Water Demand

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This lecture provides a brief overview of the reason for the paradigm shift from water supply management to water demand management. It also outlines what comprises water demand management, the benefits to be gained from its application and approaches to demand management.

Introduction

Water is one of the essential requirements of all life. Water is not only a natural resource and a social good, but an economic resource even though in many countries the cost of water is not based on a charge per unit volume consumed. Water as an economic good is now becoming much more widely accepted because of the economic and financial costs imposed by laws to protect water quality, water scarcity, competition between users and the global shift to the privatization of public sector infrastructures.

Previously, the predominant approach to satisfying the water needs of growing populations has been to develop new supplies and construct structures to utilize available supplies to meet water needs. This water supply management approach considers water needs as necessary requirements and not as variable demands. This approach has caused new water supply sources to become less accessible and their development more expensive and less environmentally acceptable. Inheritances of this paradigm include large dams, diversions, central water supply and waste treatment works which form part of the infrastructure that have contributed significantly to advances in society.
A most important fact though is that this water supply management approach does not provide permanent cost–effective solutions and therefore by itself does not support management of this water resource for sustainable use and development.

In the new paradigm of water demand management, solutions are centered on lowering or mitigating proposed demands in a more socially beneficial manner, only looking at capital intensive structures after this aspect has been fully explored.

Water demand management signals a shift to management of the water resources for sustainability, therefore both the quantity and quality aspects of water must be preserved to support public health and socio economic development. It is therefore imperative that water quality management complements water demand management.

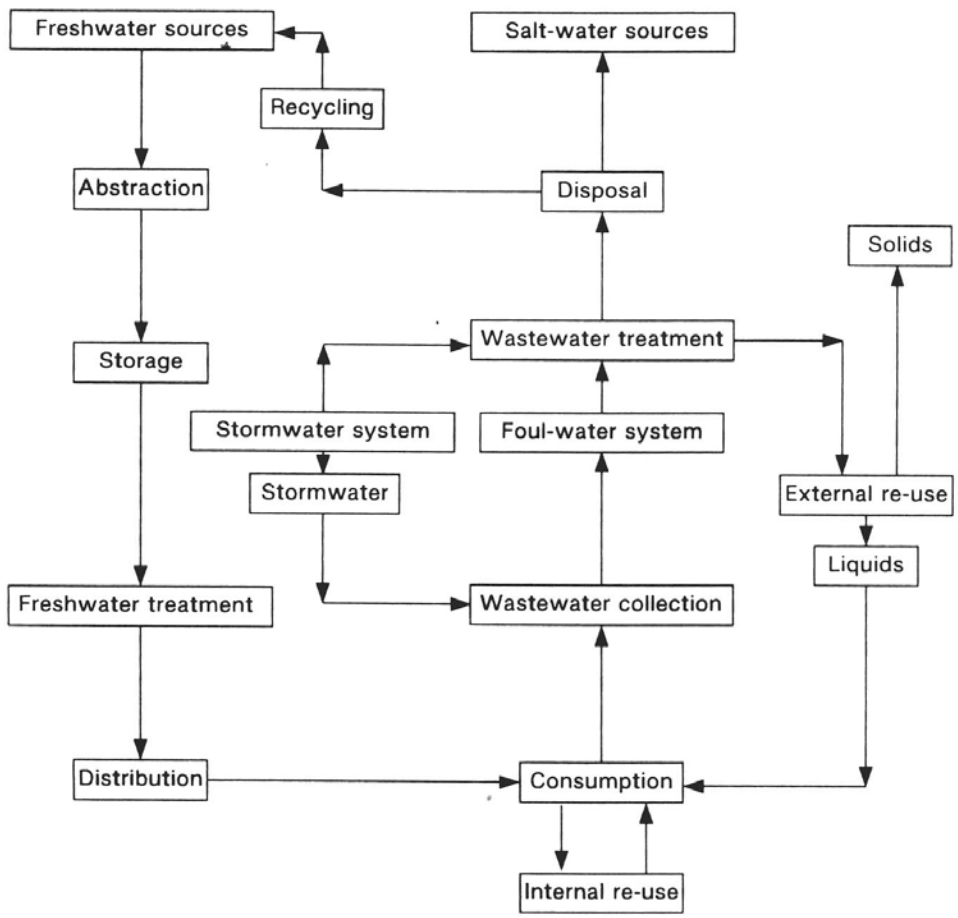
Fundamentals

The hydrological cycle

The hydrological cycle describes the movement of water during its continuous circulation from ocean to atmosphere to earth and back to ocean. Water held in the oceans and other water bodies, as well as in the landmasses and their vegetation, continuously evaporates to the atmosphere and then returns to the earth as precipitation, mainly as rainfall. On land the rainfall gathers as surface water and infiltrates as groundwater. Surface water is the flow of streams and rivers in distinct catchment areas, as well as the water in freshwater ponds, wetlands, lakes, etcetera. Groundwater is found below the land's surface and includes the water contained in aquifers. Such aquifers help to sustain surface water flows. In the world's water, 97.4 percent is in the oceans and 2.6.percent is on land. Of all the land's water 76.4 percent is in ice caps and glaciers, 22.8 percent occurs as groundwater and 0.6 per cent is surface water.

The hydrosocial cycle

The following diagram provides a simple illustration of the engineering activities of the hydrosocial cycle in the supply of fresh and wastewater services. The starting point is the natural flow in a catchment, which is available for the conversion from natural resource to social product. It must be noted that flow varies during the course of the year because of the changing seasons. However the demand-side activity of consumption takes place between freshwater distribution and wastewater collection.



1 A simple model of the hydrosocial cycle.

What is water demand management?

Water demand management refers to any socially beneficial action that reduces or modifies average or peak water withdrawals or consumption from either surface or groundwater, consistent with the protection or enhancement of water quality.

This definition clearly shows that

a) it only makes sense to implement actions on a permanent basis if they are ‘socially beneficial’ in the benefit – cost context.

b) the integration of water demand management and water quality is specially important to the potential benefits of implementing demand management strategies.

c) demand management views water use as a ‘demand’ that can be altered by means of various policy and technical means.

Water demand management relies much more on socioeconomic techniques like economic analysis, public education, and establishment of incentives and disincentives which have proven to be cost effective.

The structural components of demand management include metering, leak detection and repair, water storage and water auditing plus the construction of major works if necessary.

Benefits

Experiences in countries like Singapore, USA, Israel, and Canada have demonstrated that on adoption and implementation, demand management can

- reduce water demands by 30 to 50 percent with no deterioration in lifestyle.
- significantly reduce capital requirements and operating costs for expansion of supply
- reduce the generation of pollutants, and therefore the requirements for new or expanded wastewater treatment systems.
- enhance the development and adoption of new technologies
- lead to financially sustainable water systems
- facilitate expansion of the coverage of available water development funds
- assist with meeting the needs of present and future generations by promoting more efficient water use

Approaches to water demand management

Water demand management relies upon a range of tools and techniques, which can be divided into economic, structural and operational, and sociopolitical categories.
Its techniques encompass both the concerns of water supply and waste disposal.

Economic techniques

The aim of economic techniques is to promote better water use practices by moving toward increasing conservation and promoting sustainability in the use of water resources. These economic techniques depend on monetary incentives (such as rebates, tax credits) and disincentives (such as real cost, penalties, fines) to inform users of the value of water.
Realistic water pricing is one of the fundamental keys to water demand management as it is a direct means of controlling water demand and generating revenues to cover cost. (This is one of the main strategies of Canada’s Federal Water Policy of 1987 and

Environment Canada 1987). The metering of water use and setting a price per unit volume consumed, helps to underpin the other demand management forms. Water pricing should therefore be complementary to the other measures of demand management and not a substitute for them. In many parts of the world one of the following takes place

- No price is paid for water, which in the case of households is looked at as a social service. Otherwise, the supply of water is looked at as a municipal service partially financed by a local water tax.
- For households, water consumption is unmetered and the costs of water are met by a property based fixed charge, levied by the water service company not by a price for its use.
- Water consumption is unpriced where farmers or industry have control over their own water supply. These users have the economic costs of abstraction and treatment, but the zero prices per unit is likely to lead to wasteful use.

The big difference in revenue-raising between pricing and a fixed charge is that only the former is based on the quantity consumed by the household.

Where prices are to be introduced for consumers, price–setting policy has to be considered. Water price tariffs come in many varieties such as

- a fixed standing charge for connection to the service respective of total consumption
- unit price of water consumed may be on a flat rate basis, or increase (or fall) with each successive block of consumption
- higher prices at consumption peaks
- variations in seasonal pricing

It must however be remembered that water is the most basic of all needs and a move to water pricing may have a greater effect on the poor. Therefore to apply water pricing and commit to social justice, the implications to tariff must be recognized and, at least, the pricing for the first block of consumption should be modest giving consideration to the basic needs of washing, cleaning, cooking and sanitation.

Structural and operational techniques

Structural techniques are measures used to achieve better control over water demand. Examples include metering, retrofitting, controlling flow and recycling.
Metering measures the volume of water taken from supply and is a necessary step to effecting demand– based pricing.

Another major impact on overall consumption is the recycling and reuse of water and waste water particularly in industry.
With internal reuse, a consumer first uses the water supplied to it and then returns its wastewater internally for a second round of use and perhaps a third. For example, the installation of water storage during housing construction can make the one off reuse of bath and shower water for flush toilets feasible, reducing household water use by possibly 15 percent. With external reuse, a consumer (household, farmer or industrialist) uses its water supply and then the wastewater is supplied as an input to another organisation. For both internal and external reuse, the wastewater often requires treatment. Although reuse is viewed as a supply–side measure, it brings about a lower consumption by the community as a whole compared with the absence of reuse and therefore can be regarded as a demand management measure.

In addition structural techniques include consumption technology where changes in practice of a physical nature such as improving equipment to allow the use of less water (e.g. improving sprinkling equipment) are employed. Like internal reuse, technical measures deployed reduce consumption of the external water supply.
In this case, for example in households, the redesign of showers, toilet cisterns, washing machines and dishwashers can cut water consumption significantly. Access to new technology for the household may be through the purchase of new machines or in retrofit programmes.

Retrofitting enables municipalities, industry and agriculture to save water and reduce cost by utilizing water saving devices such as flow regulators, water-saving toilets, drip irrigation and others. Acceptance of such innovations can be underpinned by government through building regulations and water bylaws

Land use planning is another form of demand management. This is viewed from the catchment where consumption is at the limits of the supply capacity or nearly so, and increased abstraction would impose relatively high economic or environmental costs. In such a case land use planning can restrain urban development and the consumption that accompanies it - possibly diverting its location to other areas not facing the same supply-consumption imbalances.

Operational techniques, however, are actions by users to control demand patterns more effectively by modifying existing water use procedures. Included are leakage detection and repair and water use restrictions during periods of water shortages. Since unaccounted for water is fairly high and usually attributed to leakage, then leakage repair is integral to effective demand management.

Social Techniques

In the context of water demand management, social techniques refer to policy, educational and related measures to encourage support for demand management and conservation by the public and stakeholders and to the wise use of water. These techniques include effective public education and public awareness programmes, laws such as land use and appliance modifications and economic policies. Public education and awareness are critical and very necessary to obtain ‘buy in’ to demand management and conservation by the public. Educational measures also bring about a change in consumers’ habits which contribute to effective demand management.
Examples include:

- the provision of comprehensive consumption advice and information services
- residential water audits

- inspection of water use fittings and appliances in individual homes, undertaking leak detection and repair, evaluating lawn watering practices, advising on low-water garden design and recommending water saving plants.
- undertaking engineering audits, technical workshops and best practice manuals. UK studies suggest that these can save 20-35 percent of total annual water use.

The above techniques of water pricing, structural and operational techniques and social techniques are mutually reinforcing and most effective when implemented jointly.

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