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Translocal Learning for Water Justice: Peri-Urban Pathways in India, Tanzania and Bolivia

Water Justice City Profile: Kolkata, India

Jenia Mukherjee, Institute of Development Studies Kolkata
Asish Ghosh, Centre for Environment and Development

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Translocal Learning for Water Justice
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This is an output produced from WatJust, an action learning alliance led by Prof. Adriana Allen (DPU, UCL) and supported by ISSC Transformations to Sustainability Programme.

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Graphics and layout: Paola Fuentes
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For more information about WatJust and to access other outputs produced by this learning-action alliance please visit: https://www.bartlett.ucl.ac.uk/dpu/water-justice/

Abstract. *Translocal Learning for Water Justice.* (WatJust) is an action-learning alliance led by Prof. Adriana Allen at the Development Planning Unit (DPU, University College London). Launched in September 2014, WatJust explores the transformative potential of alternative water supply arrangements—small-scale, low-cost management practices, and new configurations of water governance—undertaken for and by the peri-urban poor in three urban regions: Kolkata (India), Dar es Salaam (Tanzania) and Cochabamba (Bolivia). The documentation and analysis of these practices aims to build the foundations of an innovative, grounded and in-depth exploration of the extent to which such arrangements can enhance water justice in a context where unmet needs are growing fastest, and where conventional centralised networks are unlikely to become the norm any time soon.

Foundational to the project is the establishment of a translocal learning alliance in collaboration with the three project partnerships. This report represents one of three profiles exploring the specific and localized manifestations of water injustices and alternative arrangements, mapping these approaches as a source of dialogue, comparison, and learning.

Content

City Profile

The city of Kolkata is often described as 'triple-blessed': possessing a river for drinking water, another to dispose of waste, and the wetlands between to treat its sewage and produce its food. Yet despite these rich advantages, significant disparities exist across its growing population of 14.38 million—and particularly in relation to the access to and control over water and sanitation services. While officials of the Kolkata Municipal Corporation (KMC) claim to reach 85% of the population through piped water supply, only 50% of the population has access to sewerage services. Though water is provided free of charge by the municipality, this piped coverage is disproportionately lower (and almost non-existent) in the peri-urban areas of the city. Here, lower-income communities residing in informal neighbourhoods are instead reliant upon groundwater extraction of poor quality, or the use of water vendors at high fees.

This unequal distribution of services is perhaps nowhere more evident than in the south eastern peri-urban interface of the city, known as the East Kolkata Wetlands (EKW). The wetlands play a critical role in the social and ecological functioning of the city, and are integrally linked with the historical trajectory of the city, emergence of the canal system during colonial times, and indigenous methods of waste recycling and reuse. Officially declared a Ramsar (protected) site in 2002, nearly 100,000 people are estimated to live in houses on narrow strips of land in between the wetland sewage ponds, or bheris. These areas are largely lacking policy-driven municipal water and sanitation services, and residents have instead developed a range of alternative needs-driven practices to meet their everyday needs.

Significantly, and in spite of the lack of service provision from municipal authorities, citizens residing and working in the EKW play a critical role in waste management for the city. The EKW and Dhapa landfill area absorb 750 million litres of waste water and 2,500 metric tonnes of waste generated by the city per day. Low-cost, traditional and indigenous recycling practices undertaken by fishermen and farmers residing in the area have paved the way for three major eco-environmental practices: wastewater fisheries, effluence-irrigated paddy cultivation, and vegetable farming on garbage substrates. In this way, the EKW acts as the 'natural kidney' of the city, treating and recycling nearly 30% of the total waste water generated by the city. It is estimated that the city receives nearly one-third of its daily fish and vegetable requirements as a result of the garbage farming practices in the Dhapa dumpsite.

This mutuality between the livelihoods strategies of communities living in the EKW and the ecological sustainability of the city represents a key mode of co-production at work in peri-urban Kolkata. Moreover, these practices, while holding a critical impact at the city-scale, have also offered hints for alternate modes of cooperation which could address some of the everyday challenges of water and sanitation for residents of the EKW. For instance, co-operative fisheries in the Bidhannagar area have played an important redistributive function amongst their members, and have been particularly active in supporting educational and financial investments for safer sanitation strategies at the household level.

Today, the urban development trajectories of the city have increasingly placed the EKW at risk. Despite its official protection as a Ramsar site, residents are frequently reporting a process of slow encroachment as property developers seek to convert this land into real estate, particularly in the rapidly-growing IT and leatherworks industries based in the Bantala area. Within this context of the transforming relationship between Kolkata and its PUI—and amidst increasing encroachments on the wetlands—it becomes critical to delve deeper into the challenges and potentials of the existing co-produced water and waste practices to address these injustices. Ultimately, it is hoped that such an examination can facilitate a recognition of the value of these networks, bolster the strengths of co-produced practices, and foster wider water and sanitation justice across the city. (Allen et al., forthcoming)

1. Water Injustice in the City

1.1 Introduction

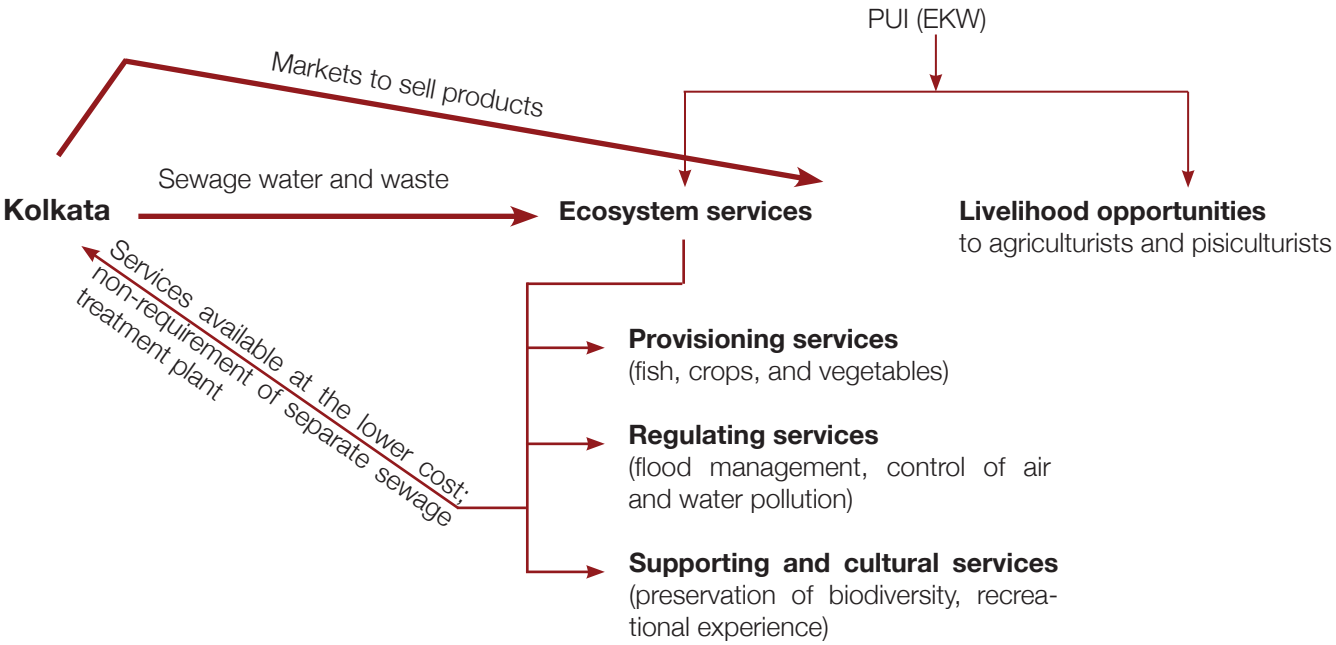
Kolkata is a 'triple-blessed' city, possessing "a river for its water, another river where it can discharge its waste, and wetlands which can clean its sewage and produce its food. Its cycle of water and waste is a closed cycle –water to water; water to food" (Banerjee and Chaudhuri, 2012).

The sustenance of Kolkata depends heavily upon its interaction and interdependence with its peri-urban interface (PUI); particularly in regards to the wetlands in the eastern part of the city,[1] which act as the transitional zone in an urban–rural continuum within a rapidly urbanizing space (Figure 1). Through the cultivation of sewage-fed ponds, or *bheris,* the East Kolkata wetlands provides a thriving ecological, social, and productive function for the city, drawing particularly upon the local innovation and knowledge of lower-income communities living and working in the area. Many of these residents—using small-scale, low cost, and indigenous waste water management and recycling practices—work as peri-urban farmers or fisherman to cultivate cereals, vegetables (25% of the total vegetables supplied in Kolkata markets/150 tonnes daily), and fish (20% of the total production supplied in Kolkata markets/22 tonnes daily). These practices also support waste management for the entire city, using and recycling the city's solid waste and effluents (810 million litres per day) that are dumped in the solid waste dumping ground (Dhapa) and carried by canals into the eastern part of Kolkata.

Despite the huge socio-ecological significance of these activities, peri-urban farmers living and working in the wetlands lack formal access to basic service provisions like safe drinking water and sanitation facilities. In addition, they face constant threats to their livelihoods as a result of the rapid urban sprawl encroaching onto the wetlands in the eastern part of the city. This generates pressures not only for these local residents, but also threatens the ecological functioning of the wetlands themselves, the only and major community-led natural waste recycling system infrastructure for the entire city of Kolkata.

While some cooperatives have formed which have sought to address some of these collective struggles related to water and sanitation, particularly amongst waste pickers

Figure 1: Sustainable flows between Kolkata and its peri-urban interface. Source: Mukherjee, 2015



and farmers, this has yet to reach a significant scale within the city. Within this context, it is important to:

- Examine drinking water supply and sanitation arrangements in the PUI for those residents of the East Kolkata Wetlands—covering a wide spectrum of policy-driven, demand-driven and needs-driven practices;

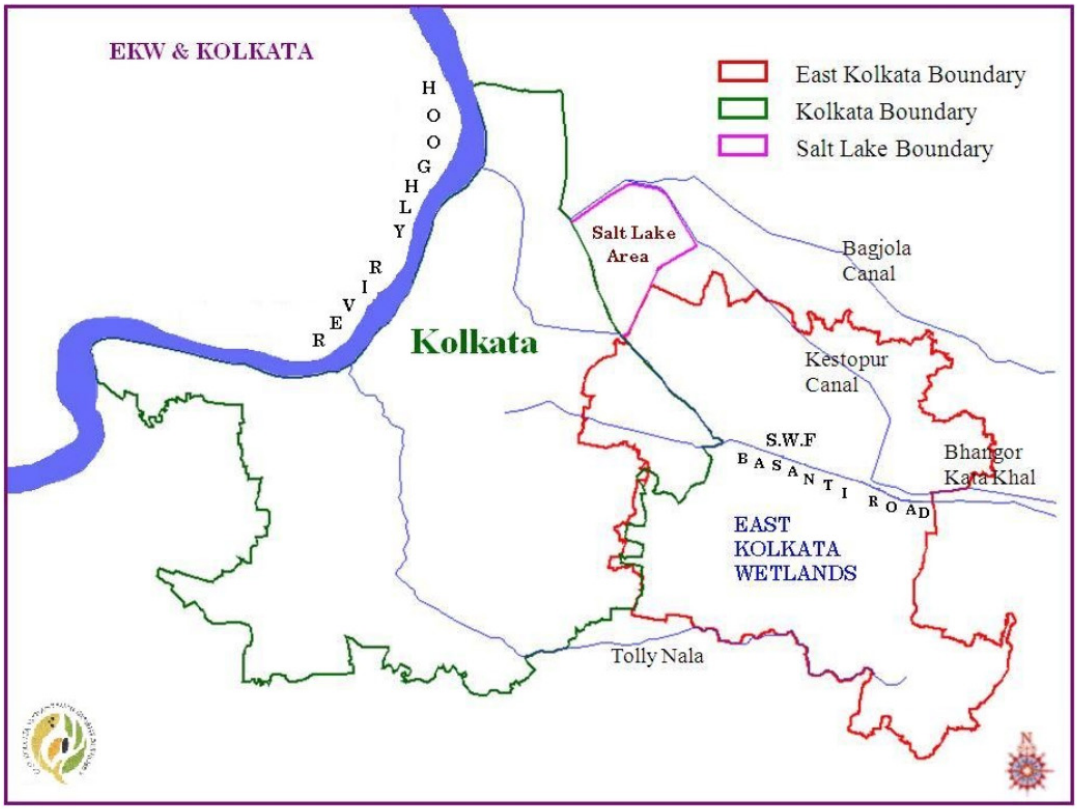
- Explore, identify and document a wide range of (co-produced) water and waste management practices across temporal scales, to understand and explore their transformative potential to build towards water justice in the city.

Critically, the peri-urban EKW should not be explored as a separate region, detached from its urban counterpart and urban processes, but as an attached, integrated and embedded water-scape (Mukherjee, forthcoming). This study aims to go beyond binary perspectives which pit urban development priorities against the ecological sustainability of the wetlands, recognizing that urban and peri-urban areas in Kolkata have a long history of co-evolution and interdependence from colonial times. Instead, it seeks to identify, map and document the existing pluralities within the complex waterscape, involving a range of players in co-produced water/waste management practices, exploring the cross-currents of power at play, for a better understanding and exploration of the scope, problems and prospects of co-production in selected sites within the East Kolkata Wetlands.

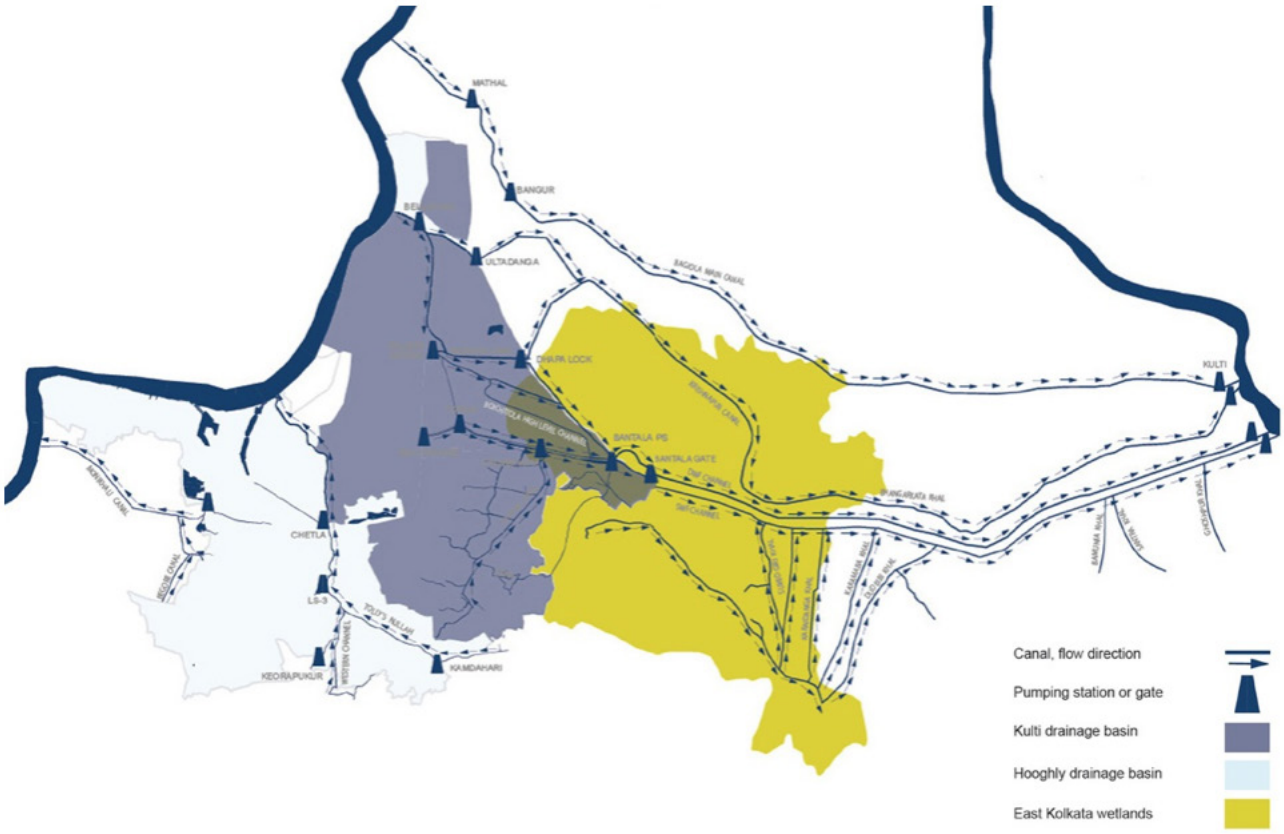
1.2 The East Kolkata Wetlands

The focus of this study is the East Kolkata Wetlands (EKW), in the eastern peri-urban interface of Kolkata, consisting of a core area of 12,500 hectares (ha), [2] and covering parts of the Kolkata Municipal Corporation (KMC), Bidhannagar Municipal Corporation (BMC) (ward no. 17) and adjoining gram panchayats (GPs) (Map 1). The EKW lies between the levee of the River Hooghly on the west and the Kulti River on the east, and is distributed nearly equally between the two sides of the storm water flow (SWF) and dry weather flow (DWF) channels that reach the Kulti River (Map 2). The morphology of the wetlands is the result of the natural gradient to the east which was then acquired, adopted, tamed and intervened with by colonial interventions paving the way for the evolution and emergence of the EKW.[3] The dimensions and depths of these waterbodies have been transformed and refined over time to "optimize the condition of biodegradation" (Herzog et al, 2008, p. 20). Today, the entire EKW region, including the core and buffer zones, is inhabited by approximately 150,000 people. The core area of 12,500 ha consists of roughly 60,000-100,000 people living in houses in the narrow strip of lands between *bheris.*

Map 1: The Location of EKW. Source: http://www.ekwma.com



Map 2: Kolkata drainage basins. Source: Herzog et al, 2008, p.60-61



Urban sprawl in the eastern part of Kolkata has seen the rapid conversion of huge hectares of the wetlands since the 1960s. In the 1990s, civil society groups along with grass-roots actors waged a battle against the state (Dembowski, 2001) and successfully sought the protection of the wetlands from further encroachment. In 2002, 12,500 ha of EKW was recognized as a Ramsar site, ensuring the conservation and sustainability of these wetlands areas. However, despite this internationally recognized protection, water bodies are still being encroached upon and converted within this area and its environs. Recently, there has been a conflict between the KMC, Kolkata Metropolitan Development Authority (KMDA), Department of Irrigation and Waterways (DoIW) and Fish Producers' Associations over the operation of gates on the sewage canals, impacting the supply of waste water being channeled into the *bheris*. A recent report published in the Times of India commented: "The flow of sewage into the fish farms or bheris has been deliberately reduced in an attempt to snuff out fishery and farming and make way for conversion of the land into real estate" (Subhro Niyogi, Feb. 6, 2015). This mirrors wider trends of urban development within the city, impinging upon hard-fought rights for the ecological protection of the wetlands. While the KMDA and other government and development agencies like the West Bengal Industrial Development Corporation, and the West Bengal Housing Infrastructure Development Corporation (HIDCO) are interested to attract private investments through urban and industrial development in this region, environmentalists, civil society groups (PUBLIC, Save the Wetlands, amongst others) and local residents are strictly against such ventures, pushing instead for the preservation of the wetlands.

1.3 Water injustice and emerging urban development trends

The evolution of modern water injustices experienced at the city-level in Kolkata can be traced back to colonial times. In 1868, the Palta Water Station was constructed [4], providing treated and filtered piped water supply (from the Hooghly River) to the then most affluent 2,316 houses out of the total 16,000 in the city. The remaining 'black town' lacked access to both piped water supply and sanitation facilities. In 1872, C. Fabre-Tonnerre, Health Officer for the Calcutta Municipality writes:

> *"A bustee or native village [black town] generally consists of a mass of huts constructed without any*

> *plan or arrangement, without roads, without drains, ill-ventilated and never cleaned….In these bustees are found green and slimy stagnant ponds, full of putrid vegetable and animal matter in a state of decomposition and whose bubbling surfaces exhale, under a tropical sun, noxious gases, poisoning the atmosphere and spreading around disease and death. These ponds supply the natives with water for domestic purposes and are very often the receptacles of filth."*

While the Palta Water Works project was laid out in stages (Table 1) to supply nearly 1,700 million litres every day, its spatial distribution has continued to disproportionately serve filtered water to more privileged populations and neighbourhoods.

The population of Kolkata has increased tremendously in the last few decades.[5] Compared to this demographic upsurge, municipal service coverage for drinking water and sanitation is inadequate. Officials of the KMC claim to cover 85% of the population through piped supply, though the Asian Development Bank's (ADB) 2007 *Benchmarking and Data Book of Water Utilities in India* puts the figure at about 80%. Only 50% of the population has access to sewerage services.

Discrimination in water supply provision is evident from plans and projections sketched out by official planners and consultants. Most strikingly, the KMC estimates vastly different levels of water demand from affluent neighbourhoods than for slum populations. For example, in 2011 the theoretical water demand calculated as a part of the urban ministry's policy of water supply and distribution was 960 million litres per day (mld) for the entire city. However, this was based on the assumption of 180 litres per capita (lpc) per day consumed by the 'resident' population, 90 lpc per day for 'slum' populations and 5 lpc per day for 'floating' populations (Chakrabarti 2013; interview with Chakrabarti, March 6, 2015). This official stance reflects the discrepancies in treatment amongst different identified categories of citizens, underlining the conditions for stratified service provision.

Table 1: Expansion of Palta Water Works. Source: Official site of Kolkata Metropolitan Water and Sanitation Authority (KMWSA)

Year	Supply of water (MGD)
1869	6
1911	46
1946	60
1950	68

In particular, the newly added areas of the KMC (ward 101 to 141), and the newly developed townships within the Kolkata Municipal Area (KMA) in the south-eastern part of the city, suffer from a lack of access to filtered piped water supply. In these areas wealthy real-estate enclaves and residents of informal areas alike depend on ground water supply obtained either through the support of the KMC or private developers, or through other needs-driven arrangements that have emerged in these areas. However, the over-extraction of ground water is considered another major threat for the delta city and its peri-urban fringes, affecting the quality of water and ecological sustainability of the entire region.

Even where residents have access to piped water, an estimated 30-35% of water is lost during transmission from the source, to pumping stations, and finally through to the receiving end, either through leaks or theft. To put this in context, this means that every day filtered water worth around 2.7 million rupees, (treated at 4.50 rupees per 1,000 litres), is lost—this in a city where more than 1,000,000 city dwellers do not have access to safe drinking water.

The KMC has not set up a taxation structure for drinking water supply to its 141 wards, and where there is piped service water is supplied absolutely free. However, in consideration of the differential treatment in water provision for different neighbourhoods, in practice, this arrangement has been experienced to the detriment of the poorer city dwellers. On this point, Asit K. Biswas, president of the Third World Centre for Water Management in Mexico, and an adviser on water to various international governments, reflected: "a person living in a slum hardly gets about 50 litres a day while the city average is around 200 litres. A poor person is subsidising a rich man the extra amount of water – around 150 litres – who is getting his car washed and watering his plants with the filtered water supply at his house" (*The Telegraph*, Jan. 22, 2012).

1.4 Institutional landscape of urban water supply

Two agencies are jointly responsible for water supply and sanitation provision in Kolkata: the KMC and the Kolkata Municipal Water and Sanitation Agency (KMWSA). While the KMC is in charge of water supply to all the wards within the KMC, KMWSA covers the rest of the metropolitan area. The water supply system consists of four Water Treatment Plants (WTPs) (Map 3):

a. Palta WTP: serving mostly the northern and central parts of the city
b. Garden Reach WTP: serving mostly the southern parts of the city
c. Jorabagan WTP
d. Watgunge WTP: serving a limited number of wards in the western KMC area

The Dhapa treatment plant has also recently been inaugurated (Dec. 2014) to supply the areas surrounding the Eastern Metropolitan Bypass, in response to depleting ground water sources in that region. However, this is still yet to be operational.

In spite of its apparently good connection and official depiction as water-surplus city, Kolkata has become in practice a water-short city. Transmission losses amounting to 30-35% of total production mean that the city supplies 145 lpc per day, in contrast to the projected 224 lpc (Anon, 2011; Banerjee and Chaudhuri, 2012; Chakrabarti, 2013). As a large part of the network has long outlived its life, tank leaks have become endemic and the bursting of pipes is frequent (Figure 2).[6] Apart from leakages, water is also illegally tapped and stolen.[7] While many households, even within the KMC, remain deprived of a piped water connection, "274 mld of treated water goes to waste because of a lack of transmission or transportation pipelines" (Anon, 2008). Within this context, a 2012 report undertaken by the Centre for Science and Environment (Banerjee and Chaudhuri, 2012) strongly emphasises that the claims of KMC officials of reaching people, and particularly lower-income populations, are tenuous.

Within the KMC, 10% of the total water supply is met from ground water sources (Chakravarthi, 2011; Chakrabarti, 2013). Other municipalities within the KMA depend on ground water exclusively, including the south-eastern peri-urban parts of the city. The Bidhannagar Municipality (one of the selected sites) is an exception which depends on the KMC (Palta WTP) for water supply. However, in general, areas with slum populations and squatter settlements are not provided with filtered piped water connection. Groundwater is available at a depth as little as 3 metres (m) from the surface.

Map 3: Major WTPs and STPs. Source: Banerjee and Chaudhuri, 2012, p. 390

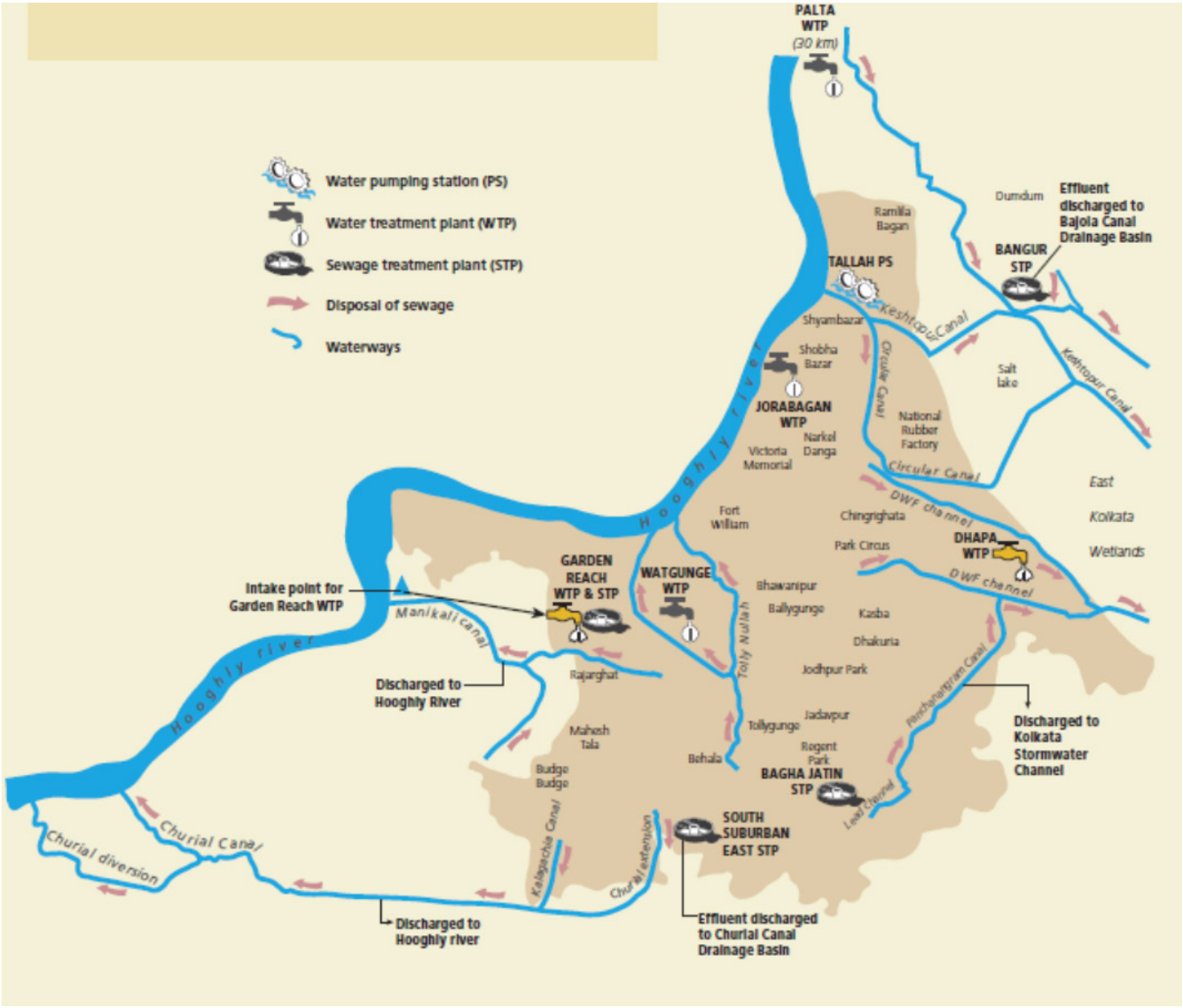
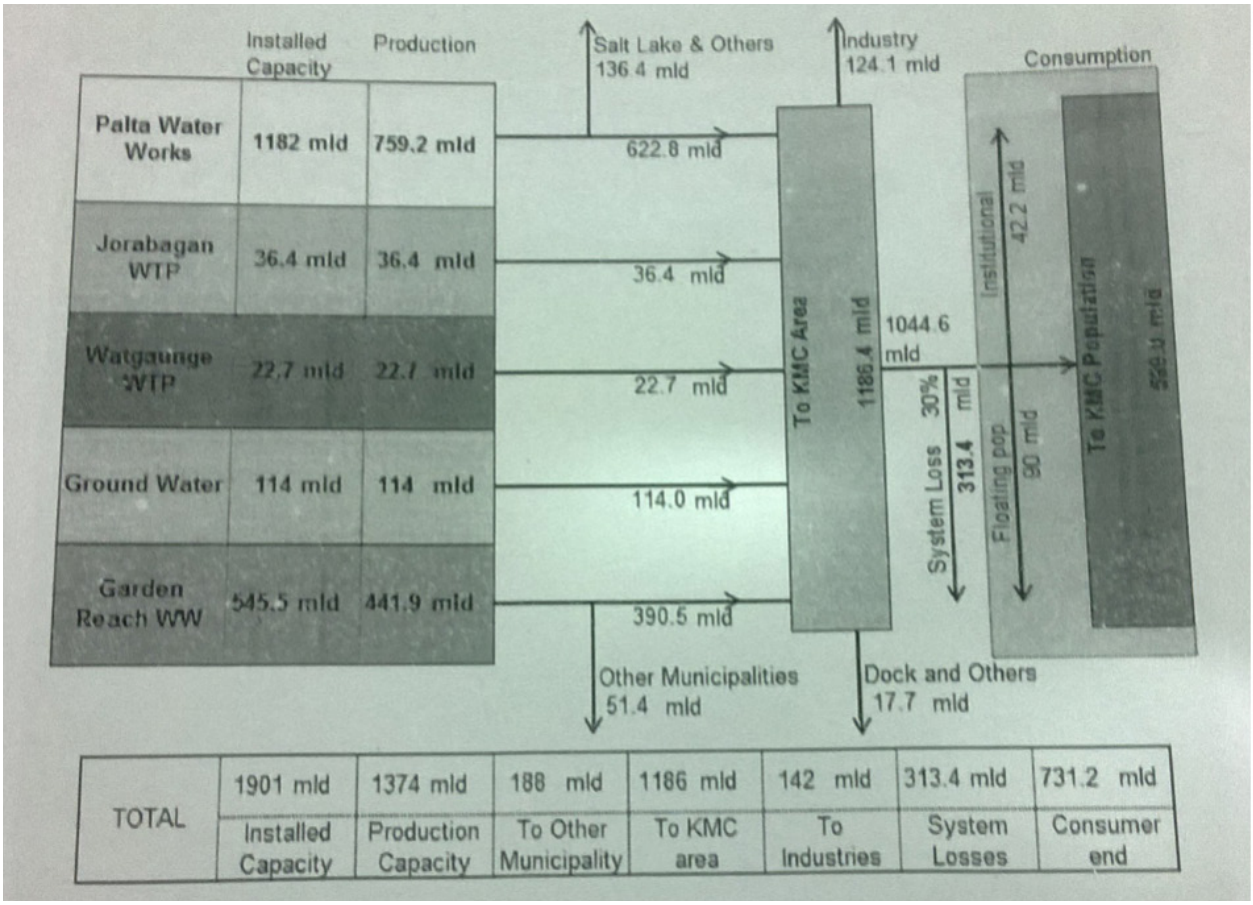


Figure 2: Water production, distribution and losses for KMC. Source: Chakrabarti, 2013, p. 25



[The above figure illustrates that despite the capacity of 1901 mld, treatment plants can only make use of up to 1374 mld due to production limitations. Of this, 1186 mld should reach the KMC, but after losses of 313.4 mld due to faulty systems, only 731.2 mld actually reach domestic consumers.]

NOTES TO CHAPTER 1

1. The wetlands are known as the East Kolkata Wetlands, and the nomenclature owes to Dhrubajyoti Ghosh, an environmental engineer who first discovered and documented the resource recovery features of the landscape.

2. The EKW consists of roughly 20, 000 ha of which 12,500ha is designated as the Waste Recycling Region (WRR). This is the core area which has achieved Ramsar recognition and protection since 2002.

3. The salt water marshes existed on the eastern part of the city for many years. The marshes were saline as a result of the Bidyadhari River overrunning into the low-lying marshes. The Bidyadhari River acted as the outfall channel for the disposal of stormwater and sewage for the city; when the river decayed in1928, the Kulti Outfall Scheme (further east of the region) was executed and commissioned in 1943. With this diversion in the discharge of the city, the salinity of the salt lakes dwindled from 800–1200 parts per million (ppm) to 500–600 ppm. This turned the once profitable nona bheris (saltwater fisheries) into sewage-fed fisheries. The saltwater marshes that existed 200 years back between the Hooghly and Bidyadhari Rivers gave rise to the present EKW (Gupta, 2005, p.24). When the Kulti Outfall Scheme was implemented, an adequate water-head was raised for supplying sewage to most of these fishponds, which resulted in the extension of wastewater fishponds further east and south-east for about 8,000 hectares (Ghosh, 2005, p.48).

4. And with this Kolkata became the first city in Asia with piped water supply.

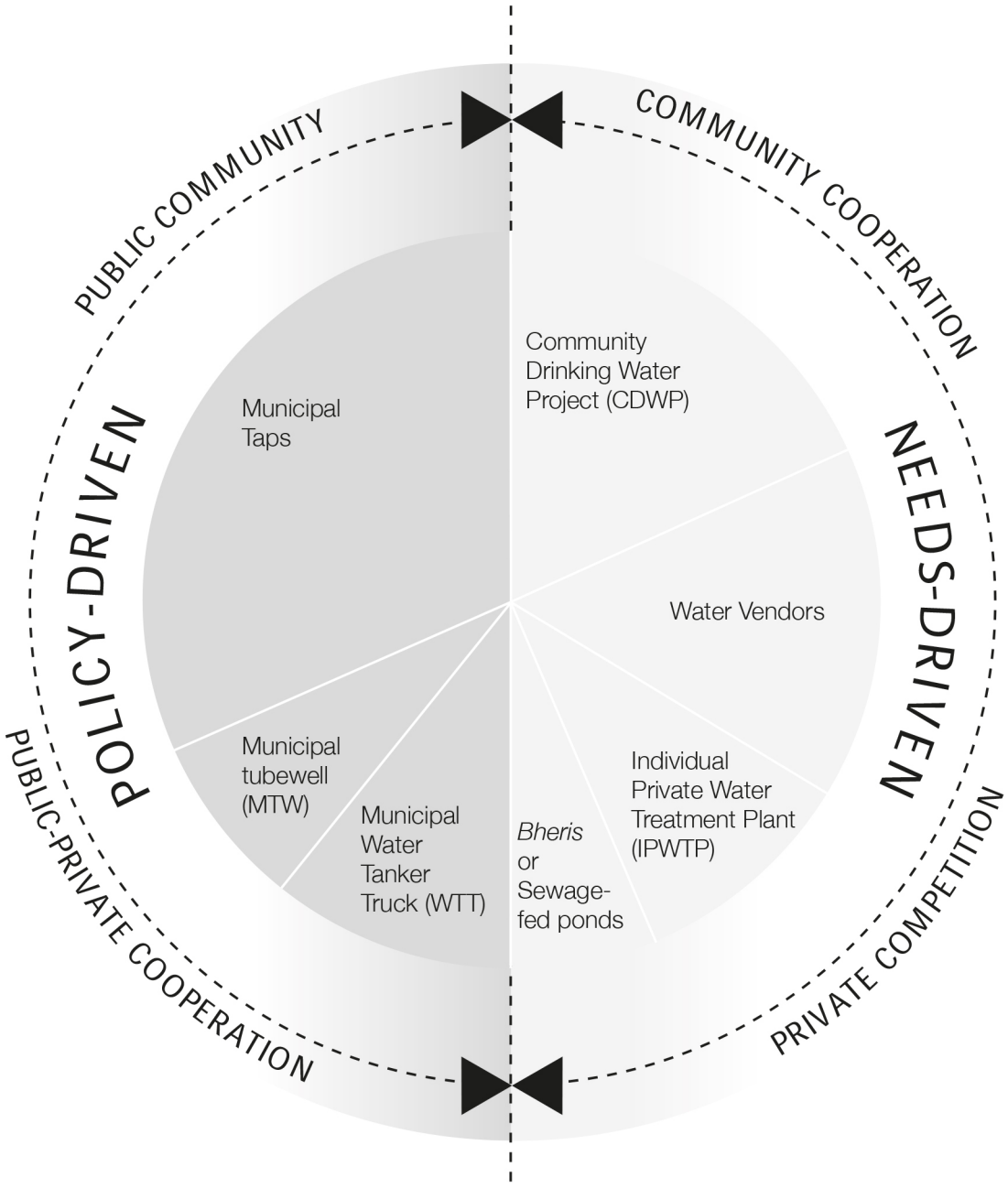
5. The population of Kolkata increased from 3.2 million in 1981 to 14 million in 2011.

6. In 2006, the Palta treatment plant had to be shut down as the 22-km pipeline connecting the Tallah pumping station to the plant developed as many as 17 leakages –this meant a frequency of one leak for almost every kilometre of the pipeline (S. Ray, TOI, Sept. 12, 2006).

7. This is the figure claimed by officials, though it has not been examined in detail.

2. Water and Sanitation Wheel for Kolkata

2.1 Policy-driven and needs-driven approaches in water supply



Source: Elaborated on the basis of Allen et al., 2006a; 2006b

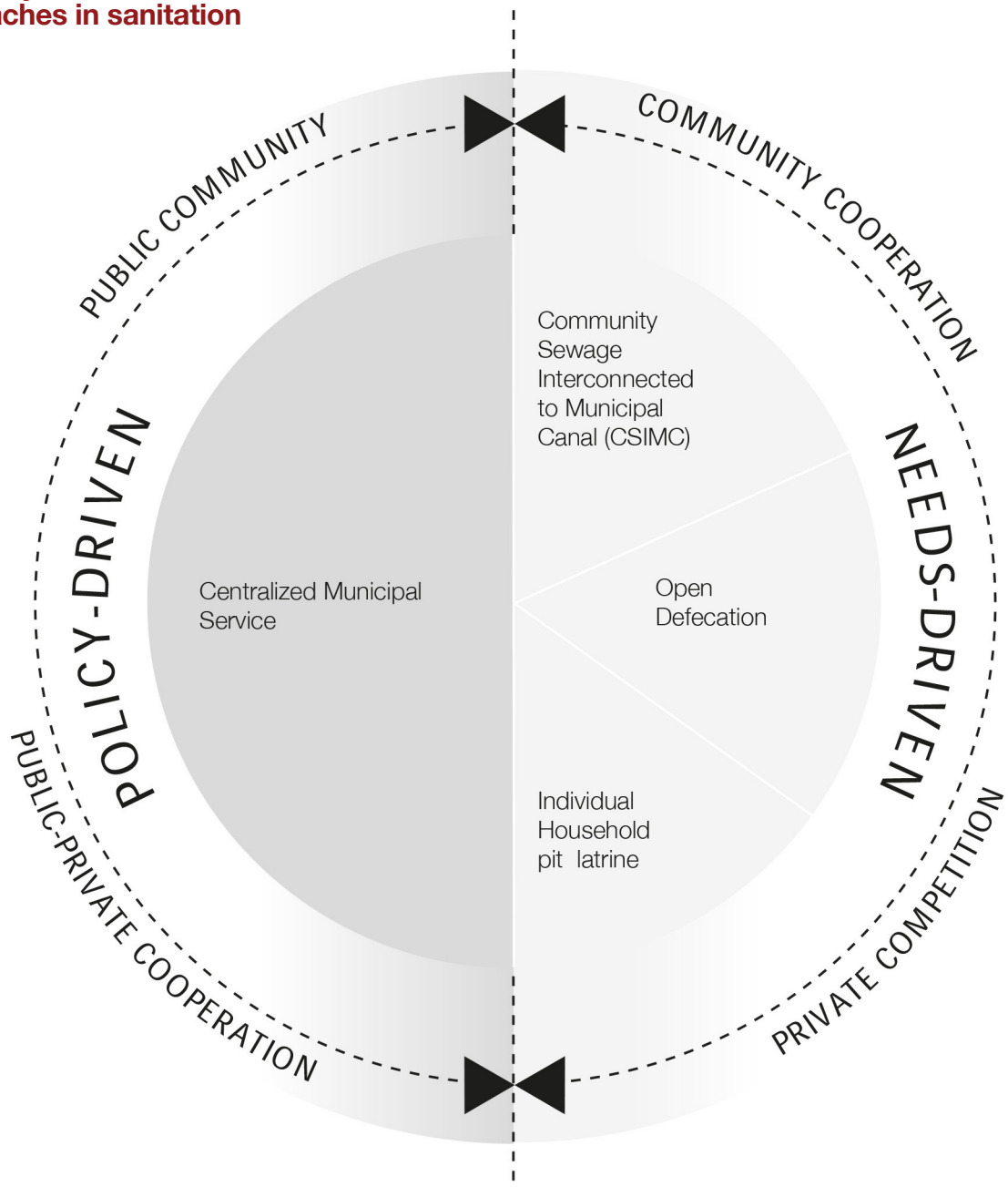
These challenges of municipal service provision are mirrored within the East Kolkata Wetlands. Within this area, the vast majority of residents lack access to filtered piped water supply. Instead, residents rely upon a number of needs-driven and demand-driven arrangements: purchasing water from municipal tankers, private vendors, an NGO-supported community drinking project (water treatment plant) (at lower prices than vendors), or for the poorest of household, collecting from the sewage-fed ponds (*bheris*) (Table 2).

Table 2: Water practices in Peri-Urban Kolkata (EKW). Source: Compiled by the authors

Practice	Type	Characteristics	Approx. Cost	Examples	Additional observations
Municipal taps	Policy Driven	Water is extracted from ground water through electric pumps. Water is provided 6 hours a day during the morning, afternoon and evening, and flows freely without the ability for residents to turn this on or off. These are public taps with no private connection, shared by members of at least 4-5 households. The quality of water is poor (saline water with high level iron and phenol content). As such better off HHs prefer not to use it for consumption, but use it for other domestic purposes like washing, bathing, etc.	Fully subsidized with a production cost	Bidhannagar (no. 17 ward)	While the better-off HHs prefer not to drink the tap water, the more marginal HHs (for example contractual labourers in the fish farms) depend on this for drinking purposes.
Municipal tubewells	Policy Driven	These are manually operated deep and shallow tube wells for extracting ground water. These are either constructed by the municipality or by private initiative with permission from the municipality.	Fully subsidized with a cost for installation	Bidhannagar (ward no.17) Bantala	The tube wells do not function properly after 7-10 years due to technical problems and the decline of the aquifer.
Municipal water tanker trucks	Policy Driven	The tankers provide treated surface water once a week up to 60-100 litres per family (regardless of the number of family members).	Free supply	Bidhannagar (ward no. 17) Bantala Dhapa	Water tanker trucks reach Nawbhanga when municipal taps go defunct for a certain period of time and complaint is lodged to the local councilor. In Dhapa and Bantala this remains the primary practice in the absence of other water supply services.

Practice	Type	Characteristics	Approx. Cost	Examples	Additional observations
Water vendors	Needs driven	Vendors work privately, either extracting ground water from tube wells, collecting filtered surface water from pressure release points, purchasing water from the community drinking water project, or leaking KMC pipes. They distribute it using bicycles or tricycles to neighbourhoods. HHs purchase the water and have it transferred into their own containers.	The price of water varies between Rs. 5 to Rs. 20 for a jar of 20 litres, dependent upon the distance travelled by the vendor.	Bidhannagar (ward no.17) Dhapa Bantala	With inadequate and poor municipal service coverage, this form of small-scale business is flourishing, with many poor members of peri-urban HHs becoming involved.
Community drinking water project	Needs Driven	A small water treatment plant has been set up through a joint initiative by a private company and an NGO (SAFE) to provide treated water at a very low price. This plant treats surface water and at the same time conserves water through rain water harvesting.	60 paisa/litre	Shukantanagar *bheri* (within Bidhannagar (ward no. 17)	This project is seldom used directly by peri-urban poor residents as they lack the storage capacity, and often cannot travel 5kms daily to reach the project. Instead, this facility is often used by middle-class HHs in the adjacent areas that also lack filtered piped water connection. It is also used by water vendors and distributors who collect and sell among the peri-urban poor and others at an inflated price.
Small individual/ private water treatment plant	Needs Driven	Individual HHs have set up water treatment plants without permission from the municipality. These plants generally use ground water as the raw source and have the capacity to produce 500-1000 litres of treated water per hour.	Rs. 10 for a jar of 20 litres	Bidhannagar (ward no. 17)	The complex dynamics relating to these distributive mechanisms are yet to be examined.
Bheris (sewage-fed ponds)	Needs Driven	The pond water is consumed directly and used for other domestic purposes.		Bidhannagar (ward no. 17) Bantala Dhapa	The poorest of the PU HHs depend on this practice.

2.2 Policy-driven and needs-driven approaches in sanitation



Source: Elaborated on the basis of Allen et al., 2006a; 2006b

Sanitation is a broad, overarching concept that includes the provision of facilities and services for the safe disposal of human excreta, solid waste and waste water. In developed countries the majority of people are served by 'environmental sanitation', which "focuses on the entire chain of managing wastewater, looking for the optimal approaches and technologies related to collection, transport, treatment and disposal of wastewater flows" (Wetlands International, 2010, p. 29). Safe disposal of wastewater is a complex issue, and the costs of wastewater treatment and disposal depend on the different technologies used along the sanitation chain (Tilley et al, 2008).

Historically, sanitation in Kolkata has had a lower priority amongst planners (Nath, 1991). 50% of the city's population and 55% of the KMC area is covered by sewerage network measuring 1,610 km, and consisting of 1,430 km of piped sewers and 180 km of brick sewer line. The city has no sewage treatment plants (STPs) within municipal boundaries. There are three small plants located outside the municipal limits at Bangur, Garden Reach and

Bagha Jatin (Map 2), however, these have little capacity: 45 mld, 48 mld and 2 mld respectively.

In spite of the lack of major STPs, the city does have a natural waste engineering plant and recycling infrastructure, which relies upon low-cost indigenous technology and techniques. The EKW and Dhapa landfill area absorb 750 million litres of waste water and 2,500 metric tonnes of waste that is generated by the city per day.[8] The low-cost, traditional and indigenous recycling practices undertaken by fishermen and farmers residing in the area have paved the way for three major eco-environmental practices in this area: wastewater fisheries, effluent-irrigated paddy cultivation and vegetable farming on garbage substrates (Table 3).

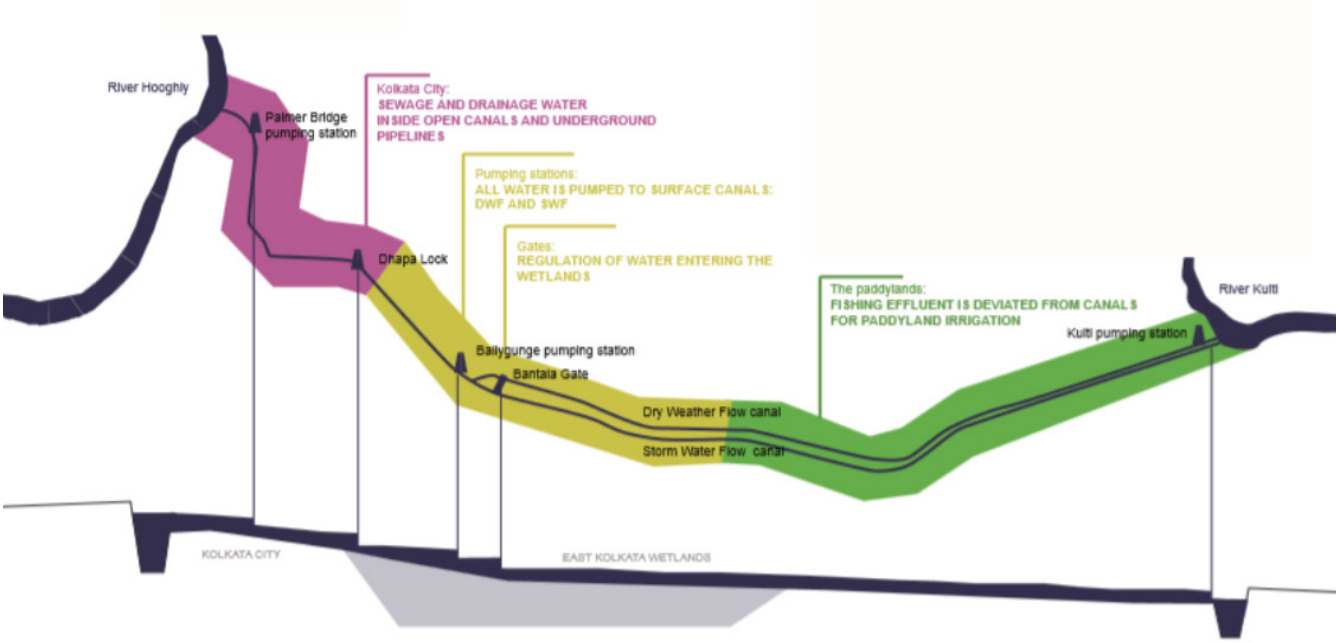
Table 3: Land use status in EKW. Source: Kundu et al, 2008, p.869

Land use	Area
Substantially Water Body-oriented Area	5852.14 Hectares
Agricultural Area	4718.56 Hectares
Productive Farming Area	602.78 Hectares
Urban/Rural Settlements	1326.52 Hectares (91.53 ha. Urban +1234.99 ha. Rural)
Total Area	12500.00 Hectares

This system works in the following way. Municipal waste water is led into the bheris from the DWF channel. The flow is regulated with pond-specific gates (Figure 3). The size of the bheris range from 5 to 50 ha and the depth is shallow (1 metre), for the proper functioning of sewage biodegradation. There are also small nursery ponds where fish eggs are grown. The sewage biodegrades in the *bheris* and gets exposed to sunlight, algae and bacteria (cloriform). When fish eggs are transferred to the *bheris* from the nursery ponds, the fish begin consuming the biodegraded waste as nutrients. Similarly, the fish manage any overgrowth of algae through consumption, another essential condition for fish growth and waste water recycling. From the *bheris*, the naturally treated waste water is discharged to the Kulti River. This cycle continues yearly as each *bheri* is drained during the winter and the pond bed is prepared for a fresh wastewater intake (Ghosh, 1991; 1997; Kundu et al, 2008; Carlisle, 2013). In this way, the East Kolkata Wetlands acts as the 'natural kidney' of the city, absorbing all manner of waste generated by the city in a completely unsorted and unprocessed way, treating and recycling nearly 30% of the total waste water generated by the city.

Despite this significant contribution to the ecological functioning and waste management of the city, at the household level residents of the EKW lack adequate access to sanitation options. Individual sanitation practices

Figure 3: Waste water receipt and discharge by EKW. Source: Herzog et al, 2008, p.58



vary from the use of single and double pit latrines connected to septic tanks, to makeshift community sanitation systems connected to municipal canals (CSIMC), to open defecation. The exact percentage for all these categories is not known and awaits further field research. While these options remain limited, residents have indicated that cooperative fisheries operating in the area are now highly discouraging open defecation and CSIMC practices as this ultimately degrades the *bheris*. Though fish in the bheris consume fecal matter, recently cooperative members have become aware that this may reduce the prices that the fish are able to generate in the Kolkata market. Some cooperative fisheries like the Baro Chaynavi (with 67 members) in Bidhannagar ward no. 17 have begun to allocate funds and/or loans to their own members with zero interest rates to construct pit latrines in their households. 60 out of 67 members have now pit latrines which they have constructed through support from the cooperative. This form of collective organization around sanitation awaits further exploration for the extent to which it can collaborate with municipal authorities to reach a greater proportion of residents.

NOTES TO CHAPTER 2

8. There is difference of opinions regarding the figure which varies between 600 and 810 million litres per day (mld).

3. Overview of Co-Produced Practices in the EKW

Co-produced water and sanitation practices in the East Kolkata Wetlands must be contextualized in relation to the wider socio-political forces and legal restructuring which occurred in West Bengal. The *West Bengal Estates Acquisition Act* and *West Bengal Land Reforms Act* were implemented in 1953 and 1955 respectively, to abolish zamindari (aristocrat) ownership of land. However, these acts contained exemptions covering tea gardens, orchards and fisheries, and as such individual fish farms in peri-urban Kolkata largely remained intact until recently. In 1995, the *Land Reforms Amendment* was passed, at which time the fisheries were covered. This led to the cooperativisation of a number of bheris, when private holdings were vested from their owners by the state and transferred to fisheries groups and cooperatives. This led to the decline of large privately owned fisheries, however a number of smaller, household-managed ponds continued to exist. At this time some of the large fisheries were also directly acquired by the government, through the State Fisheries Development Corporation.

Today, a wide range of dynamic CWM practices involving multi-level stakeholders can be identified in the EKW impacting both water and waste arrangements. Fishermen and farmers depend on the municipal supply of waste water and solid waste for pisicultural and agricultural activities. Fish production in the *bheris* depends on a number of factors, including coordination among various stakeholders. Within the government, this includes the KMDA, KMC, DoIW, Dept. of Environment (DoE), Dept. of Fisheries (DoF) and West Bengal Pollution Control Board (WBPCB). It also includes external supporting agencies and programmes such as the Asian Development Bank-funded Kolkata Environmental Improvement Investment Programme (KEIIP). Finally, this also includes fish producers associations and fishermen and women (Table 4).

Table 4: Role of multi-level stakeholders. Source: Compiled by author

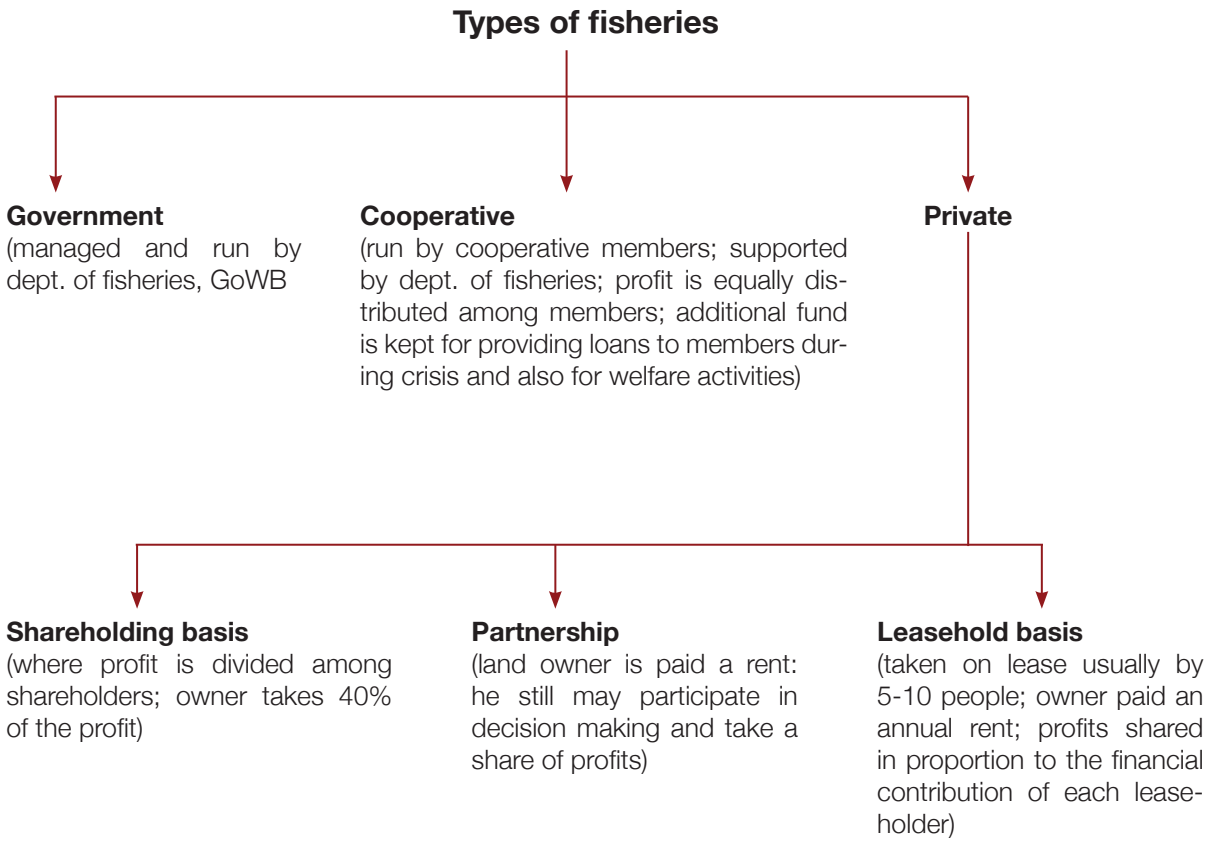
Stakeholders	Roles and Responsibilities
KMDA	Operation and maintenance of drainage
KMC	Urban authority for the city, administers part of the EKW and has significant land ownership
DoIW	Management of the sewage canals that carry waste water to the wetlands and associated sluice gates
DoE	Formulation of the wetlands management plan
WBPCB	Monitors pollution and the quality of water discharged from Kolkata
KEIP	Restoration of canals and development of infrastructure that would impact the EKW
DoF	Manages and runs some of the largest fisheries; provides support to the cooperative fisheries and advice on technical aspects of fish production
Fish Producers' Association	Association of fishermen employed in the bheris; plays an important role in determining wage rates along with other social issues
Fishermen and women	Provide skill and labour in fish production; further hierarchies are noted within this group

Around 8,500 people are employed in the 264 *bheries* that make up the waste water fisheries. A further 4,000 people are involved in agrarian activities spanning across the eastern wards of the KMC, ward no. 17 of the BMC, and some gram panchayats. Though there is no estimate on the exact number of waste pickers from the Dhapa landfill, it can be roughly assumed that around 25,000 people are engaged in this occupation.

Apart from permanent agricultural, horticultural and fish farm labourers or harvesters, a number of labourers are employed on a contractual basis especially during peak seasons. The fishery workers range from fish harvesters (early morning fishermen completing 3/4 hrs of work per day during harvest time), carriers (men and women transporting goods to the markets, carrying 12-20 kg of fish, and completing 3/4 hrs of work per day during harvest time), guards (men keeping watch for poachers at night, 8-10 hrs of work every day) and weeding labourers (men and women responsible for cleaning weeds and plants in the *bheris*, completing 6 hrs of work every day). There is variation in both wages and tenurial security for fishermen and women across the three categories of fisheries, determined primarily by their ownership patterns: government, private and cooperatives (Figure 4).

In recent years a number of threats have been experienced to the detriment of the ecological and socio-economic fabric of the EKW. Cooperative fisheries are increasingly becoming privatized, selling *bheris* to commercial companies operating in the region. This has been particularly problematic for the fishermen making a living in the EKW, who generally receive lower wages from private companies, and suffer from a greater level of job insecurity. Unlike fish farms managed under the cooperative model, private farms focus primarily on the generation of profits—and do not engage in the distributive activities of the cooperatives—including the allocation of funds to members for welfare measures such as the construction of pit latrines, or other community and household goods.

Figure 4: Types of fisheries based on ownership pattern. Source: Edwards, 2002; based on field data



4. Selected Case Studies

4.1 Bidhannagar (ward no. 17)

Ward 17 of the Bidhannagar Municipality contains 65 bheris, including two of the largest government owned *bheris*: Nalban and Goltala. Similarly, some of the largest cooperative *bheris*, such as *Baro Chaynavi Matsya Samabay Samiti* cooperative, also lie within the administrative division of the BMC. The cooperative fisheries, in particular, have played an important social and ecological function in this area of the wetlands, supporting everyday water and sanitation strategies for residents. Cooperative fisheries in this area also practice integrated aquaculture and similar activities (horticulture, cattle rearing, poultry), using municipal waste water and biodegradable solid waste.

Ward 17 lacks filtered piped water supply arrangements provided by the municipality, and residents depend alternatively upon a number of other policy and demands driven initiatives (Table 2). Individual and small-scale private water treatment plants (producing 500-1000 litres of water per day) are increasing being established in this area, particularly following the success of the community water drinking project implemented by SAFE and Waterlife. The secretary of one of the cooperative fisheries has indicated that the cooperative also has a plan for installing a private water treatment plant that would be fully managed and run by cooperative members.

Around 50% of households lack municipal sewerage coverage and rely upon makeshift private sanitary arrangements, with the sewage ultimately discharged either into the canals or the *bheris*. However, this practice is being highly discouraged by cooperative fisheries, which have taken an initiative to generate awareness among cooperative members regarding proper sanitation arrangements. The cooperatives allocate loans with zero interest rates to their members for the construction of single and double pit latrines to support better sanitation practices. The *Baro Chay Navi Samabay Samiti* has played an important role in this context; within the last five years 60 out of the total 67 members of the cooperative have created pit latrines in their individual households with support from the cooperative fishery.

4.2 Bantala

The Bantala area falls under the jurisdiction of ward 108 of the KMC, and consists roughly of 58 fisheries, 16 of which are run by cooperatives (Ghosh, 2003). Farmers in this area have been practicing effluent-irrigated paddy cultivation and sewage-fed fisheries for many years. As this area was only later incorporated into the KMC, it does not have access to filtered piped water supply, with residents relying primarily upon service from municipal tankers, a practice which is extremely inadequate for those lower-income communities inhabiting this area. The role or future plan of cooperatives in this context is an area yet to be explored.

Bantala is a site that has undergone tremendous land-use change due to the rapid eastward sprawl of Kolkata. The Bantala Leather Complex was set up at the direction of the Supreme Court of India to curb toxic pollution from the chromium used in the treatment of leather. Following this, 400 tanneries were shifted from Topsia, Tangra and Beleghata with a projected plan to set up a common effluent treatment plant with UNDP assistance. The leather complex now occupies 700 acres, and also accommodates IT firms and other commercial projects. The untreated effluents discharged from these industries flow into the city's age-old DWF and SWF, contaminating the fisheries. Thus the development of this area has seen the conversion of huge acres of wetlands at the cost of the ecological functioning of the wetlands, affecting also the livelihoods options for the poor.

In recent times there has been an escalating conflict amongst the KMC, KMDA, DoIW and Fish Producers Association over the operation of the lock-gates on the Bantala sewage canal, which controls the flow and supply of waste water into the *bheris*. Traditionally, the lock gate control at Bantala—which controls the distribution of sewage—should be maintained at a maximum GTS (Grand Trigonometric Survey) of 9 points, which is lowered to 4.5 during the monsoon season. This arrangement ensures that there is an appropriate amount of sewage water flowing into the *bheris* during peak fish cultivation season. At the Bantala point however, the irrigation department has been diverting water into the Kulti River after an accumulation of just 7.5 rather than the regulated 9. This has generated two significant problems. Firstly, it has impeded the flow of nutrients to the fish in the sewage fed ponds, impacting the livelihoods of the fishermen working in the bheris. Secondly, the water flowing into the Kulti river has been untreated, affecting the ecology of the river as well as the health and well-being of more than 20,000 people residing in the Sundarbans. Within this reality, it is critical to identify

and document the coping strategies adopted by the local fishermen in response to these challenges.

4.3 Dhapa

Dhapa has been the dumping ground for the city's solid waste from 1865, when a one-acre piece of land was acquired on the western edge of the wetlands to dump garbage from the city. During the period of colonial rule, a company called the Salt Water Lake Reclamation Company started experimenting with sewage and garbage farming to raise paddy, vegetables and cotton. From this point, "…the dumping of garbage and farming on it began simultaneously and have remained an inseparable whole" (Hertzog et al, 2008, p. 77). However, though initially successful, in absence of technical support from government actors or other experts, this practice of garbage farming was maintained only through the efforts of indigenous farmers.

The entire Dhapa region is owned by the KMC, which allows farmers to work as tenants or sub-tenants, responsible for the entirety of the farming operations and marketing. At present some 325 ha of garbage farms are located within the EKW, and particularly in and around the Dhapa area. There are around 3000 farm plots in Dhapa, ranging in size from 5-30 cottahs (1 cottah = 720 sq. ft).

Farmers produce 11-16 different varieties of crops and vegetables (Table 5), with sewage water from the *bheris* used to irrigate the farms. These farms are reported to produce 1,500 quintals of vegetables per half hectare, per annum, providing employment to 2.5 persons per half hectare, not including the additional employment required for ploughing and irrigation. Furthermore, roughly 4,700 ha of agricultural lands devoted to raising paddy or rice use effluent water from the *bheris* for irrigation. The cultivation of rice is made possible because of the persistent supply of effluent water running through the wetland canals. Fishermen and farmers live on wetland produce and sell the surplus to city markets, and 74 percent of the working population draws their sustenance from fish farming, agriculture and horticulture (EKWMA, 2010, 24). The city receives nearly one-third of its daily fish and vegetable requirements from the EKW at cheap prices due to the proximity of the wetlands.

The United Nations Environmental Programme (UNEP) recognizes that: "the best known example of garbage farming is at Calcutta's Dhapa dump" (Municipal SWM, UNEP). These low-cost and indigenous practices have allowed farmers to recycle waste to wealth, helping to make waste recycling in the city extremely cost-effective, as well as generating cheaper vegetables and crops to the benefit of lower income groups and the wider city.

Table 5: Crops and vegetables grown at Dhapa

Name of Crops	Yield
Cauliflower	15,000 heads
Ridge Gourd	45 Quintals
Maize	45 "
Radish	45"
Yam	70"
Brinjal	90"
Bottle Gourd	240"
Bottle Gourd Plant	126"
Pumpkin	180"
Pumpkin Plant	30"
Bitter Gourd	9"
Spinach	90"
Pui	108"
Danta	90"

5. Conclusion

The Kolkata case strongly highlights the need for the emergence of more inclusive paradigms in urban ecological research (Mukherjee, 2015). There seem to be two major paradigms dominating the city: on the one hand, urban and the peri-urban areas are studied using a framework of domination/subordination, in which peri-urban areas function as both an output and an input—produced and required by the city (Mukherjee, forthcoming). From another perspective, rural and peri-urban areas are perceived as a liability to the growth and development of the urban core (the economic nucleus) (UN Habitat, 2012; UNECOSOC, 2014). This research seeks to challenge these prevailing paradigms, highlighting the metabolism between the city and its PUI, characterized by mutual linkages, interactions and interdependencies, rather than in contrast or contradiction.

The East Kolkata Wetlands are the largest community managed waste-water fed aquaculture system in the world. As such, there is a strong potential to explore the ways in which these co-produced waste management practices can contribute to both the ecological sustainability and empowerment of local communities, as well as scale-up across different sites. Cooperative management structures that have formed around the fisheries have already demonstrated evidence of contributing to both the social and ecological functioning of the wetlands and its residents. It is evident in this case that marginal peri-urban communities play an immense role in the sustenance of the city. However, these systems still need to be studied in more detail, interlinking the water (and waste) trajectories at work within the city with those water regimes operating within the entire basin. It is also important to identify the (local and extra-local) challenges and conditions that have hindered a deeper recognition from local authorities (such as planners and officials) of the immense potential of this system in supporting productive, ecological, and social functions in the city.

Within the context of the transforming relationship between Kolkata and its PUI—and amidst increasing encroachments on the wetlands—it is important to explore the challenges and potentials of CWM practices in its specific socio-ecological context. This must involve a detailed identification of a wide spectrum of these dynamic practices—delving deeper into their emergence and evolution, cross-fertilization (with other spaces of participation or co-produced practices) and transformation across temporal trajectories and within different historical and politico-ecological contexts. Ultimately, it is hoped that such an examination would facilitate the recognition of the value of these networks, building upon the strength of these practices, and generating the conditions and opportunities to foster greater dialogue and interdependence among multi-level stakeholders operating in Kolkata.

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