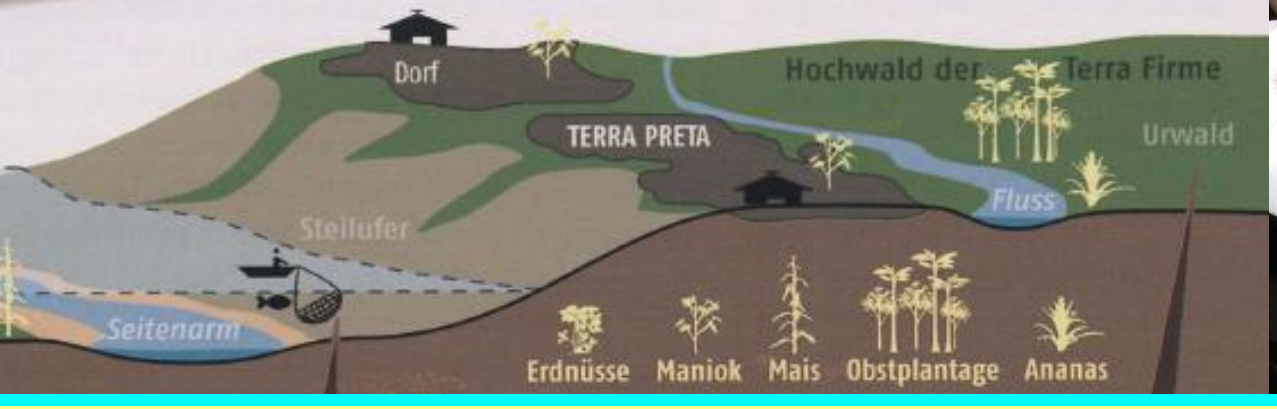

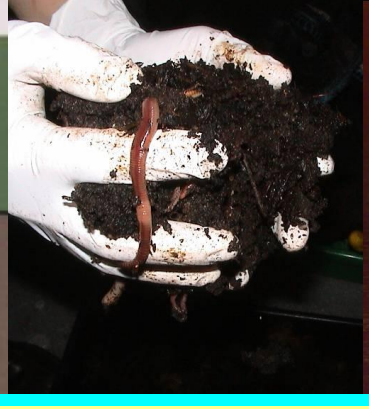


Integrating Sanitation, Bio-waste Management, Energy Production and Agriculture

Univ. Prof. Dr.-Ing. Ralf Otterpohl
Director
Institute of Wastewater Management and Water Protection

TUHH
Hamburg University of Technology

aww
Institute of Wastewater Management and Water Protection

Across Sectors!

Water Key Issues: Soil 1st!

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- Efficiency of water utilisation: irrigation, households

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-Blackwater Loop: Sanitation as fertiliser and humus factory

- Terra Preta Sanitation: Low Cost with humus production

Energy and Biowaste

Woodgas stoves and power/cooling/charcoal production for Terra Preta Composting of biomass

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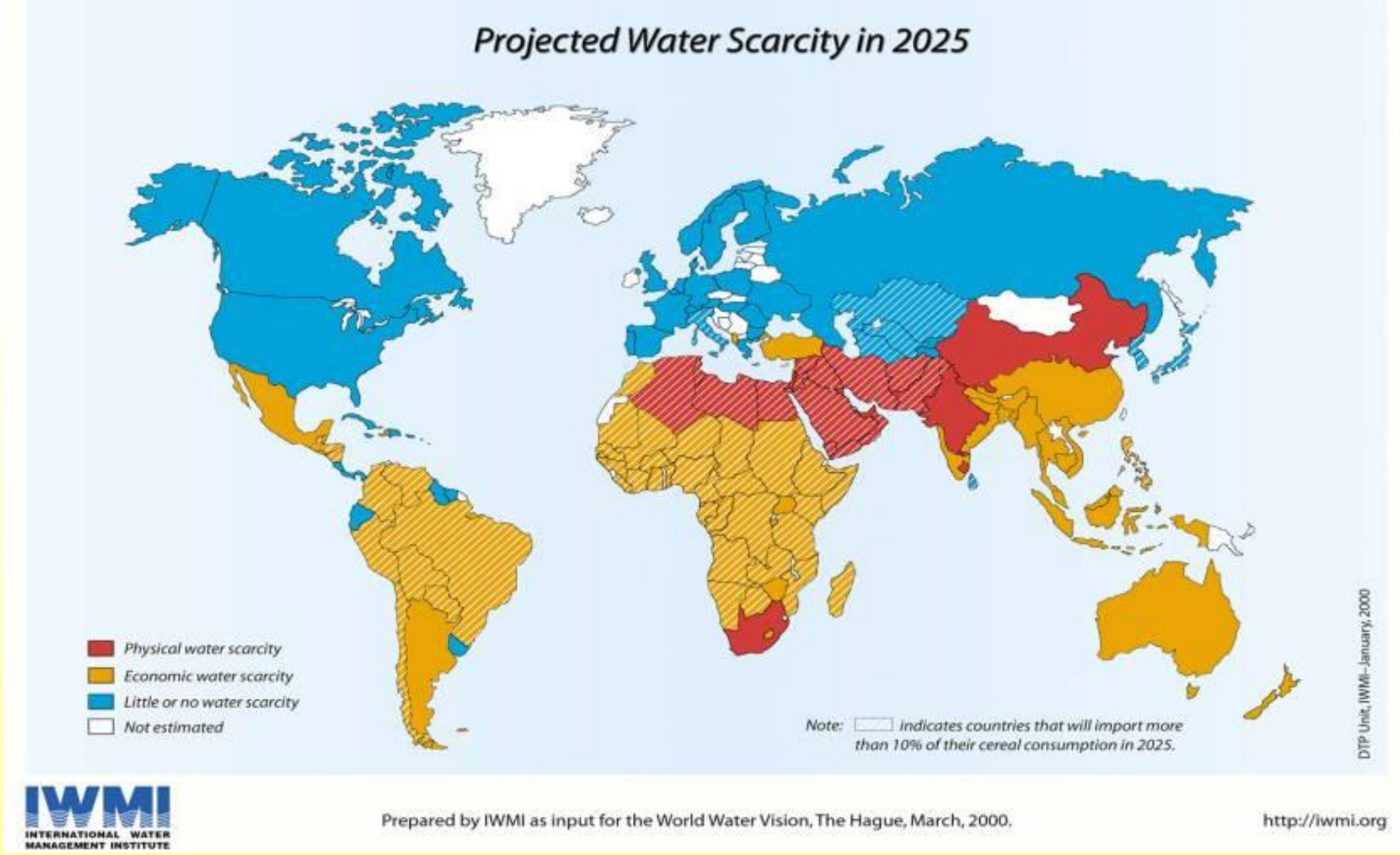
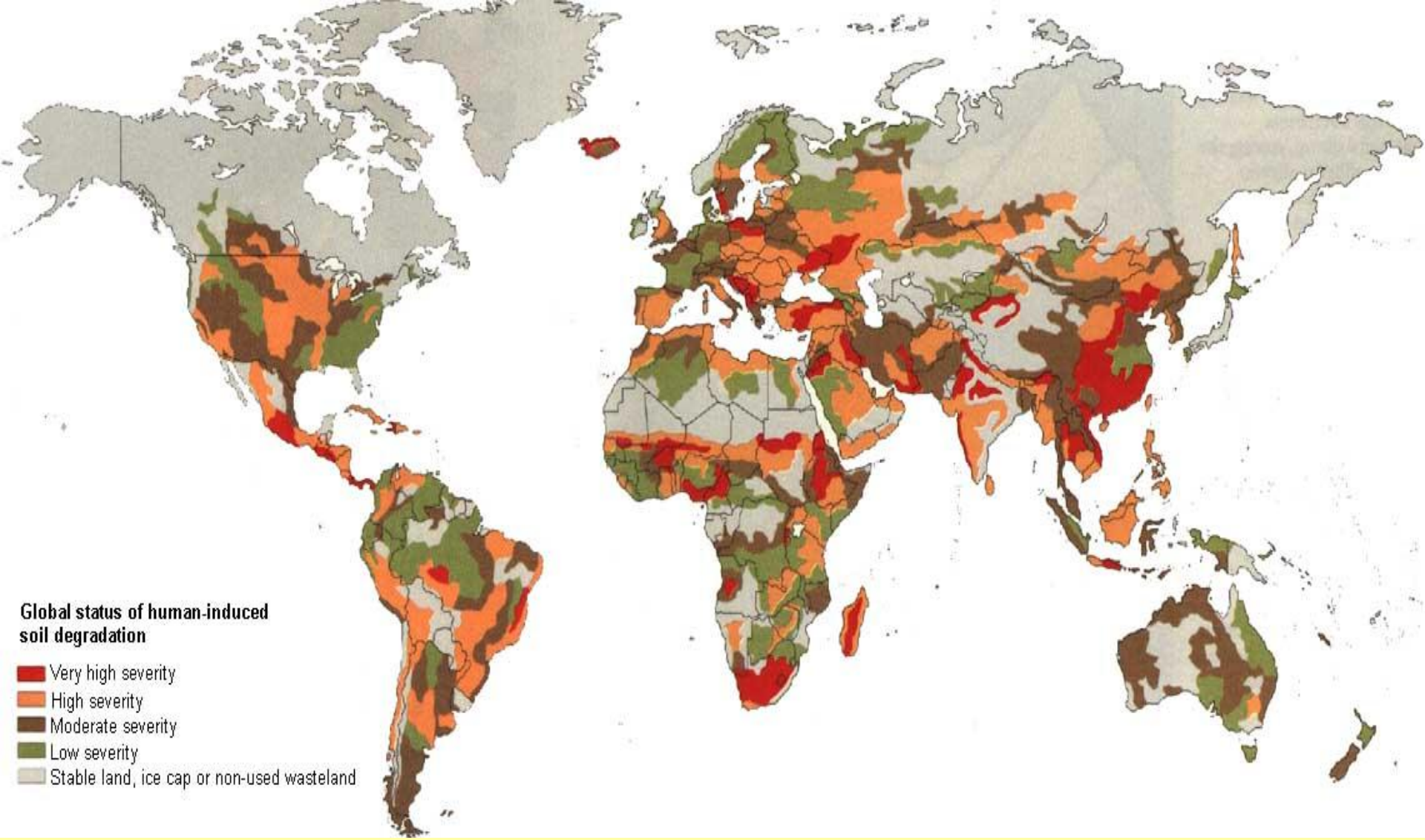


Major problems related to Wastewater (Miss)Management:

Pollution of Rivers, Lakes and the Seas

Scarcity is often a consequence of inefficient Water Usage



Loss of Soil Fertility (slow but dramatic, global scale)

counteraction by returning treated biowaste and faecals

(Map from WWW.FAO.ORG)

The World has strongly detoriated / destroyed ONE THIRD of all fertile soils between 1950 and 1990

UN Millenium Ecosystem Assessment Report

„Bio-Energy“ is often subsidized soil destruction, can create water pollution and contribute to HUNGER

better: Direct Solar Energy, Windpower, Woodgas, Efficiency!

Good Soil makes water

Good Soil prevents drought and flooding

Rainwater Harvesting

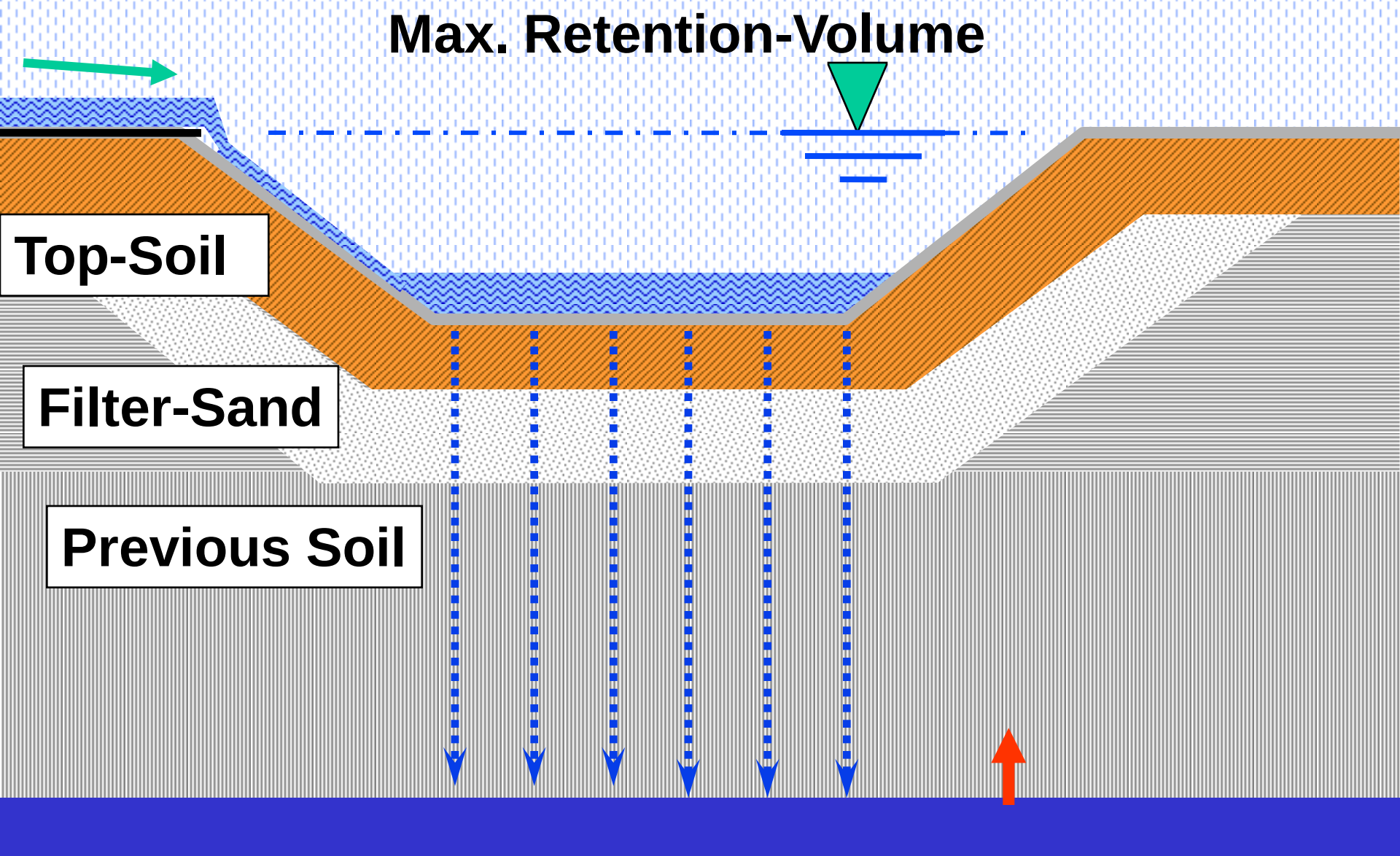
1. Checkdams
2. Infiltration Units
3. Direct Storage

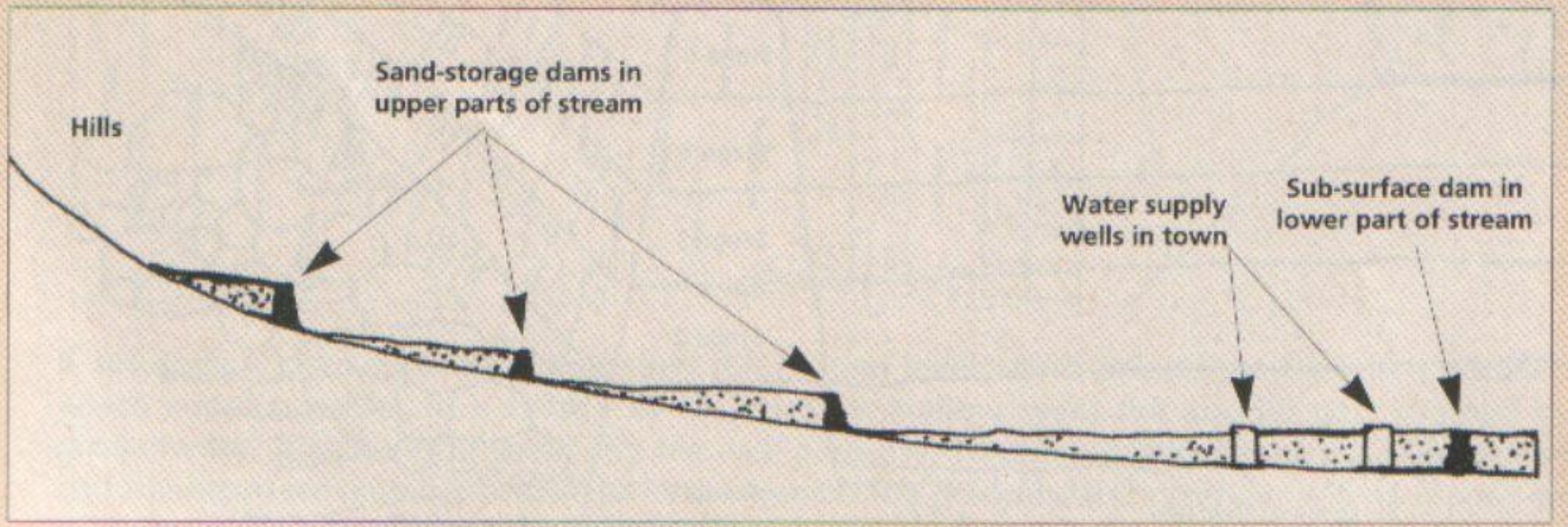
Large Scale:

Bring Water into the Ground through humus rich soil (can take up 150 litres/m²/hour!!)

Free biological treatment in top soil

Rainwater Infiltration Swale





Combined use of sand-storage and sub-surface dams on the eastern slopes of the Western Ghats.

sub surface dam

from: Dying Wisdom, Indias Traditional Water Harvesting Systems, CSE, India

Pollution Prevention, Wastewater Treatment!

Avoid pollution at source:
Green Household Chemicals
(at least EU regulations!)
Natural Medicine, Source Control in Industry

Apply appropriate treatment techniques

EXPERIMENTAL INVESTIGATION OF GREYWATER TREATMENT BY *MORINGA OLEIFERA* SEED POWDER

A Master Thesis by:

Asri Indiyani

JEMES – 20930535

Supervised by:

Prof. Ralf Otterpohl

Dr. Isabel Capela

Mayrina Firdayati

Institute of Wastewater Management and Water Protection

Presented on:

Technische Universität Hamburg-Harburg (TUHH)

Institut für Abwasserwirtschaft und Gewässerschutz

Wednesday, November 9th, 2011

TUHH

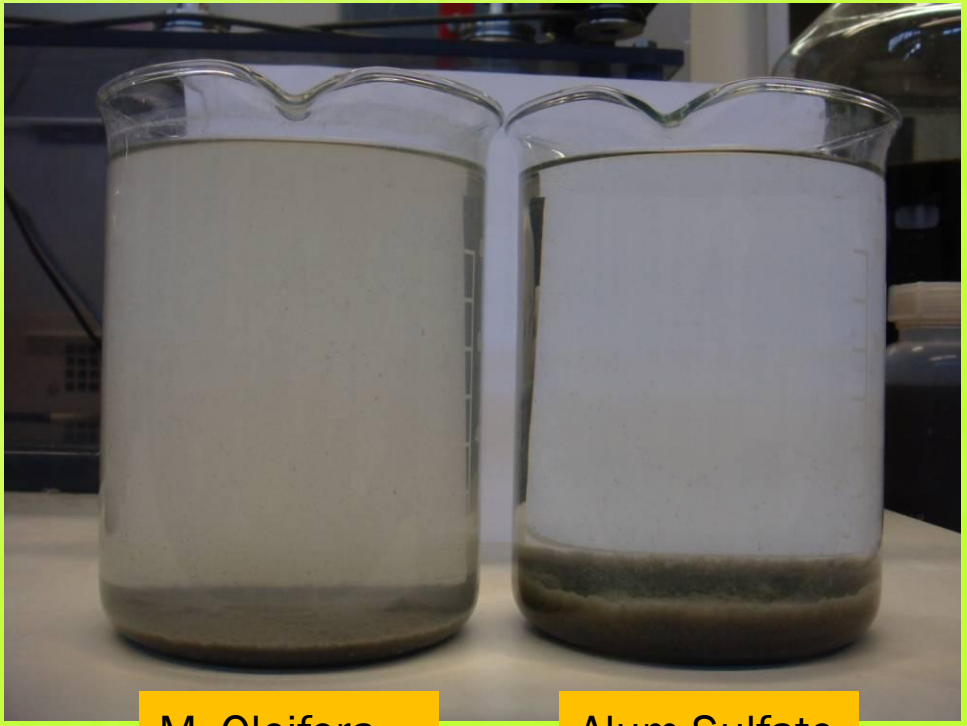
Hamburg University of Technology

COMPARISON BETWEEN COAGULANTS

pH

Initial pH of Raw greywater in average: 7,78
M.Oleifera Powder treated water: pH between 7,6 – 7,72
M.Oleifera Solution treated water: pH between 7,27 – 7,71
Alum Sulfate treated water: pH between 6,72 – 7,6

Sludge Volume

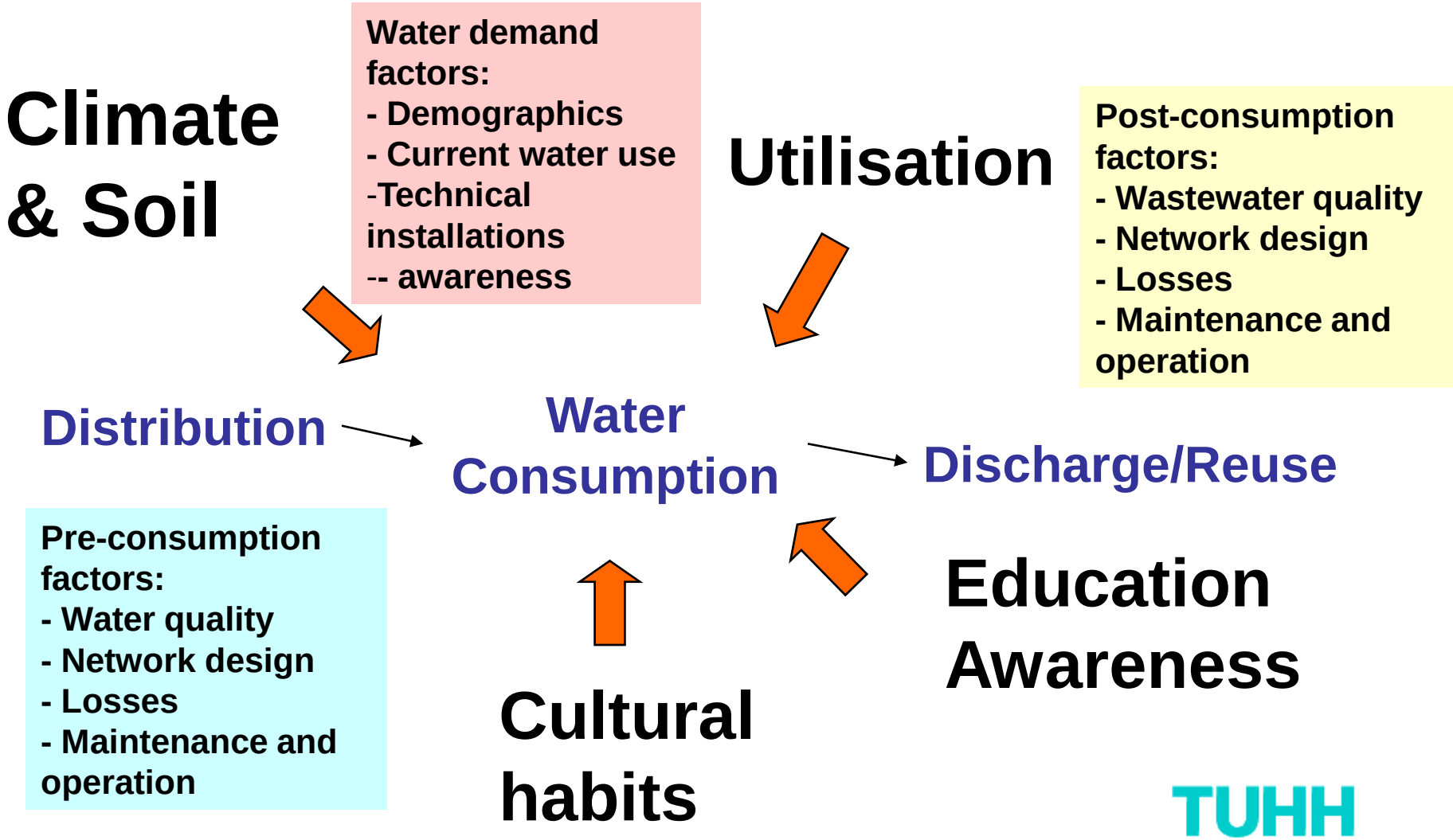


M. Oleifera

Alum Sulfate

Water demand management principles

- **Internal and external influencing factors**



Reducing Water Consumption: Efficient modern Toilets

Well designed flush toilets in Germany work well with 4 Liters of water, 10 Liters is not needed…

Across Sectors!

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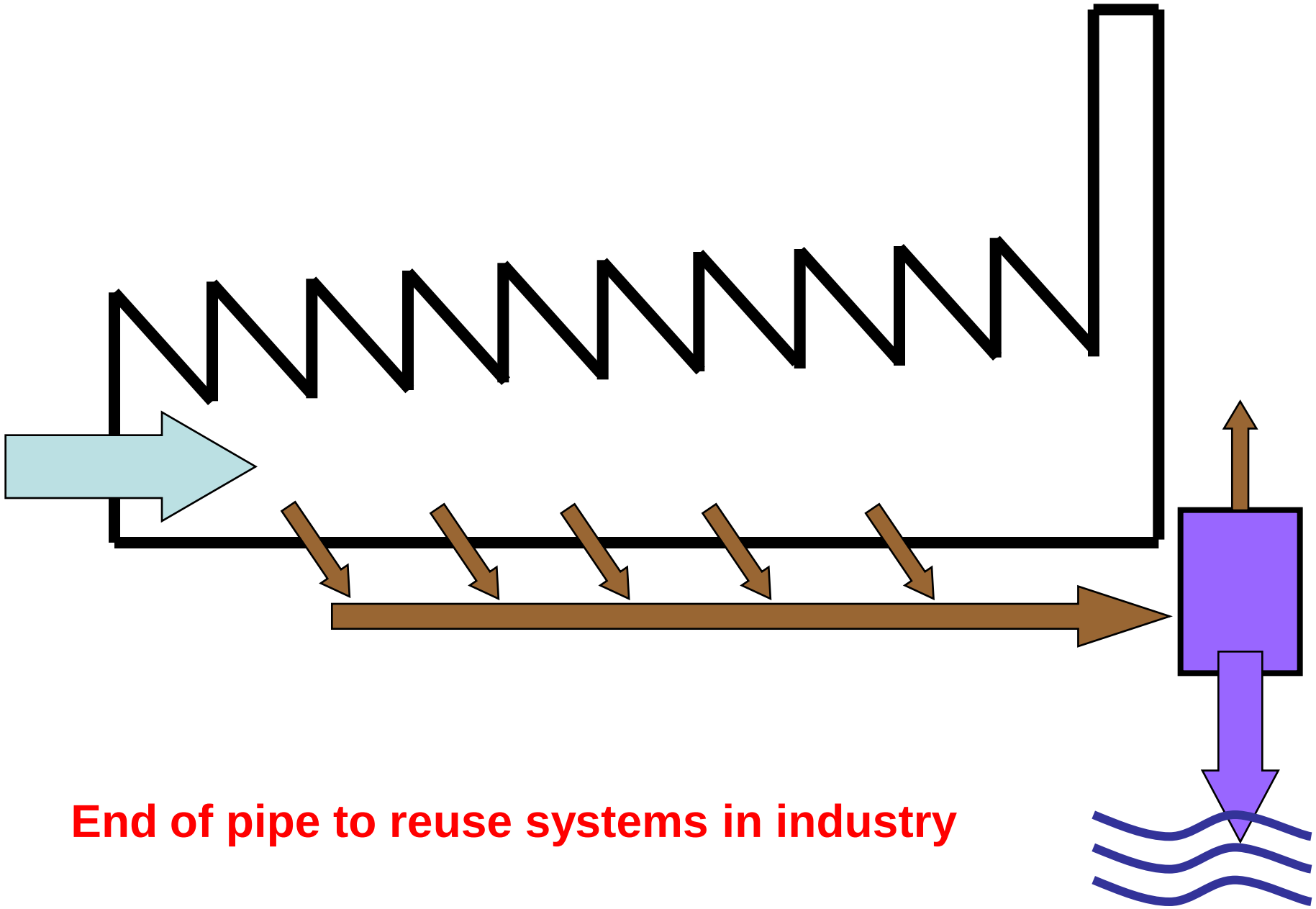
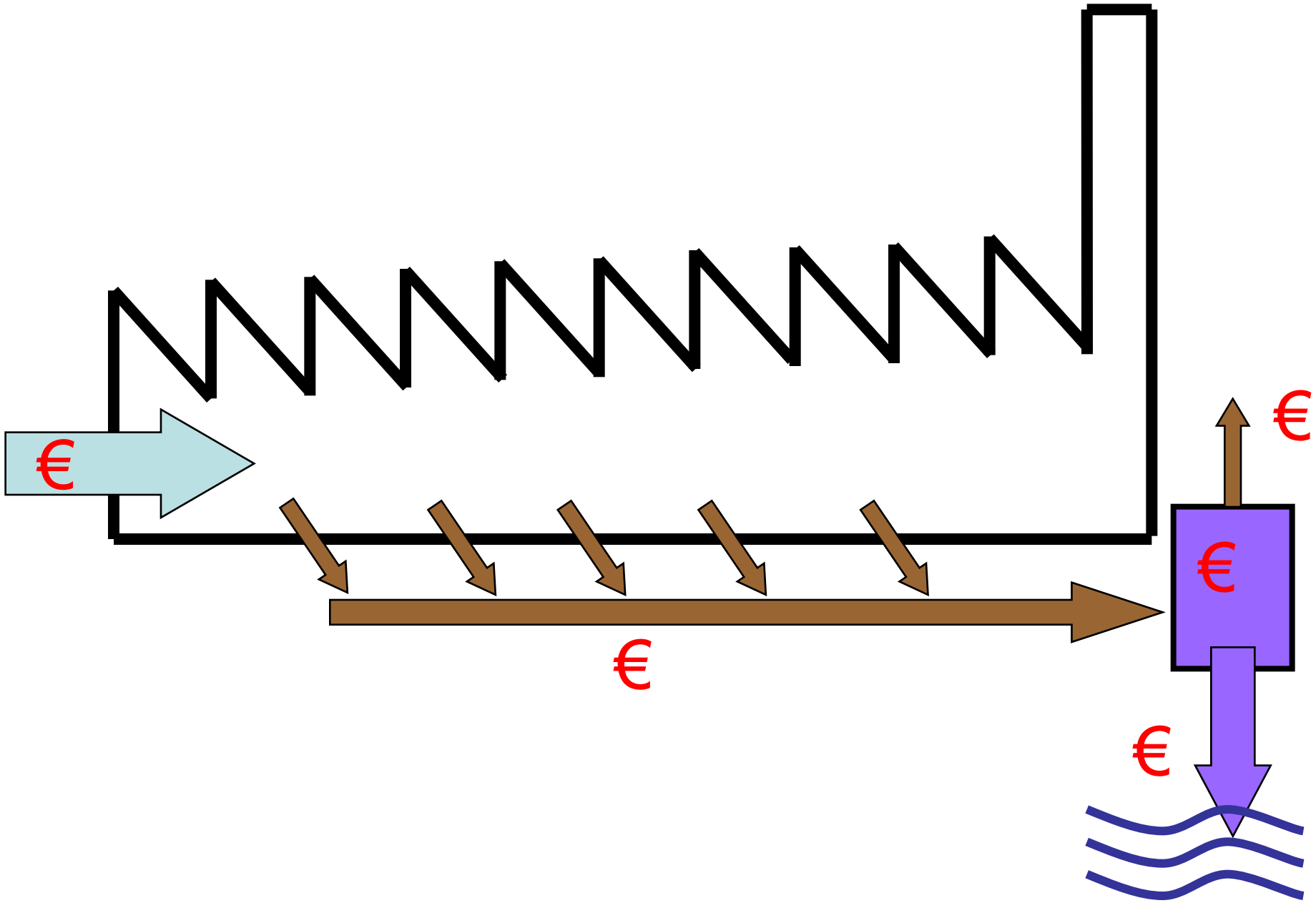
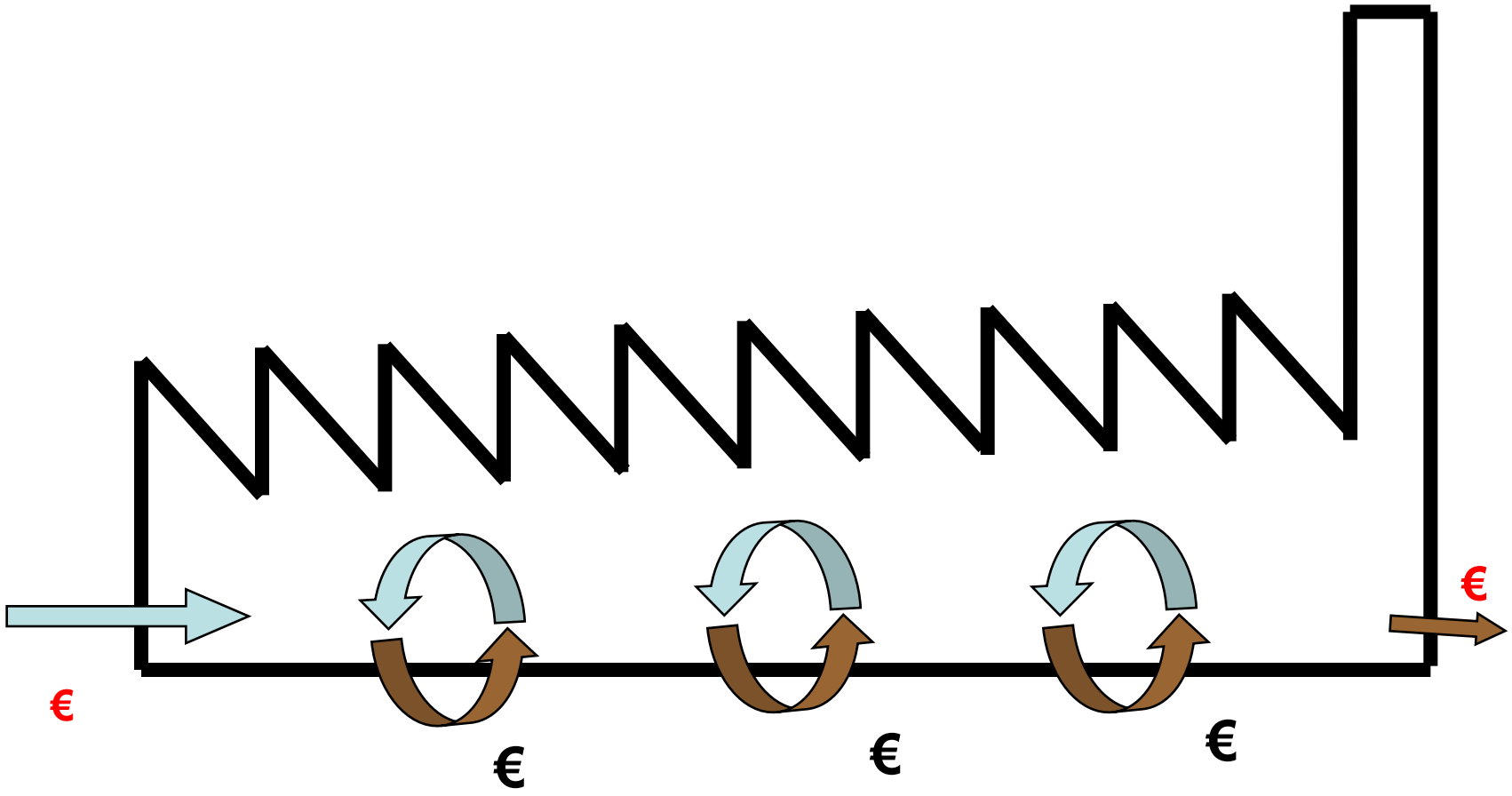


End of pipe to reuse systems in industry



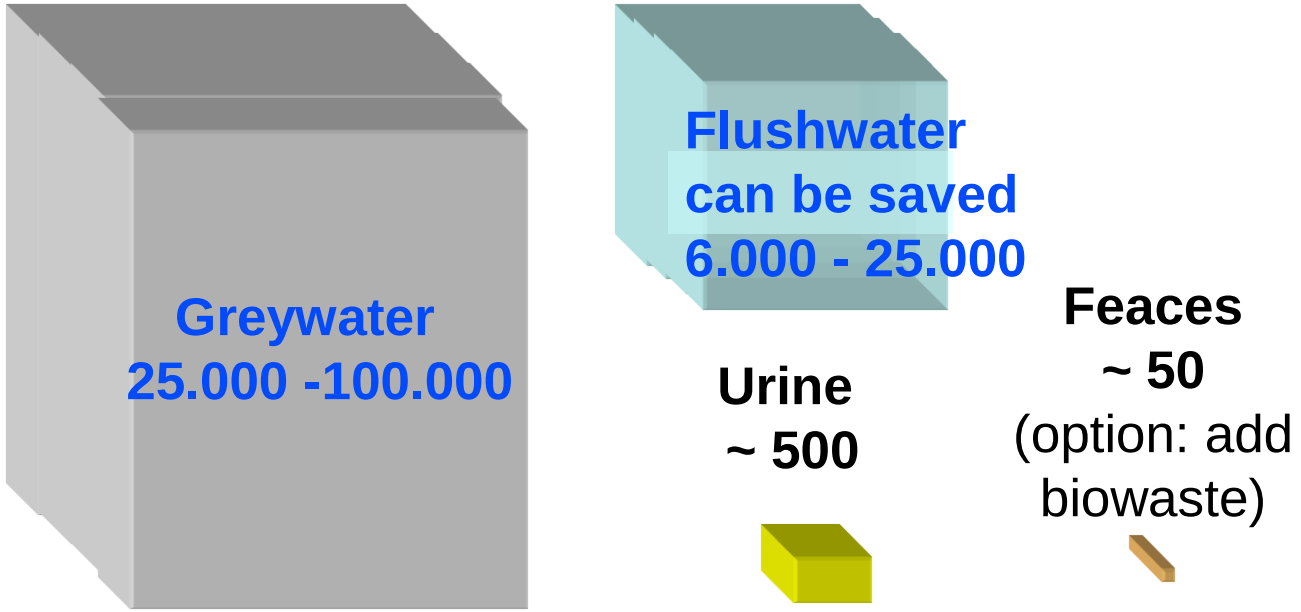


Can the same work in housing areas?

TUHH
Hamburg University of Technology

Volume l/(P*year)

Yearly Loads kg/(P*year)



Most nutrients and
Most organic matter
In toilet wastewater:
SEPARATE

Flushwater can be saved 6.000 - 25.000

Volume l/(P*year)

Greywater 25.000 -100.000

Urine ~ 500

Feaces ~ 50 (option: add biowaste)

Yearly Loads kg/(P*year)

		Greywater	Urine	Feaces
N	**~ 4-5**	~ 3 %	~ 87 %	~ 10 %
P	**~ 0,75**	~ 10 %	~50 %	~ 40 %
K	**~ 1,8**	~ 34 %	~ 54 %	~ 12 %
COD	**~ 30**	%	%	%

S, Ca, Mg and trace elements

T ent

Tr ent

Biog ant

Co ing

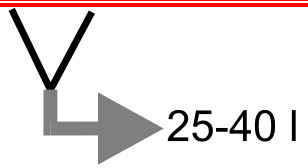
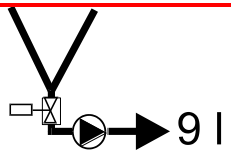
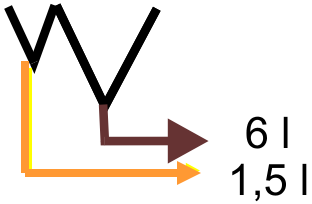
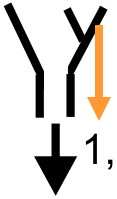
€ Reuse / Water Cycle

€ Fertiliser

€ Soil-Conditioner

Geigy, Wiss. Tabellen, Basel 1981, Vol. 1, LARSEN and GUJER 1996, FITSCHEN and HAHN 1998

Toilets and resulting Dilution

Type of Toilet	Daily Flow per P.	Pro and Con's
Flushing toilet		+ widely accepted - waste of water - high dilution
Vacuum-toilet		+ low water demand + well developed (ships) - high-tec / expensive
Separating toilet		+ little water / little dilution + simple fertiliser reuse - little experience
Waterless Urinal		+ no water / no dilution - maintenance required
Composting-toilet Desiccation toilet		+ no water needed - high space demand - maintenance needed ++ Desiccation for hot climates

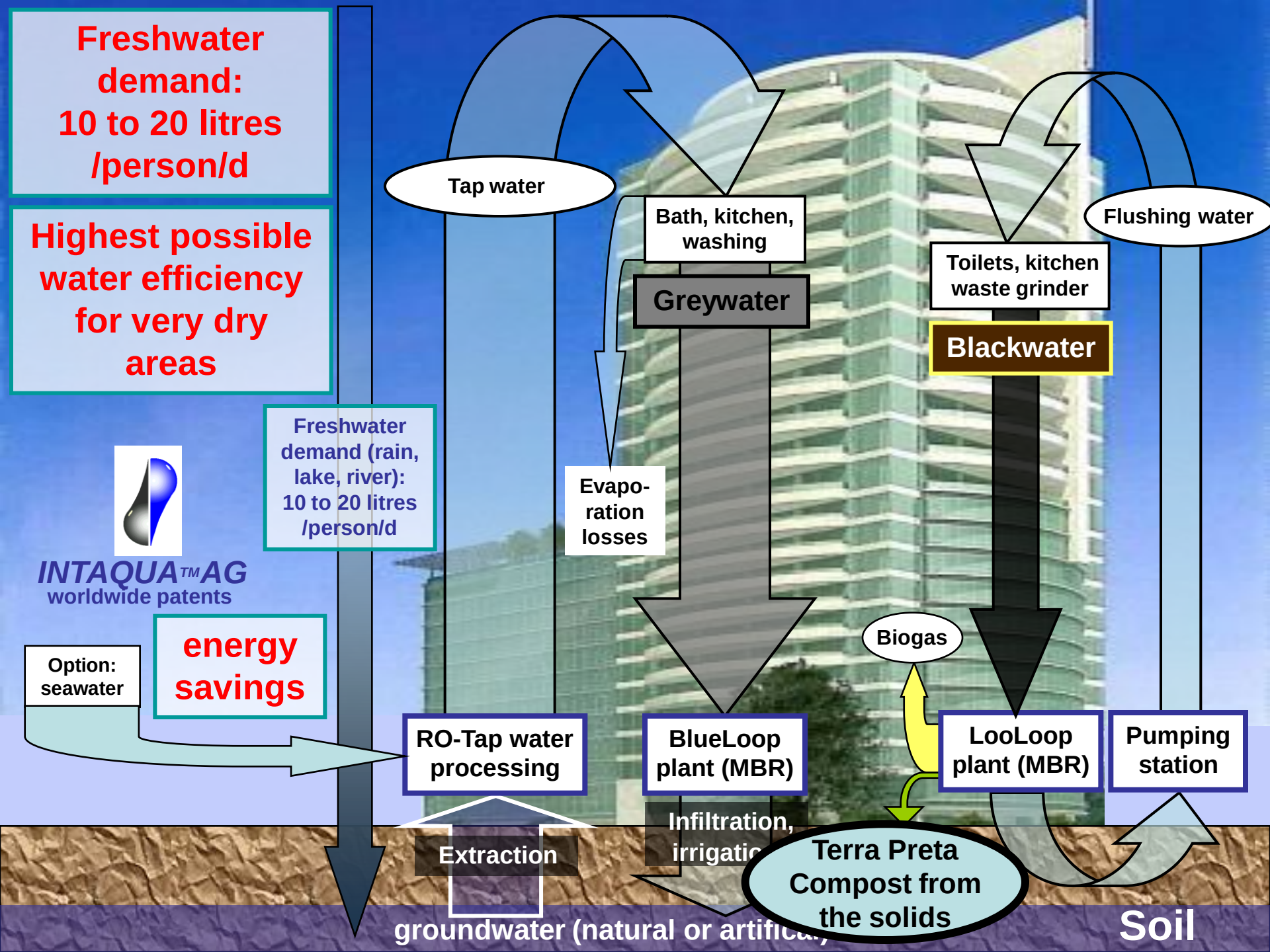
Low/Non-diluting toilets are the key for new sanitation concepts

Settlement Lübeck-Flintenbreite
Water consumption 65 l/capita/day

Double-Houses

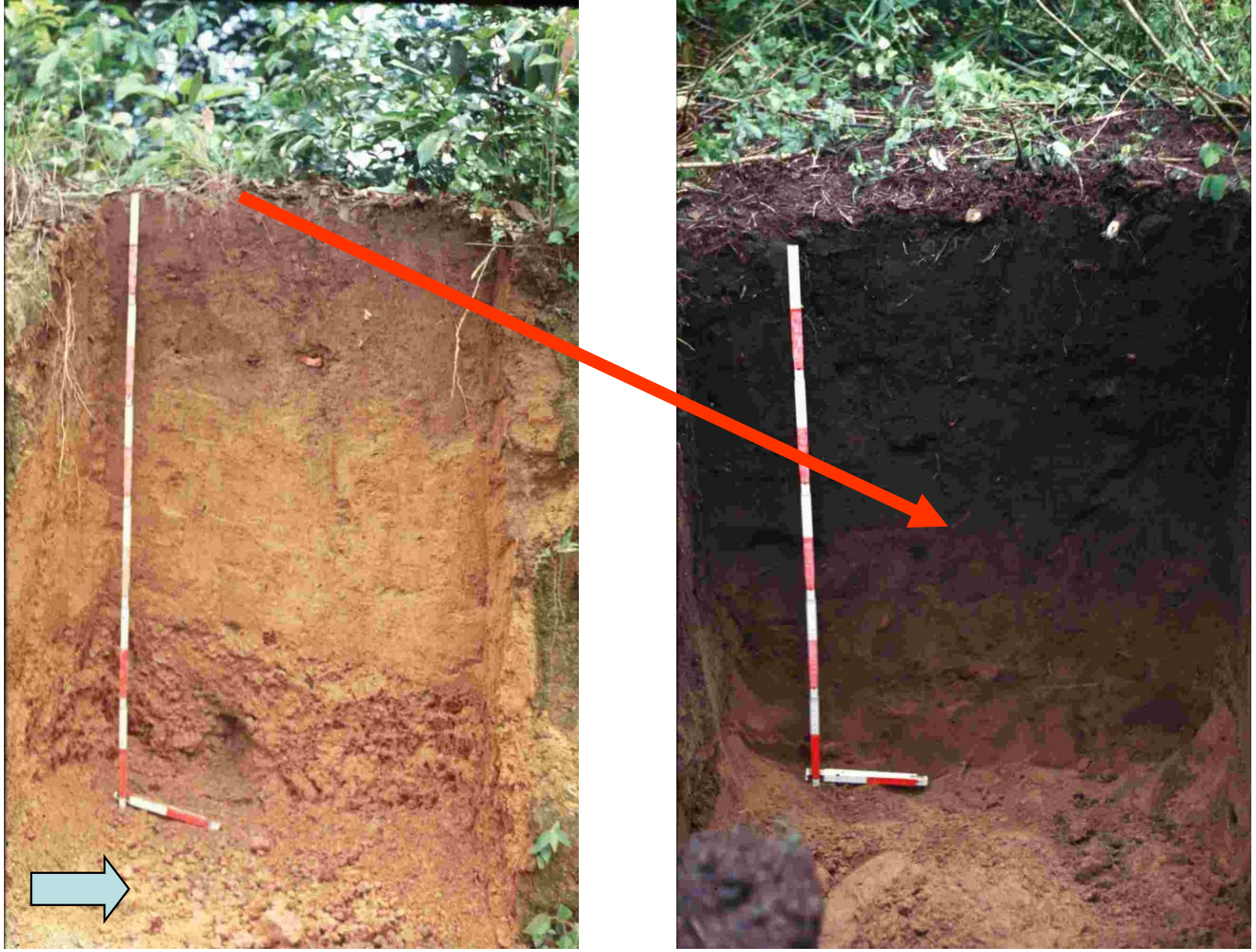
Terraced Houses

OtterWasser GmbH


Freshwater demand: 10 to 20 litres /person/d
Highest possible water efficiency for very dry areas
Freshwater demand (rain, lake, river): 10 to 20 litres /person/d
INTAQUA™AG
worldwide patents
energy savings
Option: seawater
Tap water
Bath, kitchen, washing
Greywater
Flushing water
Toilets, kitchen waste grinder
Blackwater
Evapo-ration losses
Biogas
RO-Tap water processing
BlueLoop plant (MBR)
LooLoop plant (MBR)
Pumping station
Infiltration, irrigatio
Extraction
Terra Preta Compost from the solids
groundwater (natural or artifici
Soil

GEO, March 2009

Historic Amazon: Forest Argriculture in three layers GEO 3/2009



Poor soil can become highly fertile with clever management of biowaste and sanitation

Ecosan innovation

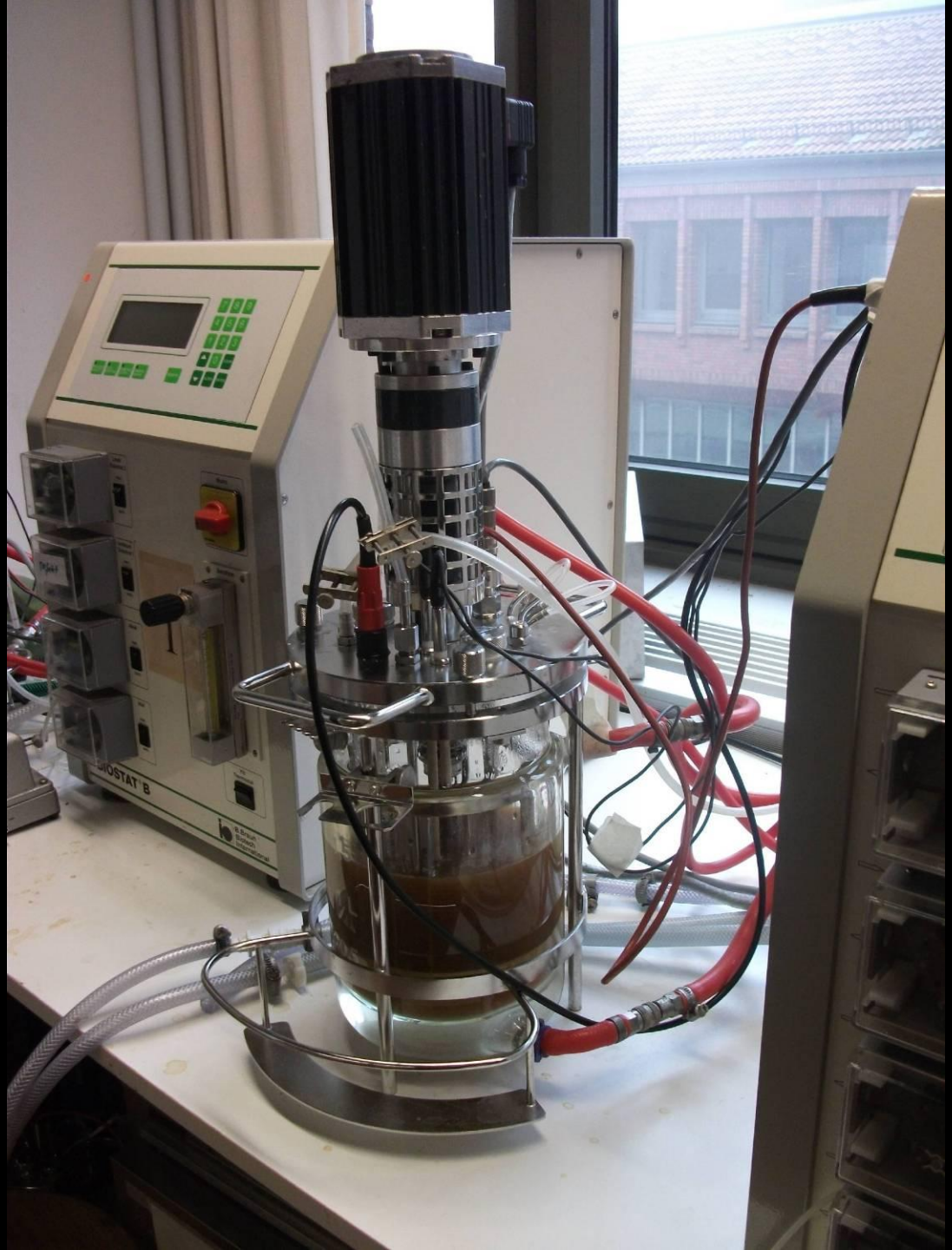
- **Mass produced toilets for lactic acid fermentation can be cheap by mass production**
- **Professional collection and vermicomposting where the humus can be used**
- **Simple first step for pit latrines: Teach people to collect and reuse urine while adding lactic acid bacteria to the pit and later worms (alternating shallow pits)**

Terra Preta is ideally produced with dry toilets with seperate urine collection

However, if it shall be flush for legal or cultural reasons, this can be done in combination with separate urine collection and a fermentation tank
(formerly rottebehälter or pre-composting tank)

Urine colletion with individual bottle like in hospitals or Pippinette


Combination of
Terra Preta Sanitation
With flush toilets
Sieving unit
for solids



Third step: Vermicomposting of feacal matter

Breakthrough in solids treatment at TUHH (BMBF / IPSWaT)

What do do if there are mainly roofs and roads?

Across Sectors!

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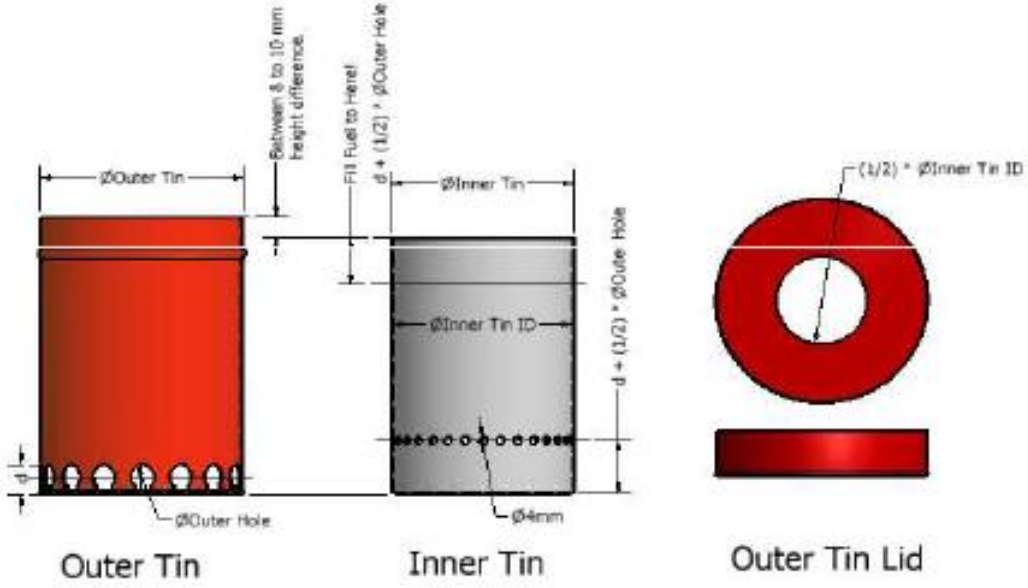
Carbonisation not incineration:

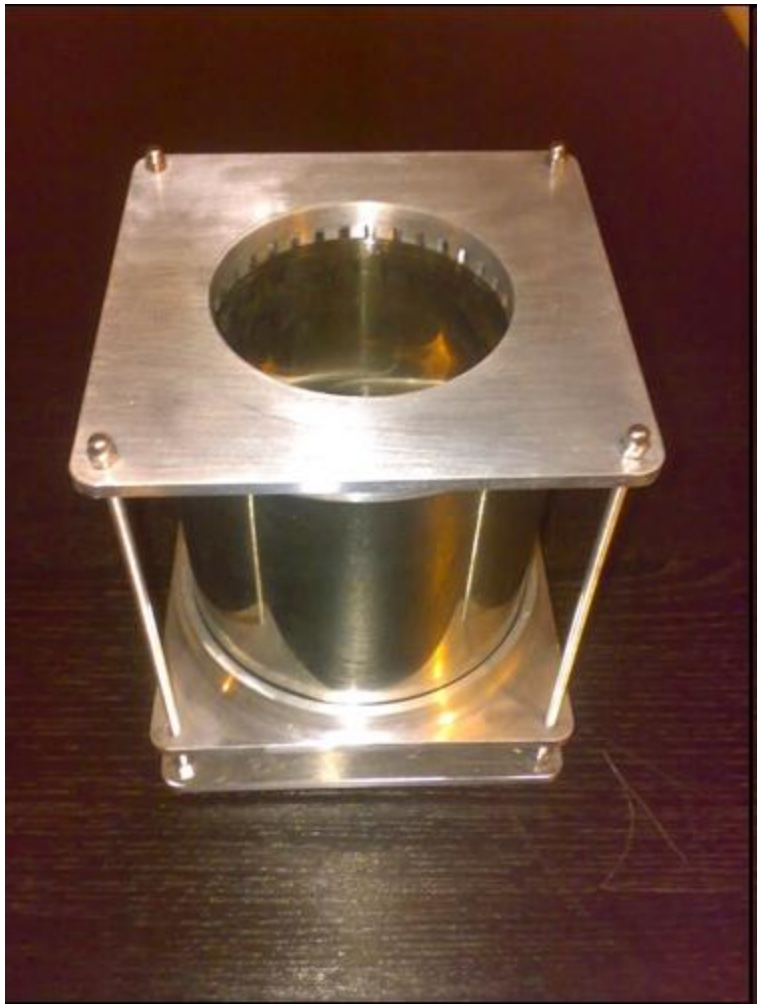
www.WORLDSTOVE.com



Creating biochar while coocking

Biochar for Terra Preta

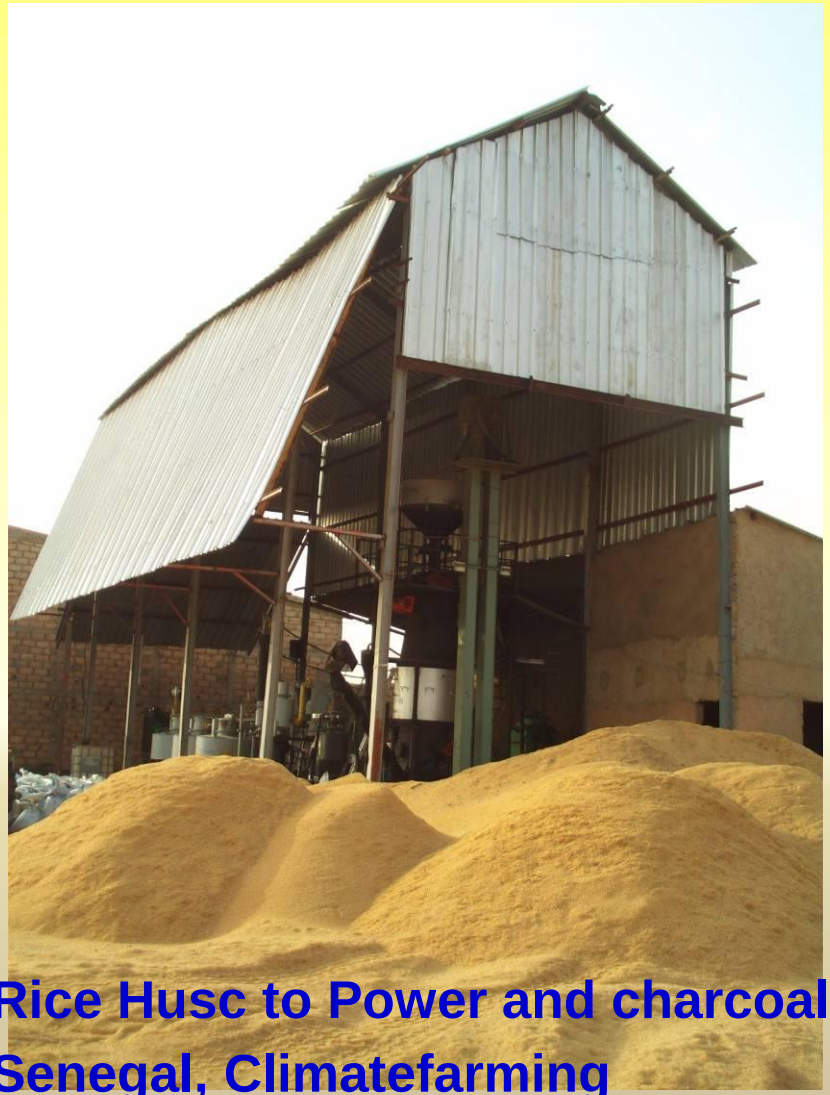
Compost makes rich soil



Organic waste is DRAMATICALLY NEEDED for keeping humus levels up!

Good Luck:

Power, Heat, Cooling and charcoal can come together



Rice Husc to Power and charcoal Senegal, Climatefarming


VENTURY SCRUB
DRAIN BOX
2011/5/20


CHECK
OIL LEVEL
2011/5/20

CONCLUSIONS

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Much is possible, let us do it for our childrens future!

- www.tuhh.de/aww
- www.terra-preta-sanitation.net
  (Design Award 50.000 $ still open)
- www.anamed.net
- www.rainwaterharvesting.org

Books:

- **Montgomery: Dirt**
- **Secrets of the soil**