# COSTS AND FINANCING OF WATER SUPPLY AND SANITATION ACTIVITIES

A report prepared for UNICEF by Hakan Wilson

CONTENTS

## List of acronyms used

| | |
|---|---|
| ADAB | Australian Development Assistance Bureau |
| AFESD | Arab Fund for Economic and Social Development |
| BMZ | Bundesministerium fur wirtschaftliche Zusammenarbeit (Federal German Ministry for Economic Co-operation) |
| CARE | Co-operative for American Relief Everywhere, Inc. |
| CCCE | Caisse Centrale de Coopération Economique |
| CIDA | Canadian International Development Agency |
| DANIDA | Danish International Development Agency |
| FINNIDA | Finnish International Development Agency |
| IADB | Inter-American Development Bank |
| IDRC | International Development Research Centre |
| ITP | Intermediate Technology Publications |
| NORAD | Norwegian Agency for International Development |
| ODA | Overseas Development Agency |
| O/M | Operation and maintenance |
| OPEC | Organization of Petroleum Exporting Countries |
| ORT | Oral rehydration therapy |
| PAHO | Pan American Health Organization |
| SDC | Swiss Development Cooperation |
| SIDA | Swedish International Development Authority |
| UNDP | United Nations Development Programme |
| UNDTCD | United Nations Department for Technical Co-operation for Development |
| USAID | United States Agency for International Development |
| VIP latrine | Ventilated improved pit latrine |
| VLOM | Village-level operation and maintenance |
| WASH | Water and Sanitation for Health |
| WHO | World Health Organization |

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# I. COST AND FINANCING ISSUES

This report represents the first effort by the UNICEF Water and Environmental Sanitation Team to acquire a coherent picture of what different types of water supply and sanitation interventions cost and why. Although individual staff are knowledgeable on cost issues, no organized body of information on this subject exists within UNICEF. This project therefore started from scratch, collecting information over a three-month period in an attempt to provide UNICEF with some new insights.

There are substantial problems related to gathering and evaluating cost data on water and sanitation. (Health education is even more difficult to cost and falls outside the scope of this report.) The data available is inconsistent, collected and evaluated by people from profoundly different backgrounds and with different objectives. Unfortunately, UNICEF must be classified as one of the worst sinners in this respect. Almost all cost information is supplied for accounting purposes or at best for financial requirements. Economic costing is completely absent. Not even the World Bank is particularly comfortable with its economic costing - one reason being the painful lack of good and comparable data. Another reason is related to methodological problems.

Economic costing is crucial to the efficient use of UNICEF resources. Accounting serves the objective of item-by-item accounting for the use of financial resources. Financial analysis is necessary to establish sufficient funding, to make sure an intervention is financially viable. Economic costing, on the other hand, aims at ensuring the optimal use of limited resources, i.e. at economizing. But the concept is really much wider. For example, economic analysis, by determining the "real" resource value of a certain service to a village in terms of cash and in-kind, can help establish whether the village population should be willing to pay for this service. Of course this is far from enough - a socio-economic survey must follow to establish if there is sufficient financial capacity, i.e. if there is enough cash available to pay for the service.

## What UNICEF needs to know about costs and why

Each cost analysis must be related to output in some respect, e.g. villages served, wells drilled or litres per capita. Any other listing of costs is merely accounting. Below follows a list of different cost items on which UNICEF needs information.

- Unit costs, total and disaggregated into per capita costs. This item should be shown both as a one-time cost and as an annualized cost over the economic lifetime of the project. Unit cost by itself can be discouraging without proper attention to capacity, i.e. number of people served. Annualized cost shows the annual financial outlay per capita and can provide a first basis for cost recovery. It is necessary to know the total one-time cost so that the cost can be applied to different lifetimes and discount rates. The overall purpose of unit costs is cost comparison between different techniques, sites, etc.

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- Operation/maintenance (O/M) costs must be studied to identify techniques which may prove excessively costly for the beneficiaries (who must often cover O/M), to show the eventual trade-off between capital costs and O/M, and to emphasize a project aspect that often falters.

- Overhead/administrative costs must be known if there is potential to extend existing programmes without increased overhead. Knowledge of these costs can thereby yield a proxy equivalent to the marginal cost for yet one more project.

- A socio-economic survey must be undertaken for every project in which costs will be totally or partially covered by the beneficiaries. This study should determine how much cash and in-kind the communities can contribute.

- Economic costs such as user costs and other significant costs are valuable in determining willingness to pay. A study of economic costs should not encompass in-kind contributions and should preferably be undertaken through direct interviews with potential beneficiaries.

- Benefits must be studied to determine the likely range of impact from certain projects under various circumstances, as well as to support field personnel in their choice of projects and headquarters in its choice of policy.

- The cost and expenditure ratios between water and sanitation (and, eventually, health education as well) are necessary for monitoring and managing the priority use of UNICEF resources.

## II. REVIEW OF THE EVIDENCE

This report focuses on costing of water and sanitation projects. The original intention to extend the study beyond financial evaluation to economic costing has not been fulfilled due to insufficient data. This chapter covers costs of water (including rainwater catchment), sanitation and combined water and sanitation projects. Each of these sections includes a summary table indicating ranges for financial costs in terms of unit capital costs, annualized capital costs per capita and annual O/M costs per capita. All figures are in 1987 United States dollars, upgraded by the United States consumer price index.

The range and results of the different studies vary considerably. There is, for example, ample information on drilled wells with handpumps and on ventilated improved pit (VIP) latrines, but only in terms of capital costs. O/M costs are much harder to come by (since they are harder to estimate), but no less important. What good is a well, unless it is maintained?

Chapter III summarizes key issues for a comprehensive view of global problems and features, while chapter IV contains recommendations. Annexes I-III provide detailed information supporting the findings of the report.

## A note on the quality of cost estimates

One of the major problems with the estimation of costs - financial and economic - is the almost complete absence of coherent, comparable data. No estimate is similar to another. Consequently, the cost tables in this report are flawed by problems such as ambiguity and incompleteness. Please keep in mind the following points/questions when reading this study:

- Most estimates and evaluations - benefits and costs alike - are ambiguous at the original source in terms of what they include or exclude and how they are calculated. For example, is overhead included, and if so, is this overhead incurred by construction firms, contractors, donor organizations and different government levels? How are cost items such as means of transport, field studies, fees and taxes incorporated, if at all? And to what part of a project are they assigned? Are contributions in-kind (labour, material) included and, if so, how are they converted into cash equivalents?

- What discount rates and economic lifetimes are appropriate, especially if different lifetimes apply to different parts of the same project?

- O/M costs are often quoted as constant over time. However, it seems more likely that O/M increases over time as machines wear down and more and more parts must be replaced.

- This report shows all costs in April 1987 United States dollars to allow easy comparison. But should costs in other currencies be upgraded by the American consumer price index? What exchange rates are appropriate, especially considering the perverse dollar values prevailing in the early 1980s?

- Costing must be related to a fixed point such as level of efficiency, number of beneficiaries or litre per capita production. But the service level, to take one example, often differs between countries, between systems and even within a country using the same system. Sometimes these differences are a function of culture, sometimes of population density. Does one compare real, experienced costs by using actual service level? Or should one instead apply a fixed, global level of service? For simplicity, the former method has been adopted here.

- And, perhaps most important, even if all figures are correct, how does one take into account inefficient management and slack in production?

Keeping these issues in mind, the reader should use the figures in this report cautiously and preferably as indicative of cost ranges only.

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## Water supply projects

The main sources for low-cost water supply estimates are UNICEF, the World Bank and WASH/USAID. UNICEF information primarily concerns handpumps in rural areas. The cost estimates are summarized in tables 1 and 2. For comparison, a slightly adjusted (extreme values disregarded) set of aggregate WHO figures is provided in table 3.

The unit cost for water supply by handpump ranges from a low of $200 with dugwell to $12,000 for a drilled well. Annualized per capita capital cost ranges from $0.17 in Bangladesh to almost $10 in Benin. The costs for yardtaps and standposts are higher for unit, annualized capital and O/M cost per capita, but do not differ greatly from handpump costs. Annualized per capita capital costs for yardtaps and standposts range from $3-$7 and annual O/M from about $0.05 to $7.

Handpump costs differ between regions, with Asia considerably less expensive in general than Africa. However, the material does not support a similar conclusion for standposts and yardtaps, pointing again to the lack of good cost information. The type of handpump itself seems to make little difference, whereas the costs for drilled wells far exceed the costs for dugwells. Furthermore, the cost per productive well depends on the success rate in well drilling, as illustrated by the difference between 1984 and 1985 costs in Uganda (see table 2).

As for O/M, although cost variation over time is likely to be quite significant, the only example is provided by WASH in Zaire (see table 1). Their study shows an increase in O/M per capita and year by almost 50 per cent over the economic lifetime of the project. There is no trade-off between O/M and unit costs for handpumps (again perhaps illustrating the importance of how the hole is dug) but a slight pattern emerges for yardtaps and standpost: the higher the unit cost, the higher the O/M cost.

The data for the sea-water projects are interesting as references but must be qualified by the following: the estimates are for the United States; the costs do not include distribution systems; and there is a substantial initial financial requirement, no less than $2 million and up to $50 million.

All estimates are financial, with the exception of one World Bank study which shows greatly increased economic costs when the time spent on water collection is included.

Table 1. Summary of water supply cost estimates: handpumps
(in 1987 United States dollars)

| Country | Agency | Type of system | Unit cost One time | Unit cost Annualized per cap. | Annual O/M per cap. |
|---|---|---|---|---|---|
| Philippines | World Bank | Handpump | | | |
| | | - shallow | 192 | 0.75 | 0.41 |
| | | - intermediate | 928 | 2.17 | 0.61 |
| | | - heavy duty | | | |
| | | a. steel | 2,581 | 8.60 | 0.14 |
| | | b. pvc | 2,030 | 6.76 | 0.14 |
| Thailand | World Bank | Shallow dugwell w/handpump | 540 | 0.70 | 0.93 |
| | | Drilled deepwell w/handpump | 2,660 | 3.48 | 0.93 |
| Bangladesh | UNICEF | #6 handpump | 150 | 0.17 | 0.04 |
| | | Tara handpump | 250 | 0.28 | 0.04 |
| India | UNICEF | Mark II handpump | 2,449 | 1.22 | 0.19 |
| Malawi | World Bank | Handpump | | | |
| | | w/dug well | 720 | 0.75 | 0.19 |
| | | w/drilled well | 1,390 | 0.73 | 0.09 |
| Benin | UNICEF | Drilled well w/Mark II pump | 12,808 | 9.90 | N.A. |
| Burkina Faso | WASH | Drilled well w/handpump | 11,613 | 6.79 | N.A. |
| General | World Bank | Handpump | | | |
| | | - low | 5,300 | 1.55 | 0.50 |
| | | - high | 12,500* | 3.65 | 1.00 |
| India | World Bank | 3-tier system | N.A. | N.A. | 0.24 |
| Zaire | WASH | Handpump | N.A. | N.A. | |
| | | - years 1-5 | | | 0.69 |
| | | - years 6-25 | | | 1.02 |
| Burkina Faso | World Bank | VLOM | N.A. | N.A. | 0.05 |

*If user costs included, add $3.5 to $7.5 per year/capita respectively.
N.A.=not available

Sources: World Bank, "Technical Report #48" (1984)
"Community Water Supply" (1987)
UNICEF, "Travel Report - Joseph Christmas" (1987)
Untitled report from India (undated)
"Report from Benin" (1981)
WASH, "Field Report #191" (1985)
"Field Report #170" (1986)

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Table 2. Summary of water supply cost estimates: other than handpumps
(in 1987 United States dollars)

| Country | Agency | Type of system | Unit cost One time | Unit cost Annualized per cap. | Annual O/M per cap. |
|---|---|---|---|---|---|
| Yemen | UNICEF | Diesel pump & standpost | 68,190 | 2.65 | N.A. |
| Guatemala | World Bank | Standpost | 844 | 4.94 | included in $4.94 |
| general | World Bank | Standpost | | | |
| | | - low | 10,500 | 3.07 | 1.87 |
| | | - high | 23,000 | 6.73 | 3.75 |
| Brazil | World Bank | Standpost | N.A. | 1.51 | 0.33 |
| | | Yardtaps | N.A. | 3.75 | 0.68 |
| Kenya | SIDA | Yardtaps | N.A. | 0.23 | 0.55 |
| general | World Bank | Yardtaps | | | |
| | | - low | 23,000 | 6.75 | 3.62 |
| | | - high | 45,000 | 13.19 | 7.24 |
| Thailand | World Bank | Dugwell without pump system | 93 | 0.15 | N.A |
| Uganda | UNICEF | Boreholes without pump system | | | |
| | | - 1984 | 5,711 | N.A | N.A. |
| | | - 1985 | 3,368 | N.A | N.A. |
| United States | UNDTCD | Sea-water desalting cubic metre/day* | | | |
| | | - 3800 | 8,364,000 | 233.00 | 251.00 |
| | | -19000 | 26,120,000 | 146.00 | 200.00 |
| | | -38000 | 47,955,000 | 134.00 | 190.00 |
| | | Electrodialysis reversal* | | | |
| | | - 3800 | 1,622,000 | 45.00 | 55.00 |
| | | -19000 | 7,007,000 | 39.00 | 44.00 |
| | | -38000 | 12,889,000 | 36.00 | 41.00 |
| | | -94600 | 28,812,000 | 32.00 | 39.00 |

*The two sea-water project estimates do not include distribution systems.
N.A.=not available

Sources: World Bank, "Community Water Supply" (1987).
"Appropriate Technology #8" (1984).
"Appropriate Technology #9" (1984).
UNICEF, "Report from Uganda" (1984).
"Report from Aden" (1981).
UNDTCD, "Water Series #14" (1985)
SIDA, "Summary of recent recommendations for rural water supply in Kenya" (1984).

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Table 3. WHO cost estimates
(in United States dollars)

| Area | Rural water/cap. | Rural sanitation/cap. | Ratio of water to sanitation |
|---|---|---|---|
| Americas | 115 | 51 | 2.25/1 |
| South-East Asia | 19 | 13 | 1.46/1 |
| Eastern Mediterranean | 116 | 106 | 1.09/1 |
| Western Pacific | 52 | 13 | 4.00/1 |
| Africa | 37 | 33 | 1.12/1 |

Source: WHO 1987 figures for the water decade. (to be updated based on mid-Oct. document)

Rainwater catchment projects

Cost estimates for rainwater catchment are even more scarce than for other types of water supply projects. While the material available points to several interesting aspects, it leaves many questions unanswered. The two main sources for information and cost data are a study by Arnold Pacey for ITP and a report by IDRC in Toronto. It should be noted that all estimates are purely financial as opposed to economic.

The costs for different rainwater catchment schemes vary considerably, from $26 to over $55 per cubic metre capacity. Size is a very important factor, with considerable economies of scale, as is the material used. (It is likely that other factors such as location and degree of technical sophistication also come into play, but the evidence is insufficient to support this notion.) By increasing the size of a ferrocement or galvanized tank in Indonesia from 2.5 to 10 cubic metres, the cost per cubic metre can be cut by 50 per cent. The cost ratio between a bamboo cement and fibre glass tank (also in Indonesia) is less than 1 to 5.

Costs range from $0.39 annualized cost in Burundi to $235 per cubic metre capacity for a fibreglass tank in Indonesia. But of the 15 to 20 specific projects studied, only two comparatively advanced systems exceed $6 annualized cost per cubic metre. There are, however, certain problems with these estimates. First, only one case explicitly includes the actual cost of roof improvement which could well be the major cost factor. We simply do not know. The second problem concerns the quality of rainwater after being held some time in the tank and without filters. Third, to estimate the effective supply from a certain tank, one must carefully study the climatic environment and constraints but will still obtain only a qualified guess as to the actual supply yielded in a particular year. On the other hand, if the concept of rainwater catchment is culturally acceptable, the relative simplicity of this kind of water supply makes it available to individuals with minimal external assistance.

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There is only one set of data on O/M costs: O/M of spring water catchment in Zaire was estimated to be more or less nil, consisting merely of a bag or two of cement every once in a while. In the following table, cost estimates of rectification of existing hafirs in Sudan and of rainwater jars in Thailand have been included for reference.

Table 4. Summary of cost estimates: Rainwater catchment tanks
(in 1987 United States dollars)

| Country | Agency | Type of system | Capacity cubic metre | Annualized cost/ cubic metre | Cost ratio Capital/lab. | Unit cost |
|---|---|---|---|---|---|---|
| Burundi* | WASH | | 10–20 (15) | .39/cap. | – | 387 |
| | | Roof improvement | 10–20 (15) | 16.00/cap. | | 16,000 |
| Indonesia | ITP | Bamboo cement | 2.5 | 3.96 | – | 82 |
| | | Fibre glass | 2.5–10 | 22.32–25.08 | – | 465–2,090 |
| | | Ferrocement WJ | 2.5–10 | 5.28– 2.76 | – | 109–232 |
| | | Z | 10 | 3.12 | 2.4 | 260 |
| | | Galvanized iron | 2.5–10 | 8.40– 4.92 | – | 174–207 |
| Kenya | ITP | Ghala type | 2.3 | 2.52 | – | 48 |
| Sierra Leone | IDRC | Unspecified with pipe | family | 11.44/cap.** | – | 572 |
| Thailand | World Bank | Tank | household | 3.35/cap. | – | 245 |
| | | Jar | family | 1.52/cap. | – | 19 |
| | ITP | Bamboo reinforced concrete | 9.4 | 4.44 | 0.76 | 348 |
| | IDRC | Ferrocement | 12.0 | 1.65 | 2.6 | 165 |
| | | Brick | 12.0 | 2.69 | 2.6 | 270 |
| | | | 14.5 | 2.57 | 2.9 | 311 |
| | | Interlocking mortar lock | 9.0 | 2.59 | 1.6 | 194 |
| | | | 12.0 | 2.44 | 1.9 | 244 |
| | | Bamboo reinforced concrete | 5.0 | 4.70 | 2.5 | 196 |
| | | | 9.0 | 3.40 | 2.6 | 260 |
| | | | 15.0 | 2.60 | 2.7 | 320 |
| | | | 21.0 | 2.20 | 2.9 | 352 |
| Sudan | UNICEF | Rectification of hafirs: manual | 30,000 | 0.45/cap. | | 3,645 |
| | | mechanical | 30,000 | 3.60/cap. | | 29,000 |
| Zaire | WASH | Development of O/M systems for spring catchment | – | 0.00/cap. | | – |

*Costs cover a social complex of several buildings.
**Includes piped distribution systems to the house(s) of the beneficiaries.
Sources: WASH, Field Report #170 (1986).
Field Report #24 (1981).
World Bank, "Community Water Supply" (1987).
Arnold Pacey et al.(for ITP), "Rainwater Harvesting" (1986).
IDRC Canada, manuscript report, "Rainwater Catchment" (1986).
UNICEF Sudan, "Memo" (8 March 1987).

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## Sanitation projects

The World Bank and UNDP, often in co-operation, provide the bulk of cost information on latrines. UNICEF has only very limited data. While information on unit costs and per capita capital costs is quite good, very few studies contain any information on O/M. As in the previous tables, almost all estimates shown in table 4 are purely financial.

Sanitation costs are somewhat difficult to estimate for several reasons: this intervention is characterized by great differences in number of users; the superstructure seems to be more costly despite the fact that construction of the upper part of the latrine by the beneficiaries themselves should lower costs; and the economic lifetime of the projects vary considerably, as for example, in the case of pit-latrines where there is the option of moving the superstructure after the initial pit is full.

Unit costs vary greatly: from $12-$100 for pit-latrines in Asia to $130-$330 for the same latrines in Africa, with costs for the Americas falling somewhere in between. Annualized costs follow the same pattern whereas O/M is most often stated to be zero, where any information exists at all.

The cost differences per capita (annualized capital costs) are well illustrated with costs up to $15 per capita per year plus $6 O/M for conventional sewerage, compared with the locally produced and almost fully self-financed water seal latrines in Bangladesh, costing a mere $0.75 a year, including O/M.

Table 5. Summary of sanitation cost estimates
(in 1987 United States dollars)

| Country | Agency | Type of System | Unit cost One time/Annualized per cap. | | Annual O/M per cap. |
|---|---|---|---|---|---|
| India | World Bank | Water seal -- dual latrine | | | |
| | | - old converted | 85.00 | 2.75 | 0.00 |
| | | - new | 103.00 | 3.33 | 0.00 |
| Bangladesh | UNICEF | Water seal | 22.66 | 0.73 | 0.00 |
| Guatemala | World Bank | Dry pit latrine | 12.29 | 0.40 | 0.04 |
| Colombia* | World Bank | Water seal | 41.07 | 1.33 | 0.00 |
| | | Dry pit latrine | 33.56 | 1.08 | 0.00 |
| Brazil | World Bank | VIP latrine | 67.13 | 2.18 | 1.35 |
| | | Pour flush | 134.72 | 4.36 | 0.67 |
| Nicaragua | World Bank | Pit latrine | 153.22 | 4.96 | N.A |
| Lesotho | WASH | Pit latrine | 130.00 | 3.92 | N.A |
| Tanzania | UNDP | Pit latrine | 171.93 | 5.57 | N.A |
| Kenya | UNDP | VIP latrine | 338.34 | 4.56 | N.A |
| Zimbabwe | UNDP | VIP latrine | 217.65 | 5.87 | N.A |
| Lesotho | WASH | Alternating-pit VIP latrine | | | |
| | | Type A | 458.64 | 9.28 | N.A |
| | | B | 581.32 | 11.77 | N.A |
| 39 country average | World Bank | Pour flush | 121.50 | 3.28 | 1.72 |
| | | Pit latrine | 211.40 | 5.70 | 0.00 |
| | | Septic tank | 351.40 | 6.80 | 3.09 |
| | | Vacuum truck | 184.40 | 3.60 | 5.50 |
| Brazil | World Bank | Septic tank | n.a | 6.74 | 0.67 |
| | | Small sewers | n.a | 9.39 | 1.36 |
| | | Conventional sewerage | n.a | 11.43 | 1.04 |
| Indonesia | World Bank | Conventional sewerage | 136.00 | 14.42 | 6.80 |

*The economic estimate differs only in respect to labour cost, and yields a slightly lower cost range: $1.06-$0.88 per capita per year.
N.A.=not available

Sources: World Bank, "Appropriate Technology #1a" (1980).
"Design of low-cost distribution systems" (1984).
"The cost of sewerage for Indonesia" (1983).
"Appropriate Technology #8 - Internal Use Only" (1984).
"Low-cost ... in India" (1980).
UNICEF, "Report from Bangladesh" (1987).
WASH, "Field Report #167" (1985).
UNDP, Inter-Regional Report INT/81/047 (1987)

## Combined water and sanitation projects

A major problem with most combined water and sanitation projects is that no distinction is made between the two components. Costs are often quoted jointly, making it impossible to distinguish anything but financial requirements and expenditure accounting. Sometimes so-called combined projects are in fact concerned exclusively with water (rarely with sanitation alone).

Common overhead costs, infrastructure and integrated health education provide one rationale for treating water and sanitation costs jointly. Nevertheless, in order to improve the scope of cost-effectiveness evaluations, the aim must be to list these costs explicitly as separate items.

# III. POLICY AND PROGRAMME ISSUES

The justification for spending resources on costing - economic or financial - is to improve productivity. Appropriate, correct and comprehensive cost information is a necessary management tool in the field and at headquarters.

This chapter contains a brief discussion of what determines costs, the use of benefit studies and the concept of user charges, both at the policy level of different development organizations and in the field.

## Factors in cost variation

A few of the many different factors influencing water supply and sanitation costs are discussed below. In general, it is difficult to establish the qualitative impact of different variables and accordingly even more complicated to conclude anything about magnitudes.

### Economies of scale

Very little data is available on specific interventions, different types of handpumps, etc. It is therefore impossible to distinguish the effects of size. Projects are seldom comparable and even if they were, other important variables cannot be held constant so as to isolate (at least partially) the effects of scale.

Nevertheless, it seems reasonable to suggest that considerable economies of scale should be available. Physics proves that a one unit increase in the radius of a tank produces more than a one unit increase in volume. And there must be an optimal production level for the 'sanitation equipment plants' which UNICEF has been instrumental in creating in Bangladesh.

On the country or project level, economies of scale must exist as regards administration. The first phase of a project involves large investment in terms of human capital, i.e. staff, training, etc. To drill an extra 10 holes or erect 100 more sanitation facilities should be possible without increasing administration and overhead. But embarrassingly little is known in terms of overhead and administration costs in relation to specific projects.

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Advanced versus less advanced systems

Comparisons of economic efficiency of projects at different technological levels would probably show that the more costly a system, the higher the economic benefits. A similar comparison of costs would probably also show that a more advanced system requires more costly parts, as well as better trained personnel. The resource costs incurred by the society would subsequently be greater.

The question is whether this is really important. Economic analysis has its place, but financial viability often constrains the choice to the less advanced, less costly system. The World Bank would probably argue for the need for improved financial structures in the society, to allow economic considerations to influence actual decision-making.

Regional differences

Costs of projects in Africa and Asia differ significantly. West Africa, in particular, suffers from high costs. (See tables 1-2). Reasons for these discrepancies include physical as well as cultural and political factors. It has not been possible to determine the importance of groundwater levels and rock formations for water supply costs. The material indicates, however, that the general economic conditions in Africa such as CFAF currency regions, lower educational levels and less advanced infrastructure affects costs for both water and sanitation.

Village-level operation and maintenance (VLOM)

There is evidence that VLOM can cut O/M costs considerably. The experience in Malawi probably serves as the best example. However, VLOM - full or partial - is not always viable due to lack of knowledge/interest.

According to a 1981 World Bank report, expatriates involved in O/M often constitute the bulk of costs. The argument for decentralized, locally organized O/M is strong from a costing point of view.

Slack and inefficient production

Efficiency and best use of available resources is a highly desirable condition when one compares different projects. However, this optimum condition seldom exists in reality and it is difficult to say to what extent slack is an important cost factor. The problem is further compounded by the lack of incentive for project managers to address this issue.

## Benefits

Evaluation of health benefits from improved water supply, sanitation and health education is complicated and subject to controversy. Some of this controversy stems from the attempts to quantify all benefits (and costs), forcing the evaluator to put a monetary value on such intangible benefits as "improved living conditions", "greater satisfaction", "improved health and shorter queuing time", to mention just a few examples. Clearly, this cannot be done easily and some claim it is impossible. It is difficult enough to estimate the effects of an intervention in qualitative terms, without assigning them a dollar value.

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The other extreme - not evaluating or attempting to weigh benefits at all - is clearly giving in to complexity at the expense of knowledge to be gained. However complicated and difficult it might be to determine the effects of an intervention, a consistent effort to draw upon existing information will eventually provide the policy makers with some guidance. This is usually the most reasonable way of using benefit estimates: as indicative of the likely range of effects an intervention has/had/will have.

Benefit estimates as management tools can have several applications. At the field level, the question one seeks to answer might be "how does one best reduce diarrhoeal diseases among rural, illiterate populations?" or "we have significant expertise in water supply but hardly any knowledge of sanitation; what target group will benefit the most from improved water, or should we focus on improving our knowledge of sanitation?". At headquarters level, the questions are framed in terms of global applications of the same basic concerns: "What are the likely effects of ORT, sanitation and water quality and quantity on diarrhoea in rural, African areas with high illiteracy rates?".

Answers to these questions can be given on three levels: purely qualitative (eg. "great, small, significant, greater than", etc.); a simple quantitative level presenting the range of impacts in percentage terms (e.g. 20-35% reduction in diarrhoea); and a quantitative level assigning an estimated dollar value, e.g. for a 35% reduction in this instance.

Preferably, the aim should be to try to work at the second level of simple quantitative knowledge. One reason for this is the lack of acceptable tools to determine values for benefits; a second is the perfectly understandable reluctance to use such values and compare them with the cost of interventions. Third, the aggregated global knowledge on benefits is limited, and rather than spending resources on a few in-depth studies with limited application, maybe we should focus on a wider field of comparable benefit evaluations. In-depth studies have a role in the development of methods and as control studies to confirm the general direction of other, less thorough evaluations.

Below is a brief summary of the findings of a few studies on the impact of water and sanitation interventions. These results are interesting and can serve as a starting point for discussions of global and country programmes, revolving around such questions as: "these interventions are optimal from an effectiveness point of view - to what extent do financial resources, political constraints and the attitudes of the population force us to alter our focus?" and "should we accept these constraints or are the benefits important enough to justify advocacy or should we consider pulling out in order save our resources for areas in which they can make a difference?".

An example of a good second level (simple quantitative) benefit evaluation is the study by Esrey, Feachem and Hughes (Bulletin of the World Health Organization, 63(4) pp. 757-772 (1985)). The authors compiled and compared 67 studies to produce an "average range" of the effects of different interventions, i.e. improved water quality, improved water availability, improved water quality and quantity, and improved excreta disposal.

Table 5. Percentage reduction in diarrhoeal morbidity rates due to improved water supply or sanitation

| Type of intervention | Percent reduction |
|---|---|
| Improved water quality | 16 |
| Improved water quantity | 25 |
| Improved water quality and quantity | 37 |
| Improved sanitation | 22 |

Also interesting is the finding that a large service improvement is more sensitive to the literacy level of the served population than is a small intervention. Moreover, whereas cholera and shigella diesases were clearly affected by improved water and/or sanitation, entamoeba histolytica and giardia lamblia were not affected at all.

In another study by Steven Esrey ("The effect of improved water supplies and sanitation on child growth and diarrhoeal rates in Lesotho", Cornell 1987), the stronger effects of water quantity relative to quality were once again stressed. Esrey has found the crucial (threshold) water supply level to be around 16-20 litres per capita per day (lcd). If one can bring water consumption up to this level, the health effects will be considerable. Esrey also showed that health education of mothers could improve the health of the children without improvements in water or sanitation.

The issue of literacy (as an indicator of average educational level) in relation to water and sanitation is another example of useful benefit studies. The knowledge gained so far points to several important policy implications. In summary, while the combined effects of literacy and water are greater than those of illiteracy and water, the opposite is true for sanitation and literacy. For an illiterate population, the possibility of infant death is up to four times greater for those without sanitation than for those with latrines. Among a literate population, the difference in infant mortality is almost negligible. Conversely, improved literacy has more of an impact in an unhygienic environment than in a hygienic milieu. (For further information, Steven Esrey can be found at Johns Hopkins University in Baltimore, Maryland).

This summary can only briefly indicate the nature of some research findings available on benefits. Nevertheless, one gets the impression that there is no consistent effort on the part of development agencies or academic institutions to gather qualitative (even less quantitative) information on the effects of different interventions in terms of improved health and economic conditions (WASH field and technical reports are significant exceptions in this respect, with often extensive qualitative reasoning on possible or experienced effects). There is clearly scope for, and potential value from, greater efforts to develop and apply this useful management tool.

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User charges

The issue of user charges (sometimes called user fees) has been the subject of increased attention in recent years, particularly in light of the United Nations International Water Supply and Sanitation Decade goal of universal coverage. There are two aspects to the question: political (to what extent should development organizations strive for full or partial cost coverage by beneficiaries?); and practical (are user charges a possible means to financial coverage and to what extent are user fees practiced?).

At the political level, there are several examples of joint statements advocating the idea of increased cost recovery. The Abidjan Statement was issued at an October 1986 meeting in the Cote d'Ivoire attended by representatives of 30 sub-Saharan countries and 15 bilateral and non-governmental organizations. (Martin Beyer represented UNICEF at this meeting.) The importance of cost recovery was stressed in the Statement, which included the following recommendation " ... donors are urged to identify and commit adequate resources and provide necessary support for the direct involvement of communities in ... paying for their water and sanitation systems."

In April 1987, IADB hosted a two-day meeting of major donor organizations in Washington D.C. (UNICEF was represented by Martin Beyer and Margarita Cardeñas.) The conclusions reached recommended strong emphasis on cost recovery, to the extent of over 100 per cent in order to subsidize financially weaker groups. These conclusions also underlined the shared responsibility of donor organizations and Governments.

The importance of improved financing - through whatever means available - becomes even more obvious when taking into account the great numbers of people still without acceptable levels of water and sanitation facilities. Even if disagreeing in principle with the concept of user charges, few can deny that cost recovery accelerates the process of serving these unreached populations. Some would claim cost recovery is the only possible means to achieving universal coverage.

Despite the potential of user charges, UNICEF has not taken full advantage of this resource. According to a recent survey of field offices (see Annex II), most UNICEF-assisted projects include some sort of user fee. Cost recovery, however, rarely extends even to O/M costs. One exception worth noting is the case of Bangladesh. Faced with a population of some 100 million, of which 80 per cent lack acceptable water supply and sanitation services, the UNICEF-assisted project recovers 120-130 per cent of costs, which are then used to create revolving funds for new production plants, aiming at national coverage. An outstanding aspect of the project has been the promotion of demand through social mobilization and health education. Today, demand is greater than supply.

Among other organizations active in water and sanitation, the World Bank and WASH/USAID have been the most interested in cost recovery. The World Bank has published several documents on this subject (see, for example, "The Cost of the Decade.") In fact, the discussion at the Bank has been quite heated as to what extent it is possible to be explicit about the necessity of total cost recovery. Research and study proposals dated March 1987 from both WASH and the World Bank refer to the interest of bilaterals such as NORAD, DANIDA, the Swiss Development Organization and SIDA and other international organizations such as IADB and PAHO.

Finally, as to the application of user charges, three different sets of knowledge are necessary: first, the financial costs of the project in question, both total and O/M; second, non-financial costs and benefits established through economic studies that can help determine the community's willingness to pay; and third, assessment of inequalities among villages and the beneficiaries' access to cash or ability to provide in-kind contributions, as determined through socio-economic studies. The availability of this information can greatly facilitate choices which must be made regarding selection of beneficiary groups.

## IV. RECOMMENDATIONS

The use of financial/economic costing and benefit/efficiency information should not be overestimated as its value is limited in itself. Economics forms a powerful management tool only in combination with knowledge from other disciplines such as anthropology, engineering and medicine. However, economic knowledge is necessary for the efficient use of limited resources.

The application of economic knowledge differs slightly at headquarters and in the field. Issues confronting the field staff include availability of resources among beneficiaries, identification of cost-efficient methods and least costly geographic areas, and selection of economic arguments to be used in rallying national and local support. Headquarters staff are more involved in decisions regarding overall policies and advocacy at the global level. In both cases, resources must be gathered and used economically.

Unfortunately, UNICEF possesses very little knowledge in terms of costing. Although UNICEF has information on low-cost handpumps, standpumps and latrines, there is only limited knowledge of why costs differ and which cost components are most important.

To begin the long process of increasing economic understanding within UNICEF and to build a base of knowledge, the organization should assist field staff through economic analyses. These should be carried out by economists, as the field staff is already overburdened and, in general, may lack sufficient economic training to take on this task.

The first stumbling steps were taken this summer towards the gathering and analysis of cost data. The next phase requires field studies in several qualitatively different areas, geographic and otherwise. If possible, at least one in-depth economic evaluation would be very valuable in order to determine whether thorough economic costing is itself economically justifiable and to set an example and develop methods for field studies. As other organizations, notably the World Bank and WASH, are interested in UNICEF's work on costing, there might be gains through closer co-operation such as short-term sharing of staff.

As to analysis of benefits, the approach developed by Esrey and others is very interesting. The idea is to establish approximate outcomes under certain common conditions through tested and controlled studies. The results can then be used as references against which one can control actual results. Such analyses can be used for advocacy on all levels - village, Government and the Executive Board - and to improve the management of scarce resources. In particular, it could be worthwhile to bring aboard a researcher such as Esrey to study the impact of health education, an area in which UNICEF has limited knowledge.

In general, the effort to increase economic knowledge within UNICEF should be led from headquarters in New York. Centralized access and consistency are prime criteria for successful economic analysis. Equally important is access to, and close dialogue with, other organizations (the World Bank, in particular). In the long term, this task needs and is worthy of a fulltime staff position. Economic costing is complicated and time-consuming but also a necessity.

Annex I

REVIEW OF FINANCIAL COMMITTMENT TO, AND KNOWLEDGE OF, WATER AND SANITATION COSTS

Many development organizations work in the areas of water, sanitation and health education. Below is a summary list of the more important organizations, in terms of financial commitment and activities in economics, financing and costs. This list is not comprehensive, and represents the judgements of the author alone.

In total, the approximate aggregate commitment to water and sanitation in 1987 amounts to about $2 billion. The bulk is provided by the various development banks, UN organizations and bilateral donors, but non-governmental organizations contribute some $150 million, of which 10-20% is earmarked for sanitation.

Major donor organizations in water and sanitation

| Organization | Approx. 1983 or 1984 commitment (in millions of 1987 US dollars) | Share water/sanitation (%) |
|---|---|---|
| **UN organizations and development banks/institutions** | | |
| UNDP/New York | 22 | N.A. |
| UNDP operates to some extent through the World Bank, by funding projects administered by the Bank. UNDP focuses its work on smaller, low-cost systems. Even though a number of publications on costing are published under the name of UNDP, the bulk of this work is being done by the World Bank. | | |
| UNICEF/New York | 60 | 90%-10% |
| UNICEF's knowledge of costs, financing and economics of water and sanitation is thoroughly covered in the main section of this report. In brief, UNICEF has only recently begun to show an interest in more than mere accounting and financing, and is at present undertaking a first review of costing, including economic costs, benefits and knowledge in these and related fields. Contact: Martin Beyer and David Parker. | | |
| UNDTCD/New York | 11 | N.A. |
| UNDTCD is primarily interested in technical solutions for rural systems and has limited knowledge on costs. | | |

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| Organization | Approx. 1983 or 1984 commitment (in millions of 1987 US dollars) | Share water/sanitation (%) |
|---|---|---|
| WHO (PAHO)/Washington D.C. | 22 | primarily training |
| PAHO does not concentrate its work on costing and financing, and has only limited information. Contact: Fred Reiff | | |
| The World Bank/Washington, D.C | 700 | N.A. |
| The World Bank is the most important source of information on financial and economic costs, and has an extensive and well qualified staff that has been working with these issues for quite some time. Contact: David Grey, Bob Roche (water) Albert Wright (sanitation) and John Briscoe (health education). | | |
| Abu Dhabi Fund | 3 | 100%-00% |
| African Development Bank and Fund | 66 | 100%-00% |
| Arab Bank for Economic Development in Africa | 1 | N.A. |
| Arab Fund for Economic and Social Development - AFESD | 36 | 70%-30% |
| Asian Development Bank Contact: Peter Wallace(CHECK) | 206 | 70%-30% |
| Caribbean Development Bank | 13 | N.A. |
| IADB/Washington D.C. | 220 | 75%-25% |
| The Inter-American Development Bank has strong expertise in economic costing and financing, but the focus of the organization's work is urban rather than rural, and therefore on larger rather than smaller and less costly systems. Contact: Juan Alfaro. | | |
| Islamic Development Bank | 33 | 80%-20% |
| Kuwait Fund for Arab Economic Development | 51 | N.A. |
| OPEC Fund | 7 | N.A. |
| Saudi Fund for Development | 110 | 90%-10% |
| West African Development Bank | 7 | 100%-00% |

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| Organization | Approx. 1983 or 1984 commitment (in millions of 1987 US dollars) | Share water/sanitation (%) |
|---|---|---|
| Bilaterals and NGOs | | |
| Australia: ADAB | 14 | 85%-15% |
| Canada: CIDA | 102 | 95%-5% |
| Denmark: DANIDA | 13 | 99%-1% |
| European Economic Community | 345 | N.A. |
| Finland: FINNIDA | 6 | 100%-00% |
| France: Coopération et Développement | 7 | 100%-00% |
| CCCE | 70 | 100%-00% |
| Federal Republic of Germany: BMZ | 227 | 100%-00% |
| The Netherlands | 15 | N.A. |
| New Zealand | 1 | 60%-40% |
| Norway: NORAD | 22 | 100%-00% |
| Sweden: SIDA | 16 | 99%-01% |
| Switzerland: SDC | 16 | 85%-15% |
| United Kingdom: ODA | 6 | 100%-00% |
| Wateraid | 3 | 100%-00% |
| United States: USAID | 275 | 80%-20% |
| WASH | 3 | N.A. |
| WASH/USAID has published an extensive series of technical and field studies, undertaken to evaluate ongoing or finished projects. The cost information varies considerably both in terms of quality and format. WASH in Washington, D.C. has a good understanding of cost ranges and a strong interest in further economic cost studies. | | |
| CARE (USA) | n.a. | N.A. |
| Catholic Relief Services (USA) | 2 | N.A. |
| MISEREOR (Federal Republic of Germany) | 7 | 90%-10% |
| Oxfam (United Kingdom) | 3 | N.A. |

N.A.=not available

Sources: International Drinking Water Supply and Sanitation Decade, publication #7, "Catalogue of External Support", Geneva 1985.

Consultation with The World Bank, PAHO, WASH/USAID and IDB in Washington, D.C.

Consultation with UNICEF staff members in New York.

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## Annex II

## UNICEF FIELD SURVEY OF COSTS, BENEFITS AND FINANCING

In June 1987, the Water and Environmental Sanitation Team at UNICEF headquarters in New York circulated a questionnaire to the field offices in order to gauge the knowledge, interest and state of the art in terms of studies of costs, benefits and financing among field staff. The idea had been discussed at UNDP and UNICEF for some time (by Frank Hartvelt and David Parker, respectively).

In order to minimize the burden on field offices, the questionnaire was written in English, French and Spanish, and asked only for brief statements. The questionnaire was divided into four parts: costs, benefits, financing and other. Respondents were asked to state whether any studies had been made in each of these four areas, the focus of these studies, the purpose and nature of the studies and if there were any plans for any future studies. An example of the survey is shown on pp. 24-26.

As of October 1987, 23 field offices had replied (see list below). Results showed that approximately 22 cost studies and 5 benefit studies had been undertaken; another 3 were planned in the area of costs, while 4 were planned on benefits. Financing costs were shown by 21 offices and some 6 reports were enclosed. As expected, the quality of the responses varied significantly.

The magnitude of knowledge is difficult to estimate, since so few offices enclosed their studies and evaluations, leaving it to the reader to infer that the information/knowledge was not immediately available, if at all. There were fairly clear cut results only for user charges. In 6 countries, no user charges at all were collected and in 8 cases the user chargers were less than the O/M costs. The user fees exceeded O/M costs in only 6 countries.

It may still be too early to draw any further conclusions. The impression remains, however, that the interest, or time and resources to follow through on an interest in more thorough cost and efficiency studies is limited. The questions on financing, on the other hand, were obviously easier to answer. This is probably a function of the organizational need to have a firm control over how much money is required and where to find it. An equally strong demand for cost efficiency and impact evaluations would likely render more comprehensive answers on costs and benefits.

### Field Offices reponding to questionnaire as of October 1987

Angola
Bangladesh
Belize
Burkina Faso
Burundi
Cameroun
Congo and Gabon
Democratic Yemen
Ethiopia
Guinea
Indonesia
Iraq
Ivory Coast
Madagascar
Mexico
Morocco
Mozambique
Nepal
Rwanda
Sudan
Tunisia
Uganda
Viet Nam

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Costs for Water and Sanitation? Gastos? Coûts?

Country/País/Pays:

Project/Proyecto/projet:

1. Costs/Gastos/Couts

a. Have any studies or other assessments been made of the costs (fixed, variable, O/M) of this project or of any elements of the project, (e.g., drilling, maintenance, sanitation services)? Algunos estudios hechos? Aucune études?

_____ Yes/Si/Oui
_____ No/No/Non

b. If yes, have any of the studies focussed on costs to users (e.g., transport, time, etc)? Acaso que si, gastos para los consumidores (transportes, tiempo, etc.)? Si oui, aucuns couts pour les consommateurs (transports, temps, etc.)?

_____ Yes/Si/Oui
_____ No/No/Non

c. If yes on either a. or b., please briefly describe the nature and purpose of the study(s). Please attach any available reports or other documentation of the scope and results of the study(s)/Descripción brevisima/Brève description.

_____
_____
_____

d. If no on either a. or b., are there any plans for such a study(s)? Please describe. Acaso que no, algunos planes? Si non, aucuns plans pour des études?

_____
_____
_____

2. Benefits/Beneficios/Bénéfices

a. Have assessments been made of the benefits (health, "convenience", new/other economic activities) either within project evaluations or any special studies? Alguna idea de beneficios (salud, quedarse cómodo, nuevas/otras actividades económicas)? Aucune estimee de bénéfices (santé, convenience, économic)?

_____ Yes/Si/Oui
_____ No/No/Non

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b. If yes, please briefly describe the nature and purpose of the study(s). Please attach any available reports or other documentation of the scope and results of the study(s)/Descripción brevisima/Brève description.

_____
_____
_____

c. If no, are there any plans for such a study(s)? Please describe. Acaso que no, algunos planes? Si non, aucuns plans pour des études?

_____
_____
_____

3. Financing/Financiamiento/Financement

a. Roughly what proportion of total project costs are currently borne by/reparticion de gastos entre/repartition des couts entres

- UNICEF/FISE_____
- Other UN Organizations (please specify)/otros ONU/autres ONU _____
_____
- National Government/gobierno nacional/governement national_____
_____
- Local government/gobierno local/governement local _____
_____
- Local communities/comunidades/communantés_____
_____
- Other (specification)/otros/autres _____
_____

b. How has this distribution of financing changed, or how is it expected to change over the lifetime of the project? Cambios en modo de financiamiento? Changes dans la manière de financement?

_____
_____
_____

c. Are any charges assessed directly to users/beneficiaries in this project? Algunas cargas para los consumidores? Aucunes charges pour les bénéficiaires?

_____ Yes/Si/Oui
_____ No/No/Non

d. If yes, please briefly describe the nature of the charges and their contribution to total service financing. Please attach any available reports or other documentation on the design and administration of the fee system, and the levels and effects of these charges./Acaso que si, descripción breve de las cargas./Si oui, description brève des charges.

_____
_____

e. If no, are there currently any plans to introduce user charges? If so, please describe or attach any available documentation./Acaso que no, algunos planes para introducir cargas? Describelo./ Si non, aucun plan your introduire des charges?

4. Any further observations or information on costs/financing issues? If so, please note below./Otras noticias acase./Au Cas échéant d'autres observations.

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