RESEARCH REVIEW JOURNALS
Volume-04
Issue-01
January -2019

ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com [UGC Listed Journal]

Assessment of degradation of the coastal wetlands using geoinformatics: a comprehensive study in south western part of Sundarban

Pinaki Sardar

Research Scholar, Department of Geography, Sri Satya Sai University of Technology & Medical Sciences, Sehore, Bhopal-Indore Road, Madhya Pradesh, India

ARTICLE DETAILS

Article History
Published Online: 20 January 2019

Keywords
Landsat, Wetlands, Transformation, Urban growth

ABSTRACT

The Ganges and Brahmaputra stream systems consolidate to frame the Ganges–Brahmaputra Delta depleting into the Bay of Bengal, containing the world's biggest delta at 105,000 km2 spreading over Bangladesh and the Indian territory of West Bengal. Wetlands give various socio – environmental benefits to our community. However, present conditions of wetlands are much vulnerable in point of Biodiversity and human wellbeing. The rapid urban growth and other Land use changes are the main drivers behind it. Besides, development planning, policy making, the transforming process and their conservative measures should be taken into account. In this study, the eco – social transformation of East Kolkata Wetland has been analyzed. Also the conversion vulnerability has been assessed here, 45% out of 38 km2 wetland area has converted to other land use classes, near about 55% of the total area are found in high to very high vulnerable zone. A decent land use planning and fruitful action of local authorities is inevitable to minimize the degradation level.

1. Introduction

The Ganges–Brahmaputra delta is additionally one of the world's most thickly populated locales, supporting 108 million individuals at a thickness of around 1280 individuals for each km2 (Ericson et al. 2006) expanding by roughly 19 million individuals somewhere in the range of 1991 and 2011 (Szabo et al. 2016). Wetlands are the most exploited fragile ecosystem in South – East Asian countries. Wetlands are known for multi functional activities. Geographic Information System has evolved many tools to monitor the changes. Increased human activities gradually undermine the uniqueness of East Kolkata Wetland ecosystem. To study the changes Landsat MSS and TM, Landsat – 08 OLI/TIRS imageries (1973, 1980, 2010, and 2017) were classified by using Maximum Likelihood Method. The study shows that rapid urban growth and land use changes are the main causes behind wetland environmental degradation. The local authorities should have take necessary measures to cope with environmental degradation.

2. Study Area

Background

Improvement arranging inside the delta has zeroed in on hard designing methodologies, portrayed by development of dykes and structures to control water streams upstream. The delta has in this manner been denied of over 35% of riverine silt inputs contrasted and authentic rates (Gupta et al. 2012), putting the trustworthiness of the delta in danger (Syvitski et al. 2009). Designed arrangements have incited an incorrect feeling that all is well with the world among delta occupants, uncovering the critical populace develop around the dykes to dangers of dike penetrates. The part of mangroves in residue growth and making sure about coastline has been basic (Raha et al. 2012). The estimation of Sundarbans as common ecological foundation has been featured, for instance, by valuation of ecosystem debasement and biodiversity misfortune in the Indian Sundarbans at US$ 0.14 billion yearly (2009 costs), comparable to 4.8% of the locale's GDP (World Bank 2014).

The Sundarbans is likewise powerless against environmental change through elements, for example, ocean level ascent at a high rate (3.5 mm every year) contrasted with different seas universally (Hazra et al. 2002; Raha et al. 2012), a quickened pace of ocean water warming (0.5 °C every decade over the Bay of Bengal contrasted with worldwide pace of 0.06 °C every decade: Center for Science and Environment 2012), changeability in saltiness patterns for certain districts expanding and others diminishing (Trivedi et al. 2016), dissolving delta islands, expanding soil and water saltiness, and diminishing harvest feasibility (Mahadevia and Vikas 2012). Powerlessness to the ocean level ascent and torrent storms is exacerbated by corruption of mangrove cradle zones (Deb and Ferreira 2016). The Sundarbans coastline is in a net erosional express, the delta front going through net disintegration of ~ 170 km2 of seaside land somewhere in the range of 1973 and 2010 (Rahman et al. 2011). Unpredictable rainstorm downpours and exceptional tornadoes increment stresses, serious cyclonic Storm Aila killing numerous individuals in India in 2009, leaving hundreds destitute and making huge harm trees, streets and framework (Times of India 2009). There is approaching attention to the danger of the Sundarbans totally lowering except if pressing worldwide activity is embraced to diminish ozone depleting substance outflows (Mahadevia and Vikas 2012). Environmental change is driving food and water uncertainty and, thus, destitution and outmigration from the Sundarbans (Sanchez-Triana et al. 2018). In the Bangladeshi area of the Sundarbans, likely decrease in wetland ecosystem services, for example, arrangement of food and crude materials because of ocean level ascent are projected to drive misfortunes of US$ 0–1 million to US$ 16.5–20 million under various situations (Mehvar et al. 2019). It is therefore basic to comprehend the job of

wetlands in the district past human employments. Guaranteeing wetland preservation and manageability will be critical to moderate and address the difficulties presented by environmental change and unified occasions.

We survey the ecosystem services gave by a little subset of wetlands in the external Indian Sundarbans islands and various zones of the East Kolkata Wetlands (EKW) toward the east of Kolkata city. The area lies between 22 0 25' N to 22 0 40' N Latitude and 88 0 20'E to 88 0 35'E Longitude, West Bengal, India. The maximum temperature is recorded during April to May (40 0 c) and minimum temperature during December to February (10 0 c). Annual rainfall ranges between 250cm – 300cm (June to September). The examination incorporates what is known in the writing about ecosystem administration creation by these wetlands. Ecosystem administration creation at the chose study destinations was then surveyed utilizing the Rapid Assessment of Wetland Ecosystem Services (RAWES) approach, embraced under Ramsar Resolution XII.(Ramsar Convention 2018) as a quick and financially savvy technique for the methodical appraisal of ecosystem services gave by wetlands. Correlation of ecosystem services tended to in the writing with field appraisals tests the worth and utility of RAWES, and gives experiences that may advise future wetland the board and astute use difficulties.

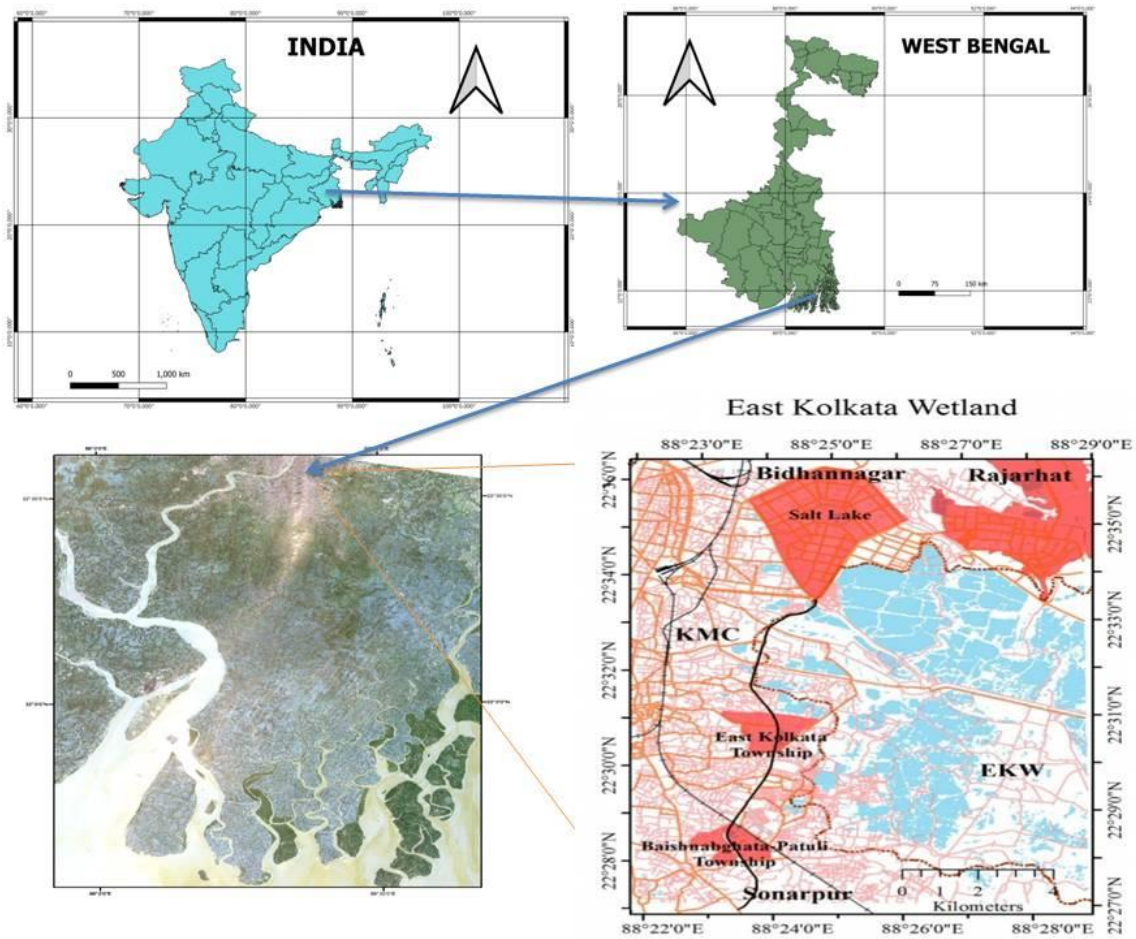

Figure 1: Location of East Kolkata Wetlands.

3. Methodology

Table 1: Different Data Sources

Obtained Data	Sources	Purpose/Uses
Landsat satellite images	USGS Earth Explorer	Land use Land cover map
Road and Canal network	Open street map	Road and canal distance calculation
Administrative boundary	Census of India	Distance calculation from municipal area
Population data	Census of India	Population density and population growth

Table 2: Detailed Satellite Data Characteristics

Satellite	Sensor	Path/Row	Year	Spatial resolution(mts.)
Landsat	MSS	138/44	1973, 1980, 2016	60
Landsat - 5	TM	138/44	1989, 2001, 2010	30
Landsat - 08	OLI/TIRS	138/44	2017	30

4. The East Kolkata Wetland (EKW)

The East Kolkata Wetland (EKW), previously the East Calcutta Wetland, involves a complex of changed wetlands crossing 215 km2 (21,500 ha) toward the east of the city of Kolkata in West Bengal. The EKW, at first a saltmarsh, was utilized as a site to release city's sewage, however thusly changed over numerous years by neighborhood individuals into a broad labyrinth of sewage-took care of fish ranches and paddy fields (Kundu et al. 2008). Wastewater (no distributed water quality investigations were accessible) is redirected into fish lakes and plowed zones under local area possession and the board from channels conveying the greater part of untreated seepage from the Kolkata megacity district with a populace of 14.1 million (Ghosh and Das 2019). Channel stature is controlled physically by conduit activity. The EKW delivers a large part of the fish, vegetable and blossom needs of Kolkata city, filling in as essential treatment of crude sewage and fundamentally forming the trademark EKW scene (Ghosh and Furedy 1984; Ghosh and Sen 1987) supporting the vocations of 74% of the working populace of connecting regions (Kundu and Chakraborty 2017; Ghosh et al. 2018). The EKW goes about as significant environment for different untamed life including flying creatures (Bhattacharya et al. 2012). Customary pisciculture and development procedures and information structure the premise of ecological security of the district (Kundu and Chakraborty 2017), a savvy use giving numerous advantages including food creation, asset recuperation, flood decrease, living space and biodiversity rebuilding, and openings for business. The EKW was assigned as a "wetland of global significance" under the Ramsar Convention in August 2002, noticing it as "Widely acclaimed as a model of a various use wetland, the site's asset recuperation systems, created by nearby individuals through the ages, have saved the city of Kolkata from the expenses of building and keeping up waste water treatment plants" additionally "… using the treated water for pisciculture and farming" giving "around 150 tons of new vegetables every day" and "approximately 10,500 tons of table fish every year" (Ramsar Commission Secretariat 2002). Under the East Kolkata Wetlands (Conservation and Management) Act 2006, formal assurance was managed the cost of these wetlands and the East Kolkata Wetlands Management Authority (EKWMA), led by the Chief Secretary of the Government of West Bengal, was set up for preservation and the executives of the EKW.

Figure 2: Glimpses of EKW (source: TNN).

EKW wetland region has decreased completely more than 40 years through metropolitan extension of Kolkata metropolitan city, a lot of it unlawful, conceivably bargaining manageable improvement of the city/locale (Parihar et al. 2013). Mondal et al. (2017) projected that solitary 39% of wetland territory will stay by 2025 under current metropolitan development patterns, underlining the crucial significance of institutional coordination, monetary help and land use guidelines. Bhattacharya et al. (2012) moreover list mechanical contamination, siltation, weed pervasion and changed land use designs as ceaselessly harming the ecological soundness of the EKW, underlining the requirement for reasonable arrangements. At present, there is no focal zonation or methodology, however the EKWMA has allegedly been aiming to distribute a system and zonation plan for certain years. A city choice to broaden the Salt Lake City zone by changing over wetland zone was effectively tested by local gatherings under India's Public Interest Litigation (PIL) framework in a milestone judgment of Calcutta High Court, saving the wetlands.

Table 3: Land use / Land cover Classes

Category	Description
Wetlands	Fisheries, Ponds, canals, Farms
Agricultural Lands	Paddy cultivation, Vegetable cultivation, Kitchen Garden
Natural Vegetation	Trees, Scrubs, Grasslands
Built up Area	Roads, Railways, Rurl and Urban settlements
Open Spaces	Fallow land, Barren Land

Table 4: Changes in Land use Categories

Category	1973(area in sq. km)	2017(area in sq. km)	Changes
Wetlands	20.2796	16.3359	-3.9437
Agricultural Lands	26.5564	43.5922	17.0358
Natural Vegetation	72.5155	48.5444	- 23.9711
Built up Area	7.1336	18.16	11.0264

5. Analysis of Land use Transformation

After obtaining and analyzing the data, it shows that, wetlands are shrinked to 26%, agricultural land 3.3%. Lack of water supply, due to siltation is the main cause of agricultural declination. Vegetation area is increased 24%, due to plantation programme taken by local authorities and NGOs. The urban area increased near about 150%, Open Space area has decreased by 48%.

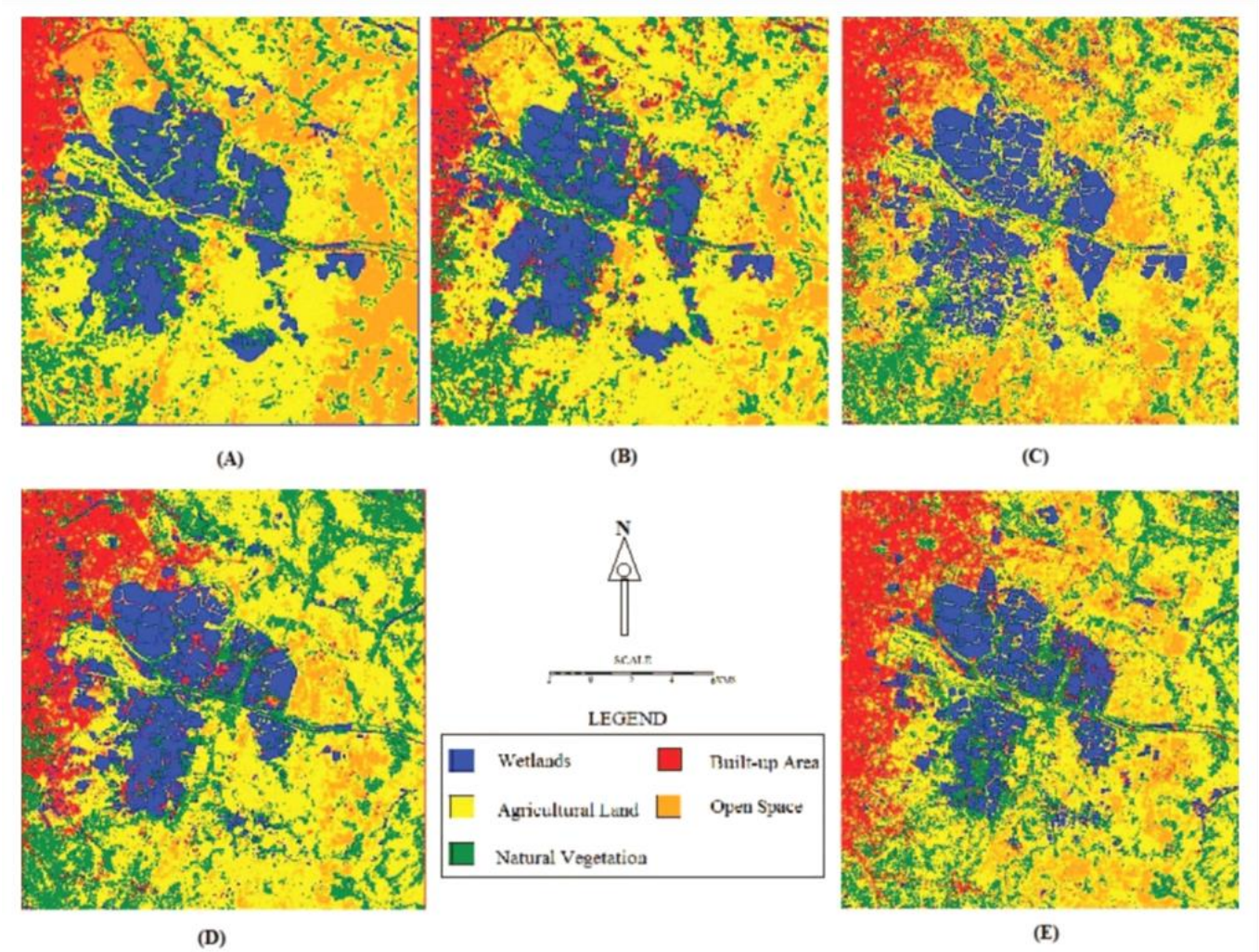

Figure 3: Land use classes using maximum Likelihood Method in Arc GIS; A) 1973, B) 1989, C) 2001, D) 2007, E) 2017.(Data source: USGS Earth Explorer)

6. Trends of Urban Growth

Kolkata is a most rapidly growing megacity Of India. Mainly rural areas of North and South 24 paraganas are quickly converting into urban areas. The EKW is at eastern part of Kolkata Megacity.

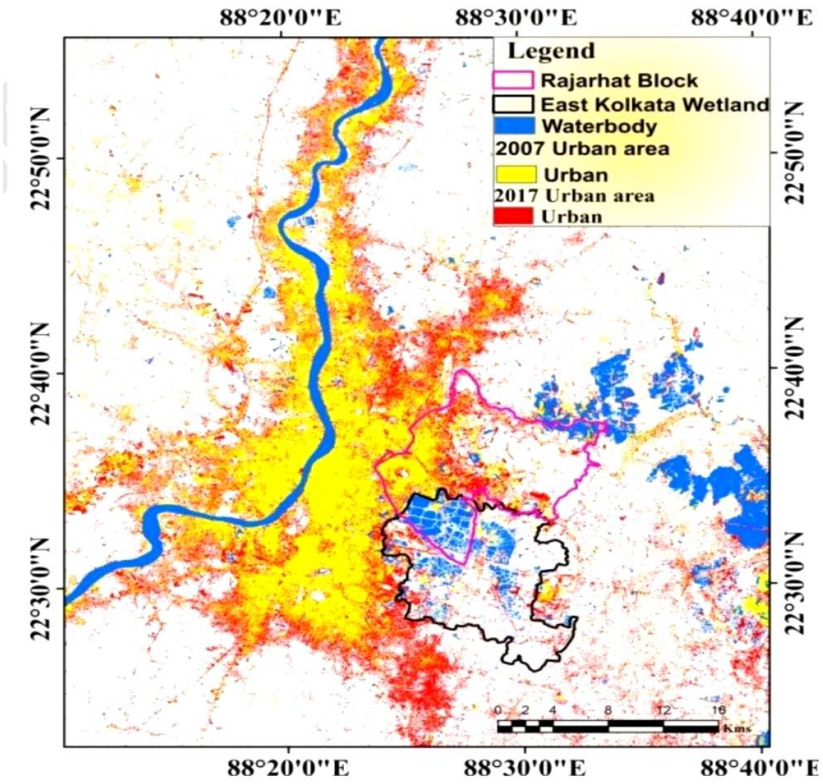

Figure 4: Changing trends in urban growth.

7. RAWES appraisal of wetland ecosystem services

An appraisal of the ecosystem services of study wetlands was attempted utilizing the Rapid Assessment of Wetland Ecosystem Services (RAWES) approach (Ramsar Convention 2018; RRC-EA in press). RAWES was created to help ecosystem administration appraisal of wetlands perceiving functional time and asset restrictions looked by operational staff, giving a basic, easy to understand, financially savvy approach supporting fundamental evaluation of the full scope of wetland ecosystem services (McInnes and Everard 2017). A fundamental methodology is significant for communicating the state of a wetland in a way that advises ecosystem the executives (Stein et al. 2009). Really fast appraisal is a key operational need recognized by Fennessy et al. (2007) and Kotze et al. (2012), a core value of RAWES being that close to two suitably prepared individuals ought to spend close to a large portion of a day in the field and another half-day of readiness and investigation. RAWES tends to the four ecosystem administration classes (provisioning, administrative, social and supporting, summed up in Table) characterized continuously Ecosystem Assessment (2005). Notwithstanding their redefinition as capacities in some resulting renamed arrangements (for instance TEEB 2010; Braat and de Groot 2012) to evade 'twofold tallying' benefits, supporting services are expressly held by RAWES perceiving the need of coordinating their imperative supporting jobs into dynamic settings to deflect sabotaging the working and flexibility of ecosystems, including their abilities to produce different services. RAWES can be utilized across a scope of scales from entire wetland to confined zones of huge and complex wetlands.

8. Observations feeding into RAWES assessment and analyses of data

Observations at Sudhanyakhali Island

Broad high quality fishing boats working in channels between islands utilize provisioning services coming about because of the commitments to fishery enrollment. Networks on Gosaba Island detailed unlawful raids into the uninhabited islands of the Sundarbans to gather wild nectar. Managing services were obvious through the dynamic geomorphology around uninhabited islands, broad mud level regions repopulating with mangrove seedlings and, in different spots, withdrawing mangroves with air-breathing roots uncovered settling banks against erosive powers. These demonstrate hydrological, danger guideline, carbon sequestration and supplement cycling measures with expansive advantages past the islands. Painstakingly oversaw resorts on the island and fringe boat visits give huge income from ecotourism. A lot more taxa and quantities of winged creatures (but not evaluated) were noticed contrasted with adjoining occupied islands, a marker of supporting services. The broad and thick mangrove backwoods crossed with flowing huge numbers described territories noticeable by boat featuring flower variety, however blocking perception of island hinterland.

9. Discussion

Qualities and the executives systems at the five wetland destinations vary notably. Unequivocal acknowledgment in the writing of ecosystem services produced by each site was low, however noticed highlights and detailed uses clarify a portion of the more critical contrasts saw in circulation and topographical scope of the ecosystem services that they give.

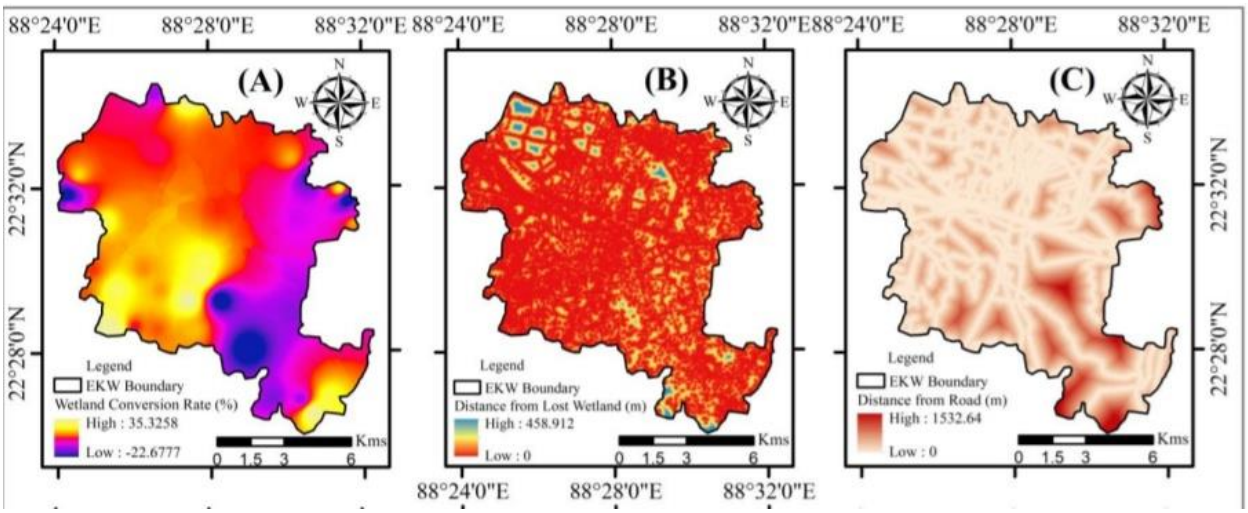

Figure 5: A) Wetland conversion rate, B) Distance from lost wetlands, C) Distance from road.

At Sudhanyakhali Island, writing look through utilizing the term 'ecosystem services' recognized single provisioning, social and supporting services, and no managing services. This stood out from the different services recognized across all classes utilizing the RAWES approach. Sudhanyakhali Island had the most elevated ESI for every one of the 32 ecosystem services pertinent to this investigation and, despite the fact that deviation from the mean examination of ESIs uncovered commonly low provisioning administration creation other than biochemical and hereditary assets, creation of supporting, social and directing services was fundamentally higher comparative with all destinations. The disintegration guideline work was especially certain, empowered by the dynamic geomorphology and free colonization by mangroves balancing out mudflats. Sudhanyakhali Island additionally created more noteworthy public and worldwide advantages than other evaluated wetland destinations, results reliable with the rejection of individuals (other than in controlled retreats) to ensure common character and trademark natural life with related ecosystem measures.

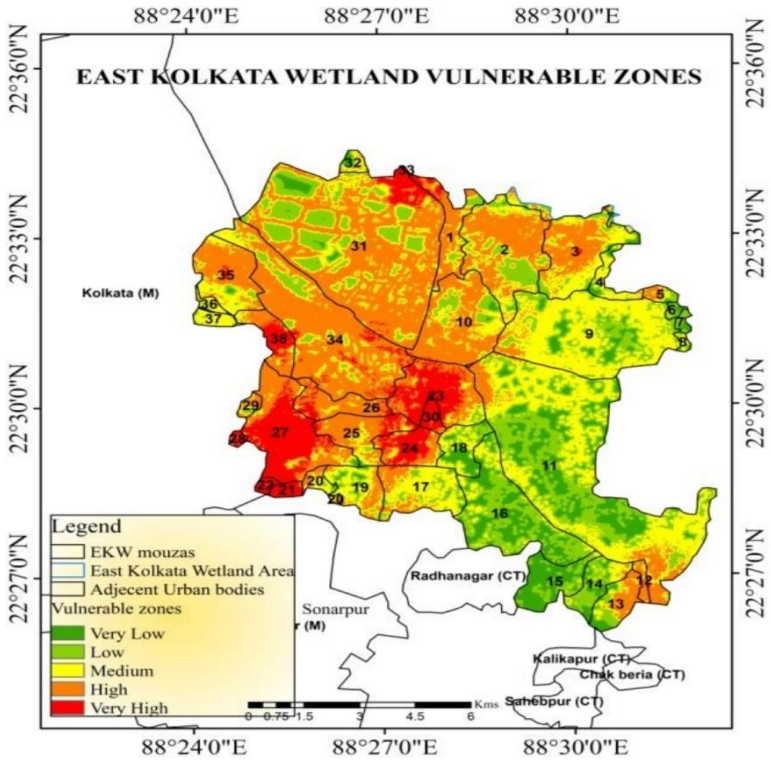

Figure 6: Vulnerable zones of East Kolkata Wetland

At Gosaba Island, writing look through utilizing the term 'ecosystem services' recognized low provisioning (N = 1), social (N = 3) and supporting (N = 1) services, and no managing services. This stood out from the 28 (counting 1 disbenefit) services recognized across all classes utilizing the RAWES approach, however with a measurably critical diverse conveyance of services contrasted with Sudhanyakhali and EKW destinations including one negative help (human sicknesses) and a considerable saltiness guideline administration contrasted and different locales. In spite of the fact that Gosaba Island is truly near Sudhanyakhali Island, isolated by the Datta River in spots by less than 100 m, RAWES appraisal uncovers an impressive contrast in help creation, with low supporting, social and managing services yet

improved provisioning services of neighborhood advantage mirroring the broad food creation exercises on Gosaba. Conveyance of advantages at neighborhood scale was similarly most elevated with EKW Harhara Pond, with moderately low contiguous catchment/city, public and worldwide advantages.

10. Conclusions

The outcomes of the research work indicate the changes in last fifty years (mainly due to human aggressiveness). With this analysis the most vulnerable zones can be predicted. The study shows that E M Bypass and the surrounding regions are more prone to conversion. These thematic maps can be use more efficiently in planning and decision making process. As wetland provides multi functional services, the authorities have to take more necessary steps regarding wetland conservation.

At the EKW wetlands, writing look through utilizing the term 'ecosystem services' yielded insignificant returns connected to genuine ecosystem services. Organized pursuits utilizing an assortment of administration related terms found adequately 2 provisioning (food creation in different structures and water system), 6 directing (water cleaning/treatment/remediation, carbon cycling/sequestration/atmosphere, water guideline, bug guideline, subsurface hydrology, mosquito guideline), 1 social (jobs/improvement) and 3 supporting (supplement/supplements/phosphorus cycling, natural surroundings/fowls, soil quality) services. Appearing differently in relation to these lower numbers, RAWES evaluation distinguished a more extensive variety of services across all classes delivered by the EKW. These are co-delivered notwithstanding the board of the EKW overwhelmingly for two connected ecosystem services: water purging (a directing ecosystem administration) and the provisioning services of food and bloom creation (provisioning services), with flood buffering (the 'water guideline' administration) additionally altogether profiting the city.

At EKW Harhara Pond, the ESI for social services was second-most noteworthy (after Sudhanyakhali), mirroring the part of the lake ecosystem as a highlight of cultural association, co-creating services across different classes. Neighborhood benefits were similarly most elevated (with Gosaba Island) with low public and worldwide advantages, mirroring the redirection of assets to nearby food creation.

References

1. Antrop M (2004) Why landscapes of the past are important for the future. Landsc Urban Plan 70(1–2):21–34
2. Bhattacharya S, Ganguli A, Bose S, Mukhopadhyay A (2012) Biodiversity, traditional practices and sustainability issues of East Kolkata Wetlands: a significance Ramsar site of West Bengal, (India). Res Rev BioSci 6(11):340–347
3. Bolund P, Hunhammar S (1999) Ecosystem services in urban areas. Ecol Econ 29(2):293–301
4. Braat LC, de Groot R (2012) the ecosystem services agenda: bridging the worlds of natural science and economics, conservation and development, and public and private policy. Ecosyst Serv 1:4–15
5. Butchart SHM, Walpole M, Collen B et al (2010) Global biodiversity: indicators of recent declines. Science 328:1164–1168
6. Centre for Science and Environment (2012) living with changing climate: impact, vulnerability and adaptation challenges in Indian Sundarbans. Centre for Science and Environment, New Delhi
7. Choudhury D, Nath D, hen W (2019) Impact of Indian Ocean warming on increasing trend in pre-monsoon rainfall and Hadley circulation over Bay of Bengal. Theor Appl Climatol. https://doi.org/10.1007/s00704-018-02751-2
8. Chowdhury AN, Mondal R, Brahma A, Biswas MK (2008) Eco-psychiatry and environmental conservation: study from Sundarban Delta, India. Environ Health Insights. https://doi.org/10.4137/EHI.S935
9. Datta D (2018) Assessment of mangrove management alternatives in village-fringe forests of Indian Sunderbans: resilient initiatives or short-term nature exploitations? Wetl Ecol Manag 26(3):399–413
10. Davidson NC, Dinesen L, Fennessey S, Finlayson CM, Grillas P, Grobicki A, McInnes RJ, Murray N, Stroud DA (in press) Wetland ecological status and changes: a meta-analysis. Marine Freshw Res
11. Deb M, Ferreira CM (2016) Potential impacts of the Sunderban mangrove degradation on future coastal flooding in Bangladesh. J Hydro-environ Res 17:30–46
12. Ericson JP, Vörösmarty CJ, Dingman SL, Ward LG, Meybeck M (2006) Effective sea-level rise and deltas: causes of change and human dimension implications. Glob Planet Change 50(1–2):63–82
13. Fennessy MS, Jacobs AD, Kentula ME (2007) An evaluation of rapid methods for assessing the ecological condition of wetlands. Wetlands 27(3):543–560
14. Ghosh A, Boykoff M (2018) Framing sustainability and climate change: interrogating discourses in vernacular and English-language media in Sundarbans, India. Geoforum. https://doi.org/10.1016/j.geoforum.2018.11.014
15. Ghosh S, Das A (2019) Urban expansion induced vulnerability assessment of East Kolkata Wetland using Fuzzy MCDM method. Remote Sens Appl Soc Environ 13:191–203
16. Ghosh D, Furedy C (1984) Resource-conserving traditions and waste disposal: the garbage farms and sewage-fed fisheries of Calcutta. Conserv Recycl 7(2–4):159–165
17. Ghosh P, Ghosh A (2018) Is ecotourism a panacea? Political ecology perspectives from the Sundarban Biosphere Reserve, India. GeoJournal 1:11. https://doi.org/10.1007/s10708-018-9862-7
18. Ghosh D, Sen S (1987) Ecological history of Calcutta's wetland conversion. Environ Conserv 14(3):219–226

