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Lifecycle Cost of Water Points in Bangladesh: Issues of Community Cost Sharing and Sustainability

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Abstract

Government agencies and NGOs in many cases establish large number of water points to increase their coverage, without considering much about sustainability. Hence, sustainability of water points under the existing modality of community cost sharing always remain a problem. Many facilities become non-functional due to lack of fund generated at the community level to maintain these facilities after phase out. Without having any scientific evidence on the extent of maintenance cost in a project life cycle agencies taking care of rural water supply used to ignore this funding issue, considering operations and maintenance as a minor expenditure to be taken care of voluntarily by the society itself, and hence, don't have any budget allocated to carry on such maintenance activities. This paper, however, highlighted that maintenance cost contribute a lion share to the total life cycle cost of water points, and so should be taken care of seriously. Analyzing life cycle cost data from a randomly selected sample of 220 water points, 1259 household beneficiaries, and other key government officials and private entrepreneurs in eight different locations of Bangladesh this study demonstrated that operation and capital maintenance expenditure occupy a lion share of the total life cycle cost of water points that would be as high as 90 per cent in few instances. Similar study can also be conducted in other developing countries to prioritize the issue of operations and maintenance cost and, thereby, develop specific business models for community cost sharing, to improve the sustainability of water points.

Keywords: Life Cycle Cost, Operations And Maintenance Cost, Community Cost Sharing, Sustainability

Introduction

Large scale non-functionality due to improper operations and maintenance always remains a threat to the sustainability of water points in many developing countries of the world (Baumann and Danert 2008; Water Aid 2010; Jones et al. 2012). During the project tenure provider of water facilities e.g. government agencies and Non-Government Organizations (NGOs) take care of all aspects including monitoring of daily operations and periodic maintenance of water facilities to ensure functionality. However, after project phase-out all operations and maintenance (O&M) become the responsibility of communities concerned. Groups of community people need to keep the facility clean and functional by monitoring its proper use, rationing usage in peak hours, collecting user fees from beneficiary households, conduct minor maintenance activities by themselves, or hire technicians and purchase spare parts in case of major defects. In many cases community groups also need to operate bank accounts to manage pool funds and user fees collected for water usages. Though it remains a myth that communities are always capable of managing their facilities benevolently of their own accord (RWSN 2010), in reality, inactive community groups and consequent non-functionality of phased out projects remains a major issue for NGOs and policy makers involved in the development of Water Sanitation and Hygiene (WASH).

In many instances societies just abandon WASH facilities due to an inadequacy of human and financial resources required for O&M that could survive functionality (Water Aid 2010). Though after project completing and phase out community people need to bear the O&M, because of the myth on community capability mentioned earlier, Government agencies usually don't have any budget allocation for such maintenance activities. Therefore, one popular demand is that govt. should have budget allocation for maintaining these community water points (Water Services Act, South Africa 1997). Though it is widely argued that government should bear the maintenance cost of facilities to reduce burden over community and keep

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facilities functional, to make informed advocacy in this regard we need to answer is the O&M cost significant enough to be taken care of by the government even after phase-out? As the provider organization cover all major costs of a water point including its O&M during the project tenure community burden can be reduced by choosing those project that have higher initial cost but very low ongoing O&M costs. Therefore, the second question that we need to answer is how the choice of particular water point technology may affect the distribution of O&M cost over the life cycle of any particular water facility? This research explores the lifecycle cost of various water supply facilities with an objective to answer these two questions.

Objectives and Methodology

In Bangladesh decades of investment in water supply both in urban and rural areas have ensured an access to safe water for more than 90% population. However, due to lower functionality of installed water point sustainability is still at stake. One major reason of lower sustainability lies on inadequate maintenance of those facilities by the community people who may not have sufficient financial resources to carry on regular maintenance after phase out. For instance, in rural areas and small town tubewells have been installed by the Department of Public Health and Engineering (DPHE) and handed over to community/group for managing. Some NGOs also installed facilities and formed management committees to operate these facilities with all required maintenance after phase out. However, it is worth noting that in practice community/water-user group ownership concept in most of the instances does not functioning sustainably. Therefore, many facilities remain out of order and later abandoned due to inadequate maintenance by the community people.

Under this context of low functionality due to improper management, the aim of this study was to measure the life cycle cost of water points and identify the burden that community people need to share in terms of operation and maintenance cost of these facilities. With this objective in mind, firstly, the study earmarked total lifecycle cost of water points under six different heads, as benchmarked by IRC (Fonseca et al. 2011). The six heads of expenditures are a) capital expenditure required to establish the facility like installation of a deep tube well; b) maintenance and minor repair activities like changing the nut-bolt or bucket of a tubewell; c) capital maintenance expenditure like changing one filter of a tube-well d) expenditure on direct support like financing the salary of a local government official who used to be an engineer and look after all installed facilities; e) expenditure on indirect support like cost incurred by govt. ministries to held discussion at the national level for the overall development of WASH. As the study was designed to assess the lifecycle cost of communities enjoying WASH facilities, it excluded the cost under item e) that doesn't incur directly with the community. Another head of expenditure f) cost of capital or interest paid on the money borrowed to establish a facility could be significant for large establishments like pipe water system. However, for small scale establishments like hand-pump, or shallow tube-well the amount was not that much significant and so was safely dropped from the life cycle cost. Another implicit reason was the sources of fund used for this purpose. As both NGO and Government funds come without any or with a very low rate of interest, cost of capital for these interventions could be avoided safely. Finally, expenditure on direct support under d) was not relevant as during the study period and even today contribution of NGOs in direct support remain insignificant.

Area Selection: To assess life-cycle cost 220 functional water points in eight different locations of Bangladesh were selected for collection of lifecycle data under this study. Locations were selected to represent all major types of socio-economic and geographical settings that may result in different cost structure in comparison with the cost structure for the same water supply technology used elsewhere. These were Slums in Dhaka (to cover volatile low income communities living in big cities) *Paikgacha* municipality of Khulna district (to cover low-income community in small towns), *Koiraupozilla* of Khulna district (to cover coastal area facing salinity); *Hymchar* of *Chadpur* district (to cover disperse population living in reclaimed land through river siltation),*Sitakunduupozilla* of Chittagong district (to cover arsenic prone area); *Bagmaraupozilla* of Rajshahidistrict (to cover low water table area), *Ajmiriganjupozilla* of Habiganj district (to cover Char or marshland that remain under water for more than half of the year), *Bandarban Sadarupozilla* of Bandarban district (to cover hard to reach hill tracts).

Sample Selection: Once the eight different geographical locations were identified a multi-stage cluster sampling was conducted to select 20% unions from each of the eight areas, and then 3-4 villages from each of the selected unions. 87 different village/wards/slums were selected in this process and all water points of those selected areas were identified by the research team. Among all the water points selected 220 water points were chosen as final sample units and GPS coordinates of those points were collected for future record. One to seven households for each water point or a total of 1259 households were interviewed for the study. Households were asked to recall the operation and maintenance cost they borne for their respective water points during the last ten years. To make comparison easier among costs incurred in different years households were asked to make their estimates in equivalent current market price. Besides households the research team also interviewed officials from DPHE- the government department responsible for the installation of tubewell and other water facilities in rural areas and low income communities. While DPHE officials were interviewed to get estimates of installation cost, dealers of different water supply equipment and service provider were also consulted for this purpose. Furthermore, published data and unpublished information from official records were also for this purpose. In each sample location data was collected for different water supply technologies being in use.

Estimation of Life Cycle Cost: Once all required data were collected, lifecycle cost of water points were estimated using a formula as follows:

Current cost of water point using LCCA = CapExHrd + CapExSft + (OpEx x time span) + (sum of CapManEx); where, time span of a water point is defined as total duration of functioning of respective water points. LCCA, CapExHrd, CapExSft, OpEx, and CapManEx stand for aggregate life cycle cost, capital expenditure for hardware, capital expenditure for software like remuneration for installation workers and engineers; operating expenditure, and capital maintenance expenditure for big repairs respectively. Using this same methodology and formula lifecycle cost was calculated for various available technologies including shallow tubewell, deep tubewell, pond sand filtering, infiltration gallery etc.

Major Results and Lessons Learned

From the analysis of collected lifecycle data a number of comparisons were made between life cycle cost of different water technologies and also among different cost components for any particular water supply technology. Some of the major findings to guide future programmatic intervention in water technology were as follows.

Drinking Water Sources used by Communities: The study revealed that deep and/or shallow tubewells with hand pumps are the most common water source for drinking water across the locations except in Dhaka slum. In the sample Dhaka slums (Low income settlement in big city) the dwellers mainly depend on piped water connections using hand pumps as water delivery devise. Not all of these water connections are legal (according to Dhaka WASA). The slum owners somehow managed to get the connections. In *Koira*, there are few unions that depend on pond sand filter or rainwater harvesting systems for drinking water. Similarly, in *Bandarban Sadar* (one of the three hill districts in Bangladesh) a number of paras (village equivalent habitations in Chittagong Hill Tracts) depend on infiltration gallery (IFG), gravitational flow systems (GFS) and rain water harvesting systems (RWHS). Rain water harvesting for drinking water has also been found in a few villages in *Sitakunda* and *Paikgacha* (Low income settlement in small town). Dhaka slum dwellers have to pay monthly water bill to the slum owner. In *Paikgacha* and *Koira* (coastal area), a substantial proportion of households have to buy drinking water. In both the places drinking water are sold in containers and in traditional pictures. In other study locations households do not pay for drinking water.

About 52% of households in *Koira* (coastal area) are in a position of collecting drinking water from same source round the year. For better understanding seasonal variation related to water source access, following 3 categories have been used: (i) round the year, (ii) dry seasons (November to June), and (iii) rainy season (July-October). The study shows that drinking water source varies depending upon socio-geographical locations. For example, piped water connection with hand pump is the most prominent source in low income settlement in big city like Dhaka. GFS is reportedly the prime source in sample Hill tract area of *Bandarban*, remotely followed by IFG and deep tubewell. In rest of the locations deep or shallow tubewells are considered as prime sources.

It is revealed that for about 23% respondent households, the source of drinking water varies depending upon seasonal variations (dry and rainy seasons). For example, in Dhaka slum almost all (98%) of 5% (out of 237 respondents) who reported of seasonal variations use to collect drinking water from submergible pump during dry seasons and 82% collect drinking water from piped water in household. On the contrary 56% out of 74% (N= 195) reportedly collect drinking water from deep tubewell during dry season and 85% from protected rain water in rainy season.

Major lifecycle Cost Components: One striking finding under this research was revealed through the comparison of Capital Expenditure (CapEx) and 'operating and capital maintenance expenditure' for different water supply technologies including shallow tubewell, deep tubewell, Tara pump, pond-sand filtering, Infiltration gallery, rain water harvesting plant, and gravitational force.

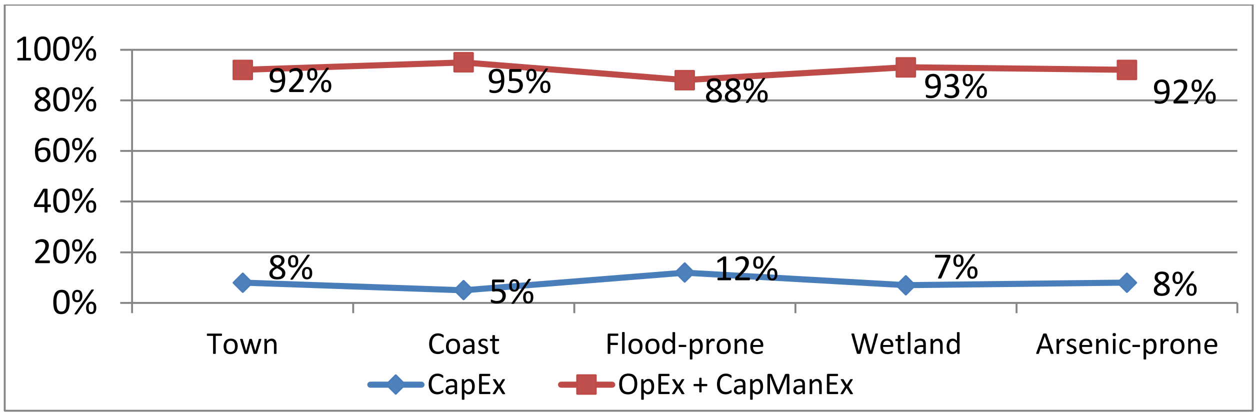

Figure 1: Lifecycle Cost Component for Shallow Tubewell

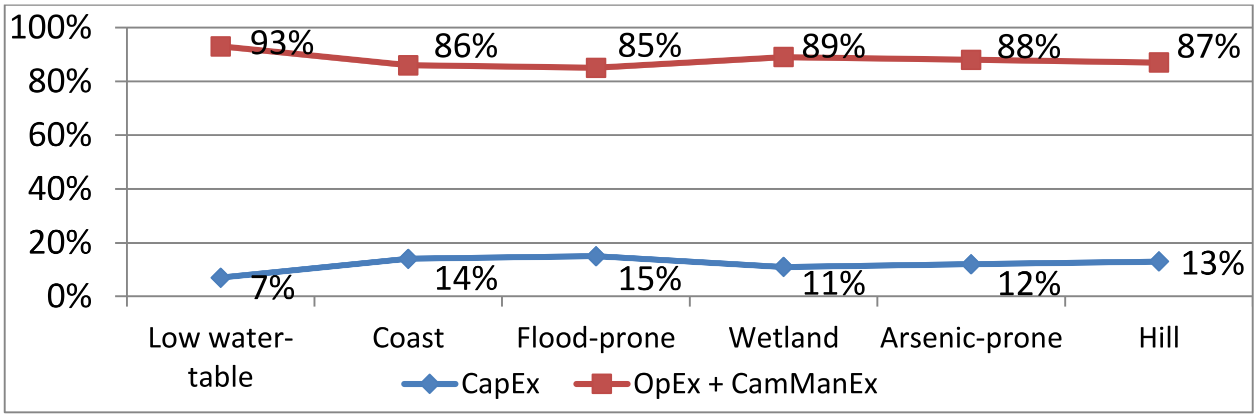

Figure 2: Lifecycle Cost Component for Deep Tubewell

As indicated in Figure 1 and 2 irrespective of the area of installation, contrary to the usual notion, a lion share of lifecycle cost for both shallow tubewell and deep tubewell is incurred through operating expenditure and capital management expenditure. As government and NGOs generally bear only the capital expenditure of water technologies, the lion share of the life cycle cost burden is usually borne by the community. As is observed in figure 3, the same is true for other water supply technologies including tara pump, rain water harvesting plant, pond sand filtering or infiltration gallery. The contrary was found only in case of Gravitational flow system in hilly areas, and can be safely set aside as an exception. It is to note that CapEx of GFS in Hill Tact area (Bandarban) is many folds higher than other water point types. It is due to capital intensive nature of the technology. Moreover, distance between water source (river) and water points is more than 500 meters (over 1,600 feet).

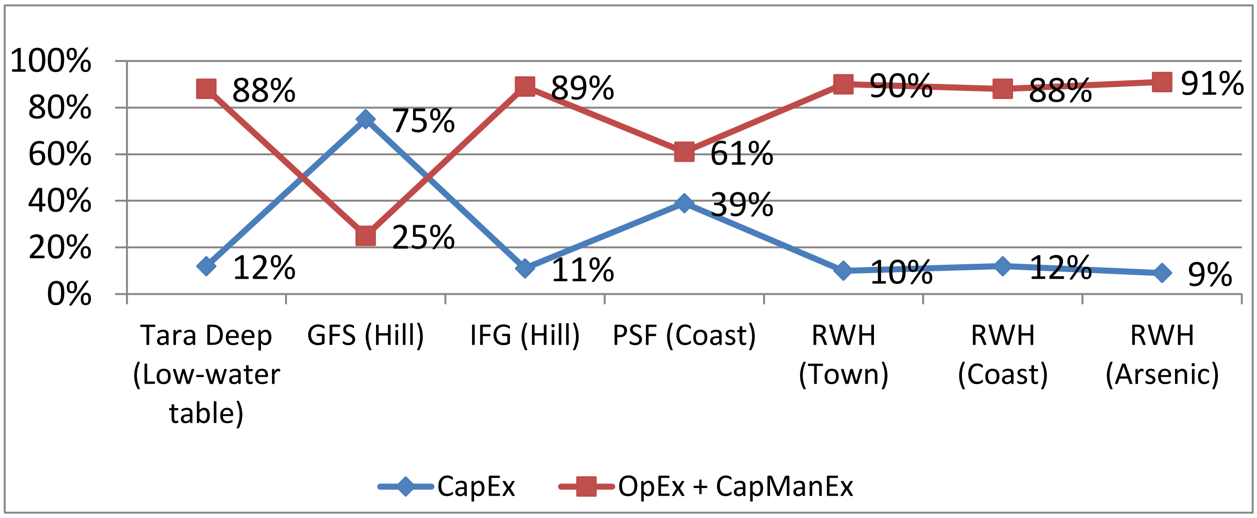

Figure 3: Life Cycle Cost Segregation for Various Water Technologies

It is not only that Capital Maintenance expenditure comprise a major share of the life cycle cost, the cost incurred for Capital Maintenance expenditure may vary over the year. As shown in Figure 4 below while for few technologies like Tara pump, Rain water harvesting (RWH) or Shallow tubewell Capital Maintenance expenditure remain stable over the year, without having any major increment, for other technologies like pond sand filtering (PSF), deep tubewell or infiltration gallery (IFG) Capital Maintenance Expenditure increase sharply over the year. Therefore, though these technologies would be attractive to community people at the initial stage, ultimately these technologies bear high risk of sustainability once community people are unable or unwilling to bear the high maintenance cost to keep those facilities functional.

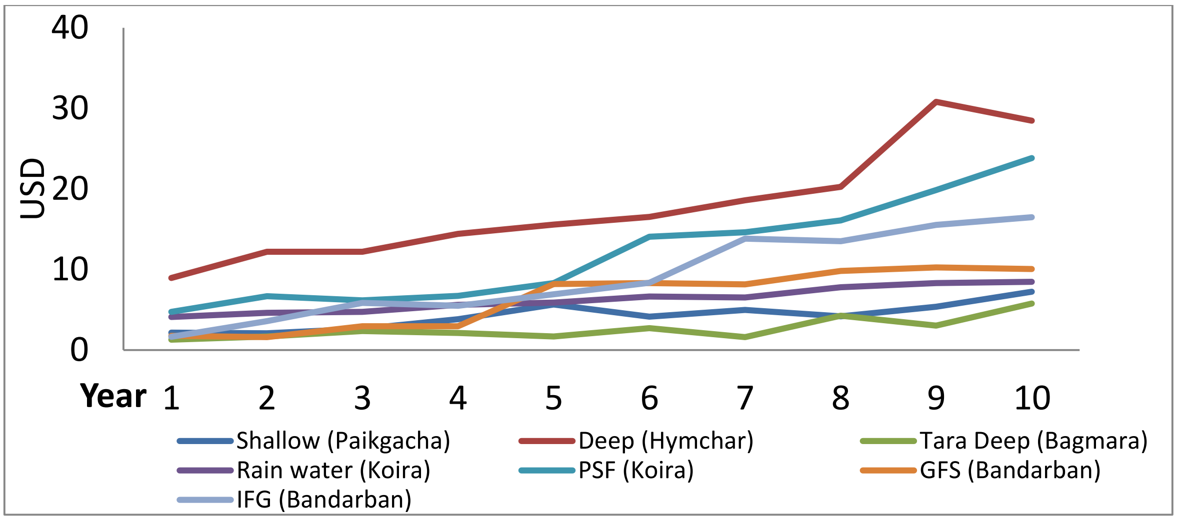

Figure 4: Dynamic Nature of Capital Maintenance Expenditure

Conclusion and Recommendations

A careful analysis of collected data under this study revealed that in many instance inadequate financing to bear recurrent maintenance activities at the community level remain one of the key factor in determining sustainability of installed water points. Further, other points identified were as follows:

1. As government and NGOs invest mostly in the installation of water facilities, leaving community to

bear capital maintenance and operating expenses after project phase-out significant under investment in CapManExby the community remains asa particular concern for long term sustainability or community water points in Bangladesh.

2. Evidence suggests that, except IFG, life cycle O&M cost for different water point technologies varies between 60% to more than 90% of total life cycle cost. The distribution of life cycle O&M may not remain stable over the years. For some water technologies like PSF, Deep tubewell, and IFG after an initial stable state for the first 5-6 years CapManEx increase sharply over the remaining life cycle. Therefore, any water point technology that seems attractive to a community at the beginning of its life cycle may turn out to be burdensome, due to an increased O&M over time and, create threat to sustainability after a certain period of time.

On the backdrop of the study findings, the policy makers and planners may consider the following recommendations for enhancing the sustainability of the non-individual household owned water points as well as better utilization of the public resources spent in water sector.

(a) Undertake appropriately designed interventions for developing a sense of ownership among the users of water points, and motivate them for a greater participation and contribution to bear O&M of water facilities installed using public resources.

(b) Government agencies and NGOs may facilitate the creation of user funds for meeting O&M expenditure involving the water point users. The users should contribute on regular basis, but based on household income, a differentiated approach as appropriate is need to be introduced.

(c) Introduction of a safety-net approach will be highly important for water point users living below the lower poverty line. Local government institutions may have some special grants to cover costs on behalf of destitute people who may not be able to bear cost by themselves.

(d) To minimize users' burden to pay O&M costs, providers may choose technologies like PSF that have comparatively higher establishment cost but reduce users' burden of O&M costs over the years. Further, providers may create a fund for major capital maintenance of each of the facilities in every two years starting from the sixth year of its operation.

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