

Informal Settlements Identification

According to UN Habitat about one quarter of the world's urban population lives in informal settlements. Informal settlements can be defined as residential areas where inhabitants have no formal ownership or lease agreement vis-à-vis the land and/or dwellings they inhabit. They exist in all regions of the world, including in highly developed countries. Modalities include homeless encampments, squatting in abandoned buildings, living in informal rental housing or in long established communities without formal title. Shelter is frequently constructed by hand out of any available materials, but may take many other forms, such as cars, boats, containers or other shelter. Some informal settlements have been built over many years in brick and mortar, but the actual neighbourhood is not fully legalised. Informal communities usually lack basic services such as water and sanitation, and infrastructure and the housing may not comply with current planning and building regulations.

An approach to detect informal settlements

Background

This project aims to detect informal settlements based on some common features that most of the informal settlements possess. These features include:

- Limited Area
- Very high population density
- Rooftops with metallic sheets or blue colored tarpaulins
- Kacha Roads
- No sewage systems resulting water inundation problems
- Unstructured houses

Example to support the above mentioned features



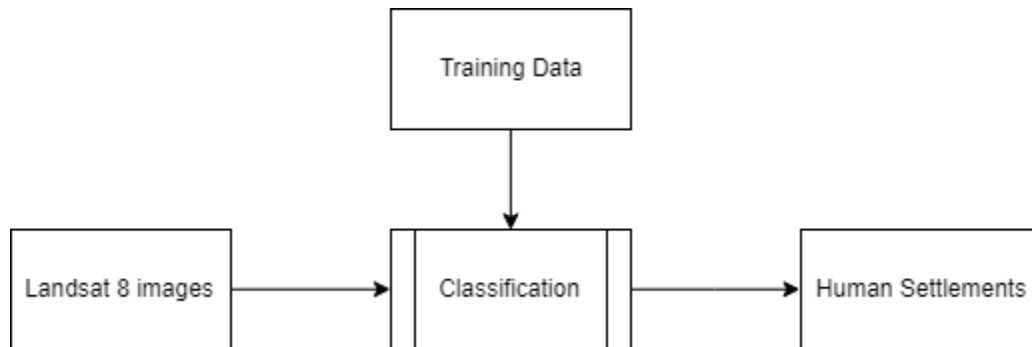
Ideology

The project runs on two levels:

- Detection of human settlements from Landsat images.
- Use of a set of conditions to identify informal settlements from others.

Detection of Human Settlements

Project Flow



Supporting Statement

Human settlements possess a different spectral behavior because of use of concrete and other supporting material. These settlements can be easily classified using any classification algorithm. Below are the details mentioned that are used to detect the settlements:

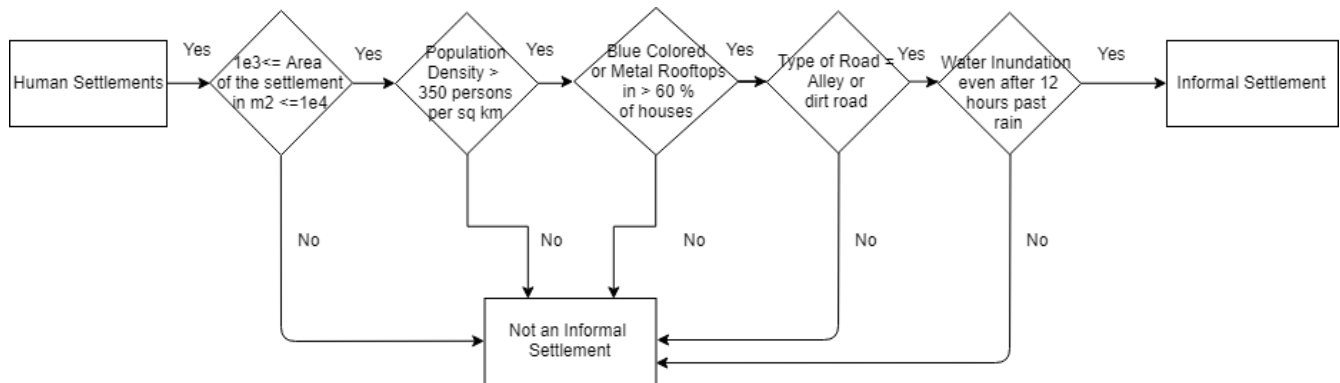
- Type: Supervised Classification
- Algorithm used: Random Forest
- Training data: Self marked polygons with urban/others flag
- Use of NDBI (Normalized Difference Built-Up Index), EBBI (Enhances Built-Up and Bareness Index) to improve accuracy

Resultant Image



Identification of Informal Settlements

Project Flow



Supporting Statement

Informal settlements can be identified from human settlements based on the features mentioned earlier. Below are the details mentioned that are used to identify the informal settlements:

- Conditions used:
 - Area greater than 1000 m² and less than 10,000 m²
 - Population density greater than 350 persons per sq km (Use of GPWv4: Gridded Population of the World Version 4, population Density)
 - Blue colored sheds or metallic sheet rooftops should be greater than 60% of the total houses in the settlement (Detection of such rooftops)
 - Detection of type of roads in the settlement and it should be Alley or a dirt road (Kacha vs pacca road classification)
 - Water inundation even after 10-12 hours past rain(Use of Global Flood Monitoring system)

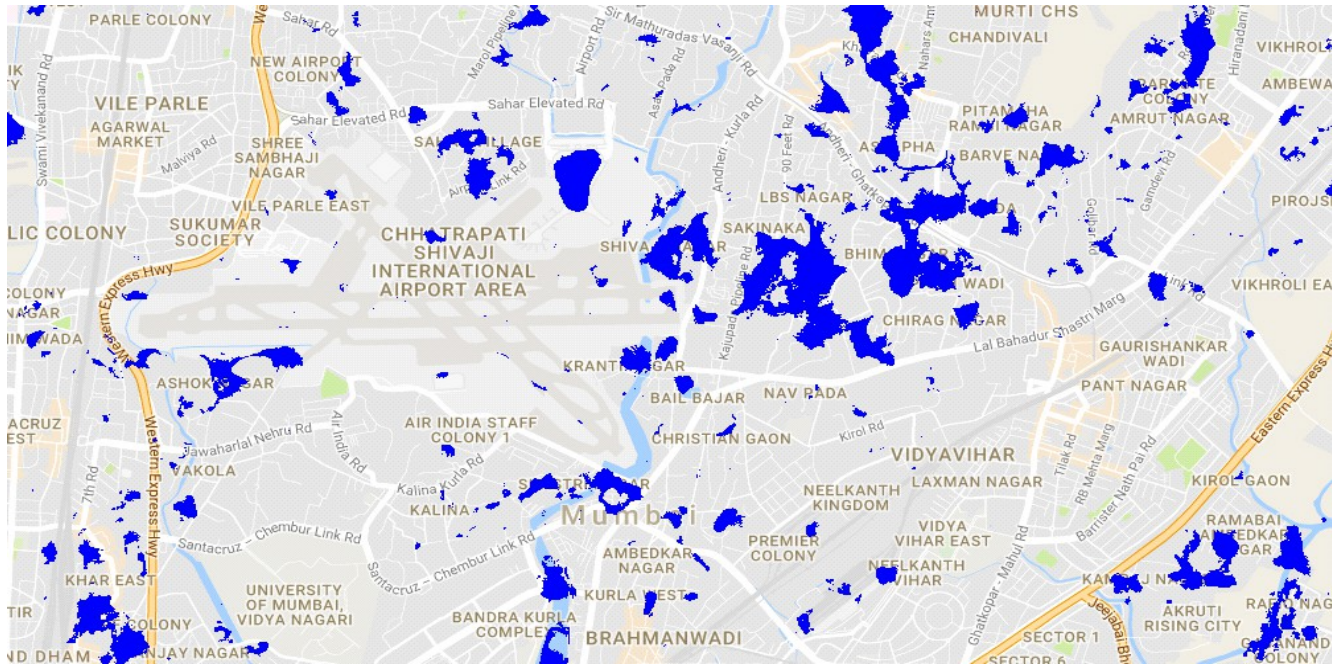
Detection of Blue colored sheds Example



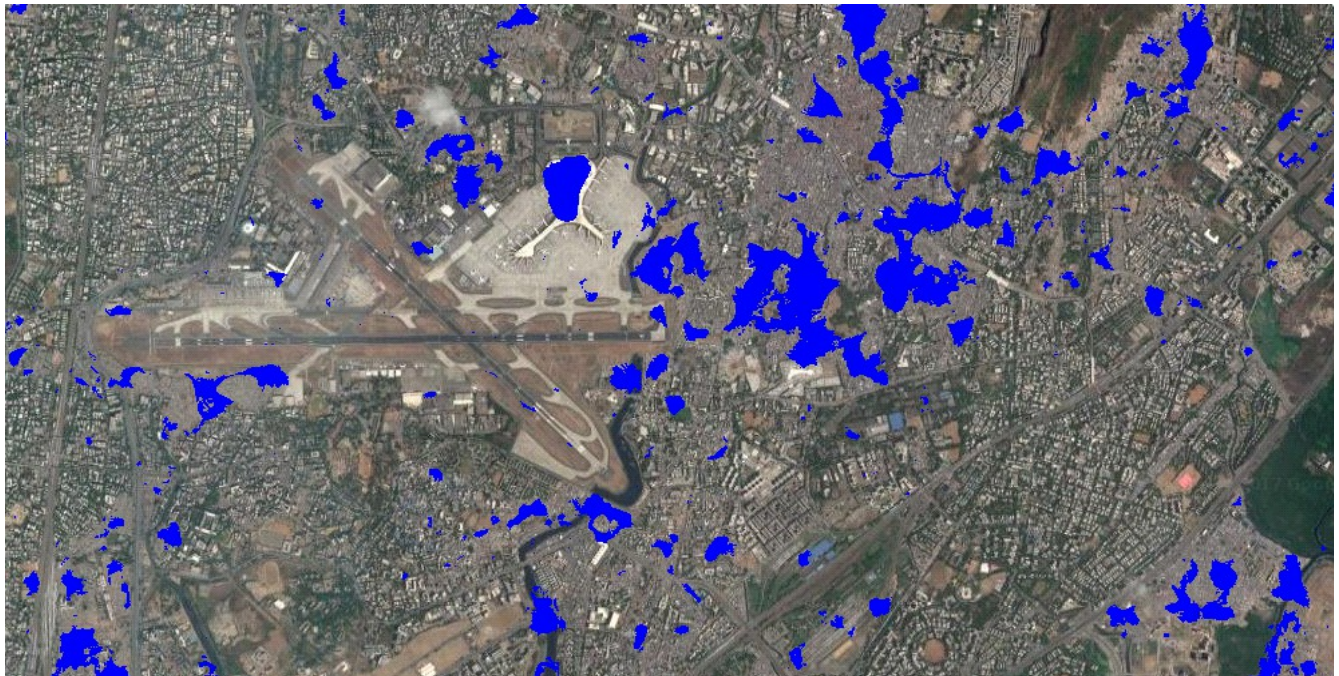
Water Inundation Identification Example

Chhatrapati Shivaji airport Mumbai Flood Analysis(Zoom level 500m)

Map View



Satellite View



Project Status

The very first level of the project i.e. detection of human settlements is been performed in around 400 districts of India. Regular steps are being carried out to improve accuracy of detections specially in areas of Eastern and Southern India because of heavy green cover and irregular pattern in housing system.

Steps like area limits, population density validation, blue color sheds are being performed and steps like metallic rooftops and roads detection are still under development process.

Results

Till now the results are quite promising. Detection of human settlement showed above 75% of accuracy in most of the areas of India but it also has limiting results with around 20-40% of accuracy specially in Eastern and Southern areas of India.

Blue color sheds detection showed 92% of accuracy and water inundation segment also showed promising results.

Expectations

Completion of all the steps mentioned to crack the problem statement can be a good measure to identify informal settlements for India.

Limitations

- All the steps are performed mainly in Indian regions and the project lacks foreign experience.
- Different countries may require different dataset to train the algorithm for supervised classification used to detect human settlements.