Supplementary material 1: Interpretation of patches of significant trends in NDVI Time series

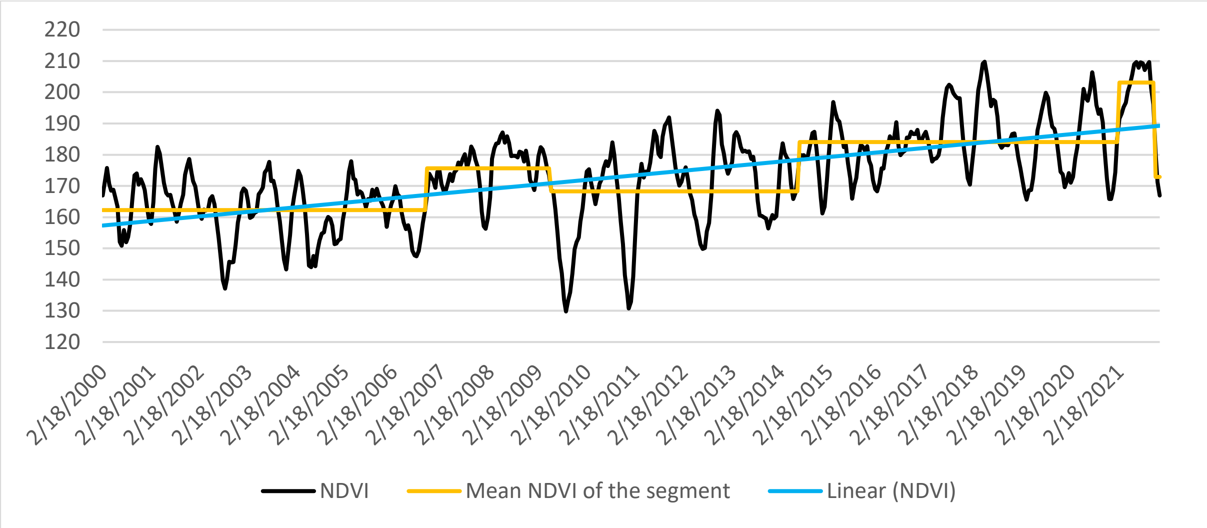

Figure SM1.1: NDVI time series, trend and binary segmentation in Nuwaragala

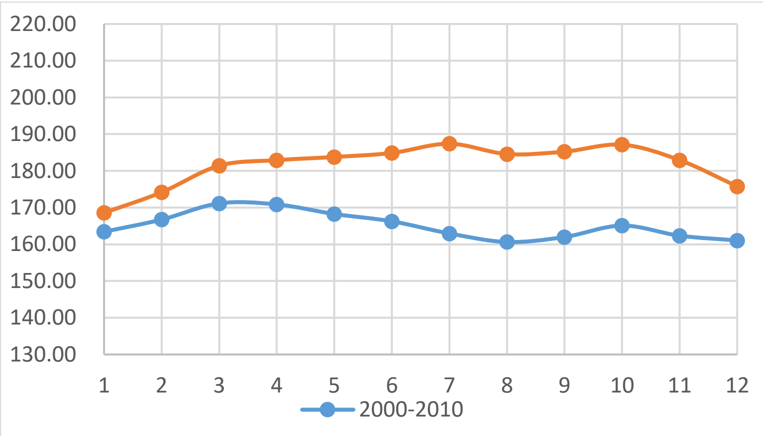

Figure SM1.2: NDVI annual Mean of 2 decades in Nuwaragala

Figure SM1.3: Satellite color composite of Nuwaragala in 2001 left and 2020 right (Google Earth)

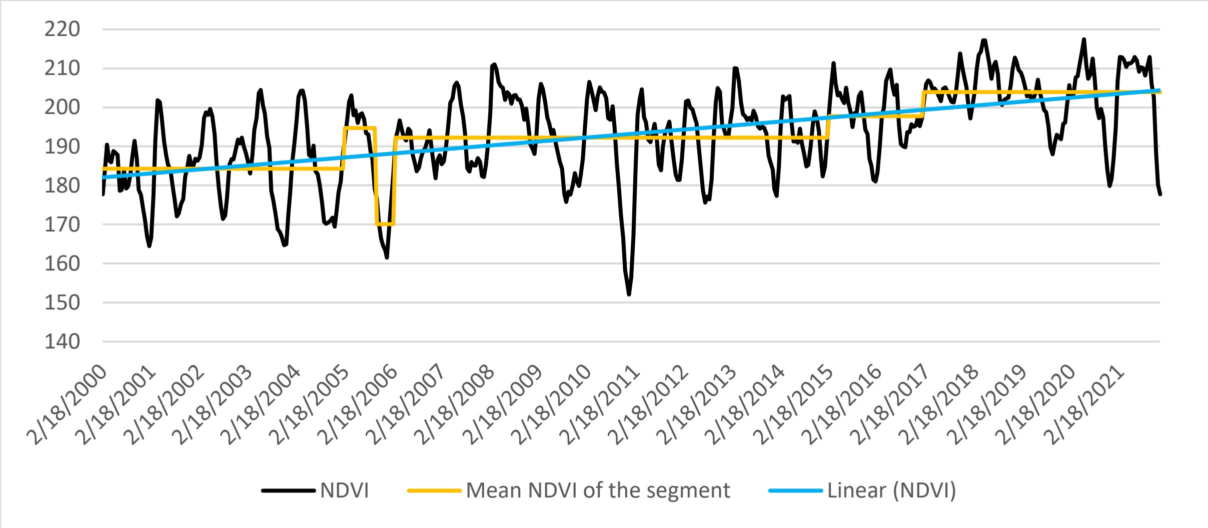

Figure SM1.4: NDVI time series, trend and binary segmentation in Badulla

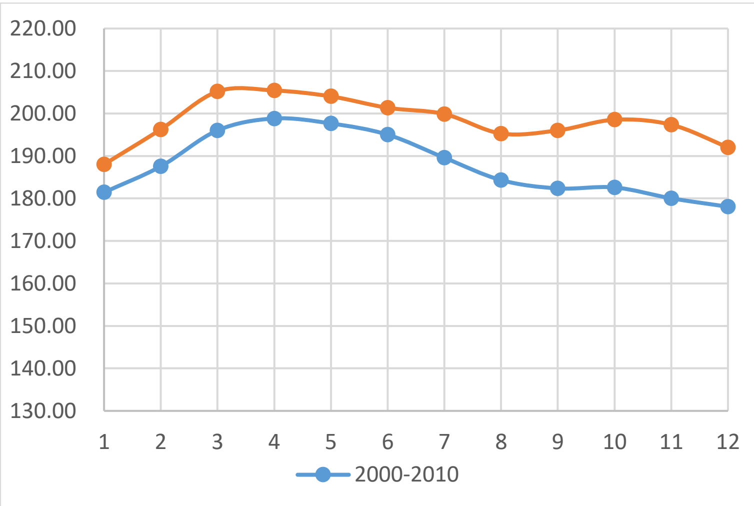

Figure SM1.5: NDVI annual Mean of 2 decades in Badulla

Figure SM1.6: Satellite color composite of Badulla in 2010 left and 2022 right (Google Earth)

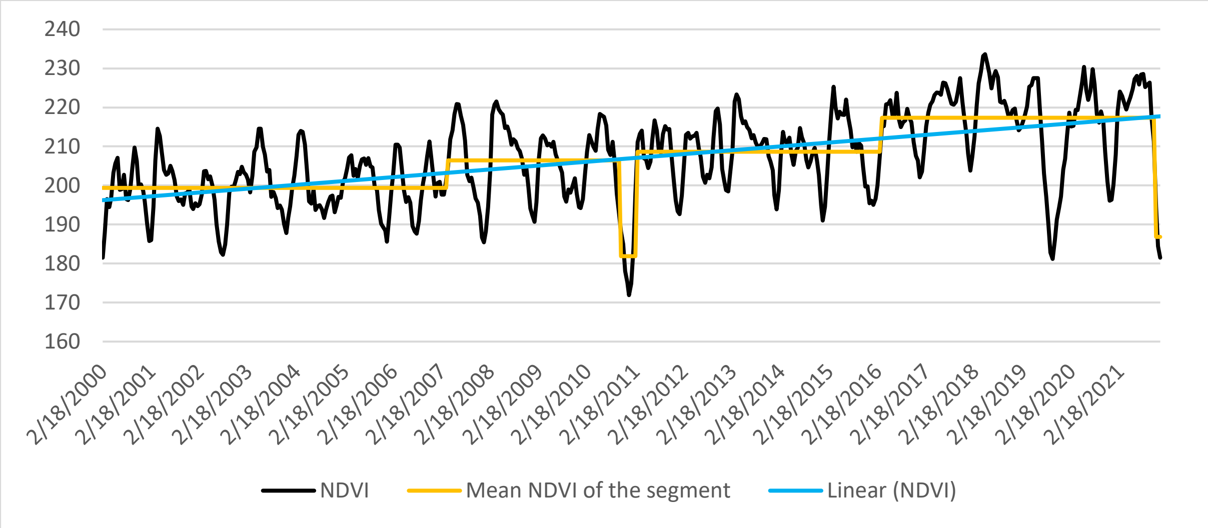

Figure SM1.7: NDVI time series, trend and binary segmentation in Monaragala

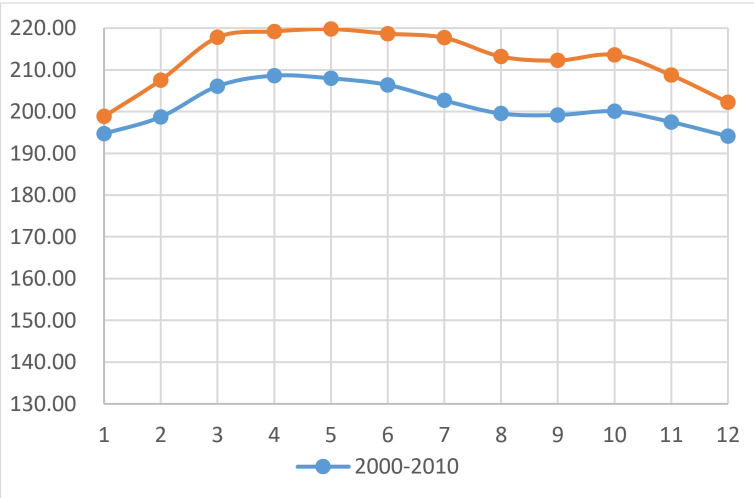

Figure SM1.8: NDVI annual Mean of 2 decades in Monaragala

Figure SM1.9: Satellite color composite of Monaragala in 2006 left and 2020 right (Google Earth)

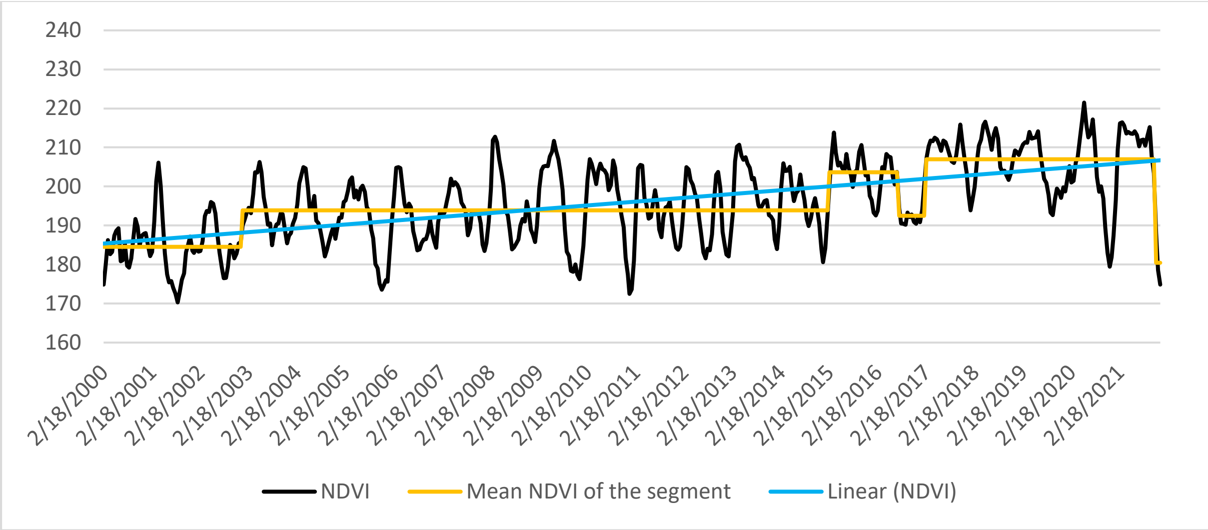

Figure SM1.10: NDVI time series, trend and binary segmentation in Salamanawewa

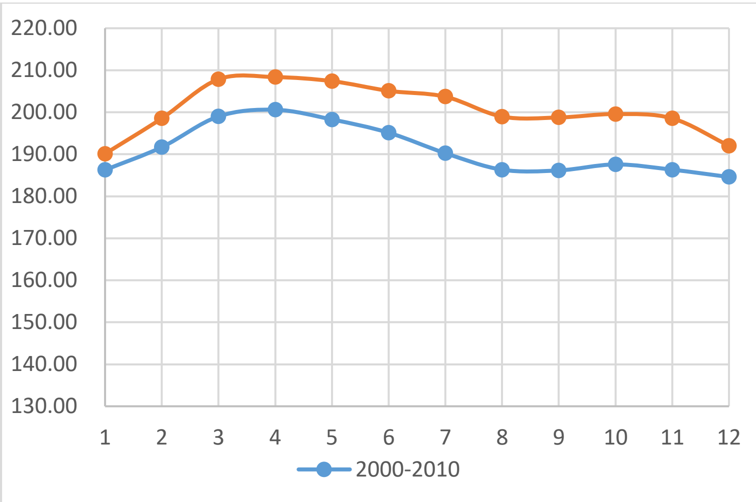

Figure SM1.11: NDVI annual Mean of 2 decades in Salamanawewa

Figure SM1.12: Satellite color composite of Salamanawewa in 2005 left and 2022 right (Google Earth)

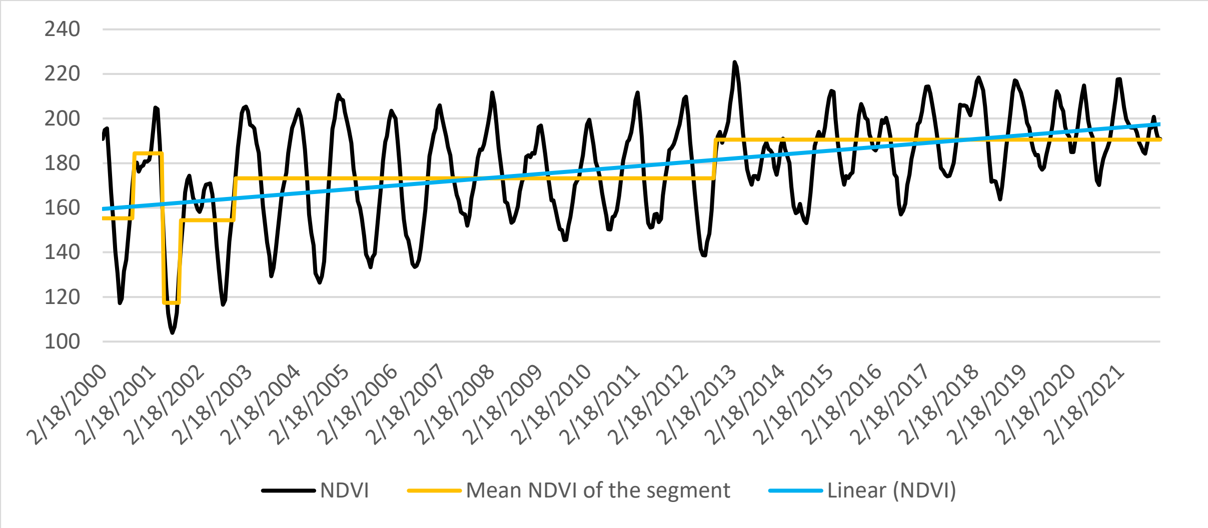

Figure SM1.13: NDVI time series, trend and binary segmentation in Udawalawe

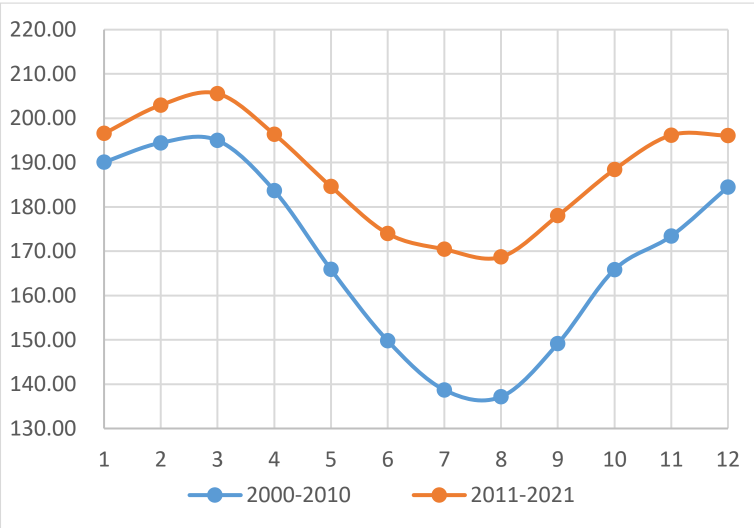

Figure SM1.14: NDVI annual Mean of 2 decades in Udawalawe

Figure SM1.15: Satellite color composite of Udawalawe in 2003 left and 2022 right (Google Earth)

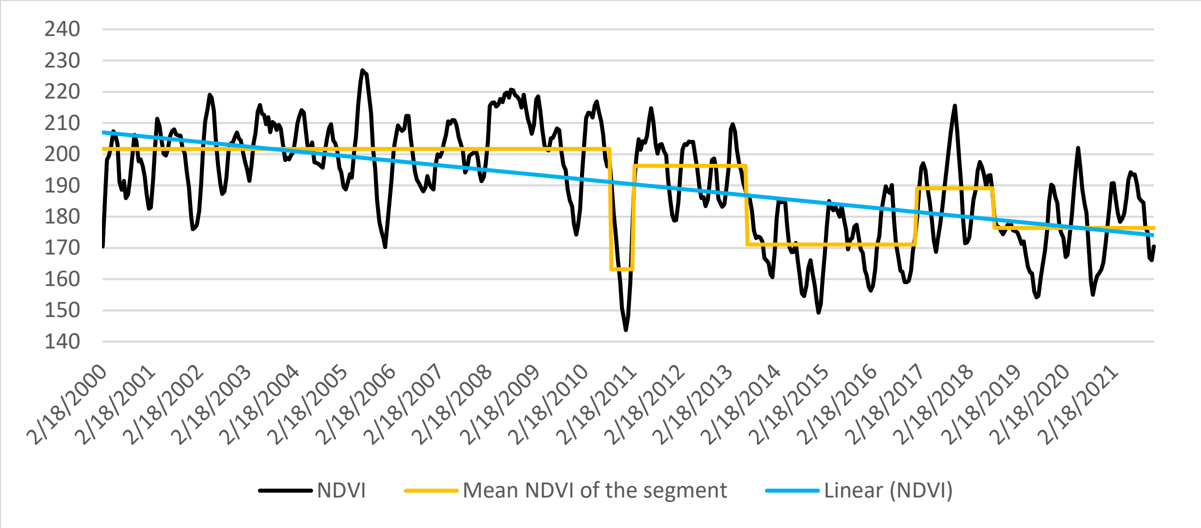

Figure SM1.16: NDVI time series, trend and binary segmentation in Kelabogaswewa

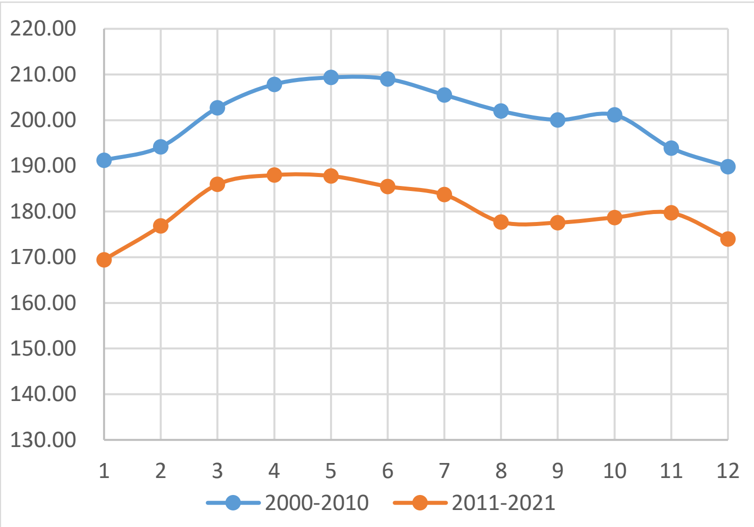

Figure SM1.17: NDVI annual Mean of 2 decades in Kelabogaswewa

Figure SM1.18: Satellite color composite of Kelabogaswewa in 2009 left and 2020 right (Google Earth)

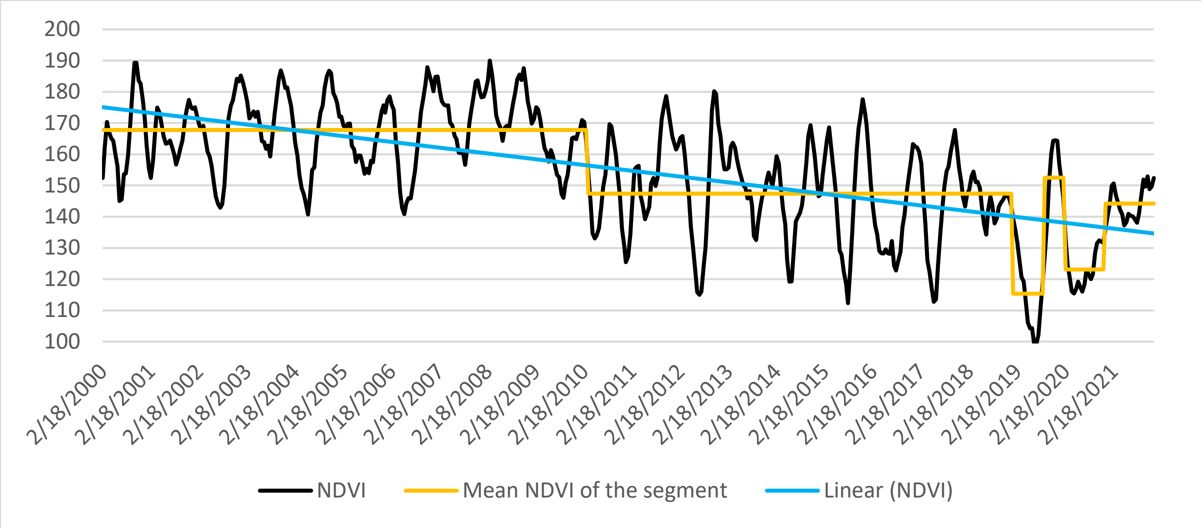

Figure SM1.19: NDVI time series, trend and binary segmentation in Trincomalee (east)

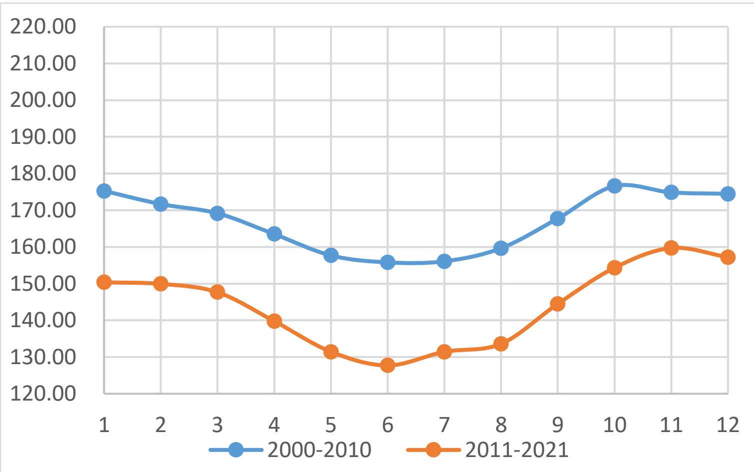

Figure SM1.20: NDVI annual Mean of 2 decades in Trincomalee (east)

Figure SM1.21: Satellite color composite of Trincomalee (east) in 2006 left and 2022 right (Google Earth)

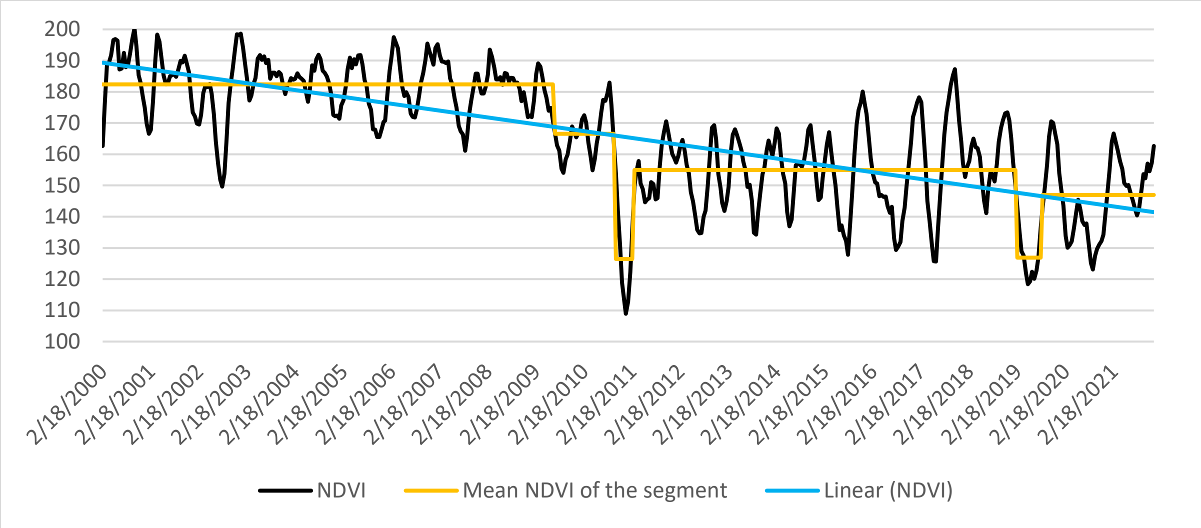

Figure SM1.22: NDVI time series, trend and binary segmentation in Trincomalee (west)

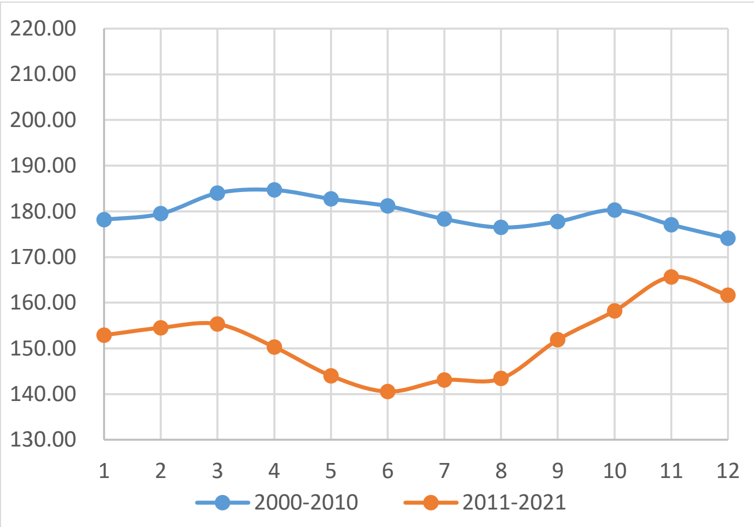

Figure SM1.23: NDVI annual Mean of 2 decades in Trincomalee (west)

Figure SM1.24: Satellite color composite of Trincomalee (west) in 2003 and 2022 (Google Earth)

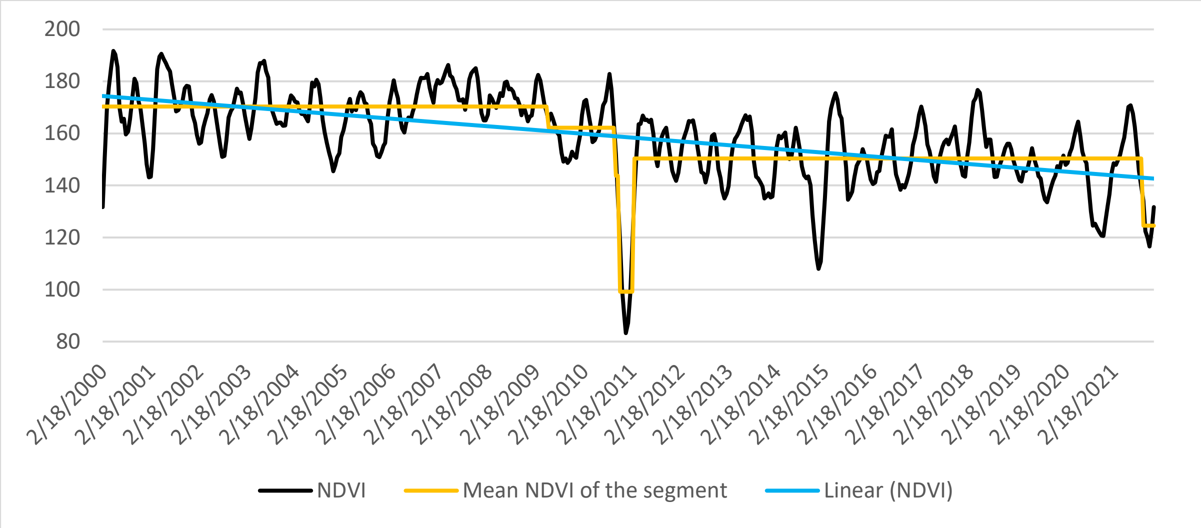

Figure SM1.25: NDVI time series, trend and binary segmentation in Trincomalee (center)

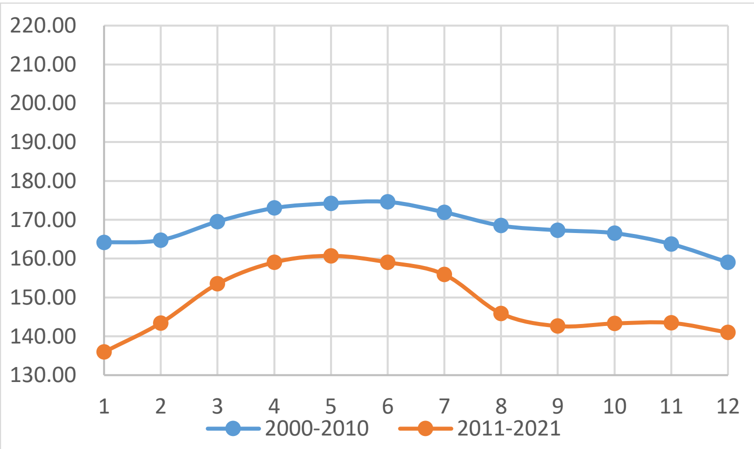

Figure SM1.26: NDVI time series, trend and binary segmentation in Trincomalee (center)

Figure SM1.27: Satellite color composite of Trincomalee (center) in 2006 left and 2021 right (Google Earth)

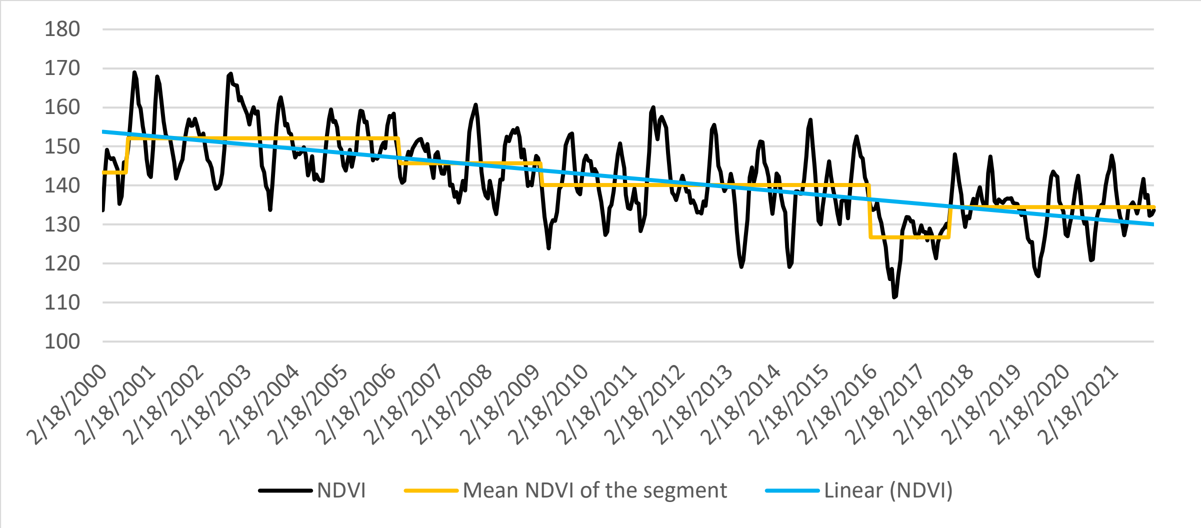

Figure SM1.28: NDVI time series, trend and binary segmentation in Colombo

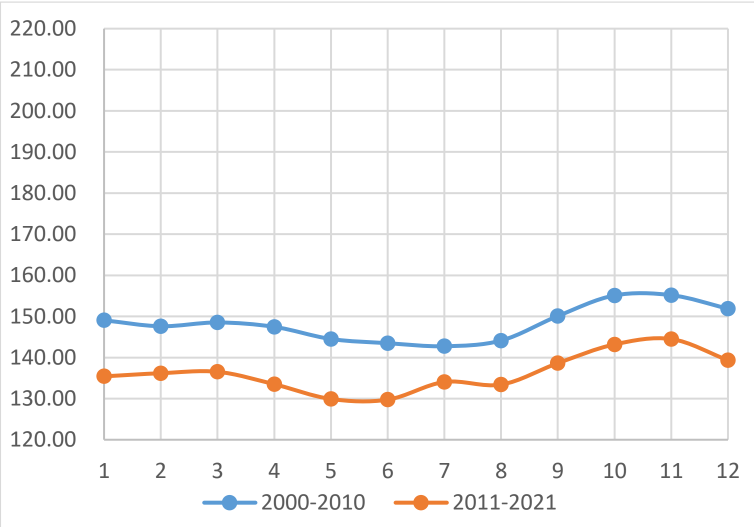

Figure SM1.29: NDVI time series, trend and binary segmentation in Colombo

Figure SM1.30: Satellite color composite of Colombo in 2004 left and 2020 right (Google Earth)

Supplementary Material 2 Local case studies of impacts of infrastructure development on the coast

Urban growth in Galle

The map of land cover change in the Galle case study shows an increase from 465 ha in 1988 to 1540 ha in 2020. A dense urban patch has expanded all around the city and along the road to Unawatuna. In addition to dense urban growth, an extension of home gardens has also been occurring but our mapping of home gardens with satellite imagery remains less accurate than dense urban areas. Our estimation of home gardens is an extension from around 1300 ha in 1988 to around 2500 ha in 2020. On the other hand, around 200 ha of home gardens have been converted to dense urban areas in 1988 (Fig.2). Moreover, areas covered by mangroves in Galle have increased between 1988 and 2020.

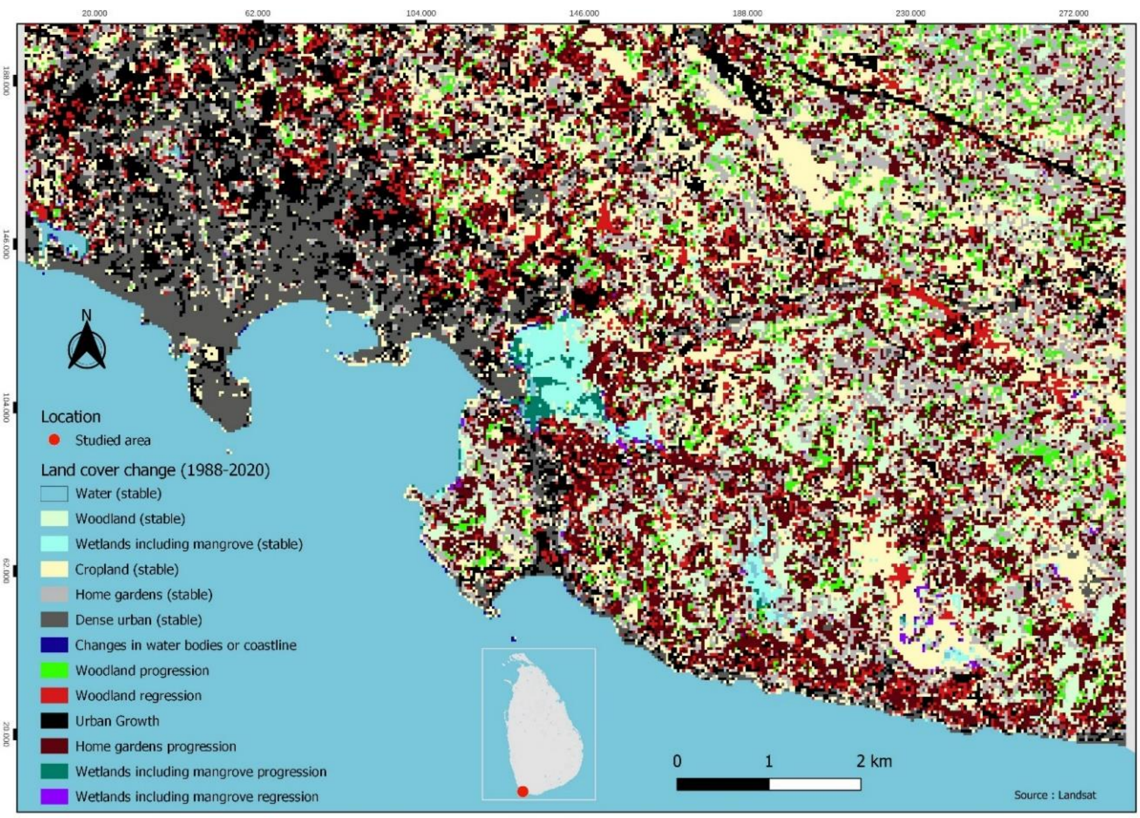

Figure SM2.1. **Map of LULC change from 1988 to 2020 in the Galle case study area**

Infrastructure development in Hambantota

In the Hambantota-Bundala-Yala case study, the extension of home gardens is important with an increase from 3434 ha in 1994 to 7658 ha in 2019. This is associated with conversion from natural land cover (scrub lands, lagoons) to infrastructure (port, industries, airport, transport network). Fig 7 shows that the newly built-up (wooded ‘home garden’) areas are either close to the Kirindi Oya Irrigation and Settlement project (older than the image of 1991) or to the industrial Port of Hambantota. The overall development infrastructure politics has therefore structured the built-up areas extension.

In the meantime, the Bundala National Park has been reinforced and the increase of vegetation cover and biomass on the eastern part of the protected area perceived on MODIS Time series is consistent with the high resolution mapping and the field verification. The exclusion of previous cattle pasture might partly explain the vegetation growth. The expansion of *Prosopis juliflora* an invasive species from America, might also largely contribute to the detected greening. The protected areas mostly appear stable in terms of land cover. However, in places where shifting cultivation locally known as “chena” is practiced between non-protected areas the land cover change detected is a woodland regression that might be explained by shorter fallows and more frequent clearing (figure SM4.1).

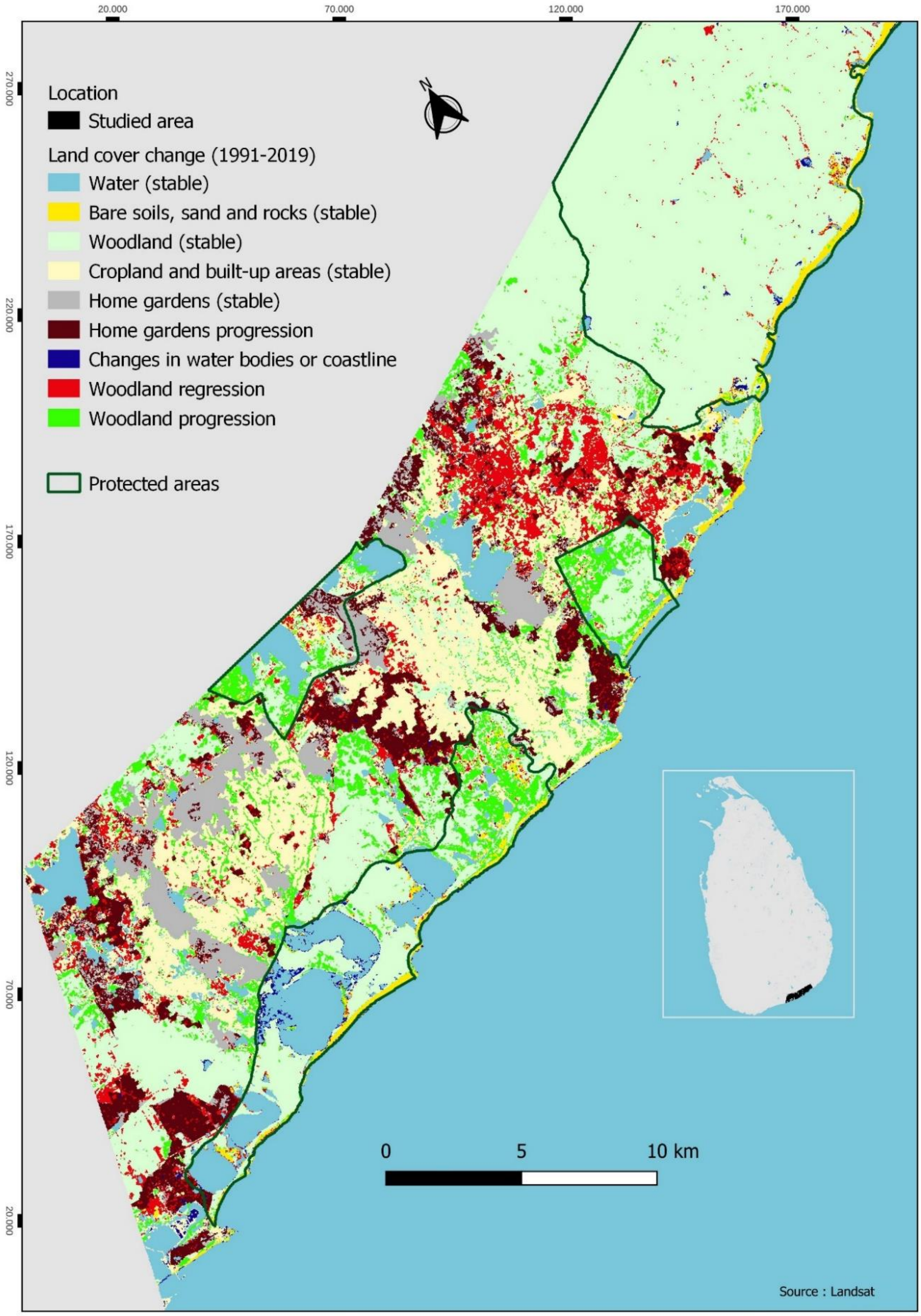

Figure SM2.2**. Map of LULC change from 1991 to 2019 in the Hambantota Case study area**

Settlement Programmes in Trincomalee

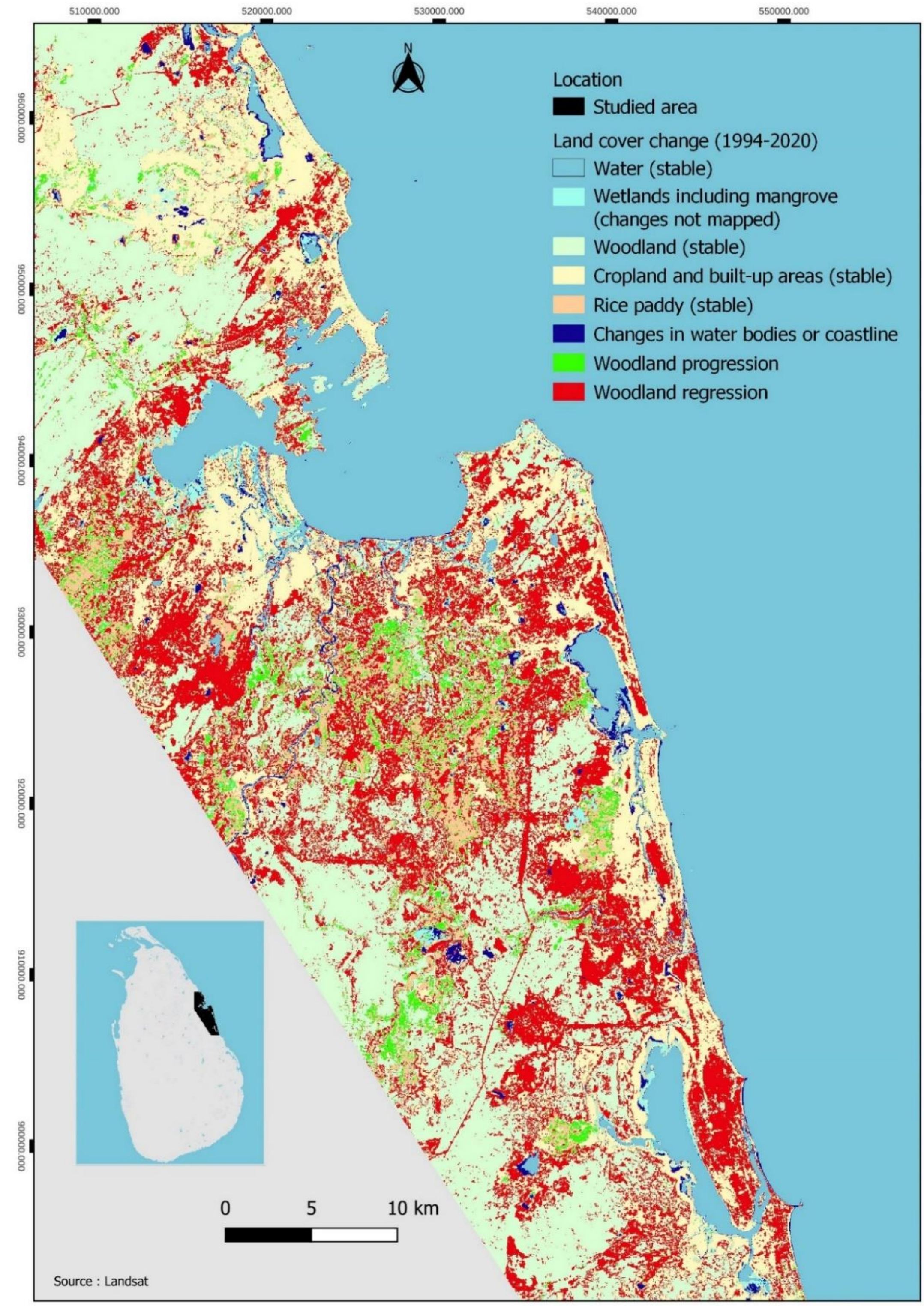

Figure SM2.3**. Map of LULC change from 1994 to 2020 in the Trincomalee Case study area**

The map of land cover change with LANDSAT data in the Trincomalee coastline is consistent with the results from trends detected with MODIS data. The region was largely covered by spontaneous vegetation until the beginning of 1990. The coast north of Trincomalee town, all around the Bay and southward, show numerous patches of deforestation. Most of these patches are post-war housing and agricultural settlement programmes. They appear as new irrigated rice cropland. This was confirmed by stakeholder interviews in the Town and Gravets, Kuchchaveli and Muttur DS Division study sites, which had all experienced resettlement of communities displaced by war, construction of roads and bridges, as well as construction of an industrial zone (Town and Gravets), a new water treatment plant (Muttur) and tourism infrastructure (Kuchchaveli). The ground issues of armed conflict since 1978 needs to be taken into account. There has been mass displacement of people, abandoning of home and cultivated lands was of significance in different periods after 2007. The relocation, resettlement in 2002 followed ceasefire and end of conflict 2009 and beyond. The development projects, specially the construction of bridges from 2007 and beyond, promoted the movement of people thus expansion of both home stay and cultivation. Clearance of coastal vegetation by Tsunami of December 2004 baring the coast in many places and might be part of some trends

Human alteration of coastal areas in Batticaloa

Eastern parts of Sri Lanka receive high rainfall during October to January, due to North-East monsoon, and this period is influenced by the cyclonic rainfall too. Both conditions bring heavy rainfall in a short period of time. The low-lying nature of the coastal areas of Batticaloa is vulnerable to flash floods. Actions have been taken to immediately release the flood into the sea, in which, local government manually opens the existing ‘bar mouth’ (naturally opens and closes due to ocean currents and sand accumulation). This operation leads a drastic geomorphological change in 2011 where the coastal area subjected to severe coastal erosion, loss of coastal vegetation and landscape, formation of a sea-bed into the sea and many more (Mathiventhan and Jayasingam, 2018) in 2011. This disturbs natural dynamics and functions of the coastal ecosystems.

Supplementary Material 3: LANDSAT Land cover change detection field validation

In February 2022, a field mission on the south Coast enabled to gather field data for remote sensing validation of some recent Land cover maps. From the land cover maps of recent date, a random set of points have been produced stratified by the land cover types. These places have been visited with a GPS. The field observed land cover has been observed and reinjected in the Geographical information system to assess accuracy and point out the main errors.

The first assessment gave a very low accuracy. Therefore, the land cover typology has been adjusted by the creation of a class for home gardens. Then, another round of stacked classification has been realized for each class with important commission errors on the Error matrix. For those, subclasses were interpreted with radiometric values and reattributed to classes with important omission errors. After such corrections, the following error matrixes are obtained for Galle (Tab 2) with an overall Kappa of 0.81 and for Hambantota (Tab3), with an overall Kappa of 0.83.

Table SM3.1. Error matrix of the land cover map in 2020 for Gall Case study

	1	**2**	**3**	**4**	**5**	**Total**	**ErrorC**
1	689	3	0	0	3	**695**	**0.009**
2	0	387	38	4	37	**466**	**0.169**
3	0	151	194	14	14	**373**	**0.480**
4	0	62	0	337	0	**399**	**0.155**
5	0	0	4	0	319	**323**	**0.014**

Total	**689**	**603**	**236**	**355**	**373**	**2256**	
Error0	**0**	**0.358**	**0.178**	**0.051**	**0.145**		**0.146**

Table SM3.2. Error matrix of the land cover map in 2020 for Hambanthota Case study

	1	**2**	**3**	**4**	**5**	**Total**	**ErrorC**
1	5638	18	8	7	66	**5737**	**0.017**
2	0	495	3	20	45	**563**	**0.120**
3	9	404	3616	141	613	**4783**	**0.244**
4	0	0	184	3592	1152	**4928**	**0.271**
5	19	14	201	425	10822	**11481**	**0.057**
Total	**5666**	**931**	**4012**	**4185**	**12698**	**27492**	
Error0	**0.005**	**0.468**	**0.099**	**0.142**	**0.148**		**0.121**

Supplementary Material 4: field photographies

Figure SM4.1 Chena field where negative trend in NDVI is observed in Yoda Kandiya (Andrieu)

Figure SM4.2 Open savannah where positive NDVI trend is observed in the Bundala National Park, in February 2022 (Andrieu)

Figure SM4.3 Mangrove progression where negative trend in NDVI is observed in Kalametiya (Andrieu)

Figure SM4.4 new house in a ‘home garden’ landscape in Heenatigala in February 2022 (Andrieu)

Supplementary Material 4: Pollen and non-pollen palynomorph (NPP) multi-proxy approach

Lake and lagoonal sediments along the coastal plains are natural archives that contain information about the dynamic patterns of past hydrological, biological, geological/sedimentological and anthropogenic activities occurring in the catchment area (Premathilake, 2003, Dilrukshi, 2019, Manawadu, 2015). Understanding these dynamics that leads to the modern evolution of coastal environmental context and differentiating the critical factors related to natural and anthropic processes is crucial matter that can be addressed using pollen and NPP data (paleoecological data). Changes in climate, vegetation and soil/sediment and landform developments in association with socio-economic factors create the spatial structure of coastal landscape. Thus, spatial and temporal data from palaeoenvironmental and palaeoclimatological contexts together with other fields, e.g. ecology and archaeology can be used to understand these changes and their drivers.

Here we present a high-resolution continuous pollen and NPP (palynological) reconstruction carried out in two coastal wetland sites in the southern (catchment of the Hikkaduwa lake in north of Galle) and eastern (Batticaloa lagoon) coastal environment, Sri Lanka. The reconstruction includes changes in vegetation, climate, sea-level, land-use and human impact during the last 7,500 years including the modern period. The pollen and NPP data together with radiocarbon dating from two coastal archives have made a picture at local/ regional scale of humans-vegetation/environment interaction around the sites, particularly changes in the late Holocene, ca. the last 3000 years are highlighted. The value addition of the palynological study provide a longer baseline for restoration, conservation, socio-economical management plans and policies in the southern and eastern coastal plains.

Site 1: Hikkaduwa (North of Galle)

Impact from climate changes towards arid condition, with lack of monsoon rains appears to have been severe which influenced the great reduction of rice cultivation between 4,500-3,600 cal yrs BP. Crop lands including the presence of crops (Areca sp. and Durio sp.) associated with cultured rainforest was also diminished. Humans seem to have re-established rice cultivation and initiated Cocos sp. (cf. nucifera) in the coastal plains responding to the fluctuation of the Late Holocene monsoon. The rice cultivation was more likely to have increased between 2,250-1,900 and 1,500-1,200 cal yrs BP, whereas the monsoon downturn prevailed. This coincides with the tank building periods and expansion of irrigation works reported in the country's historical records.

Site 2: Batticaloa Lagoon

This site also yielded palaeoclimate and vegetation records where aridity and less vegetation have been a prominent mode during the late Holocene. Aridity seems to have increased between 2300-1900 cal yrs BP which coincides with severe drought periods documented in historical sources and with the expansion of irrigation works in the dry zone of Sri Lanka. The kingdom shift from dry zone, to wet zone which took place in the 13th century (around 764-720 cal yrs BP), correlates with the severe arid conditions as indicated by lack of monsoon forest pollen. Scarcity of monsoon forest suggests a significant reduction of monsoon rains from 600 cal yrs BP to present. This coincides with the European colonization of Ceylon with the arrival of the Portuguese (600-500 cal yrs BP). The beginning of the Little Ice Age (14th-18th century) also falls within this period of aridity (>600calBP).