

49. Choosing an appropriate technology

This technical brief is intended as a guide to selecting the most appropriate options, taking as its example the selection of water-treatment facilities. It should *not* be seen as a guide for the design of individual treatment processes.

The process contained in this brief can be applied to the selection of single treatment facilities, or as a guide to the development of a *strategy* for a whole area. The process can be used both by people with direct responsibility for making the decisions, and also by other parties to ensure that the right issues are addressed by the decision-makers.

The method described below can be applied to any decision-making process — for example, to identify the technologies for a development project, such as a water supply, sanitation, or refuse-collection scheme.

(see, for example, Schulz and Okun, 1984)

There are many different types of water-treatment process to choose from. Table 1 describes some of the more common. Many of the treatment processes used in the South, however, do not work properly.

1.		
Area	Description	Comments
	Advanced water treatment, including reverse osmosis, ultrafiltration, and ion exchange.	Highly effective but expensive and energy-intensive.
	Conventional water treatment, including coagulation, flocculation, sedimentation, and filtration.	Standard process, but may not remove all pathogens and chemicals.
	Water treatment using natural processes, such as slow sand filtration and constructed wetlands.	Low cost and low energy, but slower and less predictable.
	Water treatment using chemical disinfection, such as chlorination.	Effective against many pathogens, but can produce disinfection by-products.
	Water treatment using physical disinfection, such as ultraviolet light.	Effective against many pathogens, but requires electricity and regular maintenance.
	Water treatment using biological processes, such as activated sludge.	Effective for organic matter, but requires skilled operators and aeration.
	Water treatment using membrane technologies, such as microfiltration and ultrafiltration.	Effective for suspended solids and some microorganisms.
	Water treatment using adsorption, such as activated carbon.	Effective for organic matter and some chemicals, but expensive.
	Water treatment using ion exchange, such as softening.	Effective for hardness, but requires regeneration.
	Water treatment using reverse osmosis.	Effective for dissolved solids and many chemicals, but expensive and energy-intensive.
	Water treatment using ultrafiltration.	Effective for suspended solids and some microorganisms.
	Water treatment using slow sand filtration.	Low cost and low energy, but slower and less predictable.
	Water treatment using constructed wetlands.	Low cost and low energy, but slower and less predictable.

The problem is that many of the treatment processes are *inappropriate* for their use and/or their location. For example, many were developed in the cooler climates of the North, making direct transfer to tropical climates unsuitable. The spare parts, maintenance, and power consumption required by many treatment processes makes them unrealistic options for many parts of the world.

All locations are unique; what is required is not a common *solution* to a problem, but a methodology for the *analysis* of problems.

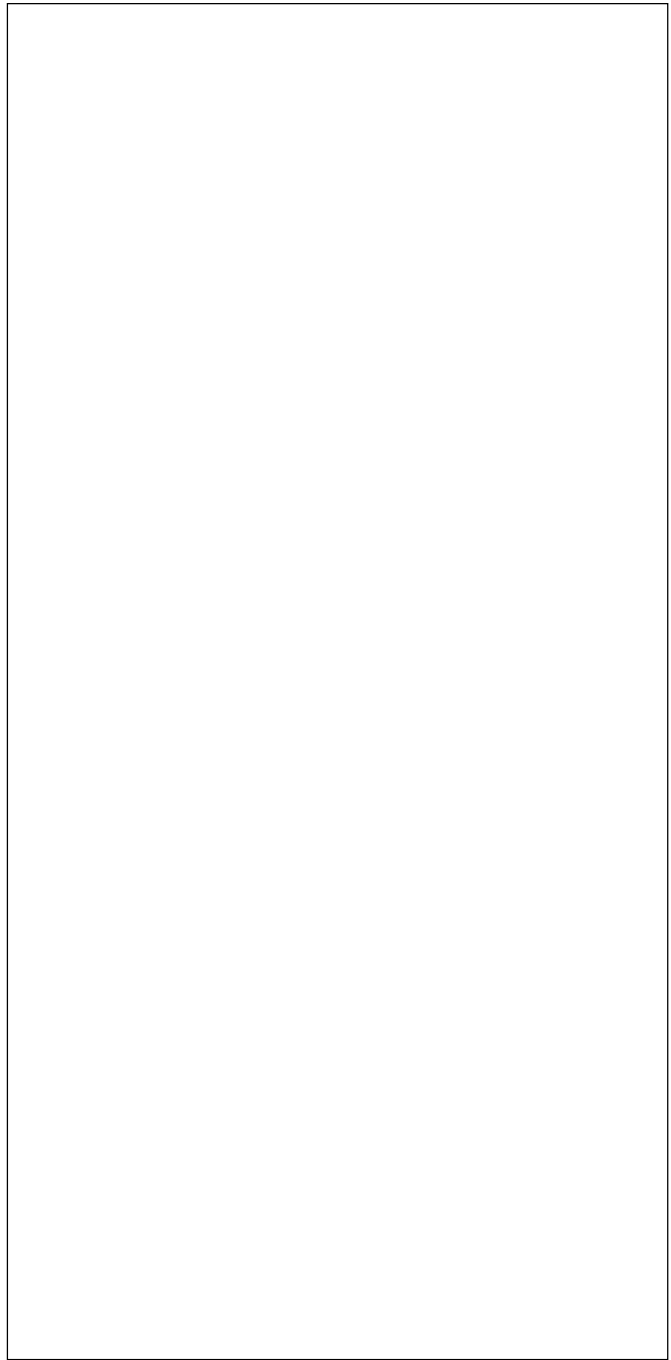
Figure 1 shows three stages for the selection procedure.

1:

The *purpose* of the treatment process must be established. What are you trying to achieve, and why? Is it achievable, is it a realistic goal, is it the main problem? There may be a need to *prioritize* the problems. This stage is often underestimated or taken for granted. For example, in the case of water treatment, the priority in developing countries often should be a low-cost, low-maintenance system.

2:

The *constraints* on the proposed development have to be identified and this can only be done by looking at the particularities of the individual case. Often, physical



- H u a ; p r bu
- Pub r a p r r ; a r a
- p r a u p u r a
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- A r r a a a p a
- E u a ; r u u w r r ; r a
- I u ab p r a a n a a

- H a a m r b a m r a r a
- S a a a - r a (a r) a r a
- H a r a a ab

- a n a a u
- A a ab p a p a a n a r a
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- S u u n , u p u b r u p a u r a a
- a r u u a n p
- M a r n p n
- F r - a a r (p r)
- A a p r r r w a r u p p
- S a n , u u p r p , b a a p a n ,
- a r a , a m a u r ab ,
- a r bu n
- A a ab p a

- F a a a ab ; m a u
- Ab a w a p a

- E r a r p b r r a a a
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- a a p b w r a a
- L a p a r u a

- C n a r a a r
- S a r , r u w a r a a r

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2:

Factor	Effect	Outcome
Sedimentation	Removes suspended solids and turbidity	Reduces turbidity and improves taste
Slow sand filtration	Removes turbidity and some pathogens	Improves taste and appearance
Chlorination	Kills pathogens and disinfects water	Prevents waterborne diseases
Boiling	Kills most pathogens	Improves taste and appearance
UV treatment	Kills pathogens	Disinfects water
Reverse osmosis	Removes all contaminants	Produces high quality drinking water
Distillation	Removes all contaminants	Produces high quality drinking water
Membrane filtration	Removes turbidity and pathogens	Improves taste and appearance
Activated carbon	Removes taste and odour	Improves taste and appearance
Ion exchange	Removes hardness	Improves taste and appearance
Ultrafiltration	Removes turbidity and pathogens	Improves taste and appearance
Nanofiltration	Removes turbidity and some pathogens	Improves taste and appearance
Reverse osmosis	Removes all contaminants	Produces high quality drinking water
Distillation	Removes all contaminants	Produces high quality drinking water

3:

Of the main treatment options listed in Table 1, the analysis has revealed that sedimentation and slow sand filtration are probably the most appropriate treatment options because of the operational and maintenance requirements. Chlorination could be considered if completely safe drinking-water were required, but the chemical requirement might mean that this option is not appropriate. Water from source 2 could be used for drinking-water supplies after treatment, leaving the water from source 1 for irrigation purposes. Otherwise, the very high turbidity in water source 1 would mean that a pre-treatment stage such as roughing filtration may have to be employed. Water-quality targets should be to remove turbidity and pathogens to acceptable levels, and to perform the routine operational tasks for the slow sand filter when required. (For further details about the operational requirements of slow sand filters, refer to *The Worth of Water*.)

So, when selecting any technology, consider the following:

- **Cost**: What is required? Why? Is it realistic?
- **Feasibility**: Can it be achieved? What are the limitations?
- **Appropriateness**: What technologies and controls are appropriate given the problem and the constraints?

Pickford, J. (ed.), *The Worth of Water*, IT Publications, London, 1991.
 Shulz, C.R. and Okun, D.A., *Surface Water Treatment for Communities in Developing Countries*, John Wiley & Sons/IT Publications, London, 1984.
 WELL, *Guidance Manual on Water Supply and Sanitation Programmes*, WEDC for DFID, Loughborough, 1998.

