Water Sources

Martin Wafler, seecon international gmbh
Copyright & Disclaimer

Copy it, adapt it, use it - but acknowledge the source!

Copyright

Included in the SSWM Toolbox are materials from various organisations and sources. Those materials are open source. Following the open-source concept for capacity building and non-profit use, copying and adapting is allowed provided proper acknowledgement of the source is made (see below). The publication of these materials in the SSWM Toolbox does not alter any existing copyrights. Material published in the SSWM Toolbox for the first time follows the same open-source concept, with all rights remaining with the original authors or producing organisations.

To view an official copy of the the Creative Commons Attribution Works 3.0 Unported License we build upon, visit http://creativecommons.org/licenses/by/3.0. This agreement officially states that:

You are free to:

- Share - to copy, distribute and transmit this document
- Remix - to adapt this document. We would appreciate receiving a copy of any changes that you have made to improve this document.

Under the following conditions:

- Attribution: You must always give the original authors or publishing agencies credit for the document or picture you are using.

Disclaimer

The contents of the SSWM Toolbox reflect the opinions of the respective authors and not necessarily the official opinion of the funding or supporting partner organisations.

Depending on the initial situations and respective local circumstances, there is no guarantee that single measures described in the toolbox will make the local water and sanitation system more sustainable. The main aim of the SSWM Toolbox is to be a reference tool to provide ideas for improving the local water and sanitation situation in a sustainable manner. Results depend largely on the respective situation and the implementation and combination of the measures described. An in-depth analysis of respective advantages and disadvantages and the suitability of the measure is necessary in every single case. We do not assume any responsibility for and make no warranty with respect to the results that may be obtained from the use of the information provided.
Contents

1. Rainwater harvesting
2. Spring water tapping
3. Surface water intake
4. Groundwater withdrawal
5. Applicability
6. Advantages and disadvantages
7. References
Rainwater Harvesting
1. Rainwater harvesting

Concept

Rainwater harvesting means capturing the rain where it falls or capturing the runoff and taking measures to store that water and keep it clean.

Rainwater harvesting can be undertaken through a variety of ways:

- capturing run-off from roof tops
- capturing run-off from local catchments
- capturing seasonal floodwater from local streams
- conserving water through watershed management
1. Rainwater harvesting

Functions of rainwater harvesting

Harvesting rainwater has several functions:

• providing water to people and livestock
• providing water for food and cash crops
• increasing groundwater recharge
• reducing storm water discharges, urban floods and overloading of sewage treatment plants
• reducing seawater ingress in coastal areas

Source: unknown
1. Rainwater harvesting

**System components** (adapted from MBUGUA unknown; http://www.irc.nl/redir/content/download/128508/350879/file/TP40_7%20Rain%20water%20harvesting.pdf [Accessed 1.6.2010])

Domestic rainwater harvesting system consist of:

- a collection surface,
- a storage tank, and
- guttering or channels to transport the water from one to the other.

Peripheral equipment sometimes incorporated:

- a first-flush system,
- a filtration equipment, and
- settling chambers

![Conceptual sketch of rooftop rainwater harvesting system](Source: http://www.eng.warwick.ac.uk/DTU/rainwaterharvesting/index.html)
1. Rainwater harvesting

Example

Rooftop rainwater harvesting at school in Misore, India

Source: M. Wafler

Water Sources
Spring Water Tapping
2. Spring water tapping

Concept (adapted from TAYONG 2002; http://www.irc.nl/redir/content/download/128509/350882/file/TP40_8%20Spring%20water%20tapping.pdf [Accessed 1.6.2010])

Spring water is usually fed from a sand or gravel water-bearing soil formation called an aquifer, or a water flow through fissured rock. Where solid or clay layers block the underground flow of water, it is forced upwards to the surface.

Distinct types of springs:
- gravity springs (water surfaces as a result of discontinuities in the strata that held the water underground),
- artesian springs (water surfaces under pressure)
2. Spring water tapping

Gravity springs (adapted from TAYONG 2002; http://www.irc.nl/redir/content/download/128509/350882/file/TP40_8%20Spring%20water%20tapping.pdf [Accessed 1.6.2010])

- occur in unconfined aquifers
- 2 main types:
  - gravity depression springs: ground surface dips below water table,
  - gravity overflow springs: outcrop of impervious soil, such as a solid or clay fault zone, forces water to surface

Schematic sketch of gravity depression (top) and overflow spring (bottom)
2. Spring water tapping

Artesian springs  (adapted from TAYONG 2002; http://www.irc.nl/redir/content/download/128509/350882/file/TP40_8%20Spring%20water%20tapping.pdf [Accessed 1.6.2010])

- water prevented from rising to its free water table level by presence of overlaying impervious layer

- 3 main types:
  - artesian depression spring: similar in appearance to gravity depression springs; higher discharge, less fluctuation (water is under pressure)
  - artesian fissure spring: water emerges under pressure through a fissure in impervious overburden
  - artesian overflow spring: often have large recharge area, sometimes great distance away

Schematic sketch of artesian depression (top), fissure (middle) and overflow spring (bottom)

Surface Water Intake
3. Surface water intake

Concept  (adapted from MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010])

natural streams, rivers or reservoirs close by are frequently most convenient source of water for small communities

River water intake  (adapted from MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010])

- Main types:
  - unprotected river intake: where river transports no boulders or rolling stones
  - protected river intake: where protection of intake is necessary
3. Surface water intake

River water intake (adapted from MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010])

- Main types (contd.):
  - pumped river (or lake) water intake: if variation between high and low water level in river (or lake) is small suction pump can be placed on banks
  - bank river intake using infiltration drains: water is collected with infiltration drains laid under riverbed and flows under gravity into sump

Schematic sketch of pumped (top) and bank river intake using infiltration drains (bottom)
3. Surface water intake

Lake water intake (adapted from MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010])

- for water supply purposes, water from deeper strata will have advantage of a practically constant temperature

- provision should be made to withdraw the water at some depth below the surface

Schematic sketch of variable depth lake water intake (top) and simple intake (bottom)

Ground Water Withdrawal
4. Ground water withdrawal

**Concept**  (adapted from OKUNI 2002; http://www.irc.nl/redir/content/download/128511/350888/file/TP40_10%20Groundwater%20Withdrawal.pdf [Accessed 1.6.2010])

- groundwater occurs in pores, voids or fissures of ground formations
- almost always preferred source for community water supply systems
- withdrawal often be continued long after drought (less subject to seasonal fluctuation)
- Main types of wells:
  - *dug wells*
  - *driven wells*
  - *drilled wells*
4. Ground water withdrawal

**Dug wells** (adapted from EPA 2006; URL: http://epa.gov/OGWDW/privatewells/basic_dug.html [Accessed 1.6.2010])

- holes in the ground dug by shovel or backhoe

- then lined (cased) with stones, brick, tile, or other material to prevent collapse

- covered with a cap of wood, stone, or concrete

- not very deep (typically, 10 to 30 feet deep) since difficult to dig beneath ground water table

- highest risk of becoming contaminated

4. Ground water withdrawal

**Driven wells** *(adapted from EPA 2006; URL: http://epa.gov/OGWDW/privatewells/basic_driven.html [Accessed 1.6.2010])*

- pull water from the water-saturated zone above the bedrock (like dug wells)
- deeper than dug wells (typically 30 to 50 feet deep)
- usually located in areas with thick sand and gravel deposits where ground water table is within 15 feet of ground’s surface
- In proper geologic setting, driven wells can be easy and relatively inexpensive to install
- moderate-to-high risk of contamination (as still relatively shallow)
4. Ground water withdrawal

**Drilled wells** (adapted from EPA 2006; URL: http://epa.gov/OGWDW/privatewells/basic_drilled.html [Accessed 1.6.2010])

- penetrate about 100-400 feet into the bedrock
- must intersect bedrock fractures containing ground water

*Schematic sketch of drilled well with submersible pump*

5. Applicability

Rainwater harvesting
Means of providing water for domestic purposes. Especially where groundwater resources are unavailable or costly to develop.

Spring water tapping
Mainly in hilly or mountainous areas.

Surface water intake
Most convenient source of water if natural stream, river or reservoir with sufficiently good water is close by.

Groundwater withdrawal
Often the preferred source of water supply for domestic purposes
6. Advantages and disadvantages

**Rainwater harvesting**

**Advantages:**
- source of water where groundwater resources are unavailable or costly

**Disadvantages:**
- unreliable

**Spring water tapping**

**Advantages:**
- can easily be tapped
- water usually has a high natural quality
- intake arrangements are relatively straightforward

**Disadvantages:**
- in periods of drought springs may cease to flow completely
6. Advantages and disadvantages

**Surface water intake**

**Advantages:**

- convenient source of water for small communities

**Disadvantages:**

- seasonal fluctuation in flow (especially in tropical countries) may affect quality of water
- surface water almost always requires extensive treatment to render it fit for drinking and domestic purposes

**Groundwater withdrawal**

**Advantages:**

- in general, safe water source

**Disadvantages:**

- high costs for water production
7. References


SSWM is an initiative supported by:

Compiled by: