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Wastewater Utilisation in East Calcutta Wetlands

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CHAPTER 1 INTRODUCTION

Calcutta is sustained by a unique and friendly water regime. To its west flows the river Hooghly, along the levee of which the city has grown. About 30 km eastwards flows the river Kulti-Bidyadhari that carries the drainage to the Bay of Bengal. Underneath the city lies a copious reserve of groundwater. Finally, and central to this regime is the vast wetland area beyond the eastern edge of the city that has been transformed to use city wastewater in fisheries, vegetable gardens and paddy fields in successive tracts of land. These combine to what has been described as the `waste recycling region' (Ghosh, 1985). This wetland and waste recycling region covers about 12,500 hectares, and is the largest of its type in the world. This remarkable work of transformation and wise use of wetlands was innovated, developed and upgraded by local fish producers and farmers through a large part of this century.

Since 1980, a good amount a data has been collected and scientific studies carried out to understand this system better. Seldom does one find an ecosystem of such size to be equally significant for bringing economic gains and ensuring ecological balance using a reliable traditional technology that has changed the grammar of conventional wastewater treatment. The system that grew in the early decades of this century peaked around mid century and is now losing ground to urban expansion, poses one of the most formidable challenges to conservation activists in this part of the world. The twin challenges are to save this city and provide a least cost alternative to wastewater utilisation.

The present paper is an introductory note describing the unique ecosystem, the practice and the emerging conflicts. Most of the text of this paper is based on the author's experience of direct involvement with the ecosystem for about two decades. It has also included the latest information and data drawing liberally from the Baseline Document prepared by the Creative Research Group, Calcutta – a survey the author had conceived, instituted and supervised.

CHAPTER 2 WHAT HAPPENS IN THE EAST CALCUTTA WETLANDS?

The east Calcutta wetlands area is an urban facility that treats the city's huge wastewater and utilises the treated water for pisciculture and agriculture, through recovery of wastewater nutrients in an efficient manner. Here, wastewater is used in fisheries and agriculture covering about 12,500 hectares that has been designated as conservation area by an order of the Calcutta high court. The conservation area, also described as the waste recycling region, has three major sub-regions of economic activity – fishponds (*bheris*), garbage farms and paddy lands.

The smallest recycling sub region on the edge of the city covers the vegetable fields that grow vegetables on a garbage substrate and are uniquely planned with alternate bands of garbage filled lands and elongated trench-like ponds locally known as 'jheels'. In these jheels, sewage is detained for sometime, after which the treated effluent is used for irrigating the garbage fields for growing vegetables. In the fishponds, the city's wastewater is made to flow through a network of drainage channels. The wastewater fishponds act as solar reactors and complete most of their biochemical reactions with the help of solar energy. Reduction of BOD (biochemical oxygen demand) takes place due to the unique phenomenon of algae-bacteria symbiosis where energy is drawn from algal photosynthesis. In this way, requirement and consumption of energy remains the minimum. Unlike conventional mechanical sewage treatment plants, wastewater ponds can ensure efficient removal of coliforms that are prone to be pathogenic (Turning Around, 1996). The fishponds drain out the used water to irrigate paddy fields.

The fishpond ecosystem of east Calcutta is one of the rare examples of environmental protection and development management where a complex ecological process has been adopted by the fish producers and farmers for mastering the resource recovery activities. What is remarkable is that the fish yield rate attained is among the best in any freshwater pisciculture in the country. The east Calcutta wetland has the largest number of sewage fed fishponds in the world that are located in one place. The knowledge that has emerged based on traditional skill, enterprise and innovation provides an alternative to the conventional option of wastewater treatment by an ecologically sustainable and wise use of wetlands. Here the task of reusing nutrients is linked with the enhancement of food security and development of livelihood of the local community using nutrient rich effluent in fisheries and agriculture. The conventional sewage treatment plant is considered an externality in the basic social and economic of Calcutta and its fringe. Interestingly, a large part of this folk technology is still retained in an oral tradition. New generation environment friendly engineering has been quick to incorporate the advantages of natural biological processes and principles of ecological regulation. In this context, using wetland functions for reducing wastewater pollution and reuse of nutrients is an example of an effort that has opened new areas of research and application in other parts of the world too.

In 1980, on an initiative of the Government of West Bengal, the wetland area and its reuse practices were assessed. By 1983, the first scientific document on this ecosystem was published which enabled the rest of the world to know about the ecological significance of this outstanding wetland area. In 1985, the map of the waste recycling region that forms the basis of all planning and development activities on this wetland area was prepared.

In the same year, the state government put forward a proposal to introduce a resource efficient stabilisation tank (REST) system for the treatment and reuse of city sewage. This was accepted by the Ganga Project Directorate as an alternative to conventional energy expensive and capital-intensive mechanical treatment plants. A number of such projects under the Ganga Action Plan have now been completed and are working.

Towards the end of the eighties real estate interest reached a new high and there was a strong tendency to convert water bodies and wetlands into housing complexes. To combat this, the Government of West Bengal initiated a number of development control measures. For a comprehensive planning and development of the entire region, a baseline document for management action plan using Ramsar guidelines has been completed.

CHAPTER 3 LAND USE HISTORY

The east Calcutta wetlands are distributed nearly equally on the two sides of the Dry Weather Flow channel reaching the Kulti Gong to the east. The region is suitable for using solar radiation and improving wastewater quality. Each hectare of a shallow water body can remove about 237 kg of BOD per day. In winter, the clearness of the sky is satisfactory (about 90 per cent) for carrying out biochemical activities in water purification.

The wetlands area falls within the south Bengal ecotone where the process of land formation is largely influenced by the Ganga river system that continues through centuries to create land by raising it through upland and tidal deposition. This pattern of delta building has also undergone significant changes due to natural and manmade reasons.

Calcutta grew along the Hooghly levee. While riverbanks are always raised to first allow human settlement and productive activities, the spill areas also gradually become higher up to the tidal level for subsequent reclamation. Unfortunately, with the death of the Bidyadhari, the tidal channel that used to deposit silt in this area, the process of natural deposition and raising of level of the spill area has completely stopped since the end of the last century. This incomplete process of delta building did not allow the low-lying areas behind the Hooghly levee, to the east of Calcutta, to rise higher.

Since the early 15th century when the Ganga changed its main course from the Bhagirathi to the Padma, this eastward change of the course of the main flow of the river Ganga brought metamorphic changes in the process of delta building in central and south Bengal. A number of distributaries and redistributaries were cut off from any upland flow that signalled the end of those channels. However, human interference in the region further reduced the spill area and the channel beds heaved up to quicken the process of decay. This way, the Bidyadhari became defunct and the opportunity of silt deposition in its spill areas ceased.

Prior to wastewater fish farming, this region was a brackish water fishery area gradually rendered derelict on account of the receding Bidyadhari spill channel. Interestingly, these fisheries were responsible for reducing the spill area and compounded with the dwindling upland flow from the river Hooghly to the spill channel caused the death of the tidal creek. During the thirties, the Bidyadhari carried only the city sewage and in the process got choked further due to the high silt content of the sewage.

In such a situation a leading fish producer of that time was successful in growing fish in a large water area using city sewage in the same process sequence as it is done today. The basic feature of this mono pond wastewater fishery was that it combined the process of sewage treatment and recovery of its nutrients through aquaculture within the same pond. Application of sewage was sequenced skillfully on the basis of detention time needed to improve the water quality appropriate for growing fish.

New varieties of fish are constantly introduced in these ponds. Fish producers in this area have shown keen interest to design the optimum crop group. In these fisheries, we find one of the most efficient yield rates from a multiple species polyculture.

In spite of the early success, lack of wastewater supply restricted the spread of such fisheries in this area. Things improved with the construction of the Dry Weather Flow (DWF) channel in 1943-44 to carry city sewage to the Kulti Gong as a new outfall receptacle with provision to channelise sewage for fishery feeding. Sewage-fed fishery spread rapidly since then. However, the scenario changed as the spectre of Salt Lake loomed larger and larger.

The wetlands began to lose stability since 1956. There were instances of forcible attempts to take over the right of land by violent farmers. Such action was long overdue. For more than 50 years owners of small parcels of land were systematically forced to give up their property rights in favour of a few large landowners. But the unfortunate fallout of such forcible occupation of land of big owners by landless farmers lay elsewhere. Fisheries were drained and cultivation of paddy was attempted. It needed much persuasion to impress upon the landless farmers that it was the fishery owners and not the fisheries that would be affected. Fishery was the most efficient ecosystem for the farmers who were natural growers of fish rather than paddy, apart from the multiple benefit that fishery provided. At present, most village people realise this and forcible takeover has largely disappeared. Organised movements by fish farm labourers have succeeded in bargaining for higher terms of labour from the employers.

CHAPTER 4 MORE ON THE FISHERIES

The resources recovered from city sewage is used in three kinds of economic activity - wastewater fisheries, vegetable farming on a garbage substrate and paddy cultivation using pond effluent – in that order. The fishponds are central to the entire waste recycling region and have therefore been described in great detail.

There are 264 fish farms operating on a commercial basis. They cover a total area of about 2858.65 hectares. The fish farms consist of units of various sizes from large holdings locally called *bheris* and relatively smaller ones called `jheels' due to their trench-like elongated shapes. But all these fish farms generally have similar types of produce, farming practice and distribution system.

4.1 Types and amount of fish produced

A variety of sweetwater fishes are produced in the *bheris*. The main varieties in the existing practice of polyculture include:

- Indian Major Carp - Rahu (Labeo rohita), Catla (Catla catla), Mrigal (Cirrihinus Mrigala)
- Indian Minor Carp - Bata - (Labeo bata)
- Exotic Variety - Silver Carp (Hypophthalmichthys molitrix), Common Carp (Cyprinus carpio), Grass Carp (Tenopharyngodon idella)
- Tilapia - Nilotica (Oreochromis nilotica), Mosambica (Tilapia mosambica)

Apart from these cultured varieties (except Tilapia), some other varieties including forage fishes are also available occasionally in the *bheris*. They are Punti (Puntius japonica), Sole (Channa striatus), Lata (Channa punctatus), Chyang (Channa gachua), Singi (Heteropneustes fossillis), Magur (Clarias batrachus), Fouli (Notopterus notopterus), Pungus (Pangasius pangasius), etc. The average marketable sizes of fishes is shown in table 1

It has been observed that the average size of marketable fishes are not of the optimum weight (in grams.) because fishes are normally netted/harvested much before they attain mature marketable sizes that can command better prices. The main reasons for this are that the management/owners are compelled to create the maximum number of man-days possible in a year to provide employment to direct labourers viz. harvesters, carriers, etc and the impending threat of poaching.

Table 1 The average marketable sizes of fishes

	Fish Variety	Average Marketable Size (in gram)
I	Indian Major Carp	
	Rahu	75 - 100
	Catla	125 - 150
	Mrigal	75 - 100
II	Indian Minor Carp	
	Bata	50 - 75
III	Exotic Variety	
	Silver carp	200 – 300
	Common carp	250 – 350
	Grass carp	500 – 750
IV	Tilapia	
	Nilotica	70 - 80 / 100
	Mosambica	50 – 75

(Source: Baseline document 1997)

Production and yield per hectare of fish varies among the *bheris* depending upon the conditions of production. It has not been possible to study all possible variables that affect the production and yield of fish in this region. However, enough data is available to give reasonably sensible indication in this matter. Table 2 gives an idea of the yield in relation to the size of the *bheris:*

Table 2 Yield in relation to the size of the bheris

Sl. No.	Area range (In ha.)	No. of bheris	Gross effective area (Ha.)	Total production (In MT)	Yield / ha. (In MT)
1.	Up to 2	76	80.83	318.72	3.94
2.	Above 2 to 10	125	608.57	2443.50	4.01
3.	Above 10 to 20	34	449.53	1850.99	4.12
4.	Above 20 to 30	13	315.94	1100.25	3.48
5.	Above 30 to 40	3	93.59	270.95	2.89
6.	Above 40 to 50	1	46.13	180.00	3.90
7.	Above 50 to 60	3	170.33	760.00	4.46
8.	Above 60 to 70	5	331.57	1496.85	4.51
9.	Above 70	4	384.66	2493.89	6.48
	Total	264	2481.15	10915.15	4.40

(Source: Baseline document 1997)

The maximum number of *bheris* (125) fall within the area range of above 2 and below 10 hectares, followed by 76 *bheris* within the range up to 2 hectares and 34 *bheris* fall within the range above 10 hectares to 20 hectares. More than 89 per cent of *bheris* fall within the area range of up to 30 hectares. The maximum average yield (i.e. 6.48 MT per ha.) has been achieved by the *bheris* of more than 70 hectares. Initially the yield is seen to increase with the increase in the size of *bheris*; thereafter, it tends to decrease as the size gets bigger and is lowest (i.e. 2.89 MT where *bheri* size is between 30 and 40 hectares). Yield per hectare again increases steadily with the increase in the *bheri* size and is the highest at 6.48 MT in fish farms where the effective area of water body is above 70 hectares. Larger size *bheris*, though few, are more organised in terms of operations, planning through efficient management of production schedules, utilisation of manpower, sewage, better procurement planning, monitoring water quality and fish health and efficient personnel management, etc. All these combine to provide the right synergy for achieving better production performance and per hectare yield.

In terms of annual production, 45 operating *bheris* reported 'increasing trend', 61 *bheris* reported 'decreasing trend', while in 76 *bheris* production was reported to be at an even level during the past three years. No proper indication of production trend was available in the remaining 82 *bheris*.

4.2 Conditions of efficiency

For a *bheri* to be operated efficiently, the following conditions are critical:

a) Maintenance of the required depth of water at all the three stages of the production process e.g. at nursery pond, rearing pond and stocking pond with proper inlet-outlet management of sewage.
b) Availability of quality spawn/fry/fingerlings at required time and quantity.
c) Proper and efficient deployment of working personnel, ensuring satisfactory labour productivity and congenial labour relations.
d) Monitoring fish health.

The most important requisite to run a fishpond efficiently is adequate and safe supply of wastewater. This is related to a number of other factors and deserves more elaborate discussion. Poor quality of sewage brings in lower quantity of nutrients and higher toxic load for the fish to feed upon. Low quality of sewage borne nutrients requires supplementing with nutrients from outside. This entails more expenditure, and increased operational costs that affect viability. In such situations the *bheri* owners, with additional input costs, seek to add value to their produce (fish) to get higher returns and recover the additional expenditure incurred on fish nutrients/feed. One way of countering this situation is by allowing the fishes to grow bigger. As this means lesser number of netting (harvesting) days resulting in the loss of man-days, the workers' union does not allow this to happen. This, in turn, gives birth to a situation of conflicting interests.

CHAPTER 5 TERMS OF LABOUR AND LABOUR COST

In wastewater pisciculture, labour cost constitutes the major part of expenditure. Apart from supervisory staff and skilled or unskilled labourers who live in the '*alas*' or field offices located within the *bheri* area engaged by the management/owners, all other categories of labourers are temporary workers in the strict sense of the term and the costs pertaining to them are 'variable' in nature. The terms of labour for the temporary workers, who constitute the bulk of the work force and are mostly, if not entirely settled by the 24 Parganas Zilla Bheri Mazdoor Union, an affiliate of the Centre for Indian Trade Unions (CITU), connected with the ruling Communist Party. The labour union has a pervading dominance over supply of labour in the east Calcutta wetlands. The labour union periodically settles with the *bheri* management/owners, the terms and conditions of labour including the number of workers to be engaged, daily wage rates and benefits, job specification, total minimum days of employment in a year for each category of worker, leave and other conditions of employment. Once settled, no *bheri* can take unilateral decision on any of the terms of employment including deployment of working personnel. Thus, the number of labour engaged that has been fixed for a particular *bheri* remains so for the whole of the agreement period irrespective of the volume of production attained. While the Union affirms the labour cost to be fixed in nature, the *bheri* owners consider the category of workers as 'temporary' and the costs pertaining thereto as 'variable costs'. In spite of the conceptual nicety involved under cost accounting procedures, most of the *bheri* owners agree that this has assumed the nature of 'fixed' costs. This will continue till the status of the workers in this predominantly agricultural vocation is defined by the concerned authorities (Baseline document, 1997).

Employer-employee relationship is a sensitive area in the fish farms. The issues that often cloud owner-worker relationship in a *bheri* are daily wage rate, leave with pay, bonus and non-cash incentives, fixation of yearly working days, deployment of labour per bheri, days of rearing and harvesting, daily harvest quantity, distribution and sale of marketable surplus, job rotation etc. This problem was addressed through a dispute settlement exercise by the owners and the workers. In 1992 a code of conduct was adopted at the meeting of the district level labour union officials and 24 Pargana Fish Producers' Association, a representative body of private *bheri* owners. In March 1996, the agreement, after minor modifications was signed and ratified by both the parties.

The salient points of the code of conduct inter-alia included the following:

A. Type of *bheri* (based on area and productivity)

Bheri type	Defined area
a. Small	Between 10 bigha and ≤ 100 bigha
b. Medium	≥100 bigha and ≤ 250 bigha
c. Large	Above 250 bigha

(A bigha is a local measure of land that is equivalent to about 1300 square meters)

B. Worker Deployment Ratio

a) One person every 3 bigha for *bheris* that do not require sewage to be pumped in mechanically
b) One person every 5 bigha for *bheris* where pumping is essential

C. Days of harvesting and harvest quantity

Area of bheri (in bigha)	Total harvesting days in a year	Minimum harvest quantity per day
Between 30-50	120-135 days	150-200 kg
Between 55-100	180 days	240 kg
Between 105-200	240 days	360 kg
Above 200	300 days	500-800 kg

D. Layoff compensation

a) No compensation to workers for the lay off period in case of *bheris* up to 200 bigha in size.
b) Half of the prevailing daily wage for *bheris* above 200 bigha in size.

In spite of the rapprochement, the owner-worker relationship remains volatile. Despondent *bheri* owners complain of the total disregard for the agreed code of conduct by the workers who often take recourse to opportunistic trade union practices particularly during the pre-festival (Durga Puja) period in the name of collective bargaining. According to them the tactics adopted and demands raised remain far from acceptable. While the owners/management complains of recurring infringement of the agreed code with unwarranted interference and demands, workers attribute such misgivings to the feudal mindset of the 'evil gentry' and the failure to come to terms with the requirements of equity and social justice.

CHAPTER 6 MAJOR CONCERNS AND DESIRABLE ACTION

Although being identified as an ecosystem that provides copious ecological subsidy to sustain the city of Calcutta commensurate action to conserve the same has always been uncertain.

Major conservation issues and causes of concern and uncertainty in the region can be grouped as follows:

1. Institutional and regulatory inadequacies
   - Information asymmetry
   - Disappearing traditional skill and wisdom
   - Absence of conservation policy guidelines and legislation

2. Physical factors
   - Siltation in the canals and fishponds
   - Inadequate availability of waste water in fishponds

3. Human interference
   - Theft, poaching and pilferage
   - Volatile and sensitive employer-employee relationship
   - Non-cooperation among *bheri*-owners themselves for sharing sewage
   - Improper inlet-outlet management of sewage for operating *bheris* and cultivating paddy
   - Tenurial instability in the garbage farms owned by the Calcutta Municipal Corporation
   - Contamination of wastewater due to untreated industrial effluent
   - Tenurial instability in the workers' managed cooperative fish farms
   - General level of insecurity and law and order problems
   - Fragmentation and conversion of land
   - Threats of real estate takeovers
   - Coordination among the various government departments/agencies viz. irrigation & waterways, fisheries, agriculture, urban development, labour, health, environment, CMC, CMDA, CMW&SA.

4. Factors arising out of legislation, tradition and rights
   - Lack of institutional credit from rural banks
   - Absence of life/health insurance facilities
   - Absence of crop insurance facility

To remedy this state of distress a set of desirable actions have been listed to initiate confidence.

6.1 Upgrading wastewater fishponds

Within the wetland conservation area, wastewater is used by all the three major recycling practices (viz. solid waste farming, fisheries and paddy cultivation). However, perennial fisheries, which need waste water supply throughout the year, are the most important users of wastewater and are also most critically dependent upon the availability of requisite supply of the same.

Variations in availability put the operational viability to strain. Effluents released by most of the fishponds are ideally suitable for paddy cultivation and are profusely practiced within the designated wetland area. Inappropriate understanding of the significance of these wetland practices has led to gradual loss of system efficiency. The actions listed below can restore stability of these recycling practices and ensure wiser use of wetlands.

a) Entire flow through the DWF channel should be distributed to the fishponds as an obligatory function of the agencies responsible for such work. Existing practice of releasing a part of the wastewater flow to Storm Weather Flow channel should be stopped.

b) All drainage channels and distributaries within ECWR should be brought under a comprehensive action plan for its maintenance. This will be implemented by a consortium of concerned *gram panchayats* facilitated by necessary technical support from appropriate departments.

c) Restoration of the vital drainage structures lying defunct within the wetland area.

d) Dredging should be initiated in the Dry Weather Flow channel and the fishery feeding channels to augment uninterrupted supply of wastewater to the *bheris*.

6.2 Upgrading solid waste using practices

The existing practice of growing vegetables on locally compostable garbage substrate using waste water stored in shallow ponds (locally known as *jheels*) suffers from institutional indifference and a few more years of apathy will lead to the collapse of this unique urban facility. Immediate action to save this waste recycling practice will include the following steps:

a) There are 49 water bodies (*jheels*) under the Calcutta Municipal Corporation (CMC) area designated for solid waste dumping. There should be no further filling up of any of these water bodies by garbage disposal.

b) All interconnecting drainage network linking these water bodies will have to be restored.

c) All formal CMC plans for solid waste recycling must include the provision for the agricultural uses of solid waste. (At present no such provisions are made in any of the CMC plans for solid waste recycling).

d) Farmers should be provided with a list of safe species that can be grown in the garbage farms around Dhapa and will have to be persuaded to discontinue the growing of relatively unsafe species. Local *Krishak Sabhas* (farmers' councils) and NGOs may take active role in this upgrading initiative and introduce modified guidelines.

e) Elaborate plantation should be taken up in this urban agricultural area taking the help of the local farmers, NGOs and the concerned agencies in the Government.

f) A shadow of uncertainty looms largely over the farmers/occupiers of the garbage farms over title/tenurial rights, as the entire land is owned by the CMC. Removal of land use uncertainty over the entire CMC area is imperative. The CMC should collect rent from the occupiers of these farming plots. A list of farmers who are presently tilling the land be prepared and appropriate rent depending upon the size of the plot be introduced. Similarly a reasonable license fee should be introduced for pisciculturists for use of CMC water bodies in the area in consonance with ground realities.

g) Extension of health care facilities for the dangerously exposed workforce engaged in rag picking in the municipal dumping grounds at Khanaberia (West) and Durgapur villages.

h) Ensuring supply of vegetable seeds particularly of the right quality to ensure and optimise cropping intensity.

6.3 Technical information base

Developing a technical information base for better management of the resource recovery systems and wise use of wetlands. Major components of the information base will include:

a) Relative relief of the wetlands area on the basis of a detailed topographical survey, including pond bathemetry and longitudinal profiles of all drainage channels and distributaries within the area.

b) Wastewater (both qualitative and quantitative) data along wastewater outfall channels (at least six sampling points).

c) Biological indicators (both aquatic and terrestrial) of environmental stress within the wetlands area.

d) Water fowl population including their habitats and food habit.

e) Types of species grown (on land and water) using city waste, their origin, spread, threats and risk to the users.

6.4 Reducing industrial polution

A large number of small and medium scale industries are availing of the drainage system laid by CMW&SA since last couple of decades to release their untreated effluent. These drainage channels are linked with the main outfall channels leading to the river Kulti. This industrial wastewater can cause undesirable impact on the fish and vegetables grown using the same. It is imperative to identify such industrial units which discharge contaminated effluent to bring them under the purview of pollution control regulations. Common in-situ effluent treatment plants for the polluting industries are considered to be the likely solution to this emerging problem.

6.5 De-silting the river Kulti-Bidyadhari

Phenomenal deposition of silt has raised the Kulti-Bidyadhari river-bed to critical limits. Immediate programmes will have to be taken up to restore the conservancy of this outfall receptacle to save Calcutta from the disastrous problem of waterlogging.

6.6 Restoring biodiversity

The work of restoring biodiversity will include the following activities:

a) plantation of trees (specially along the dykes)
b) introduction of reed-beds along the existing water hyacinth buffer margins in fishponds
c) awareness campaigns among the local people for carrying out the programme stated above;
d) promotion of scientific research through existing institutions and agencies.

6.7 Awareness campaign

Educational institutions and schools in particular should be encouraged to include the east Calcutta wetland model as a case study on urban waste management and demonstrative field trips organised where possible. These schools can be local, regional and even from other parts of the world. Almost every year, students from a few European countries have been visiting this unique ecosystem.

A state-level wetland conservation and management authority should be set up for conservation, development, monitoring and control of inappropriate use and conversions. Research and public awareness programmes should be initiated involving national and state level institutions, universities and NGOs on wetland values, wise use functioning and sustainable development of resources and their utilisation. This could help address the systemic drawbacks like public ignorance and indifference about these wetland practices.

CHAPTER 7 CONCLUSION

The Ramsar Bureau selected 17 case study sites from all over the world to demonstrate and understand wetland wise use. In that list the East Calcutta Wetlands is the only entry from India and also the only one that is by the side of a city and is largely acclaimed as an urban facility for using the city sewage in traditional practices of fisheries and agriculture. No wonder that core Calcutta has not been provided with any fund for constructing sewage treatment plant under the Ganga Action Plan. Historically, and where we tend to become forgetful, waste water management system of Calcutta, since pre-independence period, undertook all the three steps that form the basis of today's Ganga Action Plan, viz. interception, diversion and resource recovery.

The work of preparing the baseline document from which frequent references have been made, could not but be an intense process of learning by itself. In course of this not only the local people, the farmers, the managers and even political leaders remained engrossed with the research team but there was, more importantly, a commonality of purpose which was shared by all alike. Such participatory initiatives build the bedrock for any conservation programme on such sensitive tracks. We now know much more than before that conservation research is primarily a grass-roots exercise.

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