Renewable Energy generation
Resource assessment - Biomass

Resource Assessments Questions

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- What low cost biomass is available for a potential feedstock to produce bioenergy in the selected regions ?
- How much biomass waste is available?
- What is the electricity generating potential of the waste streams identified?
- The ***gross energy potential and the net electricity generation capacity*** of biomass waste biomass residues can be identified and quantified (via gasification and AD).

Biomass and waste resources

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Agricultural Residues

Livestock Residues

Forestry Residues

Human Waste Residues

Google Earth Engine

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"Earth Engine is a platform for scientific analysis and visualization of geospatial datasets" (Google Earth Engine, 2021).

Its open access platform allows for universally available and sharable content.
A user can manipulate and analyse satellite imagery and other geo-spatial data for their specific remote sensing purposes.

BEFWAM use Earth Engine to assess the surface coverage of water hyacinth to understand its spatial and temporal availability for utilisation.

Biomass and waste resources
Satellite data

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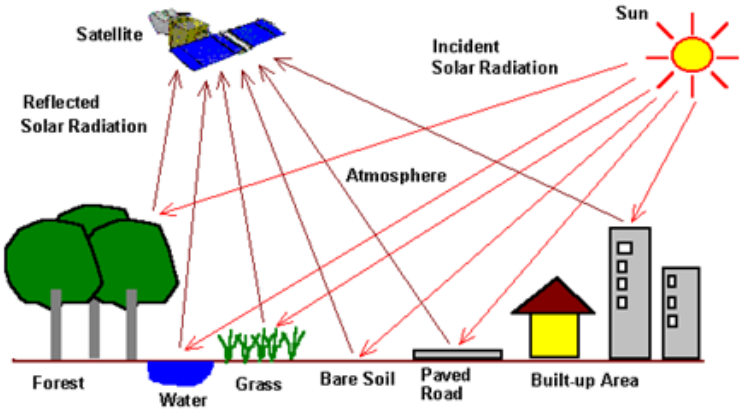
Satellites orbiting the earth such as Landsat, Sentinel and MODIS carry sensors which detect solar reflectance in well-defined electro-magnetic bands.

What is located on the earth's surface (or in the atmosphere) will determine the wavelengths reflected.

Using this theory, one can isolate specific targets for assessment



https://crisp.nus.edu.sg/~research/tutorial/optical.htm

Satellite data

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- Band information for Landsat 8 satellite

Bands	Wavelength (micrometers)	Resolution (meters)
Band 1 - Ultra Blue (coastal/aerosol)	0.435 - 0.451	30
Band 2 - Blue	0.452 - 0.512	30
Band 3 - Green	0.533 - 0.590	30
Band 4 – Red	0.636 – 0.673	30
Band 5 – NIR	0.851 – 0.879	30
Band 6 – SWIR 1	1.566 – 1.651	30
Band 7 – SWIR 2	2.107 – 2.294	30
Band 8 – Panchromatic	0.503 – 0.676	15
Band 9 – Cirrus	1.363 – 1.384	30
Band 10 – Thermal 1	10.60 – 11.19	100* (30)
Band 11 – Thermal 2	11.50 – 12.51	100* (30)

Water separation example (Lake Pashan, India)

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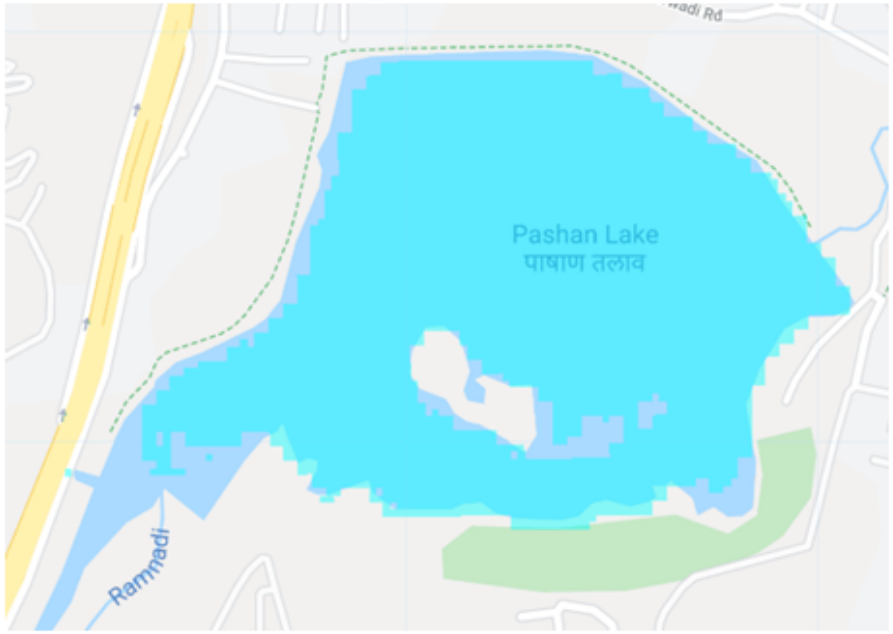

- Masking land from water
- Using Modified Normalized Difference Water Index (MNDWI)

$$\frac{\rho_{Green} - \rho_{SWIR}}{\rho_{Green} + \rho_{SWIR}}$$

- Important for gauging coverage of macrophytes and not land vegetation

ρ_x = top of atmosphere reflectance for band '*x*'

Aquatic vegetation separation example (Lake Pashan, India)

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ρ_x = top of atmosphere reflectance for band '*x*'
λ_{green} = centre wavelength for band '*x*'

- Macrophyte coverage
- Cyanobacteria and macrophytes index (CMI)
- $CMI = \rho_{green} - \rho_{blue} - (\rho_{SWIR} - \rho_{blue}) \times \frac{(\lambda_{green} - \lambda_{green})}{(\lambda_{SWIR} - \lambda_{blue})}$
- Threshold < 0.1 (Liang et al, 2017)

Data interpretation

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- Generate data over time to discover seasonal variations and meteorological influences
- Interpret the data in terms of area covered
- Estimate the biomass available using known biomass density per unit of area

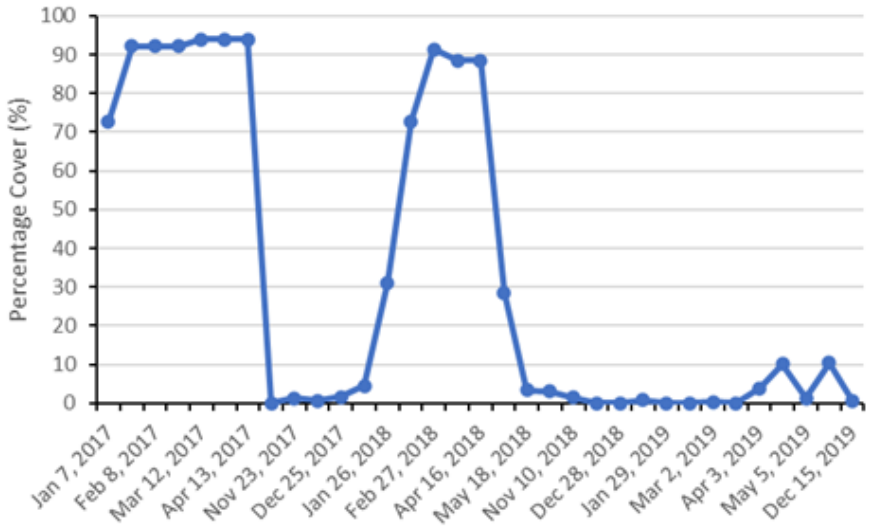

Figure. *Lake Pashan aquatic vegetation coverage betwen* 2017 – 2019