

# IST707 Applied Machine Learning

## ESG Implementation for Flooding Issues and Consequential Social-Economic Problems

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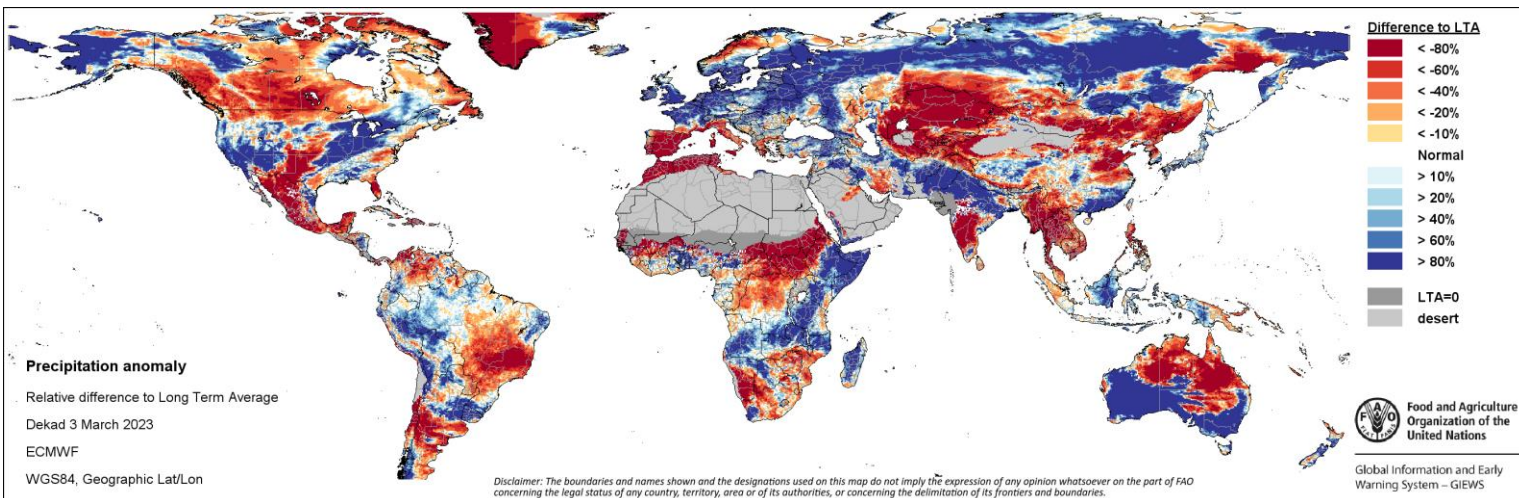
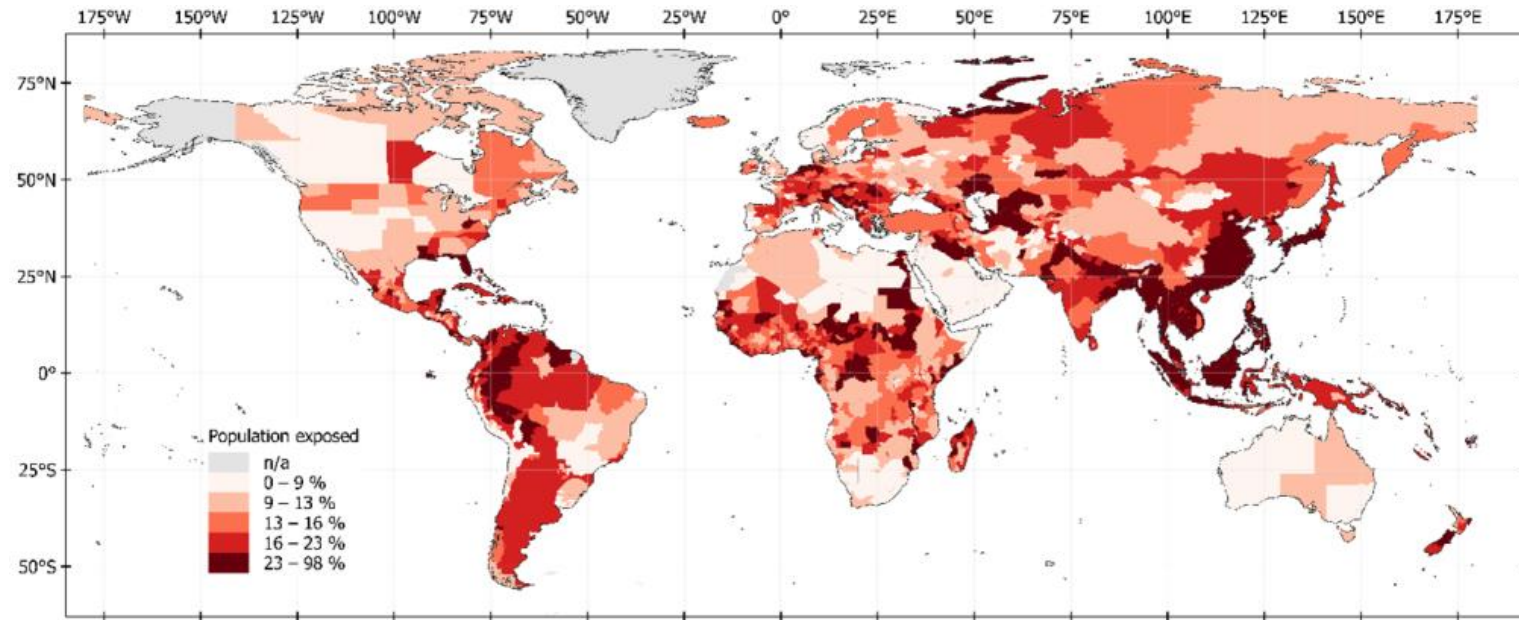


# Introduction

- **Flooding** is among the leading climatic threats to people's livelihoods, affecting development prospects worldwide. While the threat is already substantial, climate change and rapid urbanization in flood zones are likely to further drive up flood risks.
- Considering the equilibrium between the global environment and social economics for urbanization, individual government agencies and representatives start to modify **credit standards in real estate** for mitigating the exponential increment of climatic issues especially flooding.
- Collaborating with environmental scientists, arborists, and landscape architects, there are agreements approving the positive impacts of **green spaces**.
- Such a complex subject, mixed with environmental and social-economics issues, requires the support of the **theory of Environmental, Social and Governance (ESG)**.
- In this study project, we aim to reference the theory of ESG to explore relevant factors to the flooding issues associated with consequential social-economic considerations for future urbanization development.

# Introduction

Reference: [FloodList](#) & [Food and Agriculture Organization of the United Nations](#)



**USA – Heavy Rain From Atmospheric Rivers Triggers More Flooding in California**

12 MARCH, 2023

A strong atmospheric river storm system impacted the state of California in the USA from 10 March 2023, with heavy rain, snow, isolated thunderstorms and gusty winds reported. Thousands of...

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**USA – Multiple Rescues After Floods Cause Chaos in Southern California**

25 FEBRUARY, 2023

Emergency crews carried out multiple high water rescues, including some by helicopter, after winter storm dumped heavy rain in parts of Southern California. Storm winds also caused damage, downing...

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**USA – Housing Market Overvalued Due to Unpriced Flood Risks, Says Study**

20 FEBRUARY, 2023

A recent study has found that the housing market in the USA is overvalued by as much as \$237 billion due to unpriced flood risk. The increasing cost of flooding...

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**India – 8 Killed, More Feared Missing After Flash Floods in Jalpaiguri, West Bengal**

6 OCTOBER, 2022

At least 8 people have lost their lives and many more are feared missing after sudden flash floods on the Mal River in the Jalpaiguri District of West Bengal, India...

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**Latvia – Augšdaugava Communities Isolated After Daugava River Floods**

3 APRIL, 2023

Local authorities in the Augšdaugava Municipality in southern Latvia have requested a state of emergency due to severe flooding along the Daugava River and tributaries since late March 2023. Flooding...

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**Türkiye – 14 Dead, 5 Missing in Şanlıurfa and Adıyaman Floods**

16 MARCH, 2023

Disasters authorities in Türkiye report that at least 14 people have now died in the flood that swept through areas of Şanlıurfa and Adıyaman in the southeast of the country...

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# Our Roles & Focused Sections

- **Roles – Interdisciplinary Data Scientists**

Environmental Scientists, Social-Economics Scientists, Digital Data Visualization Experts and Decision-Makers

- **Environmental Aspect –**

Classification and Detection of Urban Green Spaces Factors and Management

- **Social Aspect –**

Detection of Residents' Credits to Explore Funding Opportunities for Urban Green Spaces Development

- **Governance Aspect –**

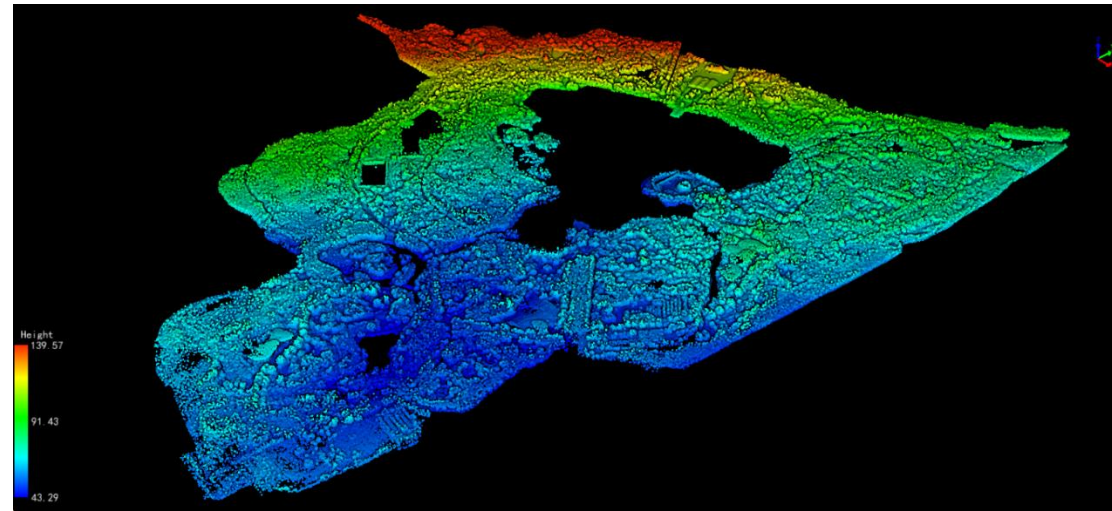
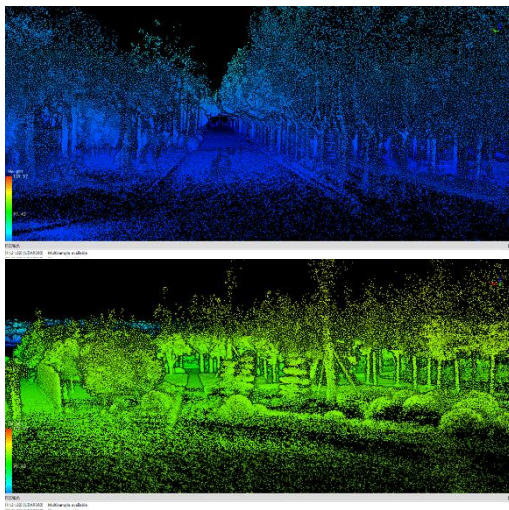
Detection of Green Spaces in an Urban Region for Future Urban Revitalization



# Environmental Aspect

- **Data Introduction**

- Real data as LiDAR point cloud collected by Beijing Digital Green Earth Technology
- LiDAR data is transferred by LiDAR360 and UFOREHYDRO-MODEL to be related factors between tree canopies and rainfall flooding potential.
- There are Train and Test datasets which contain 10 variables with 288 observations.
- The target is surface flow which means the potential of flooding
- The data is further organized as six sample areas representing either high tree canopies or bare ground across the hourly investigation of rainfall phenomena.



# Environmental Aspect

Features Name	Descriptions
Stage (hr)	Time for the rainfall event ( <b>Numeric</b> )
Rainfall (mm)	Rainfall Amount ( <b>Ordinal</b> )
LAI	Leaf area index representing trees density ( <b>Ordinal</b> )
Storage Capacity (mm)	Trees water storage capacity ( <b>Numeric</b> )
Free throughfall (mm)	Tress water penetration capacity ( <b>Numeric</b> )
Canopy Evaporation (mm)	Trees evaporation capacity ( <b>Numeric</b> )
Storage Move to next Stage (mm)	Water amount left from canopies ( <b>Numeric</b> )
Water to Ground Vol (m3)	Water amount reaches to the ground ( <b>Numeric</b> )
Soil Infiltration Vol (m3)	Soil infiltration capacity ( <b>Numeric</b> )
Surface Runoff (m3)	Surface flow amount representing flooding potential ( <b>Ordinal</b> )

Test dataset doesn't contain this variable.

Table of Environmental Data Attributes/Features

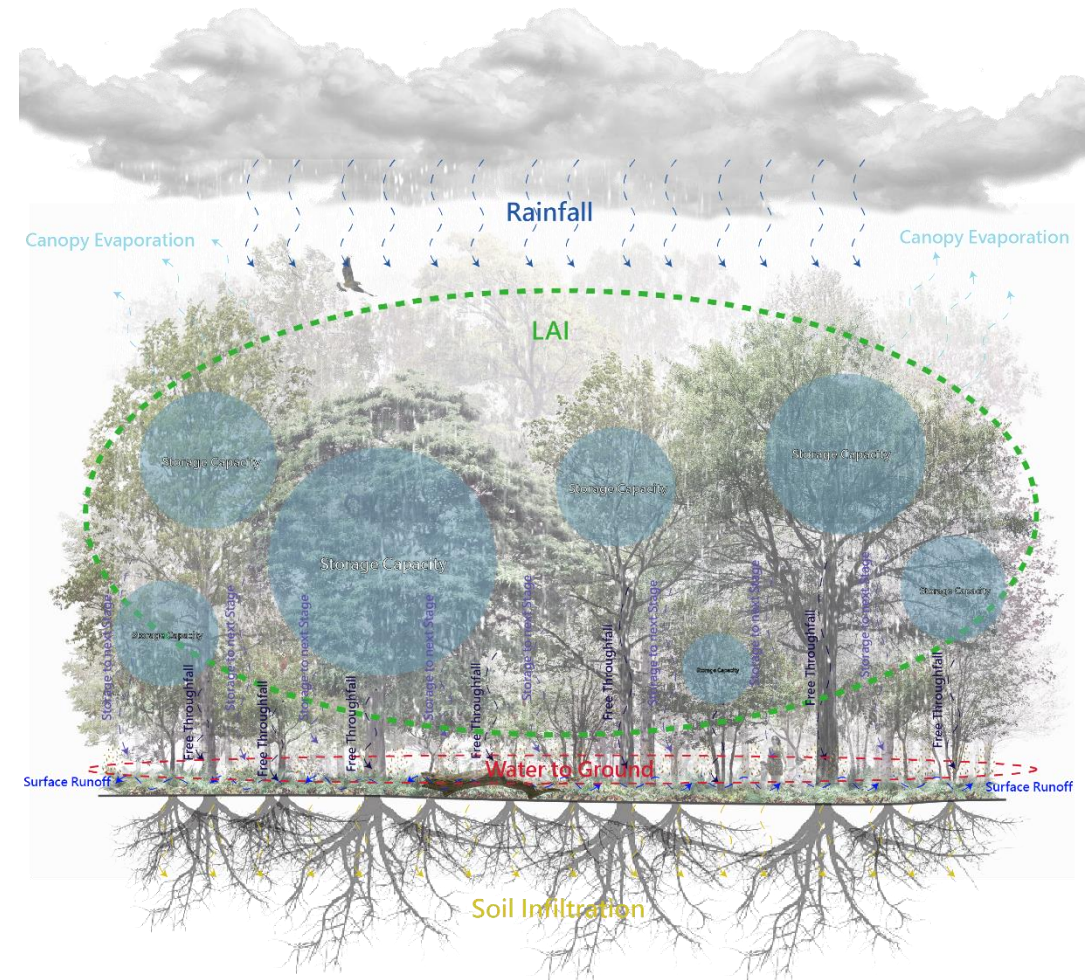


Image of Environmental Data Attributes/Features Illustration



# Environmental Aspect

- **Problems and Difficulties**
  - Time-consuming due to the requirement of seasonal satisfaction and verification
  - Difficulties in observing the relationship between factors and focused subjects
  - In this study, the problem is with ordinal and numeric attributes classification for surface flow (flooding potential).
- **Proposed Goal for Applied Machine Learning**
  - Classify types of surface flow
  - Explore the relationship between surface flow (flooding potential), leaf area index (plants' density), and other associated factors
  - Proposed Model and Method: Naïve Bayes, SVM, Random Forest and Association Rules
  - Metrics: Apply **accuracy and recall** to avoid low possibility of flooding and any risk of people's livelihoods



What factors?



How?



# Governance Aspect

- **Data Introduction**

- Real data as images collected through an unmanned aerial vehicle (UAV) by the Green Expo Park Center in Zhengzhou, China
- Extracted 140 samples are 30 by 30 pixels with individual pixel value as another dataset
- There are Train and Test dataset which contain 140 observations with 2700 values with 1 label target to classify sites for green spaces.

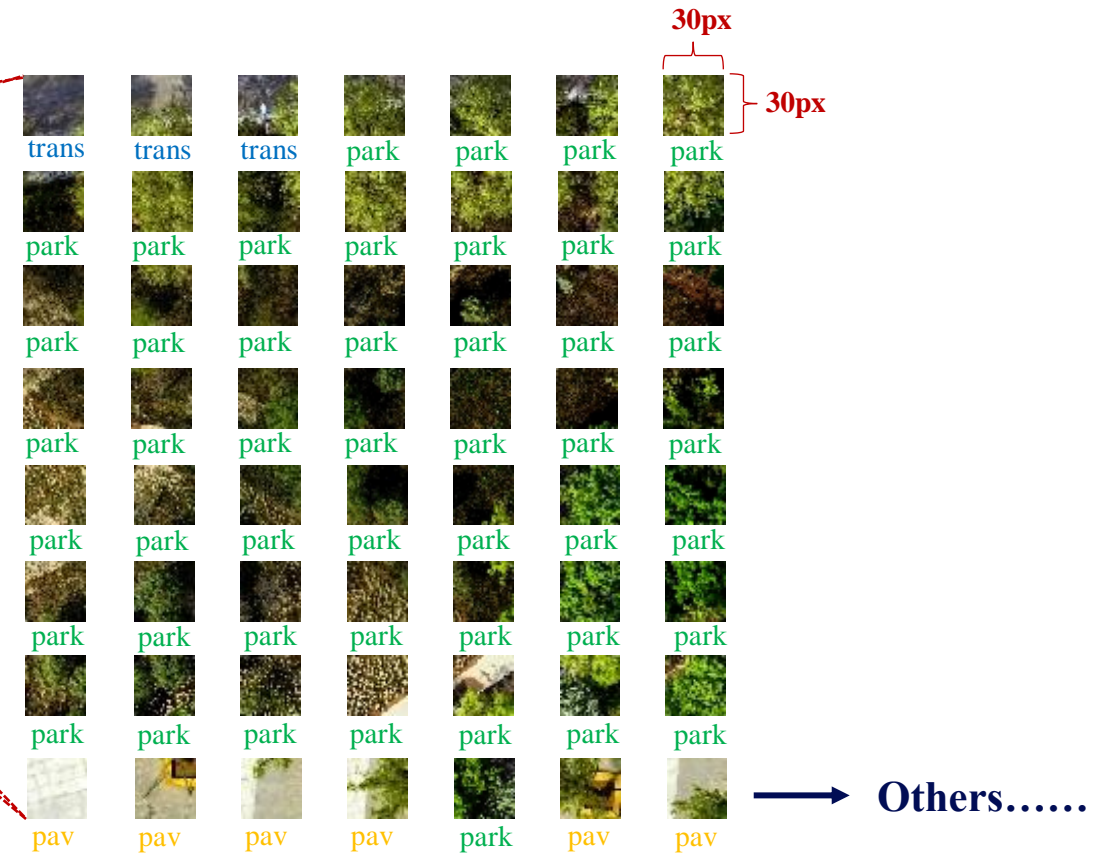
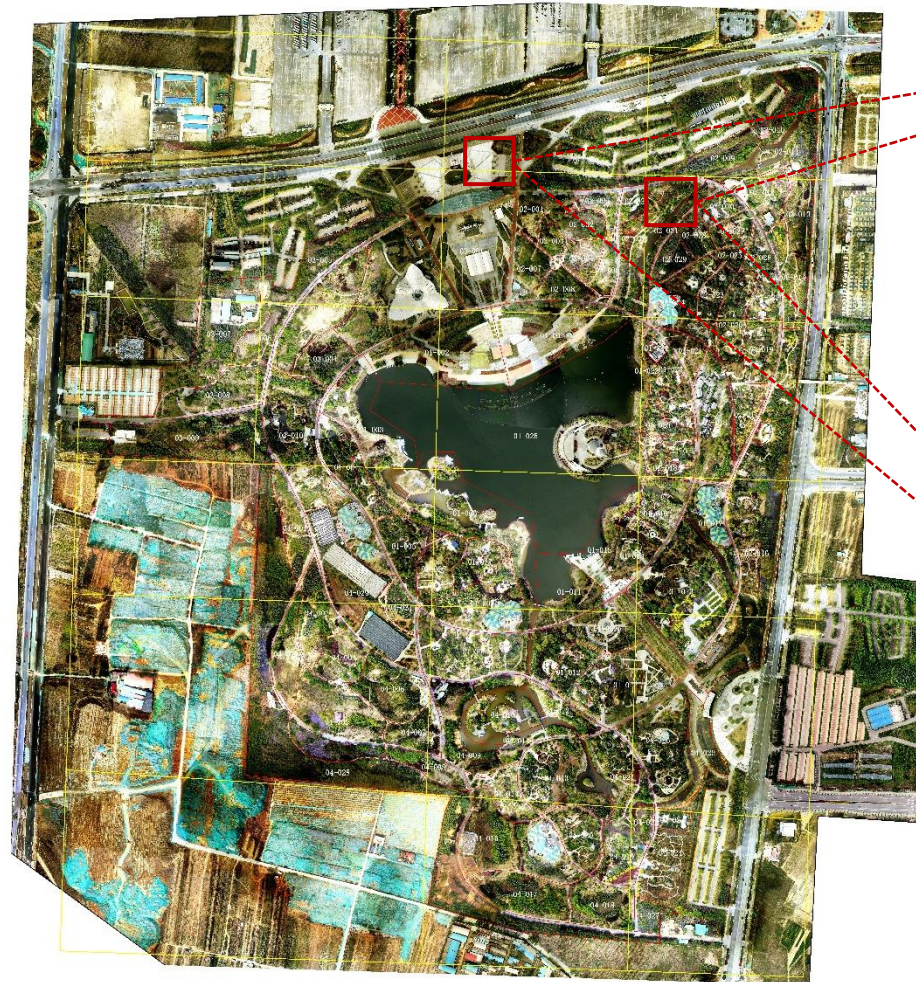
Label	V1, V2 ... V2700
Types of the site <b>(Nominal)</b>	Pixel values <b>(Numeric)</b>



Unmanned Aerial Vehicle (UAV)



# Governance Aspect



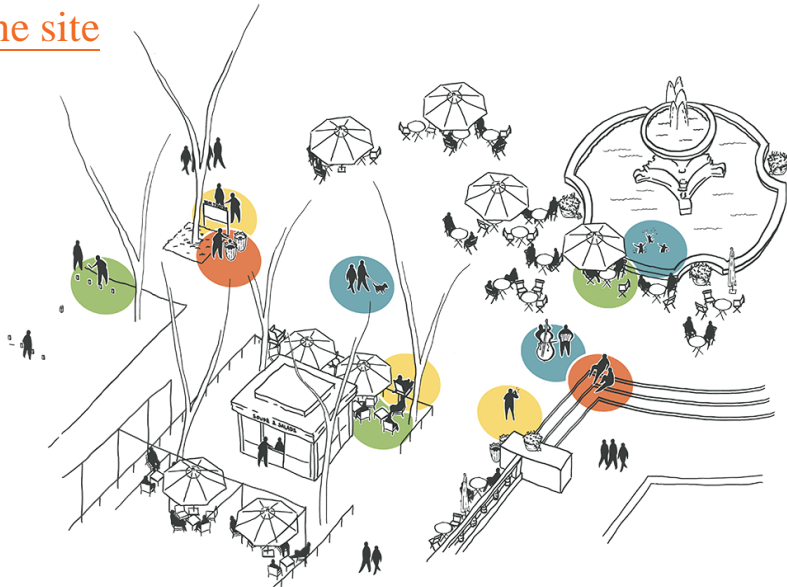
Sample images extracted from the image of the Green Exo Park in Zhengzhou, China

Image of the Green Exo Park in Zhengzhou, China



# Governance Aspect

- **Problems and Difficulties**
  - Efficiently classify sites in terms of collective aerial images
  - In this study, the problem is with nominal attributes classification for green spaces.
- **Proposed Goal for Applied Machine Learning**
  - Classify collected images into identified site categories
  - Proposed Model and Method: Naïve Bayes, SVM, Random Forest and/or Deep Learning (CNN)
  - Metrics: Apply accuracy, precision and sensitivity to generate a good model to help to detect types of the site





# Proposed Goal of the Study

**We aim to compile the results of data analysis and prediction through applied machine learning models to align with ESG theory and propose a methodology for organizations, institutions and/or the government to confidently and supportively conduct decision-making on the environmental issue (flooding) and social-economic problems (credit funding targets).**

**We hope the demonstration of our services can help on international groups in ESG projects.**

**THANK YOU FOR YOUR ATTENTION.**