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Water Subsidy Design: Implications and Consequences

> **Question**: **How should water be priced by a state water company in poor developing country? Carefully develop the economic arguments for and against subsidized water.**

Introduction:

Recognizing water as an essential basic need, the vast majority of governments have adopted some form of water subsidy for expanding coverage and making services available to the poor. Design of water tariff structures, however, requires not only a careful consideration of social welfare criteria, but also the stochastic supply of water. As a non-renewable resource, water shortages have catastrophic consequences – the foundation for civil unrest, public health crises, strain on industrial and agricultural production, and mass migration.[i] Globally, water consumption has doubled over the past 20 years, leading some experts to conclude that Malthusian consequences loom in the near future – by 2025, an estimated one-third of the population will not have access to drinking water.[ii] Simultaneously, however, a substantial increase in water tariffs under a competitive, full cost pricing method to incorporate environmental and economic externalities can engender mass riots or exclude access by the poor, such as in the case of Cochabamba, Bolivia.[iii]

The vast majority of developing countries use a form of increasing block tariffs (IBTs), a consumption-based structure widely advocated by multilateral donors and consultants. IBTs typically involve two or more tiered prices based on water use, in which each price applies to a customer's use within a defined block.[iv] In other words, for each type of water user (ie: residential, agricultural, industrial), the unit price of consumption increases in a step-wise function. Proponents argue that IBTs promote equity through cross-subsidization and encourages the conservation of water.

A cross-country examination of water subsidies by the World Bank, however, revealed that consumption-based subsidies – prevalent in 80% of the sample – were starkly regressive, in which poor households capture only half as much value of the subsidy as they would if the subsidies were distributed randomly. The authors attribute the failure of consumption-targeted utility subsidies to three main factors. First, poor households are substantially less likely to be connected or have private metered connections to the water distribution system, thus precluding any benefit of consumption-based subsidies. Second, despite the assumption that water is a normal good and consumption rises with income, empirical evidence shows that poor households do not consume substantially less water than the non-poor, hence restricting the relevance of consumption-based subsidies. Third, in the case

that poorer households do indeed consume less water, existent tariff structures result in a disproportionately high per unit cost at low volumes due to the allocation of fixed charges. As a result, in most water programs studied, the poorest 40% of the population received only 5-20% of subsidy benefits.[v]

Regardless of the shortcomings of current pricing structures, water tariffs constitute a potent public policy instrument for achieving the objectives of economic efficiency, revenue sufficiency, income redistribution, equity, and resource conservation, albeit with trade-offs. In addition, effective subsidy schemes must reflect ease of implementation and transparency, developed with full political and public accountability.[vi] The design proposed in the following section seeks to balance these competing objectives.

Subsidy Design:

Considerations

As a natural monopoly, the production, treatment, transport, and distribution of water has increasing returns to scale, in which long-run marginal costs typically fall below long-run average costs due to high fixed costs. Hence, an important economic consequence is that if customers pay the marginal cost, the utility would not break even, thus undermining long-term sustainability (Appendix – Figure I).[vii] Even if the state owns the water company, failure to recover costs can impose a substantial fiscal drain, reduce the amount of capital available for infrastructure and service improvements, and consume tax dollars earmarked for other social causes. Although two-part tariffs consisting of a fixed cost and a variable charge reflecting consumption improves efficiency, the fixed-cost component often precludes access to the poorest households. Likewise, determining the appropriate variable charge in context with social welfare considerations remains difficult, especially since collecting all relevant socioeconomic and demographic information may be costly, erroneous, or unintentionally exclusionary. In addition to high capital costs, transmission and distribution also depend on the distance from the treatment plant, raising the question of zonal pricing and fairness.[viii]

Furthermore, water faces a stochastic supply; weather patterns determine the amount available in a reservoir. Hence, at uniform prices, the standard practice of the industry, shortages may occur. Although metering to allow for pricing variability would constitute a Pareto superior solution, costs of metering remain prohibitively high for poorer households. Consequently, a fair subsidy and pricing policy must take into account that short-run marginal costs vary across time, marginal cost of distribution depends on geographic locale, and long-run marginal costs differ dramatically.

Design

To address the shortcomings of existing subsidy policy, I propose a two-part, volume-differentiated tariff (VDT), with connection and metering subsidies to improve access and targeting. Figure 2 in the Appendix visually illustrates some key features of the subsidy.

1) **Connection and metering subsidy, allocated through means-testing** – Existing subsidies have failed to benefit the poor because the poorest households face a liquidity or poverty trap that often prevents them from affording the up-front cost of gaining access to the network. Empirical studies have shown that connection subsidies are virtually always progressive, especially since poorer households are more likely to be excluded from service.[ix] To further improve the targeting of the poor, the state can give municipalities the responsibility of administering a survey to determine socioeconomic need, as in the case of Chile.[x] Since connection and metering installation charges constitute a one-time fixed cost outlay which enables water access and future revenues, the state has a substantial interest in getting households into the network, thus expanding returns to scale. To further reduce errors of mis-categorization or exclusion in means testing, municipalities can target households that are located in areas in which water service is available, but the household still remains unconnected after a certain time threshold (2-3 years), often signifying inability to pay the connection fee despite the benefits of joining the network. Likewise, the state can provide for connection cost rebates, in which a mis-categorized household that does not meet the subsidy eligibility criteria can file for compensation retroactively, subject to confirmation of a state official. As a study by Angel-Urdinola and Wodon finds, enabling access to the network rather than changing the tariff structure is the best way to improve targeting because it increases the likelihood that poor households can benefit from any consumption-based subsidy in the first place.[xi]

2) **Reduction of fixed charges for low-volume water users** – Even though the variable cost of water is set very low at the first block, the poorest households face one of the highest per unit costs due to fixed charges. Hence, the elimination of fixed charges for low-volume users mitigates one of the key factors contributing to the regressive nature of current subsidies. The cost of such a plan will be recovered by competitive pricing of water, as explained below.

3) **Means-based testing and geographic targeting to reduce fixed charge of eligible users** – Given flaws in the assumption that water consumption rises with income, the state can implement means-based testing and geographic targeting (similar to the processes described earlier) to reduce the fixed charge that households below a minimum threshold have to pay.

4) **Volume-differentiated tariff for cost recovery** – Under existing IBT tariff structures, all households receive some form of subsidy since the first few blocks of water consumed are charged at artificially low rates and the consumer pays the highest rate only on the marginal units consumed. In other words, a household ceases to be a net subsidy recipient only when the surcharge applied on the last few units of consumption exceeds all the subsidies received on the first units consumed.[xii] In

comparison, a volume-differentiated tariff is structured such that households pay the same cost for all water consumed at the highest rate, determined by the household's total use.[xiii] Consequently, VDTs incentivize greater conservation of water and reduces the cost of subsidizing consumers unnecessarily. A study of electricity subsidies in Cape Verde, Rwanda, and Sao Tome and Principe confirms that VDTs improve targeting performance compared to IBTs.[xiv]

5) **Marginal cost pricing of water when consumption is greater than the subsidized first block and below a small-scale farming threshold, set regionally** – The determination of marginal cost would vary based on available supply, given weather conditions. Setting the small-scale farming threshold requires an analysis of water consumption patterns in agricultural households. Given that different regions may have different climes and irrigation requirements, the state would allow for some flexibility in setting the threshold limit.

6) **Full cost pricing of water above the small-scale farming threshold** – The full cost of water would incorporate not only the full supply cost (O&M cost, capital charges) and the full economic cost (opportunity cost, economic externalities), but also environmental externalities. (See Appendix – Figure 3) By adopting full cost pricing above a scaled threshold, the state water utility can recover funds to promote long-term sustainability and effective stewardship of limited water resources.

Since water utilities have increasing returns to scale, the two traditional welfare theorems do not hold. In such a case, the solution ought to focus on making appropriate transfers to ensure the long-term sustainability of the utility and promote the interests of the poor, while limiting price distortions that can engender significant environmental and economic externalities. By reducing fixed costs for the poor and subsidizing connection charges, consumer surplus rises for society's most vulnerable. To promote the sustainability of the utility and conservation of water, water is priced at full cost above a pre-determined threshold and residential households pay the highest rate on all units consumed, not just on the last few units of water. Hence, high volume users who do not meet the means-based criteria for the fixed cost reduction bear the majority of the subsidy's costs. Although this reduces consumer surplus for middle and high income households, the higher charge better reflects the true cost of water, thereby allowing the market to clear and preventing the dead weight loss that results when an under-funded utility cannot expand its network services or make investments in improving water production and distribution.

<u>Economic costs of subsidizing</u>:

Although appropriate subsidy design can address common criticisms of inadequate targeting, subsidy policies in general may distort the effective stewardship of water, a finite and vulnerable resource. The fourth tenet of the Dublin Principles, communicated to world leaders in the 1992 United Nations Conference on Environment and Development (UNCED), declares that "water has an economic value in all its competing uses and should be recognized as an economic good."[xv] Past failure to incorporate environmental and economic externalities in the pricing of water has created damaging

consequences that limit future sustainability. Likewise, evidence shows that poor farmers are willing to pay more for a stable and reliable supply of water.[xvi] Main economic arguments against subsidizing water and adopting a full-cost approach to water pricing are described below:

1) *Full cost pricing of water reduces demand, thereby encouraging conservation of water*. Low-priced water incentivizes excessive consumption. Since the supply of water is stochastic, subsidized water prevents flexibility in adjusting prices upwards to temper demand during dry spells. Especially since many developing countries already face dire water shortages and a high percentage of the population fall below the poverty threshold, subsidies may result in the depletion of reservoirs during dry seasons. At this point, the necessity of rationing water reduces overall economic efficiency and introduces concerns about equity.

2) *Full cost pricing of water increases the supply of water and allows for the market to clear*. As a corollary to the first argument, higher water prices incentivize the reduction of water loss and more efficient operations. With widespread subsidies, supply and demand may not necessarily clear, leading to shortages in the short run and the use of non-price rationing to allocate scarce supply, which may adversely affect the poor who are located in geographically isolated areas.

3) *Economic pricing of water facilitates the re-allocation of water from sectors of lower value-added, such as agriculture, to sectors of higher value-added, such as urban or industrial use*.[xvii] On average, 69% of the world's water is used in agriculture, and 23% in industry. A small transfer of agricultural water can meet the demands of urban and industrial sectors. [xviii] Existing subsidies often prop up irrigation uses that create net economic losses – in other words, the value of crops produced is substantially below the cost of the inputs when calculated with the full cost of water.[xix] Given that the economic value of water differs across sectors, in which urban water use has a substantially larger return than agricultural use, full cost pricing optimizes the patterns of water consumption to support activities of higher productivity.

4) *Given failings in targeting and measurement, fair cross-subsidization is difficult to determine and inappropriate price discrimination could reduce economic efficiency and adversely affect the poor*. As discussed earlier, IBTs assume heterogeneous demand functions (poorer households demand less water at every price), which may not necessarily be true. Likewise, third-degree price discrimination in distinguishing among customers (residential, urban, industrial, etc.) and their assumed elasticity of demand may not appropriately reflect actual socioeconomic circumstances, resulting in regressive subsidies.[xx]

5) *Full cost pricing of water promotes investment in infrastructure to further decrease marginal cost and expand network access, thus benefitting the poor and increasing equity*. Even if the government operates the water utility, limited fiscal resources and inability to break-even reduces long term investment in water infrastructure. By allowing the price of water to reflect its full cost, the water utility would generate enough profit to invest in increasing network coverage to poor

populations in geographically isolated areas. Likewise, the water utility could re-invest its profits in more efficient production and distribution of water that not only decrease the marginal cost of water, but promote better water quality.

<u>Economic benefits of subsidizing</u>:

Access to safe drinking water has been internationally recognized as an essential human need, with considerable impacts on poverty. Despite the theoretical merits of full-cost pricing, most developing countries adopt some form of water subsidy because they recognize that due to market incompleteness or failure, the poor often cannot afford water at full cost. Likewise, essential public goods, such as public health and education, depend on access to water. As discussed in the subsidy design section, an appropriate subsidy structure can mitigate concerns about profligate water use, inadequate cost recovery, and adverse discrimination against the poor. General economic arguments for subsidizing water are detailed below:

1) ***By increasing access to clean water, subsidies reduce the incidence of disease, thus improving public health and potentially generating net government savings.*** Increasing access to clean water diminishes the likelihood of contracting preventable, water-borne illnesses. This indirectly decreases infant mortality, reduces the strain on the public health system, and potentially generates net government savings as subsidizing water is often a less costly alternative than widespread medical expenses. In addition, from an aggregate level, universal access to clean water moderates the risk of epidemics, which often propagate through contaminated water.

2) ***Access to municipal water (tap) reduces the opportunity cost of fetching water, indirectly leading to positive income and education impacts***. Especially in isolated villages, fetching water – a task commonly reserved for women and children – requires a substantial amount of time. Additional income generation or time spent in school reflects the opportunity cost, which can aggregate into substantial loss of economic output.

3) ***Subsidizing the connection charge helps the poor escape the liquidity trap***. A study by the World Commission on Water found that on average, the poor pay 12 times more per liter, mostly to independent vendors who sell tap water in small jugs or buckets.[xxi] Although obtaining water through the municipal system is cheaper, the poor often cannot afford the substantial up-front connection fee. They may also face borrowing constraints due to limited credit history that prevent them from financing the connection charge, even if it improves agricultural and economic output.

4) ***Subsidies address the poverty trap by enabling the poorest households to make economically optimal decisions***. In cases of extreme poverty, although a household may recognize or acknowledge that they would be unable to afford the health expenses resulting from a deficient supply of water, the household is unable afford water because of lack of money (corner solution for a bundle of goods). Given market incompleteness, one cannot assume that Pareto Optimality can be achieved without intervention.

5) ***Cheap and available water reduces household need to deplete groundwater as a substitute good, potentially reducing environmental externalities.***[xxii] When households cannot afford municipal water or do not have access to the network, they turn to groundwater as a substitute good. Excessive overdraft may permanently damage the water table, causing problems such as saltwater intrusion, subsidence, and land degradation, while harming river, lake, and wetland ecosystems that depend on groundwater.

Appendix:

Figure 1. Cost structure of natural monopolies

Figure 2. Subsidy Design

Figure 3. Full cost water pricing

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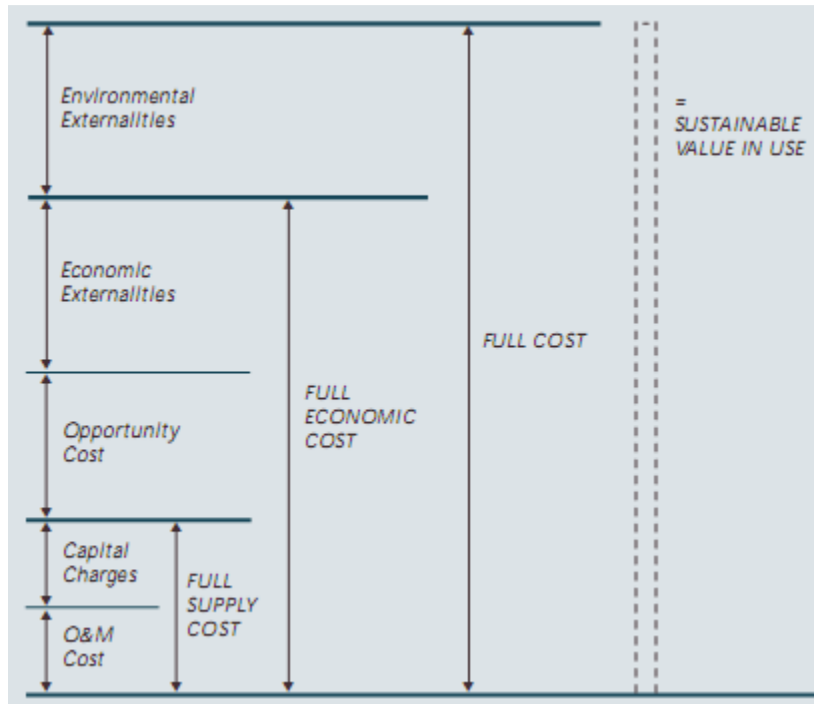
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