Training Modules

Capacity Building for Effective Decentralized Wastewater Management

Module 4 : Session Note 7

Economics and Financing

by

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1 IMPORTANT DISTINCTIONS TO TAKE NOTE:

1.1 Between Economic Analysis (EA) and Financial Analysis (FA)

- EA gives attention to social and environmental considerations. It is employed to determine if the overall economic benefits of a proposed project exceed its costs, and to help design the project in a way that produces a solid economic rate of return. Adverse environmental impacts are part of the costs of a project, and positive environmental impacts are part of its benefits.
- Thus, incorporation of environmental costs and benefits is part of economic analysis. It should be noted that an environmental assessment (which is essentially an information-gathering and analytical process of identifying environmental externalities, i.e., unintended effects of a project) is to precede the benefit-cost analysis part of the economic analysis.
- FA to financial viability of a system by considering cash flows of both expenditures (E= capital costs--CC-- plus operation and maintenance costs--O&M--.) and revenues (R=T+C+G, i.e., Taxes + User Charges + Government Payments).
- Between Cost Effective Analysis (CFA) and Benefit-Cost Analysis (BFA):

Cost-Effective Analysis is to be undertaken for finding the least expensive way of achieving a given environmental quality target or offering an environmental service, e.g., taking care of wastewater. CFA requires adoption of an approach of achieving the greatest improvement in some environmental target for for a given expenditure of resources.

Unlike CFA, which limits attention to achieving an environmental goal or offering an environmental service, in benefit-cost analysis (BCA) both costs and benefits of a project are measured and expressed in comparable terms.

1.2 Between Scale Economy (SE) and Scale Diseconomy (SD)

- SE denotes per unit cost reduction from large scale of operation. The higher the scale of the operation, the lower per unit cost. SE has been a built-in advantage in the production, distribution and delivery of urban infrastructure and services.
- SD denotes the point of decreasing returns to scale , i.e., when SE gets exhausted. When, at such a point of production , distribution and delivery , Decreasing Returns to Scale (DRS) sets in, resulting in Increased Costs (IC). Consequently unit cost or Average Total Cost (ATC= TC/Q) starts to rise.

(Note that the key appeal of Centralized WasteWater Management (CWWM) has been the benefit of scale economies. However what has been ignored is that scale economies are not unlimited and that scale diseconomies are also very real. If ‘small is beautiful’ sounds romantic (DWWM), huge is not necessarily merry (CWWM).

1.3 Between Agglomeration Economy (AE) and Agglomeration Diseconomy (AD)

- Similar to SE, AE refers to the per unit cost reduction from agglomeration, i.e., the proximity of one to the other.
- Similar to SD, AD refers to the diseconomy that starts to emerge as agglomeration exceeds the point of economy. At such apoint, higher agglomeration or density no longer gives any economic, social or environmental benefit.

(As with the abuse of many economic concepts, agglomeration and scale economies have been used to rationalize CWWM, ignoring the other two parts of these concepts--SD and AD. Empirical reality in many cities of populous developing countries reflects scale and agglomeration diseconomies, principally because of huge population size).

1.4 Between Capital Cost (CC) or Fixed Cost (FC) and Operation and Maintenance cost (O & M) or Variable Cost (VC)

- CC or FC refers to initial cost incurred in installing a facility. The usual components of CC for DWWM are land, building, machinery, laboratory equipment. O &M or VC includes labor, materials(chemcials, vehicle, fuel, spare parts, office supplies, overhead, rental cost, electricity.

(In many instances the major barrier to installinga DWWM facility--not to speak of CWWM which of course requires millions of dollars--is still the Capital Cost. O&M does not impose a serious constraint if the CC barrier can be overcome).

Accumulated evidence on Willingness To Pay (WTP) for obtaining a service suggests cost recovery, particularly O&M costs, is possible.

2 CAPITAL FINANCING

For the developing countries in general and their poor and low-income communities in particular, arguably the most important reason for DWWM is: Initial capital investment requirement is relatively much smaller than required for CWWM. One reason that CWWM remains so inadequately built relative to the need for all parts of a city and their residents is: huge initial capital requirement. Because of this insurmountable initial capital barrier, potential for gaining from scale and agglomeration economies through CWWM has remained only a theoretical proposition for many years for most countries. This signifies importance of DWWM but this needs to be demonstrated by showing the actual capital cost of undertaking DWWM. Otherwise, this option would also remain a theoretical proposition only.

In today's globalized capital market, capital inflows through FDI route have been growing at a much higher rate than ODA flow of yester-years. But high-profit making sectors are the main attractions of FDI. No urban environmental infrastructure and services (UEI&S) offer high profit; WWM by no means is an exception. Several factors have created a non-profit legacy of WWM similar to other UEI&S. These include: public utility characteristics of WWM, their ownership by public sector and the notion that such services are to be delivered at a low price, if not at all. This situation has led to non-availability of adequate financial resources for the sectors, which need them most. DWWM's potential will remain untapped if innovative financing mechanisms are not devised. Innovative capital financing for DWWM would require:

- Attracting ODA, FDI, domestic private investment and public sector funding. As long as cost recovery system will be in place, getting such investment will not be difficult.

- Exploring concessionary arrangements such as leasing, design build operate transfer (DBOT), build operate transfer (BOT), build own operate transfer (BOOT), build own operate (BOO).

- Cost recovery – through user charges for the provided service – to be built-in for tapping investment funds/financial resources. In levying user charges, affordability to pay (ATP) and willingness to pay (WTP) oh households must however be considered. Also cross subsidizing should be the guiding principle.

- Setting of the standards of a DWWM system to an affordable level so that cost recovery will be practicable.

- Identification of opportunities for fungible (interchangeable) use of resources – land, labour, capital, equipment.

- Potential use of communal resources (e.g. vacant land, unused labour).

- Exploring charity and philanthropic investment for setting up DWWM.

- All such efforts are to be geared for cost reduction so that DWWM facility and their service delivery become affordable and thereby levying of user charge becomes possible and it is in line with willingness to pay.

- Potential of using unused resources – land, labour, capital and entrepreneurship in a community context, which may not be available in a formal and large system context because in the latter context all resources are market intermediated and hence become costly.

2.1 Capital Financing Mechanisms

Human capital: Identification and use of social, civil or business enterpreneur and unutilized resources in a community requiring wastewater service.

Physical capital such as land to locate the DWWM facility: Identification of unused, underutilized public/private land or communal land (i.e., open space shared by community). Philanthropic contribution may also be found. Long-term leasing of public land is antoher option (especially right of use, as is the case in Vietnam). These are examples of obtaining required land without paying the market price for land.

Financial capital to buy machinery, equipment and vehicles: ODA, FDI or domestic private sector funding can be counted upon. If cost recovery will be built into the service provisions, obtaining capital for buying machinery, vehicles and equipment will not be difficult. See below on importance and mechanisms of cost recovery in obtaining such funding.

National and City Government Funding: Tax revenue based fund allocation from national and city government both for capital investment and O & M.

Mechanisms for attracting private sector capital: Concessionary arrangements such as leasing; undertaking designg, build, operate, transfer (DBOT); build, operate and transfer (BOT); build, own, operate and transfer (BOOT); and build, own, operate (BOO);public - private partnership (PPP); public-community-private partnership (PCPP).

3 MECHANISMS FOR COST RECOVERY

Importance of cost recovery: Cost recovery is central for getting investment fund from potential funding sources (ODA, FDI, domestic and private sources, national government money); efficient operation of the system; realistic choice of charging system (elastic, dynamic, not too high and not too low).

Principles of cost recovery: The financial system to recovery costs of wastewater management should balance three critical an interrelated aspects: (1) quality of the service, (2) investment costs, and (3) tariffs that users are willing and able to pay. Users should receive an adequate service sensitive to their ability to pay and to their contributions to pollution: “water user pays” and “polluter pays” principles are prerequisites for achieving sustainability.

Cost recovery instruments: Recovery mechanisms include consumption based user charges (user charge based on the volume of wastewater discharged and/or characteristics of wastewater, often directly related to consumption of potable water), effluent charges (based on a fixed amount per household, or in the case of industry on a proxy such as production, number of employees, etc.) and discharge permits (charges/levies can be incorporated in discharge permits); appropriate estimation of ATP (based on income as well as revealed preference method) and WTP (based on contingent valuation method) is considered important; application of decentralized and privatized approach for the improvement of collection fee.

First point to note here is cost recovery is key to any WWM project financing as well as for its O&M.

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3.1 Cost Recovery Instrument include:

- Consumption based user charges (user charge based on the volume of wastewater discharged and/or characteristics of wastewater, often directly related to consumption of potable water)
- Effluent charges (based on a fixed amount per household, or in the case of industry on a proxy such as production, number of employees, etc.) and
- Discharge permits (charges/levies can be incorporated in discharge permits);

3.2 Operational Mechanisms for Setting User Charges

- Estimation of Affordability To Pay (ATP) --based on income as well as revealed preference method-- and WTP-- based on contingent valuation method-- is crucial for setting appropriate service charge.

Cross-subsidization principle should be used to make service charge affordable to the poor and low-income families. Any loss of revenue should be offset by charging higher fees to the well-off residents.

3.3 ATP and WTP Estimation Procedures

In order to estimate Affordability To Pay two procedures are to be considered.

1. ATP is taken as a certain proportion of monthly income, e.g., half a percentage point of income (ATP = 0.5 * average monthly income). To decide on the proportion, comparable figure from good practice city/community cases may be taken.

2. A little more elaborate procedure based on revealed preference method. This involves taking expenses incurred in getting a service by In order to estimate Willingness to Pay, a sample of potential recipients of DWWM services are to be asked to express how much they would be willing to pay for taking care of their wastewater. Survey should specify various level and quality of services so that survey respondents would associate their WTP according to the nature and content of various services. an alternative way as a proxy of ATP.

In order to estimate Willingness to Pay, a sample of potential recipients of DWWM services are to be asked to express how much they would be willing to pay for taking care of their wastewater. Survey should specify various level and quality of services so that survey respondents would associate their WTP according to the nature and content of various services.

The principle of determining WTP through such social survey of residents is a hypothetical valuation of a service--formally called contingent valuation (CVM) method. This allows to assess market demand for a service.

4 FINANCIAL PLANNING

Financial planning involves setting expenditure needs (E) for providing the wastewater management services to a set target of HH and accordingly determining the revenues required (R) for meeting the capital cost (CC) requirements and operation and maintenance cost (O&M).

- Major fixed cost components include value of land for locating the wastewater facility, facility construction cost, machinery and office cost, laboratory equipment.
- Major O&M cost items include labour, electricity, materials (chemicals, vehicle fuel, spare parts, office supplies), overhead and insurance and training.
- Consideration for reinvestment during the project cycle (equipment replacement).
- Calculation of the economic internal rate of returns for deciding the project financial viability.

4.1 Some Details on Economic and Financial Analysis of DWWM

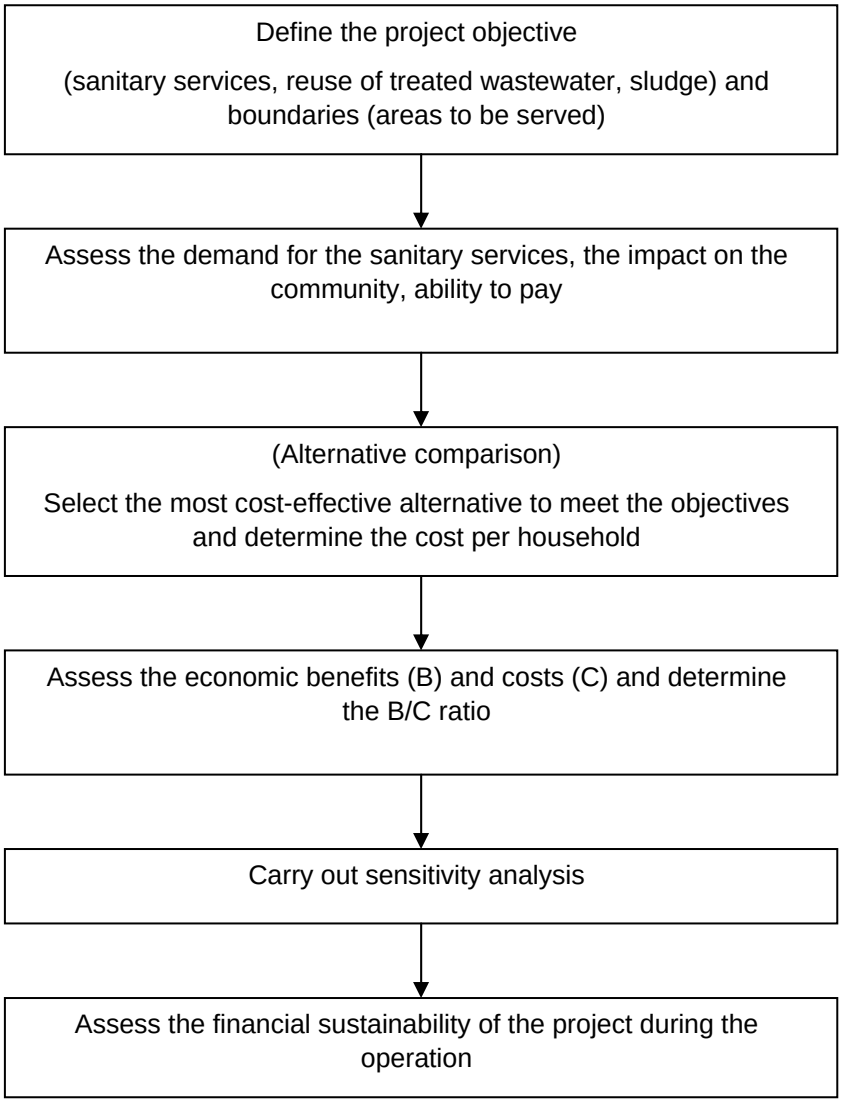
4.1.1 Economic Analysis

The main purpose of the economic analysis of projects is to have the best allocation for the limited financial resources in the country. Better utilization of the money will lead to better servicing the people and to more effective role of the government in the economic development. Sanitation services are needed for both large and small communities. Sanitation facilities should be provided to ensure acceptable living standards and to prevent environmental pollution and spread of diseases. Figure 1 shows the interrelated steps for carrying out the economic analysis of a wastewater project.

Economic analysis of a wastewater project is carried out first to select the best alternative (the one with the least resources needed) to achieve the objectives. Then, the project feasibility is examined. This can be done by carrying out economic analysis of the benefits and costs to the country. Simply, the project is feasible when benefits are more than the costs. This can be expressed in different ways and the most common one is in terms of economic internal rate of return (EIRR).

While the economic analysis address the effect of the project on the national economy, the financial analysis address the cash flow for the operating entity. In the later case, the result will be expressed in terms of financial internal rate of return (FIRR). In economic analysis, shadow prices are used when true economic values of costs are not presented in the market price due to various distortions. The shadow price adjustment is made most frequently in the exchange rate and labor cost.

Figure 1: the interrelated steps for carrying out the economic analysis of a wastewater project



Sourse: Saqqar (2000, p.3)

Basic steps for carrying out the economic analysis

- Assessment of benefits

It is known that assessment of benefits in a wastewater projects is a critical problem due to the uncertainty of the information and the difficulties found in quantification of these benefits. The following list provides some guidance regarding the benefits:

- Reduce the cost paid by individuals in digging new cesspits and in emptying these facilities.
- Reduce construction cost of buildings that serve the community (hospitals, schools, mosques, markets).
- Prevent pollution of water resources and improve the quality of drinking water.
- Increase in land value.

- Reduce the cost of unwanted damage to the infrastructures (roads, bridges, building foundations) and reduce the corrosion problems.
- Reduce the cost for curing diseases related to pollution of drinking water by wastewater and for the productivity loss of the community due to the illness.
- Improve the quality of environment, which can be reflected positively on the productivity of the community.
- Improve the productivity of the agricultural lands.
- Use the treated wastewater in agriculture and certain industries.
- Estimating the project costs

The major cost components for the wastewater projects are:

3. Land value

4. Capital cost (to be paid during the construction of the project)
   - Civil works
   - Electromechnical works (including spare parts)
   - Procurement of vehicles and equipment needed for the offices and the laboratory.
   - Consulting fees.
   - Operation and maintenance works
   - Labor
   - Electricity
   - Materials (including chemicals & vehicles, fuel, spare parts, office supplies)
   - Overhead and insurance
   - Training
   - Others

5. Reinvestments during the project life cycle (equipment replacement)
   - Calculation of the economic internal rate of returns (EIRR) for deciding project financial viability.
   - Calculation of the Economic Internal Rate of Return (EIRR)

Example

Year	Costs Land/capital/operation/replacement	Total cost	Total benefits	Net benefits (Benefits-Costs)
2001				
2002				
2020*				

* Including the residual value for the project

The internal rate of return is the interest rate at which the present worth of the net benefits is zero. The calculation is carried out be trial-and-error method (guessing an appropriate rate of return) or using computer package (e.g., excel).

$$\sum_{c=o}^{c=n} \frac{p}{f} = 0$$

$$p = \frac{f}{(1+i)} n$$

where: i = interest rate

n = years

p = present sum of money

f = future sum of money

- Sensitivity analysis

Since the estimates of future costs and benefits are subject to uncertainty, sensitivity analysis is carried out to determine the IRR under different assumptions.

Sensitivity analysis is a technique used to assess possible adverse changes on a project. It includes changing the value of one more of the variables (costs and benefits) and then calculating the resulting changes in the overall costs and benefits can be assumed. Analysis should be applied particularly to variables with significant contributions toward the costs and the benefits.

4.1.2 Financial Analysis

Sound financial management is very important for the success of the projects. If the quality of the wastewater service is to be maintained, it must be adequately financed. In fact if a project is not financially sustainable, the expected economic benefits will not be realized.

The government usually finances sanitation projects. Full cost recovery particularly in small communities may not be possible. On the other hand, these projects can hardly be sustained on government subsidy alone. Partial cost recovery and proper design of tariff, in relation to the real cost, is essential in sanitation project. Participation of all concerned parties (lenders, guarantors, contractors, users, operating entity and the government) is a

key issue in the project success. Each participant must have sufficient incentives (or returns) to participate. A golden rule in all wastewater projects is that operation and maintenance costs should at least be recovered.

Financial sustainability should be achieved during both, the construction and operation phases of the project.

- Construction phase

Sufficient fund should be available to finance the project. A financial plan should be prepared throughout the project construction duration. Usually in developing countries, the government budget is a major source of funding. The funds usually generated from internal or external resources as it is shown in the Figure 2.

It should be remembered that interest during the construction should be considered in the financial plan. The interest payments on loans might be postponed until the project facilities become operational and capable of generating revenue.

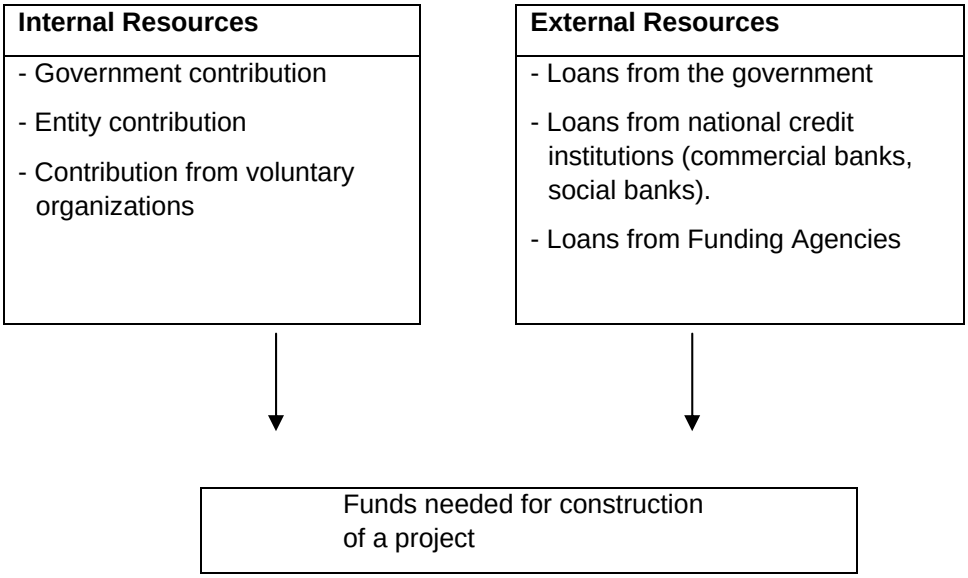


Figure 2: Potential resources for funding a wastewater project

A typical loan given by funding agencies to governments might has the following financial characteristics:

- Grace period 3-5 years
- Interest rate 3-4.5 %
- Repayment period (15-25 years)
- Contribution as a percentage from the project total cost (30-90%)

Finally it should be emphasized that efforts should be made to reduce cost and improve cost effectiveness during the operation stage (e.g., over staffing and the inefficient consumption of electricity are typical problems in this regard).

- Operation phase

The principal sources for revenue during the operation phase are the charges and tariff for the sanitation services. The desired target for cost recovery should be determined. As a golden rule, the minimum cost recovery should not be less than the operation and maintenance costs while in the ideal situation the cost recovery will be equivalent to the full costs as explained in Figure 3.

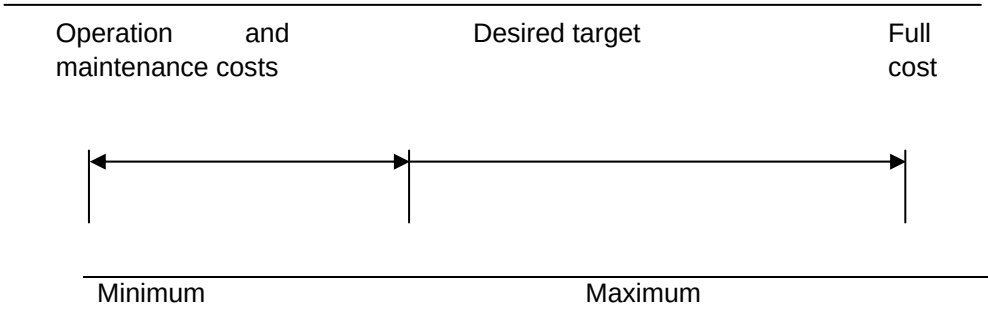


Figure 3: Cost recovery range in the wastewater projects

The desired target for cost recovery is influenced by several factors. These include:

- Contribution from the government
- Financial status of the operating entity (the taxation base and tax collection)
- The ability of users to pay
- Calculation of the annual cost

Estimation of the equivalent annual cost is essential in the financial planning for the cost recovery. Costs can be categorized into capital and operation and maintenance costs. Table 1 shows the procedure to estimate the cost recovery target based on the equivalent annual cost.

Table 1: Calculation of the annual cost recovery target

Year	**Capital cost (1)**	**Annual installments equivalent to capital cost (2)**	**Annual operation and maintenance cost (3)**	**Total annual cost (2)+(3)**	**Cost recovery target (3)+%of (2)**
1	F1	A(C)	A (OM)		
2	F2	A(C)	A (OM)		
3	F3	A(C)	A (OM)		
⋮					
20	F20				

$$P_1 = \frac{f_1}{(1+i)^n}, P_2 = \frac{f_2}{(1+i)^n} \ldots P_{20} = \frac{f_{20}}{(1+i)^n}$$

$$P = \sum_{c=1}^{c=n} P_i$$

$$A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1} + i\right]$$

A good database for the community to be served should be established during the feasibility study. The same types of data should be used in design the charging system. Basic types of data needed are:

- The estimated population to be served and the projected population growth.
- Target number of house connections.
- Drinking water consumption
- Average household income (including seasonal variations particularly in rural areas).
- Other special users (industries, farms, public buildings, commercial centers... etc).
- Cost recovery in similar communities
- Local experience in designing and implementing charging system for water and wastewater services
- Wastewater characteristics
- Average and peak wastewater flows

4.2 Charging systems

Adopted charging system should be:

- Simple and can be understood by users
- Realistic (not very high or very low)
- Take into account the poor
- Elastic (responding to growth)
- Dynamic (not rigid, it can be modified within reasonable period of time)

Usually different charging systems are developed, examined and compared and then the most suitable one is selected. The charges are described below.

1) Connection charges

Connection charges are paid once when wastewater services are provided. These charges could be fixed for each household or variable depending on the house area, number of people living in the house, the distance from the nearest collection pipeline and the land zone. Connection charges may or may not include the costs for house connection and filling the unused cesspits with the needed materials (soil, concrete, etc) depending on the local conditions.

2) Regular user charges

These charges become applicable when the system is operational. They can be:

i. Fixed charges

Each household pays fixed charges per month. This system might be suitable for similar users in terms of social status an income where all the benefits from the wastewater project

are shared almost equally and when meters are not installed in houses. A major advantage for the fixed charges is that they are simple to administer and there will be no need to volume measuring devices. A major disadvantage for this system is that it might be unfair as no differentiation between rich and poor or between households who are using the services more.

ii. Different charges

It is now common for the wastewater charges to be placed with the water supply tariff. This is because separately measuring waste volumes for residential areas is difficult and expensive. When water metering is used, two basic charging systems can be employed:

- Flat rate charges: this means that a fixed rate per unit of water supplied is used. A disadvantage for this system is that subsidies will be equal for both the rich and the poor. The system is simple to administer and easily understood by users.
- Different rates for different levels of consumption (progressive block tariffs): Progressive block tariffs are now common in water supply in developing countries. A major advantage for this system is that it can take into account some social dimensions the rich use more water and hence discharge more wastewater to the system than the poor and, therefore, should pay more. Usually the first block of water is priced at a heavily subsidized low "social" price.
- In some cases, both the rich and the poor are treated the same in terms of payments for the first block. This implies that both the rich and the poor are equally subsidized. The other alternative is that large users pay the same unit rate for the whole quantity of water consumed as her his block tariff. Experience in many countries indicates that a significant change in terms of water conservation is achieved using the progressive block tariffs. With the use of computers, it is now become simple to calculate charges to be paid by the users.
- Combined system: Combined charging system (two-part tariff) s nowadays widely applied. The first part will be fixed depending on the characteristics of the consumer and presents the minimum amount of money to be charged. The second part will be related to the volume of water consumed.

4.3 Six steps stressed for preparation of capital and financial plan include:

- Evaluation of economic factors affecting capital and financial planning;
- developing a comprehensive facility master plan;
- determining and scheduling capital requirements and evaluating alternative financing methods;
- determining annual operating and capital revenue requirements;
- calculating fees and charges and
- evaluating impact on customers.

4.4 Establishment of solid baseline data required for financial planning can be categorized in three major categories: operating characteristics; personnel characteristics and cost characteristics, (Saqqar,2000).

5 ACCOUNTING

- Itemizing cost (land, construction, machinery, laboratory equipment, wages and salaries, rent, office supplies, electricity, transport, etc.) and revenue (user fees, revenue from sale of bi-products) exhaustively (taking into account all streams of costs and revenues is central for sound financial basis of DWWM project operations).
- Identification of cost reducing measures (e.g. finding communal/neighborhood/philanthropic land for locating DWWM facility, reducing the cost of digging cesspits and emptying these facilities, reducing the construction cost of buildings, utilizing cheap or even free labour for construction and maintenance.
- Identifying revenue-maximizing sources (user charges to all DWWM service recipients, effluent charges to all wastewater discharging HH/enterprises/establishments, producing and marketing of all potential by-products, promoting use of bi-products).
- An appropriate accounting system to record all transactions in an accessible form is a key requirement for doing all that have been noted above. All work activities (administration, raw water supply, water treatment, water distribution, wastewater collection, wastewater treatment and disposal, billing and collection, marketing of by-products etc.) and corresponding costs and revenues are to be recorded. Payments and receipts should be recorded (with date and description) separately under subgroups for common expenses.

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