Human-Elephant Conflict: Insights from Vegetation Analysis in Sri Lanka

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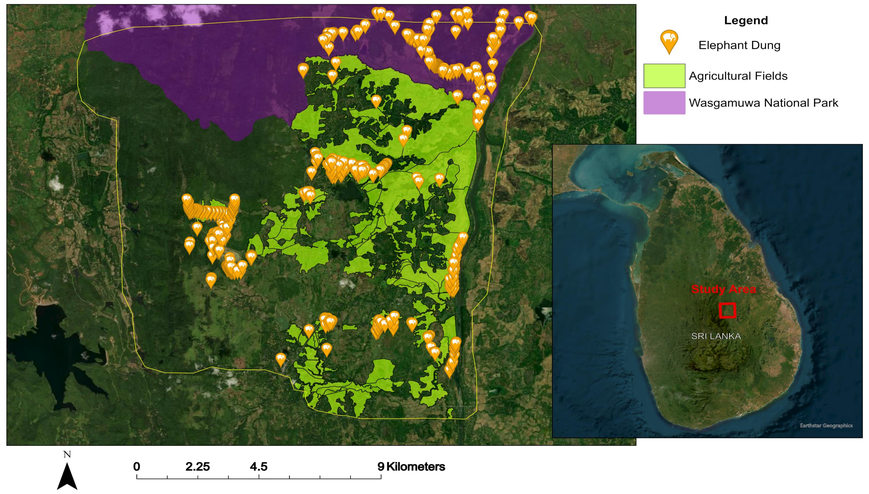
Overview

Human-wildlife conflict is a growing issue as agricultural expansion encroaches on natural habitats. This study examines the relationship between the distance of adult male elephants from agricultural fields and NDVI (Normalized Difference Vegetation Index), a measure of vegetation health. Using GPS collar data and NDVI satellite imagery, analyze whether areas with higher vegetation productivity influence elephant movement patterns. Understanding these spatial relationships can inform conservation strategies and mitigate human-elephant conflicts.

Introduction

- Human-elephant conflict (HEC) in Sri Lanka resulted in the death of 470 elephants and 145 humans in 2023.
- Sri Lankan elephant (*Elephas maximus*) are listed on the endangered animals list.
- Agriculture encroaches on elephant habitat, increasing conflict between humans and elephants.
- Normalized Difference Vegetation Index (NDVI) compares vegetation densities and health among agricultural and nonagricultural areas.
- Elephants are drawn to agricultural fields for food, leading to destruction of agricultural fields and retaliation from farmers.
- This study evaluates elephant presence in relation to NDVI to provide insights for conservation and agricultural management.
- Understanding the factors influencing elephant movement can inform policies to mitigate human-wildlife conflict

Elephant Presence Among Agricultural and Nonagricultural Areas



Research Questions

1. How does elephant presence and NDVI values vary between agricultural & nonagricultural areas?
2. Is there a significant difference in elephant presence between agricultural and nonagricultural areas regarding crop consumption?
3. Is there a significant difference between NDVI values in agricultural areas and nonagricultural areas?

Methods

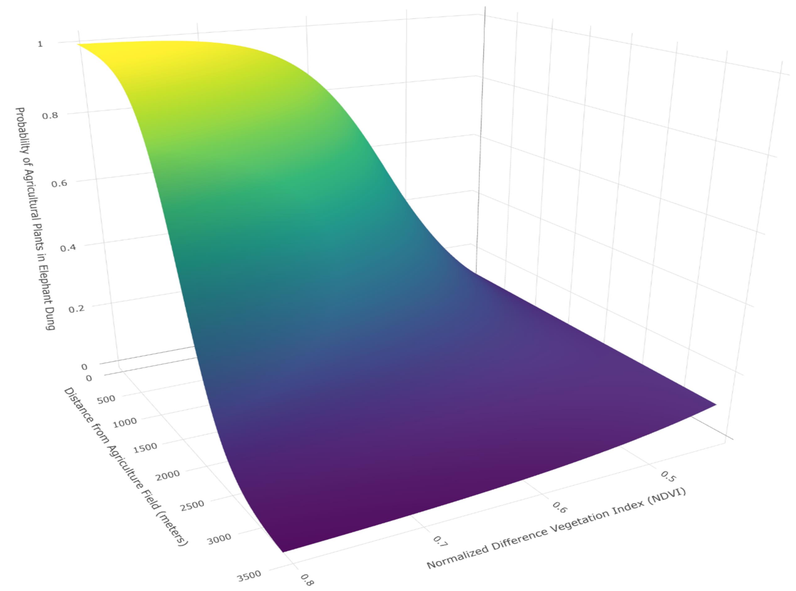
1. In Field Data Collection: (n=92), Dung Samples (< 4 days old), Dung collection assessments: GPS points, dung age, plant species & seed species present. Dung composition analysis: washed and sieved dung samples recording seeds present in dung.[4]

2. Distance From Agricultural Fields: Mapped agricultural areas, Elephant dung GPS points metric for elephant presence, "Near" spatial analysis tool measure distance (dung point to agricultural areas).

3. NDVI Analysis: Landsat Surface Reflectance 30 m resolution at each dung GPS point, Calculated NDVI average: 90-day period (45 days before and after collection date), NDVI average comparison of agricultural and nonagricultural areas.

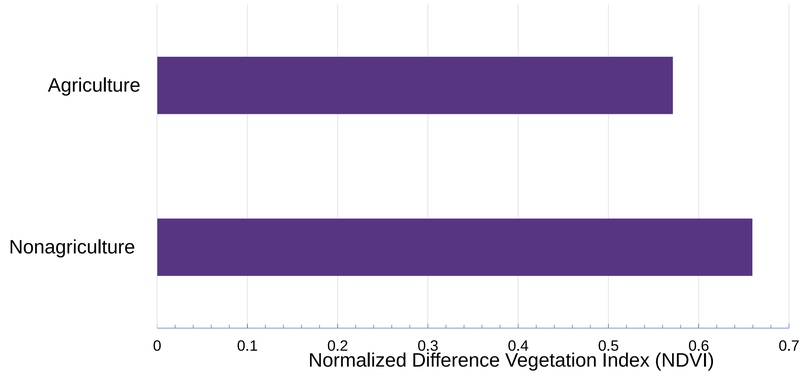
Results

NDVI and Proximity to Agricultural Influence on Elephant Diet



Probability of agricultural plants in elephant dung increases with higher NDVI and closer proximity to agricultural fields.

Average NDVI of Agricultural vs Nonagricultural Areas



Average NDVI value is significantly lower in agricultural areas compared to nonagricultural areas (p-value 0.0084)

Results Continued

Total Recorded Presence within Agricultural & Nonagricultural Areas

Area Classification	Dung Composition Analysis	Spatial Analysis	Total
Agricultural	110	146	256
Nonagricultural	595	691	1,286
Total	705	837	**1,542**

This analysis seeks to understand the frequency of elephant presences in agricultural and nonagricultural areas. Data included: 1) Dung collection assessment 2) Dung composition analysis 3) Distance from agricultural fields 4) Elephant Sighting 5) Conflict reports.

Key Takeaways

- Elephant dung found within 100 meters of agricultural area, NDVI of 0.68 is 96% probability of agricultural seeds in dung.
- Elephant presence within 1,800 meters of agricultural fields, regardless of surrounding NDVI, has a 50% chance of crop consumption.
- 17% of all data points collected indicated those elephants used agricultural areas. 83% indicated no use of agricultural areas the previous four days.
- Agricultural areas NDVI is significantly ($p<0.05$) less than nonagricultural areas.

Conflicting Results

- NDVI data alone suggests elephants aren't necessarily moving into agricultural areas.
- When looking at all elephant sighting points, they are found outside agricultural fields more often than inside.
- However, combining both factors in the model still shows high elephant presence.

Conclusion

Ecologists need to take an interconnected approach to data interpretation—one model or dataset doesn't tell the whole story. Beyond ecological factors, economics and politics also play a major role in wildlife management. The most effective strategy for reducing human-elephant conflict—electric fences—is often debated. Many farmers believe the government should cover the costs, but there's a disconnect in understanding who is responsible for implementation and long-term maintenance. Effective management requires bridging this gap, integrating ecological science with economic realities and political decision-making to create sustainable solutions.

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