Lecture note

Water demand management

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by

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Lecture notes have been prepared on the following topics:

Aggregate water balances for basinwide planning
Case study: Kok River Basin
Case study: Lower Mekong Basin
Environmental management
Floods and drought
Glossary
Good governance strategies (example from Thailand)
Internet applications in river basin management
Paddy cultivation
Poverty alleviation
Project design
Public administration
Ramayana
Reporting
River basin ethics
River basin management
Sector planning and integrated planning
Socio-economics
Strategies for natural resources and environmental management (example from Thailand)
Technology management
UTM coordinates
Water demand management
Water resource economics
Water user associations

Each note is intended as a quick introduction of a subject prepared for professional practitioners who are specialists in other subjects.

The notes are 'public domain' and can be freely copied.

Suggestions and comments are most welcome!

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Contents

1 Introduction

Many countries give priority to

- economic development;
- food security;
- poverty alleviation in towns and in rural areas;
- rural livelihood consolidation and development; and
- environmental protection.

Unless water is abundantly available - which is seldom the case - such aims can best be pursued if there is harmony between the demand of water and the availability of water.

2 Context

The following are *'Frequently Asked Questions'* within water management:

- How much water is available?
- What is water needed for?
- How much water is needed?
- Is there enough water?
- If *'no'* - what to do?

Demand management is related to the last of these questions.

3 Terminology

Water resources management is a young discipline. Its terminology is not fully standardised. Please regard the following explanations as indicative. Be aware that the same words can be used with a different meaning!

Water availability

The availability of water in a given area can be taken as:

The flow from upstream (if any)
\+ the (surface and groundwater) resources generated in the area by net rainfall
\- priority allocations within the area, or downstream of the area

Priority allocations can be for domestic use, for environmental preservation, or for maintaining a desired navigation depth. In the Mekong River, a certain minimum flow is required to maintain the freshwater regime in the (intensely cultivated) Mekong Delta (which would otherwise become saline due to sea water intrusion).

The availability is largely determined by the rainfall. It changes slowly - from one decade to the next, due to medium-term climate variations, or due to construction of reservoirs or diversions.

The availability can be measured, and/or determined by numerical modelling, with an accuracy that is determined by the coverage and quality of the basic hydrological data.

Water demand

The demand of water is the amount required for a given purpose, for example litre per person per day, or mm per crop. The demand can be *present* or *future*, and it can be *actual* (i.e. related to an available infrastructure) or *potential* (assuming full infrastructural development and no raw water shortage). The *serviceable* (part of the) demand is limited both by infrastructure and raw water availability.

A distinction can be made between *consumptive demand* (for households, industries and agriculture), and *non-consumptive demand* (for habitat preservation, fisheries, navigation, and salinity control at the river mouth). A similar but slighty different distinction can be made between *instream demand* and *offstream demand.*

In this connection, *storage reservoirs* are somewhere in between - they 'consume' water (by storing it) in part of the year, and release it in a different part of the year. Run-of-river hydropower schemes are basically non-consumptive.

Note that *availability and demand are largely independent.*

Estimates of (future) water demand are normally much more uncertain than estimates of the water availability.

Use of water

The use (or *consumption,* or *utilisation)* of water is the part of the demand that is actually served at a given time.

Many uses generate a *return flow,* (for example sewage, or irrigation tailwater). The return flow can occur at a different time or place than the withdrawal (for example a storage reservoir retaining water for release in a different part of the year).

The use of water can be increased by infrastructural development and reduced by demand management.

Demand management

Demand management is intervention in order to reduce the consumption of water. Demand management is applied in order to meet a *water shortage,* or a *shortage of money* for infrastructural development, or to improve the *water efficiency.*

Supply enhancement

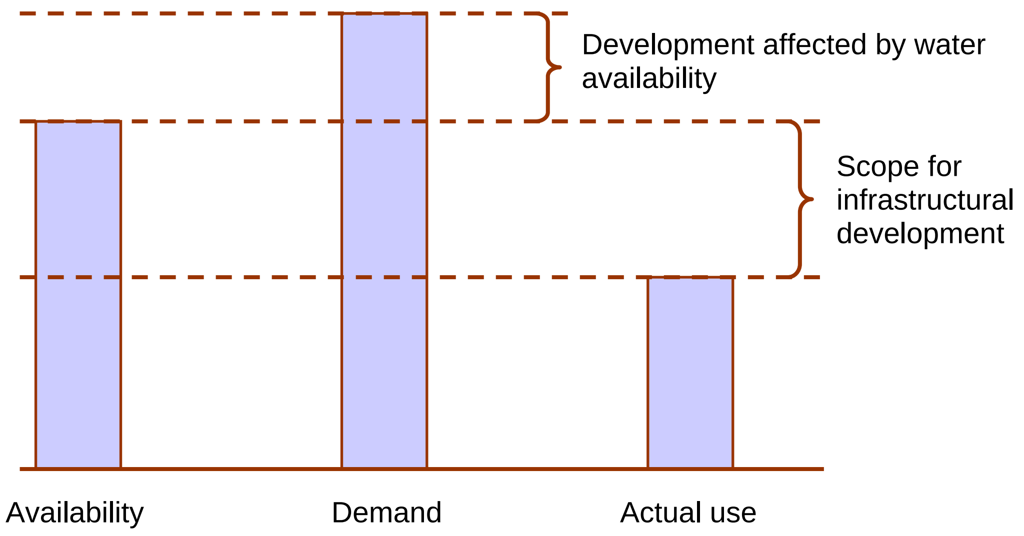
Supply enhancement is to make more water available to households, industries, farmers, and other consumers. This can be done *by infrastructural development* (of waterworks, distribution systems and irrigation systems), and/or *by storage* (in reservoirs), and/or *by using new raw water sources.*

Supply enhancement requires *raw water* and *money*.

Efficiency improvement

In general, efficiency is the ratio between outputs and inputs. The *over-all water efficiency* is the production per unit of water. The *distribution efficiency* is the ration between water supplied and raw water withdrawn. Improvement of water efficiency comprises reduction of any unnecessary losses and waste (during storage, distribution or consumption). This can be achieved (for example) by appropriate operation and maintenance (and rehabilitation if required), and/or by introduction of new technology in agriculture and industry.

4 Rationale



Water demand management is a tool for achieving harmony between the demand of water and the availability of water.

If water (or money) is limited, such management can be required in support of important water-related development goals: (i) Economic development; (ii) food security; (iii) poverty alleviation in towns and in rural areas; (iv) rural livelihood consolidation and development; and (v) environmental protection.

In some cases, the choice is open between *increasing the supply of water* and *reducing the demand of water*. In other cases, only one of these strategies is feasible, at least in the short term.

5 Demand management tools

The demand of water for *domestic consumption* can be controlled by measures such as

- installation of water meters (if not done already), and charging a water fee;
- applying different tariffs for different housing areas;
- generation of awareness about prudent use of water;
- rationing of water (normally in case of critical shortage only).

The demand of water for *industrial consumption* can be controlled by measures such as

- installation of water meters (if not done already), and charging a water fee;
- applying different tariffs for different users and different seasons;

- promotion of new, water-efficient technology; and/or
- rationing of water (normally in case of critical shortage only).

The demand of water for irrigation can be controlled by measures such as

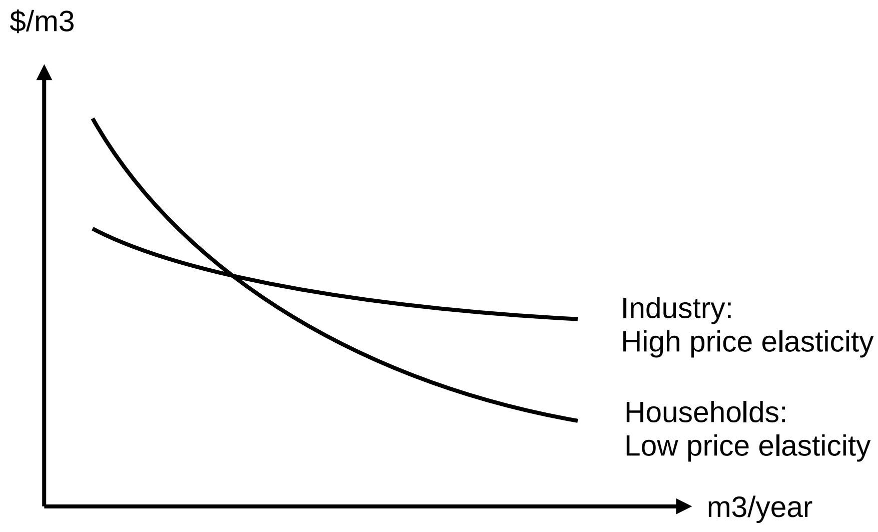
- charging a water fee that depends on the volume of water used (rather than the irrigated area);
- applying different tariffs for different seasons;
- generation of awareness about prudent use of water;
- promotion of good operation and maintenance;
- promotion of new, water-efficient technology (crops and cultivation routines); and/or
- rationing of water, possibly by de-central administration (water user groups).

6 Water fees

When a fee is introduced (or, perhaps, later on, increased), the consumption will go down. This is a general consumer habit phenomenon - it relates to many goods and services - for example telephone, electricity, buses, trains, taxis, gasoline, pesticides, fertilisers, cigarettes, beer - and water.

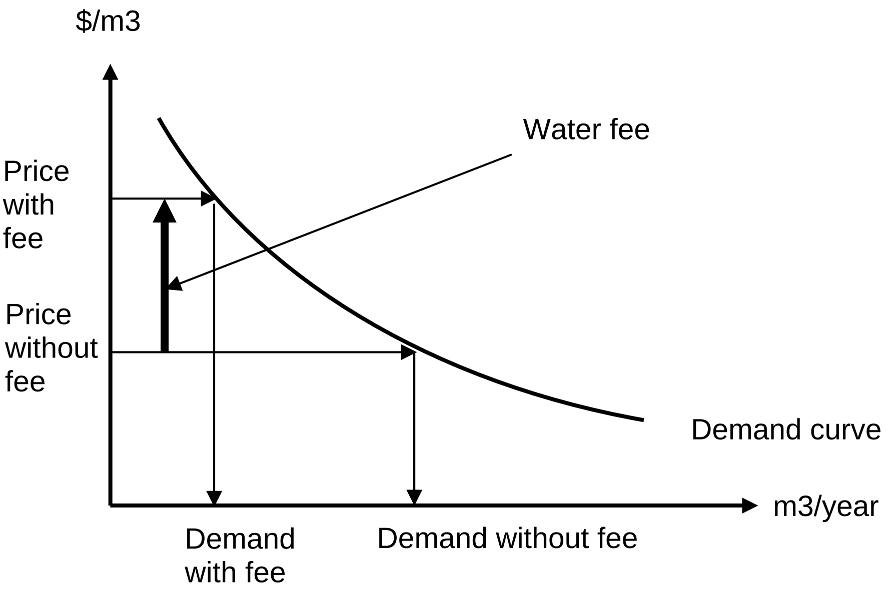
The effect is 'context-specific' - it depends on the circumstances, and is different from place to place, and from one sector to another. In case of water, industries will often respond strongly, households more gradual, and agriculture in a stepwise manner (with little response until the expenses approach the earnings, and then an abrupt cut in water utilisation).

The relation between the price and the amount consumed is called the price elasticity. It is shown in the figure below.



The first time water meters are installed and a fee imposed, the effect can be dramatic and unpredictable. Therefore, it is worthwhile to consider a water fee some years before constructing a major central sewage treatment plant. In this way, the actual volumes of sewage will be better known.

The effect of a water fee depends on the price elasticity, as shown in the figure below:



The opposite of a fee is a *subsidy*. A subsidy is applied when the costs are not recovered from the users, but are (wholly or partly) covered by somebody else - for example other taxpayers - *the costs are there in any case, whether or not they are recovered.* While a fee in general will reduce the consumption, a subsidy will in general increase the consumption.

Water fees can have several purposes: *Cost recovery;* and/or (public) *income generation;* and/or *demand regulation.* A fee can be flat or progressive. It can distinguish between different uses of water (domestic, industry, etc); different seasons; and/or different income groups.

Phom Penh Water Supply Authority (PPWSA)

In 10 years, from 1993 to 2003, PPWSA increased its distribution network from 25 % to 80 % of Phnom Penh. Non-revenue water (the result of leaks, mis-management, illegal connections and illegal sales) was cut from 72 % to 16 %. The production capacity increased from 65,000 to 235,000 m3/day, and connections from 26,881 (12 % of which were metered) to 105,000 (100 % of which are metered). Bills paid increased from 48 % to 99 %. The staff efficiency increased from 45 to 200 connections per employee, and full cost recovery was achieved.

The supplied water is now safe to drink, but frequently, the tap water is contaminated by the households' own roof tanks or underground storage tanks.

Source: Phnom Penh Post volume 13 no. 5, 27 February 2004

Fees that aim at demand regulation are sometimes called *'green taxes'*. Such fees (or taxes) are levied in order to regulate consumption, production or behaviour that affects pollution or utilisation of sparse resources. They aim at a better concordance between

- actual, immediate, direct (market) costs; and
- total, long-term social costs (including public health, environmental impact and preservation of important resources)

Green taxes can serve a fiscal purpose as well - or they can be fiscally neutral, if the income from the taxes is used for subsidies of the same sector.

7 Advantages and disadvantages of regulation

7.1 Increased supply

Advantages:

- General economic development can proceed unaffected
- Scope for serving all users with adequate water
- Basis for increased turnover (and income generated) for the water supply utility

Disadvantages:

- Capital investments required, both for treatment and distribution (and, possibly, disposal of sewage and sludge)
- Opportunity costs - the net consumption of raw water becomes unavailable for other useful purposes downstream of the town
- Risk of adverse environmental impact related to (i) increased withdrawal and (ii) increased sewage discharges

7.2 Demand management

Advantages:

- Low investment required (except for repair of distribution network, which can be very expensive)
- Public income can be generated by water fees
- Incentive to industries and agriculture to improve their efficiency (and thereby their competitiveness in an open market)
- Raw water is preserved for alternative uses downstream, including fisheries
- Less sewage treatment capacity required

Disadvantages:

- Excessive demand management can affect general economic development
- Risk of adverse social impact to the poor part of the population

The negative effects of demand management will be less if regulation is introduced gradually, by small steps, and in a transparent and predictable way.

References

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