

Financial Planning of Water Supply Schemes

By

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I. Introduction

An effort has been made in this paper to discuss various problems involved in developing a sound Financial programme of a water supply system. This is the majority opinion of experts in financing that financial planning of a Sewerage system is similar to that of water supply system and as such common broad principle could be determined to hold good for both of these facilities. In this paper however details have been discussed with specific reference to Water Supply Financing.

It has been the aim of the writer to take the advantage of experiences of many advanced countries of the world where, after lot of efforts, self-independence and self-sufficiency for water supply financial programme has already been attained. Obviously, instead of starting with trial and error, it is always preferable to take already tried examples and adjust it to suit the local requirements. Accordingly after discussing the various involved factors the writer has put forward his suggestion for developing a sound and self supporting financial programme for water facilities in this country.

II. Principle of Financial Planning

For a sound financial plan, fundamental principle as is universally accepted, is that the total needed income of a water works should be contributed by all users and non-users, *i.e.*, users and the property for whose need and benefits the facilities of the work are provided in the ratio of the cost of providing the use and benefits of the works for them.

The main objects to be achieved are the following:

- (1) *Self-sufficiency.* The minimum requirement of self-sufficient public water supply system, should be such that it should have income from all charges of water supply at such and equitable and reasonable rates for water services so that it could meet its all operating expenses and depreciation and further repay its cost on construction including the interest etc. in a reasonable time. The time factor varies in different countries as per local requirements but it is agreed by all that this reasonable time

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should not be more than the designed period of the water supply system.

- (2) *Surplus funds.* After attaining the self sufficiency as above it is further desirable that the income from various sources must yield some surplus funds to meet a portion of future demand of extension and improvement in works. It may start with a very nominal sum but in order to develop a desirable financial system on sound footings, it is important to ensure progressive increase in this account.

III. Basic Points for a Financial Programme

Important basic points for developing a sound financial planning are as listed below:

- (1) Establishment of an administrative set up for independent control of water services.
- (2) Establishment of an Engineering set-up for technical studies and execution of water supply projects.
- (3) Study of the economic structure of the community, their socio needs and habits, studying and exploring the availability of funds from national financial sources, banking and private institution and their limitation, and selecting the most suitable method of financing depending local needs and condition.

IV. Other Factor Influencing in Financial Planning

Apart from the above stated basic considerations, there are many other factors which are bound to influence the financial programme of a water supply system. Some of them are stated as below:

- (a) *Political Influence.* This is an important consideration because often water rates and charges are made local election issues and election promises. It is therefore desirable that the leaders in particular and public in general be taught that water and any of its allied matter, should not form any such political stunt. They have to be made to believe, as per belief now prevalent in Western Countries, that no matter how poor a community may be, payment for water supplies have got to be made.
- (b) *Economical Influences.* These influences could effect the water supply programme as per following problems:
 - (i) *Inflation.*—Industrialization and similar changes particularly in under-developed countries are responsible factors to bring forward inflation—no matter it may be in transitory stage.
 - (ii) *Lack of capital.*—All the private capital in particular and

Government funds in general are applied to industries, real estates and other such income yielding items causing problems of lack of funds for water supply project.

- (c) *Historical and traditional influences.* In oriental countries in general and in Pakistan, in particular, common man's belief is that "AIR" and "WATER" are a nature free gift to mankind and should be provided "free" by the Government. This belief derives its force from traditional back-ground.

V. Determination of Financial Needs

Financial needs could be classified as:

(1) Capital Cost

This includes the following:

- (a) Engineering, Designing, Planning and Estimation fee,
- (b) Engineering supervision fee,
- (c) Cost of land and property to be requisitioned for water supplies projects,
- (d) Cost of actual construction works, treatment works and equipments,
- (e) Cost of distribution system,
- (f) Cost of construction and equipments of water testing laboratories,
- (g) Cost of administration and accounting for capital works,

(2) Recurring cost requirements

These requirements shall be based on the following:

- (a) Water production cost including treatment,
- (b) General operation and maintenance cost of water distribution system and water testing laboratories,
- (c) Cost of depreciation of works,
- (d) Repayment of instalment of capital cost including interest,
- (e) Cost of administration of maintenance *i.e.*,
 - (i) Budget estimate,
 - (ii) Accounting and auditing,
 - (iii) Record keeping,

- (iv) Water rate assessment including meter reading, meter testing and billing,
- (v) Collection of water rates and charges,
- (vi) Purchasing,
- (vii) Public relations, advertisement and sales promotion.
- (f) Taxes and contribution etc.

VI. Source of Finances

At present in Pakistan the main sources of financing are Government funds and funds of Local Bodies. However to tap all possible sources, taking advantage of examples of other countries, the following sources could be usefully explored:

(1) *Government subsidiary or grant.* This is the main source generally utilised upon by the water works agencies in this country. However when the aim is to attain a sound financial system, this source should not be considered unless for a particular community it is just unavoidable.

(2) *Loan from Government.* This is a low interest loan from the Government. This is hitherto not much in vogue in this country.

(3) *Loan from Banking Institution and private sources.* This is considered as the only important source of meeting the capital cost in most of the advanced countries of the world. Unfortunately this practice has so far not been followed in this country.

(4) *Surplus and profit of past operations.* This source too is so far unknown to our country. This is so because firstly in actual practice it has never been a financing system to have independent budgeting for water works and secondly because it has never been a case with any water works to have surplus or profit on any past operation. However in order to achieve a sound financial system it has got to be made possible to earn some profit for utilization as a positive source of investment for extension in works.

(5) *Taxes.* This source could be exploited by all or any of the following:

(a) *Diverting a portion of general taxes income of a body for water works development.*

This has been nicely enunciated in the following wording in A.S.C.E. report "The use of general taxes to finance at least part of the construction or replacement work is justified since each property occupied or un-occupied and each person whether user non-user receive benefits".

(b) *Assessing a special tax for any water works construction on all abutting properties on front of foot system.*

Justification for the same is one of the internationally recognised

item which have been stated in the joint report of A.S.C.E. Bulletin No. 2 at page 175 in the following words:

“.....The use of special assessment to finance acquisition, construction or replacement is justified by benefit to the abutting properties from the existence of water supply lines in streets.”

(6) *Contribution of taxes from Insurance Companies and dealers in combustible materials.* This source too has enough potential. The need is obvious and could be exploited successfully if not on voluntary basis then by legislations. Experience has proved that about 12 per cent of total cost of construction are required for providing water facilities for fire protection in community of about a lac population. This percentage figure may be smaller in bigger community but would be higher in smaller communities. There is very justification to exploit this source of income in the ratio of the cost estimated for provision of adequate water for fire protection arrangement.

(7) *Contribution from Philanthropist.* There is a good potential to explore this source in our country on account of past history and traditions. If different component of water works system are assigned names after their donor this would form a handsome source of income.

(8) *Contribution or loan from International Aid giving Agencies.* There are many International Aid giving Agencies functioning particularly to finance the water supply needs of under-developed countries. These agencies could be approached for either aid or loan either interest free or with nominal interest. For under-developed countries where lot of material and equipments required in execution of water supplies scheme is always imported, these aid or loan could be very usefully utilised for meeting the foreign exchange component.

VII. Different Kinds of Bonds for Sources of Investment

In many countries different kind of bonds have been floated. However a good classification of the same has been given in publication of U. S. Department of Health Education and Welfare in the “Course Syllabus” of “Administration and Financing of Urban Water Supply”, as under:

- (1) *General obligation bond.* These are bonds or securities pledging for the faith, credit and taxing power of the issuer. These bonds are payable from tax income of all taxable properties levied on the basis of evaluation cost of the property.
- (2) *Revenue Bond.* These are securities backed by a solemn promise of the borrowing municipality to levy rates taxes that will produce sufficient income to pay operating expenses of the facility and interest on and the principle amount of debt and further pledges

all that income to those purposes. In this category the charges for the water are in direct proportion to the quantity made available to and used by the individual.

- (3) *Combined general obligation and revenue bond.* These are double barrelled bonds being a combination of pledges given in obligation bond and revenue bond as described above.
- (4) *Special assessment bond.* These are special obligations of the issuing municipalities and are paid from the income derived from assessments based on the estimated benefit to specific properties and as such assessments bear no relationship to the water used, available for use, or to the general tax.

VIII. Record Keeping for Financial Planning

There could be various ways and opinion on the subject. However the basic requirements are the same and as such keeping of record as detailed below is necessary for the purpose of finances and accounts:

- (1) Valuation of the existing works.
- (2) Yearly depreciation of the system.
- (3) Amount of raw water taken from the source.
- (4) Amount of treated water led into the system.
- (5) Quantity of water sold to the customers.
- (6) Water losses and un-accounted for water.
- (7) Rates of increase in number of customers.
- (8) System maps.
- (9) Maximum capacity of the distribution system at various point and the existing numbers of customers served.
- (10) Relationship between supply and demand.
- (11) Operating expenses.
- (12) Re-investment in new extension and improvement.
- (13) Long term loan and cash position.
- (14) Average income of the community per capita and the index of income.
- (15) Any other relevant item as per local condition.

IX. Calculating Depreciation cost of Water Works for Financial Planning

Depreciation charges are often ignored and remain un-accounted for, although this is a very pertinent item. There is no universally established formula to precisely define these charges as they depend on many factors of constructions and manufacture of equipments. However "Haley's Table" as shown below would give fairly reliable approximation for calculation of these

charges:

Section of Water Works	Amount of depreciation charges in relationship to total cost.
1. Reservoir	.. 2%
2. Pumping equipment	.. 4%
3. Treatment equipment	.. 10%
4. Distribution main and accessories	.. 1.5%
5. Fire Hydrants	.. 2%
6. Services	.. 3%
7. Meters	.. 4%
8. Transport equipments	.. 12%
9. Wells	.. 4%

X. Recoveries of Investment and their Allocations

The sources for recoveries of investment are the users and or the properties. This holds good for recovery of the capital cost and also for the recurring cost. The method and rate of recovery is pretty complex problem as it involves many factors such as classification of water users, classification of rates or charges etc. These factors are discussed in the following pages.

XI. Classification of Water Users

There are two main categories of the customers and each of them is composed of many classes.

(1) *Normal users.* This is that category of customers whose demand for water supplies remains practically static throughout the year. There are following classes of customers grouped in this category:

- (a) Private customers with house connection.
- (b) Private customers which are supplied through public stand posts or fountains.
- (c) Commercial establishment.
- (d) Public institutions.
- (e) Industrial users.

(2) *Special users.* This category of users include those occasional users whose demand fluctuates on season and other special requirements. This category of users warrants provision for bigger plant capacity and storage

capacity as compared to normal users. This category includes the following classes of water users:

- (a) Users for fire protection.
- (b) Users for sprinkling of lawn and irrigation.
- (c) Intermittent and seasonal users for swimming pools, public baths etc.
- (d) Wholesale customers who purchase water in abundance and sell it to domestic user with variable characteristics demand.

XII. Classification of Rates for Charges

These are classified as per category of users as discussed below:

(1) *Special charges for special users.* These charges are required to be assessed and calculated on the basis of that portion of capital cost and recurring charges which are specifically provided to meet that particular demand. There are many ways for effecting the recovery of these charges depending upon the local conditions. Some of them are described as under:

(i) *Recovery of fire protection charges.*

Fire charges can be recovered by any of the following methods, depending upon local conditions:

- (a) *By assessing fire charges on the basis of valuation of the property.* This method is simple for assessing the charges but has lot of demerits because vacant property will also have to pay same fire protection charges as the occupied one although there is less chance of fire hazard in a vacant property. Further, high cost fire proof building would have to pay more amount of money than other less valued building of the same size, although the former provides no problem for fire protection.
- (b) *By including fire charges in the commodity rates or services charges.* In this method too the charges would have to be based on meter size, *i.e.*, a major portion would have to be paid by the mass of domestic customers although a commercial concern may provide greater danger for fire hazard.
- (c) *Levying fire protection charges on the basis of insurance premium charges for fire protection of local insurance companies.* This provides a fair basis for arriving at actual calculation of these charges. An additional surcharge could further be recovered for each number of fire hazard depending upon its time duration.

(ii) *Charges for air conditioning.*

These charges could be recovered by adding some units rate as surcharge per unit capacity of the water type air conditioning equipments. The rate will be variable for non-conserved units and conserved units.

(iii) *Charges for sprinkling.*

As a general practice additional storage capacity is considered as main for supplying source of water for sprinkling and as such, the cost of necessary storage and additional distribution would be a fair guide for fixing charges for sprinkling.

An alternative method would be levying a surcharge on domestic charges for this water demand.

(iv) *Charges for intermittent and seasonal users for commercial and industrial purpose.*

These could be justifiably calculated as per the commercial and industrial value of use. In practice in Japan this kind of users pay about 2 to 3 times than the normal domestic users.

(v) *Charges for users for swimming pools and public bath etc.*

These institutions belong to community benefit group and as such deserve concessional rates unless these are run on profit earning basis. Considering this factor it is desirable to charge the same rate from these special users as from normal users.

(2) *Recovery for balance of charges.* After deduction of special charges as above, both from the capital cost and recurring charges, balance of cost would be recovered from normal users. These charges are further categorized in firstly, service charges on demand bases and secondly commodity charges on quantity bases.

XIII. Recoveries of Service Charges

These charges would include the following and could be recovered as stated under:

- (a) *Demand cost.* This is assumed as per standard practice as 50% of the balance of fix charges, *i.e.*, capital cost of depreciation and return on the investment. This shall be distributed among the customers in the ratio of equivalent number of smallest size of meter if supplied are metered or smallest size of ferrule of house connection.
- (b) *Commercial expenses.* These would comprise of expenses for administration of recurring charges and are required to be

recovered at an equal rate from all the customers irrespective of the meter size ferrule size or water consumption.

- (c) *Meter and servicing charges.* These include total of capital cost depreciation plus total maintenance and operation cost for meters and service. These shall be distributed among the customers on the same basis as for demand cost as stated at (a) above.

Working out of service charge and commodity cost (described in the following paragraph) become clear from the following Tables (A & B) which has been taken as an example from U. S. Department publication "Administration and Financing of Urban Water Supply." As mentioned above depicting conditions in Battle Creek.

BATTLE CREEK MICHIGAN RATE STUDY MAY 1955

TABLE A.—*Distribution of Annual Costs*

(1) Item	(2) Totals	(3) Fire	(4) Balance to others	(5) Balance service charge 50%	(6) Between commodity rates 50%
CAPITAL COST					
Production	.. \$145,730	\$37,200	\$108,530	\$54,265A	\$54,265
Distribution	.. 128,582	\$37,458	91,124	45,562A	45,562
Customers meters and services	.. 22,157	..	22,157	22,157C	..
	.. 18,889	18,889
	.. \$315,358	\$93,547	\$221,811	\$121,984	\$99,827
OPERATION AND MAINTENANCE COSTS					
Production	.. \$103,260	\$5,948	\$97,312	..	\$97,312
Distribution	.. \$69,363	..	69,363	..	69,363
Commercial	.. 18,582	..	18,582	18,582B	..
Meters & Services	.. 76,080	..	76,080	76,080C	..
Hydrants	.. 12,188	12,188
Sub Total	.. \$279,473	\$18,136	\$261,337	\$94,662	\$166,675
Total	.. \$594,831	\$111,683	\$483,148	\$216,646D	\$266,502E
Per cent of Total	.. 100%	18.8%		36.4%	44.8%

(1) Demand	..	\$99,827A
Commercial Expense	..	18,582B
Meters and Services	..	98,237C
		<hr/>
(2)		\$216,646D

Redistribution on the basis of meter reading E

In the table on next page the minimum size of meter has taken 5/8" and as such all figures and calculations have been drawn on the equivalent meter size of 5/8".

XIV. Rate Structure and Recoveries of Commodity Charges

The commodity rate should include the following:

(1) Remainder 50% of the balance of fixed charges after deduction of demand cost.

(2) Total maintenance and operation cost of production and distribution.

(3) The most important item in determination of the commodities rates is the availability of correct statistical data to determine the quantity of water by each customer. This is precisely possible only if all the house connections are metered. The rates are classified as under:

(i) *Unit wholesale rate (or industrial rate)*. This is calculated by deviding the total capital plus maintenance charges by total annual sale.

(ii) *Unit Intermediate rate*. This rate shall be inclusive of the following items:

(a) Unit wholesale rate.

(b) 50% of the total distribution expenses divided by total water sale to the domestic and intermediate customers.

(c) 50% equivalent for water losses and un-accounted for water.

(iii) *Unit domestic rate*. This rate would include the following items:

(a) Units intermediate rate.

(b) 50% of the cost of distribution divided by the total sale to domestic customers only.

(c) 50% equivalent of water losses and un-accounted for water.

Working out of different unit rates as described above are illustrated by the following example. The data have been taken as shown on page 12 Chapter "Water Determination Rate" of the above named U.S. department publication.

BATTLE CREEK MICHIGAN RATE STUDY MAY, 1955

TABLE B.—*Distribution of Service Charges Demand Basis*

Meter size inches	No. Meters	Commercial Expense (a)			Demand (b)			Meters and Service (c)		
		Monthly charge per meter	Ratio	Equivalent Numbers 5/8" meters	Monthly charge per meter	Ratio	Equivalent Number 5/8" meters	Monthly charge per meter	Total Monthly Service charge	Ratio
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
5/8	12,210	\$0.12	1	12,210	\$0.33	1	12,210	\$0.50	\$0.95	1
3/4	910	"	2	1,820	.66	1.5	1,365	.75	1.53	1
1	123	"	4	492	1.32	2.25	277	1.13	2.57	1
1½	6	"	10	640	3.30	4	256	2.00	5.42	1
2	95	"	25	2,375	8.25	6	570	3.00	11.37	1
3	29	"	45	1,305	14.85	10	290	5.00	19.97	1
4	22	"	90	1,980	29.70	20	440	10.00	39.82	1
6	24	"	170	4,080	56.10	35	840	17.50	73.72	
Total	13,477			24,902			16,248			

(A) Commercial expense \$18,582; Equivalent No. of meters (13,477)=\$1.38 per yr. 12=per month.

(B) Demand \$99,827; Equivalent No. of meters (24,902)=\$ 4.00 per yr. 12=\$ 0.33 per month per equivalent meter.

(C) Meters and Service \$98,237; Equivalent No. of meters (16,248)=\$ 5.87 per yr. 12=0.50= per month.

Water consumption data

Annual sale of water:—	12,045	Million Gallons
Annual sale to domestic and intermediate customers	4,040	do.
customers only;	3,005	do.

COST DATA

Production		
Source		\$18,280
Purification		\$549,000
Pumping		\$385,500
Total production	..	<u>\$951,780</u>
Distribution	..	<u>\$81,240</u>
Customer costs		
Meters and services	..	\$89,380
Accounts	..	\$97,800
		<u>\$187,180</u>
Hydrants	..	\$22,800
Total Operation and Maintenance		<u>\$1,243,000</u>

The fixed charge for interest and debt retirement are based on 5 per cent of the estimated total of the existing and prospective bond issues, as follows:

Existing Bond Issues

New Pumping Station and Existing Plant, Improvements	..	\$1,700,000
Storage Reservoir	..	\$2,000,000

Prospective Bond Issues

New Filter Plant	..	\$3,500,000
Electrification	..	\$800,000
New Mains and Elevated Storage		\$2,000,000
Total	..	<u>\$10,000,000</u>

Allowance for replacements and Extensions are included as shown in the following table:

Production

Operation and Maintenance ..	\$951,780
Debt-Interest and Retirement ..	400,000
Replacements and Extensions ..	100,000
	<hr/>
	\$1,451,780

Distribution

Operation and Maintenance ..	\$81,240
Debt-Interest and Retirement ..	\$100,000
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Total Distribution ..	\$281,240

Customer Cost**Total Expenditure**

Operation and Maintenance ..	\$187,180
Replacements and Extensions ..	\$50,000
Contingencies ..	\$12,820
	<hr/>
Total customer cost ..	\$250,000

Hydrants

Operation and Maintenance ..	\$22,800
Replacement and Extensions ..	\$6,200
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	\$29,000

SUMMARY

Production ..	\$1,452,780
Distribution ..	\$281,240
Customer costs ..	\$250,000
Hydrants ..	\$29,000
	<hr/>
Total ..	\$2,012,020

Different units rates/1000 gallons are derived as below:

(1) The unit whole rate

$$\begin{aligned}
 \text{i.e. } \frac{\text{Total production cost}}{\text{Total annual sale}} &= \frac{\$ 1,451,780}{12,045 \text{ M.G.}} \\
 &= 12.05 \text{ Cents/1000 gallons}
 \end{aligned}$$

(2) Intermediate Unit rate

(a) Unit cost of whole sale rate = 12.05 cents/1000 gallons

(b) Additional increment for inter-

mediate users *i.e.* = $\frac{\$140,620}{4040 \text{ MG}} = 3.48 \text{ cents/1000 gallons}$

(c) Lost water equivalents = 1.85 cents/1000 gallons

Intermediate unit rate = 17.38 cents/1000 gallons

(3) Domestic Rate

(a) Intermediate unit rate = 17.38 cents/1000 gallons

(b) Additional increments

i.e. $\frac{140,620\$}{3005 \text{ M.G.}} = 4.69 \text{ cents/1000 gallons}$

(c) Lost water equivalents = 1.85 cents/1000 gallons

Total = 23.94 cents/1000 gallons

For the sake of simplicity in calculation following rates could, therefore, be adopted:

(1) Whole sale unit rate = 12 cents/1000 gallons

(2) Intermediate unit rate = 18 cents/1000 gallons

(3) Domestic rates = 24 cents/1000 gallons

XV. Existing Financial and Rate Structure in Pakistan

The present conditions of Water Supply in Pakistan are not based upon any scientific system of either financing and/or method of recovery. The existing conditions in Pakistan in a nut-shell are narrated as below:

A. FINANCIAL AND ADMINISTRATIVE CONDITIONS

(1) All the water works facilities are public owned.

(2) The prevalent concept in advance countries to make water supply projects of self-sufficient and self-supporting is unknown so far and is not practised.

(3) Establishment of depreciation funds or setting apart of specific funds for extension or improvements of water works, out of water supplies income are not much in vogue.

(4) Separate budgeting, financing and accounting for water supply is non-existent.

(5) No charges are practically levied for public stand posts.

(6) Water supplies are mostly un-metered.

- (7) Levying water tax on non-users *i.e.* on property basis is neither practised nor considered.
- (8) Practically no account is kept of wastage, leakage or misuse of water. The percentage if roughly calculated is enormously high.
- (9) The idea that water should be supplied 'free' of cost is predominantly prevalent and derives its support from traditional and historical background.
- (10) Local bodies mostly shirk their responsibility and invariably look to Government for grants. In some cases even for maintenance, the funds are either wholly or partially provided by the Government.

B. RATE STRUCTURE

- (1) Rates are mostly on flat rate basis.
- (2) Rates are levied unscientifically and in some cases decided on political basis.
- (3) No classification or categories of rates is existing.
- (4) In fixing rates practically no consideration is paid to fire charges nor are recovered in any form.
- (5) Rates are fixed without any consideration to water losses and unaccounted for water, nor they bear any relationship to them.
- (6) Rates, in general, are very low as compared to the water charges.

XVI. A few suggestions for improving Financial System in Pakistan

Conclusively, in consideration to modern technique in financing of water works, as in practice in many countries and specially with the writer's experience of training in the field of Water Supply and Sanitary Engineering in Japan, the writer takes this opportunity of putting forward the following suggestions for improving the financial pattern of the facility in Pakistan:

- (1) A local authority for Administrative and Financial control be set up within the local body and it should be given adequate power of rate making and taxation.
- (2) Accounting and budgeting of income and expenditure in respect of water supplies should be made separate.
- (3) Rate structure be revised to make water projects financially sound.
- (4) Vigorous campaign for public teaching be started for using water always on payment.

- (5) Government Banks or Agencies be created on the line of the Agricultural Development Bank, etc., from where loans could be given to local bodies for development of water supplies.
- (6) In no case should water maintenance be subsidised by the Government because if a community cannot pay even for maintenance, it has not valid right to utilise the benefits of water supplies.
- (7) Government subsidies may be given to very poor local bodies or rural areas where no other source of investment is available.
- (8) Water system should be properly planned and schemes designed to bring it up to required standard to enable aid and loans to be sought from International Aid-giving Agencies.
- (9) For rural and small urban water supplies, water should be supplied through stand posts or fountain but on payment.....
NEVER FREE.
- (10) Private enterprise should be invited and encouraged to start water business.

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