UN environment

GPA Global Programme of Action for the Protection of the Marine Environment from Land-based Activities

Assessing appropriate wastewater treatment options
Technology Matrix for Wastewater

LBSA Workshop for the Nairobi Convention GEF-WIOSAP Project

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Background

Some quick facts…

- **2.5 billion** people live **without good sanitation**
- **80%** of users of improved sanitation **live in rural areas**
- In Sub-Saharan Africa, treating **diarrhoea consumes 12% of the health budget**
- Conventional system are neither an ecological nor an economical solution for sanitation problems
- To supply rural areas with adequate sanitation facilities, **sustainable solutions modelled on decentralised systems** are required.

Some quick facts…

- **Rate of return** for sanitation investments estimated to be **more than US$5 for every US$1spent** (WHO 2012, World Bank 2013)
- Evidence shows that the benefits include improvements in:
  - Public health
  - The natural environment
  - Education
  - Economic development
  - Social outcomes
  - Gender equality
  - Poverty alleviation

Wastewater challenges

The main root causes include:

- Poor sewage systems
- Runoff from small scale mining operations
- Urban storm water
- Run off from agricultural activities
- Lack of knowledge on selection of appropriate technology
- Inadequate legal and regulatory framework
- Uncoordinated approach to coastal management
- Variation in institutional arrangements
- Low Stakeholder Involvement in wastewater management

Some of the solutions

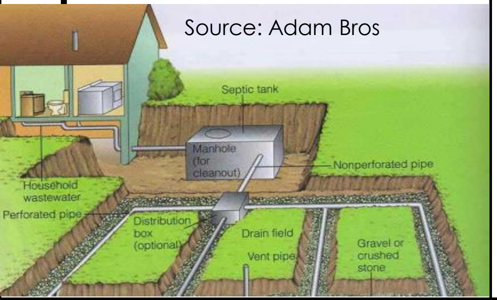
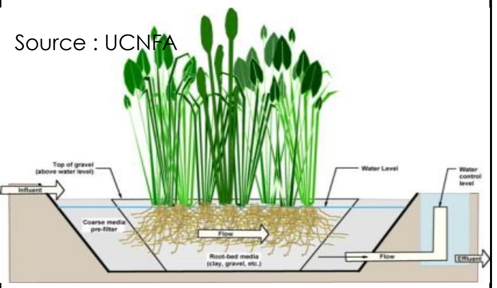
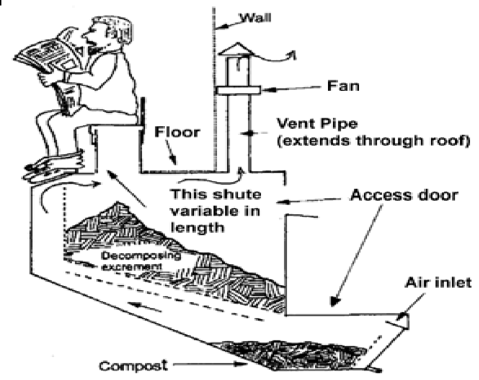
- Adopting pertinent and **flexible policy** and **institutional frameworks** for close interaction between various players
- **Updating data** on wastewater management strategies
- **Strengthening** regional and global **networks** (e.g. on marine environment conservation)
- Creation of **platforms** through which appropriate blending of **knowledge systems** and requirements can occur
- Furthering **capacity building**, **knowledge** and **awareness creation** on matters relating to marine environment degradation as well as its conservation
- Technological developments & innovation (Example - Technology Matrix for Wastewater)

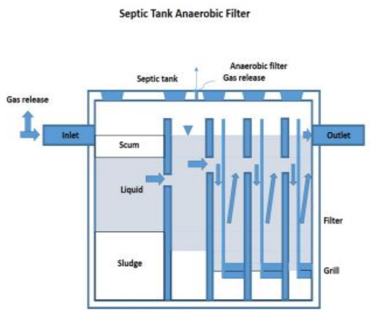
Wastewater treatment technologies

Decentralised Technologies on Wastewater Management

- Septic Tanks
- Constructed Wetlands
- Stabilisation Ponds
- Composting Toilets
- Biodigestor
- Anaerobic Filter
- Duckweed Lagoons

Source : Cameron Webb

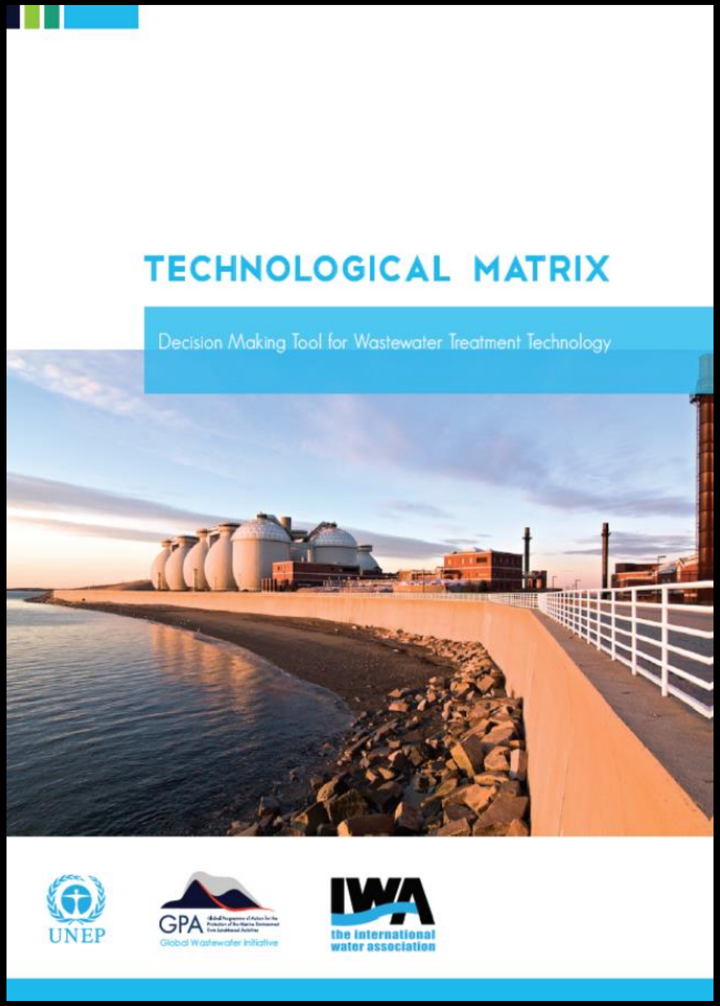
Type	Kind of treatment	Kind of wastewater treated	Advantages	Disadvantages	Nutrients removal
Septic Tank  	sedimentation, flotation and digestion	Domestic wastewater (communities until 100 inhabitants)	Simple, durable, easy maintenance, small area required	Low treatment efficiency, necessity of a secondary treatment, effluent not odorless	COD, BOD, TSS; grease.
Subsurface Flow Constructed Wetlands  	biological and physical processes	Domestic and agricultural wastewaters; small communities; tertiary treatment for industries.	Low or no energy requirements; Provide aesthetic, commercial and habitat value.	system clogging; recommended as a secondary treatment, large areas required;	TSS; COD; TN; TP.
Composting Toilets  	unsaturated and aerobic conditions provide biological and physical decomposition	human excreta, toilet paper, carbon additive, food waste	Resulting "humus" used as a resource; conservation of water resources; recycling of nutrients.	If not well sized and maintained can be a environmental problem and a threat for human being, due to its contaminant potential	Volume reduced from 10 to 30%; pathogens.

Type	Kind of treatment	Kind of wastewater treated	Advantages	Disadvantages	Nutrients removal
Biogas Digester 	Sedimentation, flotation and digestion	human excreta, animal and agricultural wastes	Recycling of resource; gas produced is used for cooking and lighting	Expensive to build, difficult to operate. Poor maintenance leads to loss of gas production and blockage of the digester tank with solids.	long period of storage removes pathogens.
Anaerobic Filter 	anaerobic degradation of suspended and dissolved solids	pre-settled domestic and Industrial wastewater of Narrow COD/BOD ratio	simple and fairly durable if well constructed and wastewater has been properly pre-treated, high treatment efficiency, little permanent space required	costly in construction because of special filter material, blockage of filter possible, effluent smells slightly despite high treatment efficiency	BOD, TDS, TSS
Duckweed Based Wastewater Stabilizations Ponds 	sedimentation, anaerobic degradation and sludge stabilization	Domestic and agricultural wastewater;	No clogging risk; High nutrient removal rates	Necessity of large areas; necessity of constant harvesting; unsuitable in very windy regions.	BOD, SS, TN, TP, metals

Technological Matrix for Wastewater

Technological Matrix for Wastewater

- Decision making tool selecting appropriate wastewater systems in urban areas.
- **Developed for non-technical people**; no or little knowledge on wastewater or sanitation
- Assist in decision making to **FIRST consider the entire spectrum** of wastewater solutions based on suitability criteria



Technological Matrix for Wastewater

- Based on Compendium of Sanitation Systems and Technologies (Tilley et al., 2014) by Eawag, IWA and WSSCC (Water Supply and Sanitation Collaborative Council).
- Allows the user to provide both local conditions and priorities to serve as basis for **ranking the different relevant technology systems**
- An efficient and user-friendly **'filtering process'**
  - Multi-criteria analysis that takes environmental, social and economic aspects into account

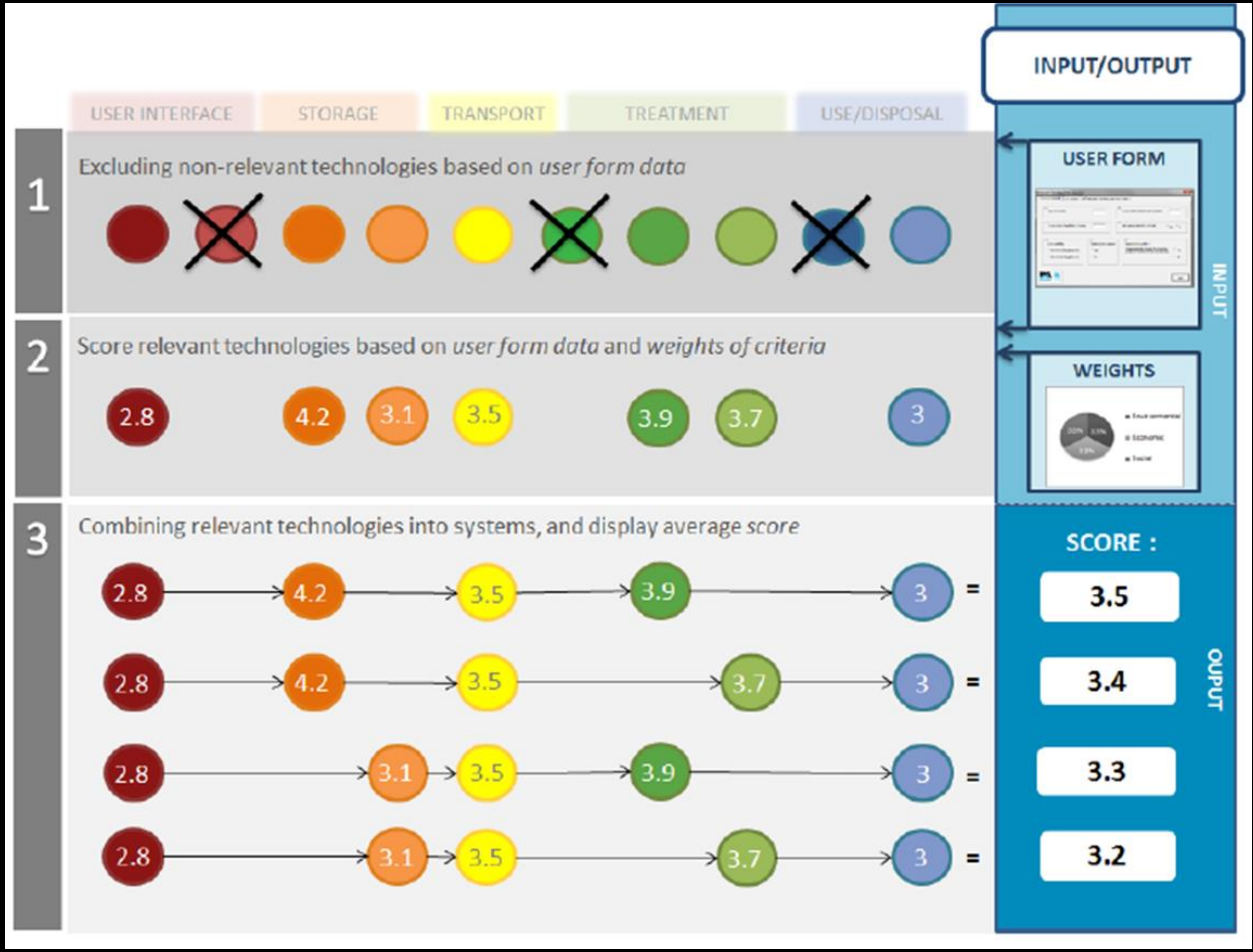
Why this tool?

- **Contains factsheets** for each of the technologies mentioned
- **Narrows down the options** hence allows efficient decision making
- **Performs multi-criteria analysis (MCA)** on different sanitation technologies

(MCA- Methods to compare all alternative options and to identify the best performing one on the basis of multiple factors)

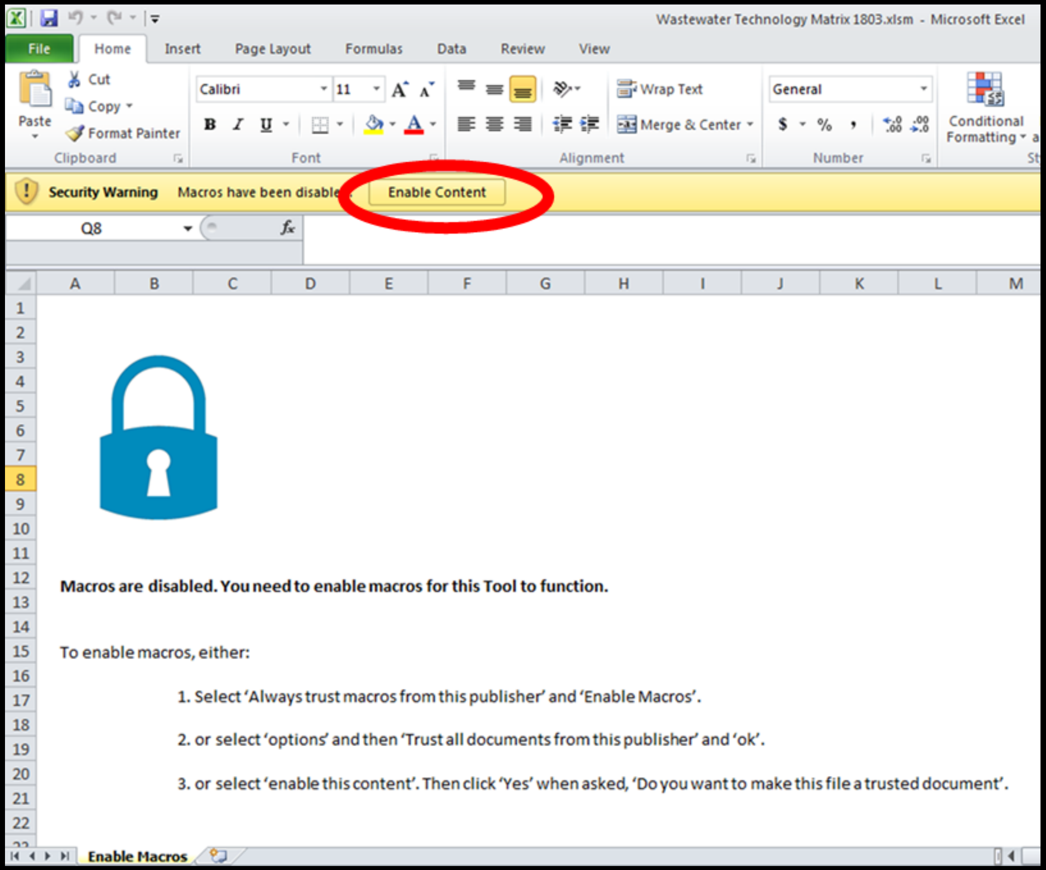
Overview of processes…how does it work?

- Input from the user form is used in **Step 1 to exclude certain technologies**, and in **Step 2 to rate them**
- The score of each technology is furthermore based on the weights, which are also provided as input by the user
- **Step 3: combines technologies into systems** and displays their **average score** as output on the results page

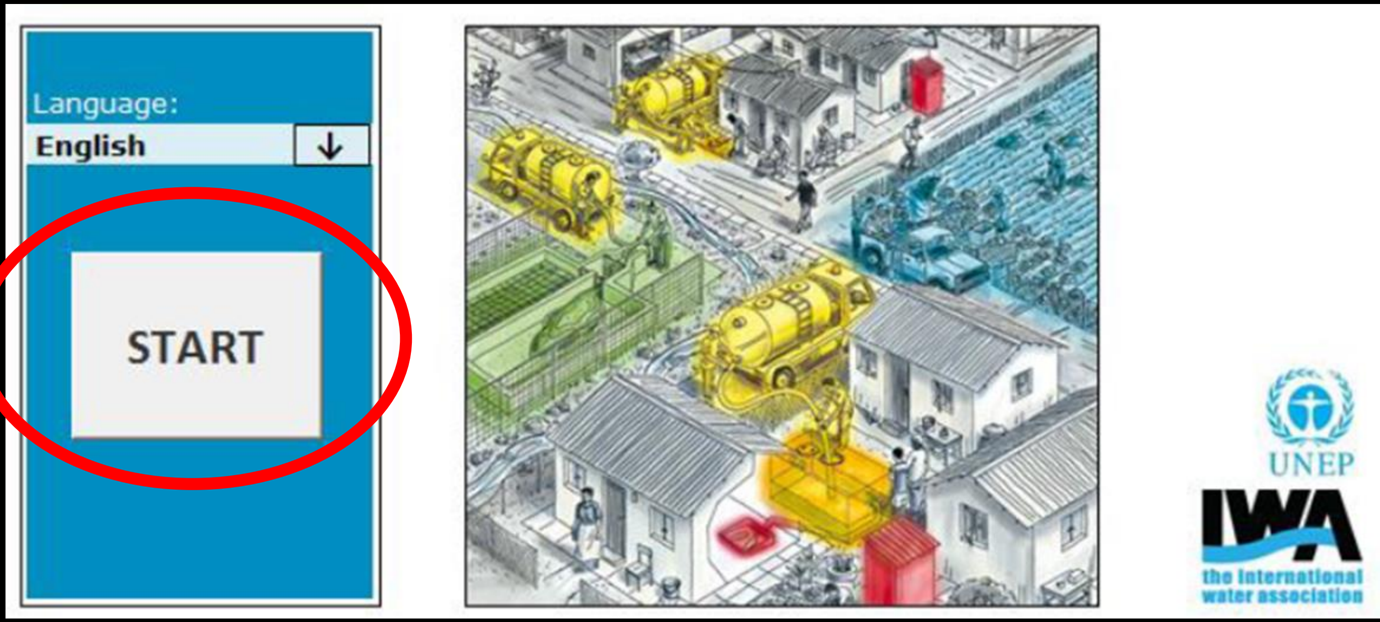


Getting started

- Microsoft® Excel-based Tool
- Open ZIP file: Wastewater Technology Matrix
- Open Excel file - enable macros; enable content
- Click START…you're on your way!



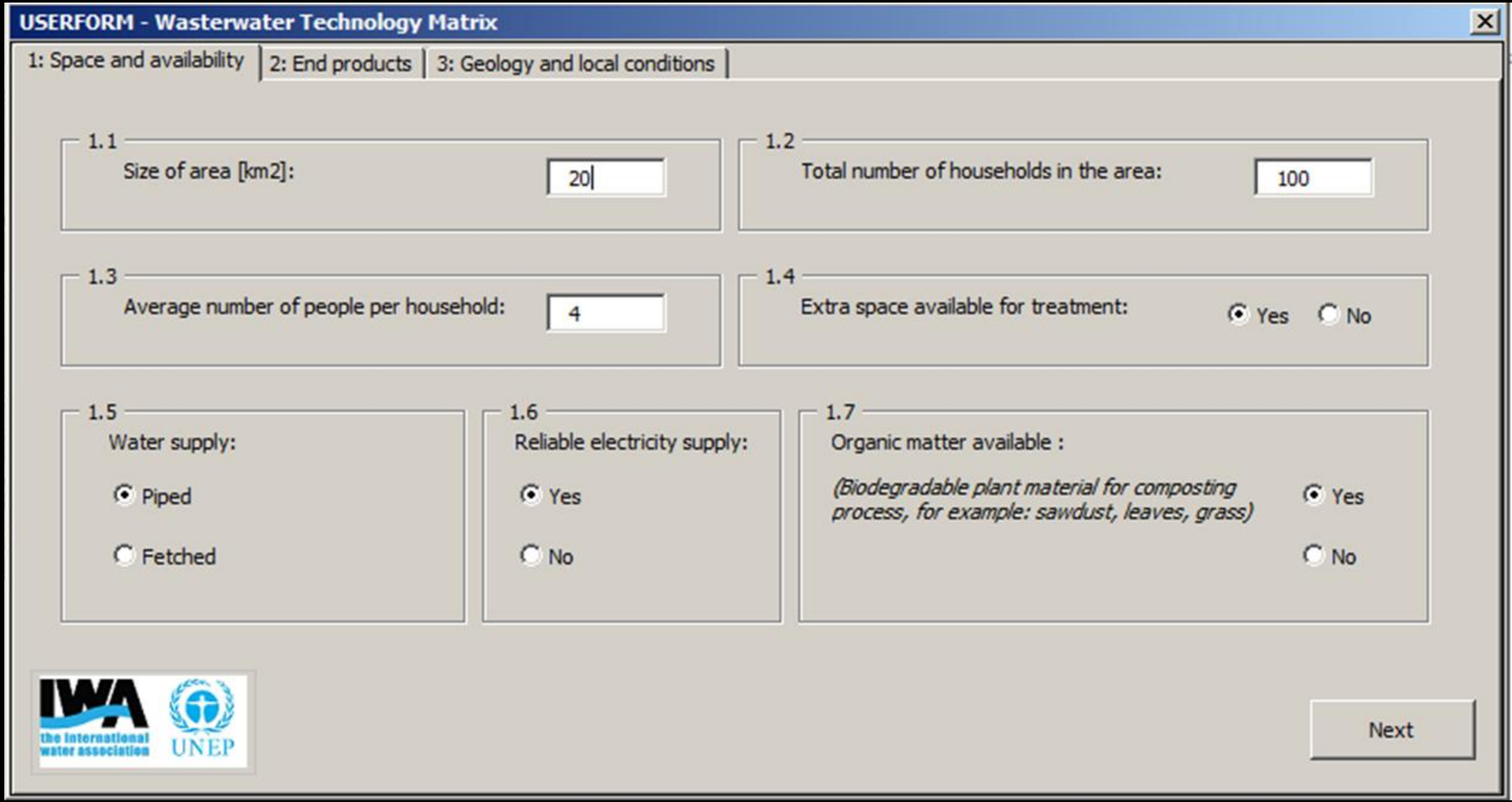
Opening screen



IMPORTANT! Try to answer as many questions as accurately as possible

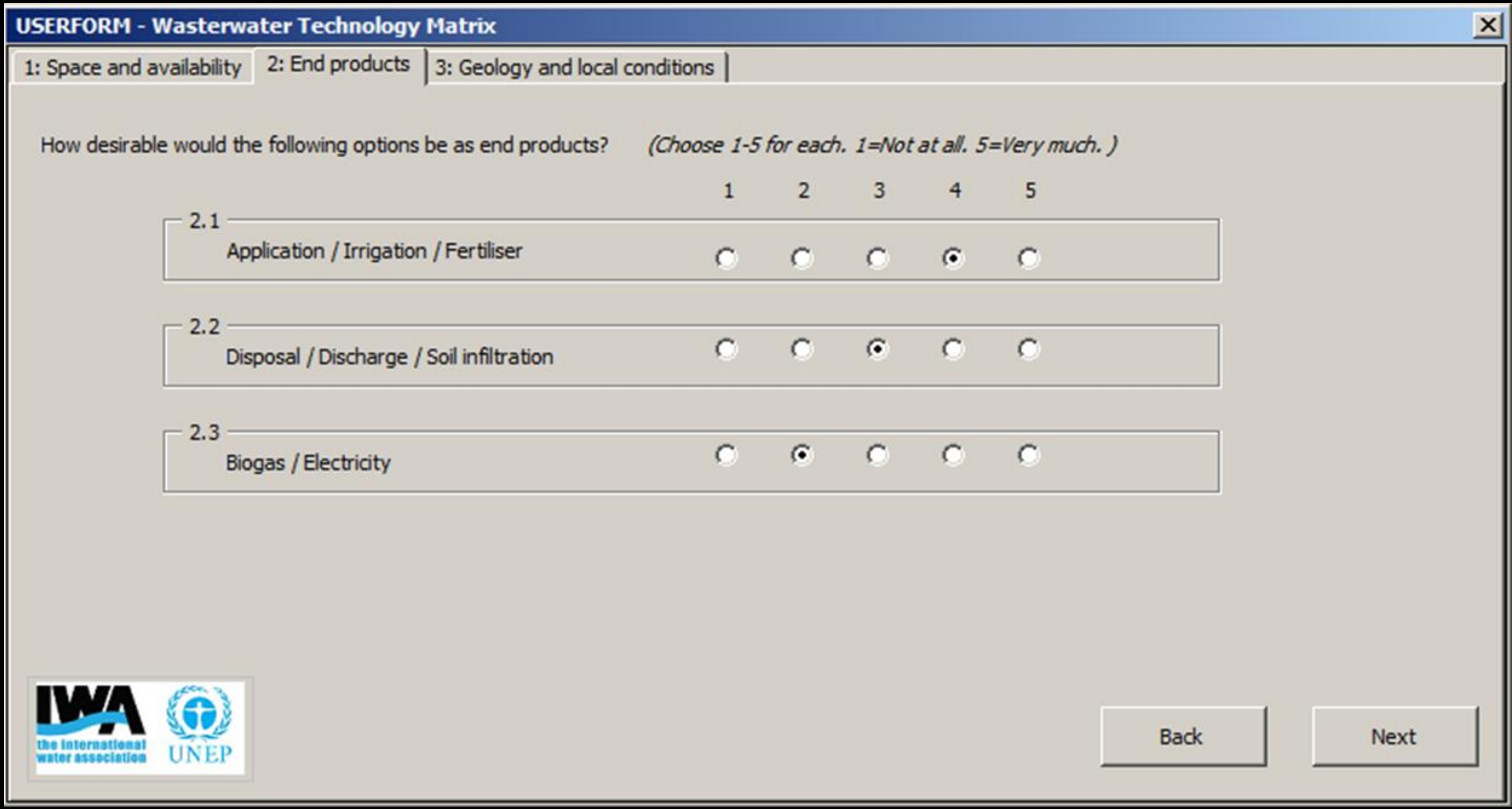
1. Space and availability

- Enter basic attributes about location, number households, space availability for treatment, water supply, etc
- Click 'Next'



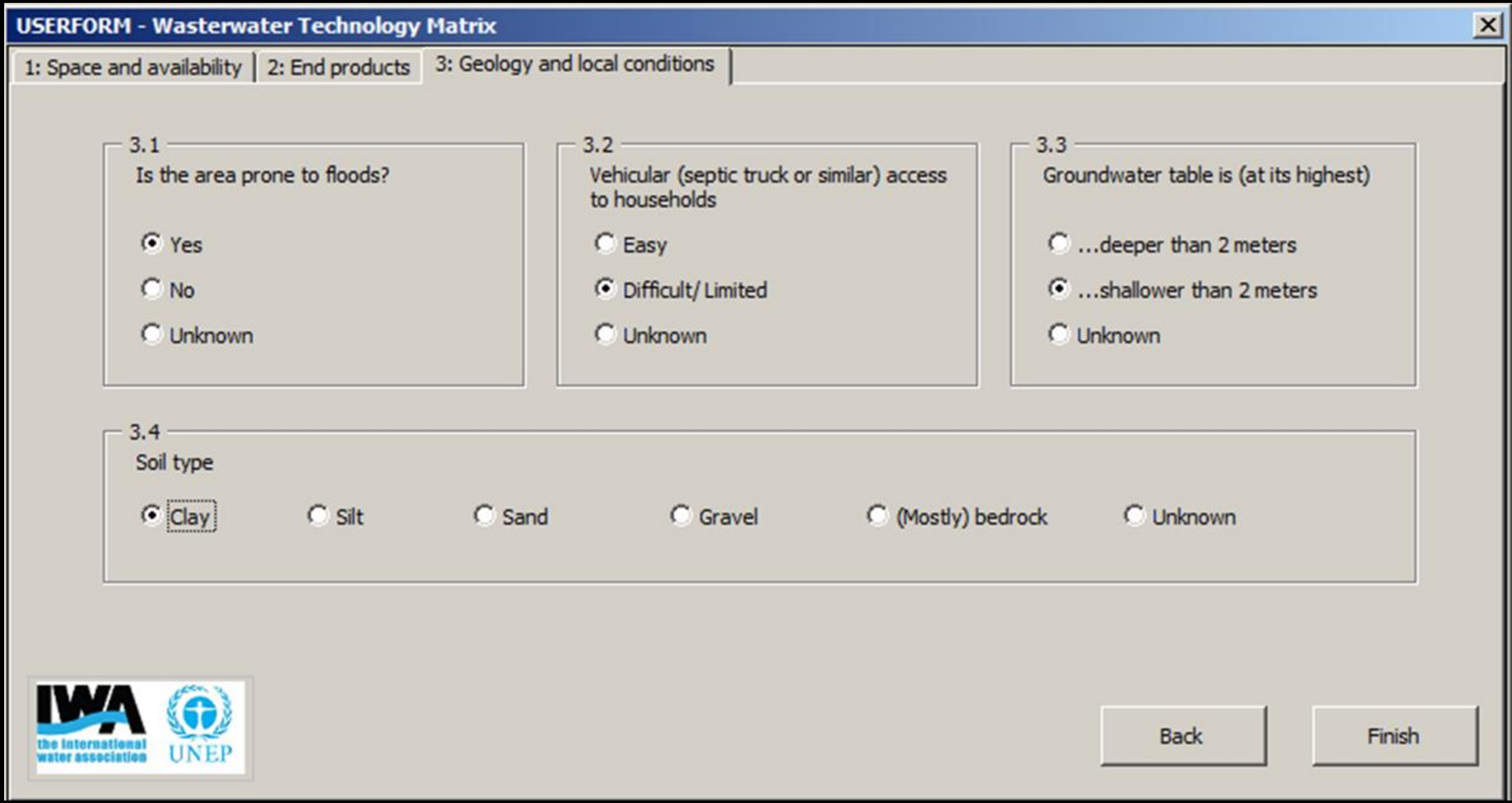
2. Desirability of end products

- Indicate by relative desirability what might the end products of treatment be useful for
- Click 'Next'



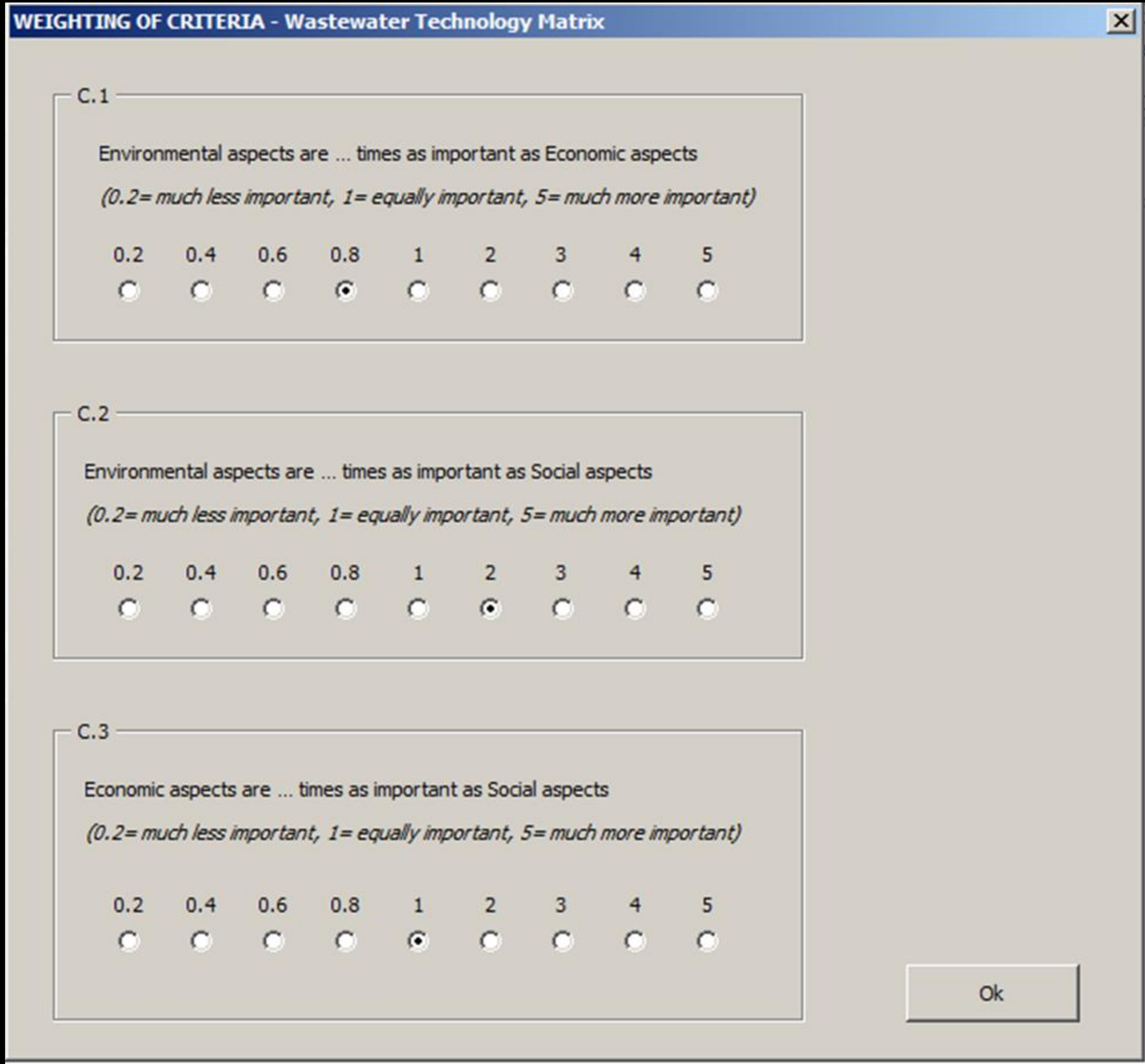
3. Geology and local conditions

- Specify the local conditions, vehicular accessibility and underlying geological/soil attributes
- Click 'Finish'



Weighting of criteria

- Each of the three criteria (Environmental, Economic and Social) is multiplied with a weight in the MCA
- These **weights can be adjusted** by answering the three questions in this user form
- **NOTE:** these answers will be important for the accuracy of results; **take care that the correct weighting is applied**
- Click 'Ok' to get the result



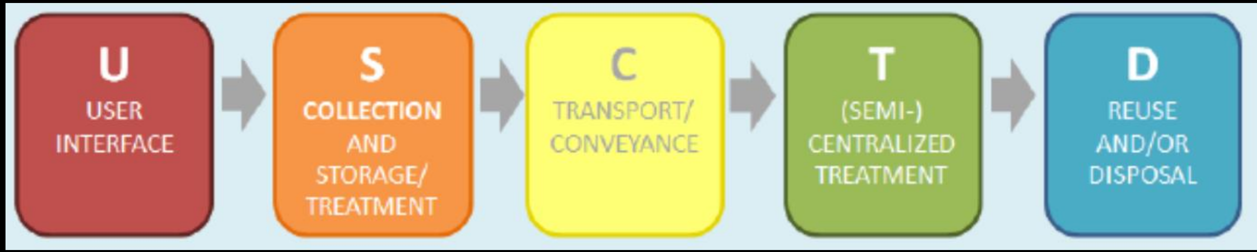
Results

- Data is sorted in **descending order of score**, according to the MCA Matrix calculations
- **Main score** and **partial score**
  - Partial score: unweighted score for each of the criteria
- **Suitable options** in green
- **Unsuited (excluded) options** in red; assigned score of ‘0’

	USER INTERFACE	STORAGE	TRANSPORT	TREATMENT	REUSE/DISPOSAL	SCORE	Environ.	Econmic	Social
1	U.4 Pour Flush	S.9 Septic Tank	C.2 Human p. E&T	T.14 Unpl. Dry.	D.X2 Disposal D.X1 Application	3.7	2.0	4.0	3.3
2	U.4 Pour Flush		C.4 Simp. Sewer	T.3 ABR T.14 Unpl. Dry.	D.X1 Application D.X1 Application	3.6	2.3	3.6	3.5
3	U.5 Cistern Flush		C.4 Simp. Sewer	T.3 ABR T.14 Unpl. Dry.	D.X1 Application D.X1 Application	3.6	2.3	3.4	3.6
4	U.5 Cistern Flush		C.4 Simp. Sewer	T.2 Imhoff tank T.14 Unpl. Dry.	D.X1 Application D.X1 Application	3.5	1.9	3.4	3.6
5	U.4 Pour Flush	S.9 Septic Tank	C.2 Human p. E&T	T.14 Unpl. Dry.	D.X2 Disposal D.X2 Disposal	3.5	2.0	4.0	3.3
6	U.4 Pour Flush		C.4 Simp. Sewer	T.3 ABR T.14 Unpl. Dry.	D.X2 Disposal D.X2 Disposal	3.3	2.3	3.6	3.5
7	U.4 Pour Flush	S.12 Biogas Rc.			D.13 Biogas D.X1 Application	3.3	3.9	3.5	3.5
8	U.5 Cistern Flush		C.4 Simp. Sewer	T.3 ABR T.14 Unpl. Dry.	D.X2 Disposal D.X2 Disposal	3.3	2.3	3.4	3.6
9	U.5 Cistern Flush		C.4 Simp. Sewer	T.2 Imhoff tank T.14 Unpl. Dry.	D.X2 Disposal D.X2 Disposal	3.2	1.9	3.4	3.6
10	U.4 Pour Flush	S.12 Biogas Rc.			D.13 Biogas D.X2 Disposal	3.0	3.9	3.5	3.5
11	U.4 Pour Flush	S.9 Septic Tank	C.4 Simp. Sewer C.3 Motorized E&T	T.3 ABR T.14 Unpl. Dry.	D.X2 Disposal D.X2 Disposal	0.0	0.0	0.0	0.0
12	U.4 Pour Flush	S.9 Septic Tank	C.4 Simp. Sewer C.3 Motorized E&T	T.3 ABR T.14 Unpl. Dry.	D.X1 Application D.X1 Application	0.0	0.0	0.0	0.0
13	U.1 Dry toilet	S.4 Double VIP	C.2 Human p. E&T		D.X1 Application	0.0	0.0	0.0	0.0
14	U.1 Dry toilet	S.4 Double VIP	C.2 Human p. E&T		D.X2 Disposal	0.0	0.0	0.0	0.0
15	U.4 Pour Flush	S.9 Septic Tank	C.4 Simp. Sewer C.3 Motorized E&T	T.2 Imhoff tank T.14 Unpl. Dry.	D.X2 Disposal D.X2 Disposal	0.0	0.0	0.0	0.0
16	U.4 Pour Flush	S.9 Septic Tank	C.4 Simp. Sewer C.3 Motorized E&T	T.2 Imhoff tank T.14 Unpl. Dry.	D.X1 Application D.X1 Application	0.0	0.0	0.0	0.0
17	U.4 Pour Flush	S.9 Septic Tank	C.3 Motorized E&T	T.14 Unpl. Dry.	D.X2 Disposal D.X2 Disposal	0.0	0.0	0.0	0.0
18	U.4 Pour Flush	S.9 Septic Tank	C.3 Motorized E&T	T.14 Unpl. Dry.	D.X2 Disposal D.X1 Application	0.0	0.0	0.0	0.0

Results

- **Row** = 1 sanitation system/sanitation chain of combination of technologies
- **Column** = 5 technology steps or
- functional groups



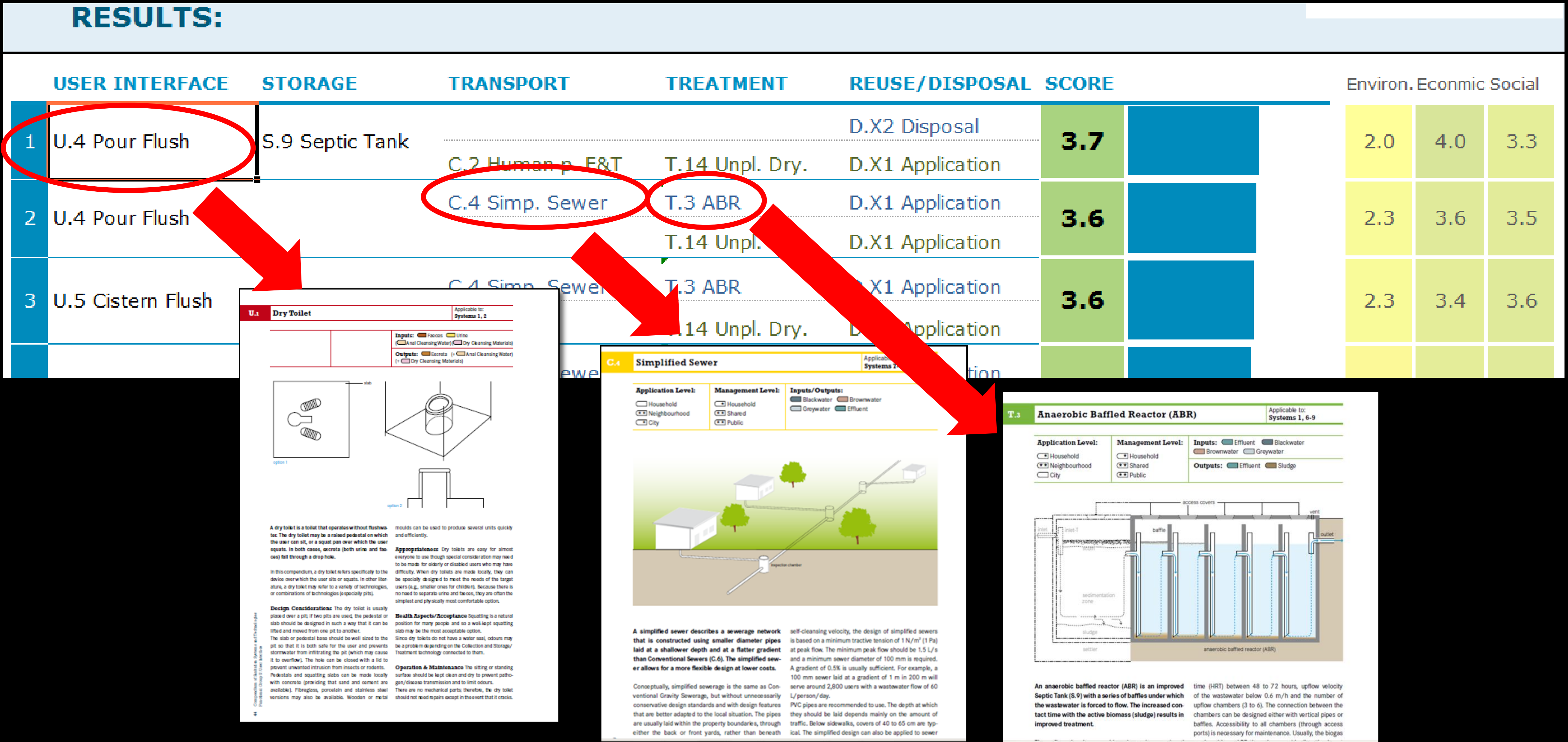
RESULTS:

	USER INTERFACE	STORAGE	TRANSPORT	TREATMENT	REUSE/DISPOSAL	SCORE	Environ.	Econmic	Social
1	U.4 Pour Flush	S.9 Septic Tank			D.X2 Disposal	3.7	2.0	4.0	3.3
			C.2 Human p. E&T	T.14 Unpl. Dry.	D.X1 Application				
2	U.4 Pour Flush		C.4 Simp. Sewer	T.3 ABR	D.X1 Application	3.6	2.3	3.6	3.5
				T.14 Unpl. Dry.	D.X1 Application				
3	U.5 Cistern Flush		C.4 Simp. Sewer	T.3 ABR	D.X1 Application	3.6	2.3	3.4	3.6
				T.14 Unpl. Dry.	D.X1 Application				
			C.4 Simp. Sewer	T.2 Imhoff tank	D.X1 Application				

Water phase *Sludge phase*

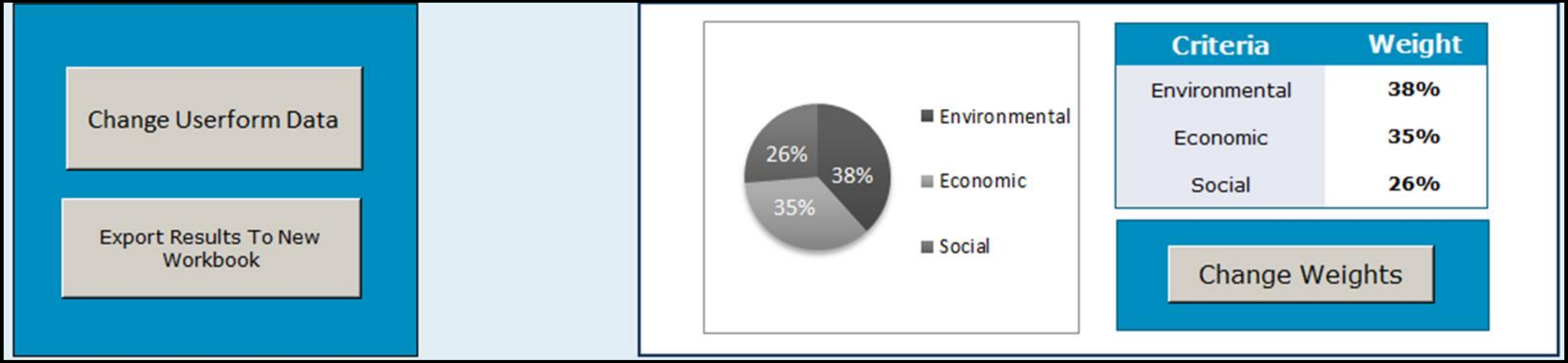
Information links to technology options

Click to access additional documentation



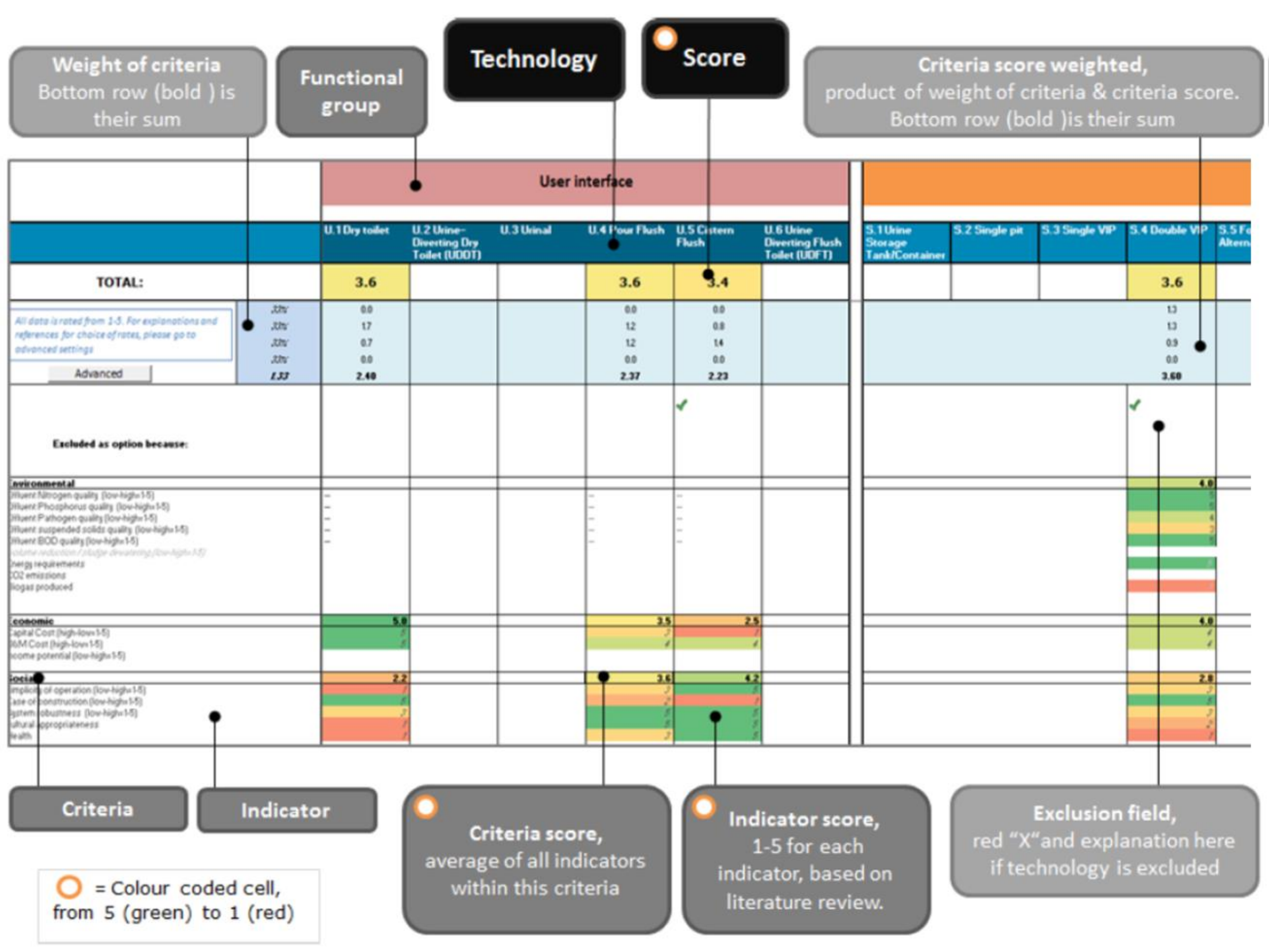
Re-evaluation

- Note the weighting calculated
- Have the option to re-evaluate the criteria weightings



Detail of the MCA

- For each criterion there are numerous indicators
- Each indicator is rated 1-5 based on a literature review and expert's consultation - cannot be changed by the user
- If the pre-screening eliminates a technology a red 'X' and a text explanation will be displayed in the 'Exclusion Field'
- The colour of each cell indicates its value from high to low (green to red).



Contribution to…

SUSTAINABLE DEVELOPMENT GOALS

Core SDG targets

- Target 6.2 - access to adequate and equitable sanitation and hygiene
- Target 6.3 – good ambient water quality
- Target 6B - participation of local communities in improving water and sanitation management
- Target 14.1 – reduced nutrient pollution in the marine environment

Resources and contact information

Contact at United Nations Environment Programme

- **Birguy Lamizana**, birguy.lamizana@un.org; UN Environment

For more information visit us at

https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution

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