URBAN WASTEWATER TREATMENT AND AGRICULTURAL REUSE

Internet Course

Lettinga Associates Foundation

Business as usual...

Sustainability...

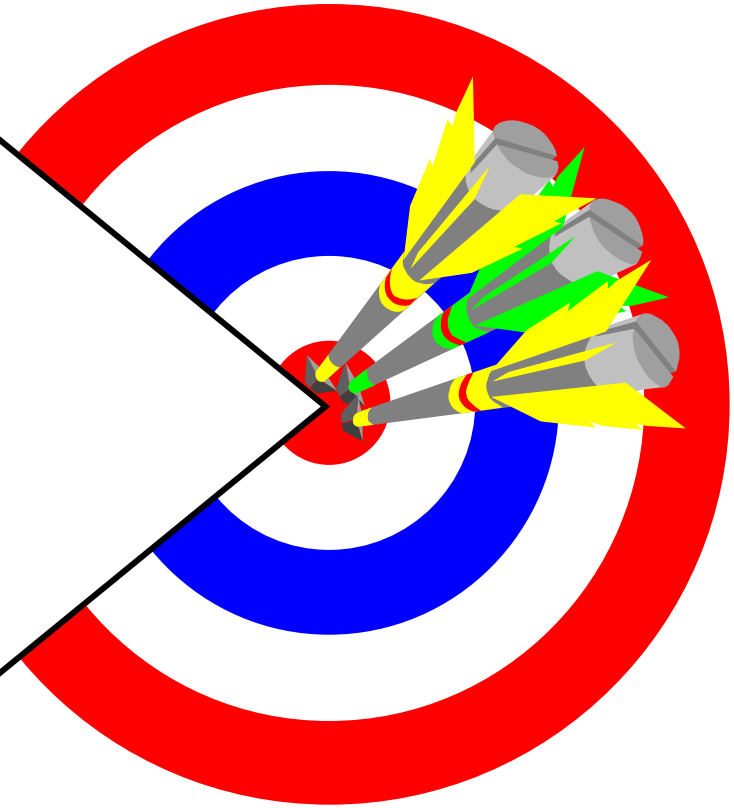
- There is a fight out there...

Layout

- Target group
- Objectives
- Sustainable development
- Sustainability assessment
- The Sustainability Matrix
- Participatory workshops
- Example
- Conclusions
- Final messages

Target group

- Policy-makers
- Government officials
- Private companies
- Teachers
- Students



Objectives

- Introduce the basic concepts of **sustainability** and sustainable development
- Raise the issue of sustainability in connection with wastewater treatment **technologies**
- Provide overview of a sustainability assessment technique (the "**Sustainability Matrix**")

Sustainable development

Definition by the World Commission on Environment and Development (WCED), 1987, The “Brundtland Report”

- “…development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs”

Gro Harlem Brundtland, Chairman of WCED;
Former Prime Minister of Norway

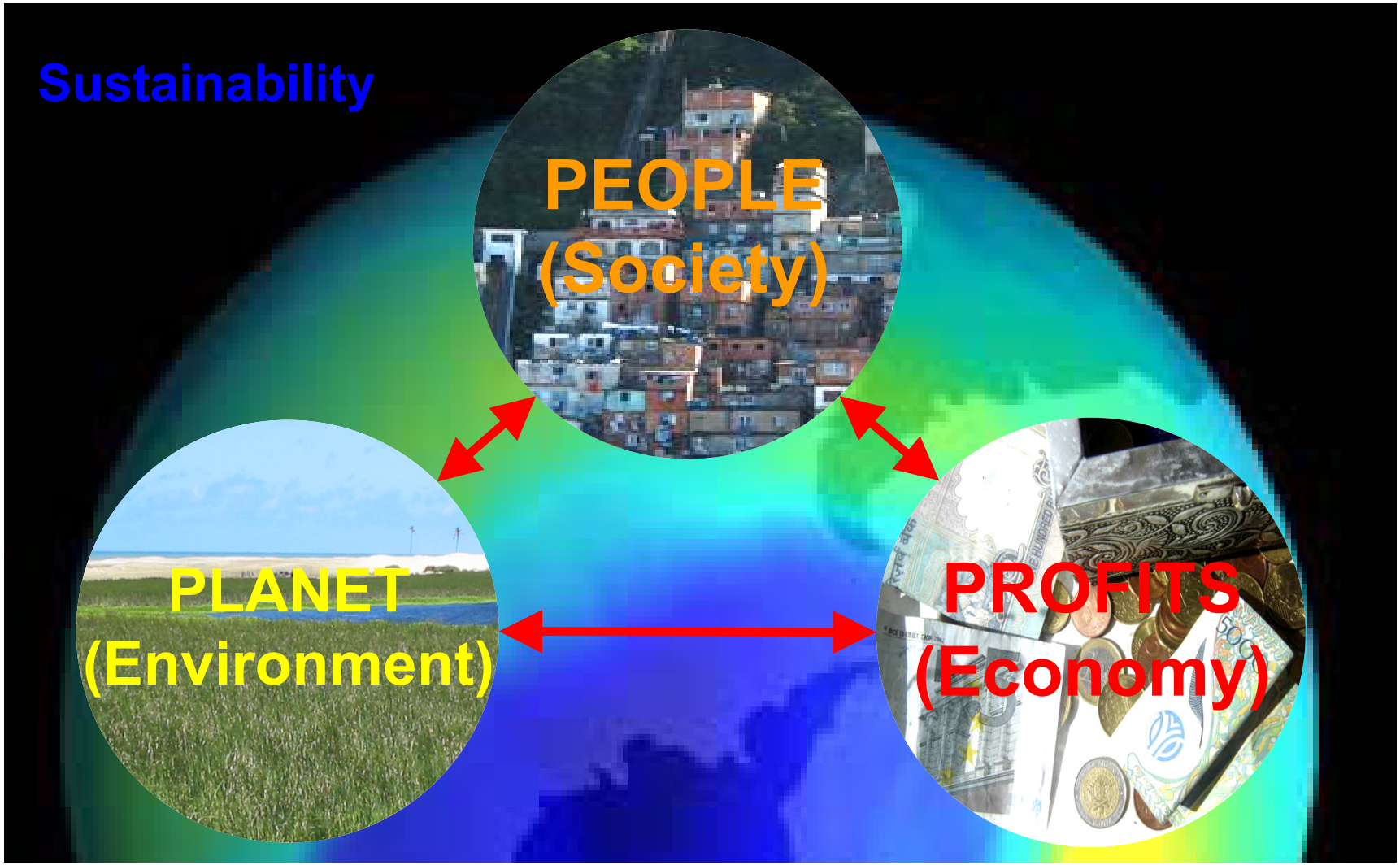
Sustainable development

Read first… or after

- Brundtland GH (2005) Sustainable development and its global significance. *International Sustainability Conference*, Basel 13-14 October 2005
- Tijmes P and Luijff R (1995) The sustainability of our common future: An inquiry into the foundations of an ideology. *Technology in Society* **17(3)**, 327-336
- George C (1999) Testing for sustainable development through environmental assessment. *Environmental Impact Assessment Review* **19**, 175-200
- Doelle M and Sinclair AJ (2005) Time for a new approach to public participation in EIA: Promoting cooperation and consensus for sustainability. *Environmental Impact Assessment Review,* In Press.
- Rijsberman MA and van de Ven FHM (2000) Design and management of sustainable urban water systems. *Environmental Impact Assessment Review* **20**, 333–345.

Sustainable development

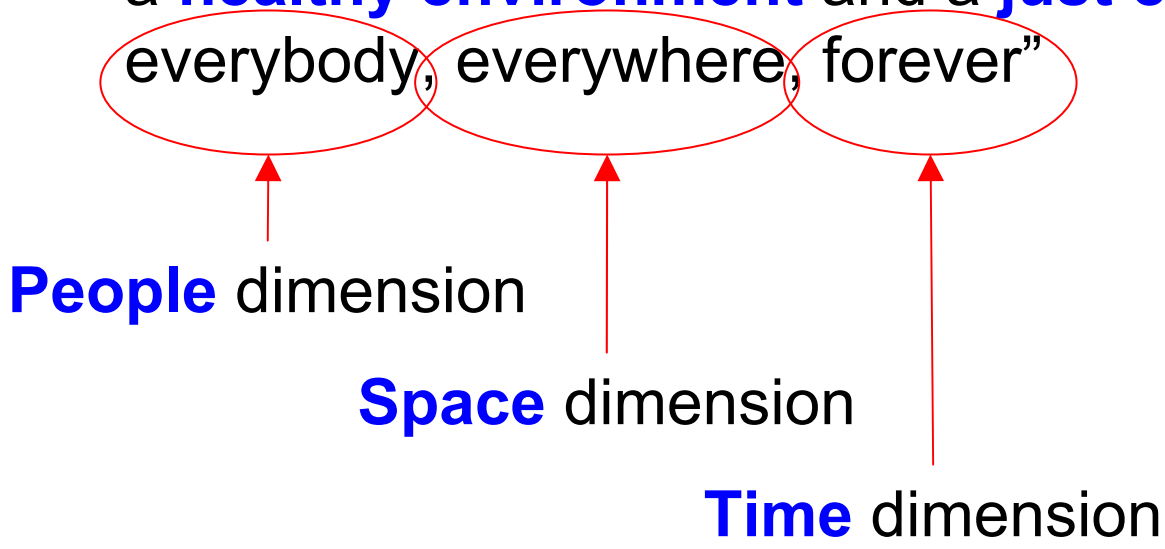
The “Triple Bottom Line”



Sustainable development

Policy

- Sustainable development policies should “...ensure a **healthy environment** and a **just civil society** for everybody, everywhere, forever”



Sustainable development

Antecedents

- Term first used by the International Institute for Environment and Development (IIED), London
- Coiner of the term was Lester Brown (Worldwatch Institute)
- The idea is said to come from the International Union for the Conservation of Nature (IUCN), 1980
- Precursors of the concept: “The limits to growth. A report for the Club of Rome” (1974); “Small is beautiful” by E.F. Schumacher (1979)
- Origins of idea can be traced back to 19th century thinkers
- There is a discussion about the ambiguity and vagueness of the term and its potential usefulness
- Consensus about the need to make the concept more operational for specific situations

Sustainability assessment

Objective

- The assessment of the sustainability of a system, concept, or technology should attempt to consider the widest possible scope of impacts in society and the environment (in space and time) of the adoption and use of this system, concept, or technology

Sustainability assessment

Many things need to be considered

- Space: local, regional, national, global
- Time: short, medium, and long-term aspects
- Cultural factors, especially in developing countries
- Unique methodology applicable everywhere impossible (adaptation of different methodologies needed)
- Specific sustainable development criteria must be included in the analysis (triple bottom line)

Sustainability assessment

Can we use the concept of sustainable development to make practical decisions like the selection of a technology?

- There are so many technological alternatives for each situation
- How to select the “best” one?
- Is sustainability a good selection criterion?
- How to use it in practical situations?
- Who must conduct this analysis?

Sustainability assessment

Business as usual

- Let's examine first the way in which decisions are being taken today, what we call "business as usual"

Sustainability assessment

Business as usual

- **Narrow** technical evaluations (only one aspect, i.e. efficiency)
- Economic (vested) **interests** (select only technologies that are sold by my friends' companies)
- **Intuition** (pretend you "know" what's good)
- **Subjectivity** (select a system based only on what YOU think)
- "**Wisdom**" (people with a lot of experience with one system think they know everything about OTHER systems)
- Preservation of **power** structures (don't want to change the relation of power with local companies, monopolies)
- **Fear** of change (this can be a major hindrance to the introduction of new technologies and systems)
- Sheer **ignorance** (…)
- **Corruption**

Sustainability assessment

Business as usual

- Even decision-making processes that claim to be aimed at sustainable development are usually conducted in this way

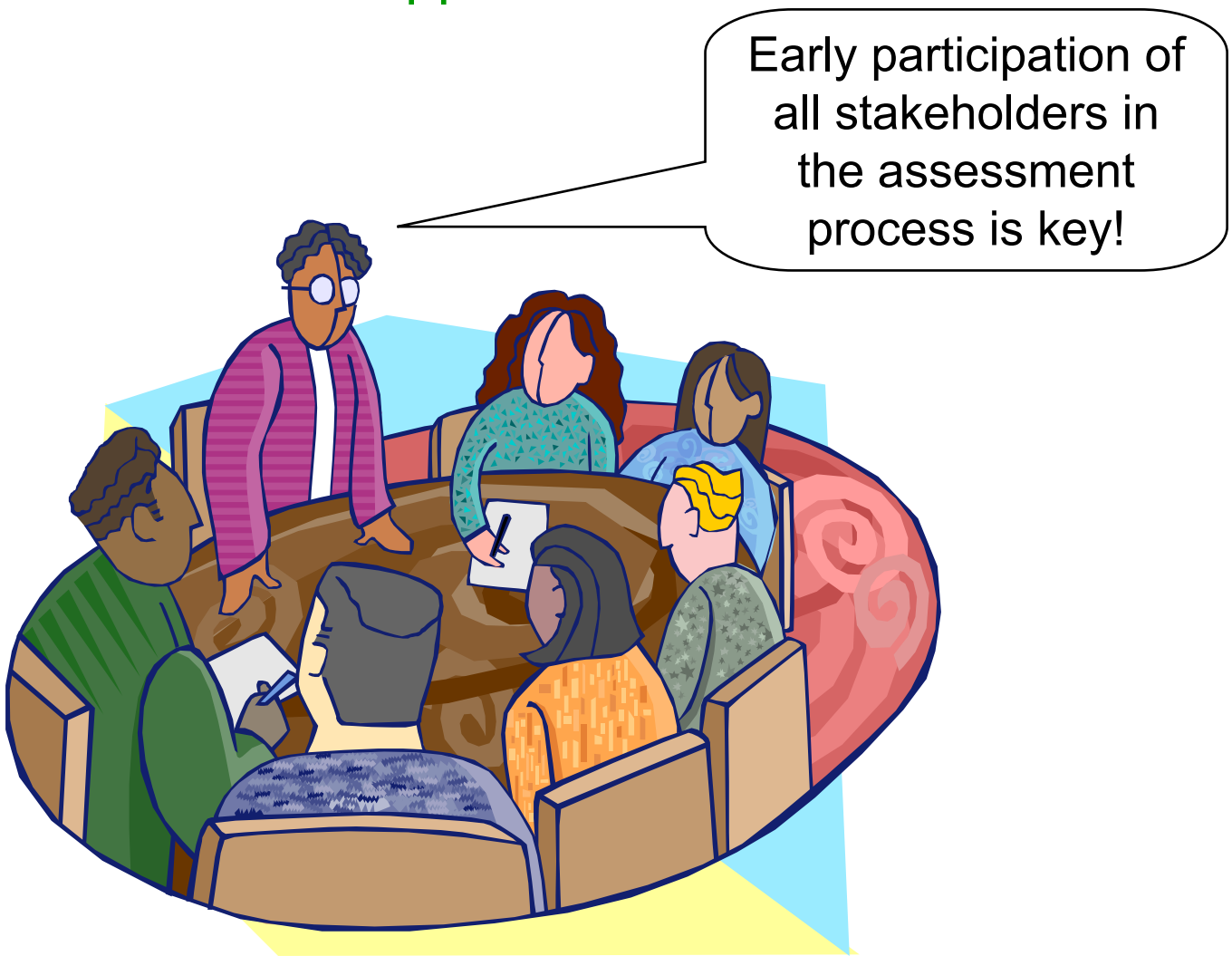
Sustainability assessment

Features of a sustainable approach

- Holistic, integrated
- Accepts different assessment methodologies
- Includes sustainable development criteria
- Integrates environmental, social, economic aspects
- Rational, democratic, explicit
- Results unambiguous, specific, understandable
- Compares sustainability of different options

Sustainability assessment

Features of a sustainable approach



Sustainability assessment

Not only words!

Sustainability assessment must help take decisions and not be yet another bureaucratic hindrance. For it to be really useful, it has to be different from conventional decision-making processes in:

- **Scope**: it is intended to reach a more sustainable society
- **Methodology**: it uses a rational but participatory approach
- **Results**: should be safer and more reliable

Sustainability assessment

Different techniques could be used

- Technology assessment (TA)
- Environmental impact assessment (EIA)
- Social impact assessment (SIA)
- Land evaluation techniques (LET)
- Integrated resource management (IRM)
- Life cycle analysis (LCA)
- Cost-benefit analysis (CBA)
- Exergy analysis
- System analysis
- …
- Multi-criteria analysis (MCA) (The Sustainability Matrix)

Sustainability assessment

Previous steps

- Some issues must be sorted out BEFORE the actual assessment takes place

- Clearly identify the problems to be solved
- Set boundaries and limit the scope of the assessment
- Detect all stakeholders and local actors
- Formulate objectives and assumptions
- Make preliminary list of possible technical alternatives

Sustainability assessment

How to buy a car…

- The process of sustainability assessment can be compared to the process of buying a car (or many other things…)
- See the pictures in the next slide and take a minute to decide which car you would buy and why

Sustainability assessment

Volkswagen Golf

Nissan Altima

Ford Focus

Van Ford 350

Sustainability assessment

How to buy a car…

- Which one and why???

Sustainability assessment

How to buy a car…

- Easy?

Sustainability assessment

How to buy a car…

- Although it is relatively easy to select in a few seconds the car that best suits your own needs, you (probably) unconsciously went through many of the issues in the following slide.

Sustainability assessment

How to buy a car…

- Identification of **problems** (I'm fed up with the bus…)
- Definition of **objectives** (I want to take the kids to school…)
- Selection of **criteria** (consumption, size, brand, color)
- **Rating** of criteria (cheap but not big enough…)
- Assessment of **performances** (this one is the cheapest…)
- **Participation** of "stakeholders" (even the children…)
- Calculation of **costs** (do we have the money?)
- **Financing** is considered (what if we pay in allotments…?)
- Consultation of **experts** (different car dealers are visited…)
- Parallel technical **studies** (why don't you ask your cousin…?)

Sustainability assessment

Difference between cars and technology/systems selection

- What's the difference between buying a car for ***yourself*** and selecting a good technology or management system for ***your company*** or for ***your municipality***?

Sustainability assessment

Difference between cars and technology selection

- None!

Sustainability assessment

Difference between cars and technology selection

Except that you, as decision maker, are liable for your decisions and you will have to respond clearly to the following two questions (to your constituency or, in the worst-case scenario, in a trial!):

- **Why?** … did you take that decision
- **How?** … did you take it

Sustainability assessment

Solution

Use a method that

- Leads you to the most sustainable decision
- Allow early participation of stakeholders
- Can be easily understood
- Can be recorded from beginning to end

We describe one… 

The Sustainability Matrix

Definition

- It is a Multi-Criteria Analysis (MCA) that was developed from techniques originally used for Environmental Impact Assessment (EIA)

The Sustainability Matrix

Principles

- The method ranks different alternatives according to their performance on a set of criteria and indicators.
- Criteria and indicators have different importance in the local setting
- Criteria, indicators, importance, and performance are defined in a participatory way

The Sustainability Matrix

Why this method?

- Simple
- Cheap
- High potential for public participation
- Conceptually coherent

The Sustainability Matrix

Application to sanitation technologies

- The method can, in principle, be applied to the selection of any type of **technology**.
- In this presentation we will focus from here onwards on the selection of **sanitation** technologies, especifically urban wastewater treatment technologies.
- If you don't know anything about sewage treatment and sewage treatment technologies you will have to go first through the rest of the **Contents** of the course.

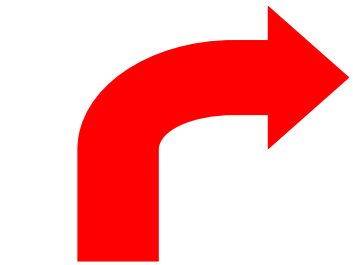
The Sustainability Matrix

Sustainability categories for sanitation technologies

- One of the first tasks is to define the **categories** (criteria and indicators) that apply to our specific situation.
- This has to be done in a **participatory** way!
- However, in the following slides a tentative **list** of criteria and indicators selected for sewage treatment technologies is presented, for informative purposes.

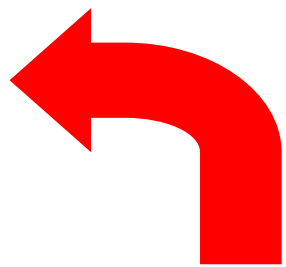
The Sustainability Matrix

Example of sustainability categories for sanitation technologies



Criteria

Technical aspects	Effectiveness
	Removal efficiency
	Reliability
	System manageability
Environmental aspects	Conservation
	External inputs
	Land use and impact
	Emissions
	Reduce, Reuse, Recycle
Social aspects	Institutions and politics
	Management capacity
	Management scale
	Change of routines
	Social acceptability
	Scientific support
	Regulatory framework
Economic aspects	Investments costs
	Running costs
	Life time
	Externalities



Indicators

The Sustainability Matrix

Sustainability categories for sanitation technologies

- Categories (especially indicators) can **vary** a lot from place to place.
- Remember **again** that the definition of categories must be done by local practicioners at the beginning of the assessment! Resist the temptation to provide a fixed list prior to the analysis. It will narrow down the discussion a lot and participants will have the feeling that they don't "**own**" the outcome of the workshop.
- The number of indicators should not be too high in order to **simplify** the analysis.

The Sustainability Matrix

Calculation procedure

- Once the categories are decided, the calculation process begins.
- The calculation is based on the combined assignment of relative weights to both
  - The **importance** of the categories (criteria and indicators)
  - The **performance** of different alternatives

The Sustainability Matrix

Calculation procedure

- The process has 4 basic steps:
  1. Assignment of **importance** to categories (criteria and indicators)
  2. Assignment of **performance** to the different alternatives for each indicator.
  3. Calculation of the **sustainability** of each combination indicator/technology (importance *x* performance).
  4. Calculation of the **sustainability index (SI)** for each technology. The SI is calculated as the sum of all individual sustainability scores summed by row for each technological option.

The Sustainability Matrix

Calculation procedure

1. Assignment of Importance

- The first thing to do is to give a relative **IMPORTANCE** to the criteria and indicators selected.
- The Importance represents the relative **contribution** of each category to the whole environmental and social system in the local context.
- Importance is **independent** of the technological alternatives available.
- Importance only depends on the **perceived** role that each category plays in the specific setting where the assignment is being made.
- The guiding question for this assignment could be: What is more **valuable/urgent** to me, here, today?

The Sustainability Matrix

Calculation procedure

1. Assignment of Importance (continued)

- Off course everything is **relevant** (People, Planet, Profits).
- The challenge is to make a sort of **priority** list according to local conditions.
- For example, in a context of extreme **poverty**, it could be more important/urgent to improve people's livelihoods instead of creating a new national park.
- On the other hand, in a relatively **affluent** society, when access to basic needs is more or less guaranteed, the protection of the environment is top in the agenda.
- This assignment of relative importance is a difficult and bold **decision** and requires a lot of commitment.
- Setting priorities is key to **responsible** decision making.

The Sustainability Matrix

Calculation procedure

2. Assignment of Performance

- The different technologies have different **PERFORMANCE** on each one of the indicators.
- The Performance indicates the way the different technologies **behave** in relation with the indicators.
- Performance is assigned **independently** of the importance previously assigned. So, forget about the importance when assigning performance!
- The guiding question for this assignment could be: How do the different technologies **function/operate/do** with respect to each indicator?

The Sustainability Matrix

Calculation procedure

3. Calculation of sustainability

- The "**sustainability**" of the different technologies can be calculated for each one of the indicators defined by multiplying the importance of the indicator and the performance of this technology for this particular indicator.

The Sustainability Matrix

Calculation procedure

4. Calculation of the Sustainability Index (SI)

- The sum of all these products for each technology gives a **Sustainability Index (SI)** that represents the sustainability of the technology in the local setting.

The Sustainability Matrix

This is how a full matrix looks like for a real case

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Assessment parameters		Importance					Performance			Sustainability					
Criteria	Indicators	Mean[a]	Ratio	Total	Value	Check	Option A[b]	Option B[b]	Option C[b]	Option A		Option B		Option C	
Technical aspects		45	47		18										
Environmental aspects		95	100		39										
Social aspects		40	42		16										
Economic aspects		65	68	258	27	100									
Technical aspects	Effectiveness	95	100		6.7		100	100	100	6.7		6.7		6.7	
	Removal efficiency	20	21		1.4		50	75	100	0.7		1.1		1.4	
	Reliability	65	68		4.6		25	100	75	1.1		4.6		3.4	
	System manageability	80	84	274	5.7	18	50	100	75	2.8	62	5.7	98	4.2	86
Environmental aspects	Conservation	35	41		4.8		25	50	75	1.2		2.4		3.6	
	External inputs	85	100		11.8		50	100	75	5.9		11.8		8.8	
	Land use and impact	75	88		10.4		100	25	75	10.4		2.6		7.8	
	Emissions	70	82		9.7		50	25	75	4.8		2.4		7.3	
	Reduce, Reuse, Recycle	15	18	329	2.1	39	50	25	100	1.0	60	0.5	51	2.1	76
Social aspects	Institutions and politics	95	100		3.9		25	100	75	1.0		3.9		2.9	
	Management capacity	40	42		1.6		75	100	25	1.2		1.6		0.4	
	Management scale	50	53		2.0		25	25	100	0.5		0.5		2.0	
	Change of routines	75	79		3.1		75	100	25	2.3		3.1		0.8	
	Social acceptability	50	53		2.0		100	25	100	2.0		0.5		2.0	
	Scientific support	70	74		2.9		25	75	100	0.7		2.1		2.9	
	Regulatory framework	20	21	421	0.8	16	100	100	100	0.8	53	0.8	77	0.8	73
Economic aspects	Investments costs	45	45		4.7		25	100	75	1.2		4.7		3.5	
	Running costs	100	100		10.4		25	100	75	2.6		10.4		7.8	
	Life time	75	75		7.8		50	100	75	3.9		7.8		5.9	
	Externalities	35	35	255	3.6	27	100	25	100	3.6	43	0.9	90	3.6	78
Total					100					**55**		**74**		**78**	

The Sustainability Matrix

Calculation procedure

- Everything will (should) become clear when doing the exercise!

The Sustainability Matrix

Ranking

- The following ranking can be used to classify the technologies according to their calculated SI:

Sustainability ranges	
Very low	<25%
Low	25-50%
Medium	51-75%
High	76-100%

The Sustainability Matrix

Ranking

- The calculation of the SI provides a straightforward methd to **compare** between the alternatives
- The SI can also be seen as related to a **hypothetical** technology which is, in theory, 100% sustainable
- Therefore, the SI provides also a sort of "**absolute**" sustainability for this specific location

Participatory workshops

The importance of participation

- The method is very **powerful** if the right people are involved!
- **Participation** is therefore key to take the right decisions
- **Who** must participate? This is in itself a very important part of the whole assignment. The whole process depends on a right answer to this question
- How to participate is also very important. The process can be done in so-called "**Participatory workshops**"
- The very issue of participation is a very **complex** one itself and we are not going to discuss it here. However, some hints are given in the coming slides about how to organize a participatory workshop (assuming that participation is desirable!)

Participatory workshops

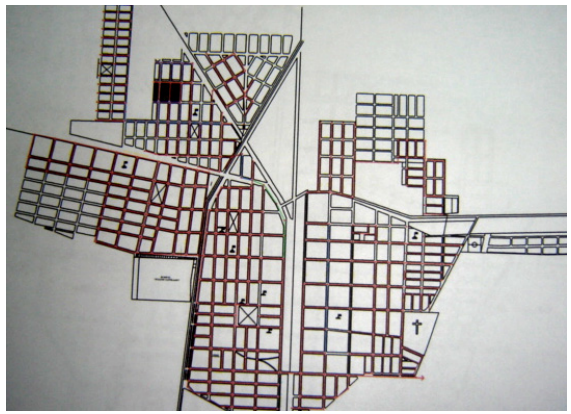
Summon the right stakeholders

Participatory workshops

Explain the methodology

Participatory workshops

Make people work…



Participatory workshops

…and present their findings…

Participatory workshops

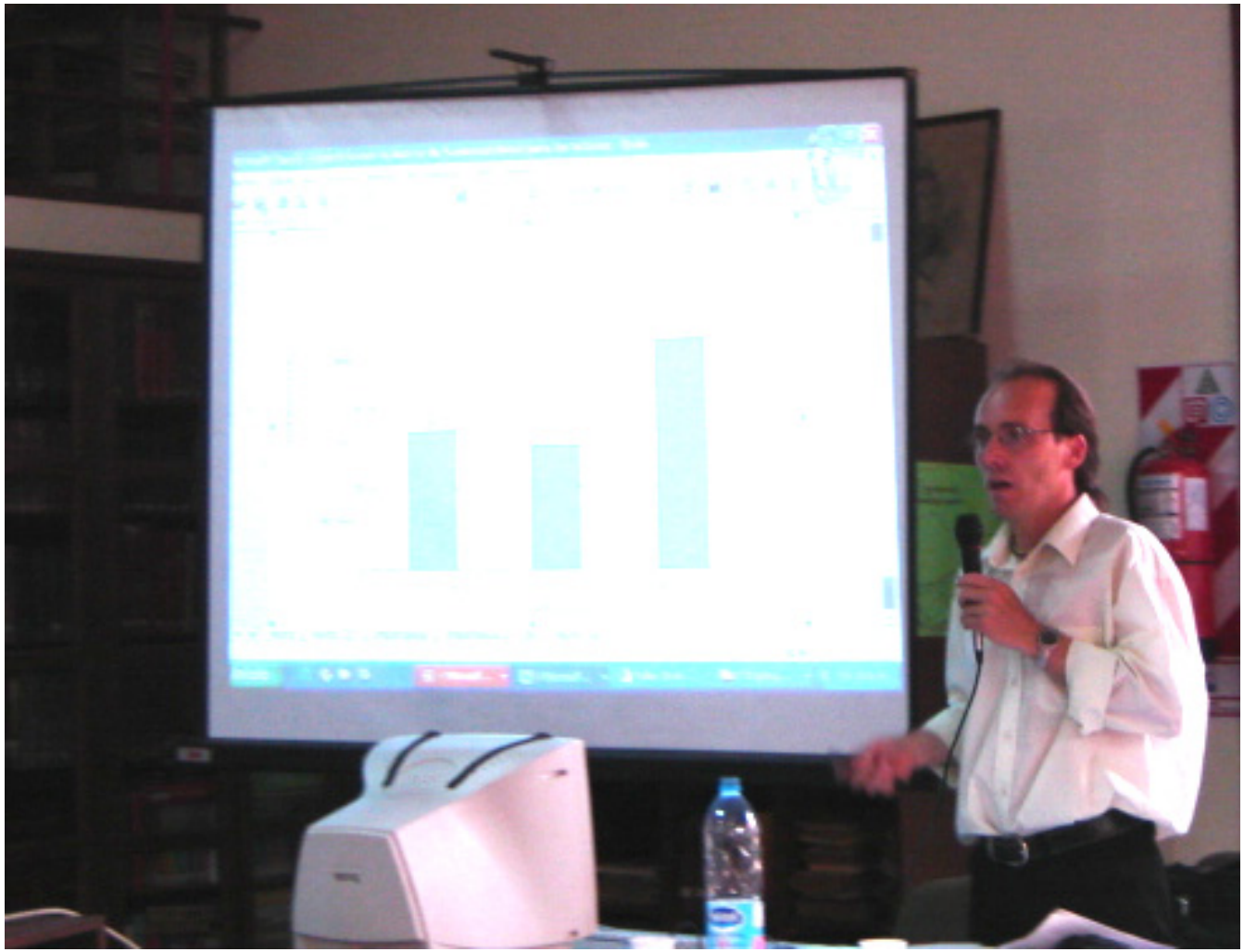
…and discuss

Participatory workshops

Provide them with technical advice

Participatory workshops

Share the results



Participatory workshops

…and discuss

Participatory workshops

…and discuss again

Participatory workshops

…and discuss as much as needed

Example

The method in practice (Exercise)

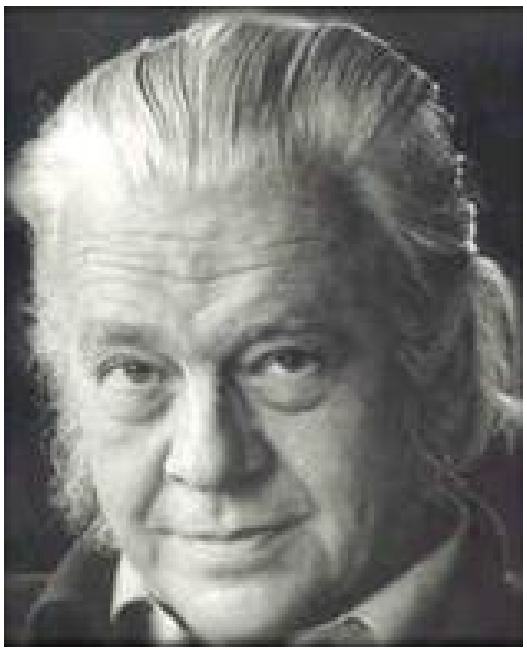
- Work with provided presentations and spreadsheet
- You have to actually assess what is the best technology for sewage treatment under the conditions of your case study
- You can do this exercise alone or working in groups

Conclusions

- The method is only useful for **comparative** assessment
- Decisions only valid for **local** conditions
- Method applicable irrespective of **data** available
- Parallel (technical) **studies** might be necessary
- **Simplicity** and **participation** should be guaranteed
- **Science**: information to reduce uncertainty and risks
- **Assumptions** must be clear
- Control and **monitoring** essential for implementation
- As long as the right **people** is around the table, the process is more likely to yield the **most sustainable solution**.

Final messages

Ernst F. Schumacher



No technology is intrinsically sustainable. Sustainability depends on People, Place, and Time

Final messages

Rachel Carson

For a noisy spring!

LeAF

Lettinga Associates Foundation