Land-use and Land-cover Change in Chittagong city (2016-2021)

Spatial data studio final project

BY: SOURAV KARMAKAR

Study Area

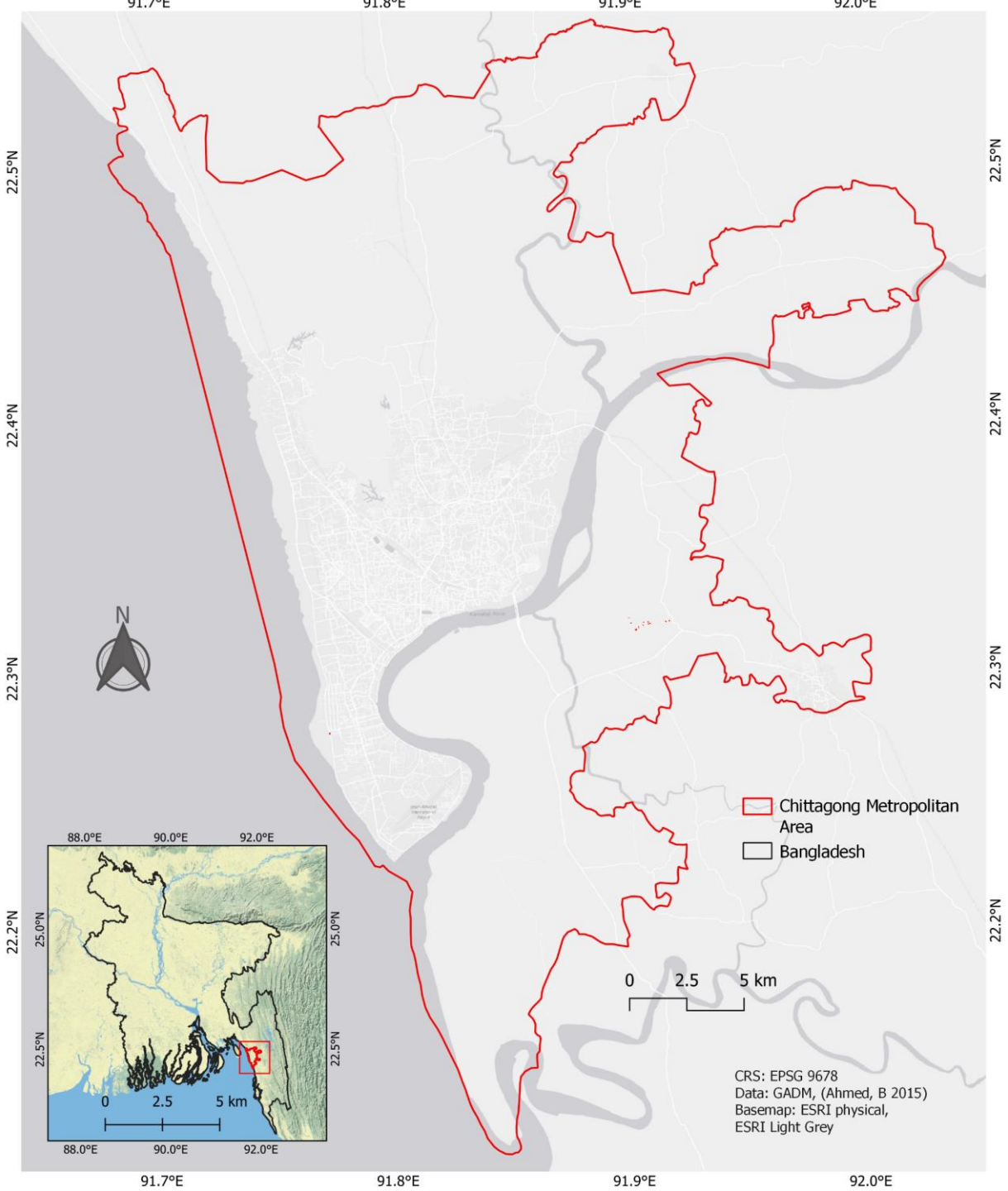
- Commercial capital and Biggest port city

Area: 773.4 sq km

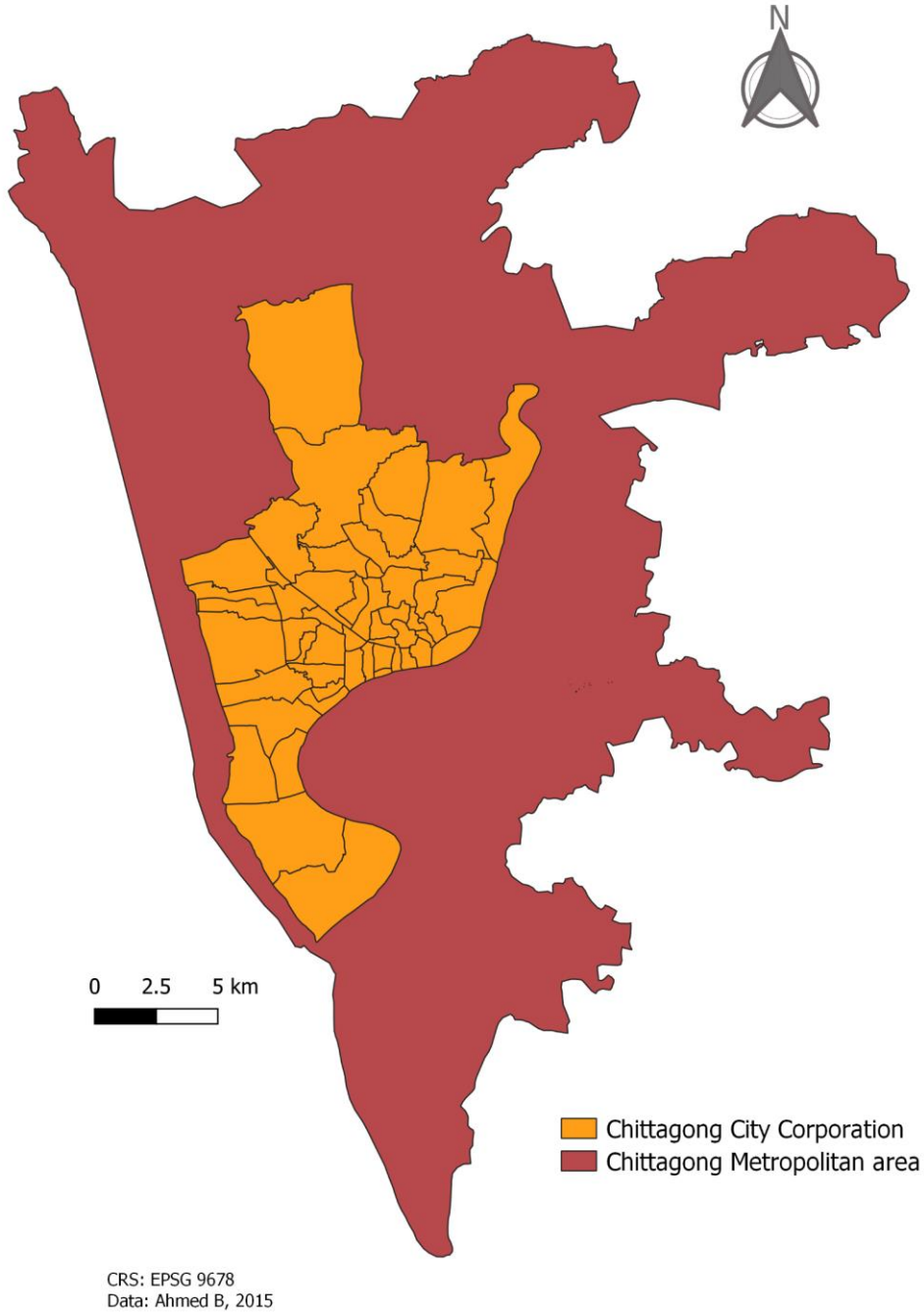
Located: 22°13’ to 22°27’ North latitudes and 91°40’ to 91°53’ East longitude

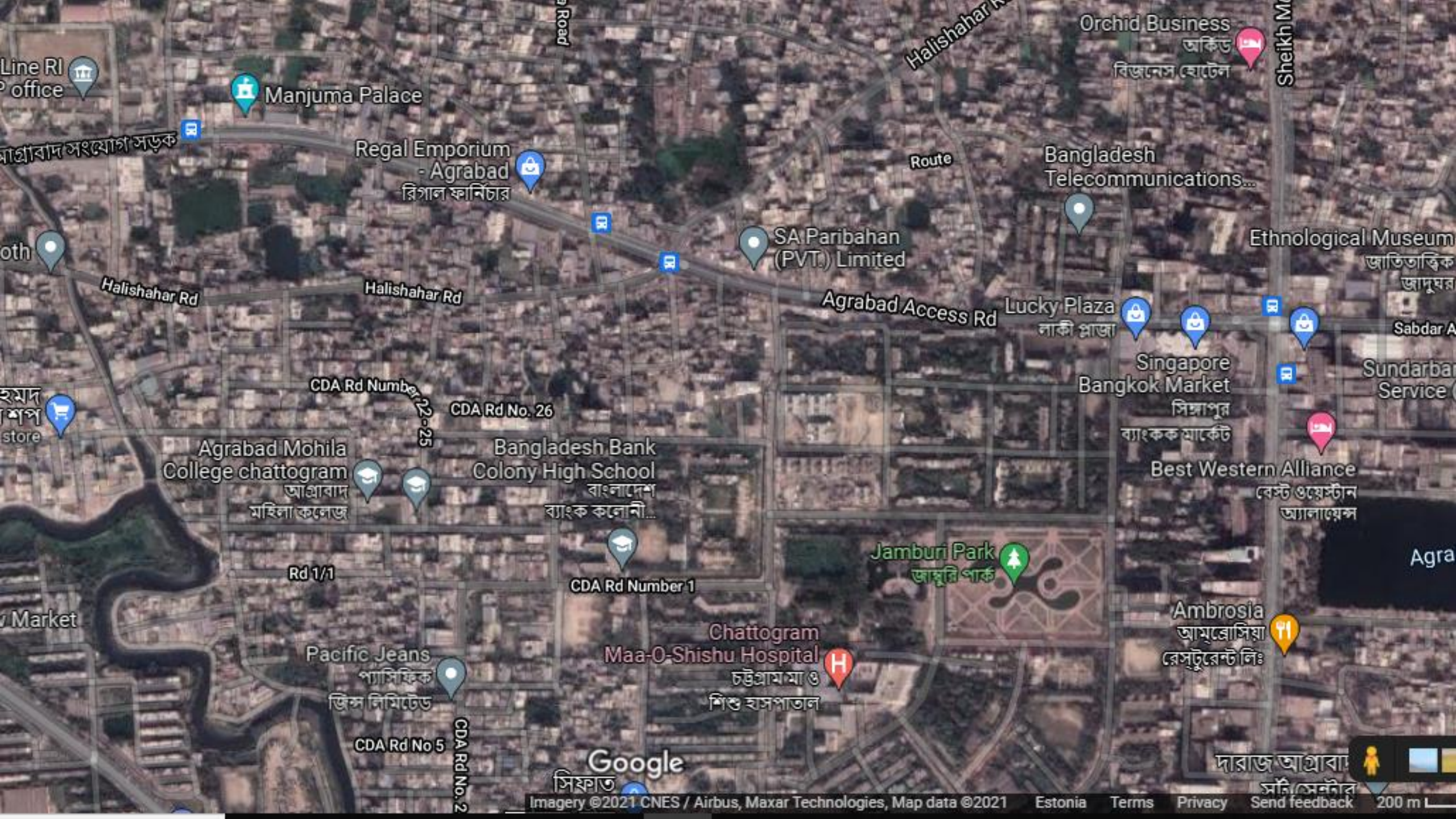
Population: 8.7 million

- **Land-use**: Port, Hills, Waterbody, Industrial residential and commercial areas, cropland, bareland etc.



City Corporation Vs Metropolitan Area




Manjuma Palace
Regal Emporium - Agrabad
রিগাল ফার্নিচার
Halishahar Rd
Halishahar Rd
Agrabad Access Rd
SA Paribahan (PVT.) Limited
Bangladesh Telecommunications...
Orchid Business
অর্কিড
বিজনেস হোটেল
Ethnological Museum
Lucky Plaza
লাকী প্লাজা
Singapore Bangkok Market
সিঙ্গাপুর ব্যাংকক মার্কেট
Best Western Alliance
বেস্ট ওয়েস্টার্ন অ্যালায়েন্স
CDA Rd Number 12-25
CDA Rd No. 26
Agrabad Mohila College chattogram
আগ্রাবাদ মহিলা কলেজ
Bangladesh Bank Colony High School
বাংলাদেশ ব্যাংক কলোনী...
CDA Rd Number 1
Rd 1/1
Jamburi Park
জাম্বুরি পার্ক
Ambrosia
আম্ব্রোসিয়া রেস্টুরেন্ট লিঃ
Chattogram Maa-O-Shishu Hospital
চট্টগ্রাম মা ও শিশু হাসপাতাল
Pacific Jeans
প্যাসিফিক জিন্স লিমিটেড
CDA Rd No 5
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Objectives

To determine the land cover of each landcover class in 2016 & 2021 at Chittagong Metropolitan Area

To measure the area how land cover has changed over the period and calculate changed areas

To generate ideas about how the city land-use has expanded from the city center

Data sources

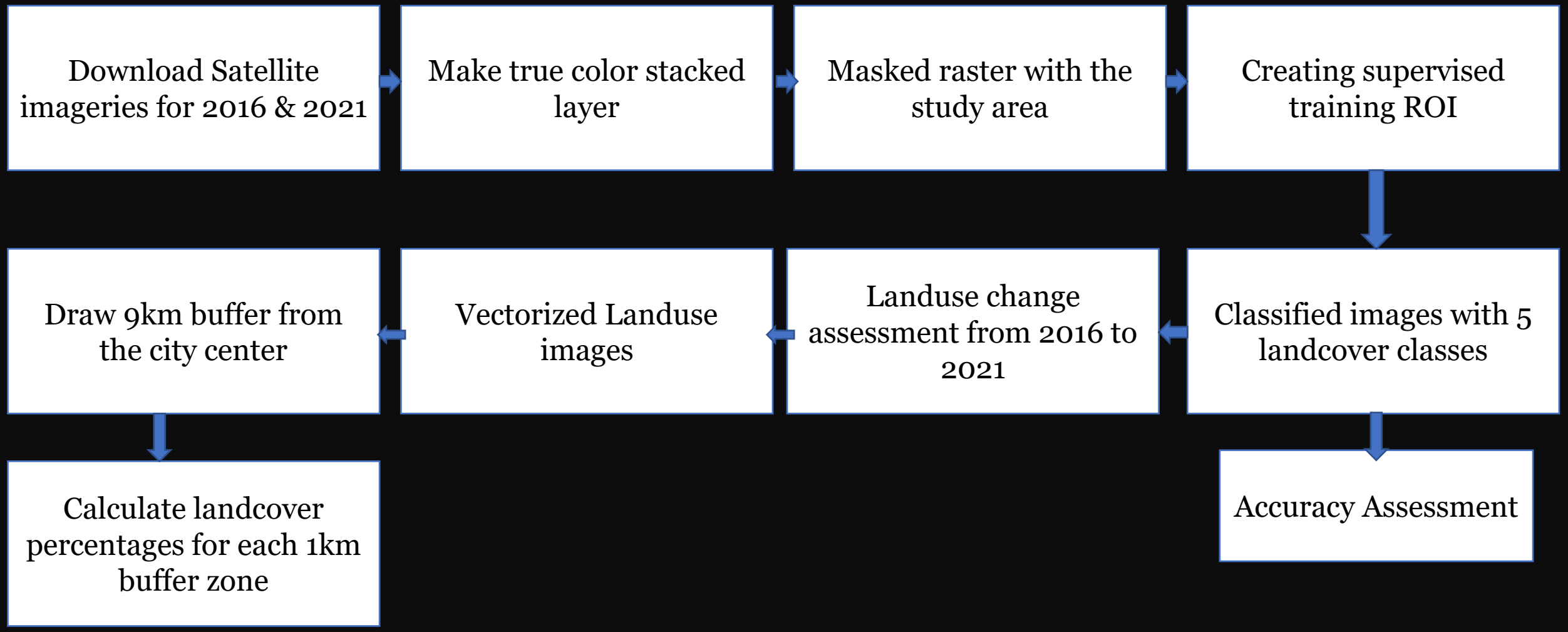
https://earthexplorer.usgs.gov/

https://scihub.copernicus.eu/dhus/#/home

Metropolitan area shape file: (Ahmed, B. 2015)

Administrative unit shape file: GADM (https://gadm.org/data.html)

Methodology



2016

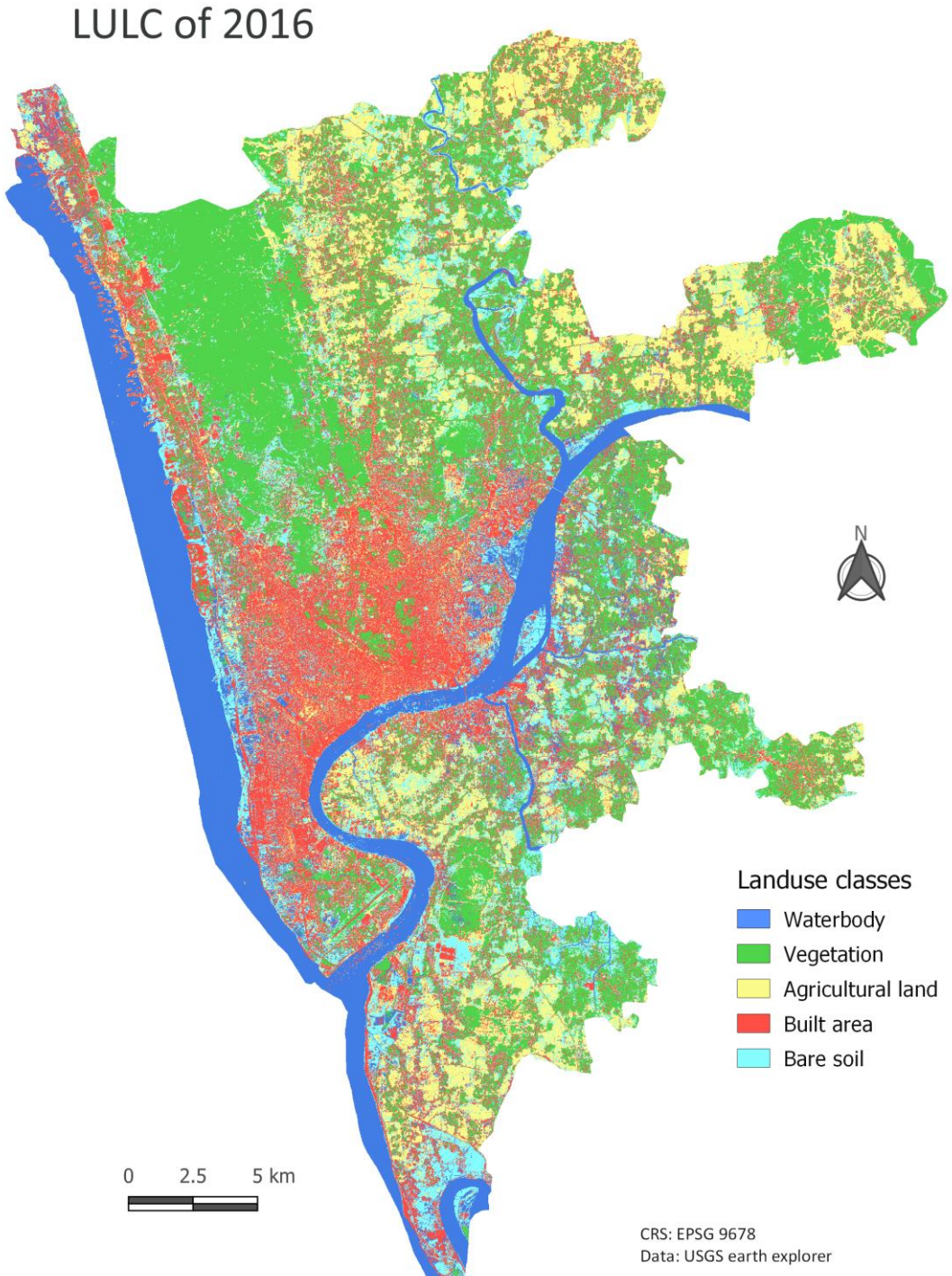
2021

True color composite

Land-use Map, 2016

- Dominated by Vegetation cover
- Built area: settlement, industrial and commercial areas, roads, port area, ships, recreational center, land prepared for buildings
- Bare soil: Char (newly island), river banks, cleaned hills

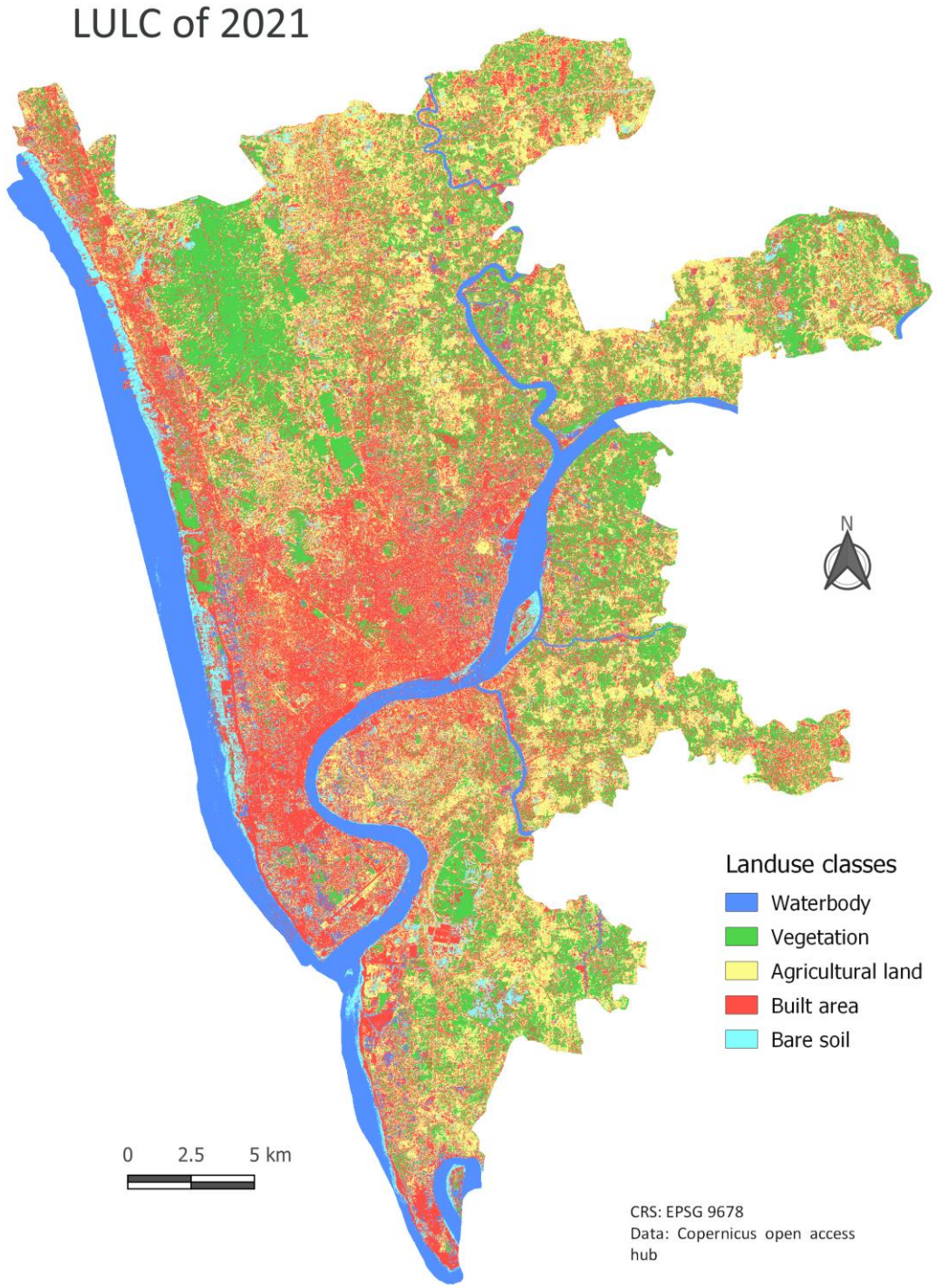
2016		
Land cover class	**Area (Km^2)**	**Percentage %**
Waterbody	122.71	15.86
Vegetation	223.17	28.85
Agricultural land	130.53	16.88
Built area	177.81	22.99
Bare soil	119.26	15.42



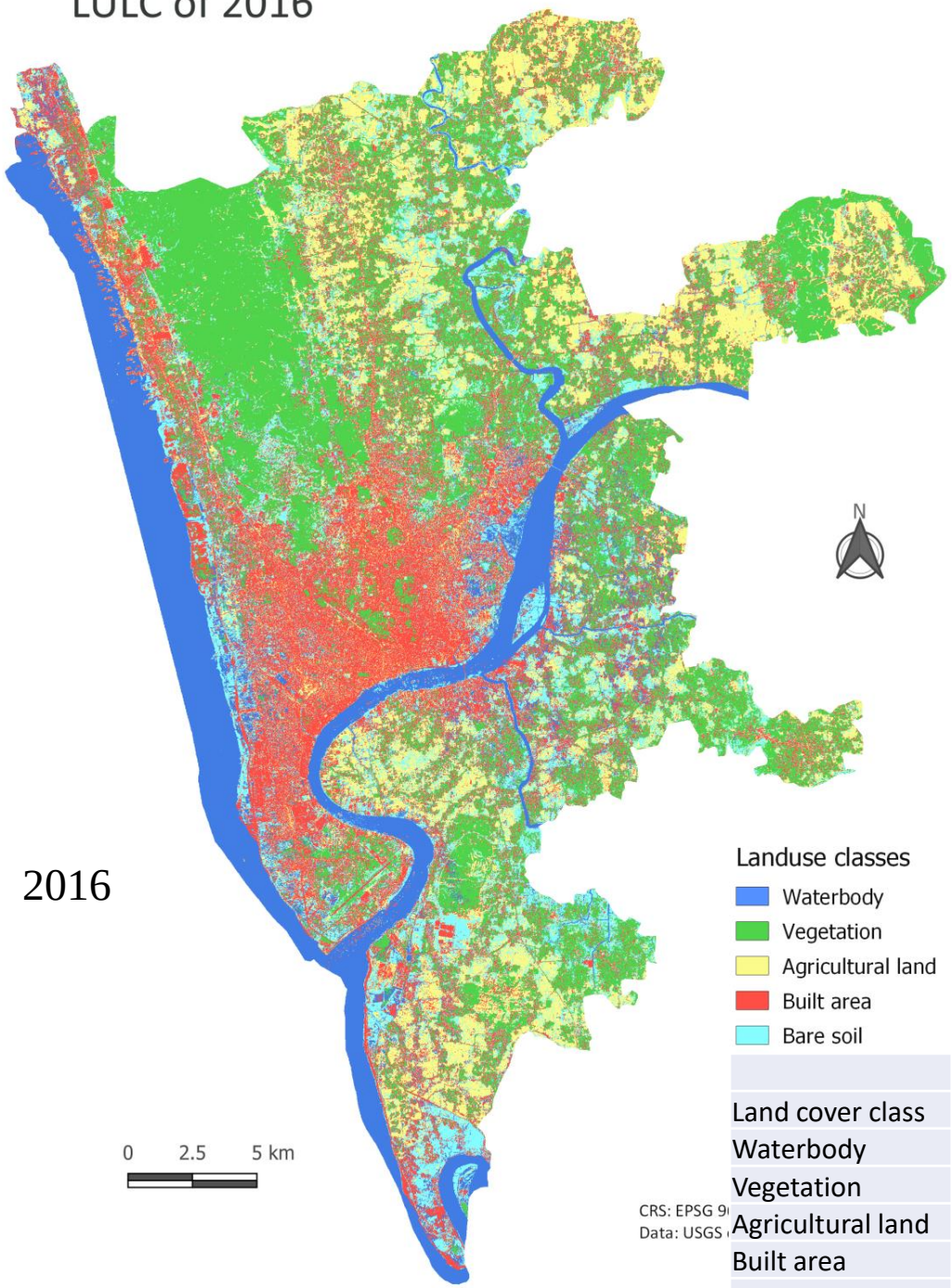
Land-use Map, 2021

- Dominated by Built area
- Built area: settlement, industrial and commercial areas, roads, port area, ships, recreational center, land prepared for buildings
- Bare soil: Char (newly island), river banks, cleaned hills

2021		
Land cover class	**Area (Km^2)**	**Percentage %**
Waterbody	90.30	11.67
Vegetation	167.64	21.67
Agricultural land	195.00	25.21
Built area	265.95	34.38
Bare soil	54.59	7.06



LULC of 2016



2016

Landuse classes
- Waterbody
- Vegetation
- Agricultural land
- Built area
- Bare soil

CRS: EPSG 9
Data: USGS

	2016	2021	2016	2021
Land cover class	Area (Km^2)	Area (Km^2)	Percentage %	Percentage %
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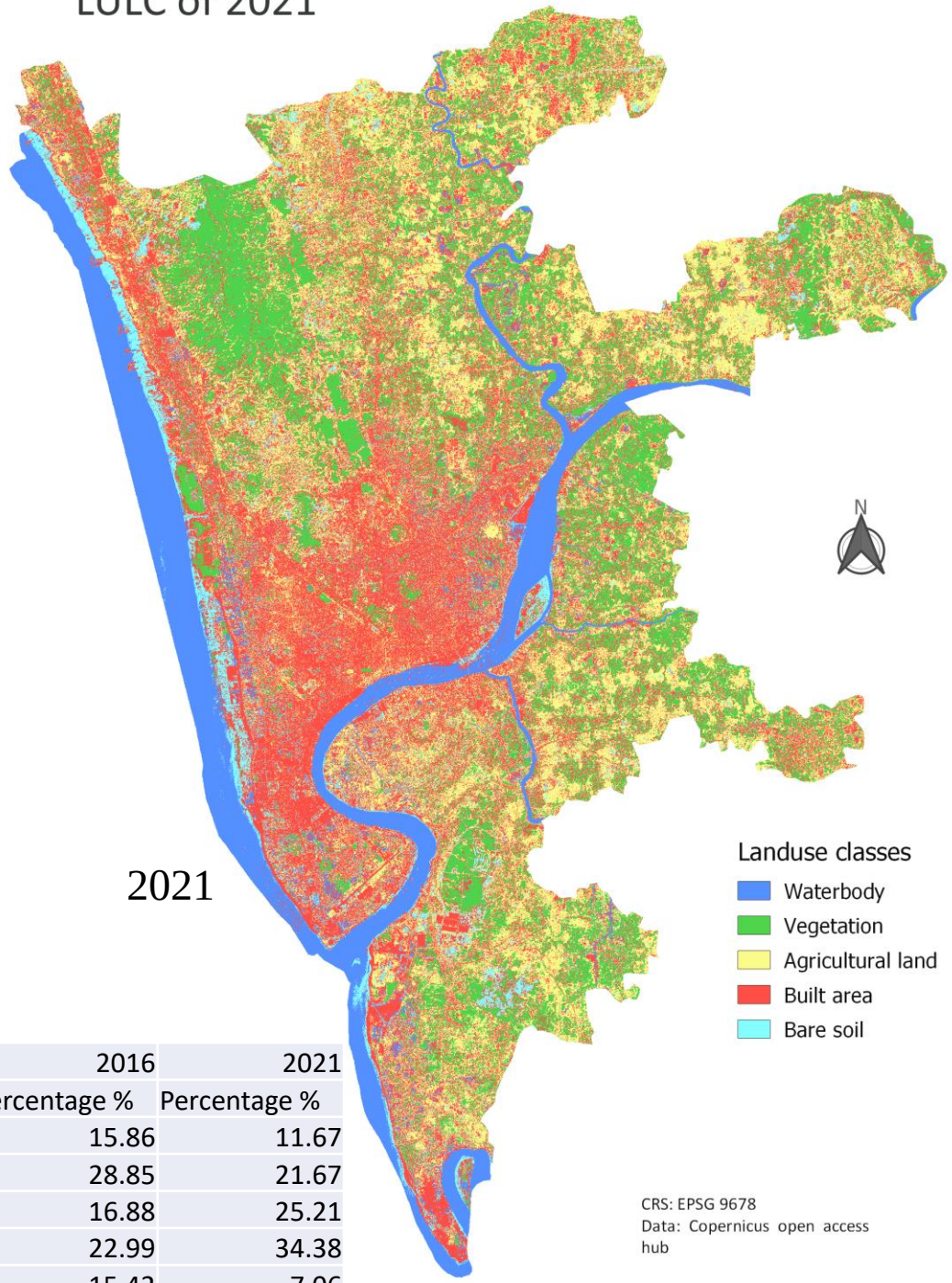
LULC of 2021

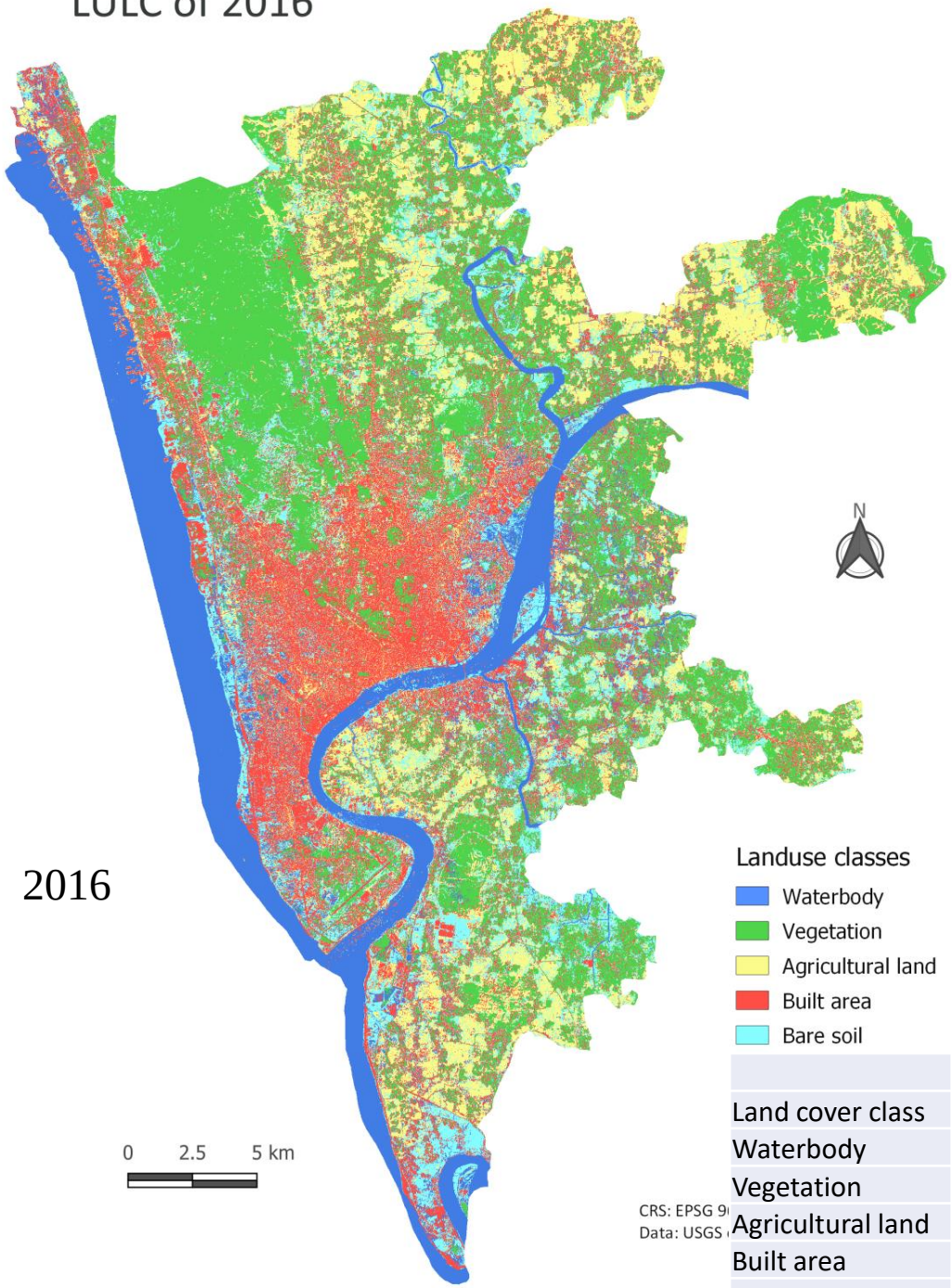


2021

Landuse classes
- Waterbody
- Vegetation
- Agricultural land
- Built area
- Bare soil

CRS: EPSG 9678
Data: Copernicus open access hub

LULC of 2016



2016

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- Waterbody
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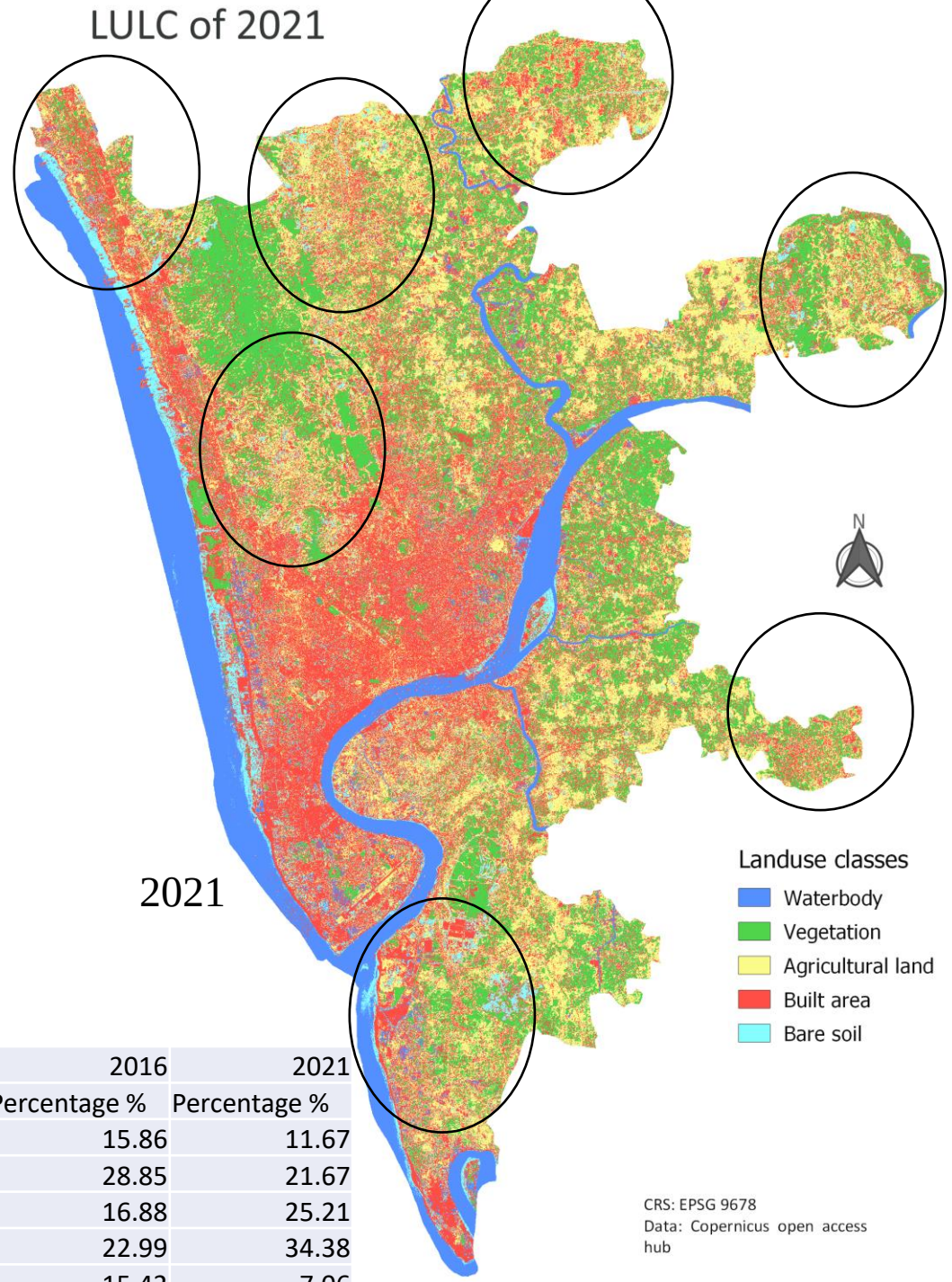
CRS: EPSG 9
Data: USGS

LULC of 2021



2021

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- Agricultural land
- Built area
- Bare soil

CRS: EPSG 9678
Data: Copernicus open access hub

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Accuracy Assessment

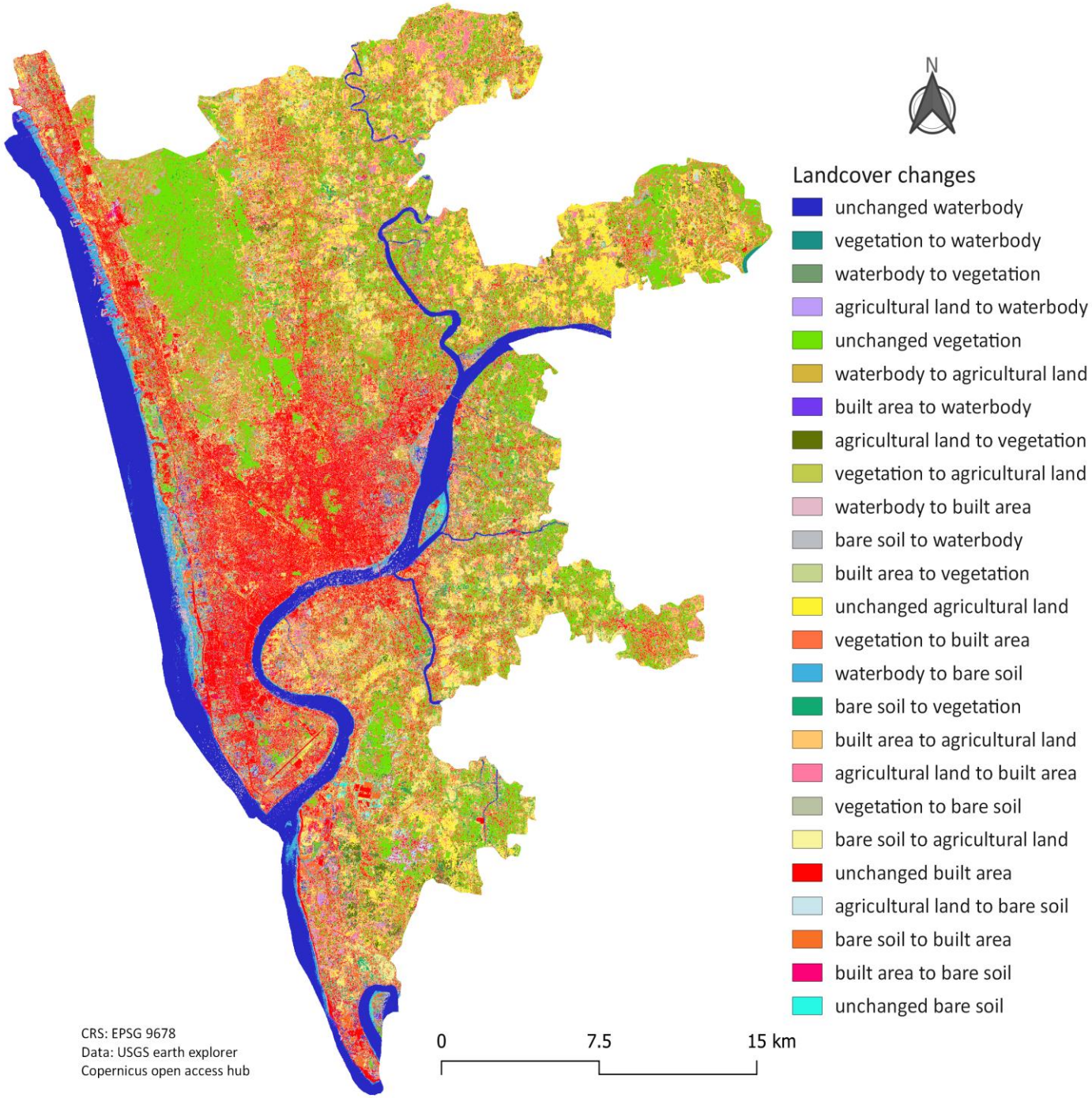
2016

2016	Waterbody	Vegetation	Agricultural land	Built area	Bare soil
Standard Error	0.0022	0.001	0.0028	0.0051	0.0047
Producer Accuracy [%]	84.5207	98.4423	72.3733	99.0216	25.585
User Accuracy [%]	98.9105	99.8403	97.8849	58.6417	85.609
Kappa hat	0.9871	0.9979	0.975	0.4249	0.8241
Overall accuracy [%]	79.1828				
Kappa hat classification	0.7288				

2021

2021	Waterbody	Vegetation	Agricultural land	Built area	Bare soil
Standard Error	0.0014	0.0048	0.0034	0.0053	0.0046
Producer Accuracy [%]	94.6899	67.4506	88.8625	98.5953	42.5808
User Accuracy [%]	95.3029	99.4719	89.828	41.9293	97.6164
Kappa hat	0.9468	0.9922	0.8635	0.3198	0.9716
Overall accuracy [%]	76.638				
Kappa hat classification	0.7047				

Land-use Change Map, 2016 to 2021

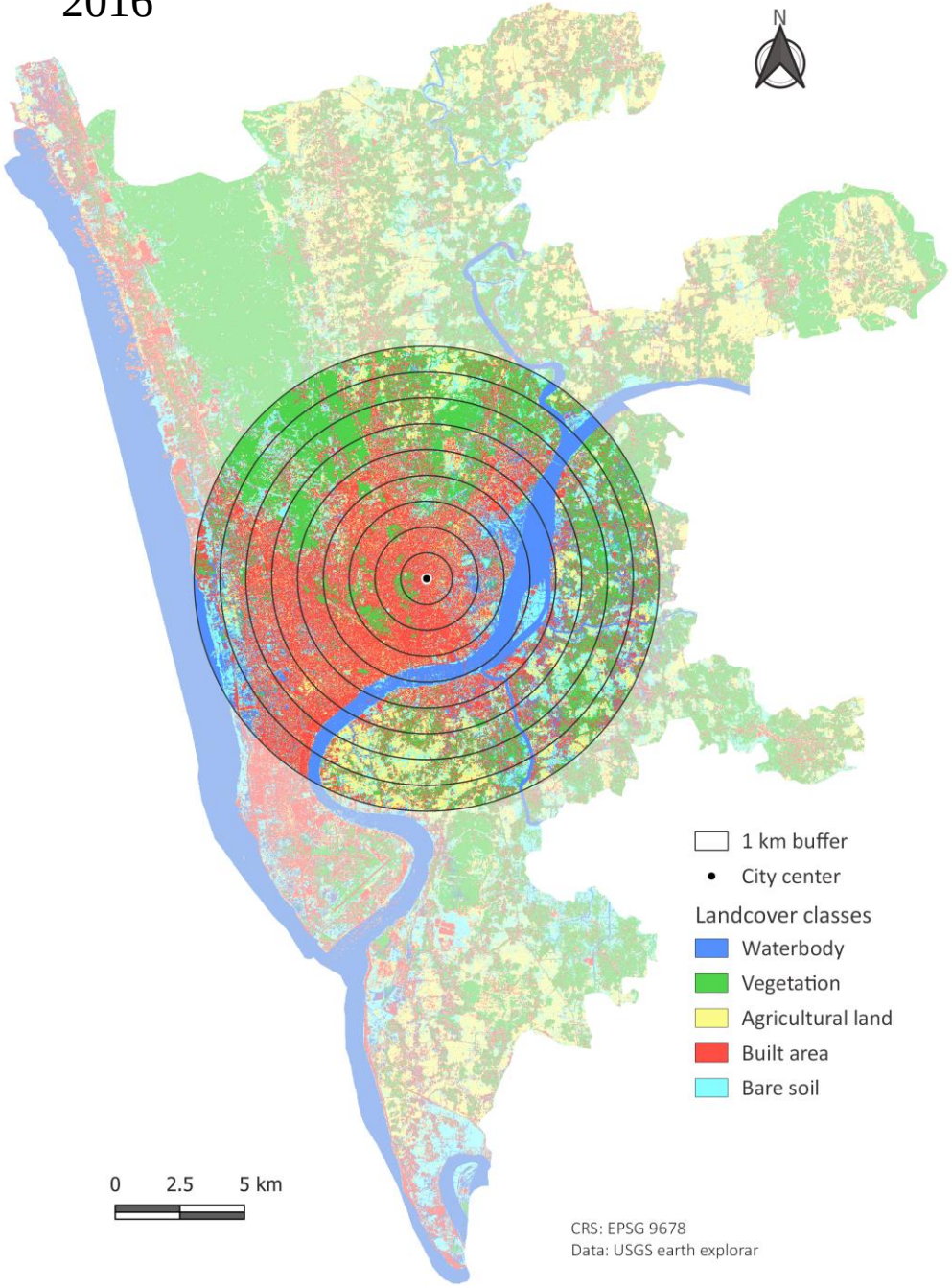


Land-use Change Calculation between 2016 to 2021

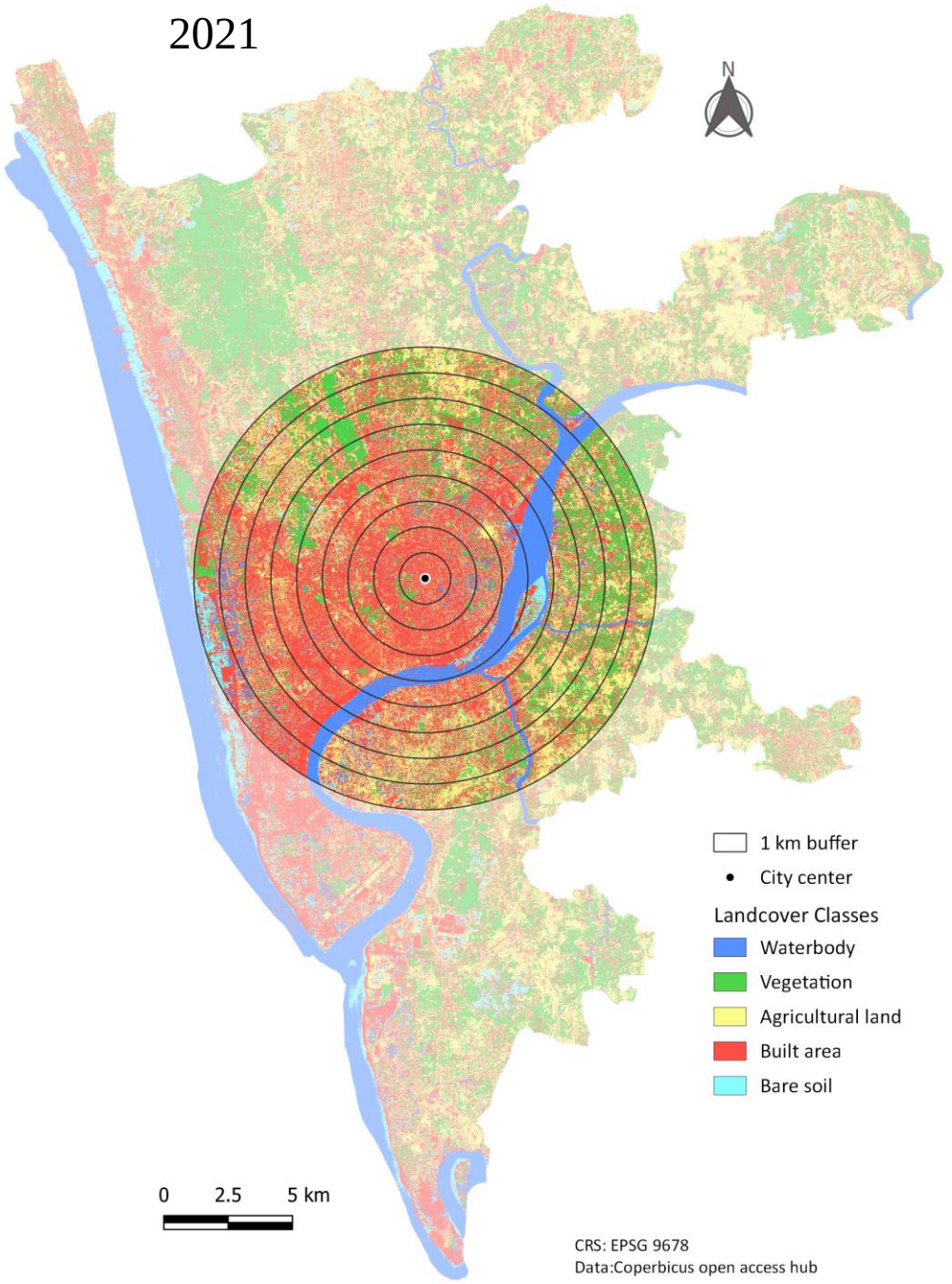
2021/ 201q. km)	Waterbody (2021)	Vegetation (2021)	Agricultural land (2021)	Built area (2021)	Bare soil (2021)	Total
Waterbody (2016)	78.63	7.46	6.52	18.36	11.74	122.71
Vegetation (2016)	1.77	119.11	38.99	55.76	7.53	223.17
Agricultural land (2016)	2.32	10.88	66.76	41.44	9.14	130.53
Built area (2016)	2.85	19.71	37.69	104.05	13.51	177.81
Bare soil (2016)	4.74	10.48	45.04	46.33	12.67	119.26
Total	90.30	167.64	195.00	265.95	54.59	1814.97

Class name	Area [Km^2]	%
Unchanged waterbody	78.63	10.17
Vegetation to water body	1.77	0.23
Agricultural land to waterbody	2.32	0.30
Built area to waterbody	2.85	0.37
Bare soil to waterbody	4.74	0.61
Waterbody to vegetation	7.46	0.96
Unchanged vegetation	119.11	15.40
Agricultural land to vegetation	10.88	1.41
Built area to vegetation	19.71	2.55
Bare soil to vegetation	10.48	1.35
Waterbody to agricultural land	6.52	0.84
Vegetation to agricultural land	38.99	5.04
Unchanged agricultural land	66.76	8.63
Built area to agricultural land	37.69	4.87
Bare soil to agricultural land	45.04	5.82
Waterbody to built area	18.36	2.37
Vegetation to built area	55.76	7.21
Agricultural land to built area	41.44	5.36
Unchanged built area	104.05	13.45
Bare soil to built area	46.33	5.99
Waterbody to bare soil	11.74	1.52
Vegetation to bare soil	7.53	0.97
Agricultural land to bare soil	9.14	1.18
Built area to bare soil	13.51	1.75
Unchanged bare soil	12.67	1.64

2016



2021



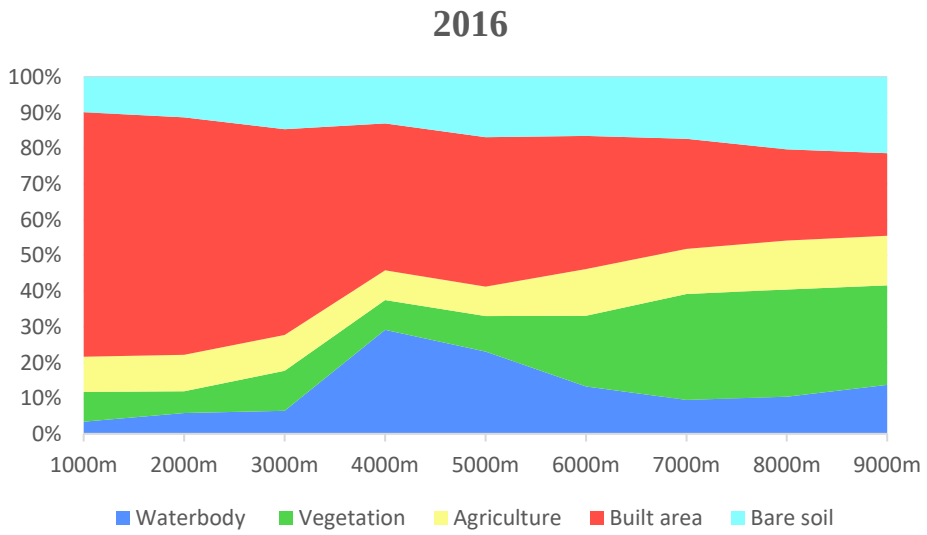
9km Buffer From the city center

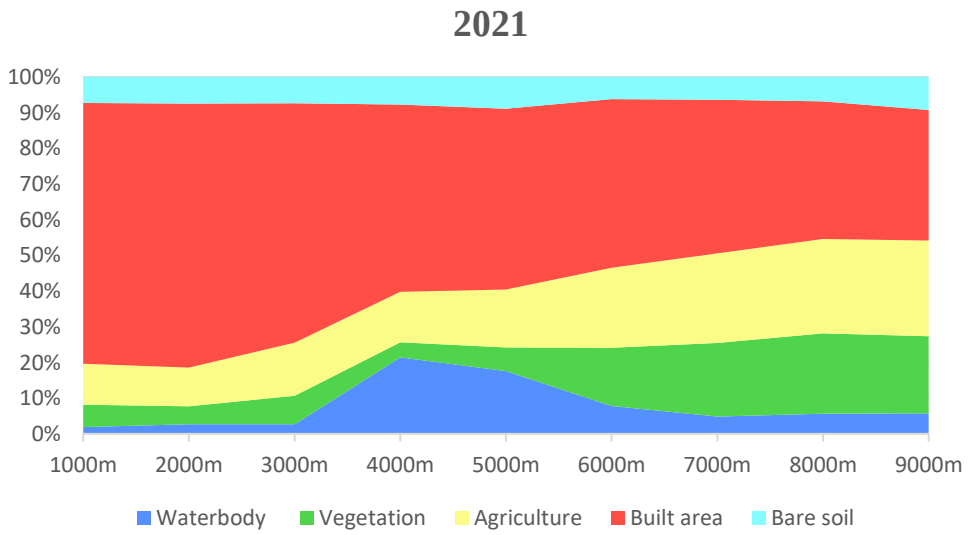
2016

LU class %	1000m	2000m	3000m	4000m	5000m	6000m	7000m	8000m	9000m
Waterbody	3.38	5.84	6.43	29.11	23.04	13.24	9.52	10.45	13.77
Vegetation	8.34	6.14	11.20	8.42	10.01	19.85	29.69	30.03	27.88
Agriculture	9.93	10.15	10.10	8.33	8.21	13.06	12.62	13.67	13.91
Built area	68.45	66.54	57.67	41.16	41.88	37.31	30.90	25.61	23.13
Bare soil	9.90	11.33	14.59	12.98	16.86	16.54	17.28	20.23	21.31

2021

LU class %	1000m	2000m	3000m	4000m	5000m	6000m	7000m	8000m	9000m
Waterbody	1.90	2.71	2.71	21.41	17.56	7.79	4.84	5.70	5.76
Vegetation	6.26	4.97	7.93	4.23	6.66	16.30	20.65	22.43	21.62
Agriculture	11.45	10.89	14.91	14.18	16.22	22.46	25.08	26.47	26.79
Built area	73.08	74.00	67.05	52.42	50.63	47.26	43.05	38.61	36.58
Bare soil	7.31	7.43	7.40	7.76	8.93	6.19	6.38	6.78	9.24





Conclusion

- Built areas and agricultural lands have substantially increased between 2016 and 2021 where vegetation has decreased
- In both years, city centered area is mostly dominated by built area, as going further from the city center, vegetation and agricultural land was increasing.
- In 2021, green vegetation has converted to built areas and agricultural lands in the buffer zones, showing unban expansion.

References

- Ahmed, B. (2015). Landslide susceptibility mapping using multi-criteria evaluation techniques in Chittagong Metropolitan Area, Bangladesh. Landslides, 12(6), 1077-1095.
- https://en.wikipedia.org/wiki/Chittagong
- Cover image: https://www.quora.com/Which-city-is-better-Dhaka-or-Chittagong