CHAPTER 7

CONCLUSION
7. Conclusion

The present study aimed to investigate the aquatic faunal community structure and dynamics of the sewage-fed fisheries ecosystem in relation with the faunal community led carbon flow. The purpose of this investigation was to assess the biological integrity of the system and to understand the underlying biotic activity responsible for sewage purification in the fish ponds. This study also provides, for the first time, a conceptual model for carbon cycling process in the freshwater wetland system. Following are the salient findings that emerged out of the entire study. Fig 21 (Plate 27) and Fig 22 (Plate 28) consecutively reflect the effects of different physico-chemical factors and biotic components on short term pond management for fish cultivation along with sewage purification and long term monitoring of sewage-fed fisheries system.

7.1. Macroinvertebrate Index of Biotic Integrity

Organic pollution is significantly indicated in the system by two crucial parameters that constitute the Index of Biotic Integrity e.g., taxa richness & community structure and tolerance of the macroinvertebrate community. As evidenced by the overall IBI parameter values, water qualities in EKW fish culture ponds do not seem to be ‘excellent’ but merely good. As indicated by the Hilsenhoff Biotic Index (HBI), organic pollution load seem to be higher in pre-monsoon and monsoon season. These assessments are reported for the first time for this sewage-fed wetland system.
7.2. Plankton community succession and Fisheries management

The age old indigenous practices in fisheries of EKW continue to play a pivotal role in purifying sewage water and recycling its nutrient components for fisheries activities crucial for sustaining the livelihoods and the local economy. As this study shows, the first 7-8 days are crucial for biodegradation of sewage as different biological and physico-chemical processes that are responsible for reducing sewage nutrient load drastically takes place during this period. DO, water pH, water temperature and alkalinity along with phytoplankton and zooplankton particularly rotifera community have positive impact in stabilization of sewage and betterment of wastewater quality.

This study reveals a distinct succession in the zooplankton community parallel to the sewage decontamination process. Phytoplankton load is significantly regulated by surface DO, soil-water interface DO and alkalinity while zooplankton load is mainly controlled by surface DO and BOD. Among zooplankton, arthropods are positively controlled by SDO and negatively by BOD while rotifers are largely controlled by BOD. This study provide critical insights into the underlying roles of planktonic faunal interactions in conjunction with the changing abiotic environment that help to purify sewage while turning polluted water favorable for commercial fish farming.

7.3. Carbon cycling process

The present study clearly indicates that the sewage fed freshwater wetlands system is relatively more efficient in sequestering organic carbon both in water and soil compared to normal freshwater water bodies. Plankton communities play important role in transfer and
transformation of organic and inorganic carbon forms like SOC, POC, DSO, SIC and DCO$_2$ in such system. The relatively higher efficiency of carbon sequestration in such system is attributed to five fold higher phyto and zooplankton carbon count compared to normal freshwater ponds. GPP and NPP are also higher in sewage fed system in comparison with normal ponds throughout the year.

This study also explored the mechanism of carbon flow in such systems and identified the regulators of various carbon components. This would further help in designing more appropriate management strategy of this system. The conceptual model of carbon cycling presented here is based both on these result as well as secondary information obtained from existing literature. Yet, this model requires fine tuning into a mathematical model calibrated and validated with longitudinal data in order to further establish the efficiency of such a system.

7.4. Fisheries management process

The age old practice of fisheries management process in EKW has two levels – short term pond preparation for fish culture and long term monitoring of these sewage-fed fisheries. These short and long term fisheries management process have some positive and negative aspect as well as important outcomes.

In short term fish pond preparation, planktons exert positive effect by decomposing dissolved and suspended solids of sewage which contain mainly nitrogen, phosphorus and carbon compounds by using it as energy or material source. Thus sewage nutrients are transformed
into food for higher trophic level as fishes while filtering sewage water. During this process phytoplankton and rotiferan species of zooplankton use sewage nutrient to increase their abundance which help in decreasing the biological oxygen demand and increase dissolve oxygen level (Plate 27, Fig 21). On the other hand, Arthropoda species of zooplankton colonize in cleaner water during the course of the sewage purification process and act as good food resource for the fishes. The immediate outcome from this short term fish pond preparation in EKW is good amount of commercial fish production (Plate 27, Fig 21).

In East Kolkata Wetlands, long term monitoring of sewage-fed fisheries shows negative impact macroinvertebrates diversity (Plate 28, Fig 22). Human intervention causes perturbation leading to organic contamination in EKW system. IBI and HBI values show assemblage of pollution tolerant macroinvertebrates in sewage-fed fisheries indicative of organic pollution (Plate 28, Fig 22). However, five-fold higher plankton carbon count, high gross and net primary production along with presence of higher amount of soil organic carbon in sewage-fed fish ponds compared to normal freshwater ponds prove these fisheries to be greater carbon sink. Our study explored the conceptual carbon cycle model of sewage-fed fisheries as the major outcome from the long term monitoring process (Plate 28, Fig 22).

Ecologically efficient city sewage management system is a growing necessity all over the world and particularly in the South and South East Asia. The present study reiterates that EKW model is not only an efficient sewage management system but is also efficient in carbon sequestration, a growing global necessity.
Fig 21. Effects of different factors and the outcome of short term pond management process of sewage purification for fish culture. Green arrows represent positive effects, mauve arrow represent outcome and black lines represent divergence of attributes.
Fig 22. Effects of different factors on long term fisheries monitoring process of East Kolkata Wetlands. Green arrows represent positive effects, red arrows represent negative effects, black lines represent divergence of attributes and mauve arrow shows outcome of our study from the long term monitoring process. (MIBI - macroinvertebrate index of biological integrity; HBI - Hilsenhoff species-level Biotic Index).