rifasa, 2016).

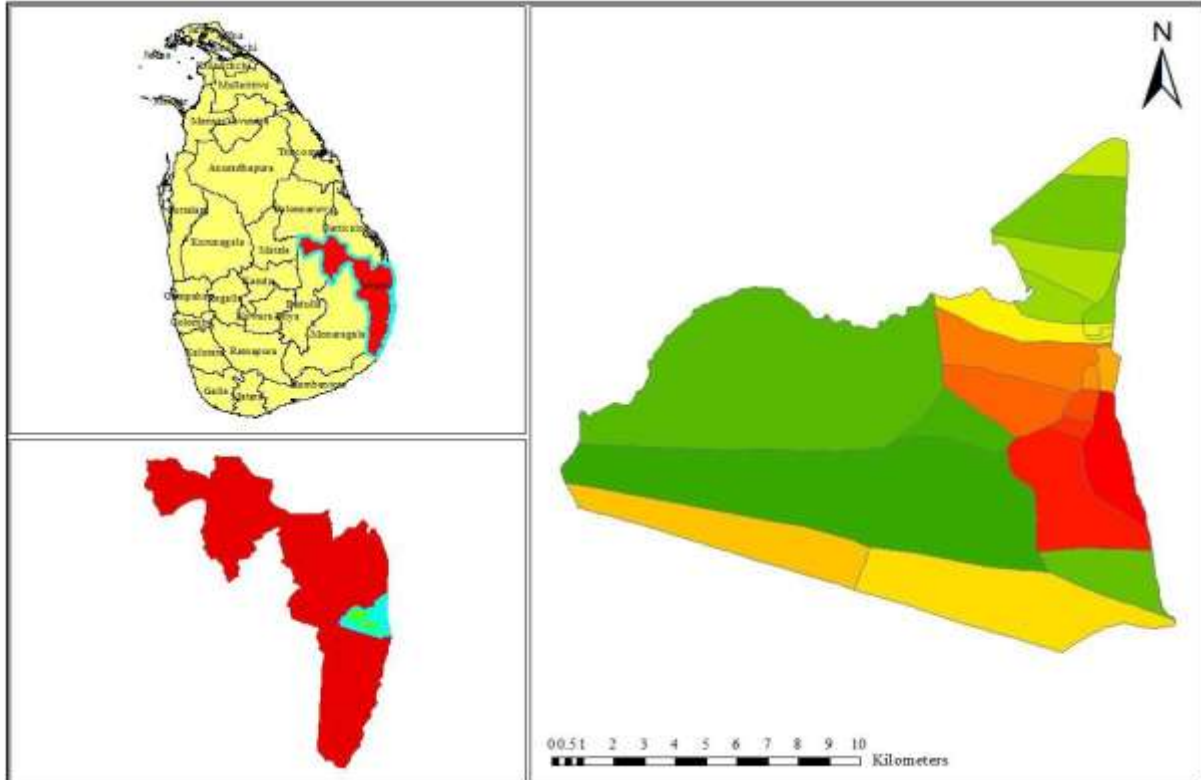
The elephant habitats are destroyed by the people, they are encroaching on elephant territory to expand the agricultural lands and habitats caused by the HEC. In the Thanamalvila DS division, 92.5% of the households were threatened by elephant arrivals in 2009, which means attacks were reported 20 times per year and 61% of attacks occurred during the night time. Chena cultivation, banana, and paddy lands are highly affected in this area (Samaraweera et al, 2011).

The most conflict is intense has been found in Anuradhapura, Ampara, Kurunegala, Puttalam, Monaragala, and Hambantota Districts (International Institute of Environment and Development, 2019) while Badulla district had an excessively high number of property damages (Prakash & Wijeratne, 2020). Hambantota district situated in the southern part of Sri Lanka is one of the major rural areas. During the last few years, HEC increased abundantly due to sudden environmental changes. The former president proposed new projects to develop the area and most of the elephant habitat areas were used to implement the development projects (Ajith, 2012).

Different management practices were introduced by the government to prevent and mitigate the HEC including the Thabuttagama DS division. Even though This village people most commonly follow some techniques to control the damages caused by the HEC' are elephant watch towers and firecrackers (Edirisooriya et al, 2022).

## Study area

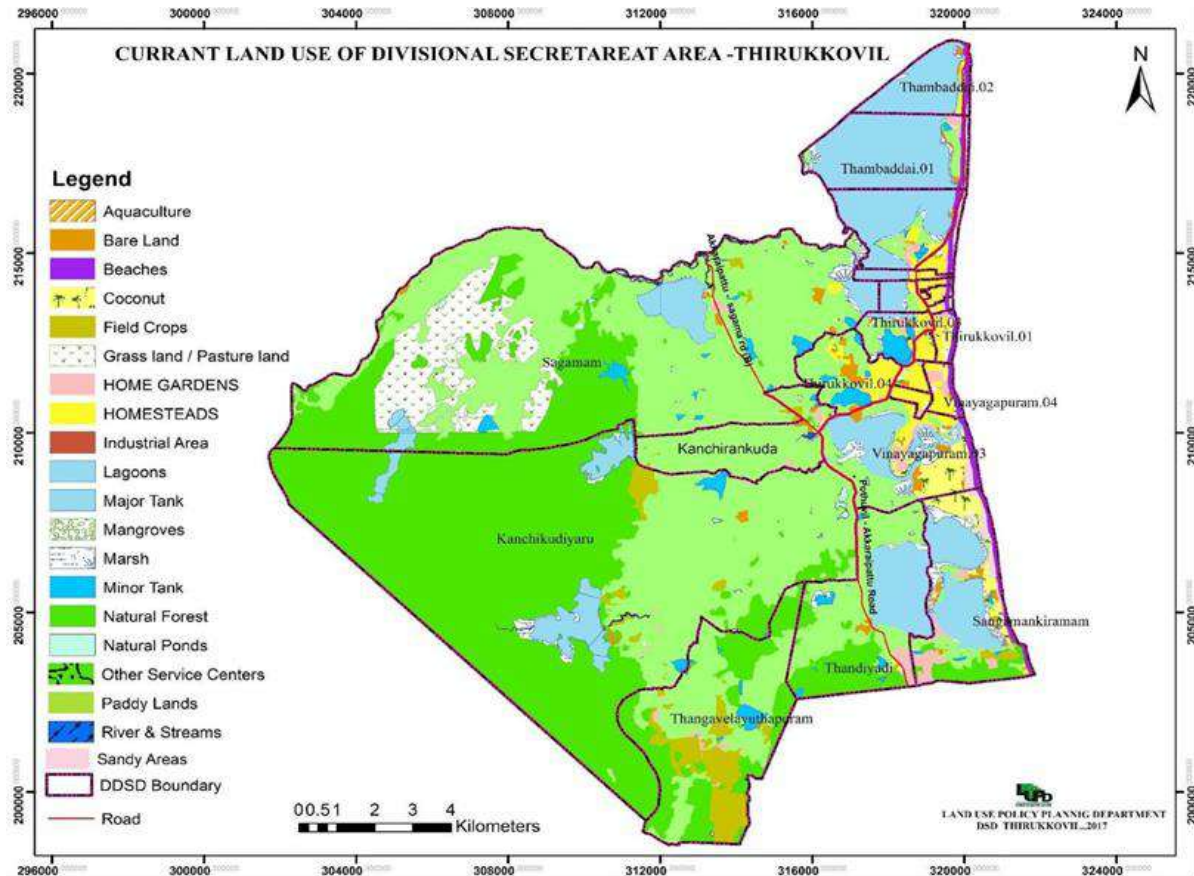
**Map 1:** - Study are Map of Thirukkovil DSD.



Source: Survey Department of Sri Lanka (2022)

Thirukkovil DS contains a total area of 237.16sq km and has a population of 34,280. The extent of the local area is 237.16sq km and the terrain is almost flat. Natural features create the boundaries in all directions such as North by Alayadivempu, East by Bangle Way, South by Pottuvil, and West by Thamana. This division has 22 Grama Niladhari divisions.

The study area consists of different types of Eco-systems with water bodies, coastal lines, paddy fields, marshy lands, and coconut plantations. Also, which is located in the dry zone of the country has a tropical climate, even though this division frequently gets intensive rainfall with relatively high temperatures. The mean temperature in the region was recorded from 250 – 350 and the mean rainfall was recorded at 140mm. The total land use is 23716.28ha in the Thirukkovil division. Among this 18768arces lands are used for Agricultural purposes. In town areas where the population is concentrated, only a few home gardens, vegetable crops, and flower gardens are grown is 845.52ha. The land is used for paddy cultivation of which 8802.52ha. This paddy field depends on big, medium, and small irrigation tanks and rainfall. In addition to this, there are about 845.60ha of field crop and coconut fields 511.68ha of upper land cultivation, 973.17ha of grazing land, and 5366.91ha of forest areas in this division. Further slough and kandal plant are 430ha. The settlement region of people is also seen to the same extent as paddy cultivation lands. Few sandy areas and small schools, post offices, temples, etc., and 450.20ha of land is mountain cover.

**Map 2:-** Land Use Pattern of Thirukkivil DSD.**Objective:-**

Identify the human-elephant conflict and associated problems in the Thirukkivil division.

**Sub objectives**

1. Identify the human-elephant conflict from 2013 to 2020
2. Identify the impacts of human-elephant conflict.
3. Find out the mitigating measures.

**Methodology:-**

Primary and secondary data collection methods were used for this study. Primary data were collected through Questionnaires, Interviews, and Observations. The secondary data was collected through the Previous literature and Government department's data including the Divisional Secretariat office, Department of Wildlife and Conservation, Department of Forestry, and Agrarian Paddy Service Center. In the field survey, 40 households were selected to incorporate for this study. A purposive sampling method was used for the household selection. The majority of the study area people engaged with the Agricultural activities. Collected data were analyzed through MINITAB and SPSS. Observation technique used to identify the property, crop, and live damages.

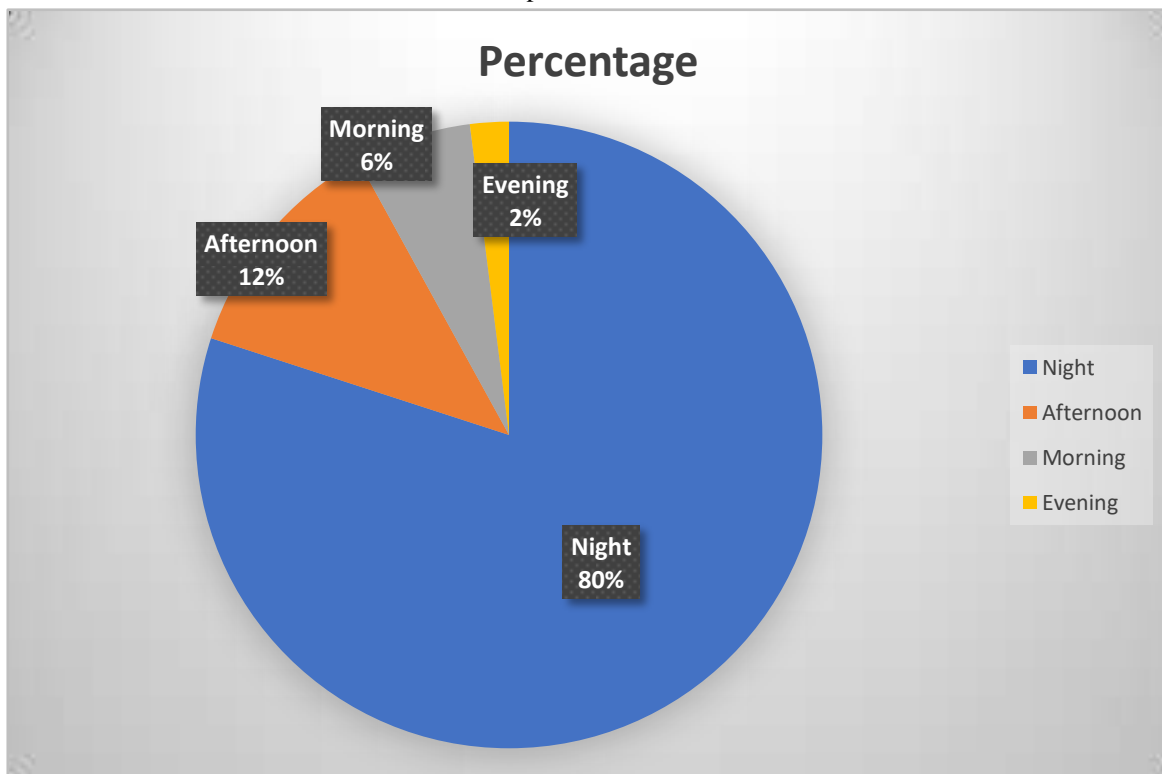
**Results and Discussion:-**

Study area people actively engaged with Paddy, Banana, Coconut, Chena Cultivations, and also highland crops. But 90% of the farmers depend on the paddy for their monthly income. Crops are severely affected by the elephants. According to the 2023 statistical data, 35% of farmers who are get their monthly income through agricultural activities. This reason caused high deforestation to get an adequate amount of land for the paddy field, chena cultivation, and resettlements.

Elephants have the lives and tend to have a particular habitat area, but the high deforestation rate of this area decreases the distance of human settlement from the protected areas (Capacity Development of Local Government 9CDLD, 2023). This extensive deforestation created problems for elephants such as habitat loss and fragmentation. Also, elephant and human lives are lost and injured. This problem has direct impacts on socio-economic activities.

According to the statistics, 40% of the people do farming activities for their primary income while 18% share for fisheries. Thirukkovil division is divided into 22 GN divisions, and 9 divisions are under the threat of HEC. The divisions Kanchikudiyaru, Sangamam, Thangavelayuthapuram, Thandiyadi, Kanchirankuda, Sangamankiramam, Thirukkovil 04, Thirukkovil 03, and Vinayakapuram are highly affected by the conflicts due to 80 – 150 conflicts in the past years. These divisions' main land use pattern is agriculture and also the affected area has a high resettlement is the main reason for the recent conflicts. These GN divisions are shrouded with the forest reservoir.

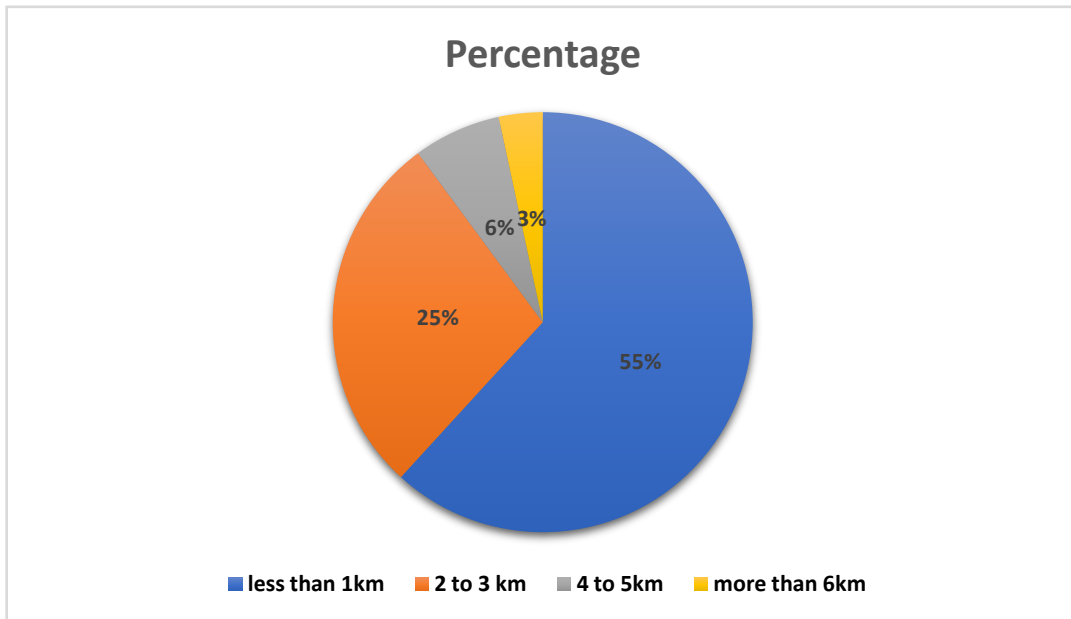
Chart 1:- Elephant Arrival Time.



Source: Field Survey (2021)

Conflict types have three major categories including high, moderate, and lower levels, collected data from 2013 to 2020 shows that the remaining 13 divisions have very moderate threats from elephants with 50- 79 conflict incidents, and 80% of people respond that Most of the Elephant's arrivals and attack happens during the night time responds while others are observed in the daytime.

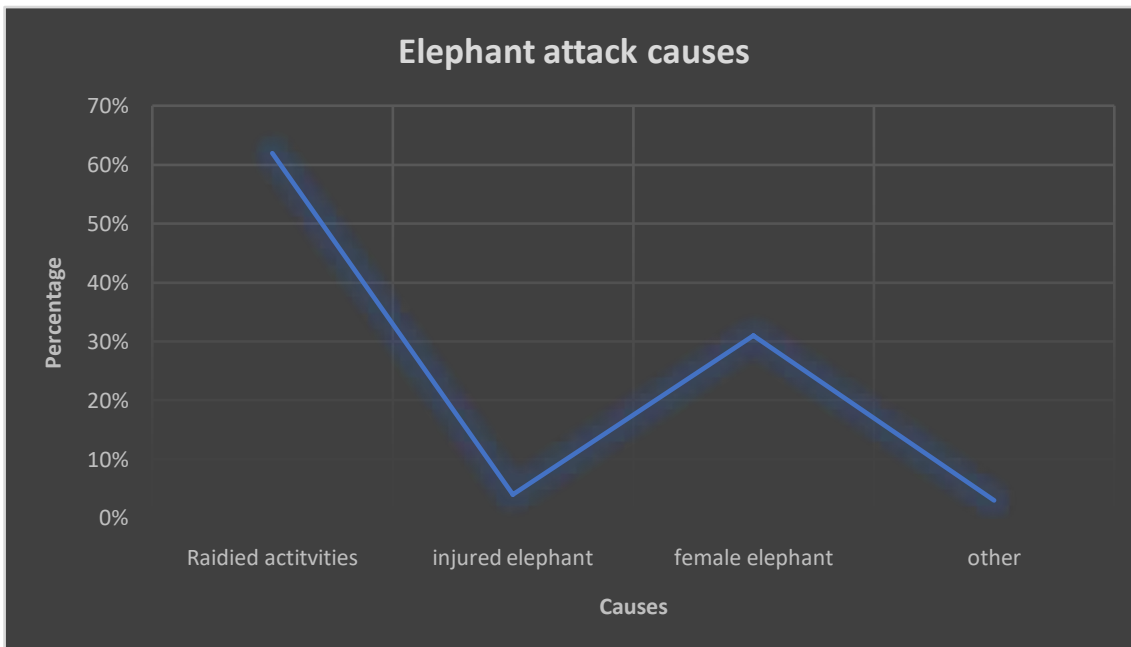
**Chart 2:-** Human settlement distance from the Forest areas.



Source: Field Survey (2021)

Most of the Disaster incidents occurred in the forest and the human-dominated fringe areas in the study area. The Public responded that 55% of human settlements are situated in less than 1km distance from the forest areas while 25% of other buildings are between 2 to 3km distance. This settlement pattern encouraged human activities including the fuelwood collection and grassing of livestock in the forest areas changing the elephant behavior aggressively. This behavior of elephants may be started due to harassment by people during crop-raiding activities, people get close to the injured elephant or female with their calves. This study found that 60% of attacks happened while humans responded during the elephant crop raiding near the human territory. Also, 30% of incidents by female elephants though with calves.

**Graph 1:-** Causes of Elephant Attack.

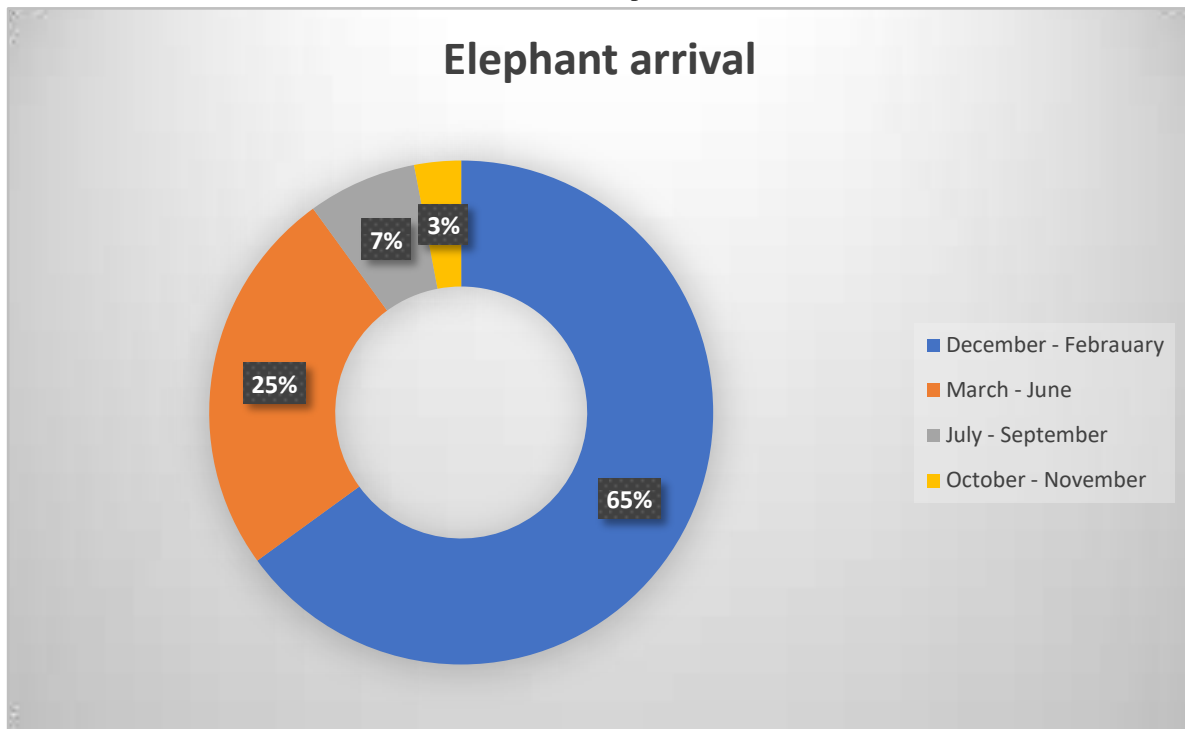


Source: Field Survey (2021)

Elephants' raids in agriculture are not new in the Study area, because elephants are megaherbivores so they eat up to 150kg of food and drink up to 190 liters per day. Elephants are navigating for food and water across the areas to fulfill their needs. But the forest areas transforming to fill the increasing human needs and adapt to climate change. These unfavorable conditions of elephants leads destruction of crops and properties. This study found that most HECs occurred from December to January and July to September. These periods are demanded for the Maha and Yala paddy seasons. 65% of HEC was recorded during the December to February Maha seasons while 25% was recorded in July to September of the Yala season.

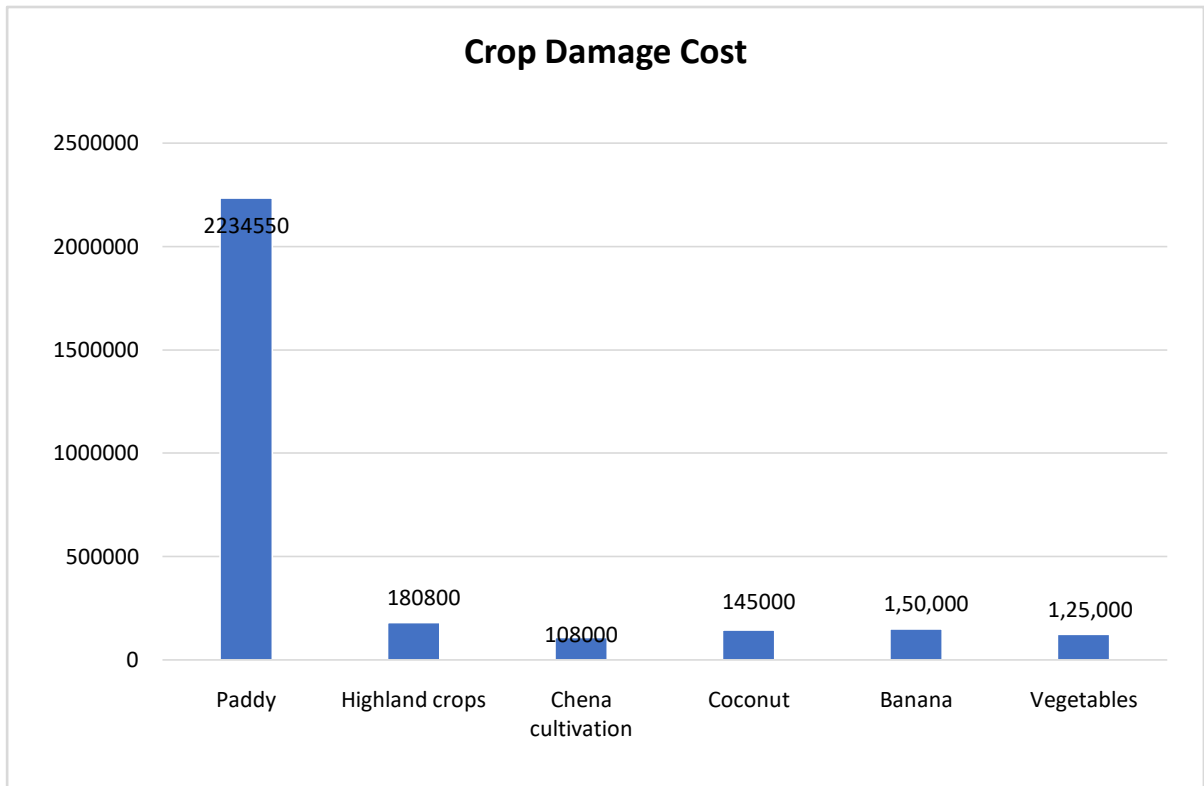
Thirukkovil DS has Maha and Yala cultivation depending on the tank system due to the dry climatic conditions of the periods also river gets dry. So, elephants enter the village paddy land to get food and water causing damage to the crops and human settlements. High damages were recorded during the March – June period. It is also 10% of conflicts that happened from October to November but not a high count of conflicts not registered.

**Chart 3:- Seasons of Elephant Arrival.**



Source: Field Survey (2021)

The incidents of crop damage were not similar across the study area. Paddy, highland crops, minor crops, and home gardens contributed to the majority of damages in this division, this may be caused due to some facts. Paddy is cultivated in 80% (8898 Hectares) of the total land area in two different seasons so it sustains greater damage than other crops. Banana is the second highest damaged crop in the home garden among other perennial crops, fruit is available throughout the year so it is easier to gather for crop-raiding elephants. Moreover, bananas cultivating in dense stands is an additional advantage. Elephants consume the entire banana plant because it is only needing a small effort due to its succulent nature. Therefore, the risk of an elephant is comparatively lower than the other crop raiding.

**Graph 2:-** Crop Damages caused due to HEC.

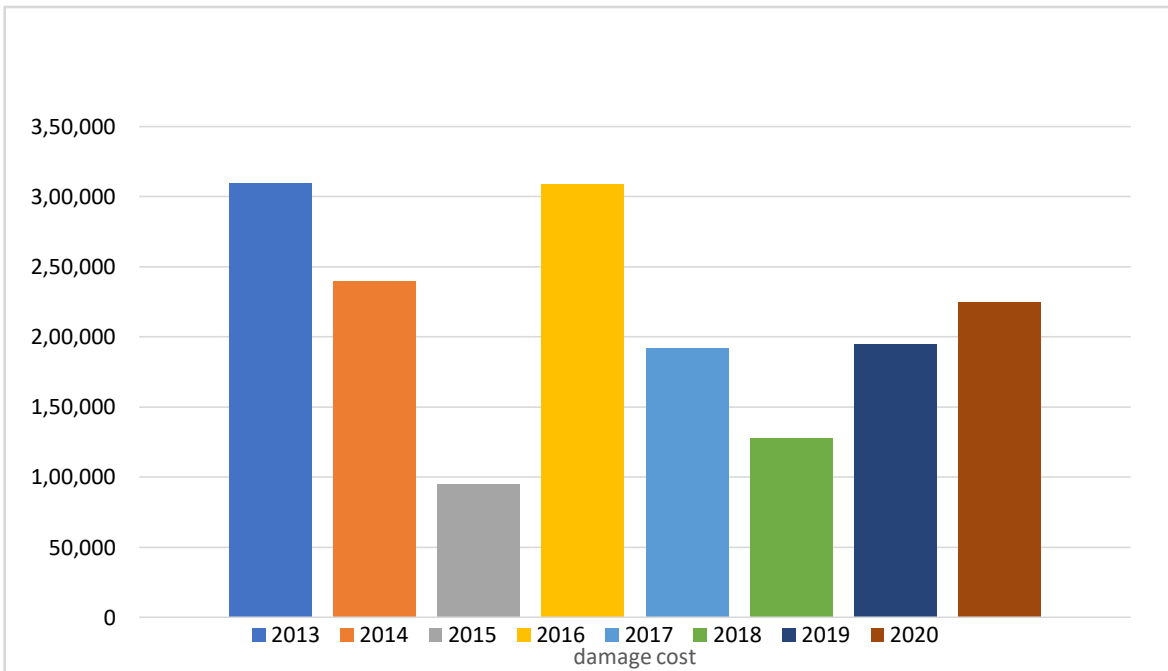
Source: Field Survey (2021)

Other highlands crops and perennial crops such as maize and Jackfruits were raided less due to high risk. Damaging other crops is also comparatively high in the study area. According to the 2013 to 2020 data, the estimated cost of paddy crop damages was Rs. 2234550 caused due to HEC, also Rs. 180,800 was due to the highland crop damages. In addition, Chena cultivation, Coconut, Banana, and Vegetables were Rs.108,000, Rs.145,000, Rs.150,000, and 125,000respectively.

Abundant amount of property damagehappened in the study area. Especially, partial damageto the House's roofs, windows, walls, doors, and temporary cottages, andalso complete damage happened in the shops and fence due to the HEC. Collected data shows that valuable property damage cost. The estimated cost of damaged property from 2013 to 2020 was Rs. 310,000, Rs. 240,000, Rs. 95,000, Rs.309,000, Rs.190,000, Rs.128,000, Rs.195,000, and Rs. 225, 000. The year 2013 is a highly affected period so far.



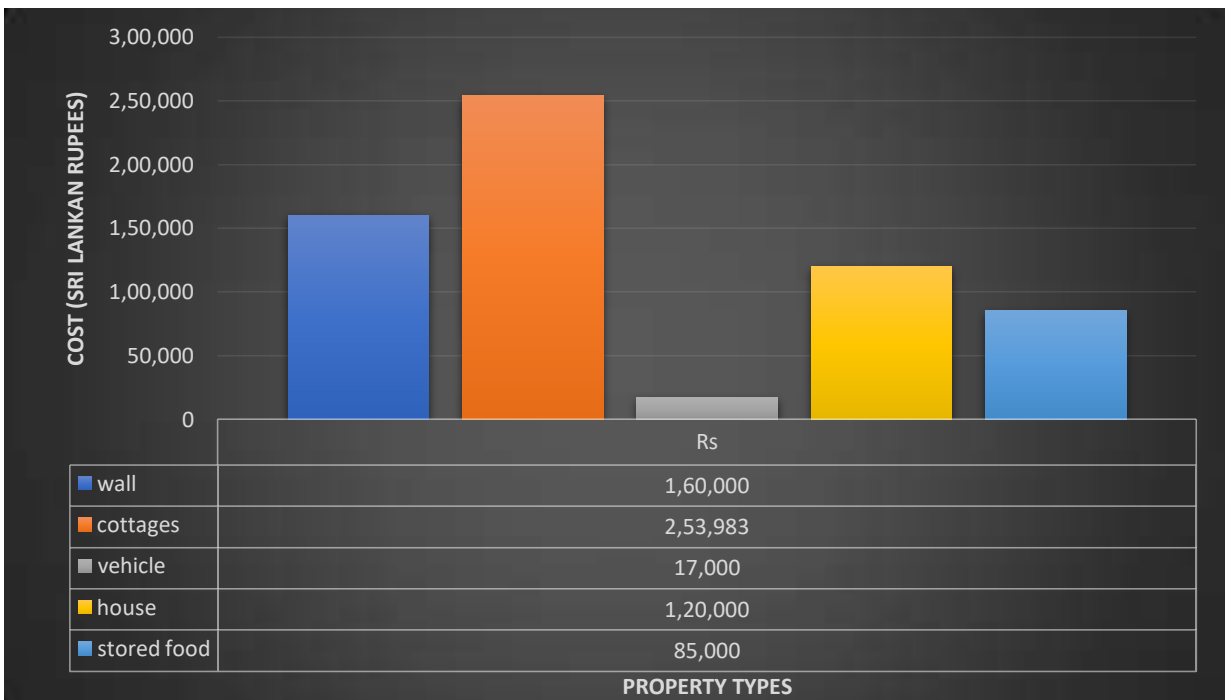
**Graph 3:-** Property Damages Caused due to HEC.



Source: Field Survey (2021)

Thirukkovil divisions faced different kinds of property damages from the 2013 to 2020 period due to the HEC. Walls, cottages, vehicles, houses, and stores foods are the commonly affected properties in the study area. According to the primary data, the damage cost of the Cottages is Rs.253,983 and the walls are Rs 160,000. Also stored food in the house was destroyed during the raiding Elephant activities.

**Graph 4:-** Types of Property Damages.



Source: Field Survey (2021)

According to the previous literature, elephants are the biggest conflict-causing species. Elephant deaths, human deaths, and injuries are hotspots shown in the study area. Elephants killed more than 10 people and 22 injuries occurred in the Thirukkovil division over the last seven years, with a bias towards men. Most of the attacks occur at night. Elephants attack and kill people in terrible ways, including trampling people underfoot, they pick up people with their trunks and smash them on the ground. Farm people who look upon their crops and livestock as a source of danger. Farm people look upon their paddy and livestock as a source of danger. The local government provided Rs. 100,000 compensation to the victim's family until 2015 years, after the compensation amount was increased by 50,000. Each year government spends Rs.300000 for human deaths caused by elephant attacks.

**Table 1:-** Death and Injuries due to HEC.

Year	Deaths	Injuries
2013	2	1
2014	1	3
2015	0	0
2016	1	2
2017	3	8
2018	2	1
2019	0	7
2020	1	0

Source: Field Survey (2021)

Thirukkovil division people are more concerned about food insecurity and the associated impacts of elephant crop raids. Also concerned about reduced safety and restricted mobility as hidden impacts threatening as the livelihoods and everyday life. Both direct and indirect impacts of elephants contributed to people's negative feelings towards elephants. 65% stated that they feel risky in the presence of elephants due to their big size, potential harm to humans, or that they are unfamiliar creatures.

People used to go to the river bank to access the water but elephant arrivals in the particular place make challenge including freedom of movement, which has a major social impact on the poor people who depend on fuelwood as their energy source for their cooking in the division. Furthermore, the public frequently visits the forest areas to collect the fuelwood to use for cooking energy sources. Some people said that when they were collecting fuel in the pushes elephants also were there so they can't afford to get the fuelwood these days in a great challenge for their day-to-day activity.

55% of the study area people said they are afraid of the elephants but they are bringing the livestock to the push for the grassing activities.

Challenges to find the alternative foods when crops are raided is a major challenge to the community people. Local shops started to sell food products that are quite expensive hence high-income people can afford to buy the foods is affects the poor people.

#### **Mitigating methods for HEC**

HES resolution has been very difficult for human and elephant protection in current landscape patterns. Local community involvement is very important to use different techniques of sustainable mitigation methods. Human habitation extension with high human densities and frequent migration of elephants lead to negative interactions between them.

The Sri Lankan Government has taken different initiatives to minimize the conflict including forest-dependent people. However, elephant habitats are not confined only to the forest areas. So, some effective mitigation methods should be adopted to minimize the risk. Elephants mostly prefer to eat Paddy, Banana, Grass and Jack fruit, Sugar cane, and Coconut. So unfavorable crops such as Chili, and bitter gourd are considered to be a non-preferred crop for elephants because of their taste. The Farmers should identify the suitable non-preferred crop for the study area for their cultivation to minimize the crop damage.

Boundary lines made up of planted trees or shrubs are called Bio-fencing. This involves growing plants with sharp spines on the stem in farmland and human settlement boundaries to control the elephants from entering the agricultural lands and human habitations. This is the most cost-effective and environmentally friendly method.

Electric fences are considered an effective way to mitigate negative interactions between humans and elephants. This is a long-term solution and simple, very effective, if it is continuously kept under good management. The technique was found to be effective in producing sufficient electric shock to deter elephants from entering the Paddy land and human settlement.

In addition to this, a trip alarm is one more prevention method to control the damage to the crops and properties from elephants. This wire is installed around the Agricultural land or human settlements to minimize the entrance of elephants. When the wired circuit is broken, it starts to make a sound, the sound can alert the area people and irritate the elephant to turn back without entering human territory. This is a cost-effective warning system which also requires regular maintenance.

Farmers can set up and maintain chili fences during the harvesting season because elephants' noses are very sensitive to smell the chili powder. Hence, sisal-rope fences covered with chili oil have worked well in keeping elephants out of the crops. Thirukkivil division farmers should set up this and maintain it during the harvesting season.

Watch tower is a place where people can monitor the elephant activities and chances to control the damages. The watch towers are built with wood or plastic covers in the tallest tree. This is suitable for building near the Farmland and forest areas to detect the elephant movement from a distance. Watchtower is a powerful method with low-cost and simple construction. The guard can see the elephant activities with the support of a powerful torch at night time.

Elephants enter human territory due to the unavailability of an adequate amount of food. So, enrichment of denuded forest land ensuring habitat improvement with food and shelter can reduce the elephant entrance into the village.

An elephant response team should be empowered with the support of Volunteers, chosen collaboratively by community members and village leaders. They should get trained with equipment such as hand mikes, torches, sound machines, and whistles. The team will be motivated to regulate HEC to control the property damages and death rate. Moreover, community management fund formation is required to maintain the installed devices including electric fences, trip alarms, and watchtowers.

Conducting awareness programs among the communities about the importance of Sri Lankan elephants and the ecosystem is a necessary action to protect the endemic species and increase the sustainable ecosystem. This program must be conducted with the participation of group leaders and officials in the most vulnerable areas.

### **Conclusion:-**

Thirukkivil DS division in Ampara district is severely affected by human-elephant conflict. Therefore, the data collected from the study area evident the associated impact of human-elephant conflict in the Thirukkivil DS division. The majority of the study area has recorded conflict incidents within the last 7 years including life-threatening. So, it is necessary to take some mitigation measures to reduce the risk.

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