SOILUTIL

Waste application on soil management concept and results

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RISK MANAGEMENT OF WASTE UTILISATION ON SOIL

1. HAZARD IDENTIFICATION OF WASTE
2. RISK OF DEGRADED SOIL
3. RISK OF WASTE UTILISATION ON SOIL

1. WASTE EVALUATION: VALUE
2. BENEFIT FROM WASTE REDUCTION
3. BENEFIT FROM APPLICATION ON SOIL

WASTE UTILISATION ON SOIL

- Waste pre-treatment: comminution, selection, fractionation
- Soil amelioration: sandy soil, compacted soil, low humus soil
- Soil amelioration : low nutrient soils
- Nutrient supply: for plants with special needs
- Erosion control by physical stabilisation: soil-texture development
- Erosion control by biological stabilisation: humus-content & vegetation
- Remediation of contaminated soil
- Soil remediation by chemical stabilisation: metal contaminated soil
- Cultivation medium from waste
- Geotechnical constructions: for water-permeable sealing
- Geotechnical constructions: capillary barriers and capillary layers
- Waste elimination in the soil by biological CO_2 sequestration

MANAGEMENT PHASE I.

SOIL EVALUATION

HAZARD: Type of degradation, contamination or other threat

NEEDS: Parameters, substances required

LOCALITY

WASTE EVALUATION

HAZARD: hazardous substance content and consequent limitations

VALUE: of waste from the point of view of the soil

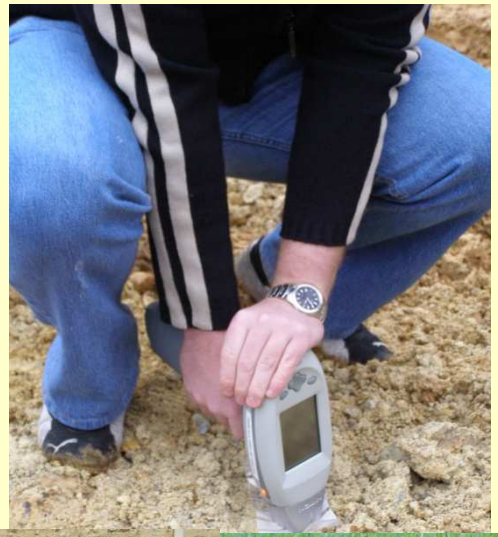
PRODUCED AMOUNT AND LOCALITY

RISK EVALUATION of waste application on soil

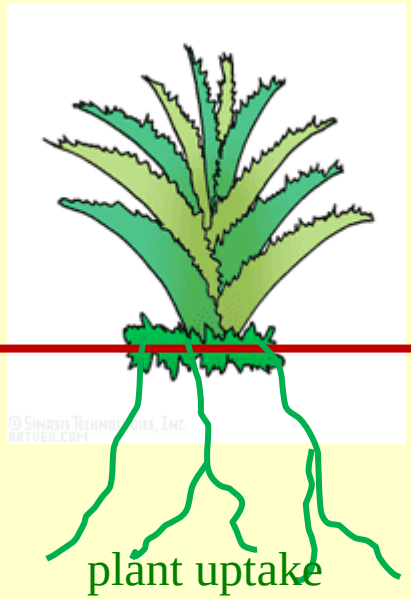
SITE SPECIFIC RISK of waste application on soil

REGIONAL AND GLOBAL RISKS, SUSTAINABILITY

FLY ASH TREATMENT OF METAL CONTAMINATED AND DEGRADED ACIDIC SOIL/ROCK



RISK EVALUATION



PRECIPITATION

METAL CONTENT IN WATER EXTRACT

runoff

infiltration, leaching

METAL CONTENT IN LEACHATE

plant uptake

PLANT BIOACCUMULATION
METAL CONTENT OF PLANT

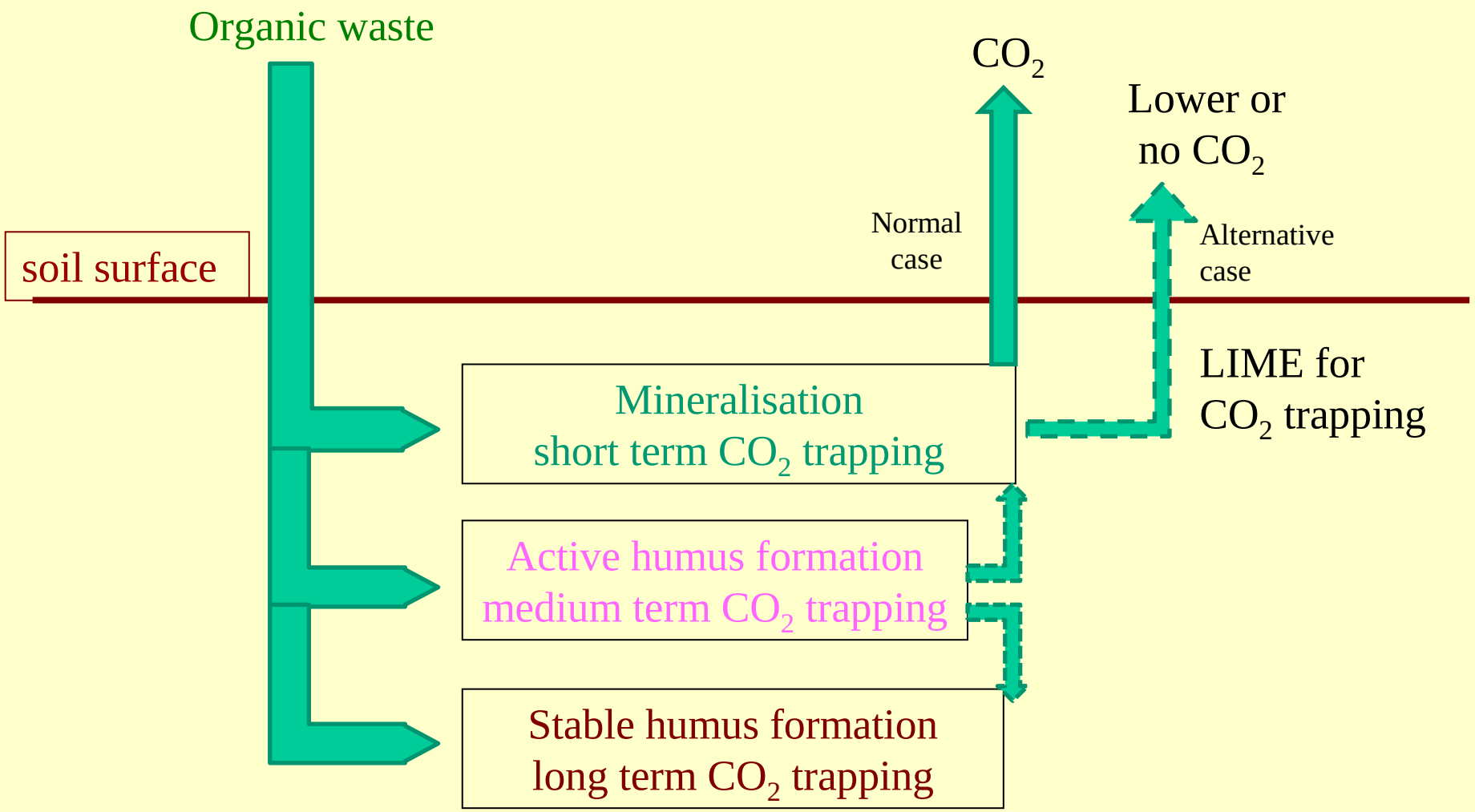
FLY ASH TREATED METAL-CONTAMINATED AND DEGRADED ACIDIC SOIL/ROCK FIELD DEMONSTRATION

	Water extract (mg/kg soil)				Plant bioaccumulation in bioassay (mg/kg dry plant)				Naturally grown grass metal uptake (mg/kg dry plant)			
Treatment	Cd	Zn	Pb	As	Cd	Zn	Pb	As	Cd	Zn	Pb	As
Control	0.24	25.7	0.56	132	1.9	345	11.3	0.8	2.8	561	117	13.0
5% fly ash	0.01	0.06	0.06	40.5	0.3	85	3.5	0.8	0.5	190	2.0	0.8

RED-MUD TREATED METAL-CONTAMINATED AND DEGRADED ACIDIC SOIL/ROCK MICROCOSM TEST

	Water extractable metal in soil mg/kg		Contaminated soil plant uptake in bioassay mg/kg plant	
Treatment	Cd	Zn	Cd	Zn
Control	0.01	0.48	2.2	119
5% red-mud	<0.004	0.10	0.35	88

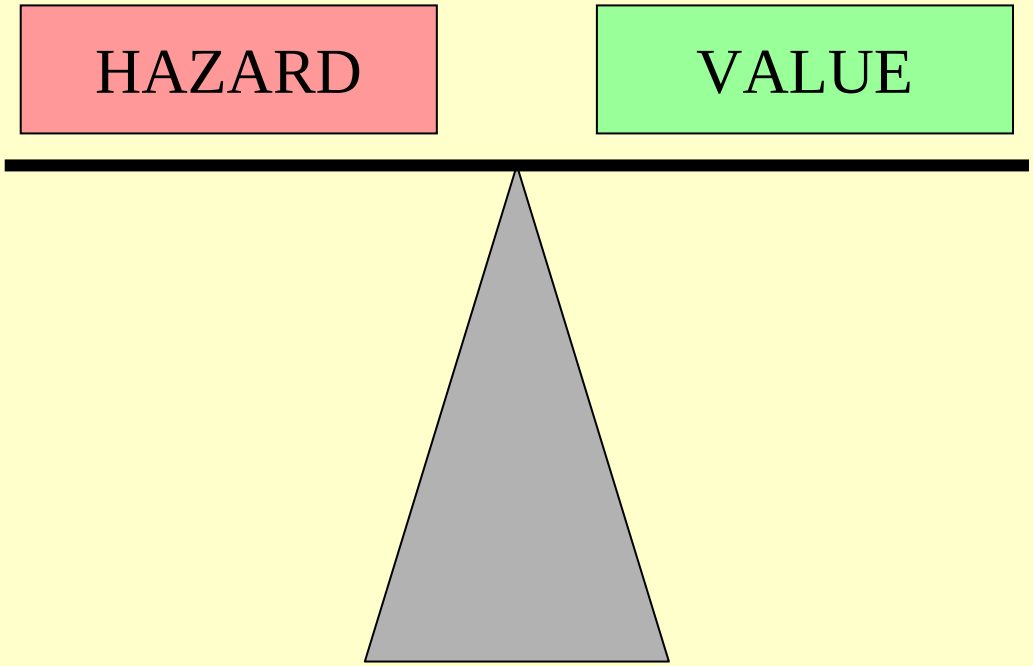
BIOLOGICAL CO_2 SEQUESTRATION



CO_2 PRODUCTION AND CELL CONCENTRATION OILY WASTE APPLICATION ON SOIL

Treatment	CO_2 discharge (mmol)	Cell-concentration (cell/g soil)	Specific CO_2 discharge (mmol/cell 10^{10})
Control	1.0	9.0×10^6	2.0
5% oily waste	1.9	7.5×10^7	0.5
5% oily waste + lime	1.2	2.3×10^8	0.1

EVALUATION OF WASTES



DIFFERENTATION BETWEEN HAZARD AND RISK

Wastes are handled today based on their default hazard, which is in contrast with the risk based approach.

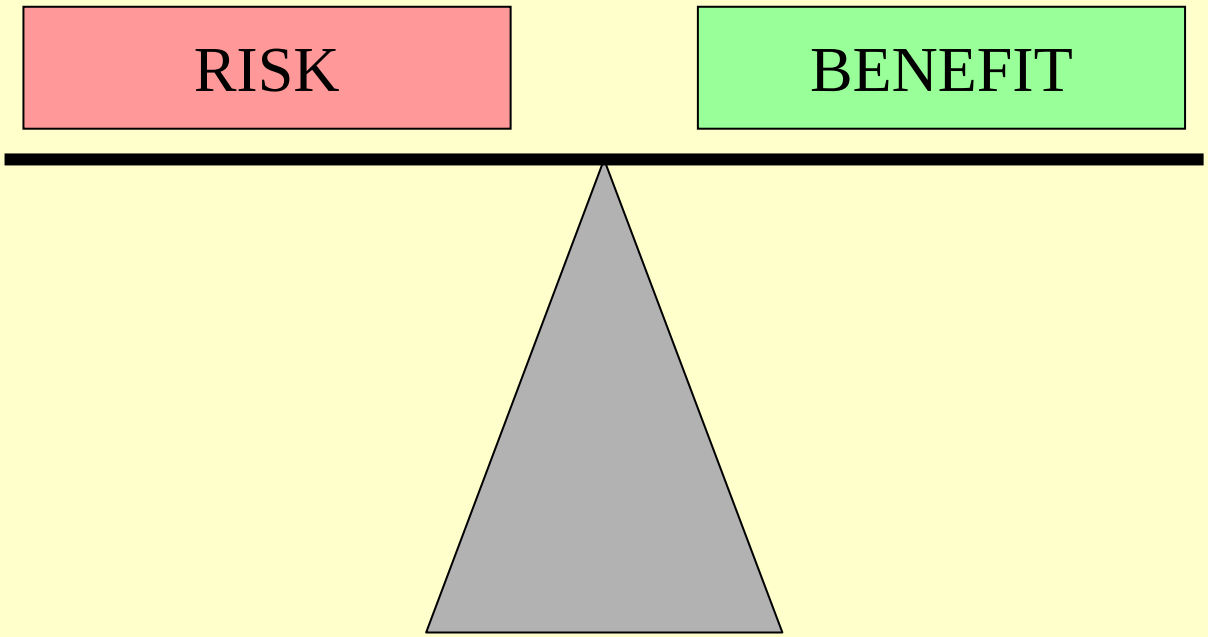
The same (hazardous) waste pose different scale of risk depending on soil type and land use.

Time is and important factor too for biodegradable waste and waste applied as plant nutrients.

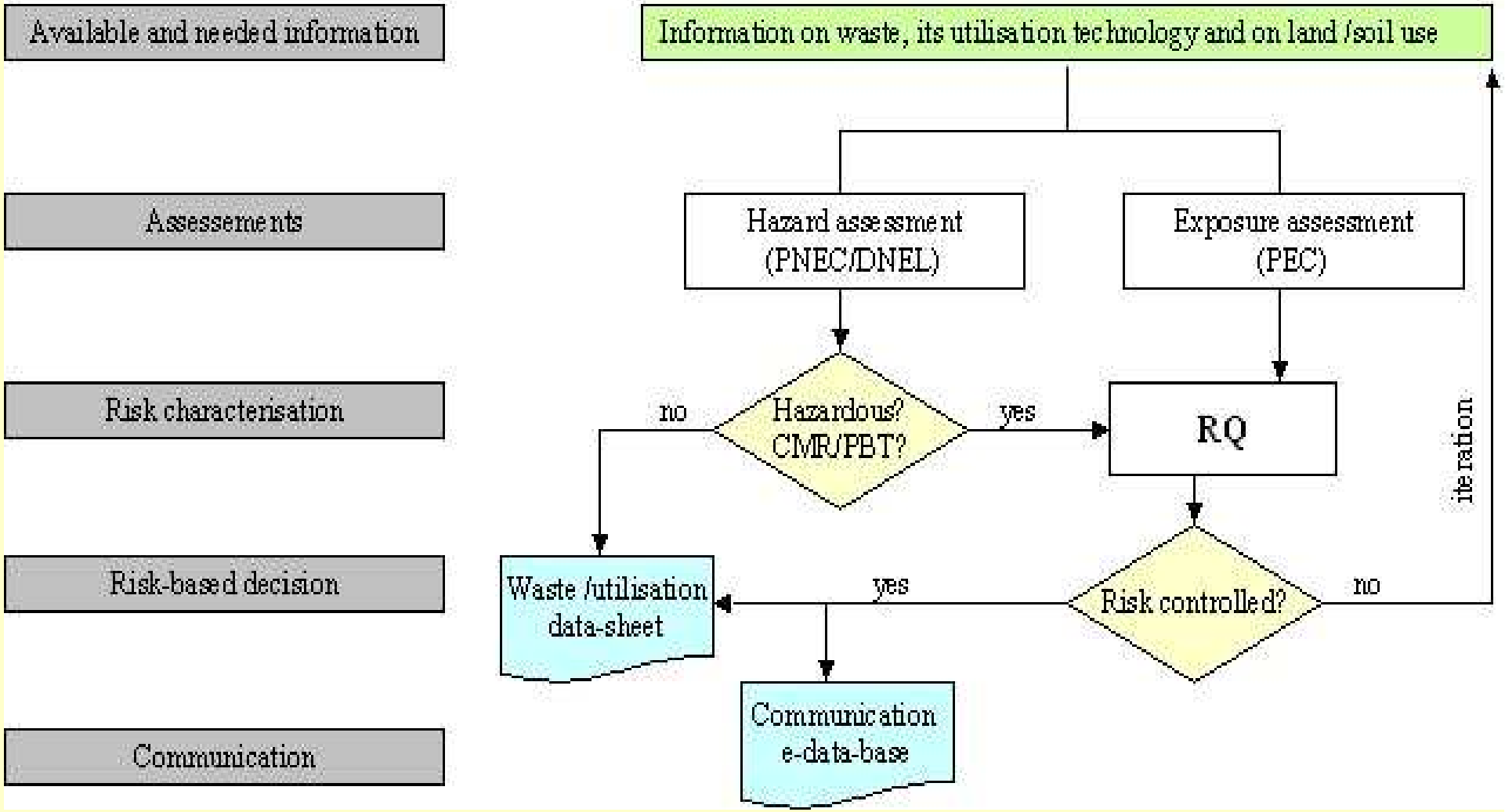
The right decision can be made only based on the quantified risks and benefits of the waste at the place of application.

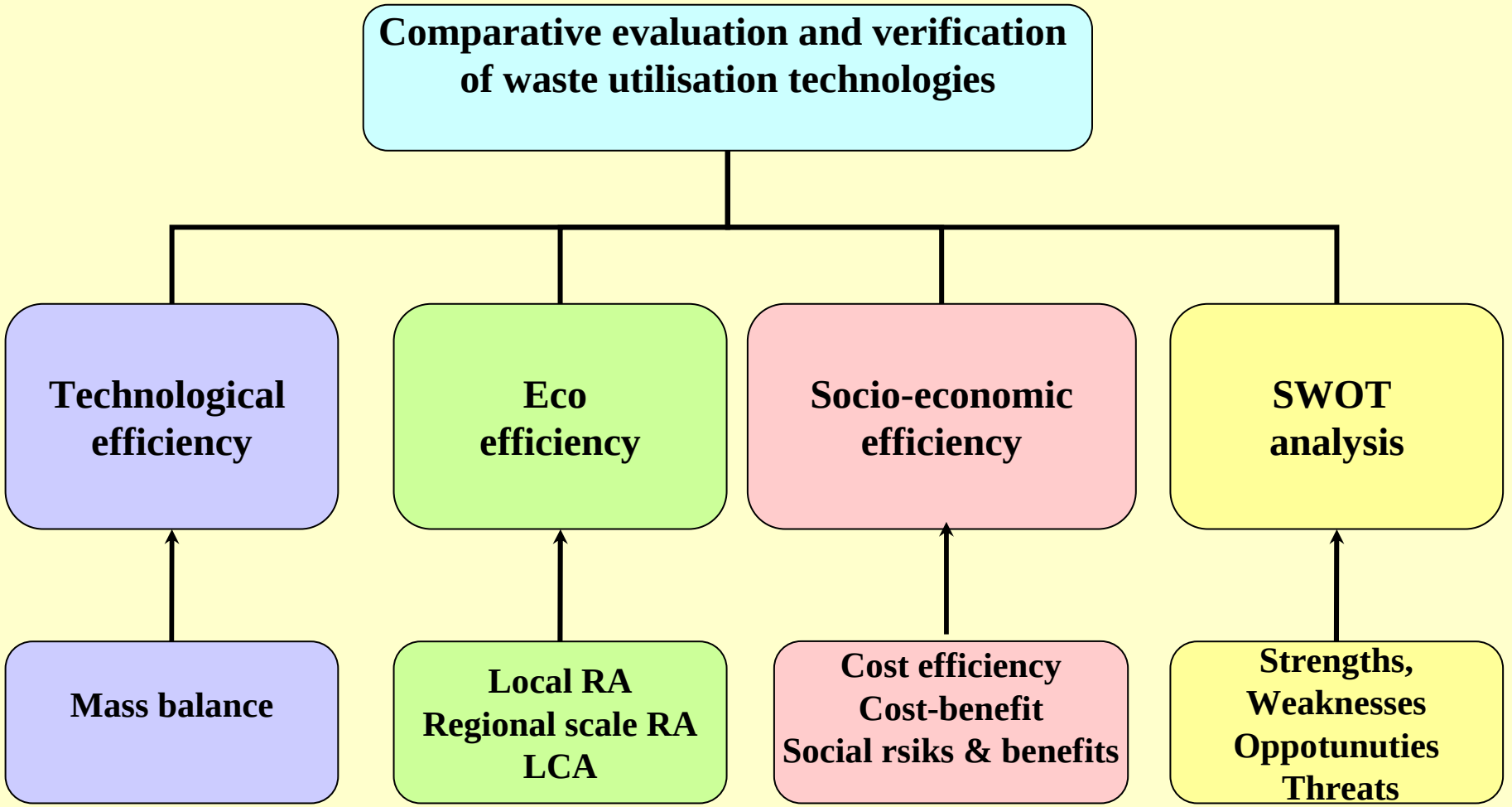
Risk and benefit can be calculated based on the substance/material contents of the waste. It means that similar to chemical substances (under REACH regulation) the existing risk should be controlled.

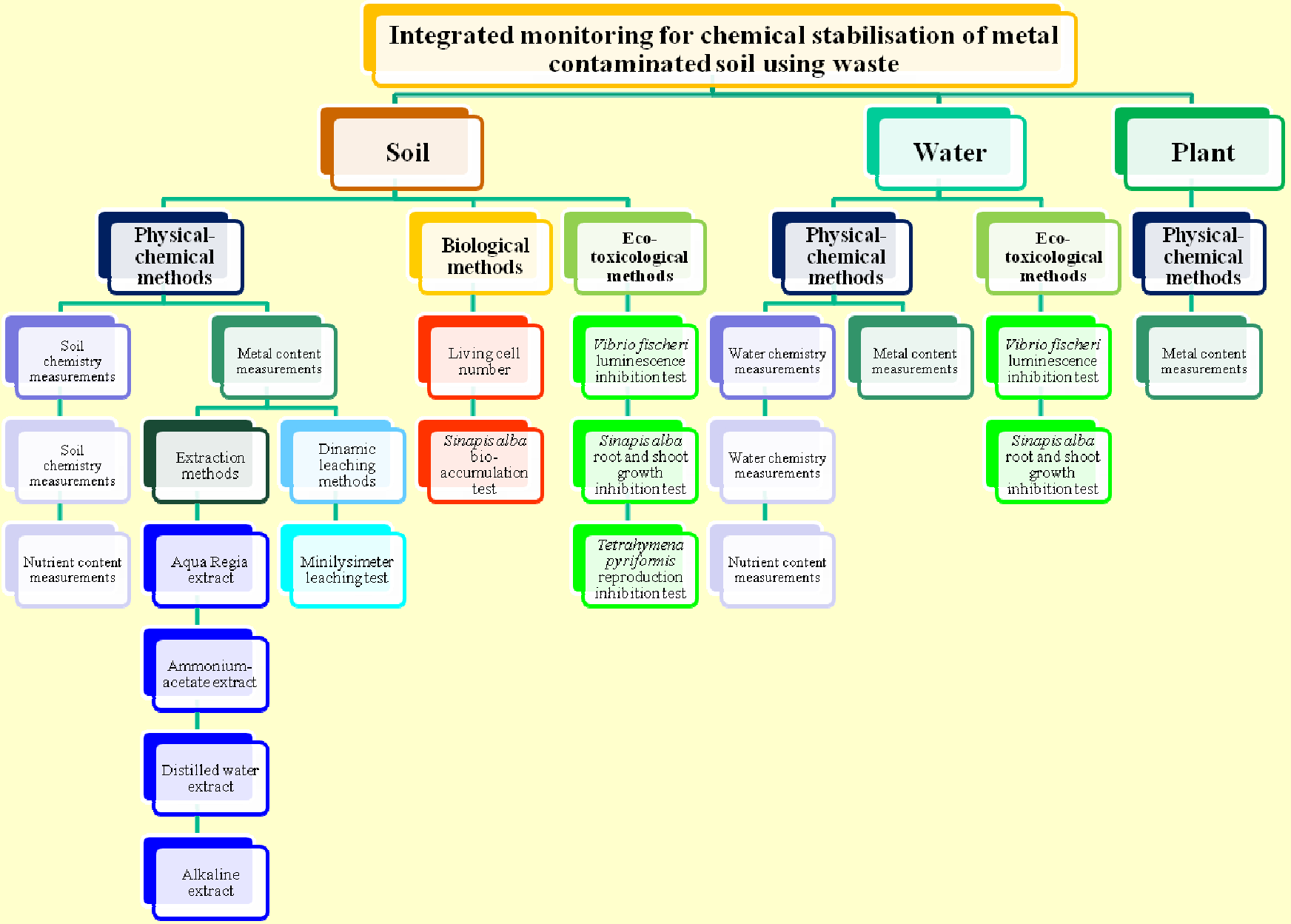
ASSESSMENT OF WASTE APPLICATION ON SOIL



Environmental risk management of waste utilisation on soil




Comparative evaluation and verification of waste utilisation technologies
Technological efficiency
Eco efficiency
Socio-economic efficiency
SWOT analysis
Mass balance
Local RA
Regional scale RA
LCA
Cost efficiency
Cost-benefit
Social rsiks & benefits
Strengths,
Weaknesses
Oppotunuties
Threats


Integrated monitoring for chemical stabilisation of metal contaminated soil using waste
Soil
Water
Plant
Physical-chemical methods
Biological methods
Eco-toxicological methods
Physical-chemical methods
Eco-toxicological methods
Physical-chemical methods
Soil chemistry measurements
Metal content measurements
Living cell number
Vibrio fischeri luminescence inhibition test
Water chemistry measurements
Metal content measurements
Vibrio fischeri luminescence inhibition test
Metal content measurements
Soil chemistry measurements
Extraction methods
Dinamic leaching methods
Sinapis alba bio-accumulation test
Sinapis alba root and shoot growth inhibition test
Water chemistry measurements
Sinapis alba root and shoot growth inhibition test
Nutrient content measurements
Aqua Regia extract
Minilysimeter leaching test
Tetrahymena pyriformis reproduction inhibition test
Nutrient content measurements
Ammonium-acetate extract
Distilled water extract
Alkaline extract

MANAGEMENT PHASE ii.

INVENTORY OF SOIL DEGRADATION AND THREATS
SOIL EVALUATION MAPS – DATABASE

INVENTORY OF WASTE PRODUCTION
WASTE MAPS – DATABASE

INVENTORY OF TECHNOLOGIES & APPLICATIONS
INTERGRATED TECHNOLOGY MONITORING
VERIFICATION OF WASTE APPLICATION ON SOILS
LEGAL BACKGROUND: RISK BASED WASTE MANAGEMENT
INSTEAD OF WASTE: SUBSTANCE, PRODUCT, BY-PRODUCT

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