

# Potentiality of ecotourism in enhancing ethno-zoological values of elephant corridors for mitigating human-elephant conflict in Sri Lanka

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DOI: 10.29322/IJSRP.10.03.2020.p9951  
<http://dx.doi.org/10.29322/IJSRP.10.03.2020.p9951>

**Abstract-** Elephant corridors are paths of wild elephants that are used to move or migrate within or between habitats. The objective of the study is to identify the status of elephant corridors and the causes behind it and to explain the potentiality of ecotourism in enhancing the ethno-zoological values of elephant corridors. To achieve the objectives, a case study was conducted in the Manage Elephant Range, Hambantota based on key informants' interviews. The information revealed that, although the corridors have a vital role in conserving wild elephant and solving socio-economic issues, including human-elephant conflict (HEC), many of the elephant corridors in the southern wildlife region of Sri Lanka have been disturbed due to poor socio-economic, and environmental commitment of some people. Although many of the causes are related to the economy, if the ethno-zoological value of elephant corridors is enhanced through sustainable forms of ecotourism, the economy can solve HEC and contribute in conserving elephants.

**Index Terms-** conservation, corridors, ethno-zoological value, human-elephant conflict, ecotourism

## I. INTRODUCTION

Elephants (*Elephas maximus*) are considered as one of the five charismatic species in the world and it (*Elephas maximus maximus*) is one of the flagship species in Sri Lanka. Ecological connectivity is an essential phenomenon for the survival of the beast in an ecosystem. Wild elephants and many other animals use corridors to move within a habitat or migrate between habitats. But unfortunately, the ecological connectivity of habitats through the corridors is under risk due to irresponsible human activities related to agriculture, urbanization, infrastructure development, etc. Thus, due to these human-mediated alterations to the landscape, wildlife habitats are being fragmented. The habitat fragmentation and wildlife corridor disturbances have caused subdivided populations and can profoundly alter both ecological and evolutionary dynamics of populations, species, and communities (Christie et al, 2015). Not only wild elephants and other wild animals but also people near wildlife habitats and their properties are also threatened.

Under such circumstances, biological corridors are the frequently proposed solution to connect those isolated patches of habitats and to solve human-elephant conflicts. According to Menon, et al.

(2017: p. 1), 'various strategies are being discussed and debated to manage and overcome the adverse effects of habitat fragmentation and loss. Wildlife corridors are an important mean of ensuring larger habitat availability to species, genetic exchange within and in between populations, and to minimize human-elephant conflict in altered habitats. These corridors have to be restored and secured on a priority basis'.

Biological corridors are the paths that facilitate animals on their daily or seasonal movements from one location to another. Wildlife corridors, habitat corridors and green paths are used as other terms to name biological corridors. In the research literature, there are many definitions regarding biological corridors (refer to Table 1). According to the definitions, an elephant corridor is a manmade or natural path, which secures elephants from dangers while moving/migrating from one habitat to another via human settlements or man-made structures such as roads, croplands, tanks, etc to achieve their needs. Therefore, elephant corridors are safety paths for the purpose of moving or migrating of wild elephants.

Elephant corridors (and any other wildlife corridors) can be grouped into two categories as natural corridors and manmade corridors. Natural corridors are the land/water areas that wild elephants usually used for migrating between habitats or moving within its native habitat while the manmade corridors are those created by humans in order to facilitate wild elephants to move or migrate within and between habitats.

The value of elephant corridors can be identified from two viewpoints: elephant conservation viewpoint, and human life and property protection viewpoint. The elephant corridors allow the exchanging of individuals between populations, which may help prevent the negative effects of inbreeding and reduction of genetic diversity (via genetic drift) that often occur within isolated populations. According to researchers and experts in elephant conservation, there are five basic needs of elephants: food, water, safety, shelter, and sex. Biologically, an elephant needs 300 kilograms of fodder and 100 liters of water per day. To achieve the above basic needs, a wild elephant moves about 30 km per day. In addition to that, the seasonal niche is another reason for wild elephants' migration. Naturally wild elephants use their traditional paths to move or migrate, if not they are disturbed, basically by people. On the one hand, if the elephant corridors are

disturbed, elephants migrate/move through the same corridor or via other areas while damaging human properties and creating life threats to humans. On the other hand, people also use different methods of protection from wild elephant attacks which would negatively affect wild elephants. Thus, elephant corridors can be considered as safety paths for wild elephants and crucial places for ensuring the security of human life and their property.

Table 1: Definitions for wildlife corridors

Author/Institution	Definition
Soule and Gilpin (1991)	a linear two dimensional landscape element that connects two or more patches of wildlife (animal) habitat that have been connected in historic times; it is meant as a conduit for animals
Rosenberg et al. (1995)	a linear landscape element that provides for survivorship and movement but not natality (birthrate) between other habitats
Natural Resource Management Information Note	a wildlife corridor is a link of wildlife habitat, generally native vegetation, which joins two or more larger areas of similar wildlife habitat
Central American Commission for Environment and Development	a wildlife corridor is a geographically defined area which provides connectivity between landscapes, ecosystems and habitats, natural or modified and ensures the maintenance of biodiversity and ecological and evolutionary processes
Michael L. Morrison	a place where the population viability is enhanced when individuals of a subpopulation are able to move to another subpopulation

Even though elephant corridors have been identified as a better solution for many ecological, biological and socio-economic issues in the areas where the elephant habitats are fragmented, it seems that the responsible agencies in Sri Lanka have not placed sufficient attention to maintain the natural corridors and to rehabilitate the disturbed corridors.

## II. OBJECTIVES AND METHODOLOGY

The first objective of the study is to identify the status of elephant corridors and the causes behind the present status of the elephant corridors in Sri Lanka. Thereby the study focuses to identify the maintenance of the elephant corridor and rehabilitating commitments of state-centered agencies and local communities. To achieve the objective, the status of elephant corridors in the Managed Elephant Range in the southern wildlife region of Sri Lanka were studied (refer to Fig 1). The second objective of the study is to explain how the ethno-zoological value of elephant corridors can be enhanced through ecotourism. To achieve the objective, the influences and contribution of ecotourism of the Hurulu Eco Park (HEP) in the Palugasewa divisional secretariat of Anuradhapura district are briefly illustrated (see Pathmasiri, 2019 for detail information regarding the HEP). The third objective of the study is to give recommendations in order to enhance the ethno-zoological value of elephant corridors in the southern wildlife region.

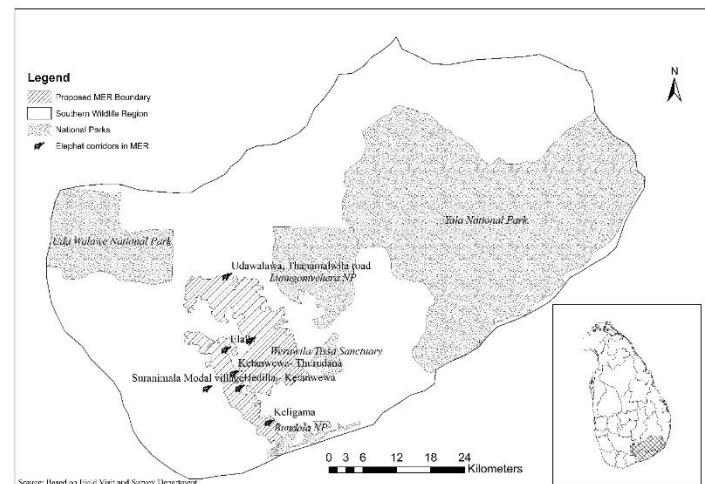


Fig 1. Location of the MER in the southern wild life region in Sri Lanka

Both primary and secondary data sources were employed to collect data to achieve the objectives of the study. Primary data was collected through key informant interviews and field observation. Primary data related to the elephant corridors in and around the Sooriyawewa area were collected in the months of September and October in 2019. Eighteen key informants from the villages in and around the MER were interviewed. Snowball and purposive sampling methods were employed to select the key informants, including Community Based Organization officials, political leaders (members of local governments), clergymen, farmers, fishermen, hunters, and businessmen.

The content analysis method was used in processing, summarizing and analyzing the key informant's information. The results of the analysis are presented as figures with explanations.

## III. BACKGROUND OF THE MANAGED ELEPHANT RANGE

A considerable portion of the MER belongs to the Sooriyawewa DSD. In the division, the total population had been about 46,449 in 2017 with a population density of 242 per km<sup>2</sup> (District Statistical Handbook, Hambantota, 2019, *Unpublished data*). Their main economic activities were related to agriculture, especially paddy farming, shifting cultivation (Chena), banana and other fruit cultivation, vegetable cultivation and cattle farming and related businesses. According to District Statistical Handbook Hambantota (2019), most of the agricultural lands (93.99%) are cultivated under large scale irrigation projects. A thorough observation of the years of settlement of the villagers reveals that the majority of the families were settled in the area for more than twenty years. The majority of the settlers possess a freehold or license for their paddy lands. If the land plot size is taken into consideration, 64.7% of the settlers have less than 2 acres, 31.8% of the settlers own 2-4 acres and 3.6% of land plots are larger than 4 acres.

Biophysically, the study area is located in the southeast dry zone of the island (annual precipitation is between 500 - 1000 mm) with low land topography and dry zone monsoon forests and grassland

vegetation (National Atlas of Sri Lanka, 2013). Most of the study area was a dense forest until the country was independent. This area was also a feeding ground of wild elephants. Several village developmental programs have been carried out in the area. However, the characteristics of the study area have been largely influenced by the rural economic enhancement projects as well as other projects that have been launched to integrate the peripheral areas to the national economy. Some of the key drivers of the transformation are as follows;

- The construction of the multifunctional Udawalawe reservoir was initiated in the 1960s and completed in 1967;
- During the 1980s, many new villages were established and simultaneously land encroachments have taken place especially for the seasonal agriculture (Chena cultivation);
- During the 1990s, Udawalawa left bank settlements initially started;
- In 1996, the first elephant drive took place intending to solve the HEC and clear the lands for development projects;
- The Walawe Left Bank Upgrading and Extension Project (WLBP) was designed during 1994/95 with the financial assistance of JICA and was implemented from 1996 to 2008 in order to maximize the utilization of available land and water resources;
- In 2005-6, the second elephant drive took place;
- After 2005, Greater Southern Development Project had started which brought a huge development resulting in deforestation over the area. Large scale development projects including harbor, stadium, airport, highways, solar panel projects (SAGA, LAUGFS, etc.) have been launched in the area;
- After 2015, model village programs have been launched in and around wildlife habitats (especially in the MER).

Under each stage of the development projects, it resulted in the human-elephant conflict which at the same time was intensified. The HEC is gradually becoming a severe issue in the area (refer to Table 2). As per the unpublished data of the Divisional Secretariat Office-Hambantota (2019), the year 2017 did not report a single case of human death owing to HEC. The number of death cases that have been reported in the years 2018 and 2019 are nine and eight respectively in the area. The number of property damage cases has also gradually increased within the last three years. In 2016, the total number of property damage cases reported to the district office were 2 and in 2019 it has increased to 125 cases. Also, during this period the Sri Lankan government has given compensations to the victims while bearing a cost of approximately LKR 20.35 million.

Not only that, between 2014 and 2018, around 25 elephants (LUPD, 2018, p. 4) died due to human activities. The main causes for the deaths of elephants in this area are as follows: power shocks due to the electric fences, gunshots and setting *Hakkapatas*. In addition to that, some elephants remain with injuries and wounds.

Table 2. The trends on human deaths, injuries, and property damages 2017-2019

Theme	2016	2017	2018	2019
Deaths	0	0	9	8

Injuries	0	2	2	4
Property damages	2	60	86	125
Compensation (Rs 100,000)		27.56	86.69	89.28

Source: Divisional Secretariat Office-Hambantota, 2019  
 (Unpublished data)

As mentioned above, the Sri Lanka government has conducted large scale drives to move hundreds of wild elephants into nearby national parks during major irrigation development projects such as Mahaweli, Walawe and Kirindi Oya (Fernando, et al. 2008). In the study area, the first and the second elephant drives took place in 1996 and 2005-6 respectively intending to solve the HEC and clear the lands for development projects. During the second elephant drive, for one and a half years, about 225 wild elephants were removed but over 400 were left behind in the area (Fernando, 2015). According to Santhiapillai (1998), during the period 1974 to 1993, between 950 to 975 elephants were driven from conflict areas into protected areas. Moreover, chasing elephants away from the Department of Wildlife Conservation areas such as the Nimalawa Sanctuary (close to Yala National Park) have been conducted in 2004 and Bundala National Park in 2006 (Fernando, 2015).

Managed Elephant Range (MER) is another measure proposed by researchers in order to overcome the HEC in the area (refer to Fig. 1). The state-centered stakeholders, such as the Department of Wildlife Conservation have also identified the value of the MER to conserve wild elephants and minimize the HEC in the area. The MER is a proposed land area to which the elephants' range in Hambantota is also included. Seven elephants in the area had been collared with GPS, satellite transmitters, under a collaborative work between the DWC and the Center for Conservation and Research (CCR) from whom the data was gathered in order to propose this particular area as the MER. These collars provided detailed information on the herd of the elephants and their regular movements which aided in demarcating this particular area.

Sri Lankan government has invested a huge amount in erecting electric fences around the elephant habitat to minimize HEC. According to the key informant interviews, average cost of the government for establishing elephant fence is about LKR 0.5 – LKR 1 million per kilometer. However, during field observation and key interviews, it was identified that many segments of the electric fences of the MER are malfunctioning due to various reasons and thus, failed to eradicate HEC in the study area.

The MER can be identified as a home as well as a corridor for many wild elephants. In the MER, there are more than 400 wild elephants. In addition to that, the MER is considered as the wild elephant habitat that can link other wild elephant habitats such as Udawalawa, Lunugamwehera, Bundala and Weerawila in the southern wildlife region (refer to Fig 1). Moreover, the area ensures the ecotourism value of small ecotourism sites in the SWR based on wild elephant viewing tourism and depend on migrating elephants.

Even though the area is proposed as the MER, on the one hand, it is visible that some of the patches are being utilized by some

villagers. The MER is largely fragmented due to various human interference, such as infrastructures, crop cultivations, settlements, etc. According to the Land Use Department, Hambantota (2019, unpublished data), the total land area in the MER is about 61,473 acres. But, the land use and land cover pattern in the MER depicts that a considerable land extent (27%) is still used for various human activities. Mainly, the land is used by humans in the area for Chena (14%), banana and paddy (4%), and seasonal crop cultivations (4%), airport (3%), and home gardens (2%) and roads.

The rest of the land (73%) can be considered as a wild elephant habitat. The mainland cover types visible in the area are scrublands (61%), tanks (7%) and open forests (3%). However, the dispersed distribution of lands which is utilized for the aforementioned human activities in the MER has led to fragment the wildlife habitat. Also, the land-use pattern in the area has seasonally changed. Thus, the available land area to the wild elephants in the MER is also fluctuating seasonally. Moreover, some forest patches and human croplands outside the MER are also used by elephants in order to achieve their needs. Thus, it is essential to identify and to manage the existing elephant corridors in the MER.

#### A. Wild elephant corridors in the MER

According to the wild elephant conservation perspective, the lands in the MER can be divided into two categories as elephant corridors and other areas. In the study, two types of elephant corridors were identified (refer to Fig 1): the corridors that link the MER to other wildlife habitats, and the corridors that connect the habitat patches in the MER.

Unatuwa, Koholangala, and Nikawewa (21 Kanuwa) elephant corridors link the MER to other wildlife habitats. In other words, those corridors can be named as inter-habitat connecting corridors.

The elephant corridors in Habaraddawala, Andigama-Burutankanda, Walsapugala-Wediwewa, Kurudana-Katanwewa (Handillawewa), Uda Mattala-Pahala Mattala, and paddy fields such as Neralugaswewa, Orukemgala, Pahala Mathtala, Elalla can be named as intra-habitat corridors. Some of the corridors, especially paddy fields are considered as seasonal corridors. Also, over the last decades, state-centered agencies have acquired, cleared and utilized some land in the area for various development activities, such as agriculture and irrigation, solar power plants, garbage disposal sites, airport, harbor, International Conference Hall, proposed Industrial Zone (BOI), Hambantota Administrative Complex and International Cricket Stadium. All these activities have led to fragment the wildlife habitat and led to new emerging corridors, such as land belt between Mattala Airport and Malala Ara. Some artificial corridors, such as in the Andarawewa area, have been built too.

#### B. Status of the elephant corridors in the MER

Many (if not all) of the elephant corridors in the MER have been disturbed by intentional and unintentional activities of local

communities, state-centered agencies, and others. As indicated in Fig 2, none of the key informants has identified an elephant corridor in the area as a well-functioning (year-round) corridor. But few elephant corridors are functioning well during off farming periods. These corridors are paddy fields, such as Neralugaswewa, Orukemgala, Matigathawewa that are cultivated by villagers under the protection of seasonal electric fences. Some non-governmental organizations, such as CCR have collaboratively worked with the paddy farmers for maintaining the aforementioned seasonal corridors, at least during the off farming season.

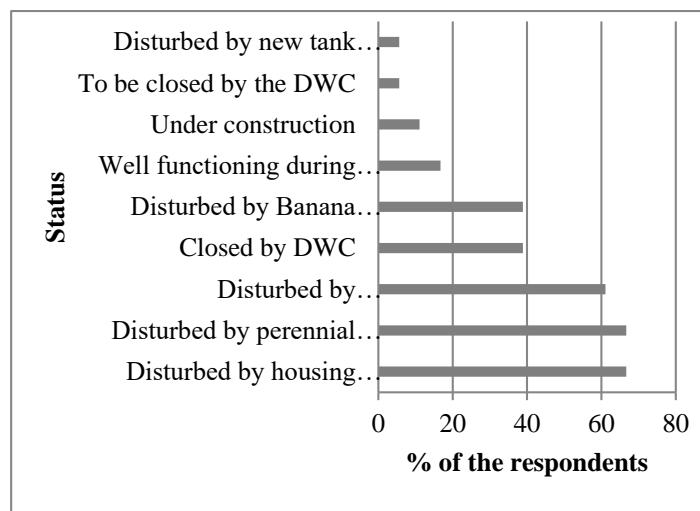


Fig 2. Status of elephant corridors in the MER

As indicated in Fig 2, not only some villagers but also the state-centered stakeholders have behaved irresponsibly in the elephant corridors. On the one hand, local people and the state agencies have ignored the nature conservational functions of elephant corridors and used the land for other purposes, such as subsistence and commercial agriculture, settlement, etc. On the other hand, DWC has closed or has planned to close some elephant corridors in the area. Thus, it is clear that they have less commitment to maintaining elephant corridors. Thereby many elephant corridors in the area have been disturbed by villagers, outsiders, and state-centered agencies.

#### C. Causes behind the status of elephant corridors in the MER

According to the key informant interviews of the study, as indicated in Fig. 3, the aforementioned elephant corridors have been seized by humans for various purposes, mainly for housing (72%), paddy farming (72%), perennial crop cultivation (61%), large-scale banana cultivation (56%), forest clearing (56%) and sifting cultivation - Chena (56%). In general, many of the causes are related to the economy. These causes can be categorized into three categories as causes related to agriculture, to development projects, and to HEC mitigation measures.

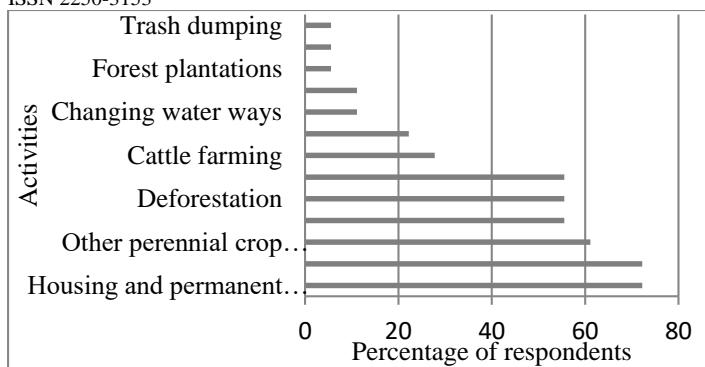


Fig 3. Human activities in elephant corridors (Source: key informant interviews, 2019)

- Causes related to agriculture

For the last 15 years, about half of the land in the Hambantota district owned by the Mahaweli Development Authority had been issued for clearing and developing (LUPD, 2018, p. 14). Thus, many of the nearby forest patches of the MER, such as Karambagasmulla Oushada forest (300 ha), Konkatiara forest (700 ha) are under the threat of deforestation. In addition to that, since 2013, MDA has taken efforts to issue its forest lands for development but the DWC has opposed to take legal action against unauthorized land acquisition, forest clearing, and land developments. According to LUPD (2018, p. 15), the main reason for such behavior is the sentence given by the Hambantota Court to an unauthorized land acquisition case (no 11795). The national environmental act (amended 1993) emphasizes the need for legal approval to clear and develop the land which is more than 2.5 acres (LUPD, 2018). Conducting EIA and getting legal approval is considered vital but this was not the case for banana and all newly developed perennial crop cultivations (coconut, cashew) of this area. Nevertheless, the Central Environmental Authority has also not fully committed to take legal actions against the aforementioned activities. Under such circumstances, villagers and outsiders have encroached lands in the elephant corridors and converted them into farmlands.

In the past, villagers had cultivated their paddy fields without electric fences or Elephant Thunder Crackers (ETC). They have to guard their paddy field and use elephant-friendly chasing methods to protect their farmlands; they had not cultivated in elephant corridors, because through lifelong experience, they had known the consequences of cultivating in elephant corridors. However, for few decades, especially since 2004, many of the elephant corridors have been fragmented and hindered by cultivating seasonal and perennial crops, establishing home gardens and settlements, building- permanent structures, and fencing with electric fences and walls.

In the past, wild elephants had migrated from Lunugamvehera Park to MER via Wilmassa and Adella area. However, after establishing an electric fence by the DWC to develop the Wilmassa-Adella paddy fields, the wild elephants lost the elephant corridor forever. Now wild elephants use the Koholangala elephant corridor to migrate from/to

Lunugamvehera Park and MER area. The corridor is very narrow; the width of the corridor is about 450 m. Also, one can notice the presence of a paddy field with a permanent electric fence in the corridor.

On the contrary, there are many large paddy fields in the MER. Some of the paddy fields have been excluded from the area enclosed by DWC's electric fence (from the MER area); the Udamattala paddy field is an example of this fact. The paddy field is about 50 acres and it is separated from the MER by the DWC's electric fence. During the off farming seasons, large herds of wild elephants enter the fields by breaking the electric fence. The story of Ketanwewa village and the paddy fields is also the same. Keligama paddy field is identified by researchers as a wild elephants' feeding ground during the off farming seasons. The residuals of paddy are one of the main food items for wild elephants. So, at the end of the harvesting period, more than 100 wild elephants migrate to the paddy field. However, the DWC has separated the fields from the MER by an electric fence. Thus, the fence has led to fragment the wildlife habitat. Wild elephants have become familiar with breaking the fence to enter into the paddy fields and some of them enter into the village too.

The inclusion of paddy fields to the MER would reduce elephant attacks to electric fences, villagers' lives and properties while safeguarding the elephants' corridors. For instance, DWC has included the Galwewa paddy field (25 acres) to the MER. Hundreds of elephants use this paddy field as a corridor during the off-farm seasons.

Banana is the most favorable highland crop among the farmers in the area. For the last two years, a considerable extent of forest lands had been clandestinely cleared for banana cultivations. According to the villagers, around eight large scale farmers have encroached, cleared and cultivated banana in a land approximately of 2000 acres near Hamuduruwewa (in between Maha-Andarawewa and Pahala-Andarawewa). About 600 acres of Andarawewa-Usgala forest, 100 acres of Wawegama forest, 400 acres of Kuda-Indiwewa forest, 25 acres of Muththalag-Ara forest in Suruwirugama and 25 acres of Weli-Ara forest in Suruwirugama have been cleared for banana cultivations (Land Use Department, Hambantota, 2018). The villagers are not satisfied with the actions which are taken by the relevant authorities. The respondents accused the responsible governmental agencies of their failure to stop the forest clearing activities of large scale banana cultivators.

A considerable extent of the lands in the corridors of the MER has been encroached by villagers and outsiders to cultivate perennial crops such as coconut, mango, and cashew too. It was found that five acres of land in the *Burutankanda* elephant corridor has been encroached by people. According to some officials of the DWC and the villagers in the area, responsible authorities have also issued a permit to cultivate mango in this area. Considering the permit, the DWC has permitted to erect a permanent electric fence enclosing the land. Furthermore, another slot of land is utilized for cashew and mango cultivation (20 acres) in the Katanwewa-Turudana elephant corridor. Now the elephant corridors are disconnected by the perennial crop cultivation and the permanent

electric fences. Hence, it is obvious that the irresponsible behavior of the relevant authorities has led to HEC in the area.

- Causes related to rural development and infrastructure development projects

According to local respondents, in the past, the Madunagala forest was a well-known elephant resting site that was connected by a forest corridor to the MER. Although people had practiced Chena cultivation, no one had disturbed the elephant corridor. Many traditional villagers had known how to interact with wild elephants. Still, there are 15-20 elephants regularly moving from Madunagala forest to MER forest via the Kenhata Pansala forest. However, the human-elephant co-existence has been turned out into HEC due to the *Udawalawe Left Bank Development Project*. The project resulted in several changes in the Madunagala-MER elephant corridor (Andigama-Burutankanda elephant corridor). Several new tanks (about 16) known as '*Us-wewa*' (high tanks) have been established under the *Uswew* project of the Walawe Left Bank Development Project. A considerable extent of forest lands in the corridors and other areas (including the forest patches developed under Farmer's Woodlot Program) has been cleared for home gardens, paddy farming, and Chena cultivation. Now people have fenced their farmlands and properties with electric fences. People use ETCs, firecrackers and other traditional methods to chase away the elephants.

Irresponsible human activities against elephants paved way for HEC in an aggregative manner. Some of the measures are elephant drives – through intensive use of ETCs and elephant translocations. Eventually, some elephants become aggressive. Moreover, the outsiders who were settled in the corridors did not have adequate awareness regarding elephant behavior and traditional methods to handle elephants. The selected land area of the Andigama-Burutankanda elephant corridor has been utilized as a garbage disposal site of the Sooriyawewa Pradeshiya Sabha. Over the last 15 years, the disposal site has attracted many wild animals and has changed to a wild elephants' feeding site. Now, some wild elephants have got adapted to garbage.

The DWC has decided to convert the Madunagala forest patch into a 'wild elephant free forest'. Therefore, an electric fence had been erected around Madunagala by the DWC, Sooriyawewa Pradeshiya Sabha and divisional secretariat. After the failure of the fence, DWC has erected a permanent electric fence (around the MER) to separate the Madunagala forest patch from the MER. Thereby the elephant corridor has been disturbed further.

Mattala airport has been established by clearing approximately 2090 acres of forest land in Mattala forest. According to the villagers, the forest had many *Palu* trees (*Dipterocarpus zeylanicus*), which is considered as one of the favorite food items for wild elephants. In addition to that, the airport has led to fragment the wild elephant habitat and hinder the wild elephant corridors. According to the officials of the airport, wild elephants have attacked the electric fence, entered the airport and had damaged the properties of the airport. So, wild elephant attacks have become one of the main security issues to the international airport. At the beginning of the Mattala Airport Project, the

narrow land belt between Malalaara and Mattala airport was not identified as an elephant corridor by the responsible agencies. Subsequently, due to the efforts of elephant conservationists, a narrow land belt (corridor) was re-opened for wild elephants. According to the airport officials, it has contributed to reduce the wild elephant attack to the airport.

As mentioned earlier, there are several new infrastructures such as the airport, harbor, international stadium, etc. in Hambantota area and the places have been connected through a highway/road network. The highway development has created many negative influences on the natural environment. First, it resulted in the decrease of the wildlife habitat extent which has led to insufficient resource supply (fodder, shelter) to the wild elephants. In the MER, nearly 185.45 acres of land have been cleared for road construction.

Secondly, highway development has led to disintegrate wildlife habitats in the area. Also, the responsible agencies have not placed satisfactory attention on creating elephant corridors to link the fragmented patches of wildlife habitats, including forest patches, large paddy fields, etc. Under the highway project, a 900 m width underpass corridor has been created in the Andarawewa area. Though, there have been numerous incidents recorded where wild elephants including calves have attacked the electric fence, broken the fence and crossed to the other side from many places of the highway.

Thirdly, the highway and related road development projects have changed the directions of the water currents. The infrastructure development activities have negatively affected the traditional cascade system of tanks. According to villagers, Matigathawewa, which is located in the Koholangala elephant corridor, is a good example. During the last 6 years, the tank has not overflowed due to an insufficient amount of water supply. The stream system of the tank was blocked by the landfilling activities done under the road development project in Sooriyawewa area. Due to insufficient water flow to the tank, soil erosion in the area and sedimentation in the tank have led to eutrophication and rapid growth of *Japan Jabara*/Water Hyacinth (*Eichhornia crassipes*) in the tank. These activities and processes have led to reduce the availability of water to elephants in the Koholangala elephant corridor. Thus, villagers emphasized the need for re-opening the water streams to the tank.

There are many existing and abandoned quarries and land mining sites in the MER. The quarries are located in Mayurapura, Sinukugala, Katanwewa, Ihala-Andarawewa, Kuda-Indiwewa, Galahitiya, and Gonnoruwa areas. The land extent covered by the quarries and the mining sites is about 316 acres. Large scale soil mining sites can be seen in Mayurapura and Nagarawewa areas. There are several tanks in the MER that have been excavated and soil or gravel is removed from the banks of the tanks to construct the highway. Pangewwa, Tammanawawewa, Galewwa, and Palugasewwa are some of the examples. In addition to that, some abandoned mining sites have not been renovated after mining. Some of such mining sites have become water stagnating spots and some of the craters are used as solid waste disposal sites. Matigathawewa area in the Koholangala elephant corridor is a

good example of the above fact where currently a huge file of concrete debris can be visible all over the place.

Similarly, many of the quarries and mining sites have very high cliff edges. The height of some cliffs is 15-20 feet. On the one hand, these cliff edges threaten the life of wild elephants. On the other hand, they have hindered the elephants' migration pattern and reduced the accessibility to resources such as water and fodder. Wild elephants use new paths to move to other areas in search of their ecological niches due to the facts that were stated earlier.

Last few years, a large extent of the wildlife habitat has been encroached, cleared and distributed among villagers to establish settlements. According to the DWC and researchers who were involved in planning and demarcating the boundary of the MER, they have provided much attention to exclude human settlements from the MER. Nevertheless, now there are many settlements including model villages in the MER. Some model villages have been established in elephant corridors; for instance, Sivarajagama Model village is located in the Katanwewa elephant corridor. Most of the human settlements have been enclosed by DWC's electric fences or/and private electric fences and then they often result in fragmented wildlife habitats.

- Causes related to HEC mitigation measures

Currently, state-centered agencies, NGOs, as well as local communities have adopted various measures to mitigate the human-elephant conflict. However, on the one hand, the weaknesses of the measures have led to disturbing the elephant corridors in the area.

The DWC has recklessly established a fence which has resulted in fragmenting or disintegrating the forest of the area and increased the threat of HEC. Negative influences of Nikawewa elephant corridors management is an example for the aforementioned data. Wild elephants in the MER and Udawalawa National Park regularly migrate through the Udawalawa-Tanamalwila road (Nikawewa, 21<sup>st</sup> milepost) elephant corridor. Thus, this area is considered as one of the main elephant corridors that link main wildlife habitats in the country. However, about 1 km away and parallel to the Udawalawa-Tanamalwila road, there is a permanent electric fence erected. After erecting the fence, few families have built houses along the road and have erected private electric fences around their houses. Although DWC has a plan to link MER to Udawalawa through the corridor, they have not taken sufficient efforts to maintain the natural elephant corridor.

Unatuwewa elephant corridor is another area which can be taken as an example. When the corridor was functioning, people didn't make any effort to use the particular space. However, after the DWC closed the corridor by establishing an electric fence, people started to develop the lands in the elephant corridor and trigger the HEC in the corridor.

Large sounds and flashlights are used to chase away elephants by the villagers as well as the DWC. According to the DWC's informants, annually, 7000 of ETCs are used in the area. Over the

last few years, the use of ETCs for chasing away wild elephants has gradually increased. In 2010, the total number of ETC distributed by the DWC in the Sooriyawewa DSD is about three thousand six hundred. In 2018, it has increased to six thousand (Land Use Planning Department-Hambantota, 2018, p. 4). As indicated in Fig. 4, about 55% of the key informants have mentioned that they use ETC for chasing wild elephants away from their lands (elephant corridors).

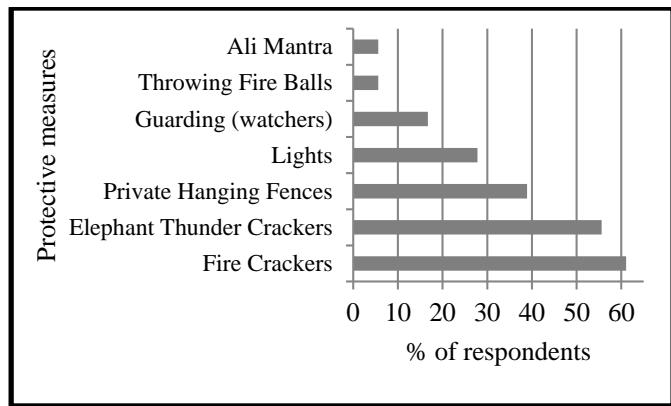


Fig 4. Protective measures taken to minimize human-elephant encounters and chasing elephants by the local communities in elephant corridors (Source: key informant interviews, 2019)

From the viewpoint of some villagers, the careless use of ETC has led to an increase in the intensity of the HEC. As per them, ETCs are provided not only for villagers but also for the farmers who have encroached the forest land and cultivated banana and other crops. The illegal farmers use ETCs in the forests (*Mahakale*), elephant corridors, and chase elephants away from the forest. As a result, elephants tend to attack the village farmlands. At that point, villagers also use ETC and other methods to chase away elephants from the villages (refer to Fig 4). Eventually, this kind of intensive use of ETCs and other harassments cause the elephants to be more aggressive.

#### IV. DISCUSSION

As per the findings of the study, it was identified that the elephant corridors in the MER have been disturbed by the intentional and unintentional activities of responsible agencies, outsiders, and the local communities. They can be summarized as follow;

- The state-centered stakeholders have acquired, cleared, developed, and used some lands in elephant corridors for settlement, infrastructure development, rural development, and agricultural purposes while some villagers have also encroached some lands for residential and economic purposes;
- The responsible agencies especially the DWC, have disturbed the elephant corridors by erecting electric fences for protecting human life, their property, habitat management purposes, etc. After closing the corridors, the land has been developed by villagers, outsiders, and state-centered agencies;
- The responsible agencies have not placed much attention on taking legal actions against those who disturbed the wild elephant corridors;
- The encroachers, settlers, and investors in the elephant corridors use various kinds of electric fences and various

chasing methods to protect their life and properties. The DWC has also provided ETC among villagers. Majority of the present protective measures harass the wild elephants. Thus, it seems that the responsible agencies have also indirectly supported to disconnect the elephant corridors.

Furthermore, it is important to note that villagers and responsible agencies have identified the land value of the elephant corridors while ignoring ecological values as well as the potential economic values of the corridors. Elephant corridors are the places which wild elephants often use for moving here and there. So, such places can be used as tourist attractions. Then that elephant viewing tourism can be used as a panacea for the socio-economic issues in the area, especially human-elephant conflict.

The tourism value of some elephant corridors has been identified and marketed by the state-centered agencies, notably the Forest Department and the Department of Wildlife Conservation. Hurulu Eco Park is an example (Pathmasiri, 2019). It is located in the Hurulu Man and Biosphere Reserve. Wild elephants use this land area for moving between Kaudulla, Minneriya, and Huruluwewa forest and tank areas. Thus, until 2006, villagers, as well as outsiders, had used the corridor for hunting elephants (for ivory and biological origin gemstones – *Gajamutu*) and catching elephant calves for trading. Some outsiders had used the corridor as an open access tourism destination where one can watch wild elephants. With the hope of controlling such irresponsible human activities and securing the life of elephants that use the corridor for migrating between habitats, Forest Department declared about 16,000 hectares of Huruluwewa forest as an ecotourism site and renamed the area as Hurulu Eco Park. In addition to that, Forest Department has introduced a safari tour package and recruited 12 people as tour guides.

From 2006 to 2016, annual total tourist arrival to the corridor has increased from 5,852 to 89,598. As indicated in Fig 5, the majority of the tourists are foreigners. During the period, Forest Department has earned LKR 238.7 million from tourism.

As identified by Pathmasiri (2019), ecotourism has contributed in several ways to the elephant corridor. First, due to the eyes of tourists, tour guides, and the officials of the Forest Department, some of the irresponsible activities such as elephant hunting and capturing calves have been controlled. Moreover, the direct financial contribution of tourists is also used for wildlife conservation activities, such as forest fire controlling, curing injured animals, removing invasive species, etc.

However, due to lack of socio-economic commitment of the state-centered stakeholders, the local community has not become the ecotourism facilitators and the guardian of the corridor; therefore, some villagers still engage in animal hunting for bush meats. In addition to that, due to poor ecotourism commitment of the state-centered agencies of the destination, safari drivers violate the basic principles of ecotourism (Pathmasiri, 2017 and 2019).

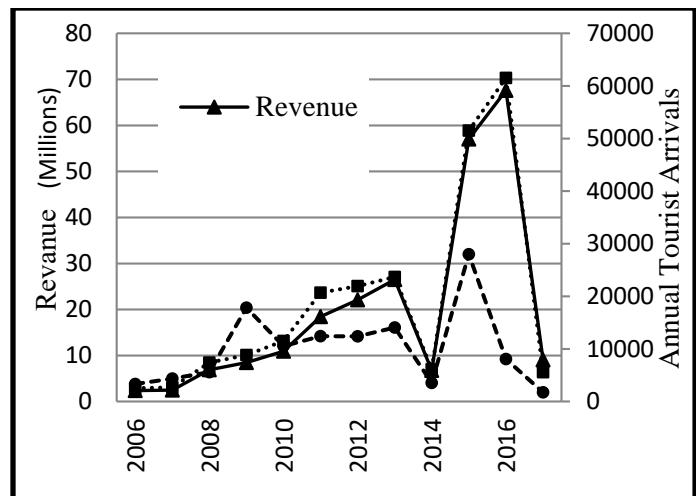


Fig. 5. Annual tourist arrivals and the tourism revenue of the Hurulu Eco Park (Source: Hurulu Eco Park office, 2019, Unpublished data)

Thus, it is obvious that, without getting local community participation and providing economic benefits to the local community, the sustainability of elephant corridors cannot be achieved. Therefore, when declaring the MER, the responsible agencies should place attention to identify the tourism values of the area, and to give ecotourism opportunities to the local communities, and thereby converting them to the guardian of the elephant corridor and facilitators of the tourists visit the elephant corridors. It would contribute to the sustainability of the elephant corridor and minimize the human-elephant conflict in and around the MER.

## V. CONCLUSION AND RECOMMENDATIONS BA

The aforementioned information revealed that the responsible agencies have ignored and/or placed less attention on the biodiversity conservational and socio-economic functions of elephant corridors in the MER. It has led to the loss of human and elephant lives as well as villagers' properties. In addition to that, it has created a huge economic cost and loss. Therefore, maintenance of elephant corridors as safety paths for wild elephants and as crucial places that ensure the security of human life and their property is essential. To achieve this, it is essential to enhance the ethno-zoological values of elephant corridors. To do that, several activities can be recommended as follow;

- Identify, map out and declare elephant corridors as very sensitive sites for the security of wild elephants as well as human;
- Prohibit the use of the lands in elephant corridors for any purposes except wildlife conservational and recreational activities that do not disturb the elephant corridor and the wild animals that use the corridors;
- Remove (or manage properly) temporal or permanent obstacles (such as roads, electric fences, crop cultivations, buildings, etc.) that hinder the movement of elephants;
- Take legal actions against the sanction violators;

- Prohibit the use of harmful and noisy chasing methods in the elephant corridors;
- Take back the lands that are used for other purposes to widening the elephant corridors through discussions with responsible parties;
- Rehabilitate degraded lands in the corridors as suitable for wild elephants;
- Developing the MER as an eco-park and developing the elephant corridors in the area as ecotourism honey pots;
- Provide ecotourism opportunities to the nearby communities of the elephant corridors.

By adopting the aforementioned recommendations, wild elephant corridors can be maintained as a better solution for many environmental and socio-economic issues in the areas.

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