Ecological History of Calcutta's Wetland Conversion

by

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INTRODUCTION

The theory of managing urban waste is undergoing change. Planning for disposal is yielding place to concern for recycling, so that specialists have tended to become serious students of the potentialities of salvage. For this, Calcutta is perhaps uniquely privileged in having a built-in tradition of using urban waste in fisheries and agriculture, and thereby employing a remarkable system of Nature to help meet three basic problems of developing countries—shortage of food, shortage of employment opportunities, and shortage of funds to treat the waste. Scientific challenges emerging out of this situation are no less flattering. Instead of using stabilization-pond effluent in fisheries as a conventional alternative, here fisheries are using an indigenous technique of sequencing sewage ingress to become more efficient, effective, economically viable, and fairly risk-free. Proper standardization of the process could provide a least-cost alternative to municipal sewage utilization. Such systems can be highly significant in river sanitation as long as the main pollutants are of domestic origin.

This tradition is now endangered. These waste-recycling wetlands are today under threat of encroachment and perhaps extinction—mainly because of the pressures exerted by the ever-expanding metropolis, which has grown from a small trading-post of the British merchants, to the country's most populous city that is now 'bursting at the seams'. The situation has endangered one of those rare ecological campaigns in which the need of the broad majority, and some entrepreneurial gains, remain easily compatible and impressively complementary. Protecting the tradition of recycling waste would not only save the city from seemingly inevitable doom but would also mean upholding a trend-setter for similar situations elsewhere in the world in this major issue of resource recovery from city waste.

The present paper, on the ecological history of the shrinking wetlands, is a part of a series of findings obtained from the ongoing research on the wastewater fisheries of Calcutta. This account, however, is still mainly a collection of bits and pieces which is intended to inform as many people as possible about these wetlands in the hope of saving them—in turn to save the city and the tradition of resource-efficient design of urban-waste management in developing countries where too many people live and too little money is available for satisfactory public-health management.

AREA AND EARLY HISTORY

The study area lies between latitudes 22°25′ to 22°40′ North and longitudes 88°20′ to 88°35′ East, approximately. It has a hot and humid monsoonal climate that is governed by the Himalaya Mountains in the north, the Meghalaya plateau in the north-east, and the proximity to the Bay of Bengal. January is the coolest month, with temperatures generally ranging between 17°C and 21°C, while May experiences the year's maximum temperature and a range between 29°C and 33°C. The average relative humidity is high, being between 70% and 90% approximately. Relative humidity remains high in July and August. The average annual rainfall is about 1,582 mm and is mainly concentrated in the months of June, July, August, and September.

This region is a part of the mature delta of the River Ganges, and the wetlands are the 'interdistributary' marshes in the delta. Here the streams—which are tributaries, distributaries, and re-distributaries, of the Ganges—were once active. But with the shifting of the main River, these streams became inactive, and some of them even dead, with loss of headwaters. While some of them were still building up land on both sides, between those raised tracts the land was depressed comparatively, being deprived of the annual deposition of silt (Bagchi, 1944). The study area is located in such a low-lying region to the east of Calcutta. It was once covered with salt-water marshes. These salt-water marshes were between the River Hugli to the west, which is the main distributary of the River Ganges, and the Bidyadhari River, now dry, to the east (Fig. 1).

The mouths of some of the streams opened directly into the Bay of Bengal and were influenced by tidal action, which accounted for the tides and salinity of these salt-water lakes* in the vicinity of Calcutta. These Lakes were actually the spill-reservoirs of the tidal channel Bidyadhari, which opened into the Bay of Bengal through the River Matla (CMG, 1924–25). One of the spill-channels of the Bidyadhari, the Central Lake Channel, extended practically into the heart of the city (Fig. 2) even until early in the present century, and was a main drainage-line for the city (CMG, 1929).

* Hereafter in the text commonly referred to as 'Salt Lakes' or merely 'Lakes'.—Ed.

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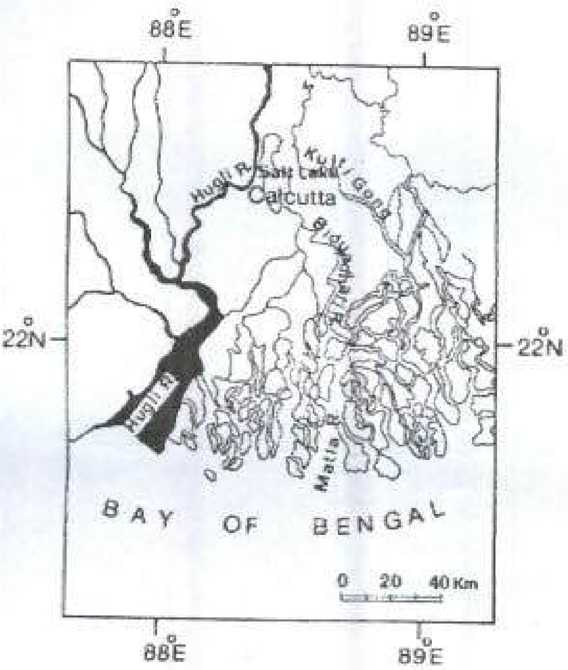

FIG. 1. *Map showing the Salt Lakes and the Bidyadhari–Kulti River systems in deltaic West Bengal.*

The land in general slopes to the east and south-east, with natural drainage in those directions. The gradient is, however, practically imperceptible. As obtained from the records of the nineteenth century, the gradient of the land from the bank of the River Hugli to the Salt Lakes was about 0'2', and the distance of the nearest margin of the Lakes was 3 km from the Circular Road, Calcutta (Clarke, 1865). In the delta-building stage, the rivers had excessive loads of silt and became sluggish, losing their gradient, so that only the recession of tidal influx could wash out the silt. Until 1830, the Bidyadhari River was an active delta-building tidal channel and was a navigation route from the Bay of Bengal to Calcutta (DECa, 1945).

The earliest known accounts (1748) of the study-area picture it as of marshy Salt Lakes teeming with fish and birds. The Lakes spread over a vast area, stretching from the vicinity of the River Hugli for about 5–6 km to the east (CMG, 1964). The present Clive House, near Dumdum to its north (cf. Fig. 2), is reputed to have been the *Sikargarh* (hunting lodge) of the Nawabs (CMG, 1964). According to these early accounts, the circumference of the Lakes was originally much greater than it is at present. In the north, the edge of the Lakes extended up to the foot of a 9-m-high mound known as Dumduma, near which the Burmese and Mug traders, arriving in boats, used to anchor. Within forty years, from the late eighteenth century, the edge of the Lakes receded about one-and-a-half kilometres.

The Salt Lakes, as found in old records, were separated into a western and an eastern portion by a ridge, and were connected by a channel. The western portion, which constituted the proper Lake, was traversed by a tidal channel diagonally for 8 km. During high tides the depth of water used to be beween 5 and 6 m. In dry seasons and during low tides, the better-drained adjoining parts of the channel were dry and exposed. The average depth of the Lakes was about half-a-metre—of stagnant water which scarcely drained. The tidal channel joined farther down with a deltaic channel of the Sunderbans, through which salt water flowed into the Lakes (Stewart, 1836).

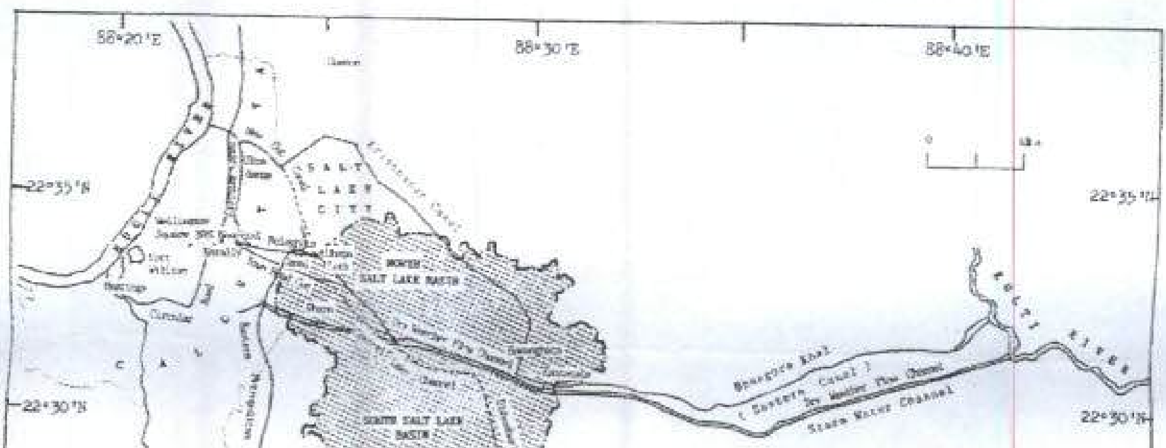

FIG. 2. *Site-map of Calcutta's waste-recycling region.*

The extensive wetlands to the east of Calcutta are facing a crisis of survival. The history of how this situation developed is an object-lesson, as revealed by study of the events over centuries which led to the present predicament. The facts point mainly to human interventions as the cause of the near-catastrophic situation now prevailing.

The Big Change

Initially, when the British settled in this area, the Salt Lakes were left alone. The immediate vicinity of these Lakes was considered inhospitable for settlement, being a breeding-ground of malaria and other diseases (DECa, 1945). In 1803, the city drainage was directed artificially into the River Hugli, against the natural slope. This proved unsatisfactory because of the annual flooding of the city during monsoon rains, and of pollution of the River which provided drinking-water to the city.

The then Governor-General of India, Lord Wellesley, appointed a Committee to examine the problems and submit recommendations for improvement (CMG, 1945). After some examination, the Committee approved a scheme of underground drainage for disposal of sewage and storm-water through the same conduit into the Salt-water Lakes, and finally into the Bay of Bengal, following the natural slope of the land towards the south-east through the Bidyadhari and the Matla Rivers (CMG, 1945). The drainage scheme was finally completed in 1884, with construction works such as canals, sluices, bridges, etc., across the wetlands. In the meantime, while the scheme was in progress, several other interferences took place. These are summarized below (Mukerjee, 1938; DECb, 1945):

Year	*Project*	*Result*	*Remarks*
1777	Excavation of the Tolly's Nala, an old bed of the River Ganges (Fig. 2).	The Tolly's Nala joined the Hugli River near Hastings and the Bidyadhari near Samukpota. Thus headwaters of the Bidyadhari were diverted, causing siltation in the lower reaches of the River.	
1810	Excavation of the Beleghata Canal (Fig. 2). This Canal was an old channel through the Saltwater Lakes and was further extended westwards into the city.		
1829	Excavation of the Circular Canal from Entally to the Hugli River (Fig. 2).	Rapid silting in the head end of the Central Lake Channel at Beleghata, which was the only drainage channel of the city. This was due to the creation of a tidal meeting-ground of the Matla and the Hugli Rivers.	
1830–34	Excavation of several east and west cuts, one of which was the Bhangore Khal (Fig. 2).	Disturbance in the tidal equilibrium of the spill-channels of the Bidyadhari and Kulti series of rivers.	
1859	Excavation of the New Cut Canal, leading from Ultadanga to Beleghata Canal (Fig. 2).	Keeping up the level of water in the subsoil and interfering with the drainage.	
1865	A square mile area (2.59 sq. km) in the Salt Lakes was acquired and handed over to the municipal authorities for dumping of the city's garbage, and for sewage farming and fisheries.	Land filling started in the Salt Lakes.	
1868–72	Construction of a railway line and a canal across the square mile area.		Around 1880, cultivation on garbage started.
1883	Dhapa Lock was constructed (Fig. 2).	Exclusion of entire tidal water from Dhapa to Entally, leading to further deterioration of the Central Lake Channel.	

Even thereafter such human interventions continued to occur almost unceasingly, as can be seen from the following examples (DECb, 1945; Mukerjee, 1938):

Year	*Project*	*Result*	*Remarks*
1896	Cross-damming of one of the most powerful tidal-spill channels of the Bidyadhari River.	Silting aggravated in the Bidyadhari River.	

Year	Project	Result	Remarks
1897–98	Canalization of the Bhangore Khal and construction of the Bamanghata Lock to facilitate inland navigation (Fig. 2).	Further deterioration of the Central Lake Channel.	Around 1900, salt-water fisheries existed in the Salt Lakes. In 1904, a warning was given regarding alarming deterioration of the Bidyadhari River.
1910	Construction of the Krishnapur Canal—a shorter route joining the New Cut Canal with the Bhangore Khal (Fig. 2).	More than 78 sq. km of the spill area of the Bidyadhari River was cut off.	In 1913 a second warning was given. In 1928 the Bidyadhari River was officially declared as dead by the Government of Bengal. During 1930, first sewage-fed fisheries started and proved successful.
1940	Sewage outfall of the city was changed from south-east to east, to the Kulti Gong or Kulti River (Fig. 2).	This was a necessity as the Bidyadhari River had died.	
1962–67	Salt Lake reclamation for the extension of the city.	Huge conversion of wetlands into urban areas. Aggravation of drainage problems of the city during the monsoons.	
1980s	Construction of the Eastern Metropolitan By-pass (Fig. 2).		

It is seen from the above chronology that the natural state of this low-lying area to the east of the ever-expanding city of Calcutta was interfered with for necessities of drainage and waste disposal with later reclamation for city extension at different times. One of the major causes of the deterioration of the Bidyadhari River and of the siltation in the Salt Lakes was the discharge of the city's untreated sewage in the area (DECc, 1945). It should be noted here that disposal of solid waste has also resulted in the reclamation of wetlands. Unlike urban conversion, however, wetlands that have been lost to garbage fill are not always of a permanent nature, this landfill having produced an economically viable natural biological system to recycle waste which is inseparably linked with the water-bodies of the area. However, there should be a comprehensive planning for disposal of garbage in the area. Together with the changing course of the River Ganges, and consequent changes in the streams of the delta region, human interventions played an important role in shaping the landscape and land-use of the region.

In the course of the last hundred or more years, what had been a saline marshy area behind the city of Calcutta thus changed gradually into a waste-recycling region bereft of salinity and of corresponding flora and fauna. The change is remarkable, especially in view of the short span of time in which it took place. A significant output of this change was the opportunity that came with it to bring out the best of the faculty of the local farmers and entrepreneurs to develop what may well be the world's largest ensemble of resource-recovery systems incorporating wastewater fisheries and agriculture based on effluents.

Significance of Wetlands

The significance of wetlands is manifold, and the salt-water lakes to the east of Calcutta are no exception. The earliest available accounts show important navigable channels and trade-routes passing through these wetlands, while the abounding fauna provided a wealth of natural resources. But the situation has changed drastically over the years, mainly through human interventions.

Resource Recovery

Before 1830, the low-lying region with salt-water lakes acting as spill reservoirs for the Bidyadhari River, were utilized for pisciculture of brackish-water fishes such as Bhekti (*Lates calcarifer*), Parse (*Mugil parsia*), Bhangar (*Mugil tade*), and prawns (*Macrobrachium rosenbergii*), etc. Spawn was introduced into the numerous cut-up water-bodies during the high tides. These water-bodies were separated by embankments and were known as Nona Bheris (salt-water fisheries). These fisheries produced on average about 0.6 quintals of fish per acre (148 kg per ha) per year (P. Ghosh, 1987, unpublished obs.).

With the diversion of city sewage and storm-water into the Salt Lakes and the deterioration of the River Bidyadhari, there was a gradual change in the aquatic environment from saline to non-saline. This ultimately led to the changes in the culture of fish in the region, especially in terms of species. In this process the sewage-grown fishes became prominent, with species such as Rohu (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*) and exotic ones such as Silver Carp (*Hypophthalmichthys molitrix*), Grass Carp (*Ctenopharyngodon idella*), and Common Carp (*Cyprinus carpio*), along with Tilapia (*Tilapia mossambica*), Walking Catfish (*Clarias batrachus*), *Heteropneustes fossilis*, etc. The change in salinity in the fisheries was from 800–1200 ppm in the Nona Bheris to about 500–600 ppm in the sewage-fed fisheries (Banerjee & Roy, 1959).

In 1945, of the total wetlands of about 20,000 acres (81 sq. km), an area of about 11,570 acres (47 sq. km) was occupied by sewage-fed fisheries with production of about 3.39 quintals per acre (837.69 kg per ha) per year (DEC*d*, 1945). The rest lay fallow. Today, sewage-fed fisheries cover about 7,500–8,000 acres (30–32 sq. km), producing 10 quintals per acre (2,471 kg per ha) per year (P. Ghosh, 1985). The loss of area under fisheries is mainly due to reclamation.

The increase in the production of the sewage-fed fisheries (Fig. 3) is due to more efficient operation than was formerly practised. It should be noted that this improvement in efficiency was obtained entirely through experiments carried out by the operators, using local and indigenous methods and resources. The processes have been proved functional over forty years, and scientific studies undertaken so far leave little doubt about their capabilities of continuing endurance. Calcutta sewage contains a low concentration of heavy-metals (Chakraborti *et al.*, 1987), and there is no evidence that normal pond-fish from other places contain fewer pathogens than the sewage-grown fishes in question.

During 1969 there was a large-scale conversion of sewage-fed fisheries, when some of these were drained and converted into paddy lands (Fig. 4). About 6,000 acres (24.3 sq. km) of fisheries were thus converted, essentially as a consequence of the unsettled-land questions and the anarchy of holding pattern in this region (P. Ghosh, 1987 unpublished obs.). Cultivation also started on the dried-up bed of the Bidyadhari River (about 1,000 acres or 4 sq. km). The entire cultivation in these regions is with fishery-effluent irrigation.

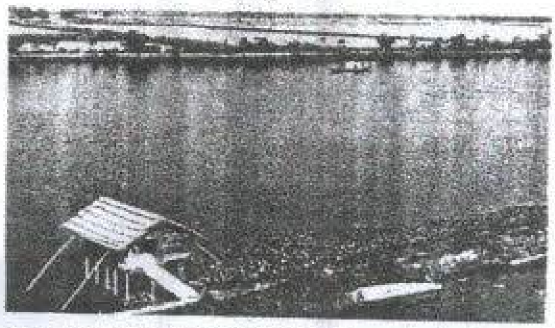

FIG. 3. *Some of the wastewater fisheries in the wetlands to the east of Calcutta.*

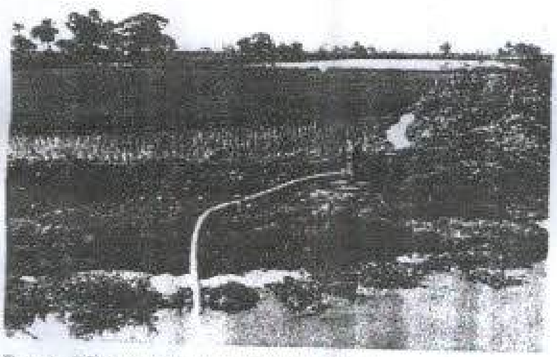

FIG. 4. *Effluent from wastewater fisheries being used to irrigate paddy fields.*

Two varieties of paddy—Aman and Boro—are cultivated of which the former is sown during the rains and the latter in winter. The production of Aman is about 8 quintals per acre (nearly 2,000 kg per ha) per year and that of Boro paddy is about 10 quintals per acre (2,471 kg per ha) per year (P. Ghosh, 1985, 1987 unpublished obs.). After Boro paddy is harvested, Aman is sown with the rains. More than half of the Aman area is not suitable for Boro cultivation, however, and remains fallow after Aman paddy is harvested. Thus the overall production from these sewage-irrigated farms is reduced and the return is poor in comparison with neighbouring fisheries, which maintain production throughout the year. Conversion of fisheries into agricultural lands has been more in the southern and eastern part of the Salt Lakes than elsewhere (*idem*).

Growing vegetables on garbage is an old practice on the fringe of the city. In 1865, a square mile area (about 2.6 sq. km) in the Salt Lakes was acquired by the Justices of Peace (the predecessor of the Calcutta Municipal Corporation) for drainage outfall works, sewage farming, and dumping of the city's refuse. This area came to be known as the Dhapa Square Mile (CMG, 1964). Embankments were constructed around the Square Mile area, to keep out tidal water. A municipal railway-line was constructed in 1868, to transport city garbage to Dhapa. A canal was constructed through this area for transport purposes, and a fish-market was also established.

As reclamation of the Salt Lakes continued with dumping over the years, reclaimed lands were leased out for short periods, for cultivation and pisciculture in the intermediate water-bodies in the reclaimed area. In 1880 a nineteen-years' lease was granted to one Bhabanath Sen for cultivation, fisheries, and unloading of garbage-wagons in this area. The lease for nineteen years was later extended (CMG, 1929–30). The cultivable lands were let out in small parcels which were again sublet. Settlements grew up, and at present there are about 800 acres (3.2 sq. km) of garbage farms in nine villages (IWMED, 1986) of which the inhabitants are mainly engaged in cultivation of vegetables in the Dhapa area on a garbage substrate with sewage irrigation.

Dumping of garbage in the Dhapa area has resulted in raising of the general level of the land between 1 and 1.5 m through all these years, and the raised part of the land is entirely composed of consolidated garbage (D. Ghosh, 1985). The garbage has been dumped in a planned sequence, to develop a landscape of alternate garbage-filled land with water-bodies between them. These water-bodies provide sources of irrigation for agriculture. On the basis of a rapid assessment, the garbage farms at present produce more than 1,500 quintals of vegetables per acre (370,650 kg per ha) per year, which are marketed in the city of Calcutta (IWMED, 1986). Given proper management and necessary technological upgrading, Dhapa garbage farms could provide a low-cost technique of solid-waste recycling in agriculture.

Lost Navigability

Records show that, early in the eighteenth century, there was a shallow and tortuous channel, partly dry at low-water, by which boats passed through the Salt Lakes to a point about two-and-a-half kilometres east of Entally. This actually came to be known as the Eastern Canal, which was essentially a series of small water-bodies connected by a shallow channel. It represented in fact a natural creek which extended across Circular Road and went down what is now known as Creek Row, leading to Wellington Square (cf. Fig. 2) which was originally known as Dingee Bagan, meaning the gathering place of small boats. It is said that, during a severe cyclone in 1837, a ship was carried across from the Hugli River and wrecked in this creek (Fever Committee, 1865).

In 1810, this old Eastern Canal was improved, widened, and lengthened. As a result, from the Salt Lakes, near a village called Chingrighata, the Canal extended almost to Circular Road at a point a little to the south of the then Campbell Hospital, now known as Nilratan Sarkar Hospital (Fig. 2). From there it was joined to an open drain known as the Old Dharamtala drain whereby a part of the drainage of the city was directed to the Salt Lakes. With the construction of this extension, boats could penetrate farther into the city, to unload their cargoes. A part of this Old Eastern Canal, from Circular Road to the site of the present sewage pumping station of Entally, was converted into a large brick-lined tunnel for draining the storm-water of the city. The remaining part came to be known as the Beleghata Canal (Fig. 2).

At a later date, the Salt Lakes provided another means of access to the city from the eastern region of the then undivided Bengal and what is Bangladesh today. This channel, known as the New Eastern Canal, was particularly important because it also provided a route for transportation of goods from Barisal to Calcutta *via* Khulna. It should be mentioned that, with the excavation of the Tolly's Nala in 1777, the traffic could pass right across the city into the River Hugli; also that, although it is well known that the city of Calcutta lies on the bank of the River Hugli, there is another river which played an important role in Calcutta's life and does so even now—although not as much as before—through the Salt Lakes. This is the River Matla. Together with numerous natural creeks and artificial canals as well as the Salt Lakes, the River Matla provided a navigable route at different times for boats connecting Bangladesh and Calcutta. The tidal channel Bidyadhari provided, at one time, the direct connection between the Salt Lakes and the River Matla.

Thus we see that the Salt Lakes, described in one of the accounts as vast wastelands to the east of the city, provided important channels for navigation through which the city could be approached from the east (Fever Committee, 1865). We also find the beginning of a new role of the Salt Lakes as a receptacle of urban wastewater from the early nineteenth century onwards. Furthermore it may be noted that, in those lakes, a wealth of fish remained available throughout the entire period under consideration.

Salt Lake Reclamation

The salt-water lakes of about 20,000 acres (81 sq. km) had always been considered as a breeding-ground of mosquitoes causing malaria, and from time to time there were suggestions for draining and putting them to other land-uses. In 1830 Lord William Bentinck, the then Governor-General of India, first proposed reclamation of the Salt Lakes by construction of embankments and draining them out—on sanitary grounds. The proposal was approved but could not be carried out for lack of the necessary finance (CMG, 1940). In 1865 the Salt Water Lakes Reclamation Company Limited was formed. The Company proposed reclamation of the area through construction of embankments, drainage, and clearing of existing jungles to the east, known as the Tardah Jungles. The proposal included a scheme for disposal of sewage, diluted with water, in the region, to develop agriculture; but it was not accepted by the Government (CMG, 1940).

During 1882–83 a proposal was made for reclamation of the northern part of the Salt Lakes by draining through the Central Lake Channel and a canalized Bhangore Khal (Fig. 2) to Kulti River from Dhapa, and closing the Bidyadhari River below Bamanghata (Fig. 2) and another channel, Kantatala Gong, below Kantatala. For the southern part of the Salt Lakes a separate scheme was proposed. These proposals were not accepted owing to the excessive cost involved (CMG, 1940).

A salt-water lakes reclamation Committee considered two schemes for the salt-water lakes. One was for the extension of the city, and the other was for the improvement of the area for fish culture—the latter being the cheaper, as the plan did not involve any construction work. After considering both the proposals, the Committee concluded that the major part of the northern Salt Lakes would be reclaimed for city extension, and most of the southern part and also the southeastern part of the northern sector would be developed for fishery and fishery-*cum*-agriculture. As proposed, the city would expand in the northern Salt Lakes region within a zone of 7 miles (11 km) radius from Government House (DECe, 1945). It was in the year 1953 that the Government of West Bengal took a decisive step on a plan prepared by consultants from the Netherlands, which proposed reclamation of the Salt Lakes and extension of the city by about 2,500 acres (*c*. 10 sq. km) in one portion of the Salt Lakes and development of agriculture, horticulture, and fisheries, in the other part (CMDA, 1976).

The Salt Lake Reclamation and Development Board was formed in 1960 under the Irrigation and Waterways Department of the Government of West Bengal, for reclamation of the northwestern part of the Salt Lakes (CMDA, 1976). Reclamation of the Salt Lakes, with silt dredged from the River Hugli, started in 1962 and ended in 1967 (SRDC, 1981–82). A Yugoslav firm was engaged for this work. About 300 acres (1.2 sq. km) were filled up and converted into the Salt Lake City (SRDC, 1981–82).

Further encroachment of the wetlands has been stopped by the local fishery owners, and legal action has been instituted by them against reclamation. It may be mentioned that various other kinds of land-use, contemplated at different times, included a landing area for seaplanes, grazing ground, sites for mills and factories shifted from Calcutta etc., in the wetland area (CMG, 1940). A suggestion for utilizing the Salt Lakes for developing fisheries, either fully or partly, remained throughout as a common element in proposals for development of the Salt Lakes area.

After reclamation of the Salt Lakes for extension of the city, approach roads have been built, as also a peripheral by-pass called the Eastern Metropolitan By-pass (Fig. 2). A part of this, running from north to south, passed through the wetlands. This construction required filling up of parts of the wetlands and of the solid-waste disposal ground. The corollaries included adverse effects on the drainage, loss of wetlands, and eviction of people. Fig. 5 shows the extent of wetland conversion through 1919 to 1960.

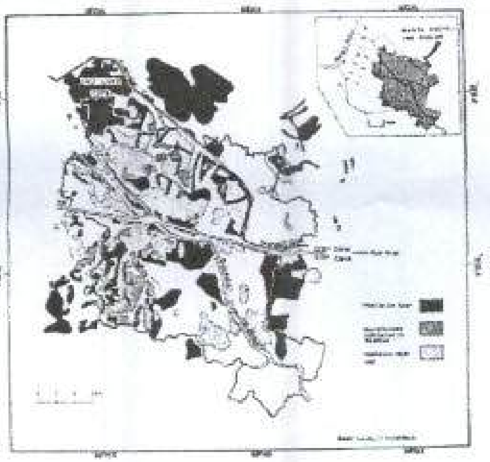

FIG. 5. *Map showing the extent of wetland conversion in the east of Calcutta through 1919 to 1960. Basis: Survey of India Maps.*

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SUMMARY

The interest in the wetlands ecosystems on Calcutta's periphery should be understood in the context of the search for development alternatives—for locally-adapted, appropriate modes of development rather than transplantation of alien models. Too often, planners look abroad for ideas without realizing that appropriate principles and practices are present in their own backyards. We are now coming to understand that ecodevelopment entails bringing together creative techniques with the ways in which people perceive and approach the issues of quality of life through environmental changes that are in the forefront of planning debates. Human and ecologically-sound planning requires an integration of such understanding with suitable techniques and procedures.

Urban waste, particularly sewage, has long been deposited in adjoining swamps and marshes in many places in the world. In the wetlands lying east of Calcutta there exists, and has existed for more than a hundred years, a lasting tradition of disposal and utilization of urban waste in agriculture and fisheries. These wetlands are shrinking. From more than 20,000 acres (*c.* 81 sq. km) in the 1960s they have already been reduced to less than 10,000 acres (*c.* 40 sq. km) (Fig. 5), the major loss being to urban reclamation and conversion of fishery to paddy cultivation that has no waste-recycling merit. Uncertainty prevails over the entire remaining wetlands because of the absence of regulatory policy and the resultant chaos threatening the entire system of urban waste utilization (Mitra, 1984).

The significance of these wetlands in environmental rescue-work is manifold (Furedy & Ghosh, 1983; D. Ghosh, 1983). They take the city's sewage and garbage and in return provide a significant part of its requirements of fish and vegetables. Furthermore, these systems provide for the city's spill-basin and excellent natural biological treatment of waste-water (D. Ghosh, 1983)—surely most important for a city where no working sewage-treatment plant exists. These shrinking wetlands conceal one of the biggest laboratories in the world for sanitary engineers to standardize and develop least-cost alternatives in municipal waste management that would ensure maximum recovery of nutrients available in waste.

Calcutta's eastern wetlands are, therefore, significant as a foremost example of a least-cost alternative in municipal waste-recycling in the City's backyard. A recent World Bank Report describes the fisheries in the east of Calcutta as the largest single system in the world to use sewage (Edwards, 1985). In these shrinking wetlands thrive traditions of resource conservation and environmental rescue which can contribute to the harmonious development of the city and its fringe. This creative and ingenious practice, associated with fishery and agriculture using urban waste, is gravely endangered. It deserves international recognition and a national policy for its protection and extension.

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