Spatiotemporal Analysis of Land Use Changes of the Cape Town Table Bay Induced by Land Reclamation

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SUMMARY

Land Reclamation (LR) from the sea has been practised for decades by developing coastal cities in order to gain an economical forte through port expansion, increased investment opportunities, infrastructure development, and increased employment opportunities. Historically, LR represents one of the most significant anthropogenic modification of coastal lines, achieved through techniques such as dredging and poldering. While these processes are good for the economy, they are pervasive and induce environmental impacts such as loss of sand, altered hydrodynamics, reduced silt deposition, turbidity, wetland degradation, biodiversity shifts and increased flood risks in low- lying areas.

The entire world has espoused LR including South Africa's City of Cape Town, which is the administrative centre of the Western Cape Province and a major coastal metropolis in Southern Africa. The city's oldest building, the Castle of Good Hope (CoGH), built in the 17th century and once located adjacent to the shoreline, now lies about two (2) kilometres from the Table Bay Harbour, illustrating coastal changes induced by land reclamation.

A spatiotemporal analysis of the reclaimed land on the Cape Town foreshore was conducted using historical maps (1932, 1942), aerial photographs (1972 to 1992), and Landsat satellite imagery (1992-2022) processed through a hybrid classification approach, in order to determine the decadal land use land changes (LULC). Object-Based Image Analysis (OBIA) was applied to the historical maps in ArcGIS, Maximum Likelihood Classifier (MLC) for the aerial photographs in ArcGIS, and Random Forest (RF) classifier for Landsat satellite data processed via Google Earth Engine (GEE) cloud computing platform using JavaScript.

The classification results revealed sustained encroachment into coastal waters; an increase in

Built_up areas (19,59% to 33,74%), a decrease in Bareground (19,68% to 2,53%) and Water (60,20% to 57,43%), and a Vegetation enhancement (0,54% to 6,29%) respectively. The study quantifies the decadal LULC, identifies trends of coastal line shifts, and introduces a predictive model for reclamation over the next 50 years.

These findings provide critical insights for climate- resilient urban planning and sustainable coastal management.