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Valuing Water for a Smart and Sustainable City: Lessons from Kolkata

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ABSTRACT The issue of valuing water is contentious because of its physical, political and economic dimensions. Yet, it is an important debate, as valuation is key in estimating the benefits and costs of different management options. An effective valuation supports better informed decision-making in the allocation and use of the resource, as well as in the implementation of SDG6, i.e. to "ensure availability and sustainable management of water and sanitation for all." For cities to qualify as water-smart and sustainable, utilities must identify the values of different benefits, explore potential trade-offs between diverse values, and include them in the decision-making processes to address efficiency, equity and sustainability concerns. This brief analyses the management of water in Kolkata and argues that, so far, the desired outcomes are yet to be met.

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INTRODUCTION

In many cities across the world, rapid urbanisation and population growth have led to scarcity and rising costs of water. Currently, 55 percent of the world's population lives in urban areas, and the proportion is expected to increase to 68 percent by 2050.[1] Scientists predict that water demand will exceed supply by 40 percent by 2030, due to the combined threat of climate change and population growth.[2] Moreover, water scarcity will likely worsen due to inefficient water management and treatment systems, resulting in water loss through a network of leaking distribution pipes and dilapidated infrastructure. These challenges demand a systemic change in urban planning and urban water management.

In India, urban piped-water supply is over 70 percent, while rural piped-water supply is around 30 percent. The Government of India (GoI) aims to cover the increasing number of habitations with uninterrupted 24x7 water supply: piped-water supply with all metered household connections (designed for 70 LPCD or more). The campaign seeks to ensure that at least 90 percent of households in India have access to piped-water supply; at least 80 percent households have piped-water connection; less than 10 percent use public taps; and other 10 percent use hand pumps or other safe and adequate private water sources.[3]

With these and other more ambitious targets, the GoI initiated the "100 Smart Cities Mission" in 2015 to integrate city functions, utilise scarce resources more efficiently and, overall, improve the quality of life of citizens. Water is a crucial element in these efforts. A 'smart city' is envisioned to improve safety and security as well as efficiency of municipal services by linking multiple systems within a network to facilitate data-sharing across platforms. The use of information and communications technology (ICT) is at the core of enhancing a city's liveability, workability and sustainability.[4]

The Ministry of Urban Development has identified 24 key areas that cities must address in their 'smart cities' plan. Of these, three are directly related to water and seven are indirectly related to it. These include: smart-metre management, leakage identification, preventive maintenance and water-quality modelling.[5] More recently, the Sustainable Development Goals (SDGs) have also being incorporated in cities' development plans. Water and sanitation (SDG6) are at the core of sustainable development and the range of services they provide are key to poverty alleviation, economic growth and environmental sustainability.[6]

In September 2015, the Indian government made a commitment at the UN General Assembly to implement the SDGs. The commitment was to make cities smart, sustainable and engines of progress by 2030, building on earlier goals of ending poverty, and providing housing and basic services to all by the early 2020s. The Smart Cities Mission is one of the many mechanisms that will help operationalise the nationwide implementation of the SDG priorities—poverty, employment, and basic services (including provision of safe drinking water for all).[7]

WATER-SMART AND-SUSTAINABLE CITY: CORE IDEAS

A water-smart city must integrate urban planning and urban water management to create a green and resilient infrastructure that can cope with the challenges related to supplying freshwater, resource-use efficiency and energy transition, preserving freshwater sources, obtaining climate resilience, draining rainwater and waste water outside the city limits, importing water from rivers far outside the city, and minimising environmental degradation. A water-smart system is designed to gather meaningful and actionable data on flow, pressure and distribution of a city's water.

For a city to qualify as 'smart' in terms of water provision, it must build a "smart and sustainable water network," which is conditional on how well municipal water utilities manage distribution networks with available resources, create awareness regarding efficient use, provide safe water, manage leak-loss, and generate revenue. At the same time, customers need data to understand their own consumption and manage their water-use behaviour. Universal access to safe water and sanitation requires huge investments, and an appreciation of the value of water can go a long way in creating awareness among users regarding efficiency in resource use and combining economic benefits with environmental aspects, while at the same time stimulating innovation and investment.[8] While SDG6 does not specifically refer to valuing water, many desirable outcomes, including those related to SDG6, can be achieved by valuing water: universal access, adequate sanitation and hygiene, improved water quality, increased water-use efficiency, and ecosystem protection. India's ability to value water is inadequate. The 2017 UN/World Bank High-Level Panel on Water has launched a new initiative for charting principles and pathways for valuing water. The general consensus is that valuing water goes beyond monetary considerations and future policies and investment must view valuing water as a governance challenge.[9]

The provision of water for domestic use in cities often entails huge costs, mainly related to construction and maintenance of water-treatment infrastructure and fresh and wastewater pipelines. By valuing water, governments and utilities are able to better understand the benefits delivered by these services and weigh them against the costs. Such an approach ensures that varying preferences are taken into account in the decision-making process.[10] Moreover, valuation can also indicate whether operation and maintenance recovery is possible through pricing water services, given the budgetary constraints of the utility. For the pricing to be sustainable to support the management of water resources for present and future generations, it must take into account the value assigned to the resource by its consumers for diverse uses.[11]

Robust water management, modelling and accounting are the foundations of water valuation. Smart and sustainable solutions to development of water resources require utilities to identify and value benefits associated with water at multiple temporal and spatial scales—including environmental, socio-cultural and economic—and resolve trade-offs between different values of water, incorporating them in decision-making processes.[12] A holistic valuation of water will help in its conservation, much-needed infrastructure investment, setting of water quality standards, water pricing and water allocation.

THE CASE OF KOLKATA

This brief attempts to put in perspective the variability of piped-water supply in Kolkata, along with the policy of not pricing water supplied to households without bulk metres. In

2002–03, Ashok Bhattacharya, the then urban development minister of West Bengal, announced a water tax to be introduced by all municipal bodies in the state—ranging from INR 30 to 120 per month and depending upon the household's property tax—for maintaining the financial viability of the utilities. Domestic households with bulk metred connections were to be charged INR 3/kilolitre (kl), whereas for residents of multi-storeyed complexes, the charge was fixed at INR 4/kl of water and for commercial and industrial establishments, it was INR15/kl. It was also decided that unmetered households would have to pay 30 percent of their property tax, payable quarterly to the Kolkata Municipal Corporation (KMC) as water tax.[13] The move faced stiff opposition and was eventually dropped. However, the municipal body reduced the tax eligible property valuation from INR 10,000 to INR 4,600, as a result of which households with ferule size of 15 mm also came under the ambit of taxation.[14] Currently, the KMC levies a volumetric water-usage charge on commercial enterprises and any other establishment using bulk metred connections. The civic body is in a poor fiscal condition to sustain its operations, much less to achieve its target of 24x7 water supply to the city's residents by 2020.

Kolkata currently faces a dilemma of whether to choose the right path of valuing water and then deciding on the pricing policy or the popular path of not imposing a price.

The city, surrounded by wetlands on the east and the Ganga on the west, suffers from high variation in water availability. The dwindling supply has left most of its residents water-poor. The KMC is embroiled in a vicious circle of poor service delivery, as demonstrated by the highly unequal distribution of water in many parts of the city.[15] This can be blamed on the lack of required infrastructure, which in turn can be ascribed to the weak financial condition of the civic authority.

The lack of financial independence of the KMC is a direct result of the Government of West Bengal's stated policy of non-imposition of water charge on domestic households that do not use a bulk metre. The genesis of the state's policy lies in its definition of water as a "human right" to be provided free of cost for domestic consumption. By defining water this way, the state ignores the discrepancy between the necessity of the resource and the finiteness of it. At the 1992 International Conference on Water and Environment (ICWE) in Dublin, freshwater was declared an "economic good," as well as a "finite and vulnerable resource." The recognition of water as an economic commodity means water has value in competing uses. In other words, water must be allocated across competing uses in a way that maximises net benefit from the available amount of water.[16]

In actual use, water is both a social good as well as an economic one. Water satisfies various human needs and services essential for supporting basic life functions. At the same time, water also has definite uses as a market good, which have a bearing on the competitive allocation of the resource. However, water-allocation decisions through the market may be suboptimal, given the special nature of the resource. Managing water purely as an economic good hinders the socially equitable allocation of water for basic human needs and can also disturb the environmental flows that are essential for the sustenance of the ecological system.[17]

In practice, decisions about allocation are based on two approaches. One considers water as a free good of unlimited supply essential for basic human survival, ignoring the costs at the point of supply. This approach exempts water from allocations based on competitive market pricing, as is the case with Kolkata. The other approach favours allocation through competitive markets based on the value of pricing. The core idea underlying price-based allocation for water rests on the premise that an appreciation of the true value of water encourages wise and responsible use. Appropriately designed water tariffs will discourage or prevent waste and encourage water-saving.[18]

THE CONCEPT OF VALUING WATER

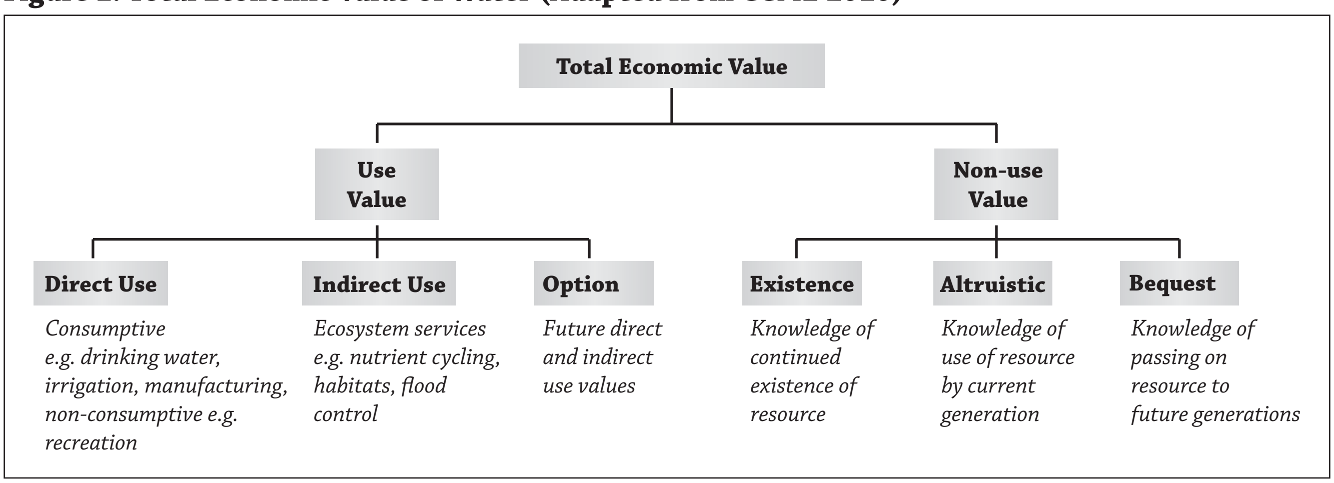
The value of water exists in its ability to provide benefits in the form of flows of services over time. 'Value' is a broad concept that covers all people and all alternative uses, including the benefits that people will receive in the future. These benefits relate to economic, environmental, social and religious considerations. Water has value in all these facets and the existence of opportunity costs in different uses challenges the 'free good' status of water (making it an 'economic good') and requires prioritisation of water use.[19]

Valuation refers to monetisation, since the purpose of any valuation exercise is to assign a monetary value to a change in the provision of commodity or service.[20] Could this mean that a resource—in this case, water—is of less value to the poor since they have less capacity to pay for it?

Efforts to value water have advanced over the last 30 years to deal with such issues of wealth and income. There are a variety of 'valuation methods' that are used to collect and interpret water valuation evidence and their potential role for informing water management decisions.[21] The methods range from willingness to pay for drinking water and ecosystem services, to participatory processes that capture water's diverse benefits. A useful classification for understanding water valuation and who may be affected by changes in water availability and supply is that of total economic value (TEV) (Figure 1). TEV provides a systematic approach for assessing the combined economic values of a variety of goods and services (benefits) provided by natural resource systems. An additional dimension in economic valuation is the concept of "stocks" and "flows." Considering flows and stocks in valuation requires a process of discounting.

The TEV framework distinguishes between use and non-use values. Option value is about

Figure 1: Total Economic Value of Water (Adapted from CCME 2010)



not using water resources at present but preserving it for future use. Use values arise from either a direct or indirect interaction with a resource and non-use value from altruistic motives (for others' well-being), bequest motives (for the wellbeing of future generations) and/or for the sake of the resource itself (existence). Thus, the TEV of water can be defined as:

TEV = *Use Value* + *Non-use Value*

There are two main approaches to reveal the value of water (use and non-use) depending on the benefits to people: administrative and market-driven.[22] An administrative approach implies that decisions are made by a central authority on the basis of available information. For instance: water-resource planning, deciding on competing users and jurisdictions, assessing options for investment in urban water supply and sanitation, benefits people obtain from access to water and observing their water-use behaviour. On the other hand, under a market approach, decisions are made by water users on the basis of the benefits they receive from water. Atapattu notes that market valuation of a good (or a resource) is based on the principle of marginal costs and benefits as the basis of determining optimum allocation and welfare is maximised when water is priced at "marginal cost" and is used until the marginal cost equals marginal benefit.[23]

In practice, however, one can find elements of both administrative and market approaches (hybrid model) in revealing and taking into account the value of water. The hybrid model mainly applies, among others, to pricing of water-related services and infrastructure, pricing of pollution, and securing tradable water rights.[24]

DECISION-MAKING CONTEXTS AND WATER VALUATION

Though water valuation is not a necessary pre-condition for making decisions concerning any of the water-resource management or decision-making contexts, valuation outcomes can help in establishing tariffs or charges associated with the use of water or any other policy instrument and improve decision-making. Valuation can be useful in providing a monetary estimate of the full cost of water abstraction, which can guide the setting up of tariffs. Outcomes of valuation can reflect the social and environmental costs (in terms of estimating the value of damages).

A variety of decision-making frameworks and tools exist that can guide policy and could be used in project analyses:[25]

a) Cost-effectiveness analysis (CEA) relates the costs of alternative ways of producing the same or similar outcomes to a measure of these resulting outcomes. Water valuation can be an input to CEA to determine the least expensive option for water supply.

b) Cost-benefit analysis (CBA) is concerned with economic efficiency, which focuses on ensuring that (scarce) resources are put to the best use. CBA allows decision-making to consider whether a project or policy should be implemented at all.

c) Multi-criteria analysis (MCA) facilitates decision-making by combining both quantitative (including monetary) and qualitative assessments of alternative policy and project outcomes, in terms of economic, social and environmental impacts. MCA can also be applied to establish priorities for investment and appraise the relative merits of projects and policies.

d) Bio-economic models can help link changes in natural resources and the environment to outcomes in terms of expected changes in well-being. These models are data intensive and require specifications of how changes in ecological functions relate to natural processes. Water-valuation evidence can provide an input to models for valuing changes in the provision of market and non-market goods.

There are three broad sets of economic valuation methods that can be applied to water-management issues. Market price and production input methods are mainly applied to value market goods and services associated with water resources. Revealed preference and stated preference approaches are applied to value non-market goods and services associated with water resources. An alternative approach based on secondary evidence is the benefits transfer approach. Benefits transfer makes use of valuation evidence provided by any of the earlier approaches and can be used to estimate all components of TEV. To make informed decisions, combinations of methods may be required.

To decide which method to apply and how realistic the valuation exercise is, considerations relating to data availability are important. Valuation exercises require some form of quantitative, physical or spatial (e.g. GIS) data on the change in provision of the resource (e.g. quantity of water, biochemical quality, size of user population affected and so on). The lack of such data can preclude water valuation. Moreover, since water valuation studies are usually expensive, budget constraints may also determine their feasibility.[26]

Thus, economic instruments such as abstraction and pricing play an important role in water-resources management. Assessing the value users place on water against the cost of accessing it, these instruments promote an understanding of the underlying costs involved in water provision. For investments in water infrastructure to be sustainable over a long period of time, appropriate valuation of water is crucial. In regions that face water scarcity, high variability of supply or lack of infrastructure for water storage, flood management is critical to achieve universal access to clean water.[27]

WATER PROVISIONING SERVICE OF THE KMC: SOME FACTS

The KMC claims to generate 402 million gallons of water daily (MGD) and supplies 134 litres per capita per day (LPCD) to 141 wards with an average availability of eight hours, thus covering 82.7 percent of households. In addition to these, there are 9,138 tubewells that provide groundwater to another 10 percent of the households, increasing the total coverage to 92.7 percent. Compared to other tier-1 cities, i.e. Delhi, Mumbai and Hyderabad, Kolkata has the highest per-capita consumption of water (116 LPCD). While these statistics fare rather well, a closer examination reveals an alarming scenario. According to an Asian Development Bank (ADB) report in 2017, supply of water is highly "uneven," ranging from 310 LPCD to 40 LPCD. Kolkata is also estimated to have the greatest variation in water consumption (64.9 LPCD) amongst the aforementioned cities.[28] The presence of high inequality in distribution of water is also evident from the fact that wards one to six (i.e. northern areas of the city) receive municipal water almost all through the day and at a much superior quality, whereas wards such as 58, 108, 109 and 127 (southern and especially south-eastern fringes of the city) have to depend mainly on groundwater, which has been found to be contaminated by arsenic.[29] The slums of the city fare even poorer. A 2016 survey, carried out by scientists from the Indian Association for the Cultivation of Science, revealed that 100 out of 141 wards have arsenic deposits in their groundwater, which is higher than the WHO prescribed limits of 10 μg/l. Half of these 100 wards were found to have deposits even higher than the Indian standard of 50 μg/l. Repeated studies have also shown that the presence of faecal contamination and heavy metals in the municipal piped-water supply greatly lowers the quality of drinking water.[30] In addition, lack of water metering and non-imposition of tariffs has caused the municipal corporation to incur huge subsidy costs, thus reducing the rate of improvement of physical infrastructure. The rusting in pipes and leakages result in intermittent water supply and wastage of almost 35 percent of the total water produced. It is thus quite evident that the water supply situation in Kolkata is disconcerting and drastic measures need to be adopted and implemented.

FISCAL DEBACLE OF KMC AND A CASE FOR PRICING WATER

In 2012, the Controller of Municipal Finance and Accounts (CMFA) expressed serious concerns to the Municipal Commissioner of KMC regarding the critical fiscal health of the municipal body. Later in 2017, the CMFA reiterated its concerns and suggested drastic measures to boost revenue and curtail mounting expenses. The CMFA was worried that the huge deficit would negatively affect the expansion and modernisation plans of the city's essential services, especially water supply and sanitation. Various budget statements of the KMC reveal rising deficit with stagnated revenue at least for the last five years.

The opening balance of the KMC, as presented in the mayor's budget statement of 2012–13, stood at INR –197.07 crore, which burgeoned to INR –1,087.22 crore for 2017–18, effectively creating a 451.7 percent hike in budgetary deficit. In the year 2017–18, only 13 percent of the proposed expenditures of the water-supply department could be funded by its own revenue. The fiscal situation improved marginally in 2014–15, when there was a 10 percent rise in revenue. However, it has been declining since. Almost half of the KMC's revenue comes from grants provided by the state and central governments, and the majority of its infrastructural improvement projects are funded by loans from ADB and the World Bank. The KMC has been receiving financial support from the ADB for multiple projects since 2000. The latest is the US$400-million loan sanctioned in 2016 for providing 24x7 water supply to Kolkata's residents, rehabilitating 700 km of dilapidated water-supply pipes and treatment plants in peripheral areas of the city where the need is greatest, installing metres, and for other infrastructure development. Thus, the municipal body clearly lacks the financial independence necessary to expedite the process of infrastructural development, which is the main contributing factor for the inequitable distribution of water.

In a study conducted by Arcadis in partnership with the Centre for Economics and Business Research[31] on the sustainability of cities with respect to their water profile and systems, it was found that Copenhagen and Rotterdam ranked at the top in terms of efficiency, quality and resilience of water utilities, whereas Mumbai and Delhi featured at the bottom.[32] The former two had a healthy water-tariff regime, negligible water leakage and a high incidence of water metering. The other cities lacked infrastructural development due to their low-price water regime.

The erstwhile Soviet Union—where ultra-subsidisation of resources led to a fiscal fiasco—is a study in the consequences of treating water as a 'free good'. Under the communist regime, water was provided for free, causing macroeconomic distortions, since the economy was unable to meet such unfunded liabilities and was pushed towards insolvency. The municipal body transferred resources from other sectors of the economy, which was not in accordance with consumer preferences. Moreover, the lack of a pricing mechanism meant that the resource was not valued by the consumers, who had neither an availability constraint nor a budget constraint. This abundance resulted in wastage of the resource. Thus, the move clearly violated the principle of economic efficiency, wherein resources are optimally allocated to minimise waste.

The example of communist Russia bears an uncanny resemblance to present-day Kolkata, where over-subsidisation of water supply and hapless performance on parameters of water metering, cost recovery and unaccounted-for water have undermined the credibility of the KMC. The public infrastructure is in such shambles that the current funding agency of KMC, the ADB, claims that 65 percent of the water supplied to the pilot area did not reach the end users.[33, 34] The World Bank, too, claims that almost half of the water supplied through stand posts, i.e. 45 MLD, is being wasted due to running taps.

A tariff regime is expected to impart an economic signal to the consumers, based on which a household can decide upon its optimal level of water usage. Additionally, a water tariff, coupled with smart water metres, will help determine the city's actual water demand schedule, allowing the KMC to supply water optimally and enabling the civic authority to upgrade its water-distribution network.

Contingent valuation studies carried out in the KMC area reveal that people are willing to pay for an improved service. For instance, Majumdar & Gupta[35] found that on an average, people are willing to pay INR 3.18/kl for an average monthly usage of 12.59 kl. Roy et. al.[36] found that out of their 240 sampled households, 77 percent were willing to pay, since they were already employing some form of water-purification techniques.

CONCLUSION

Smart cities in India will benefit from round-the-clock supply of potable water at a cost people can afford and are willing to pay. As Hanemann[37] states, this has been difficult to accomplish for various institutional reasons, including problems of governance. The capital intensity and longevity of surface water supply infrastructure necessitate collective action in financing water supply, a need that is not relevant for most other commodities.

In Kolkata, there is a lack of piped-water availability not due to financial or physical shortage, but mainly because of issues of governance and politics. The city is in the midst of a classic problem of cost allocation, for which no satisfactory technical solution is yet in sight. Thus, there are increasing challenges to provide financially sustainable water and sanitation services.

For Kolkata to become a water-smart and -sustainable city, its present leaders must realise the relevance and importance of economic instruments in financing huge infrastructure costs, e.g. abstraction and pollution charges or water pricing. In addition to these instruments, there are other options for financing water infrastructure, such as transfers, capital contributions and self-financing from users. Tariffs and taxes can help users understand the costs involved in water provision or accessing water, allowing them to better value water.

Additionally, appropriate and effective ICT solutions in the form of smart-water management (SWM) must also be adopted to address water issues. SWM can alleviate urban water management and sanitation challenges if it is integrated with ICT products, solutions and systems. Since such technologies are designed to continuously monitor water resources and identify problems in the urban water sector, their adoption will allow for better management of maintenance issues. It will also facilitate collation of complex data on the city's water-management system and information disbursement to the residents and civic authority.

Effective valuation of water resources, coupled with appropriate ICT solutions, can play a critical role in improving the sustainable, equitable and efficient management of water. Decision-making frameworks that factor in evidence from multiple values and are inclusive are more likely to fill up investment deficits and sustainably manage water resources for a better water future for all. ORF

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