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Socio-Ecological Impact of Peri-Urbanization on the Shrinking East Kolkata Wetlands

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ABSTRACT

The East Kolkata Wetlands (EKW) is a setting example of resource recovery wherein waste water and storm water are transferred into the fishpond locally known as '*bheris*'. The East Kolkata Wetlands forms a base of ecological security for the direct and indirect stakeholders of the region by offering all the major ecological services. The daily anthropogenic wastewater is being removed by the EKW through the sewage fed fish ponds. Apart from sewage fed aquaculture, the wetlands are known for horticulture, agriculture from sewage water. But different types of construction work on and around the wetland have imparted negative effects on ecological services as well as on the concerned stakeholders. The paper aims to point out the importance of ecological services offered by the wetlands as well as throw some light on the myriad of ecological, economical linkages of the wetland use. The paper also aims to highlight the unregulated peri urban expansion towards the wetlands which is destroying not only the critical areas of environment, but also is taking a toll on the livelihoods of the stakeholders. Infilling of wetlands for residential projects and govt projects is forcing the direct stakeholders to forcefully change their livelihood pattern leading to a silent death. Primary data was collected through interviews and focus group discussions. LULC data over the years have proved that there is a large-scale shrinkage over the years thereby threatening its ecosystem services. In the process of such transformation, the study showed the perceptions of different stakeholders of EKW over the value of wetland, their response to such change and its impact on human-water resource relationship.

Introduction

Wetlands are areas of marsh, fen, peatland 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. As per The Convention on Wetlands there are several criterions for identification of wetlands.

According to the Ramsar Convention, there are now 49 Ramsar sites in India. These sites have immense ecological importance and are mainly termed as wetlands of ecological importance. Ashtamudi Wetland, Kolleru wetland, Sunderbans are the common examples. The latest wetland in the list of Ramsar Sites in India is Bakhira Wildife Sanctuary in Uttar Pradesh Kolkata too has its own kidneys.

The wetlands in the Eastern fringe of the city, is popularly known as the East Kolkata Wetlands (EKW). The wetlands to the east of Calcutta comprises of a large number of water bodies distributed across the districts of South and North 24 Parganas. The multifunctional wetland ecosystem is spread over 12,500 hectares. It is called the "Kidneys of Kolkata" as it purifies the wastes generated by the city of Kolkata[1]. This region constitutes a part of the South Bengal "ecotone". The East Kolkata Wetland represent the remains of the marshy salt water lakes which once extended beyond the present international boundary of Bangladesh[3].

The historical background about the discovery of the East Kolkata Wetlands dates back to the time of British Rule when the eastern fringe of the city of Kolkata were covered with swampy salt lakes serving as the spill area of Bidhyadhari River. With the geomorphological change in the delta building process in south Bengal, many distributaries and re-distributaries were cut off from the main channel. Advent of human infrastructure and interference fastened the process of silt deposition in the Biyadhari River, making the Bidyadhari fully defunct with all its spill water lakes. Thus, the drainage problem of Kolkata was solved with the transferring of waste and storm in the lakes in the eastern fringe of the city [12]

The East Kolkata Wetlands serves important ecological as well as consumptive functions. The important ecological functions are as follows:

- Absorb and treat in the most efficient, economical and natural way the huge volume of sewage and wastewater and urban solid and air wastes generated by Calcutta at no cost to the city[2][5];
- Fulfill substantially the requirement of fish, vegetables and food grains in the city;
- Absorb the pollution from Kolkata Municipal Commission, and purify the air that citizens breathe;
- Absorb and pass to downstream creeks and the sea, the flood waters that the monsoon brings to the city;
- Provide a habitat for a variety of flora and fauna and living organisms endemic to wetlands[3][4];
- Maintain the micro-climatic condition of the region;
- Maintain the delicate ecological balance in a fragile environment and eco-system;
- Passage of storm water from Kolkata:

Kolkata being sloped towards the east; the entire storm and waste water are flowed towards the east Kolkata wetlands.

The East Kolkata wetlands also serve important consumptive functions. They are as follows:

- By generation of direct employment: Those who are directly dependent on the EKW for their livelihood like fishermen, farmers.
- Generation of indirect employment to those who are selling the products which were bought from the direct beneficiaries.
- Supplying affordable and fresh fish and vegetables to markets serving poor communities
- Mitigating environmental degradation and reducing health risks
- Waste Recycling Region (WRR): The economic activities that have mushroomed across the wetland complex is literally converting urban waste into wealth[7]

Thus, the EKW is very important to the city of Kolkata and its existence is undeniable. Thus, based on its immense importance, the paper aims to understand the relation between natural treatment of Kolkata's sewage and wastewater aquaculture in the EKW as a method of resource recovery, find out the land-use pattern of the EKW, assess the extent of urban encroachment in recent period and estimate the growth of population, identify the impact of changing land use and over urbanization on biodiversity and lastly assess the patterns and scale of transformation of livelihood/ occupation of the local stakeholders

Locational Setting of Study Area

The EKW is situated about 5 km from the eastern edge of Kolkata. It lies within latitudes 22° 25' to 22° 40' north and longitudes 88° 20' to 88° 35' east. The average elevation is 2–5 meters (m) above mean sea level.

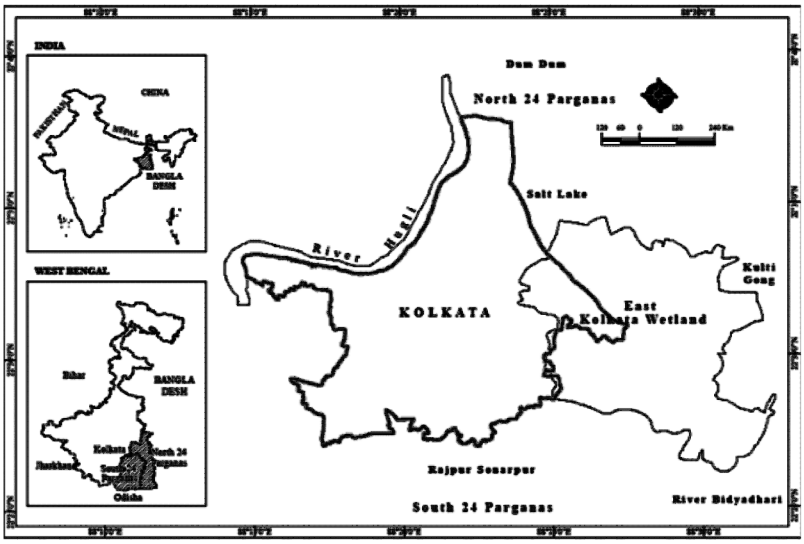


Fig 1 Locational Map of the study Area

Methodology

Primary survey:

- The stakeholders associated with EKW were interviewed on the face-to-face basis. About 220 families were surveyed.
- Random sampling was used for interview of the respondents.

Secondary data:

- Satellite imageries were studied, mouza maps and data from aquaculture, sewage fed agriculture was collected for statistical analysis.
- The resource recovery practices have been established by collating and synthesizing facts and figures from different official reports, printed documents and other secondary sources.
- The data collected was further processed for statistical analysis.

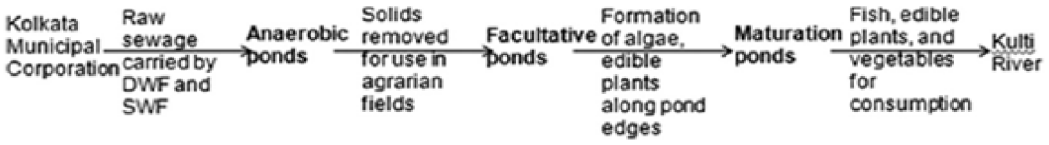


Fig 2-showing the transfer of wastes from Kolkata to the sewage fed fisheries of East Kolkata Wetlands

Results and Discussion

Kolkata generates about 600 million liters of sewage daily that is carried into the EKW through the natural gradient of the city (from west to east). The contributing factors include hot and humid climate, shallow ponds, abundant sunshine and prevalence of water hyacinth (said to play a role in heavy metal removal). The city of Kolkata now has almost 264 sewage fed fisheries on the East Kolkata Wetlands which produces 3000 tons of fish per year [13].Thus, the passage of sewage from Dry Water Flow (DWF) and Storm Water Flow (SWF) from the city of Kolkata to the wetlands and its further transfer after filtration process for fisheries is explained with the help of a flow chart.

Thus, the model of sewage fed fisheries which is not only producing 3000 tons of fish [13]every year but also filtrating out the sewage laden effluent from the city has been explained in detail with the help of the following flow chart. The flowchart was prepared after considering the transcripts from focus group discussion with the fisherman stakeholders of the EKW

Not only sewage fed fisheries use the waste water but it is also used in production of fresh vegetables and fruits in and around Dhapa area of Kolkata. The land use pattern of the EKW can be summarised in the following ratio.

47 percent i.e. 5852 hectare area is the sewage fed fisheries, 38 percent i.e. 4718 hectare area is used for sewage fed agriculture.

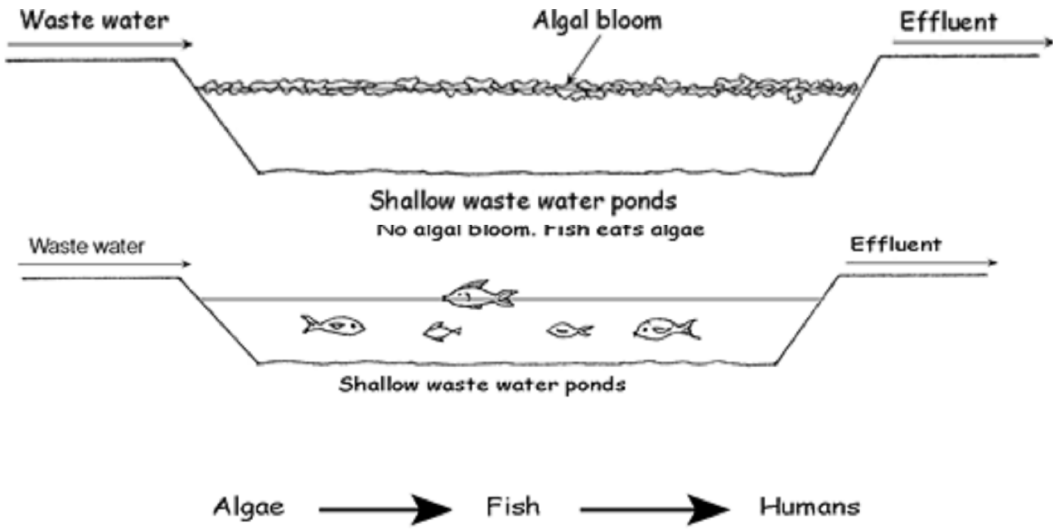


Fig 3 showing the mechanism of waste water aquaculture from waste water as a method of resource recovery

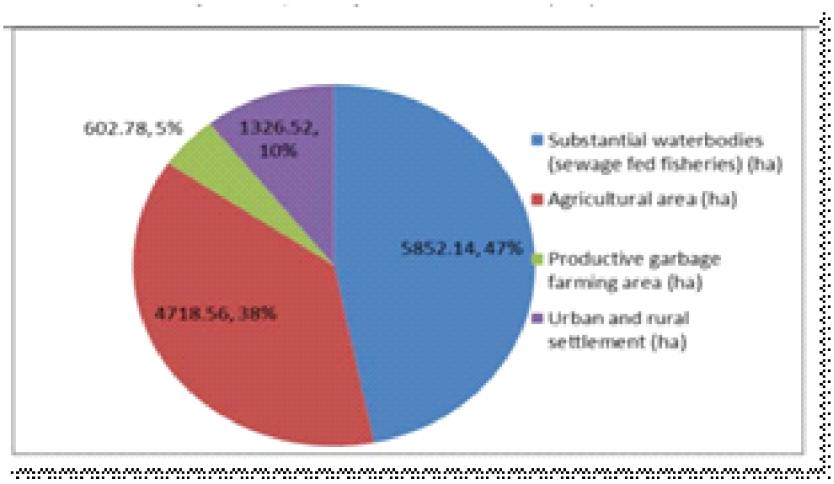
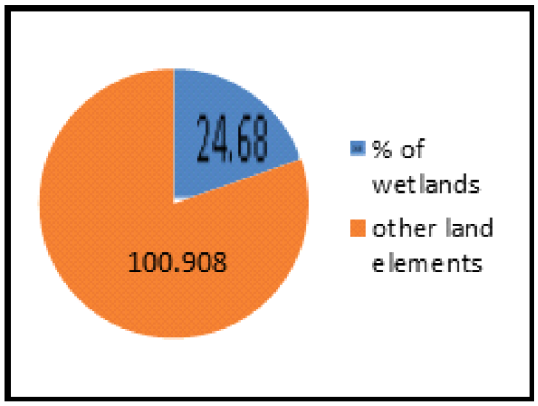


Fig. 4 showing the Land-use pattern of the East Kolkata Wetlands

However, this percentage of area has changed a lot due to the urban encroachment. Infilling of wetlands for developmental activities due to burgeoning burden of population pressure have resulted in massive loss of wetlands.

LAND USE of 1984 in (%)



LAND USE of 2015 in (%)

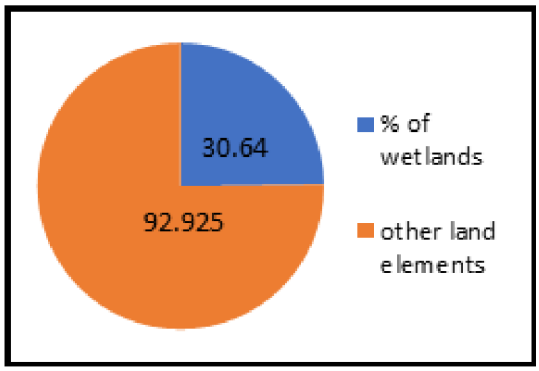
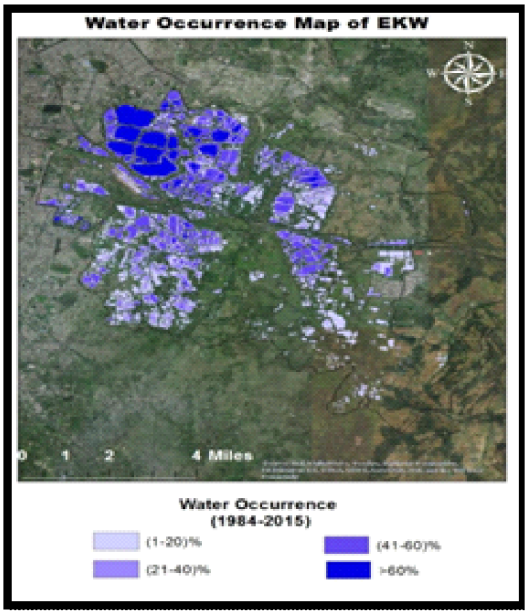


Fig. 5 showing the change in Land-use pattern of the East Kolkata Wetlands from 1984-2015 Fig 5 showing the change in water occurrence in the East Kolkata Wetlands



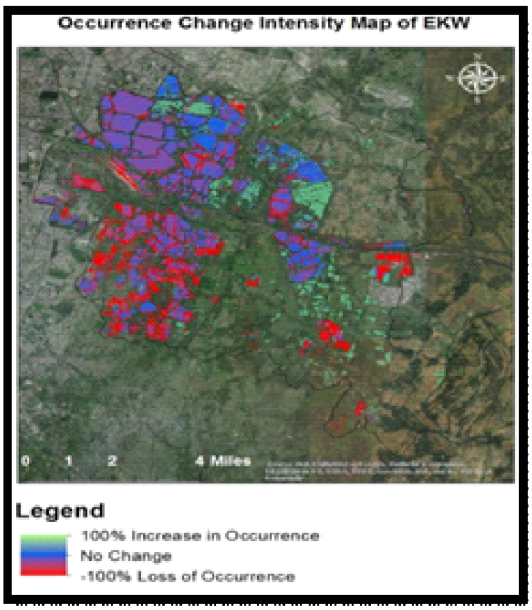


FIGURE 6 SHOWS THE WATER OCCURRENCE AND WATER DEPLETION OF THE EAST KOLKATA WETLANDS FROM 1984-2015.

In the levee deposit on the bank of Hugli river thin lens of shallow aquifer occur within 12m Below Ground Level (B.G.L) , where ground water occurs under water table condition. Ground water also occurs under unconfined condition within 17m below ground level in the marshy/swampy lands around Ballygunj, Tollyganj, Tiljala, Dhakuria, Kasba, Santoshpur. There is no catchment for these water bodies i.e. for the wetlands and perched aquifer is found to occur below these water bodies at depth greater than 400 feet .The underground water table of the wetland area is recharged through from natural seepage both from precipitation and percolation through drainage channels in sub surface layers serving as potential site for ground water development to cater to the needs of water for irrigation, industrial use. However due to advent of urbanization projects, the wetlands are not being able to recharge the acquifers to a great extent as it used to do before, leading to the fall in the piezometric level of ground water and thus subsidence of land in the pre monsoon phase when the recharge of groundwater is the least is the result under this factor. Thus, the infilling of wetlands for developmental activities have resulted in massive fall in the piezometric levels of ground water and may eventually lead to potential disaster in these areas from subsidence of land. The following are the data related to fall in piezometric level. Based on the land subsidence rates, vulnerability index was calculated and was represented through vulnerability map. The entire city of Kolkata was divided into three heads. Vulnerability index showing the most vulnerable areas which includes the central Kolkata. Moderately vulnerable areas of Kolkata which is mainly in the eastern part of the Kolkata owing to the recent developmental activities. The less vulnerable comprise a meagre portion of the metropolitan city.

Table Showing Year Wise Data of Fall in Piezometric Level in Relation to Subsidence

Location (1)	Years (2)	Decline in piezometric head (m) (3)	Rate of Subsidence for years (in column 2)
Salt lake	1981-2004	9.61	7-15.5 mm/year
Bantala	2001-2005	8.76	20.46 mm/year
Rajarhat –Salangari	2001-2005	9.71	5-6.5 mm/year

Classification Of Land Subsidence Rate

Land subsidence rate (mm/year)	Class
>20	Very high
15-20	High
10-15	Medium
5-10	Low
0-5	Very low

Source: KMDA, 2011

The infilling of wetlands has been attributed to ever increasing growth of population in the vicinity of the EKW. The reason behind popularity of these places is mainly the effects of enhanced connectivity and infrastructure development, supply of cheap fresh vegetables, fruits and fishes from the EKW, improved medical facilities for example ruby hospital, peerless hospital located in this stretch.

The censuses from 1981 to 2011[6] have shown a steady increase in the population in the Biddhanagar and Rajpur Sonarpur areas which

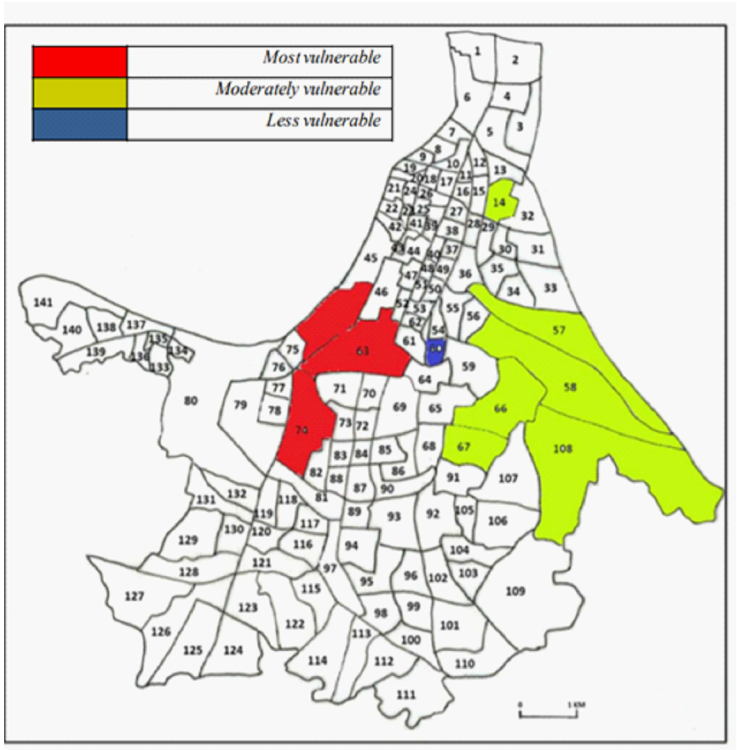


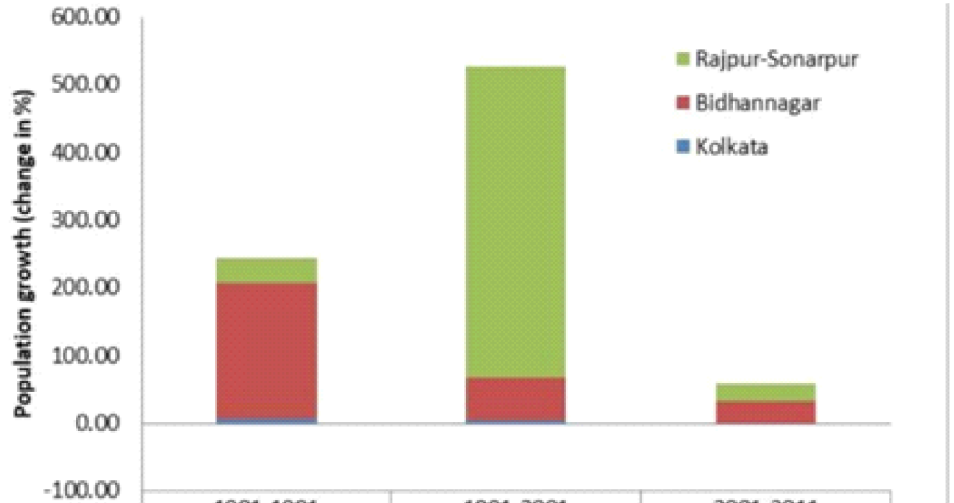
Fig.7 Map showing the subsidence vulnerability index of Kolkata.
Source: EKWMA

are in the vicinity of the East Kolkata Wetlands. The bar graphs show the increase in the population pressure in and around Kolkata

Graph showing Population growth in Kolkata including key EKW areas during 1981–2011(Source: Census of India.)

The East Kolkata Wetlands is home to the marsh mongoose and the amphibian species. of urban development[4][10] [11]. The eastward expansion of Kolkata by filling up the East Kolkata Wetlands has disturbed the ecological balance and functions of the waste recycling region. This has resulted in the decline of bio-diversity associated with the wetlands.

With the infilling of wetlands, there has been shift in the livelihood of the stakeholders of



	1981-1991	1991-2001	2001-2011
Rajpur-Sonarpur	36.81	459.55	25.87
Bidhannagar	201.58	64.14	32.94
Kolkata	6.61	4.11	-2.05

Graph showing Population growth in Kolkata including key EKW areas during 1981–2011(Source: Census of India.)

There has been a considerable decline in the number of mollusca species as well ~ from 25 in 1989, the number has dwindled to 10 in 2004. This declining trend in fish, mammal, amphibian and mollusca species can be attributed to large-scale human intervention and rampant conversion of the wetlands in the name the East Kolkata Wetlands. Around 220 stakeholders of East Kolkata Wetlands were interviewed and it was found that nearly 56% of the respondents have forcefully shifted their livelihood from pisciculture to informal sector and 44% of the total stakeholders have shifted their livelihood at their own will. The Captain's

Bheri had a workforce of around 4000 labour and fisherman in the late 1970's[10]. However, after the construction of metropolitan township and the Eastern Metropolitan Bypass, a huge chunk of captain's *Bheri* have been in filled hence a large number of people lost their livelihood options. The present workforce has been reduced to 35. The wage rate is round Rs. 160-180/day.

Those who have lost their basic livelihood from the wetlands, have undergone a occupational change. They presently work as daily labours, masons, rickshaw pullers, security guards in apartments for their daily livelihood. The women who worked in activities other than fishing which was mainly done by males, works now as domestic helps.

Nearly 44% of the total surveyed stakeholders have suffered from economic loss by the shift in their livelihood and 27% of the total surveyed stakeholders think that they have been benefitted due to the shift in their livelihood pattern as their present and future generation is not interested in pisciculture or farming from the waste water fed wetlands.

Conclusion

Uncontrolled population growth, rapid urbanization, infrastructure development, rural-urban migration, land conversion, climate change and pollution have already exerted immense pressure on the wetlands.

Conservation and Management of the wetlands is the need of the hour. The waterlogging problem in Salt-lake and New Town-Rajarhat area clearly–speaks how encroachment has adversely affected the drainage system of Kolkata.

Few of the management techniques can be followed for proper conservation and management of the wetlands:

Regular monitoring to understand changes in physical, environmental, economic and social characteristics of EKW is needed. Official documentation of traditional knowledge of the functions and benefits of the EKW may be made. All developers and real estate agencies may ensure zero encroachment. Participation of indigenous people in decision making/ planning committees is necessary to ensure inclusion of their invaluable knowledge in conservation action. The older local people may motivate their younger counterpart on the values of the traditional practices, and how livelihood shift (to newer jobs) can dilute the legacy of the system.

Acknowledgement

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