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**BY**

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1. **List and briefly describe the measures by which the success or otherwise of a public–private partnership providing water supply services can be assessed.**

To measure the success of a PPP providing water supply, some parameters are used for evaluation. These parameters include the following: Accessibility, affordability, cost-recovery, minimization of non-revenue water, water quality and operational efficiency.

1. **Accessibility**: The extent of coverage of the population, and the distance to the water point;

According to WHO, from the public health standpoint, the proportion of the population with reliable access to safe drinking-water is the most important single indicator of the overall success

of a drinking-water supply programme. There are a number of definitions of access (or coverage), many with qualifications regarding safety or adequacy. Access to safe drinking-water for the Millennium Development Goals is currently measured by the WHO/United Nations Children’s Fund (UNICEF) Joint Monitoring Programme for Water Supply and Sanitation through a proxy that assesses the use of improved drinking-water sources by households. An improved drinking-water source is one that by the nature of its construction and design adequately protects the source from outside contamination, in particular by faecal matter. The underlying assumption is that improved sources are more likely to supply safe drinking-water than unimproved sources. Improved and unimproved water supply technologies are summarized below:

* Improved drinking-water sources:
* Piped water into dwelling, yard or plot;
* Public tap or standpipe;
* Tube well or borehole;
* Protected dug well;
* Protected spring;
* Rainwater collection.
* Unimproved drinking-water sources:
* Unprotected dug well;
* Unprotected spring;
* Cart with small tank or drum provided by water vendor;
* Tanker truck provision of water;
* Surface water (river, dam, lake, pond, stream, canal, irrigation channel);
* Bottled water (Bottled water is considered to be improved only when the household uses drinking-water from an improved source for cooking and personal hygiene).

Determining the proportion of a population with reliable access to drinking water is an important function of a drinking-water surveillance agency. This task can be facilitated by establishing a common definition for reasonable access, appropriate to a local context, which may describe a minimum quantity of water supplies per person per day together with a maximum tolerable distance/time to a source (e.g. 20 liters, and within 1 km/30 minutes, respectively, for basic access).

Also, according to the Joint Monitoring Programme of WHO/UNICEF, Universal access to safe drinking water is a fundamental need and human right. Securing access for all would go a long way in reducing illness and death, especially among children. Since 2000, 1.6 billion people have gained access to basic drinking water services, such as piped water into the home or a protected dug well. In 2017, 785 million people still lack a basic water service and among them 144 million people still collected drinking water directly from rivers, lakes and other surface water sources. The data reveal pronounced disparities, with the poorest and those living in rural areas least likely to use a basic service. “Safely managed” water services represent an ambitious new rung on the ladder used to track progress on drinking water. In 2017, 5.3 billion people used safely managed services, i.e. accessible on premises, available when needed and free from contamination. A further 1.4 billion used a ‘basic’ water service, i.e. improved sources within 30 minutes per round trip to collect water. Over a quarter of a billion (206 million) used a ‘limited’ service where water collection from an improved source exceeded 30 minutes. In most countries the burden of water collection continues to fall mainly to women and girls. When assessing accessibility of water, the Technician questions are:

1. How far are water collection points from where people live (minimum standard: shelter to water point 500m).

2. Is it possible to tanker if water sources are inadequate? If so, from where?

1. **Affordability**: The cost of the water needed should be less than 5% of the household’s income. The affordability of water and sanitation services and the related ability to pay of the users may be expressed as:

* Cost of water and sanitation services as a percentage of the minimum wage rate for the respective area or;
* Cost of water and sanitation services as a percentage of the monthly household expenditure or;
* Ratio of the monthly household water consumption expenditure to the monthly household income

According to WHO, The affordability of water has a significant influence on the use of water and selection of water sources. Households with the lowest levels of access to safe water supply frequently pay more for their water than do households connected to a piped water system. The high cost of water may force households to use alternative sources of water of poorer quality that represent a greater risk to health. Furthermore, high costs of water may reduce the volumes of water used by households, which in turn may infuence hygiene practices and increase risks of disease transmission. When assessing affordability, it is important to collect data on the price at the point of purchase. Where households are connected to the drinking-water supplier, this will be the tariff applied. Where water is purchased from public standpipes or from neighbours, the price at the point of purchase may be very different from the drinking-water supplier tariff. Many alternative water sources (notably vendors) also involve costs, and these costs should be included in evaluations of affordability. In addition to recurrent costs, the costs for initial acquisition of a connection should also be considered when evaluating affordability.

To be affordable, the cost of sanitation services should be proportionate to the households’ disposable income.

This proportion not only depends on several socioeconomic factors, but is also contextually influenced by cultural perceptions. Moreover, the concept of willingness to pay will have greater prominence in the affordability of sanitation services than for drinking water supply services, as sanitation is often not a priority expenditure compared to water, food and medicine. It is generally assumed that facility ownership is an incentive for households to invest, to the extent possible, in its maintenance.

In many countries there is no explicit tariff for sanitation because of the existence of mechanisms for cross-subsidizing from the revenues from drinking water supply services. This has its roots in the fact that there is a greater willingness to pay for drinking water supply than for sanitation services. Also, combined billing can contribute to cutting administrative costs. In many instances it is, however, recommended to maintain a separate tariff-setting, specified billing and a distinct cost-recovery mechanism for sanitation, in order for users to acknowledge the value of the service that is provided, but also for the sake of transparent accounting for each of the services. This should help reduce under-investment in sanitation which perpetuates the gap between service provision for water supply and for sanitation. There are mainly two kinds of cost for sanitation services for end-users: the connection charges typically represent a bigger affordability challenge as a single instalment; therefore, they represent a higher obstacle to accessing the service. When the public service is widely accessible, priority should be given to subsidy mechanisms targeted to deal with this challenge. On the other hand, if no public service is available, public support for the installation of on-site sanitation facilities is a viable option, provided it targets those in need and is accompanied by a campaign promoting the use of the facilities. A regulatory framework should be in place to ensure the periodic emptying of on-site solutions, such as septic tanks, at an affordable price.

User fees typically generate funds for daily operation and maintenance and long-term capital investments for drinking water and wastewater systems. As a percentage of household income, U.S. households pay less for water and wastewater than other developed countries. There is a perception that water is readily available and water services are generally inexpensive. Public education on water sector system operations and private water conservation can help us meet our essential infrastructure needs. Pricing decisions involve considerations of equity as well as efficiency. Low-income households, especially those served by high-cost systems, may face affordability problems if prices are raised. To alleviate these hardships, communities can offer pricing structures that mitigate impacts on low-income households. The most common example is "lifeline rates," where low-income households are charged lower rates on non-discretionary water consumption (the minimum sanitary requirement, e.g., 6,000 gallons a month), and higher rates on water consumed beyond that amount. The [Water Research Foundation](http://www.waterrf.org/Pages/Index.aspx) [Exit](https://www.epa.gov/home/exit-epa) has comprehensive information on water affordability programs. Prices signal value to consumers and help determine whether consumers use water efficiently. If prices are too low, consumers will use too much water. It is also essential that the pricing of water services covers the costs of providing service, for both operations and maintenance and capital expenses.

1. **Cost recovery**: The cost of providing the water should be claimed back from the population;

Water Recovery Services, Inc. (WRS) was founded on the principle that water is a precious resource and should be treated as such. Each water well is a portal and should be maintained properly to provide optimum flow and clean, quality water. The fact is, any well can experience a decrease in water capacity or run dry due to sediment buildup, mineral scale, or other biological blockages, or become contaminated with iron bacteria and other water-fouling microbes. These are common water well problems that can be corrected without the major expense of drilling a new well. Cost recovery for water services is increasingly being utilized to generate a significant part of the finances necessary for the construction and maintenance of water supply and sanitation infrastructure; and to conserve water. This principle of cost recovery is reflected in a series of international declarations and agreements, with the provision that cost recovery should not become a barrier to access to safe water by poor people. However, the latter consideration is often insufficiently addressed when it comes to setting tariff structures for water services. This results in tariff structures that are unfavorable to the poor. An effective cost recovery policy is built upon some basic design principles:

* Quantify all program costs. Investments for facilities but also expenditures for hygiene training, educational materials, project supervision, follow-up, and support;
* Ensure that local contributions to investment costs rise in proportion to the service level of the facilities. This is essential if the community is to making a meaningful choice among service level options (e.g. household water connection versus community standpipes). Experience has shown that the use of subsidies for all service levels leads to the use of inappropriately expensive facilities and creates expectations that cannot be replicated or effectively scaled up;
* For facilities, at least operation and maintenance (O&M) costs should be recovered to ensure sustainability. Ideally, the cost of building, operating, and maintaining facilities should be charged;
* In general the following guidelines should be followed;
* Subsidize only the most basic level of facility, leaving the community to make improvements as able;
* Ensure that the economic ranking of various technical /service level choices remains the same based on the real costs, so that a more expensive option does not become more attractive than a less expensive option because of the subsidy;
* Find out what the community is willing to pay or what is affordable.
* Establish a common financing strategy for the sector. The lack of such an agreement can lead to projects and programs undermining each other;
* Establish financial management and cost sharing at the community level. Financial plans to ensure operation and maintenance of facilities should be developed before project implementation and should include, at a minimum, recurring and replacement costs. If resource allocation from community is insufficient, cost recovery of O&M can be organized through user fees to be paid for the use of facilities (ensuring that this does not hamper the ability of the poor to use it); payment in kind through the provision of soap, cleaning materials, or labor.

1. **Minimization of non-revenue water**: This should be reduced to 15% or less;

Minimizing or Reducing Non-Revenue Water (NRW) from real losses3: Non-revenue water means the water that is produced by the service, but does not fetch any revenues. This includes water that is lost in transmission and distribution through leakages and theft, free water connections provided in the city. PAS-SLB database for year 2011-12 shows that almost 24 % of water produced in the ULBs is non-revenue water. The water audits conducted by the PAS team in ten cities also show that almost 30-50% of the water produced is NRW. Hence any reduction in water lost in the system would enhance the water supply. Non-revenue water is one of the lowest hanging fruits in order to improve the efficiency of water utilities around the world. Especially the water losses in the distribution systems are obvious when analyzing data from water utilities. It is more than a decade since it has been presented the ‘best practice’ standard water balance but many water utilities have still no overview of the situation. Around the world one still sees that non-revenue water accounts for 25 to 50 per cent of the total water supply and in emerging markets one has experienced even up to 75 per cent non-revenue water. For example, Danish water supplies have over the last decades worked intensively on reducing non-revenue water and managed to significantly decrease. It all started in 1989 by a tax on the water produced by the water utilities. The water supplies hereby got a strong incentive to reduce water losses and improve the quality of the distribution system. The result today is that most Danish water supplies are below 10% non-revenue water. The many benefits of reducing non-revenue water are obvious. The less drinking water the utility needs to treat and pump out in their network – the less energy the utility use. The less leakage from drinking water into sewage pipelines – the less sewage water needs to be pumped and treated. The less water loss, the less water abstraction and the stress on the environment. The less leakages in the pipelines the less risk of contaminating the drinking water. The measures to reach this low national level have been many. Among the most important are setting up meters for all consumers, dividing the network into district metering areas, introducing pressure management to decrease pressure, installation of frequency converters for distribution pumps, establish hydraulic models of the distribution system, identify illegal connections, conducted active and not least focused leakage detection, recording of leakages and network quality on GIS, and in general optimizing the investments in renewals of the most deteriorated pipelines and joints. At the same time of reducing the non-revenue water, Danish utilities have managed through awareness campaigns and pricing without subsidies to lower the water consumption in Denmark. Nowadays, the Danish utilities have a good overview of their water distribution network, an overview of the daily production and consumption and in addition much lower energy consumption than a decade ago. Sharing knowledge about non-revenue water Many Danish consultancies work closely together with the Danish water utilities helping other utilities around the world decreasing their water losses. Within the last years such knowledge-sharing projects have been implemented in Malaysia, China, Thailand, Georgia, Taiwan, Turkey, Abu Dhabi, Saudi Arabia, Mali and South Africa. Recently, the entire Danish water sector, involving consultants, equipment suppliers, contractors, universities, authorities and water utilities have prepared a knowledge-sharing platform “Rethink Water” with some white papers presenting examples of state-of-the art practice. Three of the white papers are focused on water supply and non-revenue water: “Greater water security with groundwater”, “Ensuring great-tasting and safe tap water 24/7” and “Reducing urban water losses”.

1. **Water quality**: The water should meet national standards for quality;

Water quality testing is an important part of environmental monitoring. When water quality is poor, it affects not only aquatic life but the surrounding ecosystem as well. Quality standards for sanitary facilities should address several safeguards limiting risks associated with their use. Safeguards are location-specific, are linked to the level of sophistication of the facility and take into account the prevalence of different diseases associated with poor sanitation (so-called water washed diseases). Clear standards and procedures should be defined regarding the minimum hygiene conditions for public sanitation to guarantee their consistent quality. The quality and effectiveness of wastewater management are critical in minimizing the several potential impacts on the environment, on public health and on human well-being. Public utilities or private companies operating sanitation services are responsible for ensuring that wastewater is effectively collected, treated and disposed of in compliance with established regulations. Primary concerns driving these regulations relate to direct risks of faecal contaminants to the population, as well as to risks of drinking water source contamination. The role of regulatory bodies with respect to wastewater management is rapidly evolving, and in some countries well-defined. When assessing accessibility of water, the Technician questions are:

* Is the water source contaminated or at risk of contamination (microbiological and chemical/ radiological)? If so,
* What is the contaminant?
* Is treatment required?
* Is treatment possible?
* What type of treatment is necessary?
* Is disinfection necessary, even if supply is not contaminated?
* Is water contaminated while storage and transportation? If so, why?

1. **Operational efficiency**: The quantity of water supplied per capital, and the duration of water supply per day. The three main indicators of operational efficiency are: (water losses through leakage, etc., payment collection and labour productivity).

Operational Efficiency is defined as the ratio of input utilized in carrying out a business operation to the output produced with those inputs. Inputs maybe raw materials, labor, capital etc. whereas output maybe goods, customer loyalty etc. Operational efficiency is primarily a metric that measures the efficiency of profit earned as a function of operational costs. The operating expenditure could be reduced by improving operational efficiency (through no-cost or low-cost actions or through substantial capital investment). A substantial one-time capital investment would include, for example, replacing sections of the water supply network. Some of the other initiatives that could lead the reduction in operating expenditure include: Reducing Non-Revenue Water (NRW) from real losses, Reducing inefficiencies in energy consumed.

1. **Give six possible causes of water emergencies, three due to natural causes and three due to humans.**
2. Three possible natural causes of water emergencies:

* Drought;
* Flooding;
* Earthquakes.

1. Three possible causes of water emergencies due to humans:

* Accidental contamination of the water supply (example as in the Camelford incident by a chemical tanker driver who was not familiar with the plant layout and delivery procedures in Case Study 14.1).
* The microbial contamination of water sources due to human mismanagement (such as the cholera outbreak in Haiti);
* Deliberate poisoning of the water supply as an act of terrorism.

b. **What are the options for safe water supply during a water emergency?**

The possible options for safe water supply during a water emergency are:

* 1. Delivery of water to consumers by water tanker and/or bottles (distribution of safe water to people through the use of water tankers and/or plastic bottles);
  2. In emergency situations, use bottled water if possible; bottled water is the safest choice for drinking and all other uses. If bottled water is not available, the following methods can help make water safe to drink. For example Water contaminated with fuel or toxic chemicals will not be made safe by boiling or disinfection. Use bottled water or a different source of water if you know or suspect that your water might be contaminated with fuel or toxic chemicals.
  3. The other option is to give the water consumers the means of treating water for themselves to render it safe (treatment of the water at the household to render it safe e.g. by boiling);
  4. Treatment of available poor-quality water in the home using filtration and disinfection ;
  5. Adding disinfectants;
  6. Filtering;
  7. Etc.

3. **You are about to set off to conduct a sanitary inspection of an abstraction point at a river.**

1. **What would you take with you?**

I would need to take:

* An appropriate checklist of questions to ensure that you inspect thoroughly and don’t forget anything;
* Schematic, and Sanitary Control Area (SCA) Map
* Notebook and pen or pencil to record all the information you collect;
* SOP for sanitary inspection for reference and procedure or the WHO guidelines to illustrate the principles and the sort of questions that are involved;
* Containers to collect sample water for laboratory in case of need of that.

1. **Explain four things you will be looking for during your inspection.**

I shall look for any four of these important things:

* The location of any latrines or other possible sources of contamination (due to farming or industrial activities) relative to the river;
* The possibility of any landslide or mudflow,
* A good solid fence, a screen on the intake,
* The presence of a dam;
* The presence of a filter and, if a filter is present,
* That it is operating properly,
* And whether there is any uncontrolled flow.

1. **Explain briefly why a Water Safety Plan is necessary (WSP)**

Major benefits of developing and implementing a WSP include:

* A Water Safety Plan is necessary to ensure that the water that is produced and delivered to consumers is safe;
* It also ensures that the chance of an incident disrupting the continuous supply of water is minimized;
* The WHO recommends the development of Water Safety Plan, because it is through its use that one ensures constantly the most effective means of safety of a drinking water supply;
* The systematic and detailed assessment and prioritization of hazards;
* The operational monitoring of barriers or control measures and improved documentation;
* In addition, a WSP provides for an organized and structured system to minimize the chance of failure through oversight or lapse of management and for contingency plans to respond to system failures or unforeseen events that may have an impact on water quality, such as increasing severe droughts, heavy rainfall or flood events;
* System assessment to determine whether the drinking-water supply chain (up to the point of consumption) as a whole can deliver water of a quality that meets health-based targets;
* Identifying control measures in a drinking water system that will collectively control identified risks and ensure that the health-based targets are met;
* Management plans describing actions to be taken during normal operation or incident conditions and documenting the system assessment (including upgrade and improvement), monitoring and communication plans and supporting programmes;
* Measures to protect the source of drinking water from risks of pollution;
* Measures to ensure an appropriate treatment such as pre-treatment coagulation, flocculation, sedimentation, filtration and disinfection are undertaken to assure the safety of water for the consumers;
* Appropriate operational monitoring system including monitoring parameters that can be measured and for which limits have been set to define the operational effectiveness of the activity; frequency of monitoring and procedures for corrective action that can be implemented in response to deviation from limits. If, during production it is found that the water is polluted, the producer shall stop all operations until the cause of pollution is eliminated;
* Measures to ensure all installations intended for the production of drinking water exclude any possibility of contamination. For this purpose and in particular:
* The installation for collection, the pipes and the reservoirs shall be made from materials suited to the water and in such a way as to prevent the introduction of foreign substances in water;
* The equipment and its use for production, especially installation for washing and packaging, shall meet hygienic requirements;
* A verification plan to ensure that individual components of a drinking-water system, and system as a whole is operating safely.

5. **Distinguish between the two types of maintenance at a water utility and give reasons why one of them is better**

Maintenance deals with the activities that keep the system in proper working condition. Mainly there is two types of maintenance:

**Preventive maintenance:**

Management, cost recovery and maintenance activities undertaken in response to pre-scheduled systematic inspection, repair, replacement, leading to continuity in service level, O and M spread overtime, extension of life span of equipment, users’ satisfaction and willingness to pay.

Preventive maintenance: this includes work that is planned and carried out on a regular basis to maintain and keep the infrastructure in good condition, such as network inspection, flushing of the well, cleaning and greasing of mechanical parts and replacement of items with a limited lifespan. It sometimes also includes minor repairs and replacement as dictated by the routine examinations.

**Breakdown maintenance (crisis maintenance)**

Maintenance undertaken only in response to breakdowns and incase of public complaints, leading to poor service level, high O & M costs, faster wear and tear of equipment, and users’ dissatisfaction. Sometimes this maintenance refers to corrective maintenance and reactive maintenance.

Corrective maintenance: replacing or repairing something that was done incorrectly or that needs to be changed; an example is the reallocation of a pipe route or replacement of a faulty pump.

Reactive maintenance: this is a reaction to a crisis or public complaints; it normally occurs as a result of reported pipe breaks and the malfunctioning or breakdown of equipment.

The Technician is in charge of maintenance, repairs and general technical oversight of the infrastructure, the Operations Manager must ensure that the Technician has a standard system for preventive maintenance and that he/she has the adequate tools to accomplish the job.

**Preventive maintenance is better than break down maintenance because it helps prevent breakdowns and ensures that the assets can be used until the end of their service life. By undertaking preventive maintenance, crises which are costly can be avoided.**

**Preventive maintenance is an important aspect in ensuring sustainability of the system. If ignored or belittled by the managers of the scheme, it may eventually lead to collapse of entire scheme.**

References

Barbara E and Duncan M (2011), Sanitation and Water Supply in Low-income countries.

COHRE, AAAS, SDC and UN-HABITAT (2007), Manual on the Right to Water and Sanitation.

USAID and HIP (2010), Access and Behavioral Outcome Indicators for Water, Sanitation, and Hygiene.

Vivian C (WSP), Neli M and Charles M (DAWASA) (2009), Sustainable Community Management of Urban Water & Sanitation Schemes (A Training Manual).

UNICEF Nigeria, DFID) of UK and EC (2007), Trainees Participatory Hygiene and Sanitation Promotion Manual.

Jonathan E. M (2009), Water and Sanitation Accessibility and the Health of Rural Ugandans

(A Thesis).

FI and WL (2001), the Right to Water and Sanitation - A Practical Guide.

USAID and HIP (2009), Guide for Training Outreach Workers.

Mercy Corps Water (2008-2009), Sanitation and Hygiene Guidelines.

Swiss Red Cross (2014), Water, Sanitation and Hygiene Guidelines.

Theodore M. H and Germaine A. H. (1998), Water Supply Handbook.

PAEPAR, DEA, MADAGASIKARA(2005), Manuel de Procédure Eau Hygiène Assainissement.

PPP, CDC (2018), CDC’s Public-Private Partnership Guidelines: A Tool to Support Engagement with the Private Sector to Achieve Public Health.