International Journal of Academic Research and Development
ISSN: 2455-4197
Impact Factor: RJIF 5.22
www.academicsjournal.com
Volume 3; Special Issue 1; February 2018; Page No. 57-67

Shrinkage of East Kolkata Wetlands and its Effect

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Abstract
East Kolkata wetlands is a complex natural and human made wetlands lying east of Kolkata, covers 125 sq. km. of area which include salt marshes, salt meadows, as well as sewage farms and settling ponds. It is the largest sewage fed aquaculture of the world. It is designated a "Wetlands of International Importance" under Ramsar convention on 19th August 2002. The Ramsar Convention describes EKW as one of the rare examples of environmental protection and development management" where city's sewage is treated through a network of canals and fishponds, more over, it is the ground of waste water pisciculture. This system is so effective that Kolkata was not provided funds for setting up conventional sewage treatment plant under the Ganga Action Plan.
Now, a part of EKW is used by Kolkata Municipal Corporation as a dumping ground of solid-waste. The problem is that the wetlands are shrinking because of various reasons, such as- rapid urbanization, excessive silting, human habitation etc. The results are obvious- pollution, loss of biodiversity.
In this present paper the focus will be on the reasons for the shrinkage of East Kolkata Wetlands and the effect on biodiversity loss and most importantly the possible suggestions to overcome this problem.

Keywords: shrinkage, East Kolkata wetlands, biodiversity

Introduction
East Kolkata Wetlands are a complex natural as well as man-made wetlands lying east of Kolkata, designated "a wetlands of international importance" under the Ramsar Convention (19th August, 2002). These wetlands are of great significance as they are used a system of sewage disposal and transforming the city's sewage into a rich harvest of fish and vegetables. Several fishermen Cooperative Society is working on them. Nearly 20,000 fishermen are involved into this directly or indirectly. There are several benefits but also there are some hazards too.
History and Development- West Bengal Government has started its developmental projects since 1950(S) with the eastward expansion of East Kolkata Wetlands, for the creation of more space for residential and commercial purposes. With the explosion of population in the 19th century, the need for more spaces was inevitable. In order to accommodate this growing population the policy for eastward expansion of Kolkata was adopted, by filling up large tracks of wetlands on the eastern fringe of the city. Since 1875, these wetlands have became the depository ground for sewage and storm water. This was discharged into the Bidyadhari River flowing through the wetlands creating a natural ecosystem. But in 1928 the riverdried up since the sewage and storm water was discharged into the Kulti-Gong, which is located near Ghusighata some 28 km. towards east of the city, through 69 lock gates. Sewage-fed pisciculture was there since 1930s as these sewage undergo some bacterial processes. It helps KMC to save nearly 1500 million per year on treating waste water and fish farmers also can avoid an expenditure of rs. 60 million per year of buying fish feed. Thus the East Kolkata Wetlands serve as a perfect 'waste recycling region' of the city. These wetlands also support a wide variety of flora and fauna. They constitute a carbon sink and help to reduce air pollution.

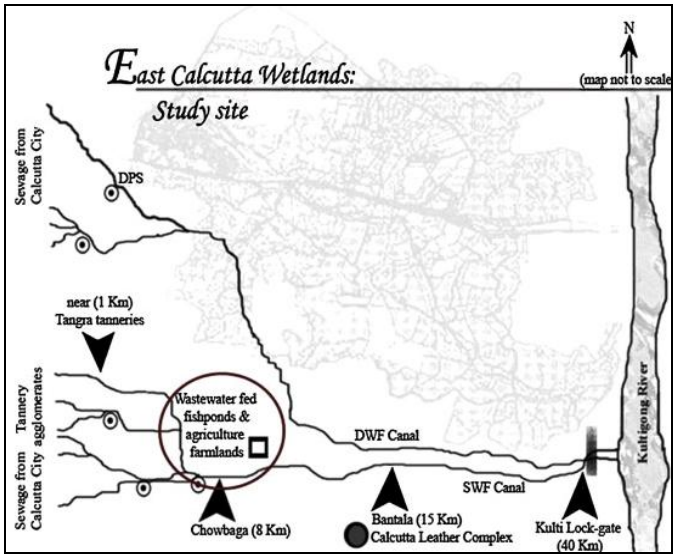

Fig 1: Diagram showing a rough sketch of storm water and sewage flowing into Kulti-Gong.

KMC generates 600 million litres of sewage and waste water every day and more than 2500 metric tons of garbage. The waste water is led by underground sewers to the pumping stations and then into the open channels. Thereafter, the sewage and waste water move into the EKWs by the owners of the fisheries and within some days biodegradation of these waste material takes place.

In these wetlands organic materials are present in a huge quantity and the result is obvious –high BOD (above 80%) and the solar radiation is about 250 Langley per day, which is very good for photosynthesis. Solar energy is tapped by a dense population of plankton and plankton is consumed by the fishes.

Planktons play a significant role in the degradation of the sewage material and fishes play a very important role to maintain a proper balance. So here a complex ecological balance has been developed and the farmers adopted a very important role by maintaining the balance of the growth in the fishes and the plankton.

In the East Kolkata Wetlands 14 aquatic, 12 semi –aquatic and 11 species of non-auatic birds,4 aquatic and 6 semi-aquatic species species of reptiles,6 species of amphibians, 40 species of fish,11 species of prawns, 3 species of crabs, 26 species of insects were recorded so far (De, *et al*., 2007).

- Inventorization and assessment of key waterbird habitats within EKW basin, ie Bartee Beel, Gobadiabad Beel, Nalban and Goltala be carried out. Plantation of phragmites, shola, typha and other indigenous spp be undertaken and community reserves be created at Goltala, Nalban, Birtee and Gobariabad beels to restore waterbird habitats. Bird protection committees with conservation incentives be formed to control poaching. Networking with national and international treaties be done to strengthen habitat conservation efforts.
- Enhancing fish biodiversity through establishing a centre for culture of indigenous fish species at Goltala. Establishing units for standardization of captive breeding of endangered species at Captain bhery.

Fig 2

Apart from the environmental implication, wetland biodiversity's are responsible for socio-economic upliftment. A good number of biological resources of this East Kolkata Wetlands are used as food, fooder, fuel, vegetables, pulses, oils, paper-pulp, thatching materials, medicine and other.

So this region is very significant not only for maintaining ecological balance and also for economic opportunity for employment generation.

Location

It is located in the eastern part of Kolkata between the levee of the Hooghly River on the west and the Kulti-Gong in the east. It is situated in the eastern fringe of Kolkata, 22°25' to 22°40' and 88 22' to 88 55'East. The uniqueness of these wetlands is that the sewage and wastewater of the city get treated in a natural way through the practice of sewage-fed pisciculture is an important economic activity practiced in the East Kolkata Wetlands area.

Shrinkage of east Kolkata wetlands

Reasons responsible for the shrinkage of wetlands

Lust for land

The hunger for land for real estate development exerts a relentless pressure on this unique ecosystem of vegetable gardens and shallow fishponds that has been recognised as a Ramsar site since 2002. It is unique even among the world's most prized wetlands in its sustainable symbiosis with a metropolis. A law barring new construction on the wetlands, which entered its tenth toothless year last month, has not dissuaded property developers. The instances are too many to be denied.

More instances are not hard to find. In Kharki village near Bantala in the wetlands, a 29 bigha (about 10 acres) bheri is being slowly filled up.

Dirty industries

On the stretch towards Bantala, more than 25 leather-processing units boil leather waste in huge cauldrons, emitting noxious fumes. It is then spread to dry and subsequently shipped to tea gardens as manure. "Leather units release effluents into the sewage canals that feed the bheries. It harms the fish," said Das Gupta. The air pollution around the cauldrons is also intolerably high.

These patently illegal units are conducting business openly. "They are not supposed to exist at all," said Ghosh. But they do and hardly any voices are raised. Violence is never too far away in the wetlands, where laws of the land are often observed only in the breach.

The steady encroachment on the wetlands worries the communities that have been living here for generations. More than 1,20,000 residents, many of them vegetable farmers and fisher folk, are providing a useful service to the city, Das Gupta points out. There are also 5,000 local rag pickers who manually recycle Kolkata's solid waste at Dhapa, the city's garbage dump in the wetlands, a daily effort that has been lauded internationally. "They cannot just be pushed out," she said. "It is unacceptable."

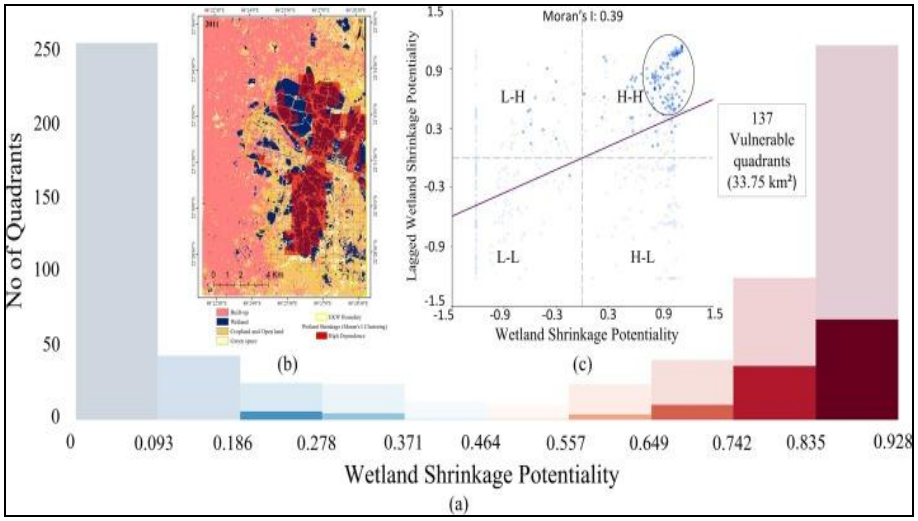

Fig 3

The above diagram is showing the potentiality of the shrinkage of wetlands due to the course of time and 250 quadrants has been selected based on which the shrinkage is shown.

Though there are several laws to protect these wetlands these are gradually diminishing in an alarming rate. There are several maps regarding this and the map on the next page clearly showing this. There is a sharp decline of the area under wetlands in last 50 years. Although KMC knows about the benefits of these wetlands they have a least interest of protecting this. This is very unfortunate.

Case Study

The East Kolkata Wetland and waste recycling region serves to:

(a) 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 the Kolkata city – at no cost to the city but with much gain.
(b) Fulfill substantially the requirement of fish, vegetables and food- grains in the city.
(c) Absorb the pollution from, and purify the air that the citizens breathe.
(d) Absorb and pass down to downstream creeks and the sea the flood waters that the monsoon downpours bring down on the city.
(e) Provide a habitat for a variety of flora and fauna and living organisms endemic to wetlands.
(f) Provide the food chain and waste- to- wealth recycling so unique and essential to this city.
(g) Maintain the micro climatic condition of the region.
(h) Maintain the delicate ecological balance in a fragile environment and eco- system.
(i) Provide livelihood support for thousands of local villagers who also have the unique skill of using wastewater to grow fish and vegetable and thereby help sustain a stable urban fringe.

Hydrology

Hydrology of this wetland is particularly different from any other aquatic systems. The wetland has as such no catchment area of its own, although an estimated amount of approximately 250 million gallons of sewage per day is being charged into it. So far as ground water is concerned, there is hardly any good aquifer upto a depth of 400 feet. Water is present in basically perched aquifers. The total dissolved solid content sometimes exceeds 1800 ppm. The water table stands at a depth of 8 m. with a downward fluctuation of 1- 2 m. during summer. In the fishery water the average pH is 7.5. In the fisheries the BOD remains within the range from 35 to 50 ppm. & COD remains within the range from 55 to 140 ppm. The East Kolkata Wetlands consists of 264 operating bheris which are given below:

P.S Bidhannagar(S)	Bheris 46
Bhangar	37 104
Sonarpur Tiljala Total	77 264

Climate

Climate here is more or less sub- tropical with the annual mean rainfall around 200 cm. The maximum temperature during summer rises around 39^0 C. While minimum temperature during winter is around 10^0 C. The average temperature during most part of the year is around 30^0 C. During day time with a fall in temperature of 5^0 - 6^0 C. at night

Socio- Economy

In formations from Fishery Co- operative Societies of East Kolkata Wetland reveals that, this World's largest wastewater fed aquaculture system produces about 13,000 tonnes fish per year and as such provides the livelihood of more or less 60,000 inhabitants of this area. This has been possible due to development and practice by the fishermen of this area, since 70 years and unique eco- based sustainable technology for the treatment of raw sewage of the city flowing through drainage channel in and around these areas.

Land use pattern of the catchment area

East Kolkata Wetlands are sewage fed & it takes sewage &

garbage from the city through different canals & channels. So, it has no natural catchment area. The total area is 12,741 ha. The region comprises of water spread area - 4728.14 ha, degraded water spread area1124 ha, agricultural land - 4959.86 ha, garbage farming area (Dhapa)- 602.78 ha and urban and rural settlement- 1326.52 ha (IWMED).

Landuse	Area in hectare
Water body(Fish farming)	3898.7
Other water body	1953.44
Agricultural land	4959.86
Garbage disposal site	602.78
Urban settlement	91.53
Rural settlement	1234.99

Vegetation & flora

Aquatic vegetation in the sewage fed ponds are mainly dominated by some floating macrophytes. Sometimes, at the edge some emergent macrophytes also cover the wetlands, which are not used in the fishery purposes harbor mixed types of wetland vegetation with major growth forms. Majumder recorded 38 species of dicots from 19 families, 62 species of monocots from 12 families and 3 species of ferns from 3 families of aquatic plants from Kolkata and adjacent localities.

2. Biological Diversity

Biodiversity does not just refer to the biological variation of species and protection of the threatened ones but covers the whole spectrum of the natural environment. Biodiversity studies in the East Calcutta Wetlands have dealt with vascular plant diversity, some common ecological indices computed from the quantitative study of the birds, fin fish and molluscan community of the East Calcutta Wetlands and the interrelationship between various physico- chemical variables of the water bodies of the East Calcutta Wetlands

A. Faunal Diversity

In the East Kolkata Wetland 14 aquatic, 12 semi- aquatic and 11 species of non- aquatic birds, 4 aquatic and 6 semi- aquatic species of reptiles, 6 species of amphibians, 40 species of fish, 11 species of prawns, 3 species of crabs, 20 species of molluscs and 26 species of insects were recorded

a) Zooplankton

The planktonic diversity studies reveal 17 species of zooplanktons, which are commonly found in fresh water bodies. The details of planktonic diversity and load during thisperiod are shown in Table- 8. The result showed that 3 Cladoceran species are common to fresh water and not found in the Sewage fed fishery. All the 5 Rotifern species are common to Sewage fed fishery. All the 5 Copepodan species are common to fresh water fishery.

b) Crustaceans

Previously the crustacean in the East Calcutta Wetland system was composed of both brackish water and fresh water forms. But after the large- scale intervention by the owners for cultivation of only few number of fresh water fish species and through sewage fed fisheries, diversity of brackish water crustaceans have disappeared from the wetland system. And now a days only 4 fresh water crustacean species are recorded from these wetlands. Main Crustaceans are Macrobrachium lamacaei (Pukure Chingri), M. rude Pukure (Chingri), M. Malcomonii (Pukure Chingri), Artoriana spinigera (Telo Kakra)

c) Aquatic Insects

The survey results showed that the numbers of aquatic species belong to 4 Orders viz. Hemiptera, Coleoptera, Odonata and Diptera. The survey result shows 7 number of Hemipteran species, 7 number of Coleopteran species, larvae of Dragonfly and Damselfly and larvae of Dipteran species belonging to Anophilidae, Culicidae and Chironomidae.

i. Hemiptera

Gerris spinolae, Sphaerodema annulatum, Ranatra elongate, Ranata varipes, Laccotrephes Griseus, Diplonychus annulatus, Diplonychus molestrum.

ii. Coleoptera

Canthydrus laetabilis, Cybister tripunctatus, Hydrocoptus subvittatus, Hypoporus bengalensis, Eretes sticticus, Hydrophilus olivaceus, Berosus indicus.

d) Mollusks

Benthic fauna, comprising mollusks, reveals 8 Gastropod species and 2 species of Bivalvia which are common in distribution, except one species of bivalvia (Pelecyora trigona – Estuarine species). Bellamya bangalensis (Geri), Pila globosa (Samuk), Digoniostoma pulchella(Geri), Thiara tuberculata (Geri), Lymnaea luteola f. Ovalis (Googli), Lymnaea luteola f. Austraalis (Googli), Lymnaea auminata f. Rufescens (Googli), Indoplanorbis exustus (Googli), Lamellidens marginalis(Jhinuk), Pelecyora trigona (Jhinuk).

e) Fishes

The fish species in wetlands largely depend on plankton in their younger stage. With the age and growth in size, these tend to feed on larger prey and organic matter from the Msewage water. Previously the fish fauna in the East Calcutta Wetland system was composed of both brackish water and fresh water forms. But after the large- scale intervention by the owners through sewage fed cultivation of only few number of fresh water fish species diversity as well as population has changed. And now a days only fresh water fish species are recorded from these wetlands. The wetland owners commonly culture the survey results showed that 37 fish species are recorded of which 23 species are recorded as wild fish species.

i. Cultured Fish

Catla catla (Catla), Labeo rohita (Rui), Cirrhinus mrigala (Mrigel), Labeo bata (Bata), Labeo calbasu (Kalbos), Hypothalmicthyes molithrix (Silver Carp), Ctenopharyngodon Idelea(Grass Carp), Aristichthysnobillis nobilis (American Rui), Oreochromis mossambica (Telapia), Oreochromis nilotica (Nilotica), Briget (Hybrid Magur) Lates calcarifer (Bhetki), Liza parsia (Parse).

ii. Wild Fish

Puntius chola (Punti), Puntius guganio (Punti),

Amblypharyngodon mola (Murala), Glossogotius giuris (Belay), Salmostoma bacaila (Chala), Aploeheilus panchax (Techoka), Mystus vittatus (Tangra), Mystus (Tangra), Channa striatius (Sol), Channa gachua (Chang), Channa punctatua (Lata), Clarias batrachus (Magur), Heteroneustes fossilis (Singhi), Mastacembetus panalus (Pankal), Mastacembetus armatus (Ban), Pisodonophis boro (Kucho), Ophisternon bengalense (Bero), Chanda ranga (Ranga Chanda), Notopterus notopterus (Falui), Anabas testudineus (Koi), Badis badis (Bhada).

f) Amphibia

The East Calcutta Wetland system offers suitable habitat for amphibian species - as they prefer impounded water for breeding, water body with submerged vegetation for development of young and cover on the bank vegetation to hide and feed. A study conducted around the middle of 1960's in the Calcutta cluster of wetland has recorded 5- 6 species of amphibians. Current survey result showed that 4 amphibian species recorded from the wetlands. e. g. Rana tigrina (Bull Frog), Rana hexadactyla (Green Frog), Rana limnocharis (Cricket Frog), Bufo melanostictus (Common Toad).

g) Reptiles

Types of reptiles recorded from the temperate wetland are mainly water snakes, other snakes, monitor lizard, common lizards, and fresh water tortoises. The invertebrates as well as lower vertebrates (fish and amphibians and rats) provide food to the carnivore reptilian species. A study conducted between 1980 and 1995- recorded 16 species of reptilian. The survey results showed 19 reptilian species recorded from the wetlands representing 13 snake species, 2 species of monitor lizards, 3 species of common lizards and 1 species of fresh water tortoise. The main Reptilian Species are Naja naja naja (Ghokro), Naja kaonthia (Keutiya), Bungarus fasciatus (Sankamute), Vipera russelli (Chandra Bora), Lycodon aulicus (Ghar Chiti), Ptyas mucosus (Daras), Xenochropes piscator (Jal Dhora), Amphiesma stolata (Helay), Dendrelaphis tristis (Bet Achra), Typhlops porrectus (Puo), Ahaetula nasutus (Laudoga), Enhydris entrydris (Metuli), Boiga trigonata (Kard Sap), Mabuia caranata (Anjani), Calotes versicolor (Girgiti), Varanus bengalensis (Go Sap), Varanus flavescens (Go Sap), Hemidatylus flaviviridis (Tiktiki), Melanochelys tricarinata (Kachap).

h) Mammals

Wetland areas offer suitable habitats to maammals for diversity of different nitches water body for aquatic mammals and grassland, scrubs and orchards for others. Wetland dependent species are Mongoose and Fishing cat, other carnivores and rats and mice prefer grassland and scrubs around the wetland; flying insects attract the bats. A study conducted around the middle of 1960's in the Calcutta cluster of wetland has recorded 22 species of mammals, representing Shrew (1 species) Bats (9 species), carnivores (7 species), Squirrel, Rat and Mouse (5 species). A more recent study recorded 22 species of mammals, representing carnivores (10 species), Squirrel, Rat and Mouse (9 species), Bats (3 species). The main Mammalian species are Herpestes auropunctuatus (Beji), Herpestes edwardsii (Neul), Viverricuka indica (Gandha Gakul), Paradoxurus hermaphrodites (Bham), Felis chaus (Khatas), Canis aureus (Sial), Lutrogale perspicillata (Bhodar), Pteropus giganteus (Badur), Pipistrellus coromandra (Chamchika), Funambulus pennantii (Kathbiral), Mus booduga (Metho Indur), Bandicota Bengalensis (Dhere Indur), Bandicota indica (Indur), Mus platythrix (Nangti Indur), Suncus murinus (Chuchu), Herpestes palustris (Marsh Mongoose). One mammalian species is endemic to the East Calcutta Wetland area, i.e. Salt Lake Marsh Mongoose.

i) Birds

During the summer of 2004, there is revealed a total of 66 species, it may be noted that the last report on the birds of salt lake recorded 132 species based on a three year study. Obviously the number recorded during the summer does not reflect the potential avifauna of the area. At least four of the sixty- six species appeared to be new record.

1. Dinopium benghalense (Lesser goldenbacked woodpecker or Blackrumped flameback), 2. Megalaima zeylanica (Large green barbet or brownheaded barbet), 3. Megalaima haemacephala (Coppersmith Barbet), 4. Upupa epops (Common Hoopoe), 5. smyrnensis (Whitethroated or White breasted Kingfisher Halcyon), 6. Ceryle rudi(Pied Kingfisher), 7. Merops orientalis (Green bee- eater or Small Green Bee- eater), 8. Hierococcyx varius (Common hawk cuckoo or Brain- fever bird), 9. Eudynamys scolopacea (Asian Koel), 10. Centropus sinensis (Greater coucal or Crow pheasant), 11. Psittacula krameri (Rose ringed Parakeet), 12. Cypsiurus balasiensis (Asian palm Swift), 13. Columba livia (Rock pigeon), 14. Streptopelia decaocto (Eurasian collared dove or Ring dove), 15. Streptopelia senegalensis (Laughing dove or Little brown dove), 16. Streptopelia chinensis (Spotted dove), 17. Treron phoenicoptera (Yellow- footed green pigeon), 18. Amaurornis phoenicurus (White breasted water hen), 19. Gallinula chloropus (Common moorhen), 20. Gallinago gallinago (Common snipe), 21. Tringa glareola (Wood sandpiper or Spotted sandpiper), 22. Calidris minuta (Little stint), 23. Himantopus himantopus (Black- winged stilt), 24. Hydrophasianus chirurgus (Pheasant- tailed jacana), 25. Metopidius indicus (Bronze- winged jacana), 26. Charadrius dubius (Little ringed plover), 27. Sterna sumatrana (Black naped tern), 28. Gelochelidon nilotica (Gull billed tern), 29. Sterna aurantia (River tern), 30. Milvus migrans (Pariah kite or Black Kite), 31. Elanus caeruleus (Black shouldered kite), 32. Tachybaptus ruficollis (Little grebe or Dabchick), 33. Phalacrocorax niger (Little cormorant), 34. Phalacrocorax carbo (Large or Great cormorant), 35. Phalacrocorax fuscicollis (Shag or Indian cormorant), 36. Egretta garzetta (Little Egret), 37. Mesophoyx intermedia (Intermediate or Median egret), 38. Casmerodius albus (Large or Great Egret), 39. Bubulcus ibis (Cattle egret), 40. Ardeola grayii (Indian pond heron), 41. Ardea cinerea (Grey Heron), 42. Anastomus oscitans (Asian openbill or Openbill stork), 43. Lanius cristatus (Brown shrike), 44. Shrike Lanius vittatus (Bay- backed), 45. Dendrocitta vagabunda (Rufous treepie or Treepie), 46. Corvus splendens (House crow), 47. Corvus macrorhynchos (Jungle or Large- billed crow), 48. Artamus fuscus (Ashy swallow shrike or Ashy woodswallow), 49. Dicrurus macrocercus (Black Drongo), 50. Copsychus saularis (Oriental magpie robin), 51. Sturnus contra (Asian pied

starling or Pied myna), 52. Acridotheres tristis (Common myna), 53. Acridotheres ginginianus (Bank myna), 54. Acidotheres fusus (Jungle myna), 55. Hirundo smithii (Wire- tailed swallow), 56. Pycnonotus cafer (Red- vented bulbul), 57. Prinia inornata (Plain prinia), 58. Acrocephalus agricola (Paddyfield warbler), 59. Acrocephalus dumetorum (Blyth's reed warbler), 60. Acrocephalus stentoreus (Clamorous reed warbler or Great reed warbler), 61. Orthotomus sutorius (Common tailor bird), 62. Passer domesticus (House sparrow), 63. Motacilla flava (Yellow wagtail), 64. Motacilla citreola (Citrine wagtail), 65. Anthus rufulus (Paddyfield pipit), 66. Ploceus philippinus (Baya weaver) etc.

B. Floral Diversity

a. Phytoplankton

From the different locality of the study area 30 genera of phytoplankton have been encountered of which yxophyceae, Chlorophyceae and Bacillariophyceae contained 11, 12 and 7 genera respectively.

b. Macro Floral Diversity

From the different locality of the study area 96 species of vascular plants encountered mainly growing in wetlands & bank regions. These species were under 79 genera & 38 families. The vascular plant contained 62 species under 53 genera and 25 families of dicotyledons, 31 species under 23 genera and 10 families of monocotyledons and only 3 species under same number of genera & families of pteridophytes.

c. Aquatic Macrophytes

The diversity of wetland plants showed a total number of 55 species under 41 genera & 26 species. The vascular wetland flora had different growth forms and as per Cook's classification (1996) these can be segregated into -

i. Helophytes [34 species] - Plants not physiologically bound to water but tolerating longer period of submergence. The species are - 1) Alternanthera paronychioides, 2) Alternanthera philoxeroides, 3) Bacopa monnieri 4) Centella asiatica, 5) Canna indica, 6) Colocasia esculenta, 7) Commelina benghalensis, 8) Commelina diffusa, 9) Commelina suffruticosa, 10) Cyperus rotundus, 11) Cyperus, 12) Cyperus, 13) Cyperus, 14) Dentella repens, 15) Dryopteris, 16) Eclipta prostrata, 17) Enhydra fluctuans, 18) Eragrostis unioloides, 19) Grangea maderaspatana, 20) Ipomoea aquatic, 21) Kyllinga brevifolia, 22) Leersia hexandra, 23) Lindernia hyssopoides, 24) Ludwigia adscendens, 25) Ludwigia perennis, 26) Murdannia vaginata, 27) Oplismenus composites, 28) Persicaria berbata, 29) Persicaria hydropiper, 30) Phragmites karka, 31) Phyla nodiflora, 32) Rumex dentatus, 33) Sauropus bacciformis, 34) Tonningia axillaris.

ii. Hyperhydate [12 species] - Plants with some photosynthetic parts in contact with air, roots penetrating the substrate & leaves or stems emerging above the water surface. The most important species are 1). Aeschynomene aspera, 2) Cyperus alopecuroides, 3) Eleocharis acutangula, 4) Hygrophila difformis, 5) Hygrophila quadrivalvis, 6) Hygrophila schulli, 7) Hygrophila, 8) Ipomoea fistulosa, 9) Sagittaria montevidensis, 10) Schoenoplectus maritimus, 11) Schoenoplectus, 12) Typha angustifolia etc.

iii. Pleustophytes[6 species] - Free floating plants on the water surface. There are 1) Azolla pinnata, 2) Eichhornia crassipes, 3) Lemna perpusilla, 4) Marsilea minuta, 5) Pistia stratiotes, 6) Spirodela polyrhiza pleustophytes are found.

iv. Vittate[2 species] - Submerged bottom rooted plants with the leaves arranged along the elongated stems, which are 1) Ceratophyllum demersum, 2) Hydrilla verticillata.

v. Rosulate[1 species] - Submerged bottom rooted plants with the leaves borne in rosette. The species is Vallisneria spiralis.

d. Bank Flora

The floristic components excluding the helophytic species at the bank region consisted of 41 species under 39 genera and 20 families. Among them only 3 species were monocot & the rest were dicot. The herbaceous floral diversity on the bank, other than helophytes are - 1) Acalypha indica, 2) Achyranthes aspera, 3) Ageratum conyzoides, 4) Andropogon aciculatus, 5) Anisomeles ovate, 6) Blumea lacera, 7) Boerhavia repens, 8) Breynia vitisidaea, 9) Cardiospermum halicacabum, 10) Cassia sophera, 11) Cassia tora, 12) Cestrum diurnam, 13) Cleome rutidosperma, 14) Clerodendron infortunatum, 15) Croton bonplandianum, 16) Cuscuta reflexa, 17) Daemia extensa, 18) Datura stramonium, 19) Desmodium triflorum, 20) Eleusine indica, 21) Eragrostis tenella, 22) Evolvulus nummularius, 23) Flacourtia indica, 24) Heliotropium indicum, 25) Jatropha gossypifolia, 26) Malachra capitata, 27) Mecardonia procumbens, 28) Mukia scabrella, 29) Peperomia pellucid, 30) Phyllanthus niruri, 31) Pluchea, 32) Portulaca oleracea, 33) Ruellia tuberosa, 34) Scoparia dulcis, 35) Sida rhombifolia, 36) Sida veronicifolia, 37) Solanum nigrum, 38) Tephrosia purpurea, 39) Trianthema monogynum, 40) Urena lobata, 41) Xanthium strumarium.

e. Major shrubs & trees along the bank site

1. Acacia arabica (Babul), 2. Aegle marmelos (Bel), 3. Albizzia lebbek (Siris), 4. Anona squamosal (Ata), 5. Artocarpus heterophyllus (Kathal), 6. Azadirachta indica (Neem), 7. Borassus flabellifer (Tal), 8. Butea monosperma (Palash), 9. Caesalpinia pulcherrima (Krishnachura), 10. Cassia fistula (Badar- lathi), 11. Casuarina equisetifolia (Belati- jau), 12. Clerodendron infortunatum (Bhant/Ghentu), 13. Delonix regia (Gul- mohor), 14. Ficus bengalensis (Bat), 15. Ficus geniculata Kurz, 16. Ficus hispida (Dumur), 17. Ficus religiosa (Asvattha), 18. Flacourtia indica (Benchi), 19. Lagerstroemia flos- reginae, 20. Lantana camara, 21. Leucaena leucocephala, 22. Mangifera indica (Am), 23. Mimusops elengi (Bakul), 24. Morinda citrifolia (Ach), 25. Peltophorum pterocarpum (Radha- chura), 26. Phoenix sylvestris (Khajur), 27. Pluchea, 28. Polyalthia longifolia, 29. Ricinus communis (Bherenda), 30. Samanea saman (Khirish), 31. Swietenia mahagoni (Mahogany), 32. Syzygium cumini (Kala- jamb), 33. Trema orientalis, 34. Zizyphus jujube (Ber), 35. Zizyphus oenoplia (Shiakol).

f. The climbers / lianes

The climbers / lianes were also a major floristic components of the bank regions having 14 species e.g. 1. Basella rubra (Ban- poi), 2. Calamus rotang (Bet), 3. Cardiospermum halicacabum (Sibjhul), 4. Coccinia cordifolia (Tela- kachu), 5. Cuscuta reflexa (Swarnalata), 6. Daemia extensa (Chagul- bati), 7. Dioscorea bulbifera (Kham- alu), 8. Dioscorea pentaphylla, 9. Mikania micrantha, 10. Mukia scabrella (Bilari), 11. Stephania hernandifolia (Nimukha), 12. Tiliacora racemosa (Tiliacora), 13. Tinospora cordifolia (Gulancha), 14. Vitis trifolia (Amal- lata).

g. Wild Flora

The wetland floral diversity showed several economically important wetland plant resources of which the number of species in the use of medicine(28), paper- pulp / thatching materials(3), vegetable(4), food for water- fowl(4), food for fish(3), as green manure & compost(6), water purifier(9) and fodder(12) were respectively. The potential / actual medicinal use of different plants collected from study area are given below -

The plants use in other socio- economic purposes are enlisted in the following:-

i. Plants Used For Paper- Pulp, Fibre & Thatching Materials

1. Cyperus rotundus, 2. Phragmites karka, 3. Typha angustifolia.

ii. Plants Used For Vegetable Resources

1. Bacopa monnieri, 2. Enhydra fluctuans, 3. Ipomoea aquatica Forssk., 4. Marsilea minuta.

iii. Plants Used As Food For Waterfowl

1. Cyperus rotundus, 2. Lemna perpusilla, 3. Pistia stratiotes, 4. Spirodela polyrhiza.

iv. Plants As Food For Fish

1. Ceratophyllum demersum, 2. Hydrilla verticillata, 3. Vallisneria spiralis.

v. Plants As Fodder

1.Alternanthera paronychioides, 2. Alternanthera philoxeroides, 3.Commelina diffusa, 5.Eichhornia crassipes, 6.Eragrostis unioloides, 7.Ipomoea fistulosa, 8.Leersia hexandra, 9.Oplismenus composites, 10.Phragmites karka, 11.Typha angustifolia, 12.Vallisneria spiralis.

vi. Aquatic Plants Used As Green Manures And Compost

1. Ceratophyllum demersum, 2. Eichhornia crassipes, 3. Hydrilla verticillata, 4. Lemna perpusilla, 5. Pistia stratiotes, 6. Vallisneria spiralis.

vii. Aquatic Macrophytes Serve As Water- Purifier

1. Alternanthera philoxeroides, 2. Ceratophyllum demersum, 3. Eichhornia crassipes, 4. Hydrilla verticillata, 5. Lemna perpusilla, 6. Phragmites karka, 7. Spirodela polyrhiza, 1. Typha angustifolia, 2. Schoenoplectus maritimus.

h. Cultivated Flora

Apart from the aquatic plant resources for economic importance growing in wild condition, a good number of plants were cultivated for highly economic benefits in several areas of East Kolkata Wetland. In the garbage farm of East Kolkata Wetland area 24 species of vegetable & crops, 5 species of fruit plants and 10 species of ornamental plants were extensively cultivated by irrigating the sewage water. There mostly cultivated flora are

i. Major Cultivated Crops & Vegetables

1. Amaranthus tricolor (Lal- shak), 2. Amaranthus viridis (Natia- shak), 3. Amarphophallus campanulatus, 4. Benincasa hispida (Chal- kumro), 5. Beta vulgaris (Beet), 6. Brassica campestris (Sarisha), 7. Brassica oleracea (Phul- kopi), 8. Capsicum frutescens (Dhan- lanka), 9. Chenopodium album (Betua- shak), 10. Coriandrum sativum (Dhane), 11. Cucurbita maxima (Lau), 12. Ipomoea aquatic (Kalmi- shak), 13. Lagenaria siceraria Standl (Kaddu), 14. Luffa acutangula (Jhinga), 15. Lycopersicum esculentum (Tomato), 16. Momordica charantia (Karela), 17. Momordica cochinchinensis (Kakrol), 18. Momordica dioica (Uche), 19. Raphanus sativus (Mula), 20. Solanum melongena (Begun), 21. Spinacia oleracea (Palang), 22. Trichosanthes anguina (Chichinga), 23. Vigna sinensis Savi (Chim), 24. Zea mays (Bhutta) etc.

j. Fruits

1. Carica papaya (Pepe), 2. Cocos nucifera (Narikel), 3. Cucumis sativus (Sasa), 4. Musa sapientum (Kanthali- kala), 5. Punica granatum (Dalim).

k. Ornamental Flowers

1. Aster sp. Asteraceae, 2. Canna indica (Kalabati), 3.Chrysanthemum (Asteraceae Chandramallica), 4. Clitoria ternatea (Aparajita), 5. Gardenia, 6. Helianthus annus (Surja- mukhi), 7. Hibiscus rosa- sinensis (Jaba), 8. Mussaenda frondosa (Mussanda), 9. Tabernaemontana divaricate (Tagar), 10. Tagetes patula (Ganda).

Observation

The scope of work as such remain restricted both in terms of time and space. However the results of the survey clearly indicate a decline in the biodiversity profile of East Calcutta Wetlands but still confirms is suitability for conservation of diverse elements of fauna. It is unique in terms of peri- urban wetlands providing a multidimensional profile in terms of both wise use, complying with fish criteria and water fowl habitat. The area is well known for migratory water birds and any survey during winter months can reveal the current status of species and population size of migratory birds.

Aquatic macrophytes are very important components in the respective ecosystem for their significant contribution in primary production, water purification & sensitive indicator of water quality. They have also key role for providing and substrates to bacterial growth and by altering physico- chemical environment of water & in the rhizosphere. Aquatic plants have different growth forms according to their adaptive capability to the habitat condition. The absence of epihydate is probably due to either excessive eradication from the system for aquaculture or incapability to tolerate sewage water. The prevalence of sewage water or onstant human

interference may be the causes of not to sustain the juvenile states of tenagophytes and thus explains their non- availability in the study area. Floristic component along the bank of any aquatic system have very significant role for their existence & sustenance through checking erosion & rapid eutrophication, supplying essential nutrients and harboring innumerable bio- diversity. The varied preference of habitat & association with of other plants of wetland and bank give an ecological picture of individual species. This would be informative for conservation & developmental aspect of this wetland. The extinction of the species like, Aldrovanda vesiculosa L. from this region (Cook,1996) is an indication of habitat destruction of this important wetland.

Conclusion

The assessment of biodiversity requires a complete spatial and temporal collection of data both qualitatively and quantitatively. During the present study, the vast area of East Kolkata Wetlands was not covered in the survey due to shortage of time. Therefore, to inventories the biological wealth of this internationally important wetland, a long- term project with a minimum of three years is very much essential. This preliminary study is the first hand knowledge of the biodiversity of East Kolkata Wetlands. But for conservation and sustainable development of this precious wetland, more in- depth study is required in near future. The East Kolkata Wetland, recently being designated as Ramsar site of International importance, draws attention for its exceptional wise use concept.

The extinction of the species like, Aldrovanda vesiculosa L. from this region (Cook,1996) is an indication of habitat destruction of this important wetland. Like this species several other wetland plants may be extinct if the environmental condition is not to be properly maintained from the ecological point of view. Therefore, the rich floristic and faunal diversity of this ecosystem needs an environmental security for the sustainable development & wise use of this Internationally important wetland & to explore or conserve the hidden potentialities of the floristic resources as well.

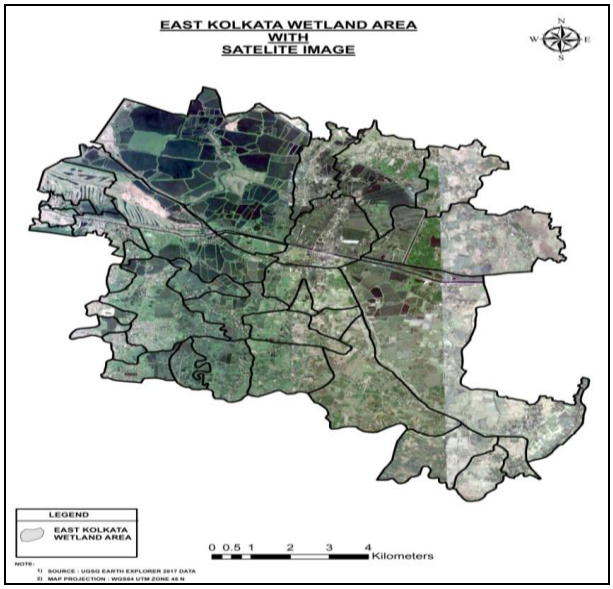

Fig 4

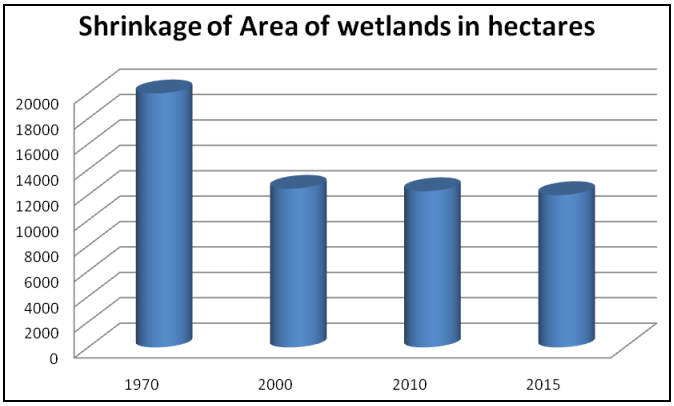

Fig 5

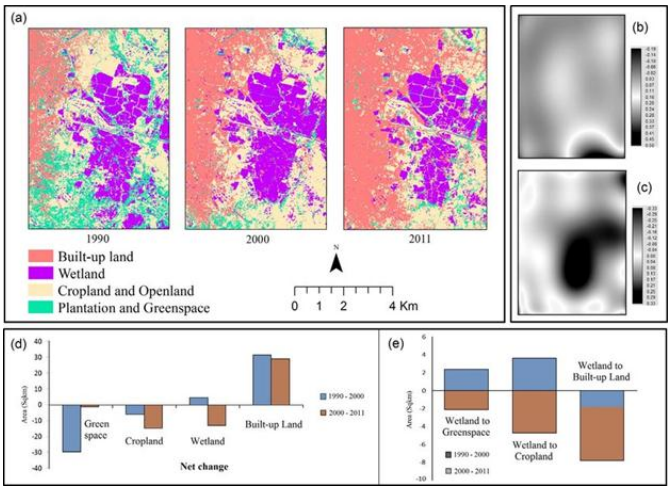

Fig 6

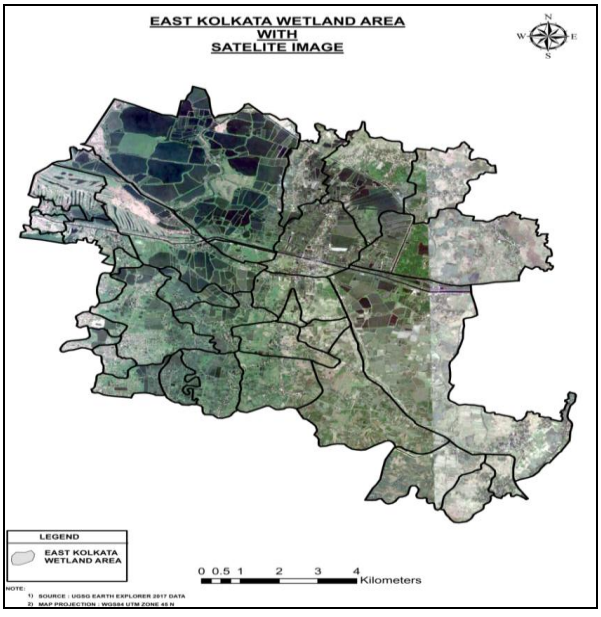

Fig 7

Now, the impact of this shrinkage will be discussed

- There will be an immediate felling of 2 Lakh trees which led to adecline of the bird population. According to a survey conducted by the Zoological Survey of India there

was 248 species of birds in 1960s but according to Prakriti Samsad, NGO recorded only 123 species in the late 1980s. During 1990s and 2010 there was a sharp decline of migratory birds frm 15000 to 150.

- The fisheries into which the waste water is fed and inturn treated produce 8000 tons of fish annually and employing 17238 fishermen. Species like Bhetki, Parse, Prawns etc. are the major fish catches with the loss of marine connection and diversion of city sewage and run off waters, the species composition of fishes changes into freshwater living fishes like Catla, mrigel, tilapias. Due to the shrinkage of the wetlands the total number of fishes gradually decreases.
- If these wetlands fills up like this then the problem of waterlogging will also increases.
- A huge number of fishermen agricultural workers are working on these wetlands, they will lost their jobs.

Conclusion

From the above discussion it is noticed that wetlands are the kidney of Kolkata as they are transforming the sewage laden water into fishes and agricultural outputs but due to the greed of human being these wetlands are shrinking for several reasons. Various environmentalists and ecological scientists are working on this issue but due to lack of neglegance of developental authority and KMC these wetlands are still suffering. There are several flora and fauna in East Kolkata Wetlands but due to gradual decline in the area of EKW these plants and animals are declining in number.

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