T E C H N I C A L N O T E

INFORMATION FOR ACTION FROM THE WATER AND SANITATION FOR HEALTH PROJECT

A Primer on Comparing and Using Cost Data in Water and Sanitation Reports

1. Introduction

Many reports on water and sanitation activities contain information on costs that is incomplete or too vague to provide a reliable basis for cost comparison. This technical note is intended for nonspecialized A.I.D. personnel and consultants who review reports, prepare project papers, perform project evaluations or collect data for use by others. Its main objective is to provide these practitioners with a working knowledge of the major factors that need to be considered in comparing costs across regions and countries and over time. Project cost data often lack specific information concerning the kinds of costs being discussed. Yet knowing precisely what each figure refers to is essential to rational cost analysis.

2. Cost Components, Per Unit Costs, and Time Frame

Meaningful cost comparisons can be made only if the components of each cost are clearly delineated and if the units in which these components are denominated are explicitly stated. As with all projects involving construction of infrastructure facilities, costs of water and sanitation interventions consist of initial investment costs as well as operation and maintenance costs. Yet, in many reports, the distinction between such cost elements is not clearly made, nor are the units in which costs are denominated always stated. It is also essential to indicate the year to which costs apply. This basic information is critical to cost evaluation. Its omission leaves the reader with important questions.

One may read, for example, that the cost of water in a particular country ranges from, say, $5 to $35 (such statements appear in many reports). Which cost component (capital, operation and maintenance) is being described? And to which unit does the specified range refer? To annual costs, per capita costs, or costs per cubic meter of water provided? Finally, in which year were these costs valid? Example 1 below introduces the kind of problem that arises when a time frame is not specified.

Example 1. *A 1989 article stated that "operations and maintenance costs per capita for water supply in Malawi were US$.25 per year." Although it is implied that the quoted costs were not for 1989, the article does not indicate the year to which those costs apply. The author should have explained that the statement was based on a 1986 report. The year in which cost data originate is especially significant because factors such as a high inflation rate or currency devaluation may have affected costs in the intervening years. Indicating that the figure was for 1986 would have supplied the reader with information needed to update the quoted operations and maintenance costs.*

3. Comparing Costs across Countries: Exchange Rates

Since costs are often compared across countries, it is necessary to convert local cost figures into dollars or another single currency before the comparison can be made. The exchange rate (or price of one currency in relation to another at a given time) is used for conversion.

The need to restate costs in terms of a single currency raises the question of which exchange rate to use in performing the conversion, the "official" or the "parallel" rate. In many developing countries the market for foreign exchange is in disequilibrium because the demand for foreign exchange at the official rate is greater than the supply. As a result, the parallel, or

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"black market," rate for foreign exchange will be higher than the official rate. The official exchange rate can be obtained from government publications, the Central Bank or the Ministry of Finance. The parallel rate is derived from estimates based on current conditions and may be obtained from economists or financial analysts familiar with the country. It is not a published rate.

In working with cost data, care must be taken to state whether the official or parallel market rate is being used. Although these exchange rates may differ only slightly in certain cases, in many other instances, the divergence between the two rates may be significant.

A country may, in addition, have different "official" exchange rates that apply to different sets of commodities, for example, an "official" rate for strategic commodities and a "commercial" rate for other imports or exports.

Examples 2 and 3 illustrate the importance of indicating which exchange rate is used in calculating costs:

Example 2. *Comparing costs of the Dominican Republic-manufactured ETINCA pump and the U.S.-manufactured MYONO pump, one report concerning a project in the Dominican Republic concludes: "Under average conditions, the estimated annual cost for the MYONO pump (DR$236) is about 16% higher than the ETINCA pump (DR$203). This difference, however, might not be too significant since it could well fall within estimating error."*

Here it is important to stress that an official exchange rate of DR$1 = US$1 was used in this calculation. Since the MYONO pump is imported, using the parallel rate of DR$1.49 = US$1 would have raised its total annual cost by approximately 50%, thus significantly altering the analysis.

Example 3. *Recognizing that in any given funding period it is not feasible to provide all communities with improved water supply and sanitation facilities, government officials and donor representatives in an Asian country convened a meeting to select one of two project sites under consideration. Several factors were examined, but cost was identified as the sole criterion for deciding which community would be served. It was then agreed that a study should be commissioned to estimate the costs of providing identical services to the two potential target communities.*

Table 1 presents a summary of the total estimated costs for communities A and B divided into two components: a foreign, or imported, component and a local one. Local costs are estimated in shillings (Sh) and then converted into dollars using two foreign exchange rates, the official rate and the parallel market rate. Note that, if the official exchange rate is employed to calculate project costs in dollars, community A will be selected. But if the parallel market rate is used, community B will be chosen.

Overvaluation of a currency as reflected in its scarcity value in the parallel market sometimes leads to a devaluation, whereby a government acts to lower the value of its currency by decreasing the official exchange rate. The dramatic implications of a devaluation for cost calculations are illustrated in Example 4.

Example 4. *A 1989 evaluation team was unable to obtain the data to compute operation and maintenance costs of a water distribution system and the capital costs associated with maintenance of the pumping station and water treatment plant at Kitingari in the Newala District of Tanzania. For the purposes of the evaluation, the team decided to estimate that these costs would be about 10%*

Table 1. **Cost Estimates of Providing 30 Liters of Water per Capita per Day to 100,000 Inhabitants in Two Potential Project Sites**

Location	Foreign cost	Local cost at official and parallel market exchange rates			Total cost at official and parallel market exchange rates	
	$ (million)	Sh (million)	$ (million)		$ (million)	
			Official (Sh1 = $.95)	Parallel (Sh1 = $.45)	Official (Sh1 = $.95)	Parallel (Sh1 = $.45)
Community A	2.000	1.800	1.710	0.810	3.710	2.810
Community B	1.600	2.400	2.280	1.080	3.880	2.680

of the initial capital costs in 1984, the year that the system was constructed. However, the team was faced with the following dilemma as a result of a massive devaluation of the Tanzanian shilling (Tsh). If they based their estimate on the initial cost as expressed in 1984 dollars, *the O & M estimate would total Tsh48,000,000 yearly (or U.S. $500,000 at the 1989 exchange rate). This was very high. If, on the other hand, they based their estimate on the initial capital costs as expressed in* Tanzanian shillings, *the amount would be too low— Tsh6,000,000 yearly (or U.S. $60,000 at the 1989 exchange rate). The dollar difference was more than 800%! The team resolved the dilemma by using the average of the two estimates.*

4. Comparing Costs over Time

The need to compare costs over time is particularly critical in situations where data are available only for certain years. Example 5 is typical.

Example 5. *A consultant writing a report in 1991 on the costs of sanitation facilities in an African country is seeking information on annual per capita costs of communal latrines in that country. In reviewing available reports, the consultant finds that these costs were CFA1,000 in 1987, the most recent year for which such data are available. But it is highly unlikely that this activity cost the same amount in 1991. The question is how to adjust this figure for greater precision. The answer is that inflation must be taken into account, as explained below.*

Inflation and Price Indexes

Inflation refers to an increase in the general level of prices for all goods and services in an economy. When inflation occurs, a currency buys less than it used to: it has less purchasing power. The rate of inflation refers to the percentage increase in the general price level, usually from one year to another.

A positive rate of inflation in a given period means that the purchasing power of a currency during that period declines annually at a rate equal to the rate of inflation. Thus, the amount must be adjusted upwards if its purchasing power is to remain constant. Similarly, a positive rate of inflation in a given period means that the cost of an activity during that period rises annually at a rate equal to the rate of inflation.

Countries usually develop one or more indexes for measuring inflation and for adjusting prices and costs. The most commonly used tools for measurement and adjustment are the consumer price index (CPI) and the gross national product (GNP) deflator. Specifically for water supply and sewerage projects it is sometimes possible to obtain specific construction indices that have been prepared by the Department of Public Works.

Table 2. Adjusting Costs for Inflation Using the Consumer Price Index

Year	CPI		Adjusted Cost (CFA)
	Index	% change	
1987 (base)	100		1,000
1988	108	8	1,080
1989	122	13	1,220
1990	131	7	1,310
1991	140	7	1,400
1987-91		40	

The Consumer Price Index (CPI). A price index is a weighted average of selected prices in the economy at any given time, divided by the prices of the same goods in a *base year, or reference point.* For example, the CPI in a given year is the ratio of an average of the prices of consumer goods in that year to the average prices of the same goods in the base year. Assume that the base year is 1980, then a CPI of 1.75 for 1991 means that average prices in 1991 were 75% higher than average prices in 1980.

Assuming that the CPI in Example 5 above reflects an inflation rate of 40% between 1987 and 1991 in the African country under consideration, the annual per capita costs of communal latrines for 1991 in that country can be estimated as follows, as shown in Table 2: CFA1,000 X 1.40 = CFA1,400. Adjusted costs for other years can be estimated using similar calculations. Although updating costs requires, at a minimum, knowledge of the precise year for which the cost data are quoted, such critical information is often neglected.

To obtain more accurate estimates, the per capita costs of these sanitation facilities could be broken down into costs of capital, materials, and labor. Since costs for certain components (fuel, reinforcing bars, laboratory equipment for testing water quality) may rise at a higher rate than costs for others (staff salaries, visual aids and teaching materials, office furniture and supplies), additional information on the various cost elements would enable the researcher to update these estimates more accurately.

In a recent water project in Malawi, for example, estimated construction costs and actual construction costs varied by as much as 50%. Even though price contingencies had been included in the estimates to allow for a general level of inflation, the cost of PVC pipe, which accounted for about 60% of the total cost, had doubled. The lesson here is to pay close attention to those items in the cost estimate that are likely to increase faster than the rate of inflation – imports, for example – as well as any single item that makes up a large proportion of the total estimate.

The Gross National Product (GNP) Deflator. The GNP is the market value of all currently produced goods and services during a particular time interval that are sold through the market but are not resold. The GNP deflator (see Table 3) is the economy's aggregate price index, and is defined as the ratio of nominal GNP to real GNP (the terms "nominal" and "real" are defined below).

Alternative Indexes: the MUV and the GDP Deflator. To compute total expenditure for any water and sanitation project, the costs of local components (cement, labor) must be added to the costs of imported components (trucks, drilling rigs, pumps). As relative costs of different components may vary over time with local and international inflation, alternative indexes such as the World Bank's Manufacturers Unit Value (MUV) index or the U.S. gross domestic product (GDP) deflator can be used to adjust for inflation differentials.

The MUV index is the cost, insurance and freight (CIF) index of U.S. dollar prices of industrial countries' manufactured exports to developing countries. It is frequently used to measure changes in the prices of industrial exports to developing countries.

The GDP is the market value of all goods and services currently produced within a country during a particular time interval. (GNP, by contrast, measures national income generated both within and outside the country. The difference between the GNP and the GDP deflators follows from this distinction.) Using the U.S. GDP deflator may be more appropriate than the GNP deflator in circumstances where the U.S. inflation rate is believed to be a more relevant measure of changes in the cost of specific items than the local rate.

Using the MUV index as shown in Table 3, it is clear that US$100 worth of exports of, say, water pumps or pipes, increased in cost by almost 46% to US$145.78 between 1985 and 1990. But if one instead uses a measure of US inflation, which takes into account a wider basket of goods – food plus manufacturing and services – the inflation increase is only 18%, or about 3% per year over the period.

***Table 3:* Inflation Indices, 1985-1990**

Year	MUV Index		U.S. GNP Deflator	
	1985 = 100	%change	1985 = 100	%change
1985	100.00	0.81	100.00	2.98
1986	117.91	17.91	102.69	2.69
1987	129.51	9.84	106.06	3.28
1988	138.94	7.28	109.72	3.45
1989	137.97	- 0.70	114.24	4.12
1990	145.78	5.66	118.90	4.08

Source: World Bank, International Economics Department, International Trade Division.
Date: October 21, 1991. Washington, D.C.

"Current" and "Constant" Prices

One of the lessons learned from many development projects is that at least some costs must be recovered from users because government and donors cannot bear the financial burden alone. Such costs must reflect actual costs over time if they are to be recovered in actual values. The "current" and "constant" price concepts provide a basis for adjusting costs and are useful in calculating user fees or tariffs. Example 6 shows what can happen when only current user fees are considered.

Example 6. *In examining a "time-series" (data covering a span of time) of fees that were charged users of a particular piped water supply system, a policymaker discovered that the fees had increased by 100% over the 1986–1991 period. It seemed logical to conclude that the fees had become excessively high and therefore could not be raised further. But was this conclusion actually warranted? To determine whether the time-series examined provides a strong rationale for such a conclusion, the concepts of "nominal" and "real" values will be introduced.*

A *nominal* value is the actual amount of currency that comprises an expenditure. If a person's nominal spending on a particular item, say the yearly rental of an apartment, rose from $10,000 in 1980 to $16,000 in 1991 it could indicate that the person was renting a better apartment in 1991 than in 1980, or it could simply indicate that rents had increased. Was the person better off? Or did price increases leave him or her no better off

Table 4. Calculation of User Fees in Constant Prices Using the Consumer Price Index

Year	CPI		User Fees			
			Current US$		Constant US$	
	Index	% increase	$	% increase	$	% increase
1986	100		1		1	
1991	225	+125	2	+100	.75	-25

than before? Looking at nominal values will not answer these questions. They obscure more than they reveal.

In contrast, a *real* value reflects the purchasing power of a given expenditure. It is expressed in the price of an arbitrarily chosen base year. If the base year were 1980, the real expenditure for 1991 would be expressed in 1980 prices. For instance, if all prices doubled between 1980 and 1991, then a yearly rental of $16,000 would be only $8,000 in 1980 prices — and the person would be better off, as his or her rent would have increased by only 60%, not by 100%, as reflected in the general trend. Real values are adjusted for the effects of year-to-year changes in prices.

In sum, real values are constant values of a base year, as opposed to nominal values, which are current. Real values are found by adjusting nominal values for the rate of inflation as explained in the previous section.

To illustrate, suppose that the user fees in Example 6 were $1 in 1986 and $2 in 1991 (a 100 % increase over five years) and that inflation had increased by an average of 25% per year, or 125% over the five-year period. When 1991 fees are adjusted for inflation it becomes apparent that user fees had increased by 100% in current terms, but *decreased* by 25% (125 - 100) in constant terms. The user fee data in Example 6 is summarized in Table 4.

Summary

To sum up, Example 7 shows that without clarification and explanation it can prove impossible to interpret cost and revenue figures for different years.

Example 7. *Table 5 is taken from a report assessing the results of an institution-strengthening water and sanitation project. At first glance it appears that the project had a salutary impact. However, taking a closer look, it becomes clear that, without additional information, the cost and revenue figures in the table are almost meaningless.*

Table 5. Assessing an Institution-Strengthening Project

Indicator	Before Project (1984)	End of Project (1990)
Piped water produced (millions of M^3/year)	155	219
Billed connections (thousand)	79	185
Billings (R million)	224	503
Collections (R million)	56	422

According to the table, 56 million rupees (R) were collected in 1984 for supplying 155 million cubic meters of water, or 0.4 million rupees per million cubic meters; and 422 rupees were collected in 1990 for 219 million cubic meters of water, or 1.9 million rupees per million cubic meters. Looking at these two figures, it appears that collections had increased almost five-fold. But since these revenue figures are given in current rupees, as is the normal practice, without some information on the inflation rate over the 1984-1990 period, it is impossible to know whether progress in increasing revenue had actually been made or not.

If the inflation rate had been just 10% a year during the specified period, the extent of the revenue increases would have been much lower than five-fold. With 10% inflation per year, the 1984 figure would have to be adjusted to about 99 million rupees to be comparable with the 1990 figure. The revenue increase would then be approximately three-fold in constant terms. This is a considerable difference. If, however, the inflation rate had been higher than 10%, as it is in many countries, the figures in the table might actually show a decrease in real revenue.

Thus, Table 5 is accurate, but incomplete. Specifying the rate of inflation between 1984 and 1990 or, equivalently, expressing the 1990 revenue figure in real terms would have allowed the reader to assess whether or not progress had been made in collecting fees.

5. Comparing Ability to Pay

Another useful, though indirect, method of comparing costs over time and space (between regions or countries) is to compare costs relative to users' ability to pay for water and sanitation facilities. Although affordability parameters in this area are yet to be developed, experience indicates that they can be formulated as a percentage of per capita disposable income (income that individuals have available to spend or save) of the target group. Reporting such data, when available, would greatly enhance water and sanitation cost comparisons.

For example, a report discussing the cost of water sold by vendors points out that the price in one large town sometimes is as high as 30 shillings a bucket, the equivalent of an entire day's wages in agriculture.

6. Financial Versus Economic Costs

Both financial and economic analyses use cost estimates expressed in monetary terms. These two types of analyses are closely related, but they are not the same. When working with cost figures, it is important to understand the difference between the two terms – "financial" and "economic."

A *financial* analysis looks at costs (and benefits) from the viewpoint of a specific entity: a specific project, for example. All expenditures incurred because of the project and all revenues resulting from it are taken into account. A financial analysis provides information about whether a project will generate sufficient revenues to meet its financial obligations.

An *economic* analysis takes a wider view. It looks at costs and benefits from the viewpoint of the national economy as a whole. Its purpose is to determine whether or not the activity – or project – will contribute to the total economy of the nation. It will answer the question: Is it justifiable to spend scare resources on this project or will these resources yield more benefits if spent on some other activity? In other words, an economic analysis focuses on the opportunity cost (also termed shadow price) of each activity, or the "next-best" alternative use of available resources.

In a financial analysis, current costs are used. When both domestic costs and foreign costs are needed to derive total costs, these are simply added together using the official exchange rate. Capital costs are annualized, or amortized, so that costs can be budgeted over time.

An economic analysis may start with the same data base used in a financial analysis, but it adjusts the data to reflect the costs to the economy as a whole. For example, because foreign exchange is scarce in most developing countries, an economic analysis would make adjustments when adding costs that represent local costs to costs that represent scarce foreign exchange costs. These costs would not simply be added together as in a financial analysis.

The *financial* cost of labor in a particular project, for example, is calculated as the number of days worked multiplied by the daily wage rate. Suppose a minimum wage rate is set by government regulation. The *economic* cost of labor would then be lower than its financial cost. Assuming a large pool of unemployed, unskilled labor, the opportunity cost – or the next-best use of unskilled labor – is low because other productive uses for unskilled labor are scarce. The economic, or shadow, wage rate indicates that the supply of suitable labor is probably higher than demand at the prevailing minimum wage rate.

The two types of analyses have different viewpoints and purposes. For instance, an economic analysis of a water supply project might seek to quantify the time savings that women realize when a village standpost is installed and they no longer have to walk several kilometers to fetch water from a traditional source. This increased productivity benefits the nation as a whole but does not specifically benefit the water supply institution or agency that constructed the water point.

Due to the prevalence of various price distortions, such as interest rate subsidies, exchange rate overvaluations, and minimium wage legislation, only a few of the elements comprising the total cost of water and sanitation facilities in developing countries reflect their opportunity cost. Therefore, financial and economic analyses are likely to yield very different cost estimates, as shown in Example 8.

Example 8. *Assume that the only three inputs, or components, used in the operation and maintenance of a water and sanitation facility in a particular project area are labor, fuel, and local materials. Total annual operation and maintenance costs of the project may be calculated as shown in Table 6, using the following assumptions: (1) the price of local materials reflects its opportunity cost and needs no adjusting, (2) there is a 10% subsidy on fuel consumption, (3) due to minimum wage legislation, the wage rate is 25% higher than it would be without government intervention. Note the significant difference between total financial costs and total economic costs.*

Since costs are usually reported in financial rather than economic terms, it is important to flag instances where economic rather than financial costs are given in order to avoid misleading the reader.

Table 6. Total Annual Operation and Maintenance Costs ($Thousand) of a Water and Sanitation Project, in Financial and Economic Prices.

Input	Financial Cost	Conversion Factor	Economic Cost
Labor	130	0.75	97.5
Fuel	45	1.10	49.5
Local Materials	63	1.00	63
Total	238		210

7. Comparing Costs in Project Evaluations

The concepts outlined in this note are relevant to all water and sanitation activities where collection and analysis of cost data are performed. Rigorous cost comparisons are particulary important in project evaluations for at least two reasons.

First, owing to the considerable variability in the costs of providing improved water supply and sanitation services, project efficiency can be determined only after all project inputs are listed with sufficient detail and their costs appropriately measured. Second, evaluation of water and sanitation projects often requires comparing project costs with those of other health interventions, such as immunizations and oral rehydration therapy, in terms of health impacts and the number of people served. Inaccurate identification of project costs and outputs may lead to erroneous conclusions. Cost comparisons necessitate a thorough examination of all data.

When comparing costs in project evaluations, follow these guidelines:

1. First, identify all project inputs (money, commodities, personnel, labor and services, etc.). Then identify all input costs, including depreciation of buildings and equipment and community contributions valued at their opportunity cost.

2. State all assumptions used for cost calculations. For example, when annual per capita capital costs are presented, the discount rate, or the opportunity cost of capital, as well as the period over which costs are calculated should be specified.

Rules of Thumb for Comparing Costs

These rules of thumb apply for persons actively providing cost data for use by others as well as for those engaged more passively in trying to understand a study, examine a project paper, or make a decision based on cost data.

The Fundamentals

Give the **time frame**. When were the costs valid?

Make sure that all the **components** of a given cost are clearly stated (construction costs as well as operation and maintenance) and that the **units** in which costs are given are explicit (annual costs, per capita costs, or costs per volume of water provided).

Comparing Costs from Country to Country

Convert all figures into a single currency (normally U.S. dollars) using either the official or the parallel exchange rate – whichever is most sensible given the situation.

State clearly which exchange rate is being used and why.

Comparing Costs over Time

Adjust all costs to account for changes over time in the value of money. A base point, or reference year, should be used, as in the Consumer Price Index, the Gross National Product Deflator, or the Manufacturers Unit Value Index.

Financial and Economic Costs

Flag instances in which costs are reported in economic, rather than in financial, terms to avoid confusion.

Following these rules of thumb will increase the utility of reports discussing costs and the correctness of decisions based on cost data.

3. Construct, over the life of the project, a time-series of all costs in both nominal and real terms, applying an appropriate price deflator to each cost.

4. Since expenditures in local currency are normally expressed in U.S. dollars, justify the exchange rate selected. When no selection criteria can be identified, use both the offical and parallel exchange rates.

5. If a currency devaluation has occurred during the project, describe its magnitude and provide a full explanation of its implications on cost calculations.

6. Identify all project outputs achieved and express them quantitatively. This is very important, because economic efficiency, defined as extracting the maximum output from a given set of inputs, is a major consideration in project evaluation. Cost calculations for project evaluations will not be meaningful unless the various outputs, including level of service and volumes of water provided per capita, are fully described.

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