



# Geospatial Analysis of Wetland Shrinkage in Kozhikode City and Suburbs, Kerala, India

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## Abstract

Kozhikode is a bustling city, located on the southwest coast of India. As city expanding, wetlands are devoured by infrastructural developments. The main objective of present study is to examine wetland shrinkage in Kozhikode city and suburbs during the year 1993 to 2023. LULC change analyzed for the years 1993, 2003, 2013 and 2023 using Landsat images. During the span of thirty years 1213.46 hectares of wetlands disappeared in Kozhikode city and suburbs. The study pointed out the significance of conserving wetlands to maintain the ecological balance of the green blue spaces in fast growing Kozhikode City.

**Keywords:** Land Use Land Cover, Wetlands, Inland wetlands, paddy wetlands, Coastal wetlands

## Introduction

Wetlands are productive ecosystems that are temporarily or permanently drowned by water. The Ramsar Convention (1971) defines wetlands as “areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters”. They exhibit diverse characteristics according to their geographical location, origin, water regime, soil and sediment properties (Space Applications Centre, 2011). Kozhikode city’s geographical location in the vicinity of Arabian Sea and

copious amounts of rainfall provides a wide range of wetlands, including paddy wetlands, rivers and streams, canals, estuaries, lakes and ponds. Wetlands deliver essential ecosystem functions, which are crucial to hydrology, biogeochemical function, and biodiversity conservation (Cohen et al., 2016). Human lives are intricately entwined with these ecosystems as they offer wide range of ecosystem service including groundwater recharge, water purification, coastal protection, recreation and livelihood support. These ecosystems are under threat due to infrastructure development activities. As Kozhikode city has grown, wetlands are devoured by residential buildings, commercial complexes, and infrastructural developments. Thus the objective of this study is to quantify the spatio-temporal shrinkage in wetlands of Kozhikode city from 1993 to 2023.

## **Methodology**

Landsat images of Kozhikode City and suburbs for the year 1993, 2003, 2013 and 2023 were downloaded from US Geological Survey website (<https://earthexplorer.usgs.gov>). These images have been undergone atmospheric, radiometric and geometric correction. Initially, LULC maps prepared for understanding the LULC changes in the study area. Supervised classification with the Maximum Likelihood Classifier was employed. LULC classification scheme of NRSC was adopted for the study. The study area was categorized into five LULC classes- built up, mixed crops, barren land, paddy wetlands and wetlands other than paddy. LULC maps prepared for the years 1993, 2003, 2013 and 2023. On screen manual digitization following on-screen visual interpretation was carried out. Then the wetlands of Kozhikode city and suburbs were categorized into inland wetland and coastal wetland as per NRSC Land Use Land Cover classification. Inland wetlands in the study area include paddy wetlands, rivers, streams, canals, lakes and ponds. Coastal wetlands comprise of estuaries and mangroves. ERDAS Imagine 15 and Arc Map 10.8 software were used.

## **Study area**

Kozhikode is a bustling city situated along the Malabar Coast in Kerala. The study area comprises Kozhikode Corporation, Feroke and Ramanattukara municipalities, Kadalundi, Olavanna, Perumanna, Peruvayal, Mavoor, Kunnamangalam, Kuruvattur, Kakkodi, Chelannur, Thalakkulathur, Atholi, and Chemanchery panchayaths and lies between the coordinates 11°7'24" N - 11°26'26" N latitude and 75° 42'35" E-75°

58°15"E longitude. The area chosen for the study includes major urban clusters and peripheral areas with low to high degree of urbanization. Location of the study area is given in figure 1.

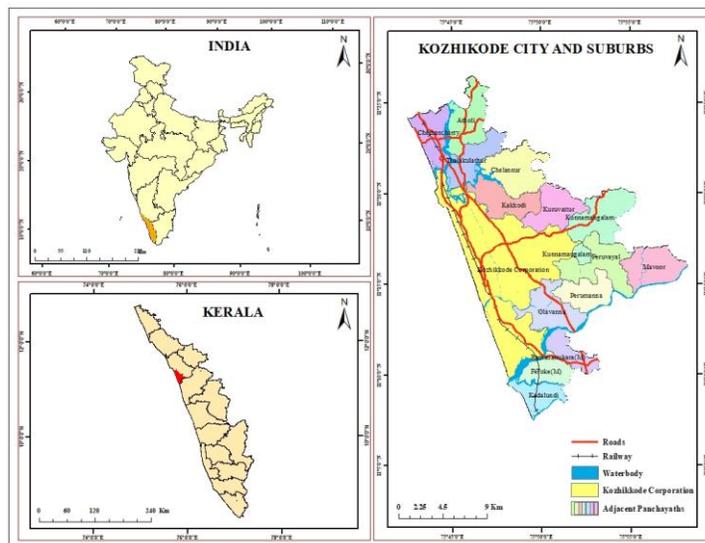


Figure 1: Location of the Study area

## Result and Discussion

### Land Use Land Cover Change in Kozhikode City and Suburbs

Wetlands across the globe are under stress due to anthropogenic pressure, rapid urbanization and negligent land use pattern. In 2022, UNESCO reported that 85% of wetland extent lost all over the world during the past 300 years. Urban expansion induced land use change adversely affecting the ecosystem services offered by wetlands (Assefa et al., 2021). Kozhikode city is expanding at faster rate by invading green blue ecological space in the peripheral areas. Kozhikode City's growth is directed to all directions along the major transport network; however, its growth is more prioritized along the National Highway 66 bypass through Pooladikunnu, Thodayadu, Cyber Park – Palazhi, Panthirakavu Azhikillam, and Ramannattukara. The NH bypass fragmented the wetlands in this area and the city has almost encroached upon the marshes in Olavanna, Kadalundi, Feroke, and Ramanattukara. The NH 66 bypass through this area is lined with restaurants, recreational centers, and vast areas left barren by land developers. Therefore, this study integrates the land use land cover data of Kozhikode city and suburbs for better understanding of wetland loss in the study area. For understanding the changes in LULC pattern, the study area was categorized into five LULC classes- built up, mixed crops, barren land, paddy wetlands and wetlands other than paddy (figure 2). Built up land consist of commercial buildings, residential buildings and other infrastructure development. Wetlands other than paddy wetlands include canal, ponds, lakes, rivers, streams, estuaries and mangroves.

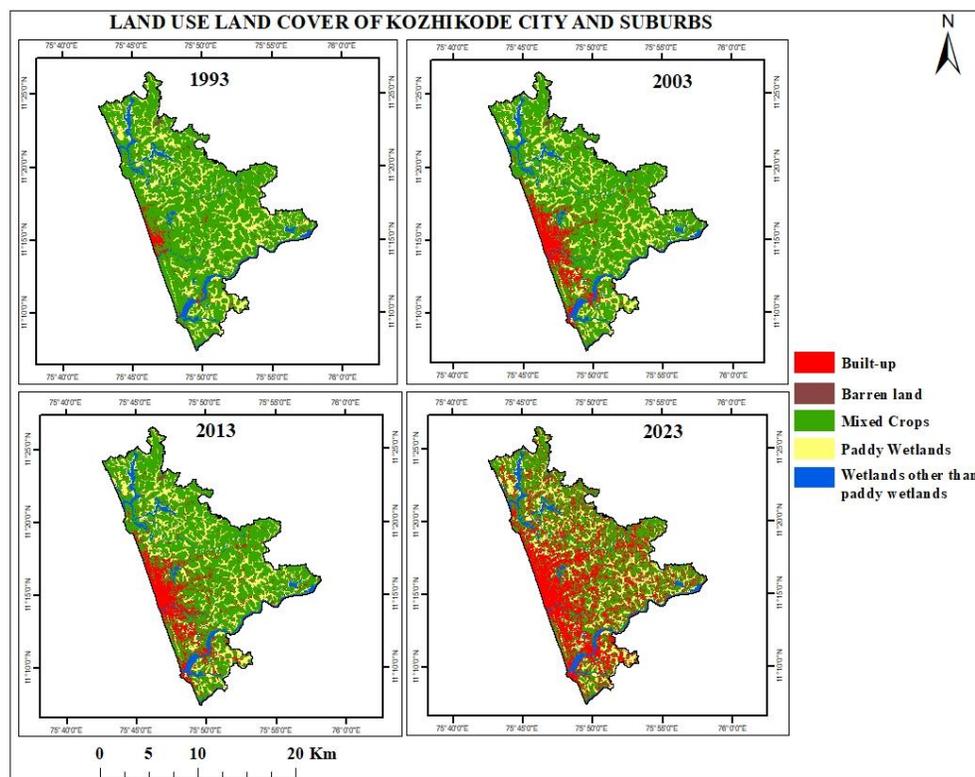


Figure 2: LULC of Kozhikode City and suburbs 1993-2023

The result of temporal changes of LULC classification shown in table 1 reveals that Kozhikode city and suburbs witnessed drastic changes.

Table 1: Land use Land cover of Kozhikode City and Suburbs: 1993 -2023

LULC CLASS	1993		2003		2013		2023	
	Area (Ha)	Area (%)						
Built up land	838.64	2.20	3596.35	9.43	4978.85	13.05	13168.09	34.52
Barren land	341.00	0.89	269.87	0.71	269.41	0.71	98.17	0.26
Mixed crops	27611.18	72.38	25174.50	65.99	24097.60	63.17	16738.01	43.88
Paddy wetlands	7114.67	18.65	6879.01	18.03	6571.98	17.23	6040.94	15.84
Wetlands other than paddy wetlands	2243.18	5.88	2228.93	5.84	2230.83	5.85	2103.44	5.51
<b>Total</b>	<b>38148.66</b>	<b>100.00</b>	<b>38148.66</b>	<b>100.00</b>	<b>38148.66</b>	<b>100.00</b>	<b>38148.66</b>	<b>100.00</b>

### Wetlands of Kozhikode City and Suburbs

Kozhikode city and its suburbs are endowed with four rivers namely Kallai river, Chaliyar, Korapuzha, and Kadalundi river and Manmade canals namely Canoly canal (EK Canal) and BK Canal. The significant wetlands and marshes in the study area Kottuli, Eranjikkal, Kadalundi and Mavoor wetland and Olavanna marshes need immediate conservation measures. The study primarily focuses on the conservation measures of the wetland in the heart of the Kozhikode city as well as in the suburbs. Kottuli wetland is the prominent green patches in the heart of Kozhikode City, comes under National Wetland Conservation Programme. The

Canoly Canal runs on the western side of Kottuli, a navigation channel linking the Korapuzha and

Kallaipuzha (Bhagyanathan A & Dhayanithy D. 2023). This wetland functions as natural sponge in trapping the flood water and surface water runoff in the city during the rainy season. It spreads over an area of 1300 acres in the wards namely Nedungottur, Chevayur and Kottuli of Kozhikode corporation limit. The wetland act as natural kidney of the city, despite the wetland premises facing rapid urbanization. Out of 215 acres of original wetland, about 55.6 acres has been reclaimed for human settlement and the reclamation is continuing (P A Azeez & Raj PN2010). Swift urban expansion in Kozhikode city has led to the extensive degradation of the Kottuli wetlands. Kadalundi wetland is the part of Kadulundi – vallikkunnu community reserve, lies partly in Kadalundi panchayath of Kozhikode district and partly in vallikkunnu panchayath of Malappuram district. The Kadalundy wetland, the confluence of Kadalundy River at its drainage point forms the Kadalundy estuary that drains into the Arabian Sea in the northern Malabar Coast. This estuary is located in Kozhikode district. It is one of the major wintering grounds for shorebirds and seabirds in Kerala and declared as community wetland reserve in 2008. Mavoor –Thengilakdavu wetland located in Mavoor , 20 km away from Kozhikode city. It is the significant eco patch in the outskirts of the city. Apart from these wetlands, marshy tracts can be seen in Eranjikkal, Peruvayal and Olavanna and Ramanattukara.

### **Spatio Temporal Changes in Wetlands of Kozhikode City and Suburbs during 1993 and 2023**

Wetlands of Kozhikode city and suburbs were categorized into inland wetland and coastal wetland as per NRSC Land Use Land Cover classification. Inland wetlands in the study area include paddy wetlands, rivers, streams, canals, lakes and ponds. Coastal wetlands comprise of estuaries and mangroves. Landsat image analysis of the study area revealed a continuous decline of wetlands during the past 30 years from 1993 to 2023. Area under inland wetland was 8813.14 ha in 1993, 8573.17 ha in 2003, 8267.42 ha in 2013 and 7624.29 ha in 2023. During the span of thirty years from 1993 to 2023, 1188.9 ha of inland wetlands disappeared. Paddy wetlands constitute major portion of the inland wetlands in the study area. The area under paddy wetlands were 7114.67 ha in 1993, 6879.01 ha in 2003, 6571.98 ha in 2013 and 6040.94 ha in 2023. In the year 1993, the area under river or streams, canal, lakes and ponds and waterlogged due to mining was 1619.4 ha, 22.35 ha, 45.48 ha and 11.24 ha respectively. In the year 2003, the area under river or streams, canal, lakes and ponds and waterlogged due to mining was 1600.33 ha, 17.01 ha, 44.33 ha and 32.49 ha respectively. In the year 2013, the area under river or streams, canal, lakes and ponds and waterlogged due

to mining was 1537.97ha, 18.4 ha, 42.03 ha and 97.04 ha respectively. In the year 2023, the area under river or streams, canal, lakes and ponds and waterlogged due to mining was 1520.56 ha, 14.58 ha, 41.6 ha and 6.61 ha respectively (Table 2). During the span of thirty years 1213.46 hectares of wetlands disappeared in Kozhikode city and suburbs. Decadal change in different types of Wetlands of Kozhikode City and Suburbs for the year 1993-2003, 2003-2013, 2013- 2023 is shown in table 3 and figure 3.

Table 2: Area under different types of Wetlands of Kozhikode City and Suburbs– 1993 to 2023

Type of Wetlands	Sub type of Wetlands	Area in hectares			
		1993	2003	2013	2023
Inland Wetland	Paddy Wetlands	7114.67	6879.01	6571.98	6040.94
	Rivers/Streams	1619.4	1600.33	1537.97	1520.56
	Canal	22.35	17.01	18.4	14.58
	Lakes and Ponds	45.48	44.33	42.03	41.6
	Waterlogged due to mining	11.24	32.49	97.04	6.61
	<b>Sub-total</b>	<b>8813.14</b>	<b>8573.17</b>	<b>8267.42</b>	<b>7624.29</b>
	Coastal Wetland	Estuaries	469.35	463.35	463.35
Mangroves		75.36	68.1	68.1	46.26
<b>Sub-total</b>		<b>544.71</b>	<b>531.45</b>	<b>531.45</b>	<b>520.1</b>
<b>Grand Total</b>		<b>9357.85</b>	<b>9104.62</b>	<b>8798.87</b>	<b>8144.39</b>

Table 3: Change in different types of Wetlands of Kozhikode City and Suburbs – 1993-2003, 2003-2013, 2013- 2023

Type of Wetlands	Sub type of Wetlands	1993-2003	2003-2013	2013-2023
		Change in Area (Ha)	Change in Area (Ha)	Change in Area (Ha)
Inland Wetlands	Paddy Wetlands	-235.66	-307.03	-531.04
	Rivers/Streams	-19.07	-62.36	-17.41
	Canal	-5.34	1.39	-3.82
	Lakes and Ponds	-1.15	-2.3	-0.43
	Waterlogged due to mining	21.25	64.55	-90.43
Coastal Wetlands	Estuaries	-6	0	10.49
	Mangroves	-7.26	0	-21.84
<b>Total</b>		<b>-253.23</b>	<b>-305.75</b>	<b>-654.48</b>

Real estate boom urban expansion and infrastructure development are the prime reason for wetland shrinkage in Kozhikode city and its suburbs. A substantial portion of the real estate demand comes from Non Resident Indians who invest in commercial complexes and residential buildings. Real estate agencies acquire low lying areas for low prices and earning huge profit by dealing with large real estate projects. Therefore, low lying wetlands are converted to built up land (Bhagyanathan A).

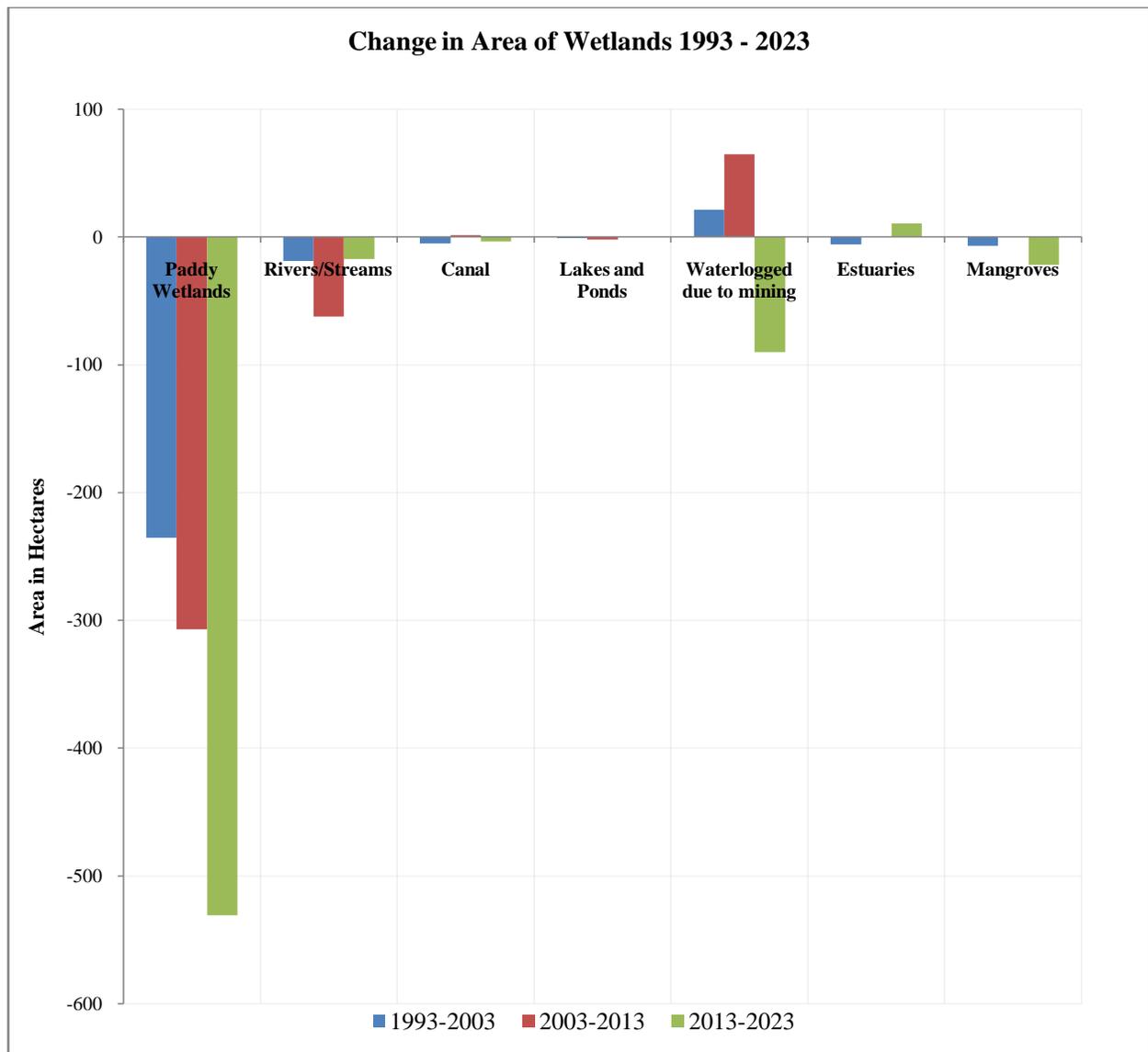


Figure 9: Change in Area of wetlands in Kozhikode City and Suburbs

### Conclusion

Kozhikode is a coastal city, has grown on marshy tract, reached to its present magnificence by filling the wetlands. Spike in infrastructure development and associated land use changes degraded the wetlands substantially. Major threats to wetlands include filling and reclamation for built-up, weed infestation, pollution, waste disposal, siltation and sedimentation, and reckless tourism. Real estate pressure leading to the encroachment of wetlands is a significant problem in Kozhikode city, as it is in many urban areas. As cities expand, the demand for land rises and paddy wetlands become prime target for real estate and illegal construction. During the span of thirty years from 1993 to 2023 1213.46 hectares wetlands disappeared in Kozhikode city and suburbs. As they are sensitive and delicate ecosystems, they may be irreversible once degraded. The ecological services they provide to humans and other animals on the planet, however, make them unique. Thus, this unique ecosystem must be preserved at any cost. There should be a concerted effort

to reverse the degradation of wetlands. The 2018 and 2019 Kerala floods taught the people of Kerala a valuable lesson about what will happen if the state's wetlands are not protected and conserved.

## Reference

1. Bhagyanathan A, Dhayanithy D. (2023). A canal, urban sprawl and wetland loss: The case of Kozhikode, India, from colonialism to climate change era. *Area*.55. doi:<https://doi.org/10.1111/area.12875>.
2. United Nations Economic and Social Council. (2022). Progress towards the Sustainable Development Goals, Report of the Secretary-General. E/2022/xxx pp14.
3. Assefa W. W., Eneyew B. G. & Wondie, A. (2021).The impacts of land-use and land-cover change on wetland ecosystem service values in peri-urban and urban area of Bahir Dar City, Upper Blue Nile Basin, Northwestern Ethiopia. *Ecological Processes*10 (1), 39.
4. Kerala State Remote Sensing & Environment Centre Planning. (2019). Inventory of Natural Wetlands of Kerala State and Development of an Information System – A Holistic Approach using Remote Sensing and GIS – Part II. Retrieved from [www.kerenvis.nic.in](http://www.kerenvis.nic.in). Assessed on 25 October 2020.
5. Cohen, M. J., I. F. Creed, L. Alexander, N. B. Basu, A. J. K. Calhoun, C. Craft, E. Damico.(2016). Do Geographically Isolated Wetlands Influence Landscape Functions.Proceedings of the National Academy of Sciences 113 (8): 1978–1986. <https://doi.org/10.1073/pnas.1512650113>.
6. Space Applications Centre. (2011). National Wetland Atlas: Kerala. Space Applications Centre (ISRO), Ahmedabad, India: 48-51.
7. Azeez PA & Raj PN. 2010. Public on Conserving an Urban Wetland. *International Journal of Social Ecology and Sustainable Development*.1 (1):14–19. doi:<https://doi.org/10.4018/jsesd.2010010102>.
8. Ramsar Convention Bureau. (2006). The Ramsar Convention Manual: A Guide to the Convention on Wetlands, Ramsar, Iran, 1971. Ramsar Convention Bureau.