"A methodological approach for comparing different Management Systems of Effluents: The Italian and Israeli case studies"

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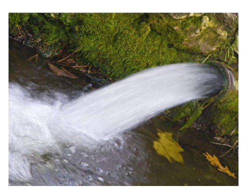
Scenarios compared for Italy and Israel

Std quality Italy and Israel

Reference flow: 1m^3

WWTP

Energy consumption



Scenario 1: Discharge to river

Scenario 2: Use on soil

Outline of the work – Preliminary Study

1) Development of a comprehensive methodology and indicator based on Sustainability Assessment (SA) for comparing different management systems of effluents;

2) Sustainability Assessment is based on:
   2.1) Environment impacts;
   2.2) Social impacts;
   2.3) Economic impacts.

Background of Sustainability Assessment

Sustainability science aims to link science to action (e.g. political, planning, products)

Sustainability assessment procedure:

- <u>Approach to sustainability</u>;
  - Values: the value-based nature of the goal.
  - Principles; precautionary principale; irreversibility; holistic apporach; polluter pays; intergenerational equity… are some of sustainability principles.

  Values and Principles define the sustainabilty framework.

- <u>Target definition necessary for comparing the SA results.</u>

Background of Sustainability Assessment

Sustainability assessment procedure:

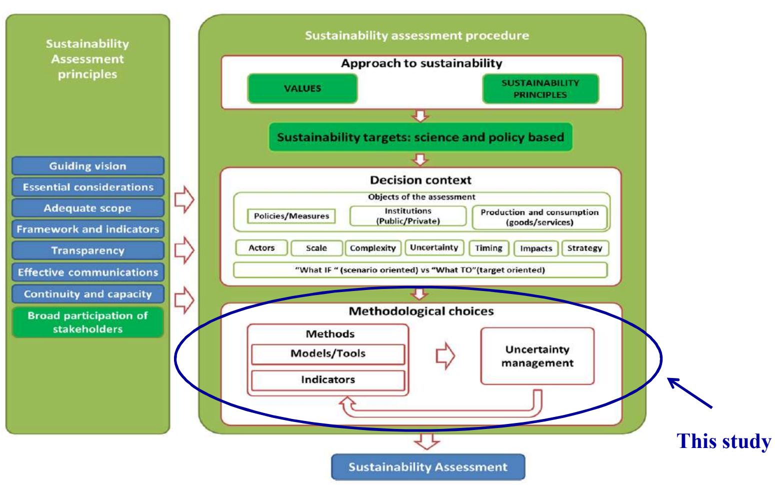
- **Decision Context; actor (subject and driver); the scale; complexity of decision; time horizon; activity affected by the decision...**

- **Methodological choiche; this is the core of the assessment. It is composed by three phases:**

  1) Identification of the assessment methodologies: methods, models, indicators…
  2) sensitivity and uncertainty analysis;
  3) monitoring strategies to track progress toward sustainability.

- Uncertainty assessment; Complex to be evaluated but relevant for correct informations

Background of Sustainability Assessment: Procedure



A methodological approach for comparing different Management Systems of Effluents:...

The implemented sustainability procedure

- Values: Best use of wastewater.
- Principle: holistic approach by E-LCA, S-LCA, Costs.
- Target: Comparison for Optimization of wastewater management system.
- Decision context: Scenario planning (policy and decision makers)
- Methodological choiche:
  1) Assessment methodology based on quantitative specific (Environmental, Social, Economic) and integrated indicator;
  2) Sensitivity and uncertainty analysis: NA;
  3) Monitoring strategies to track progress toward sustainability:NA.

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The implemented sustainability procedure: Methodology

- Environmental indicators

1) Impact indicator directly affected (from ILCD 2011+ Impact assessment method E-LCA – midpoint):

1.1) Freshwater Eutrophycation (FWE) (kg Peq);

1.2) Freshwater ecotoxicity (FWec) (CTUe).

2) Indireclty affected:

2.1) GWP (kgCO_{2eq}) based on average kWh/m^3 of energy consumed by WWTP and on the amount of kgCO_{2eq}/kWh;

2.2) Italy 0.23-0.28 kWh/m^3 and 0.305 kgCO_{2eq}/kWh;

2.3) Israel 0.5 kWh/m^3 ^{and} 0,601 kgCO_{2eq}/kWh.

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The implemented sustainability procedure: Methodology

Social indicator

From UNEP/SETAC (2009) guideline for S-LCA

Main stakeholder	Impact categories	Impact indicator
Workers	Human rights	-
Local Community	Working conditions	-
Society	Health and safety	HH
Consumers	Cultural heritage	-
Values chain actors	Governance Socio-economic repercussions	-

Society, Health and safety embraces:

1) Human Health (HH);
2) Human Dignity (Not Affected);
3) Well-being (Not Affected).

HH (DALY) was evaluated on the basis of the IMPACT 2002+ assessment method - endpoint

The implemented sustainability procedure: Methodology

Economic indicator (Industrial-market)

1) Italy (on the basis of fees per water consumption):

1.1) from 0.7-1.3 €/m^3 for domestic;

1.2) from 1 up to 30 €/m^3 for industrial.

2) Israel (on the basis of WWTP management costs):

2.1) 0.5 €/m^3

All the results were referred to 1m^3 of water discharged/reused

Input data for the calculation of Environmental and Social indicators

Emission limits from std quality regulation for Italy and Israel

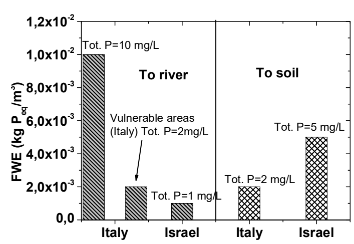
		Reuse on soil			Discharge in river		
Parameter	Unit	Italy	Comp.	Israel	Italy	Comp.	Israel
Emissions to water							
pH	-	6-9.5	-	6.5-8.5	5.5-9.5	-	7.0-8.5
SAR[1]	0.5mmol/L	10	>	5	-	-	-
Na	mg/L	-	-	150	-	-	200
Suspended total solids	mg/L	10	=	10	80	>	10
BOD_5	mgO_2/L	20	>	10	40	>	10
COD	mgO_2/L	100	=	100	160	>	70
Total P	mgP/L	2	<	5	10	>	1
Total N	mgN/L	15	<	25	-	-	10
$N\text{-}NH_4^+$	$mgNH_4^+/L$	2	<	20	15	>	1.5
N-Nitrite	mgN/L	-	-	-	0.6	-	-
N-Nitrate	mgN/L	-	-	-	20	-	-
Total hydrocarbons	mg/L	-	-	-	5	-	-
Electrical Conductivity	µS/cm	3,000	>	1400	-	-	-
Al	mg/L	1	<	5	1	-	-
As	mg/L	0.02	<	0.1	0.5	>	0.1
Fecal Coliforms	UFC/100ml	100	>	10		-	200
Others…..	……………	……	…………	………	…………….	…………	…………………

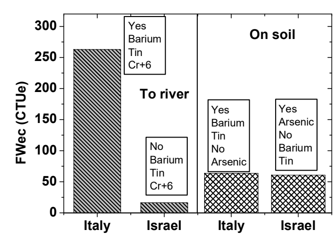
Italian parameter > Israel

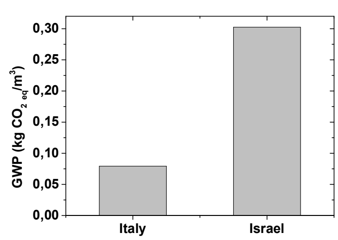
- FWE
- FWec
- HH

Results: Environmental indicators

Impact indicators characterization for $1m^3$







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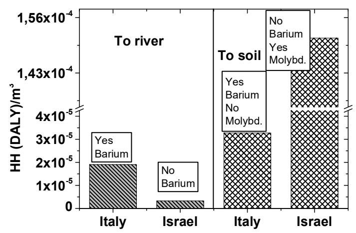
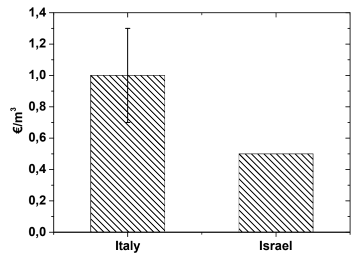
Results: Social and Economic indicators



Social indicator: HH



Costs

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Results: Integrated Sustainability Indicator (ISI)

$$Integrated\ Indicator = \sum_{i=1}^{n} a_i * I_i$$

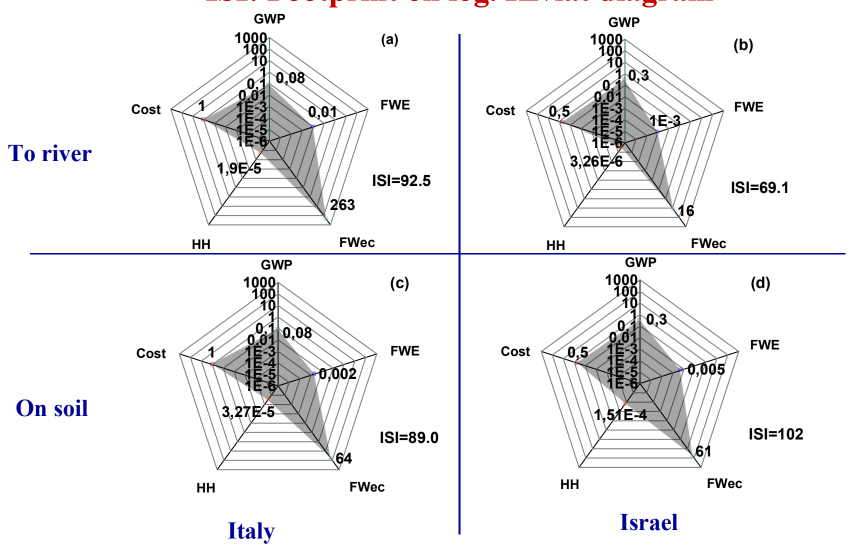
a_i =? ⇨ **Target = No specific target only compariosn => a_i=1**

⇩

ISI = Kiviat diagramm footprint

Higer ISI => lower Sustainability

ISI: Footprint on log. Kiviat diagram



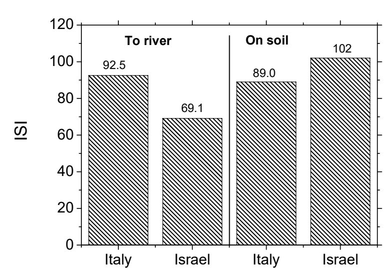
ISI: Footprint on log. Kiviat diagram

On the basis of the assumptions:

- **For Italy: use on soil more sustainable than discharge to river;**
- **For Israel: discharge to river more sustainable than reuse on soil.** ?

⇩

- **Absence of target and of specific weight**
- **Standard quality**
- **Lack of specific indicator for water depletion**
- **Indicators able to considere specific context**



Average ISI of discharge to river < use on soil

Conclusions

- ISI is able to account for all the three main pillars for sustainability: environmental, social and economic;
- Social indicator based exclusively on HH is suitable for specific areas;
- Discharge to river showed lower average ISI of reuse on soil.

- Future improvements:
- Uncertainty;
- Omogeneization of std. quality;
- Larger number of quantifiable social indicators
- Specific indicators for water depletion and context analyzed
- Target and weight?

THANK YOU FOR THE ATTENTION!

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