

5 WATER SUPPLY

SUMMARY:

- Water supply involves a chain from source to disposal: source > treatment > distribution > consumption > disposal.
- The two main sources are ground-water (underground aquifers) and surface water (rivers, lakes and man-made reservoirs) – but rain water represents an untapped potential.
- Treatment is used to remove contamination and make water potable (safe to drink) –all public water supply needs to be regularly tested.
- Selecting the most suitable source must consider the cost of source development and treatment – a distant non-contaminated source may be more cost-effective than a close source that is more contaminated and requires higher treatment costs.
- The piped network delivers water to:
 - Individual houses or institutions
 - Public standpipes
 - Commercially operated kiosks
- Piped systems are supplemented by tanker trucks, donkey carts etc and people collecting water for themselves.
- Planning must include disposal of waste water – areas around public standpipes must be drained to remove surface water and discourage the breeding of insects and worms.
- Variable levels of treatment need to be considered given:
 - high capital and recurrent cost of treatment
 - consumption accounts for less than 10% of domestic water usage
- *Quantity before quality*: an approach that prioritises delivery of primary-treated water for all before investing in expensive treatment, combined with public education on simple methods for making water safe to drink – this would have a beneficial effect on livelihoods of low-income households.
- All households who receive water supply are required to pay for water they consume.

Introduction

- 5.1 The provision of **reliable and safe water supply** is a basic requirement for all urban households. Water is an absolute necessity for life, and impacts on health, hygiene, nutrition, convenience and comfort.
- 5.2 It is one of the four main elements that need to be addressed to promote the environmental health agenda

↻ 4 - Environmental Health ↻ 6 - Sanitation ↻ 7 - Sanitation ↻ 8 - Drainage

- 5.3 The conventional water supply system comprises a chain from the source through to disposal:



- 5.4 This section considers each of these in turn, to explain the general principles that determine planning, design and implementation of water supply.
- 5.5 The detailed planning, design and implementation will be done by specialist water engineers through the Urban Water Corporation (*name?*). But UM staff need to understand the principles involved, so that they can ensure that the delivery of water supply matches broader UM objectives.

Source

- 5.6 Urban water supply usually comes from one of two sources:
- **Ground water** held in underground aquifers: this can be near the surface (reached by shallow hand-dug wells) or deep down, often more than 70 metres (reached by mechanically drilled boreholes, fitted with hand or motorised pumps). **sketch**
 - **Surface water**: extracted from rivers or lakes (natural or man-made reservoirs) and pumped into elevated storage tanks for gravity-fed piped distribution, or into tankers, carts etc for direct delivery to consumers.
- 5.7 Another much under-used source is **rain water**: this has considerable potential given the amount of rainfall in South Sudan:
- It is completely free;
 - It is uncontaminated and safe to drink (as long as storage is efficient).

Greater efforts should be made to save rainwater and recycle it for domestic and commercial use. This will need investment in bulk and individual household storage facilities, as well as public education programmes.

- 5.8 Water from the source either goes into **bulk supply**, serving a large number of consumers (typically through a piped network) or into **individual supply**, serving an individual property or single institution e.g. school.
- 5.9 Where underground conditions are suitable, a number of deep boreholes can be drilled in a cluster to contribute to the bulk supply - this is called a **well field**.
- 5.10 The total volume of water required for domestic consumption relates to population. A basic planning standard is to supply **40-50 litres per capita per day**.

Contamination

- 5.11 The purpose of treating water is to remove contamination in order to make it *potable* - safe to drink.
- 5.12 A deep aquifer source usually has low contamination - it may be perfectly safe to drink straight from the ground. But shallow aquifer and surface water sources are very likely to be contaminated:
- Open ground, streams and drains are commonly used for open defecation - so human waste and other contaminants are washed into rivers and lakes by rainfall.
 - Shallow wells are liable to contamination from seepage from poorly- constructed pit latrines constructed close together; and from contaminated surface water draining into the well during heavy rain.
- 5.13 Contamination is particularly acute in the rainy season, when water-borne diseases show a marked increase.
- 5.14 The type of treatment required will depend on the level of contamination - all sources must be tested regularly to establish the level of contamination.

Treatment

- 5.15 Bulk supply treatment is carried out in a treatment plant at source, before the water is distributed to consumers. This is an expensive process - both capital and recurrent costs.
- 5.16 Selection of the most suitable source must consider the amount of treatment required to make the water safe: a contaminated river or lake may be cheaper to develop than a distant uncontaminated bore hole - but the cost of treatment over many years may outweigh that initial cost advantage.
- 5.17 Treatment of individual supply (from shallow wells, or collection from a river/lake by individuals or a water seller) obviously cannot be carried out in this manner. Note *that the great majority of urban households currently receive untreated water.*
- 5.18 There are some low-technology methods that can be used for domestic water treatment - but these require special training for users. Perhaps more important is to give direct advice on hygiene and safe practices on water use to many households that receive untreated water.

Distribution diagram

- 5.19 Bulk supply is distributed through a piped network from the treatment plant to consumers. The conventional method is to pump the water to a high reservoir that uses gravity to distribute to consumers.
- 5.20 Intermediate storage reservoirs and pumps may be required at selected locations on the piped network to ensure a balanced pressure throughout the system.
- 5.21 The piped network delivers to different supply points:
- Individual supply to a household or institution
 - Public standpipes
 - Commercially operated kiosks (which can combined with washing facilities)
- 5.22 Given the limited extent of piped networks in all towns, bulk supply distribution is supplemented by a variety of methods: tanker trucks, donkey carts, pedal carts, and hand carriers.
- 5.23 These carry treated water from the treatment plant or untreated water direct from the source (borehole, lake, river) to local communal storage tanks or individual consumers.

- 5.24 Leakage through damaged pipes and reservoirs are a major problem:
- There is wastage of expensively produced water.
 - Contamination can 'flow back' into the piped water system through cracks and joints when the pressure drops, so contaminating the 'safe' water supply.
 - Escaping water can cause roads and footpaths to collapse.
- 5.25 This emphasises the importance of good quality initial construction work and of consistent O&M.

Disposal

- 5.26 The planning and design of water supply must include ensure the efficient disposal of used water - this is for convenience and to promote environmental health: poor disposal results in pools of standing water that encourage the breeding of insects and worms.
- 5.27 Areas around communal facilities (standpipes, kiosks) need particular attention: these should be surrounded with a hard standing area linked to effective drainage to remove surface water.
- 5.28 Individual plot holders must be encouraged to remove water from their plot efficiently into a proper drainage channel, rather than simply pushing water to the edge of the plot.

What type of treatment?

- 5.29 The environmental health objective is to deliver potable water to all; and this is particularly important for low-income families who experience the worst health conditions. However, there are two important considerations:
- **Capital and recurrent costs of treatment are high:** It requires construction of a special treatment plant with imported equipment, regular supplies of chemicals and spare parts, and a constant power supply.
 - **Drinking accounts for less than 10% of domestic water usage:** More than 90% of water is effectively thrown away - so it does not need to be potable.
- 5.30 Distribution of potable water to all households will therefore be unrealistic for some years to come - and so other approaches need to be considered.

The 'quantity before quality' approach

- 5.31 This approach advocates delivering primary-treated water in sufficient quantities to all urban households before investing in expensive treatment plants. Providing every household with a regular, plentiful supply would have significant beneficial impact, especially for low-income groups.
- 5.32 The main benefit will be simpler and cheaper water supply - low-income households pay significant additional costs for their water:
- **indirect cost** - for time and effort to collect themselves from a hand pump or river;
 - **direct cost** - for payment to a water seller. Those who buy from a water seller pay a much higher price per litre than those who enjoy a piped water connection - this can be 20-30 times higher.
- 5.33 Public health education programmes need to be carried in parallel, to teach the importance of safe water for health (especially with children) and to teach simple methods for making water safe for drinking (through boiling, simple filtration methods etc). Institutions with special requirements e.g. hospitals can be provided with on-site water treatment plants.

- 5.34 The suitability of this approach will depend on the level of contamination at source and the characteristics of water demand in the town.

Cost-recovery

- 5.35 An important principle is that people who receive public water supply are required to pay for what they consume:
- to ensure cost-effective operations of the supplier agency;
 - to encourage efficient careful use of water and discourage waste.
- 5.36 Many public standpipes currently provide free water, with no charge for water taken and no supervision of standpipes. This is unsustainable because there is no revenue to the supplier to pay for O&M; and it encourages waste (taps left running). So beneficiaries of public water supply must pay an appropriate charge.
- 5.37 The Urban Water Corporation is responsible for determining the tariffs to be paid by consumers. The tariff structure can be designed according to the type of supply (individual or communal) and to volume of consumption: in this way, higher volume consumers pay more than the commercial rate per cubic metre, which is used to subsidise low-income groups who tend to be low volume users.