IWRM Action Hub

IWRM TOOL - C3.02

Supply Efficiency

Summary

Supply efficiency is a method of reducing water losses across the system by investing in and improving infrastructure. It aims to increase revenue generation or delay investments in new water supply infrastructures. This Tool introduces supply efficiency, its interlinkages with reliability, and pathways to implementation including its opportunities and challenges.

What is Supply Efficiency?

Efficiency in the supply and delivery of water is an important strategy towards achieving water security. Improving efficiency can keep costs down and ensure that the water system is reliable and its potential is being fully utilized. Average global water losses are estimated at 35% (Heryanto et al., 2021) or more in some cases. Supply efficiency should minimise water losses throughout the water supply process such as during water abstraction, treatment, storage, bulk transfer and local distribution. Reducing water loss involves aspects related to design, construction, operation and maintenance of water systems. Supply efficiency can also be supported by accurately matching water supply volumes according to demand volumes. Hence, capacity building for improved forecasting can be beneficial to gain a balance between demand and supply. Such capacity building can also be extended towards having better maintenance and management for water utilities.

Supply Efficiency in IWRM

Looking at supply efficiency in a basin scale, there are upstream-downstream linkages. For example, when upstream managers cannot ensure conveyance efficiency, there may be no incentives for downstream water users to make efficiency gains (FAO, 2003). The efficiency of surface water storage may also be affected by natural hydrology such as rate of siltation. Better land management practices upstream can reduce the rate of siltation in water storages downstream helping storage/supply efficiency.

Water policies are often supply-dominant. However, supply-oriented policies have a physical, social, economic, and environmental limit. Furthermore, efficiency improvements in water distribution can lead to abundance and wasteful use of water. Hence, need to be accompanied by appropriate changes in water use practices in order to be effective. To avoid such cases, they should supplemented and balanced with demand management (Tool C3.01) and social and behavioral change (Tool C5.04).

Fully utilising water infrastructures by reducing any losses can relieve pressures on water resources and associated ecosystems to limit groundwater depletion, land subsidence, water quality deterioration, and saline water intrusion. Furthermore, water sources can be diversified to provide additional water and reduce pressure of increasing demand. Conjunctively using groundwater and surface water as well as introducing new sources such as water reuse and recycling (Tool C3.03), Nature-based water storages (Tool C3.04) and rainwater harvesting.

Economic Rationale for Water Supply Efficiency

High levels of water loss in distribution networks lead to low levels of efficiency. The difference between the amount of water produced and put into a supply system and the amount of water which is billed to consumers is called Non-revenue Water (NRW) (ADB, 2010a). It consists of three main components physical losses due to leakage, commercial losses due to poor metering and unauthorised consumption of water (Wyatt, 2010). The concept of non-revenue water, revenue water and NRW are illustrated in Figure 1 with reference to the total water supply. When a utility’s product (water) is lost, water collection, treatment, and distribution costs increase, and income through water sales decrease (Tool C4.01) causing a vicious cycle of water and economic losses (Farley, Wyenth, Ghazali, Istandar and Singh, 2008). Supply efficiency improvements lead to reduction of these losses, allowing suppliers to meet greater demand through the same system allowing better cost recovery and economic sustainability of water supply.

<table>
<tr><td rowspan="4">Total Water Supply</td><td>Real Losses</td><td>Physical Losses Due to Leaks</td><td>Unbilled</td><td rowspan="2">Unaccounted-for-water</td><td rowspan="3">Nonrevenue Water</td></tr>
<tr><td>Apparent Losses</td><td>Illegal Connections and Incorrect Measurements</td><td>Unbilled</td></tr>
<tr><td colspan="2">Metered and Unmetered Connections</td><td colspan="2">Unbilled</td></tr>
<tr><td colspan="2">Metered and Unmetered Connections</td><td>Billed</td><td colspan="2">Revenue Water</td></tr>
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Figure 1. Components of Total Water supply including unaccounted, non-revenue and revenue water (Adapted from ADB, 2010b)

Reducing physical losses as a result of leaks and evaporation include options such as lining irrigation canals and fixing leaks in urban water-supply systems can improve conveyance efficiency. Regular maintenance of infrastructure supports to maintain and archive water efficiency levels and is more cost-effective than rehabilitation or new infrastructure development (WEF, 2014). It does no good to develop a lot of new water infrastructure if it is not going to be maintained, as poor conditions lead to inefficiencies and major losses over time.

These technical measures have to be complemented by regulation and compliance (Tools B1) to limit commercial losses, through illegal connections or broken metering. Commercial losses can be identified by walk-through surveys and illegal connections can be legitimised as well as added to the network. Therefore, before considering expansion of distribution networks, or new supply systems, supply efficiency should be considered to reduce physical losses and NRW.

Supply efficiency can postpone major capital investments in supply infrastructure. However, interventions such as lining of irrigation canals to reduce conveyance losses is capital intensive. Hence, the cost-benefits of efficiency should be weighed and compared with the cost-benefits of new infrastructures through an economic analysis (Tool D1.01). On an equitability dimension, there may be trade-offs between efficiency and accessibility. Such as, the choice between expanding service to new users and making current infrastructures more efficient.

Intermittent and Continuous Water Supplies

Intermittent water supply systems are prominent in many parts of the globe. These systems allow water to flow for limited times according to a recurring schedule helping to reduce water losses in damaged/poorly maintained systems. However, it faces challenges of water quality and accessibility while also potentially damaging metering systems (Vairavamoorthy, 2021). Intermittent water supply system schedules can be designed to match the required household demands (Andey and Kelkar, 2009).

Continuous Water Supplies are more convenient for water users. However, in order to have continuous supply of water, the water source must be resilient and reliable. This may require water storage systems that can bridge the seasonal water demand and supply gap. With increasing uncertainties due to climate change, storage plays a greater role in reliable and efficient supply (GWP, 2021). Having multi-purpose storage infrastructures (for irrigation, energy and municipal water supply), can maximise benefits and share associated risks.

Key Methods for Improving Water Efficiency

Key measures for improving water supply efficiency include:

- **Universal and Zonal metering:** This allows water utilities and consumers to monitor their water usage while also providing information for water accounting (Van der Berg, 2008). It can support reduction in water usage as well as better monitor water losses. A key point to note is that metering is only socially valuable if the benefit from reducing overconsumption exceeds the cost of metering itself (Ornaghi, 2021). Smart metering allows utilities and users to determine water consumption and operational status of conveyance systems in real-time (ADB, 2018). Identifying leakages in the system quickly and acting to fix them can limit water wastage.
- **Irrigation canal lining:** Irrigation Canal lining is an impermeable layer added to canals to make their surfaces smoother, allowing greater flowrates while also reducing seepage (Ding and Gao, 2020). A range of different materials can be used as the impermeable layer ranging from concrete, earth to geosynthetics. Irrigation Canal lining can prove very expensive and the reduction in seepage results in limited groundwater recharge.
- **Leakage and pressure reduction:** Leakages of a system must be continually monitored and systems must be maintained to prevent losses. Furthermore, pressure control can be an effective way to reduce leakage in water distribution systems. To further prevent bursting of pipes, Pressure Reduction Valves (PRVs) can be installed in the distribution system in an optimised through hydraulic modelling (García-Ávila et al., 2019).

Thematic Tagging
Water services
