

# Addressing Human-Elephant Conflict in the Sinharaja Forest Reserve Area: A Comprehensive Study on Landscape Design Approaches

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## Abstract

Human-elephant conflict is a major problem in Sri Lanka which has existed since recent past times and now it has increased. Sinharaja rainforest is a tropical rainforest and it has two male elephants who have special concerns due to the limited number of wet zone elephants in Sri Lanka. Because of roads and tea plantations their natural corridors have been blocked. Therefore those elephants tend to enter residential areas and plantations. As landscaping solutions maintaining their corridors with their favourite trees and grasses leads the elephants through only the corridors and avoid entering the other areas. To join the forest fragments on both sides of the road, an eco-bridge can be used. To enhance tourism around the forest reserve, elephant-watching stations can be established. White colour rounded or sharp stones can be used as a buffer zone. Besides, to prevent elephants from entering roads, *Citrus* bio fences can be established.

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*Keywords: Human-Elephant Conflict-HEC, Wet Zone*

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## Introduction

Human-elephant (HEC) is a major problem in Sri Lanka which is threatening both human and elephant lives. Human- Elephant conflict has existed since ancient times and now it has increased due to the Habitat loss and fragmentation of elephants, Lethal revenge against elephants, Kill the elephants for ivory, meat, and elephant pearls, Crop raiders, Low forest quality, climate change-related incidents("Sri Lanka human – Elephant conflict," n.d.). The elephant habitat in Sri Lanka has been reduced by 15% over the last 50 years(Writer S, 2022). The human-elephant conflict has intensified in the past three years. Usually, elephant deaths happen due to gunshots, electrocution, jaw bombs, and train accidents. Human deaths happen by hitting the elephant. Other than that elephants are damaged properties and agricultural fields. Data indicate that every year in Sri Lanka, over 100 humans and over 300 elephants die as a result of the HEC and the elephant census indicates that around 6000 elephants are living in Sri Lanka, with just 5% of them being tuskers. (Writer S, 2022).

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## Objectives of the Study

The present study focused on achieving the following aim/ objective.

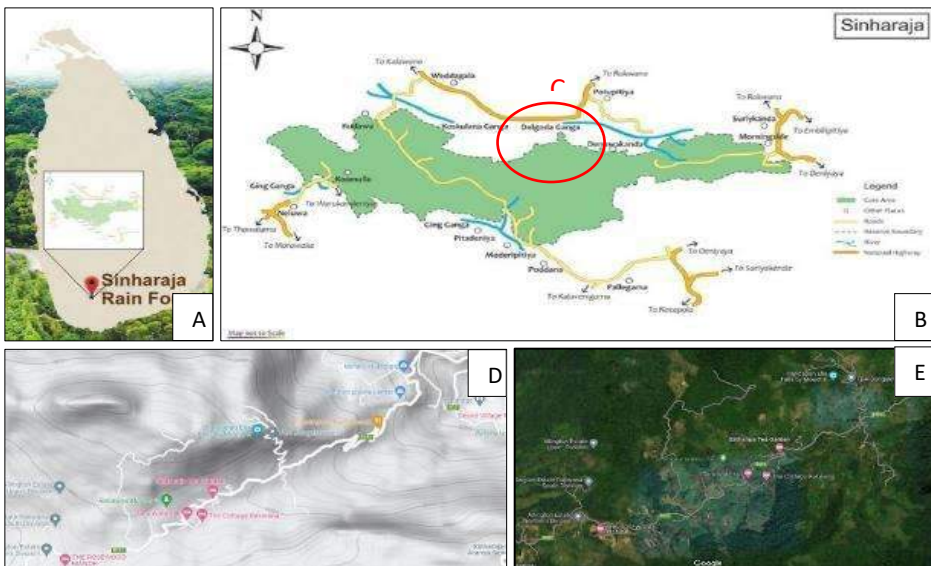
- To design a landscape solution for minimizing the human-elephant conflict in the Sinharaja forest reserve.

## Introduction of the Selected Site

Sinharaja rainforest is a wet zone forest that has heritage value. In 1920, around 40 elephants were in the Sinharaja. But in 1950, 20 elephants were caught in Panamure and Kalawana elephant camps. In 1968 first HEC was reported with one human death. Now there are only two male elephants in the Sinharaja forest reserve and they also have special concerns due to the limited number of wet zone elephants in Sri Lanka. These two male elephants are called “Panukota” and “Lokualiya”. These elephants are wet zone elephants that can climb slopes. These two rainforest elephants play a major role in controlling illegal activities such as poaching, illegal logging and mining activities within Sinharaja and adjacent Kudumeeriya and Delwala-Walankanda forest reserves as those who engage in these illegal activities greatly fear the elephants (Lanka, 2018). But because of the fragmentation of forest reserves to construct the roads and tea plantations their natural corridors have altered and closed. Therefore those elephants tend to enter residential areas and plantations.

The selected site is the Rakwana area near the Rakwana mountain. This area is a hilly area with tea plantations. There is a secondary road named B181-Kalawana- Rakwana road and it is connected to A17 main road. Around this area, there are several hotels and a few residential houses. The elephants' corridor has been identified as Handapan Ella to Rakwana Mountain. But when they migrate they are not always using the same pathway. When they cross the B181 road vehicle accidents can happen and may harm both elephant and human lives.

**Figure 01:** A; The location of the Sinharaja forest reserve (The Natural Beauty of Sinharaja Rainforest | Sunday Observer, 2021), B; The location of selected site (Padmal et al., 2023), C; The selected site, D; Terrain map of the site(Google Earth Pro), E; Satellite image of the site (Google Earth Pro), F;Rakwana mountain



**Figure 02:** Two Sinharaja elephants “Panukota and “Loku Aliya” (Sinharaja Conservation Master Plan - Rainforest Protectors Trust, n.d.)



### **Theoretical Position**

Countries in the world have followed different solutions for HEC. Understanding the behaviour of elephants is an important thing to reduce the HEC. Buffer zones are Clear strips 15-50m wide around cultivated land between the farm boundary and the edge of the forest boundary. Other than that warning alarms such as trip alarms, Cellphone & LED light-based systems, Infrared or motion-triggered sensors, and watch towers can be established to detect the elephant’s coming. Boundary protection such as Beehive fences, Chili deterrents, Noise deterrents, Metal strip Fences, and bio fences can be used to expel elephants. Besides landscape solutions such as trenches, and alternative water points, eco bridges can be used to provide a favorable environment to elephants.

As well as culling and translocation methods are also used in other countries to prevent human-wildlife conflict. Elephant culling is the practice of controlling elephant populations by killing them(International Fund for Animal Welfare, n.d.). This method is biased toward the human side. Translocation is introducing the elephant to a new area. But elephants are adapted to their habitat and when they translocate they can die. This method is not fair for all elephants. This solution does not lead to the coexistence of humans and elephants. When considering the Sinharaja forest even though the government tried to translocate elephants to a new location, zoologists did not agree with that (Sinharaja Jumbo Emerges; Wildlife Officers Manage to Avert Incidents With Villagers, n.d.).

### **Methods**

#### ***Prob the Problem***

The real problem was identified according to information on the history and causes of the HEC. The current situation of the problem in Sri Lanka and other countries was identified. Then, information on solutions, that other countries have followed to minimize the HEC was collected.

#### ***Site Selection***

The area near B181 road and the Rakwana mountain in the Sinharaja forest reserve was selected as the site. The satellite images and terrain images were observed and elephant corridors, residential areas, buildings, plantations, infrastructures, and other constructions were identified.

### Landscape Solutions Designing

Using the solutions of other countries, feasible landscape solutions for selected sites were designed. Maintaining elephant corridors as a favorable environment for elephants, building an eco-bridge above the road, establishing bio fences along the road and around areas to be protected, establishing elephant-watching stations and A zone of rounded or sharp stones are the feasible solution for the site.

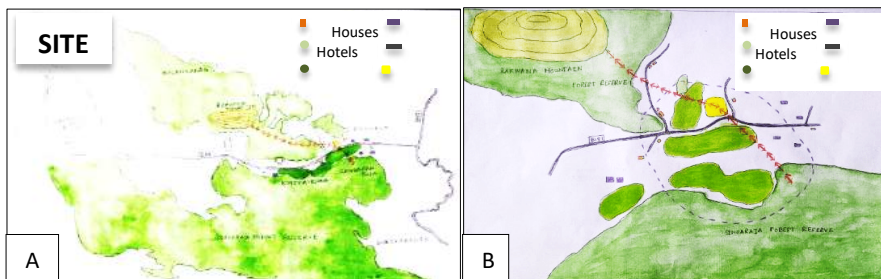
### Results and Discussion

#### The selected Site

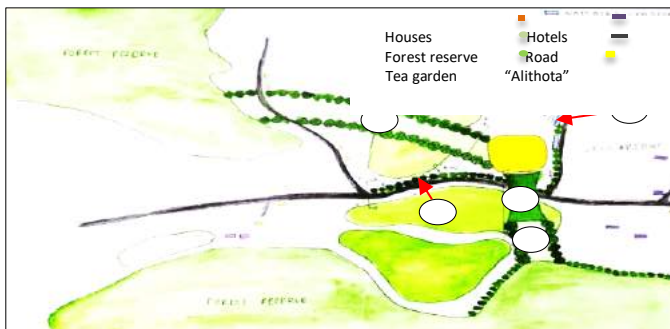
**Figure 03:** The differentiation between selected site in 2002 and 2022 – A; Satellite image of the site in 2002, B; Satellite image of the site in 2022 (Google Earth Pro pictures)



**Figure 04:** A; The map of the selected site, B; The zoomed map of the selected site Landscape Solutions for HEC in Sinharaja forest reserve

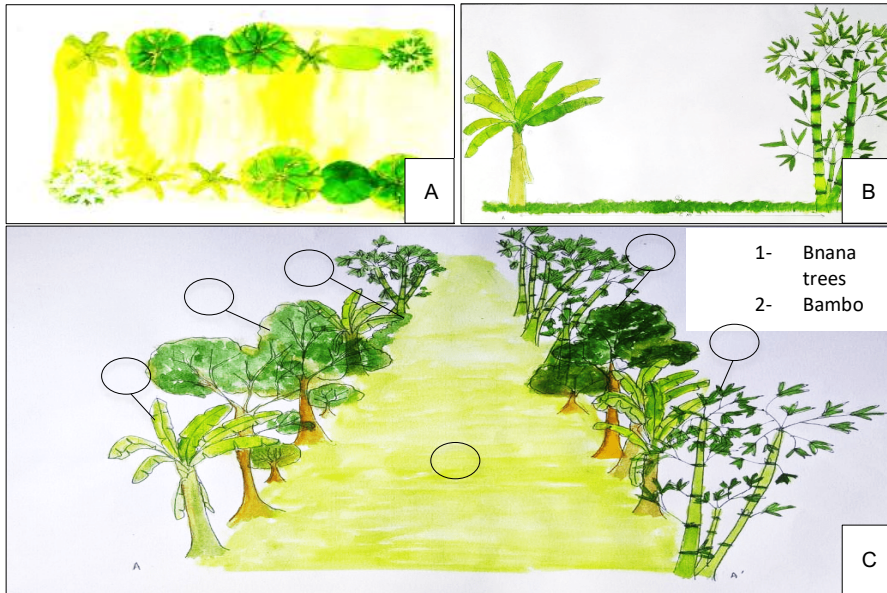


**Figure 05:** The map of the solutions- A; MForest Reserve elephant corridors, B; Eco bridge, C; Bio fence, D; Watching stations



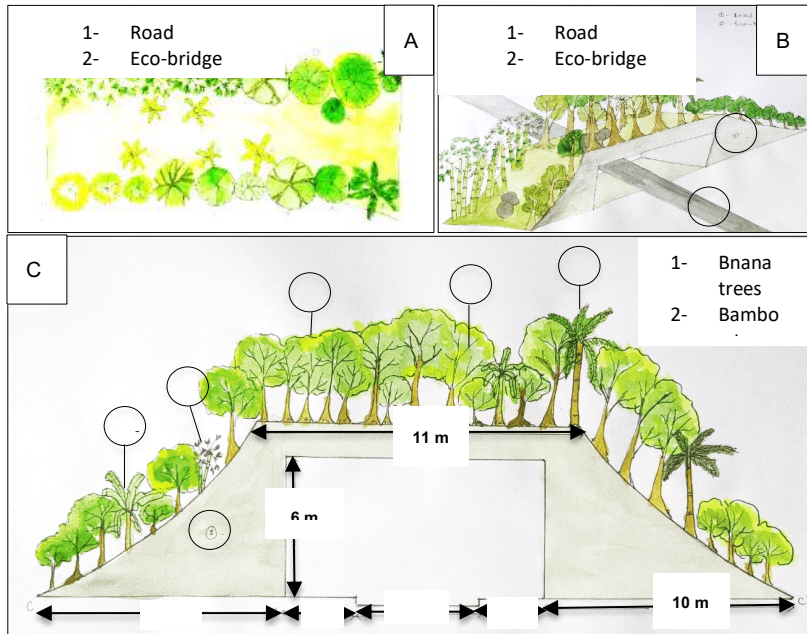
**A- Maintaining Elephant Corridors**

**Figure 06:** A; The plan of the elephant corridor, B; The elevation of the elephant corridor, C; The perspective of the elephant corridor



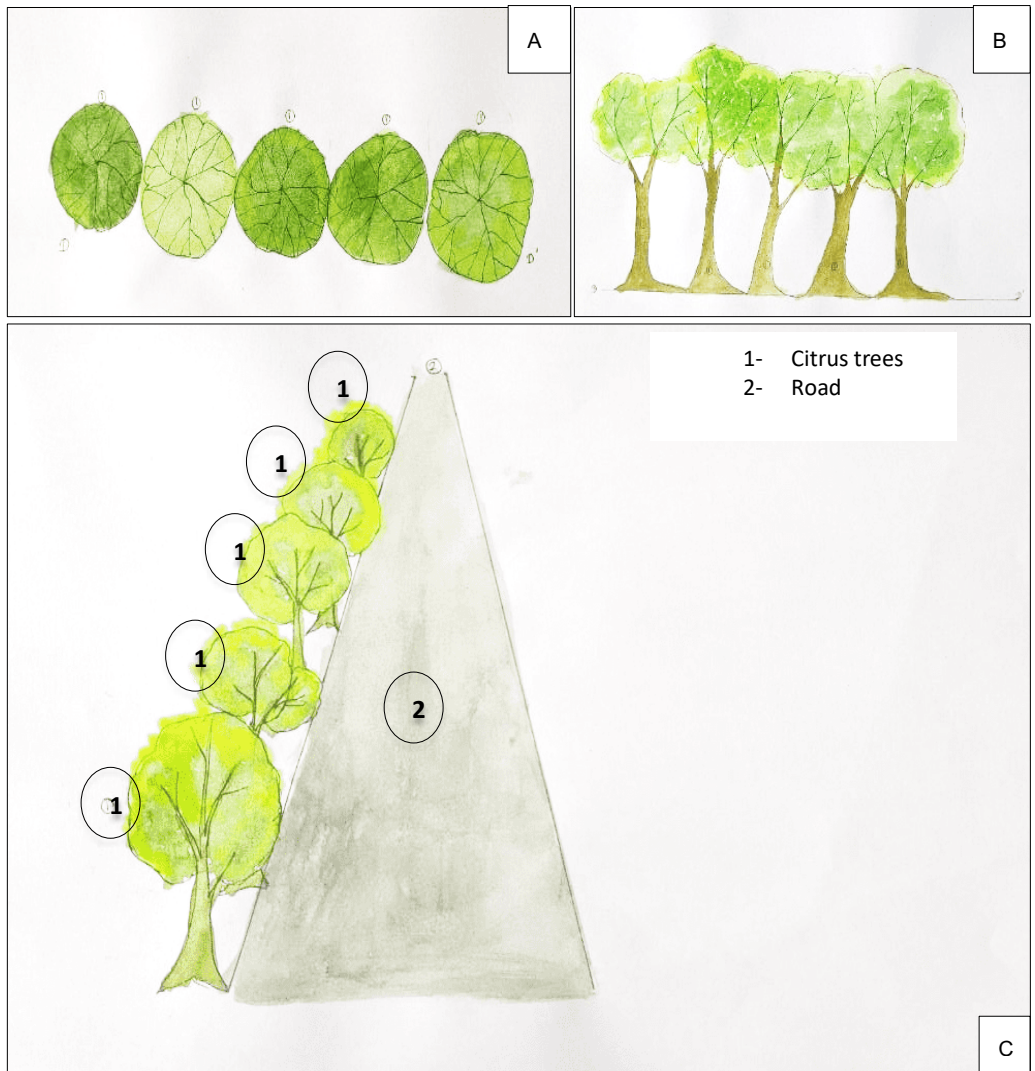
**B- Eco Bridge**

**Figure 07:** A; The plan of the eco bridge, B; Perspective of the eco bridge, C; The elevation of the eco bridge



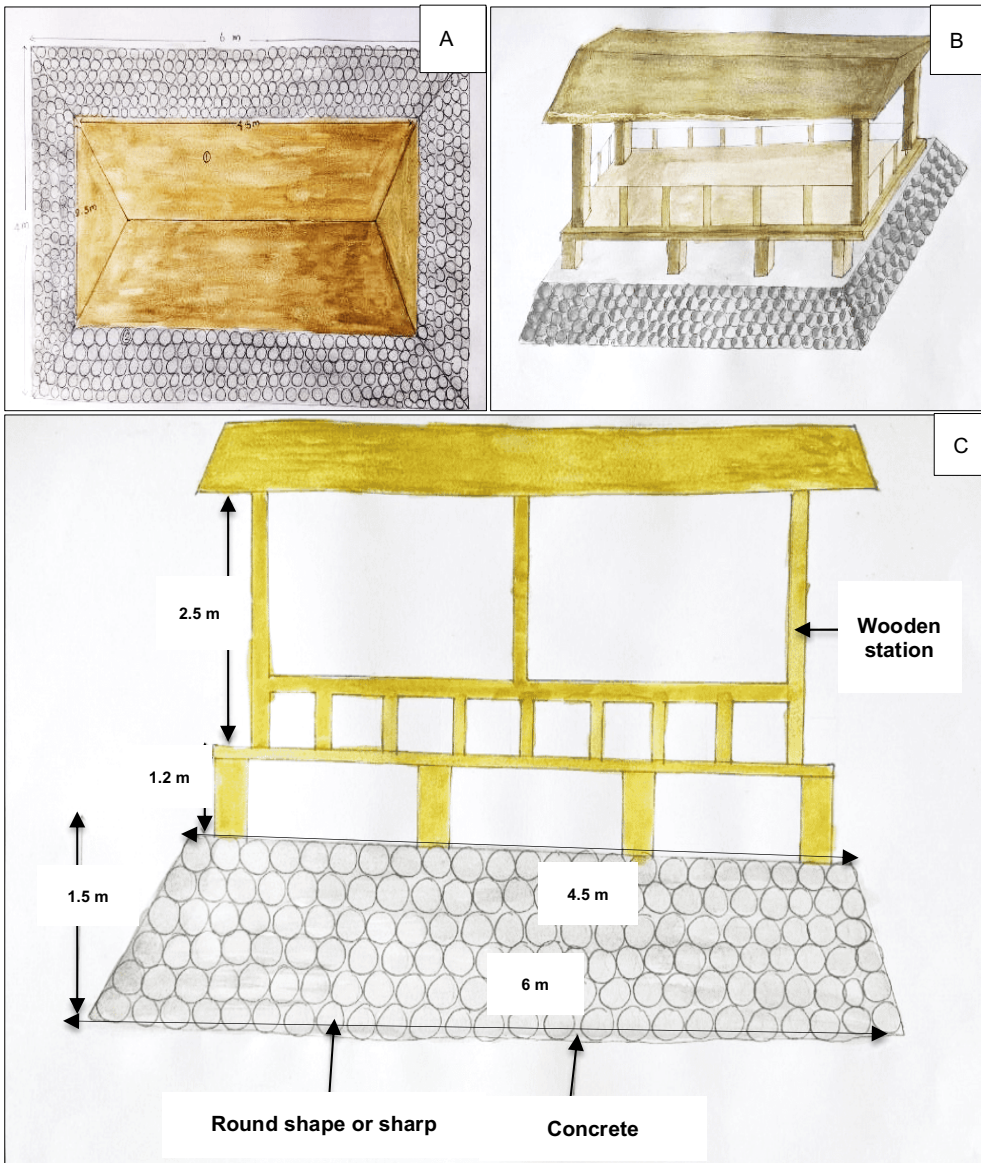
### C- Bio Fences

Figure 08: A; The plan of the bio fence, B; The elevation of the bio fence, C; The perspective of the bio fence



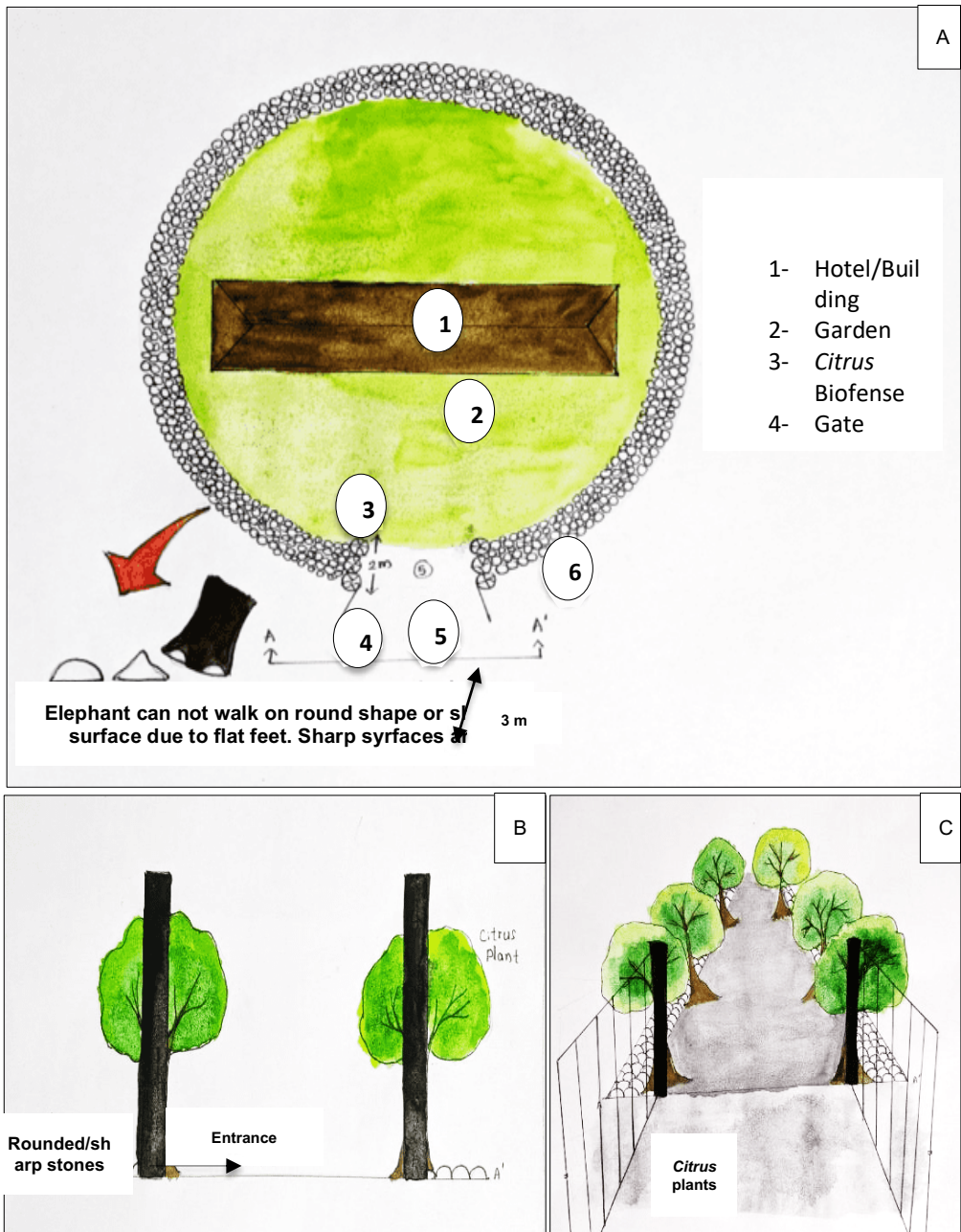
### D- Elephant Watching Station

**Figure 09:** A; The plan of the watching station, B; The perspective of the watching station, C; The elevation of the watching station



**E- A Zone of Rounded or Sharp Stones Around Buildings**

**Figure 10:** A; The plan of the stone zone, B; The perspective of the stone zone, C; The elevation of the stone zone



In Sri Lanka, a lot of solutions like electric fences, trenches, beehive fences, walls, etc. have been established to minimize the HEC. But due to the habituation of elephants and lack of proper maintenance, these methods are not successful.



According to above figures, deforestation, the number of constructions, and the number of agricultural sites in selected sites have increased from 2002 to 2022. In the selected site, there is an elephant corridor from Handapanella to Rakwana Mountain. But due to fragmentation, they tend to enter the villages around the corridor. That corridor also has varied and closed due to plantations and B181 road.

When designing the landscape solutions for this site, the forest reserve should be protected. A lot of concrete solutions are not suitable for this site because of the value of the Sinharaja forest. Therefore the best solution is to maintain the natural elephant corridors. An elephant corridor can be established from Handapanella to the place called “Ali Thota” and “Ali Thota” to Rakawan Mountain. These corridors can be maintained with favorable trees like banana, bamboo, wood apple, mango, willow, Kithul, etc. Perennial trees are more suitable for this. The corridor width should be large enough to provide enough space. Then elephants can be restricted to these pathways and prevent entry into villages. These corridors can be maintained by the Department of Wildlife Conservation.

When the elephant crosses the B181 road, vehicle accidents can happen. Therefore an eco bridge can be used above the road. The eco bridge also can be maintained using trees that are used in corridors. This eco bridge should be an optimal area and strong enough to bear the weight of trees and elephants. The floor of the bridge should be covered with soil to provide a natural environment. To minimize the entry of elephants to roads or other areas bio fences can be used. To build bio fences citrus plants can be used. Because elephants are not like *citrus* plants due to the spines and smell of the leaves. These citrus plants should be planted close to each other around plantations or along roads.

Besides, elephant-watching stations can be established around “Ali Thota”. Because of the Sinharaja forest, Handapanella waterfall, and Rakwana mountain, there are a lot of local and foreign visitors visiting this place. Then they can watch elephants safely. This watching station can be made of wood and it should be established at a certain height from the ground level. The base of the station should be made as a slope. But these elephants can climb the slopes. Therefore that slope should be covered with round or sharp stones. Because elephant feet are flat and they can not walk on sharp round surfaces easily. Normally elephants do not like to white colour (Pioneer, 2017). Therefore these stones can colour with white colour. This will support the improvement of the tourism industry. Other than that a zone around buildings such as hotels, houses, or other construction can be covered by rounded or sharp white colour stones up to 3 m wide. This zone acts as a buffer zone while elephants can not pass this zone easily.

As plant-based solutions, maintaining elephant corridors and *citrus* bio fences are economically feasible. Besides these fences provide food and extra income for farmers (Banerjee & Banerjee, 2022). When building an eco bridge, a watching station and stone buffer zone concrete are needed. To build a watching station wood is needed. Other than that sharp or rounded stones are needed to build the watching station and the buffer zone. For plant materials, no need to spend a lot of money. But a maintenance cost should be allocated. However, these design solutions are economically feasible, environmentally friendly, and sustainable.

## Conclusion

As a rainforest, Sinharaja has a high value. Therefore to prevent HEC in the Sinharaja forest area, plant-based solutions are more suitable to protect the natural environment rather than artificial constructions.

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