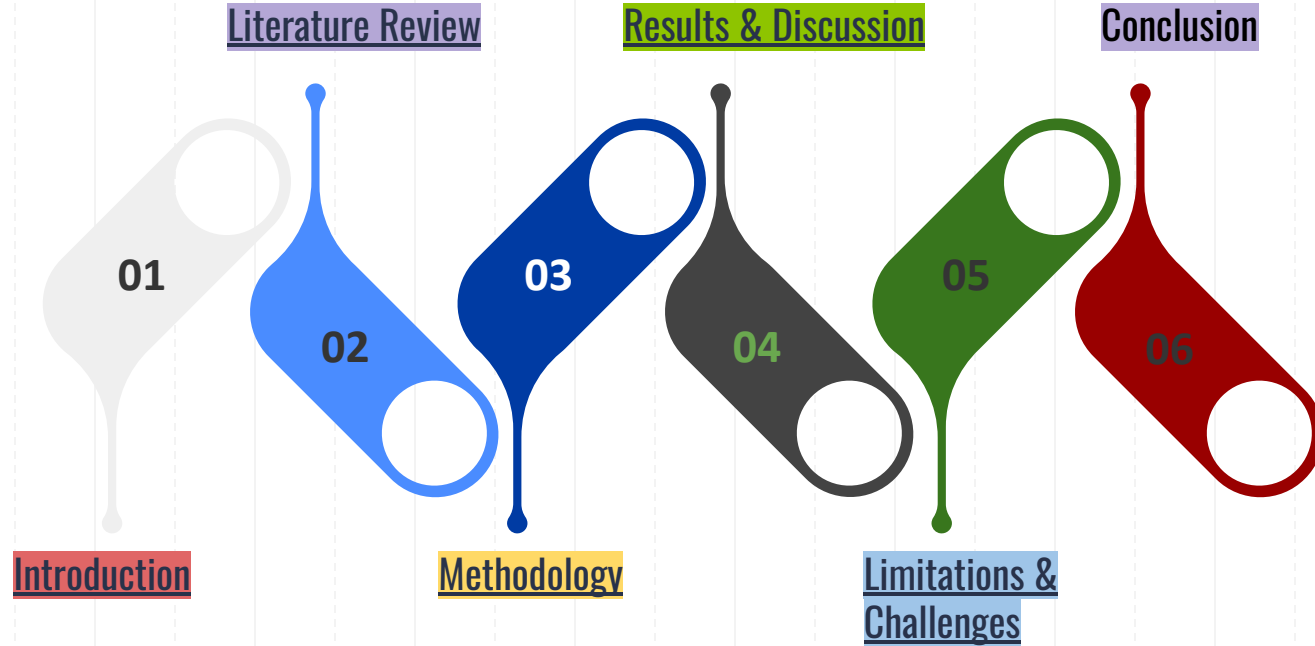




# DETECTION OF DEFORESTATION USING SATELLITE IMAGES

# OUTLINE





# INTRODUCTION

1

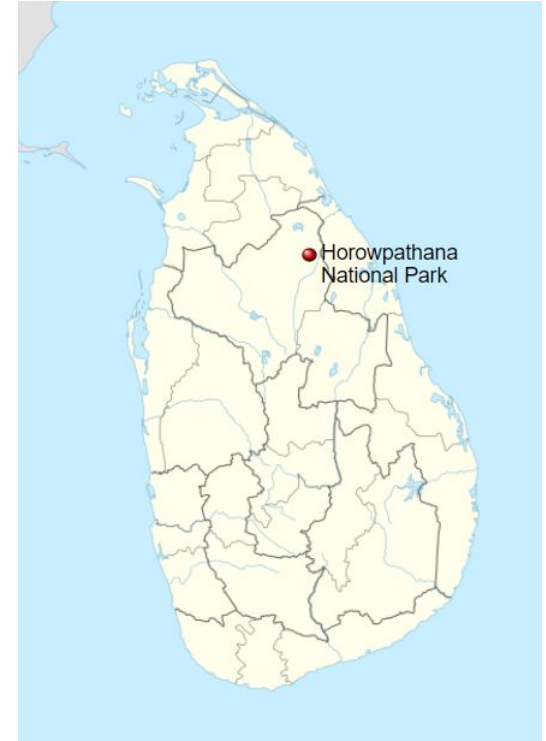
# What is Deforestation ?

- **Removal of trees and forest cover**
- **Causes:**    **Logging**(to obtain wood and paper products)  
                  **agriculture**(to create space for farming)  
                  **urbanization**(for building cities and infrastructure)  
                  **mining** (to access minerals and resources)
- **Environmental Impact:**    **Loss of Biodiversity, Climate Change, Disruption of Water Cycles**
- **Human Impact:**            **Loss of Livelihoods, Increased Pollution**



# Horowpathana National Park

- Located in North Central Province, Sri Lanka
- Rich in biodiversity and endemic species
- Under threat due to human activities





# Literature Review

# 2

## Satellite Imagery for Deforestation Prediction using Deep Learning

- Satellite Imagery Dataset from Kaggle
- Convolutional Neural Network with ResNet transfer learning

## Deforestation detection using multitemporal satellite images

- Sentinel-2 Satellite images
- NDVI, and dNBR to detect deforestation

## Tropical deforestation monitoring using NDVI from MODIS satellite: a case study in Pahang, Malaysia

- MODIS imagery
- NDVI classification



## Detecting Deforestation Using Satellite Imagery

- Satellite Imagery of Amazon rainforest from Kaggle
- Convolutional Neural Network

## USING LANDSAT SATELLITE IMAGES TO DETECT FOREST COVER CHANGES IN THE NORTHEAST REGION OF VIETNAM

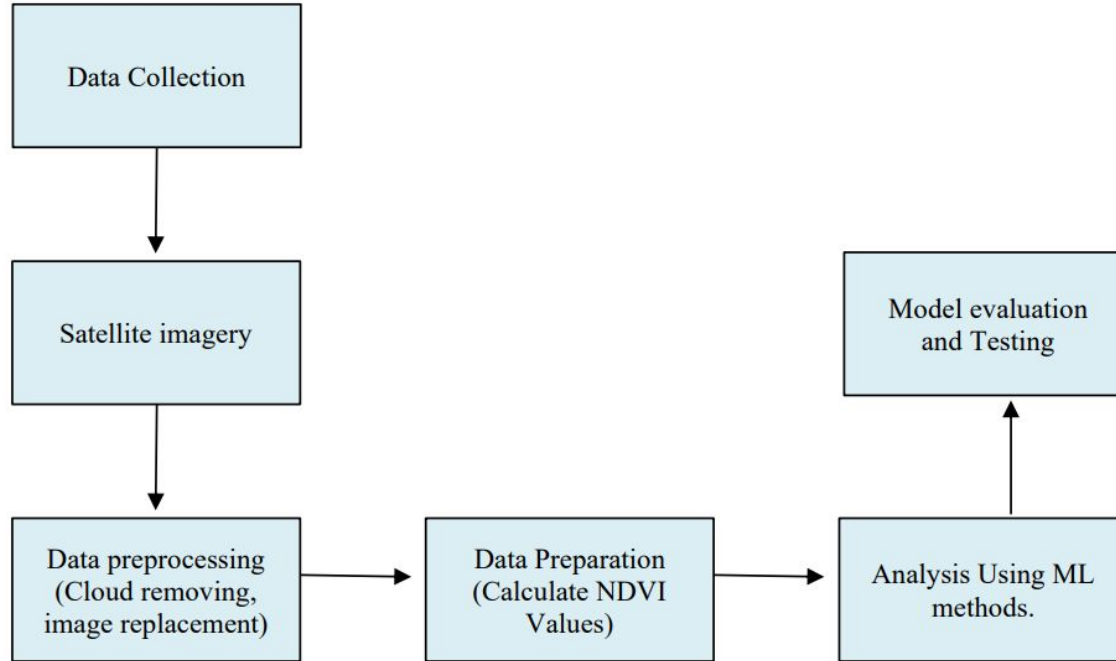
- used Landsat 5-TM and Landsat 9-OLI/TIRS satellite imagery
- NDVI and the SAVI were used to assess forest cover losses and gains







# Methodology 3



## Data Collection

- Images and image data were obtained from USGS Earth Explorer.
- Vegetation features
- Satellites - LANDSAT 8 & 9
- Monthly Images (2020/06 - 2023/08) - having least cloud cover
- Datasets include Metadata(text, JSON, XML) and Band files(TIF).

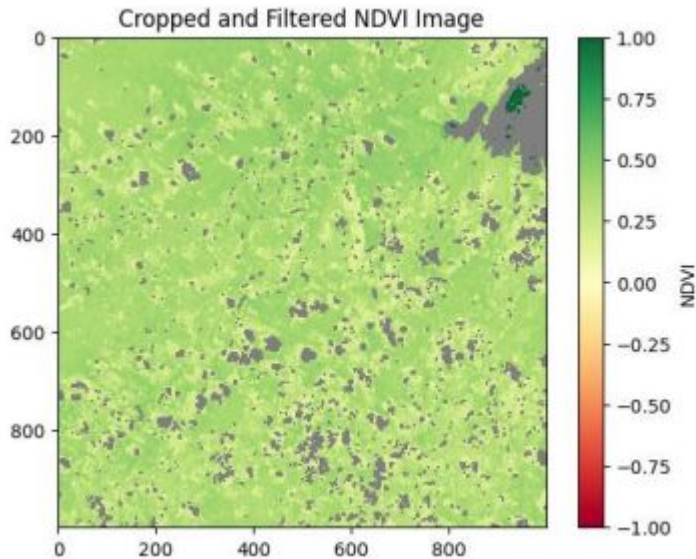


# Data Preprocessing

- Cloud removal
  - Imprinting - Using a satellite image with less clouds to imprint a satellite image with clouds
- Selecting Area of Interest (AOI)
  - Cropping - Horawpothana area



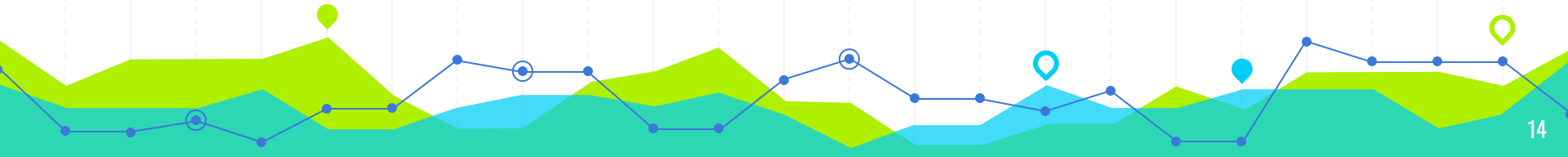
# Data Preparation - NDVI Calculation



- Measure of the amount and vigor of vegetation on the land surface
- $NDVI = (NIR - Red) / (NIR + Red)$
- RED = the red portion of the electromagnetic spectrum (0.6-0.7  $\mu m$ ) and
- NIR = the near infrared portion of the electromagnetic spectrum (0.75-1.5  $\mu m$ )

## Deforestation Percentage

- Deforestation percentage is calculated relative to the month 2020/06
- Percentages are calculated using Average NDVI values



# Forecasting Future NDVI

- ARIMA Modeling
  - An ARIMA model is defined - order (5, 1, 0)
  - ARIMA model is fitted using the 'Average\_NDVI' column from the training data.
- NDVI Forecast
  - Get the forecasted NDVI value for the closest date.



# Forecasting Future Deforestation Percentage

- Random Forest Modeling
  - 'Average\_NDVI' as input features and 'Deforestation\_Percentage' as the target variable are used in training a Random Forest regressor
- Deforestation Percentage Prediction
  - Using the new DataFrame with the forecasted NDVI value, and the trained Random Forest model, deforestation percentage for future dates is obtained.

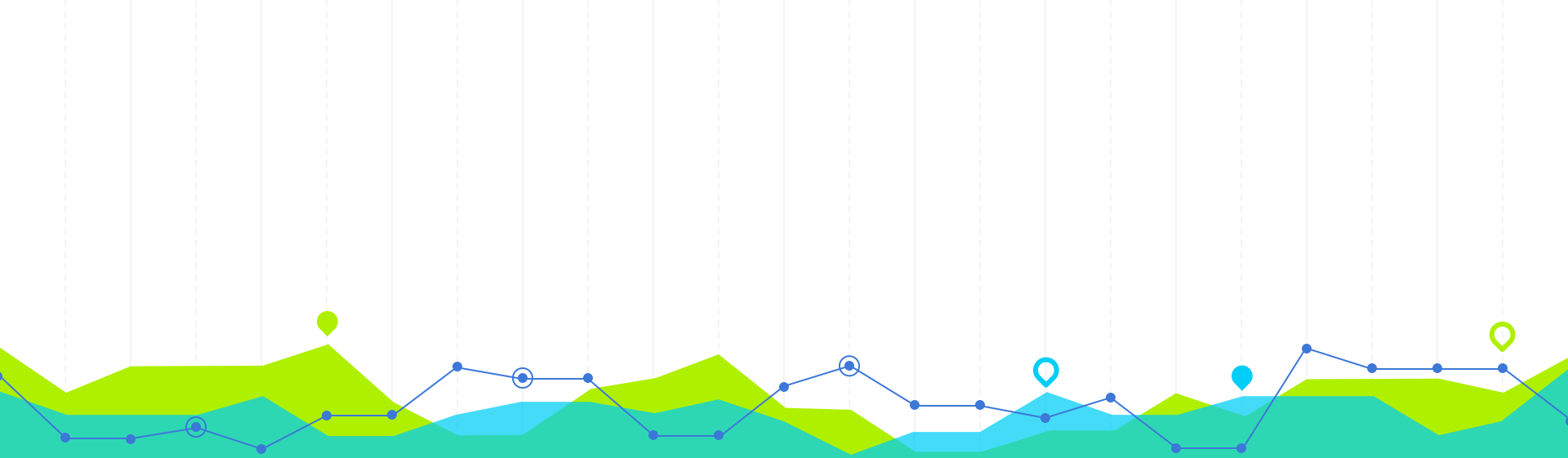




# ARIMA Model

- Statistical model used for forecasting time series data
- The ARIMA model is made up of three components:
  - **The autoregressive (AR) component:** This component models the relationship between the current value of the time series and its past values.
  - **The moving average (MA) component:** This component models the relationship between the current value of the time series and the errors of past predictions.
  - **The integrated (I) component:** This component is used to make the time series stationary, which means that its mean and variance are constant over time.

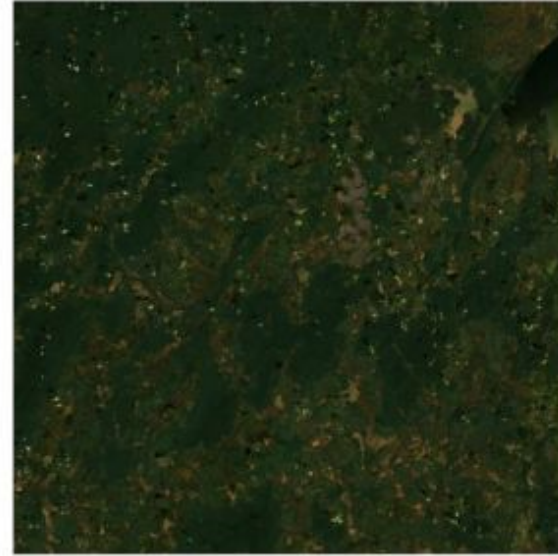




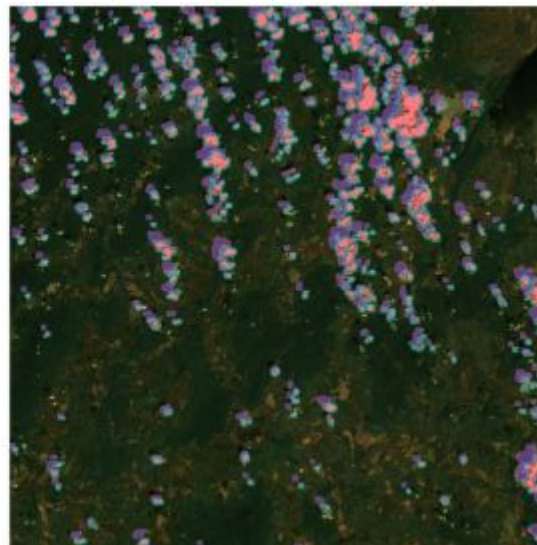
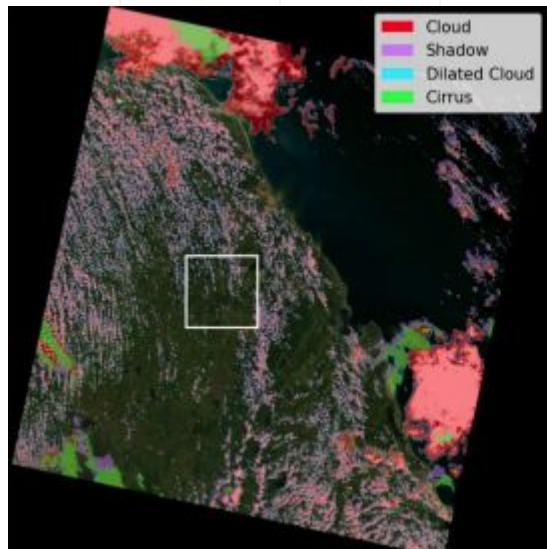
# Results and Discussion

# 4

## Area of Interest



# Cloud imputation and Cropping images



## Cloud Types

- Cloud
- Shadow
- Dilated Cloud
- Cirrus

## Removing the clouds

- Used a satellite image with less clouds to imprint a satellite image with clouds



- Then we got an NDVI image based on its indices and then calculated the average NDVI values for each image

1	Folder	Average_NDVI
2	LC08_L2SP_141054_20200614_20200824_02_T1_replaced	0.360736832
3	LC08_L2SP_141054_20200716_20200912_02_T1_replaced	0.285379829
4	LC08_L2SP_141054_20200817_20200920_02_T1_replaced	0.274821684
5	LC08_L2SP_141054_20200918_20201005_02_T1_replaced	0.26757831

- After that, we Calculated the deforestation percentage compared to the 2020/06/14

1	date	Average_NDVI	Deforestation_Percentage
2	6/14/2020	0.360736832	0
3	7/16/2020	0.285379829	20.88974447
4	8/17/2020	0.274821684	23.81657207
5	9/18/2020	0.26757831	25.82451061
6	10/4/2020	0.277102845	23.18421055

**Average NDVI values**

**ARIMA model  
(predict the  
percentage)**

**Calculated the  
deforestation  
percentage compared  
to the 2020/06/14  
(Random Forest)**



# Model Evaluation

Mean Absolute Error (MAE)

0.2976

Mean Squared Error (MSE)

0.1540

R-squared (R<sup>2</sup>) Score

0.9982





# Limitations & Challenges

5

## Limitation and Challenges

- **Cloud Cover:** Cloud cover can obstruct satellite imagery, making it challenging to acquire clear and continuous data, particularly in regions with frequent cloud cover.
- **Data Availability:** Access to high-quality, up-to-date satellite data can be costly and restricted, leading to potential gaps in coverage.
- **Interpretation and Validation:** Accurate interpretation of satellite data requires expertise, and on-ground validation can be logistically complex.
- **Data Processing:** Processing large volumes of satellite data can be computationally intensive, requiring suitable hardware and software



# Conclusion 6

# Conclusion

- Through the application of ARIMA, we were able to analyse historical deforestation data and identify underlying trends and patterns
- the integration of Random Forest, a powerful machine learning algorithm, enabled us to explore the multifaceted factors contributing to deforestation
- By considering NDVI values, we gained an understanding of the facts behind deforestation
- Here is the dashboard we created

<https://deforestationpredictorwebapp-pedv77wsmxjhovppeyptq5.streamlit.app/>

# THANK YOU!

