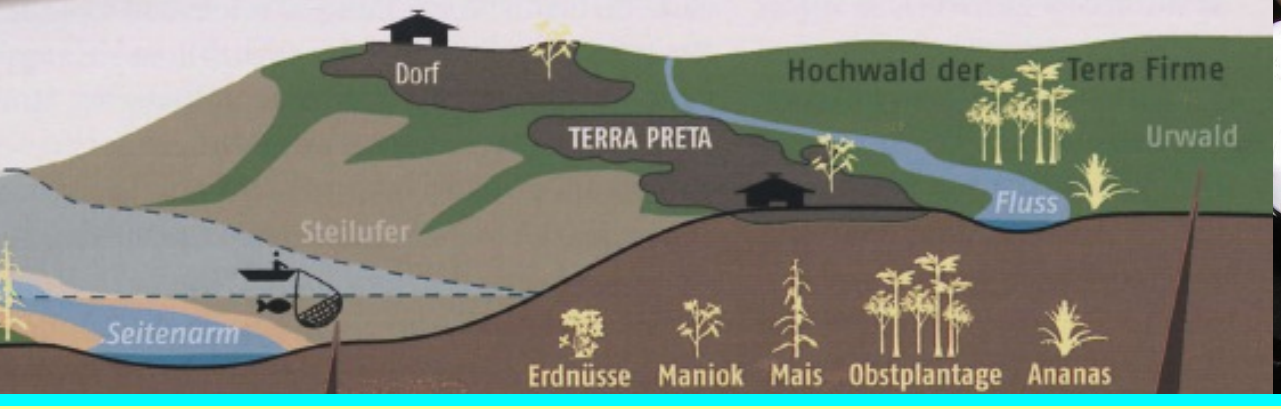
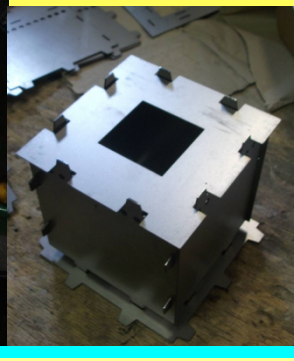


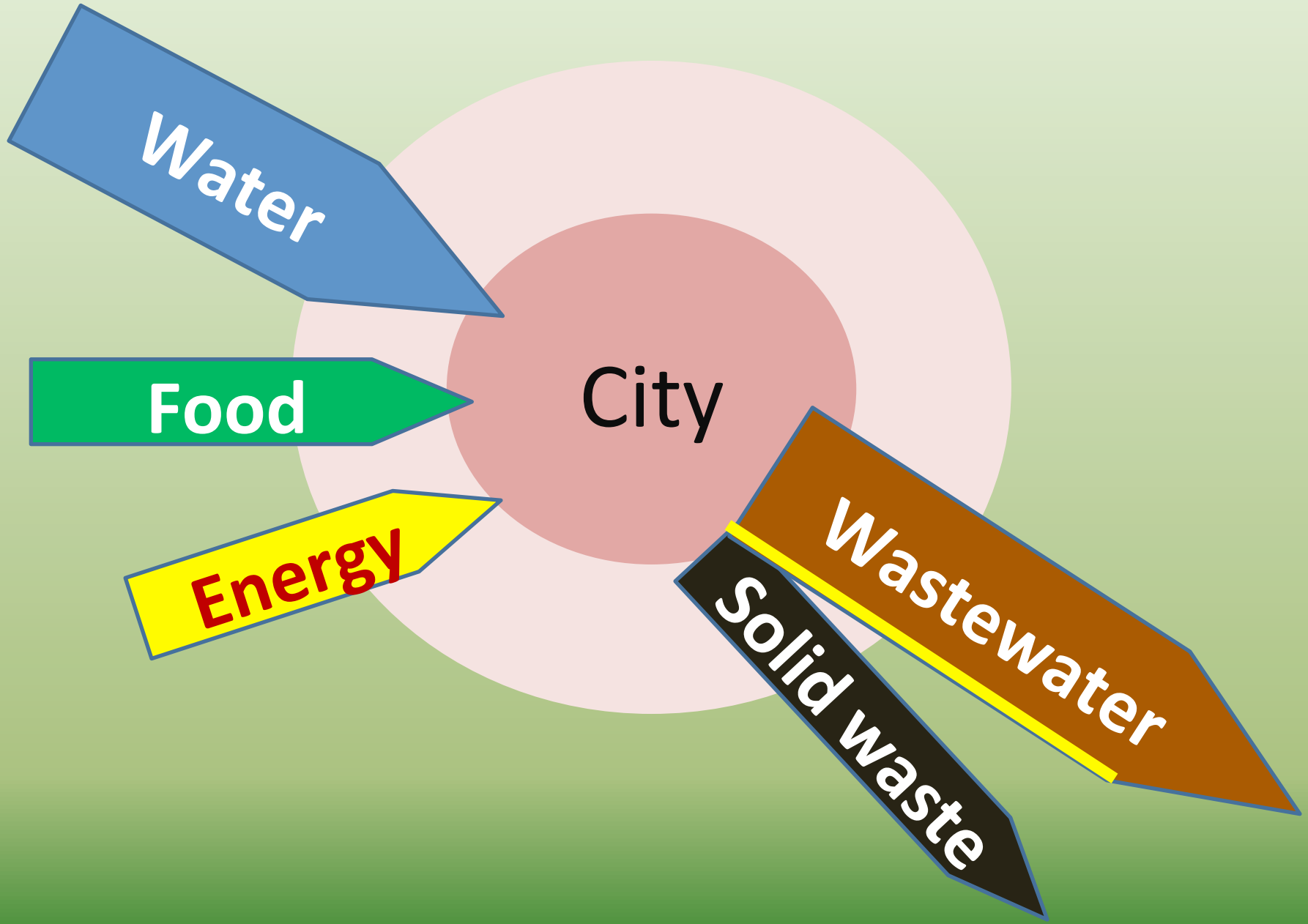



Integrating Sanitation, Bio-waste, Energy and Agriculture: Terra Preta

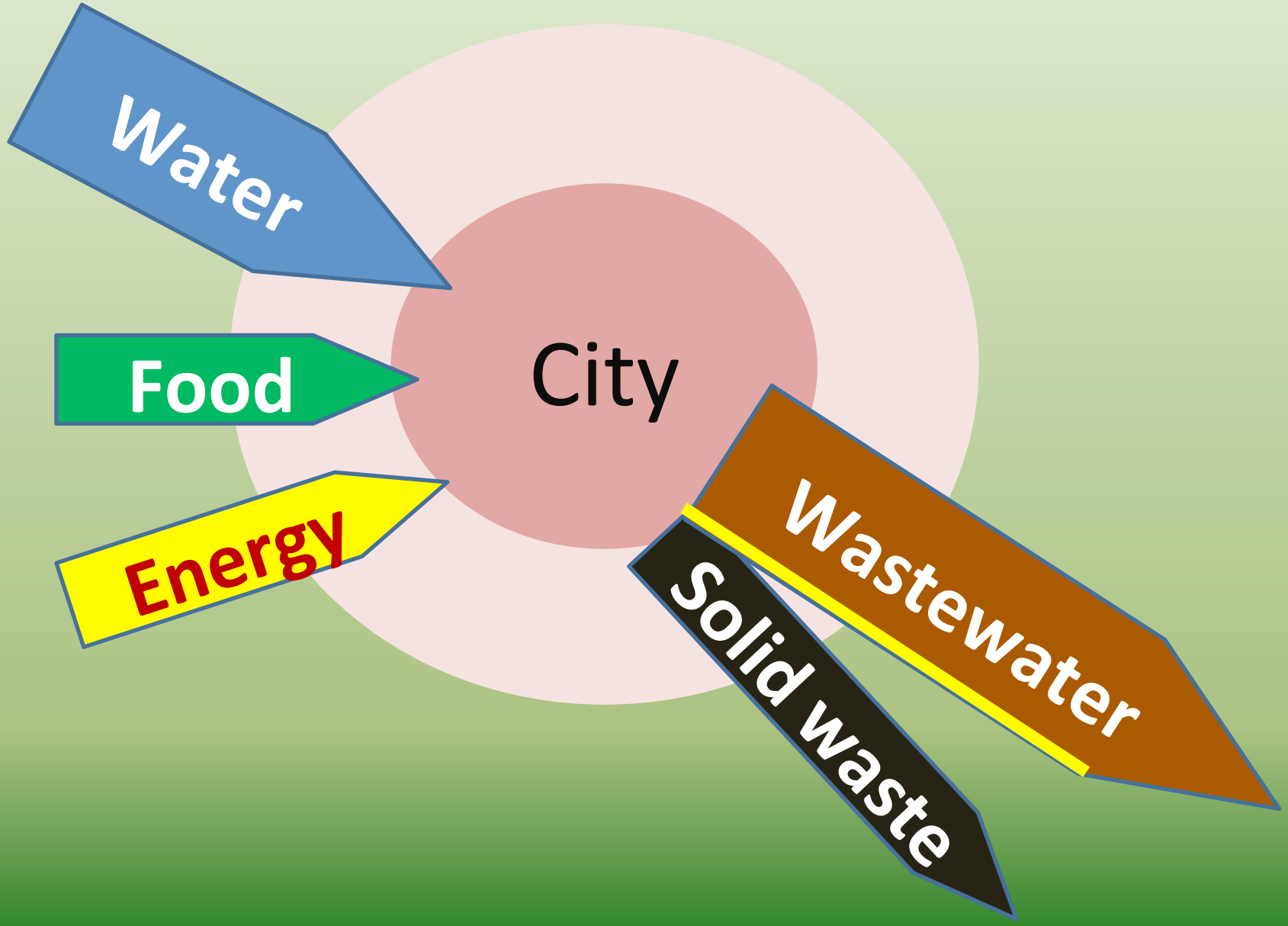
Univ. Prof. Dr.-Ing. Ralf Otterpohl
Director
Institute of Wastewater Management and Water Protection

TUHH
Hamburg University of Technology

aww
Institute of Wastewater Management
and Water Protection


Water
Food
Energy
City
Wastewater
Solid waste

LIVING Humus Soils



OUTLINE

Water Key Issues: Soil 1st!

- Humus rich soil Soil has a very high water uptake, cleans it, stores it, keeps moisture for plants
- Rainwater Harvesting and Reuse,
- How to convert dryland to green land

Innovative Sanitation

- Pollution to be avoided at the source: Water Protection
- Efficiency of water utilisation: irrigation, households
- Blackwater Loop: Sanitation as fertiliser and humus factory
- Terra Preta Sanitation

Energy - Water - Soil

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

Conclusions

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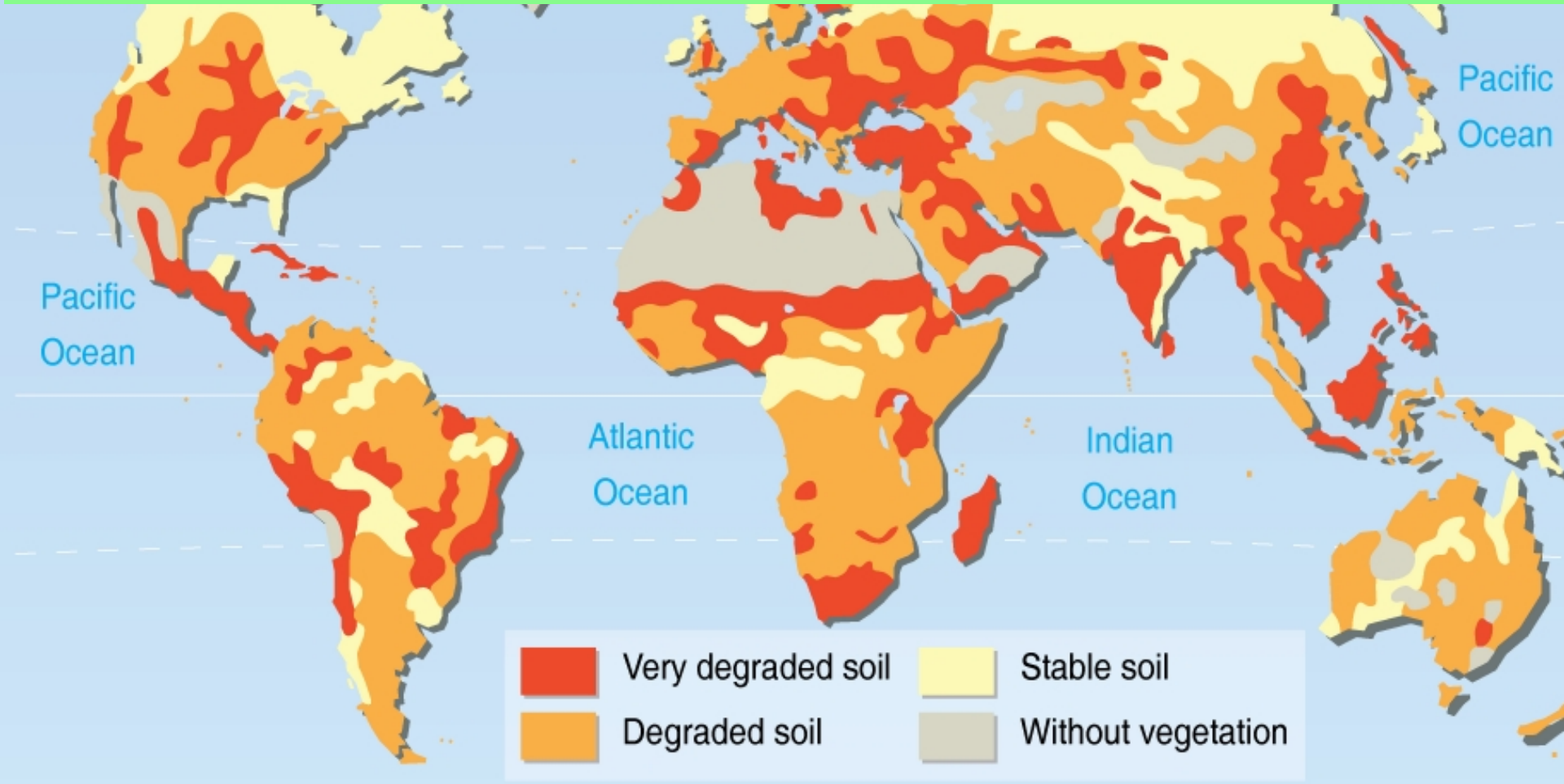
Loss of Soil Fertility (slow but dramatic, global scale) counteraction is THE key issue for a good future for Many including Climate Change

(Map from WWW.FAO.ORG)



Source: UNEP, International Soil Reference and Information Centre (ISRIC), World Atlas of Desertification, 1997.

Philippe Rekacewicz, UNEP/GRID-Arend

The World has lost ONE THIRD of all fertile soils between 1950 and 1990

UN Millenium Ecosystem Assessment Report

Industial agriculture tends to destroy humus in the long run, what will likely cause starvation for billions of people

„Bio-Energy“ is often causing soil destoriation, can create water pollution and less food production.

Good Soil can retain and regenerate water

Must See: lessons of the loess plateau, John D. Liu

Good Soil prevents drought and flooding

Lost your good soil around?

resolve the problem immediately. Antara Photo/Zabur Karuru

Rainwater Harvesting

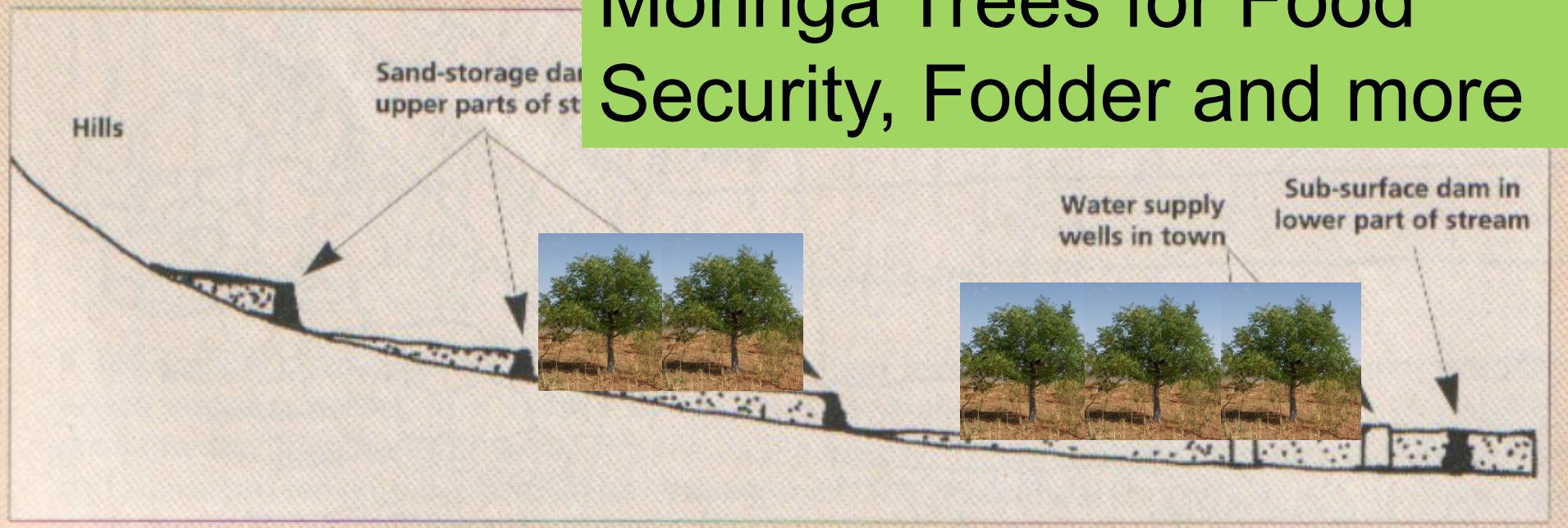
chniques to s nwater
surfac ls, ground
omestic or
ag

Three main comp
- **catchment area**
- **Storage / reservoir**
- **delivery system**

However, before you start: look for the overall situation: Topography, soil quality (sponge or rock?), Forests in the slopes, Illegal logging? Destructive grazing (unplanned)? Legal situation, stakeholders, community groups …

Stopping Erosion in Ethiopia, Konso hill slopes turn productive waterstorage, March 2012

Moringa Trees for Food Security, Fodder and more



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

Video: Miracle Water Village, India

Check dams for erosion prevention capture soil and water

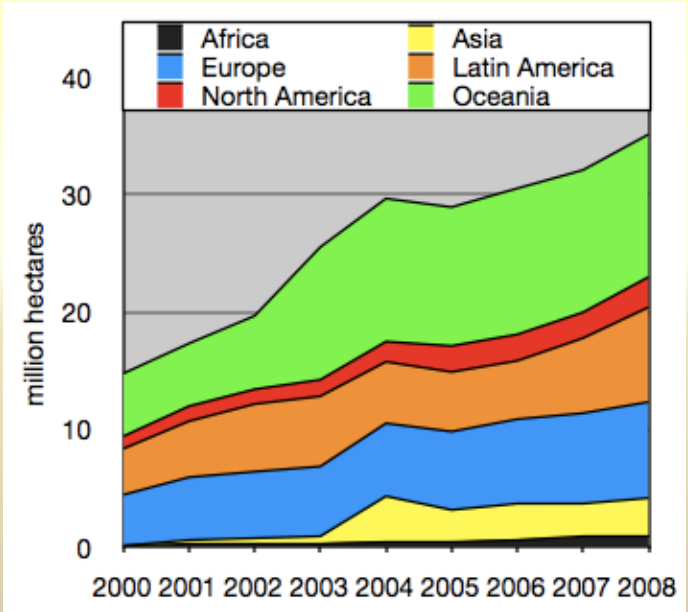
from: Dying Wisdom, Indias Traditional Water Harvesting Systems, CSE, India

Good Soil makes more and better food

Wikipedia
11/2011

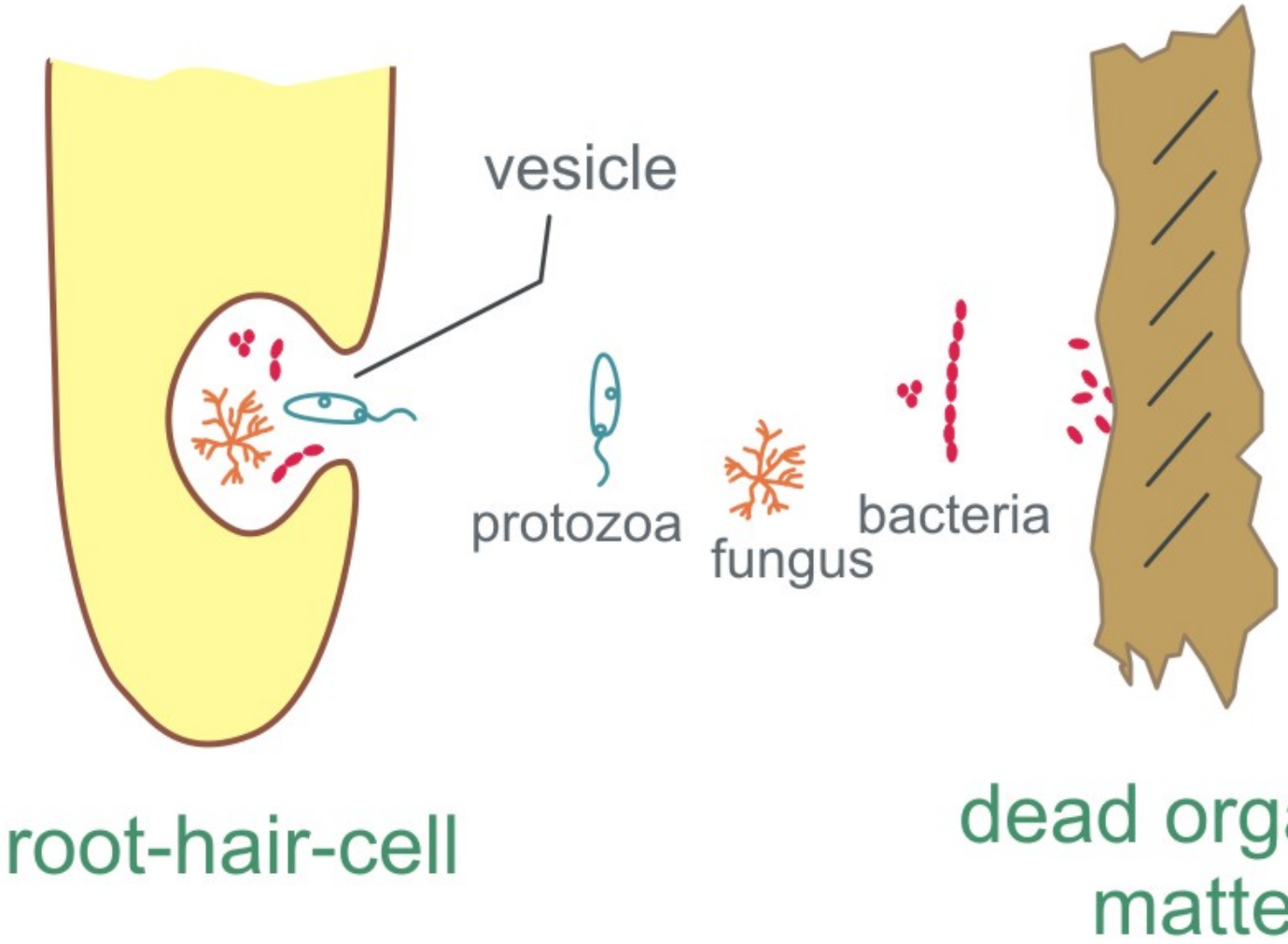
Good Soil makes lots of food and organic material for good soil

organic agriculture is growing strongly, and it can still improve



Wikipedia
11/2011

Endocytosis



Dr. Bargyla Rateaver Organic Method Primer Update, San Diego, USA, 1993

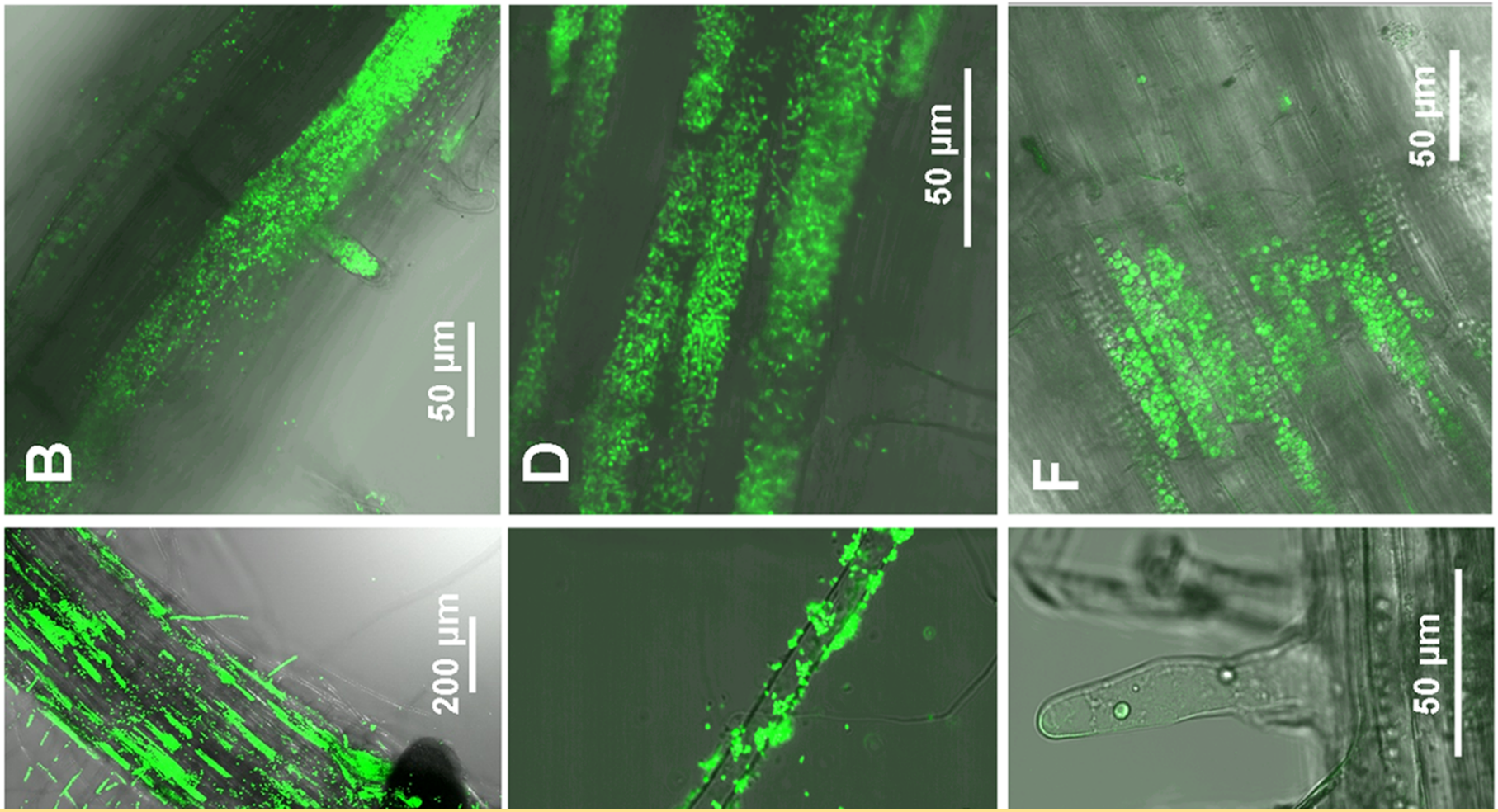
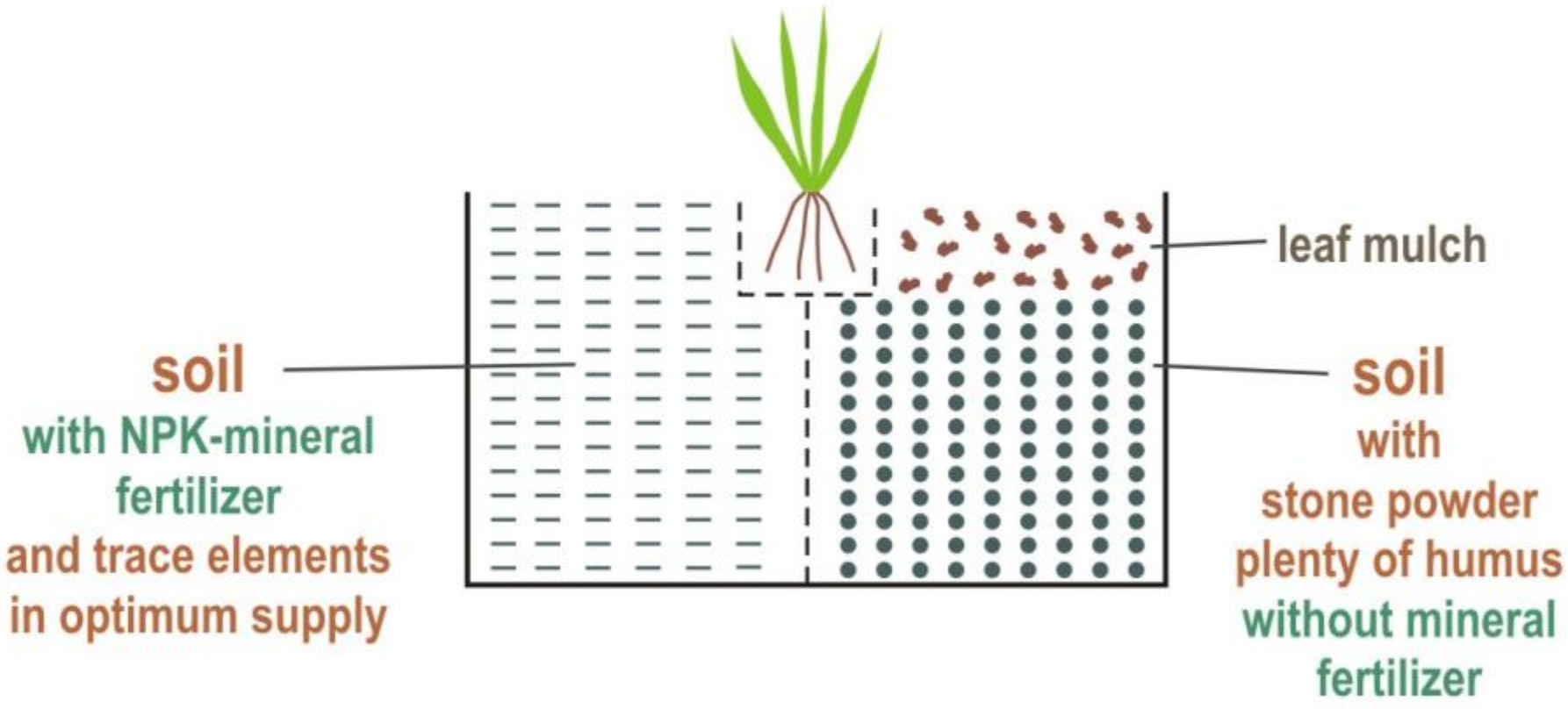


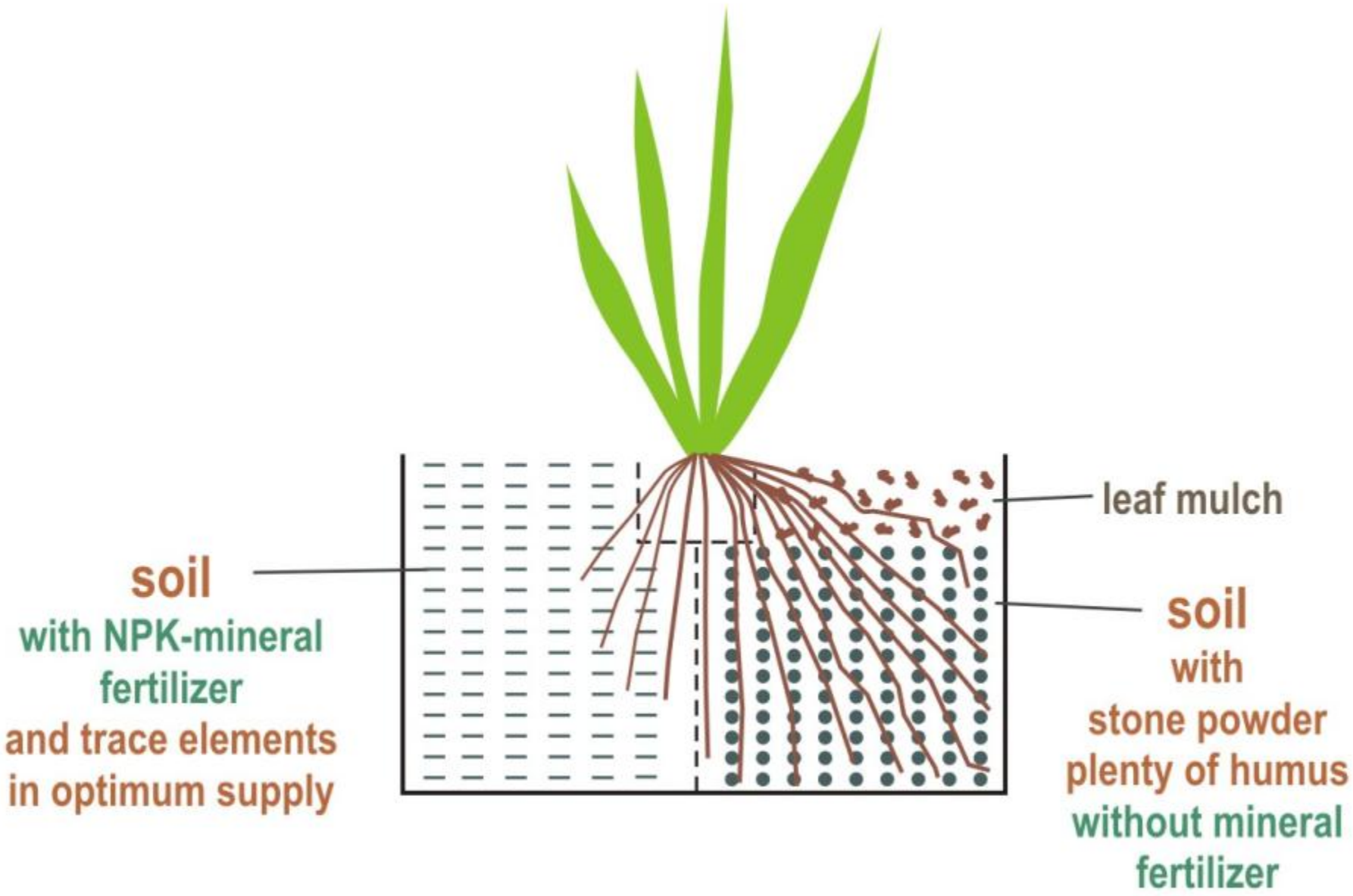
Figure 1. Roots of axenically grown Arabidopsis and tomato were incubated with *E coli* or yeast expressing green fluorescent protein (GFP*E. coli* or GFPyeast). GFP*E. coli* was detected at the surface of roots and root hairs (A and C), and inside roots and root hairs (B and D). GFPYeast was present inside roots and root hairs (E and F). (A, D and F) and (B, C and E) correspond to tomato and Arabidopsis root, respectively. Fluorescent images were taken by confocal laser scanning microscopy (CLSM).

2 Simple and vivid experiments in matters of feeding plants



Dr. Jürgen Reckin, Spechthausener Straße 20, 16244 Schorfheide, Germany jreckin@telta.de

2 Simple and vivid experiments in matters of feeding plants



Higly Productive Organic Gardening in Norway, Northern Europe

Most People fed per hectar with the least Energy requirement

Feeding the humus directely with fresh ground clean organic bio-waste once per month, Needs to be kept moist, mulch! (based on Hans-Peter Rusch Bodenfruchtbarkeit, OLV publishers)

18 kg of onions per m² over many years
(normal yield: around 3 kg / m²)

Herwig Pommeresche: Humussphäre Highly productive at 65% Humus!
www.youtube.com/watch?v=pSShndKiA3g&feature=youtu.be
See also: www.youtube.com/watch?v=tKxDOZ7ctMs

SRI System of Rice Intensification

Prof. Dr. Mubiar Purwasinita, ITB Bandung, Indonesia

Too may free grazing

many plants, less

soil,

tion…

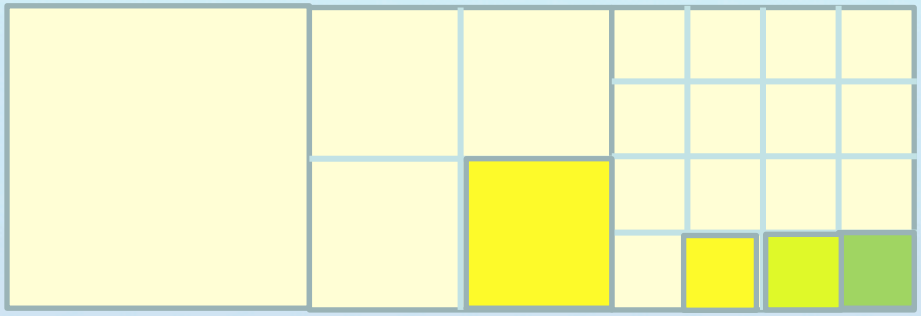
Another mainstream belief,
most are wrong…

This animal may only be mismanaged…

Allan Savory: Savory Institute

Holistic Planned Grazing

www.savoryinstitute.com

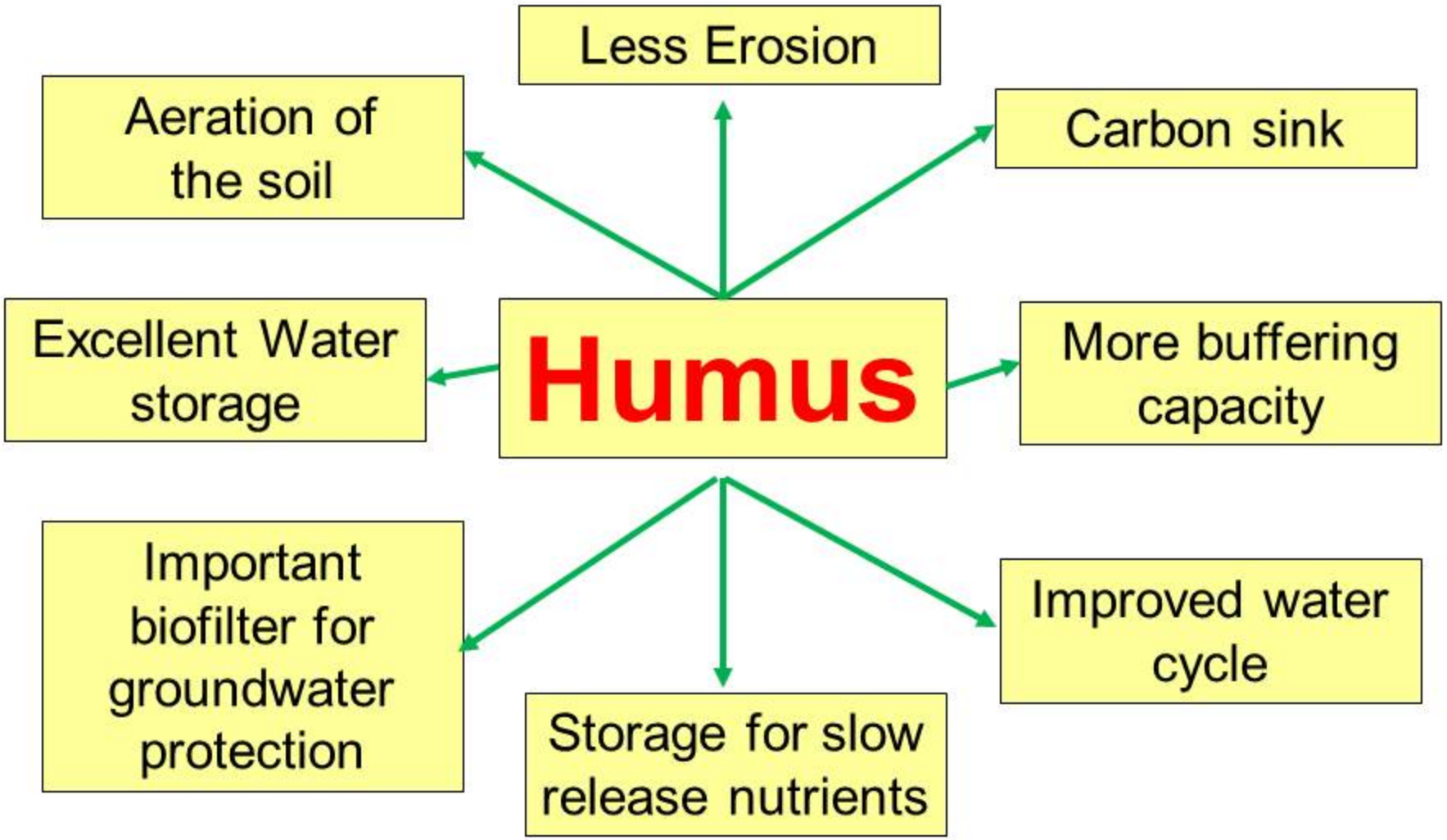


- Video

www.youtube.com/watch?feature=player_embedded&v=5LHoh-OKUfU#!

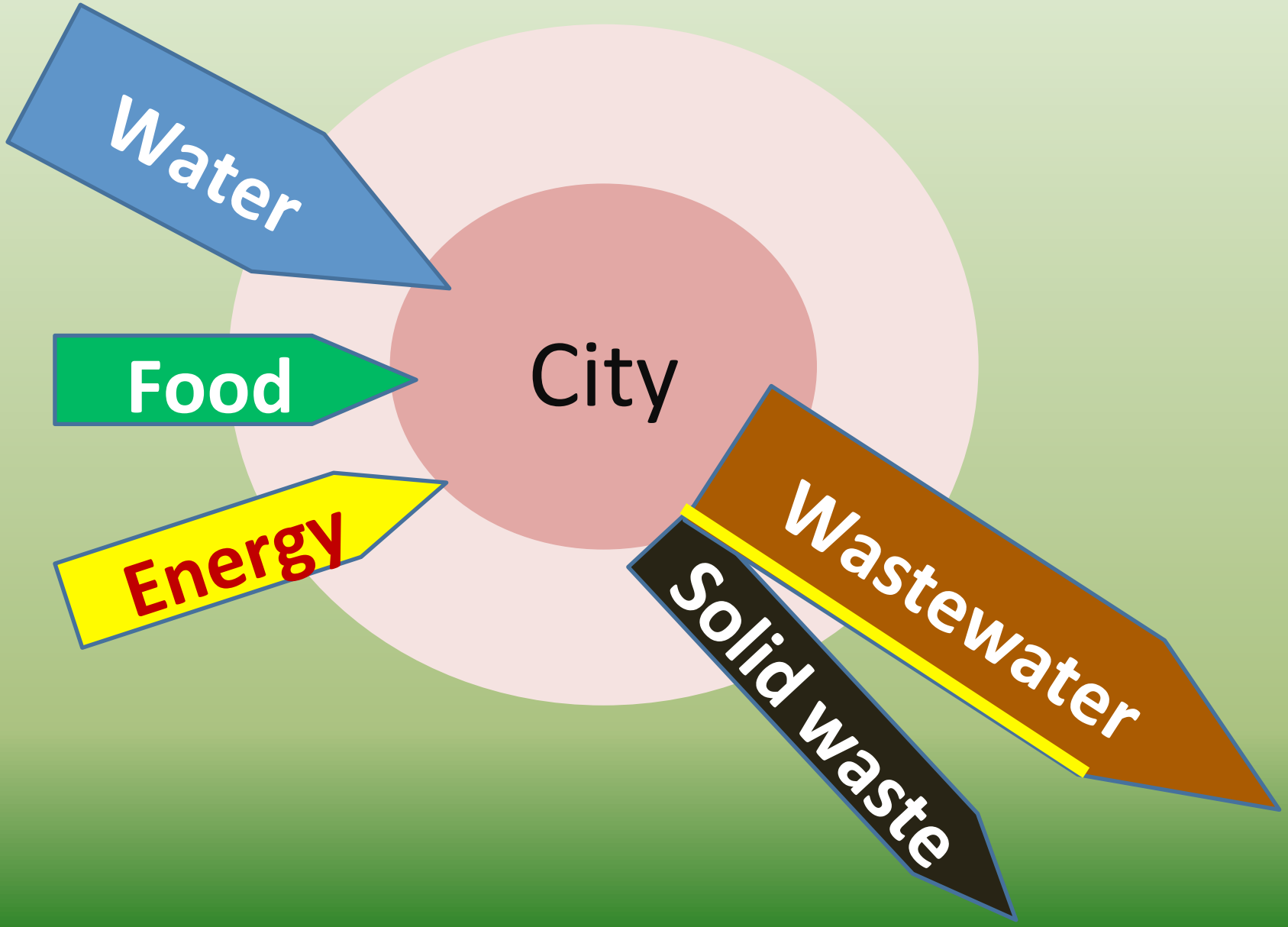
Video: Holistic Planned Grazing

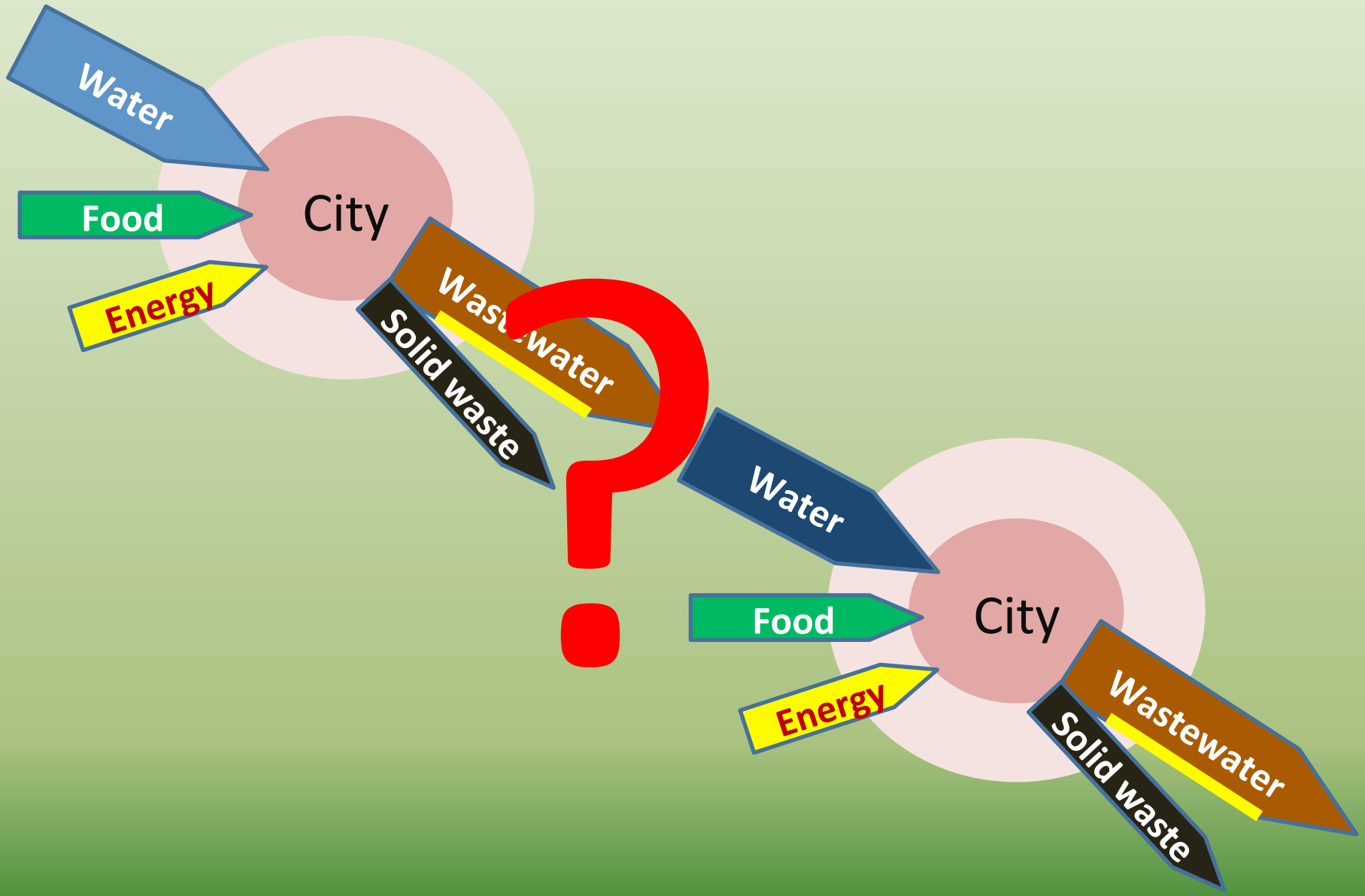
Good Soil makes Water

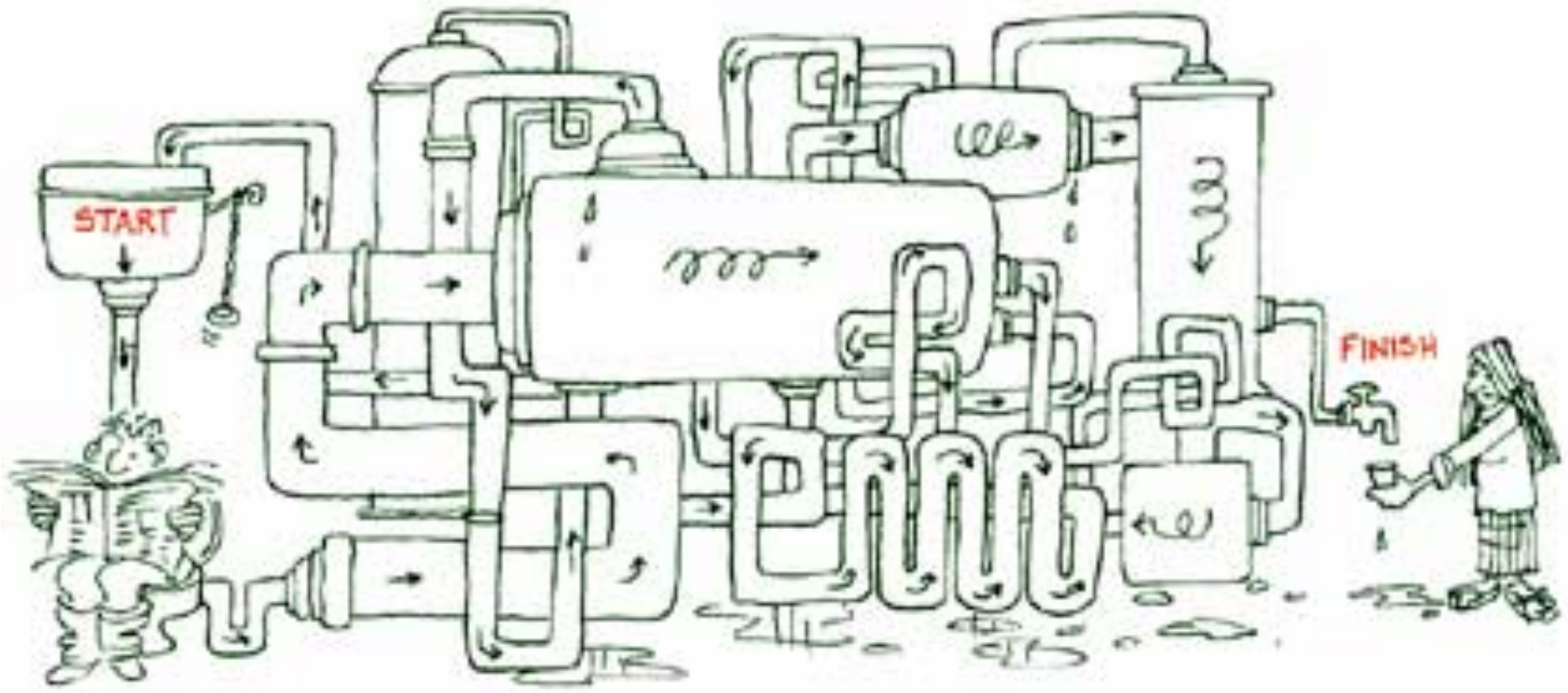


LIVING Humus Soils

Humus needs Fodder!!!




Water
Food
Energy
City
Wastewater
Solid waste
Water
Food
Energy
City
Wastewater
Solid waste



Down to Earth, CSE, Delhi, India

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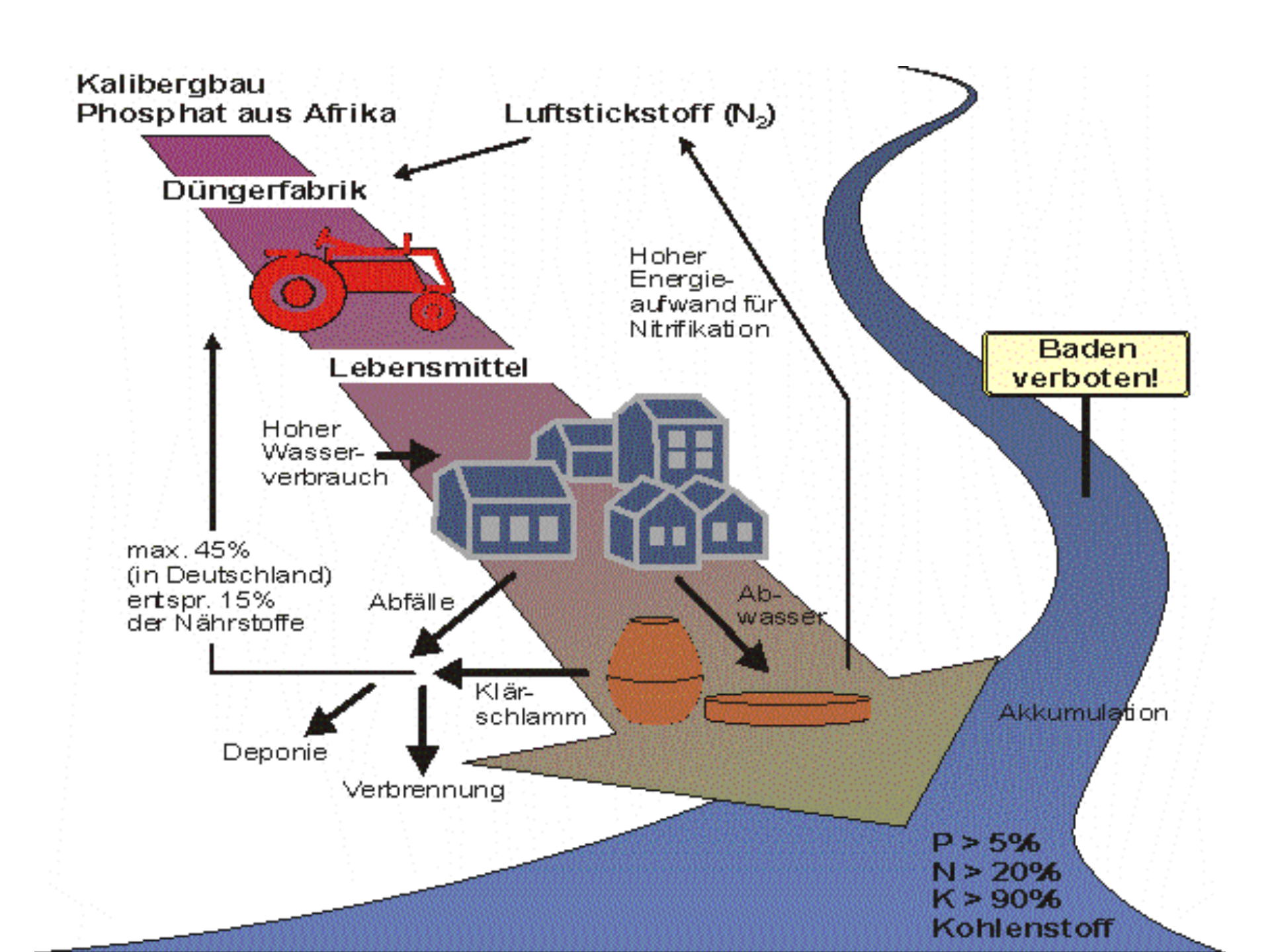
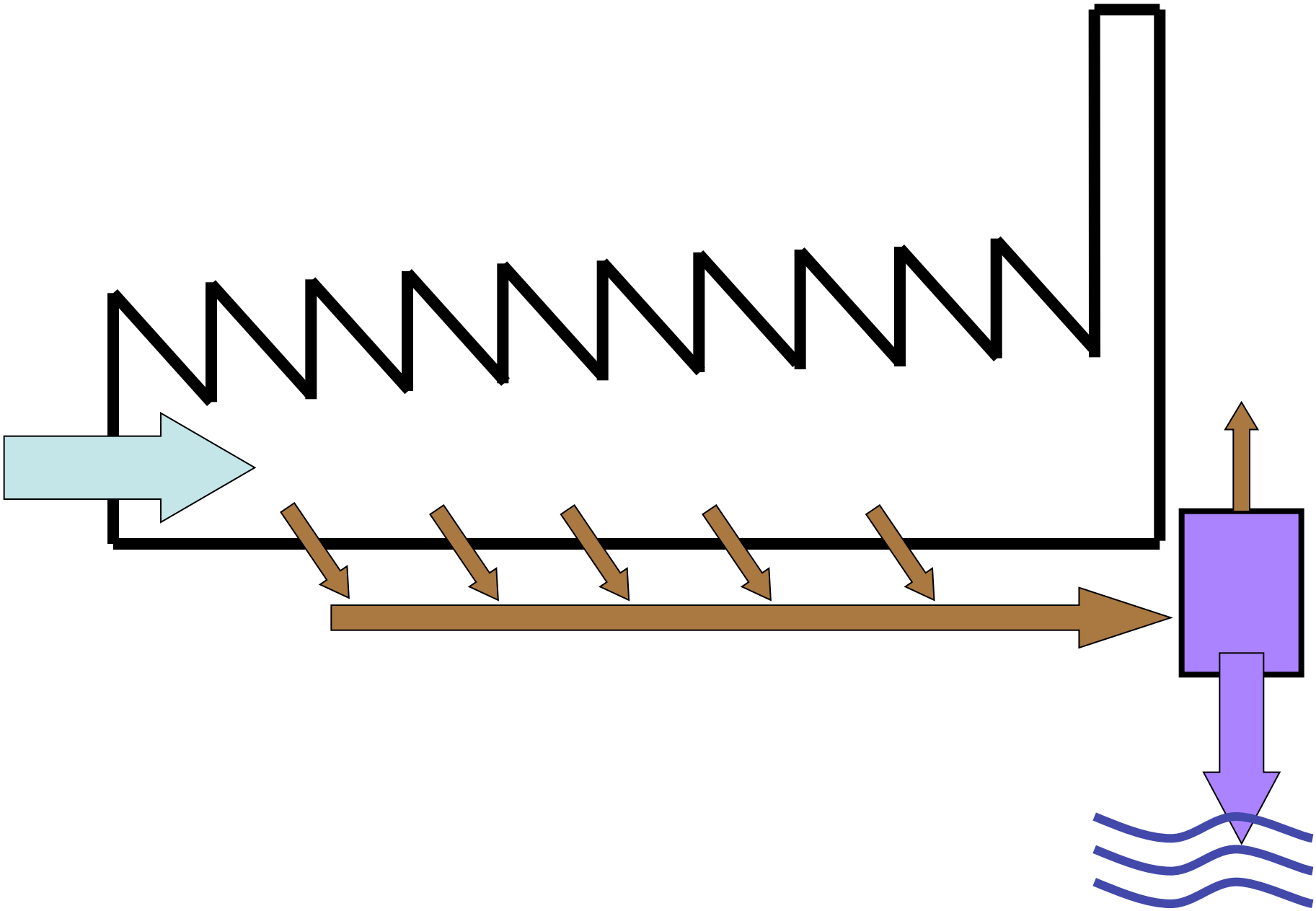
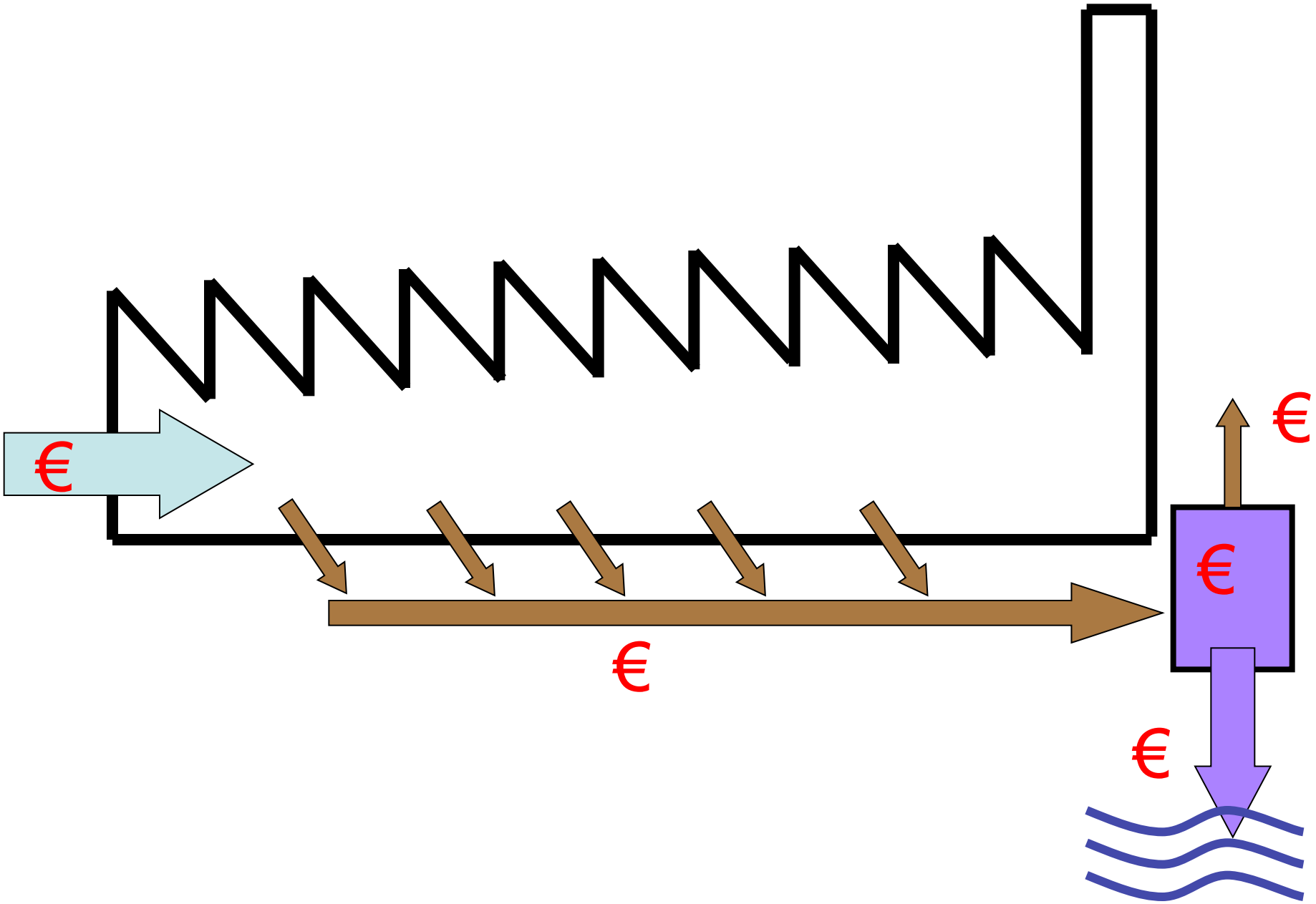
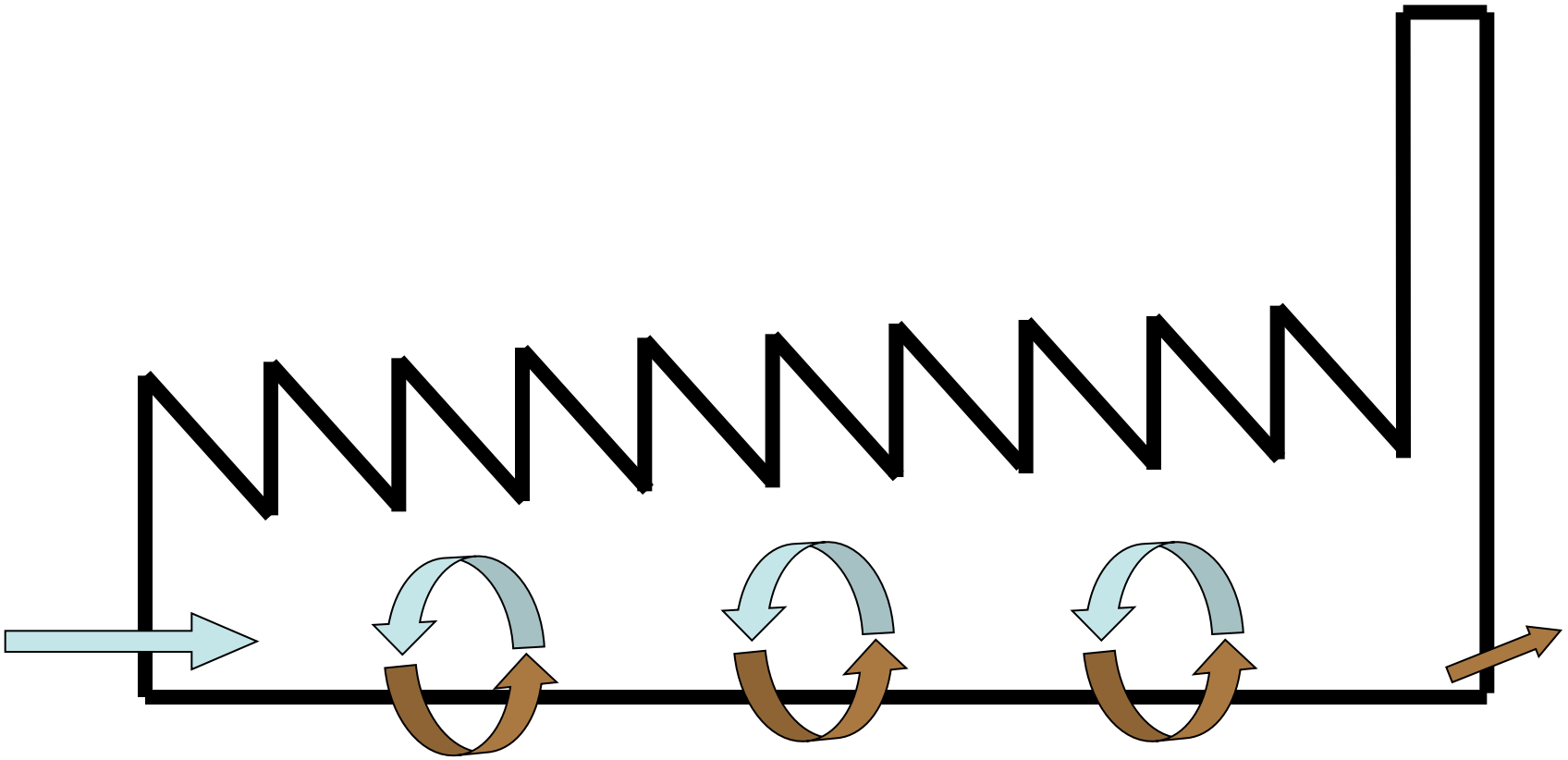
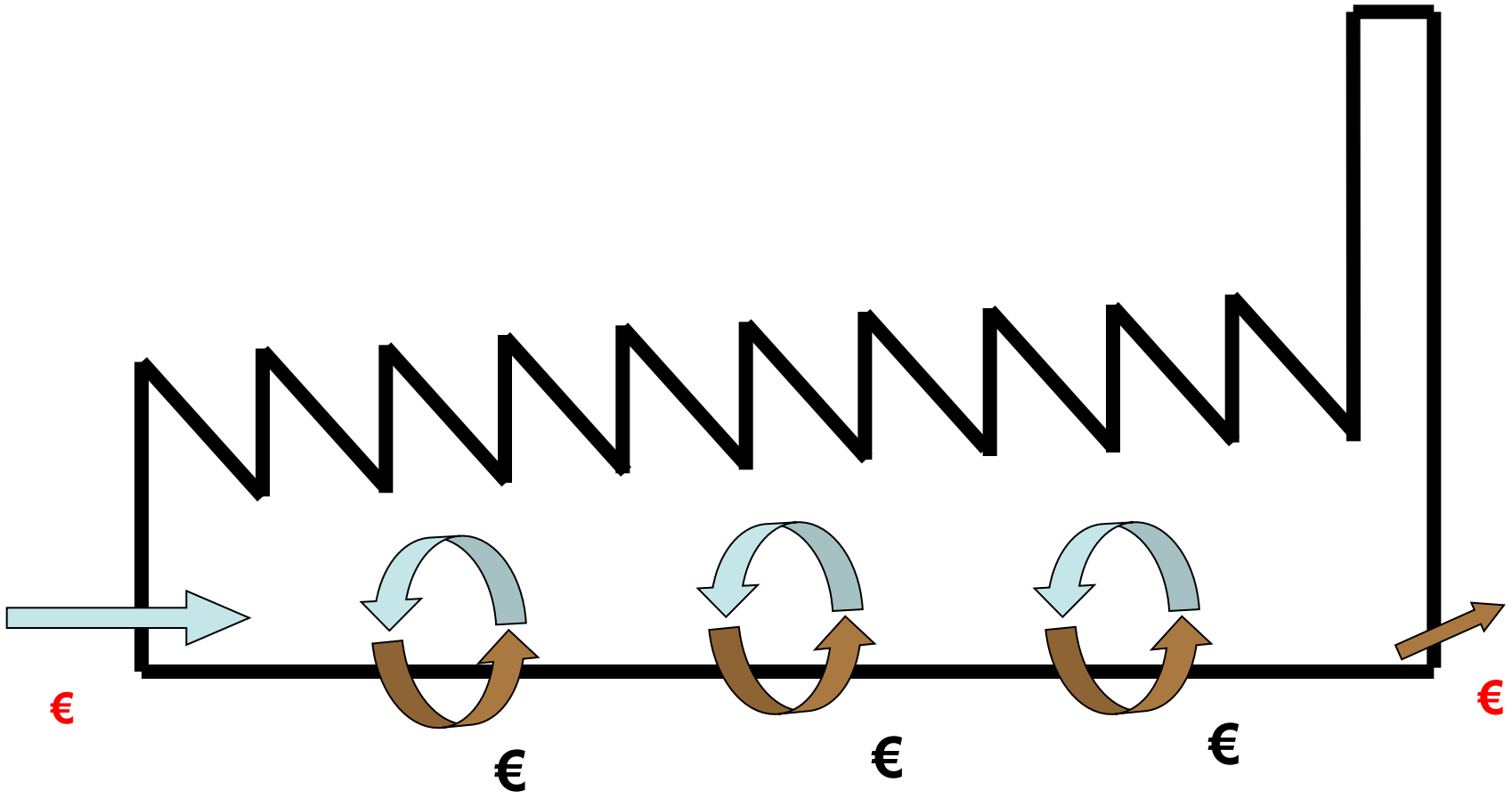

Kalibergbau
Phosphat aus Afrika
Luftstickstoff (N_2)
Düngerfabrik
Hoher Energie-aufwand für Nitrifikation
Baden verboten!
Lebensmittel
Hoher Wasser-verbrauch
max. 45% (in Deutschland) entspr. 15% der Nährstoffe
Abfälle
Ab-wasser
Klär-schlamm
Deponie
Verbrennung
Akkumulation
P > 5%
N > 20%
K > 90%
Kohlenstoff



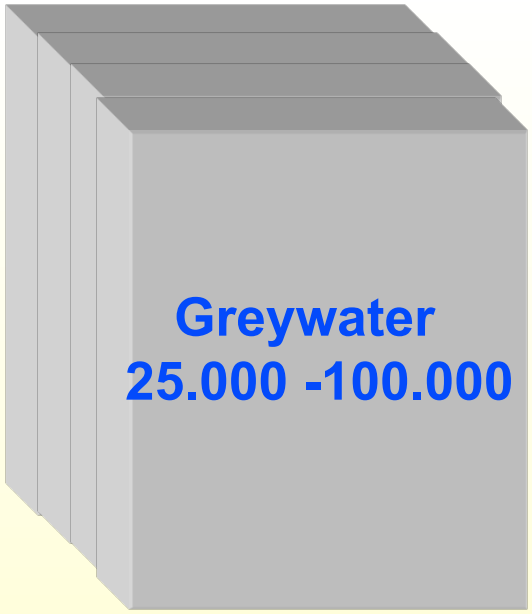


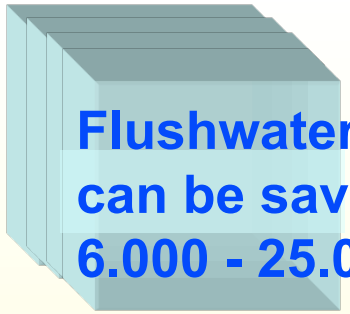




TUHH
Hamburg University of Technology

Volume l/(P*year)



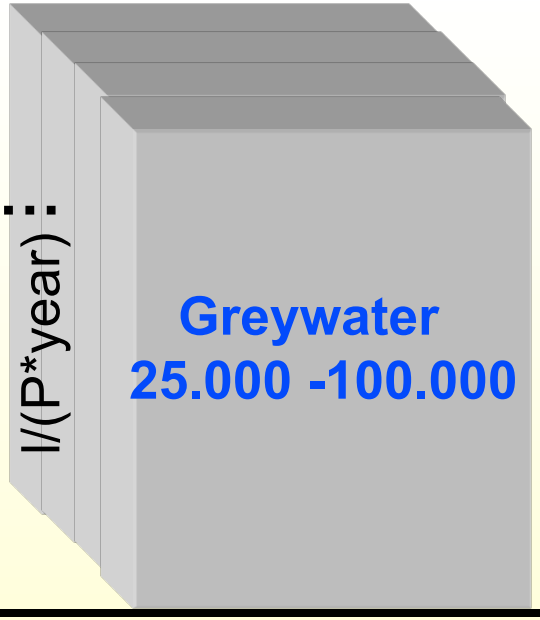


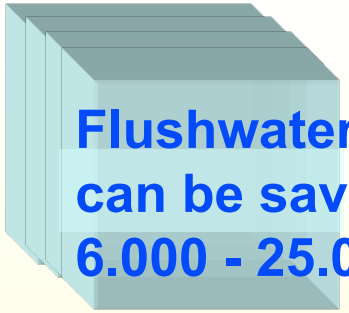
Urine
~ 500

Feaces
~ 50
(option: add biowaste)

Yearly Loads
kg/(P*year)

Teilstrom-behandlung bietet sich an…

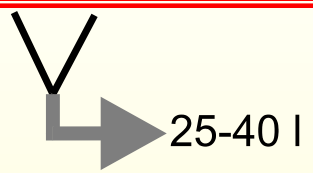
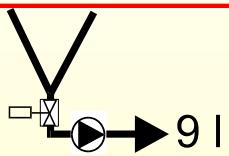
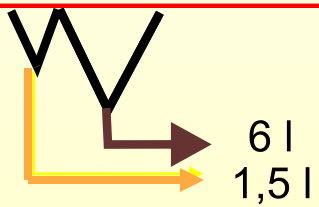
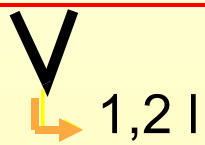
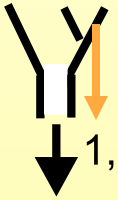




Yearly Loads kg/(P*year)			Greywater 25.000 -100.000	Urine ~ 500	Feaces ~ 50 (option: add biowaste)
N	~	4-5	~ 3 %	~ 87 %	~ 10 %
P	~	0,75	~ 10 %	~50 %	~ 40 %
K	~	1,8	~ 34 %	~ 54 %	~ 12 %
COD	~	30	~ 41 %	~ 12 %	~ 47 %
S, Ca, Mg and trace elements			Treatment → Reuse / Water Cycle	Treatment → Fertiliser	Biogas-Plant Composting → 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

Teilstrombehandlung erfordert neue Toilettensysteme

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

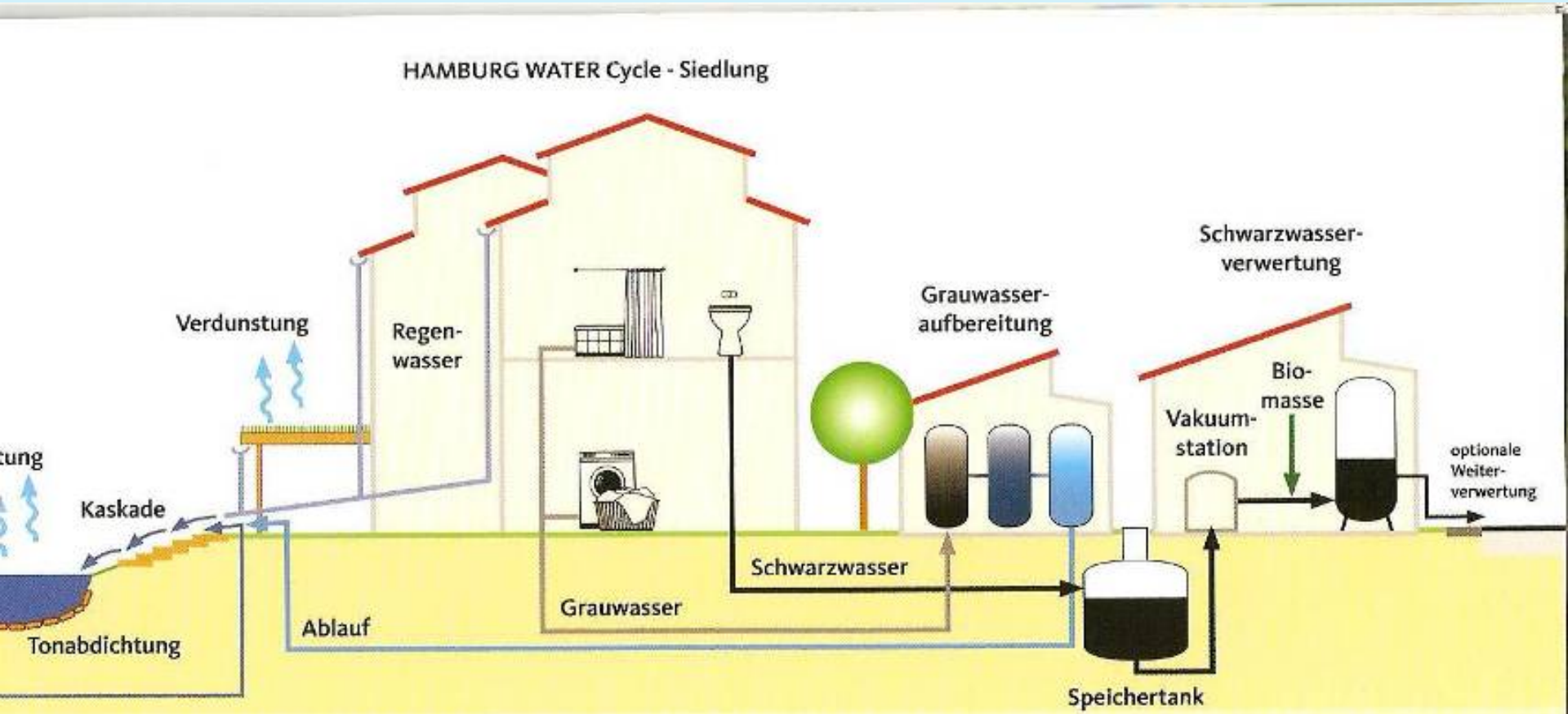
Double-Houses

Terraced Houses

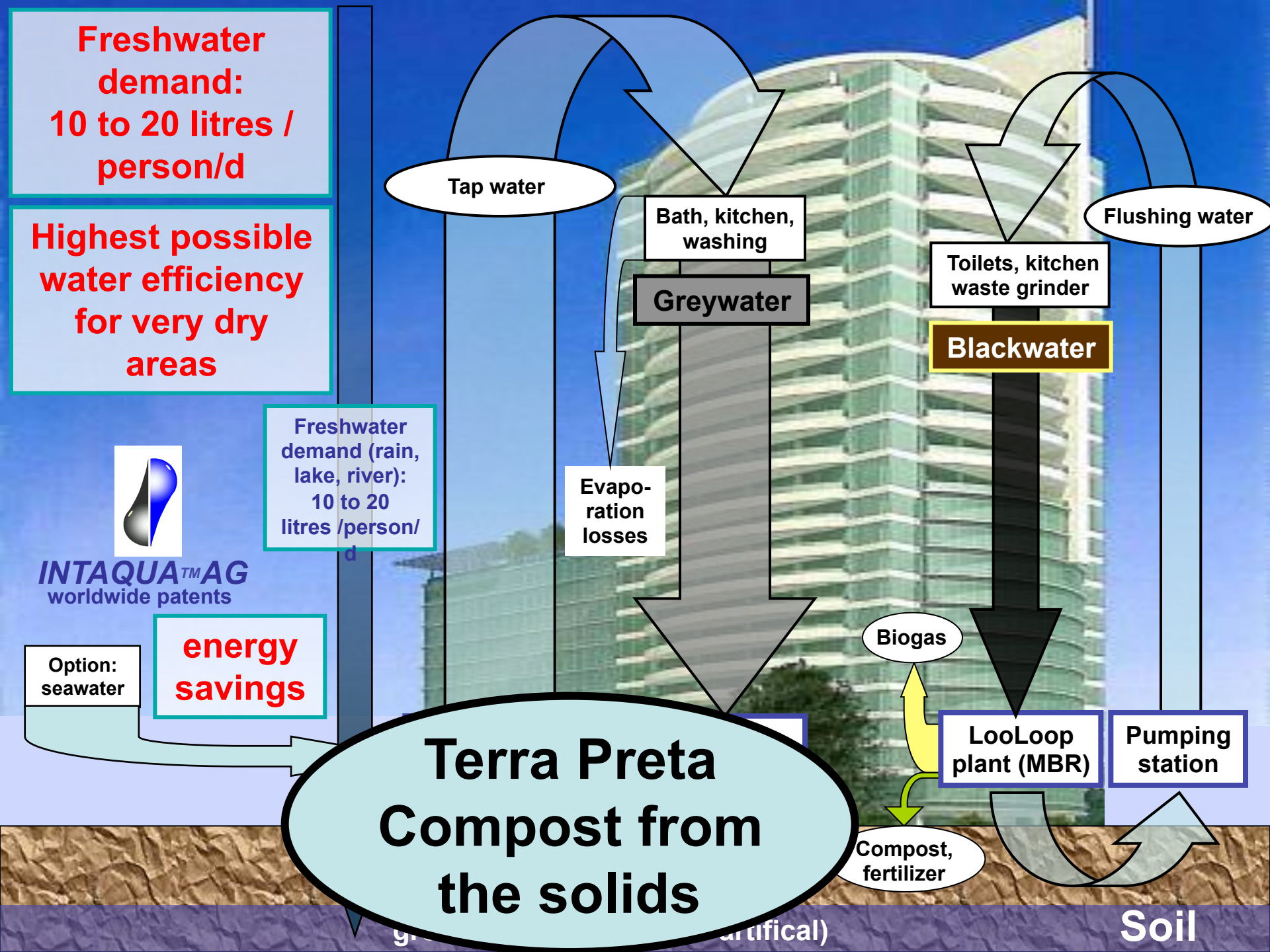
OtterWasser GmbH

Hamburg Water Cycle by Hamburg‘s Water Utility

Vacuum-biogas system for 2.000 inhabitants, production of electricity and heat from waste Start in 2010



URG Erschließung neuer regenerati- Durch die Veredelung des bei der Abwasser-


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
Evapo-ration losses
Flushing water
Toilets, kitchen waste grinder
Blackwater
Biogas
LooLoop plant (MBR)
Pumping station
Compost, fertilizer
Terra Preta
Compost from the solids
Soil

Bio-Reactor / (Fixed Bed)

INTAQUA™AG
worldwide patents

Ultra-Filtration

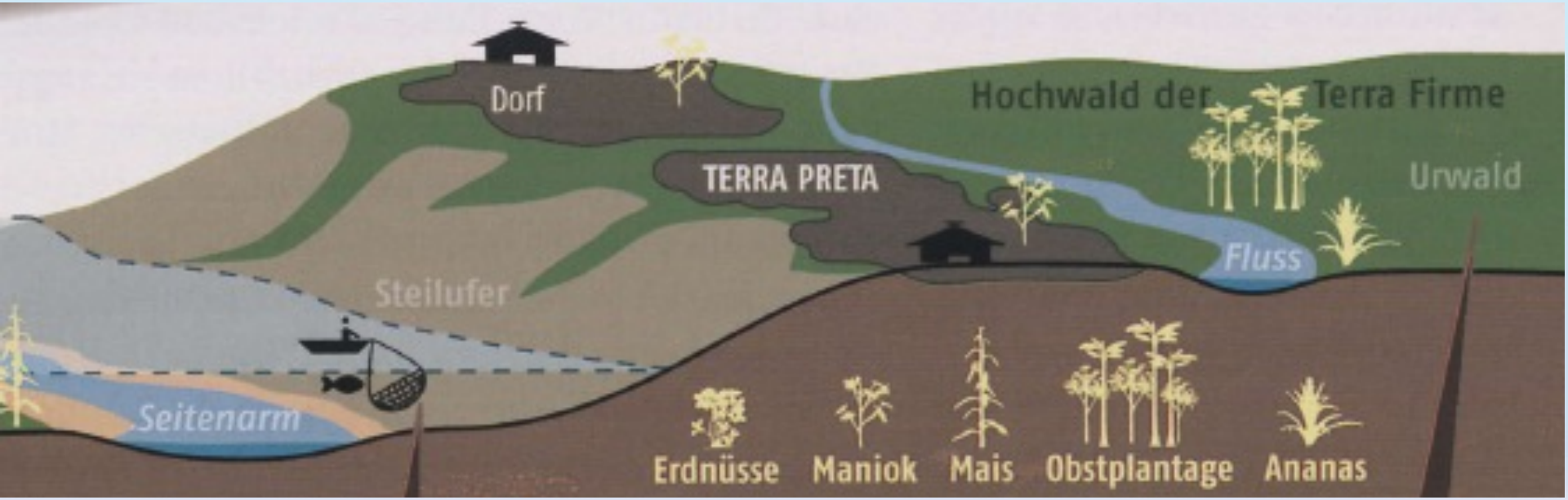
Nano-Filtration

High Efficiency
Very Low Costs
ingrated with soil building
very comfortable:

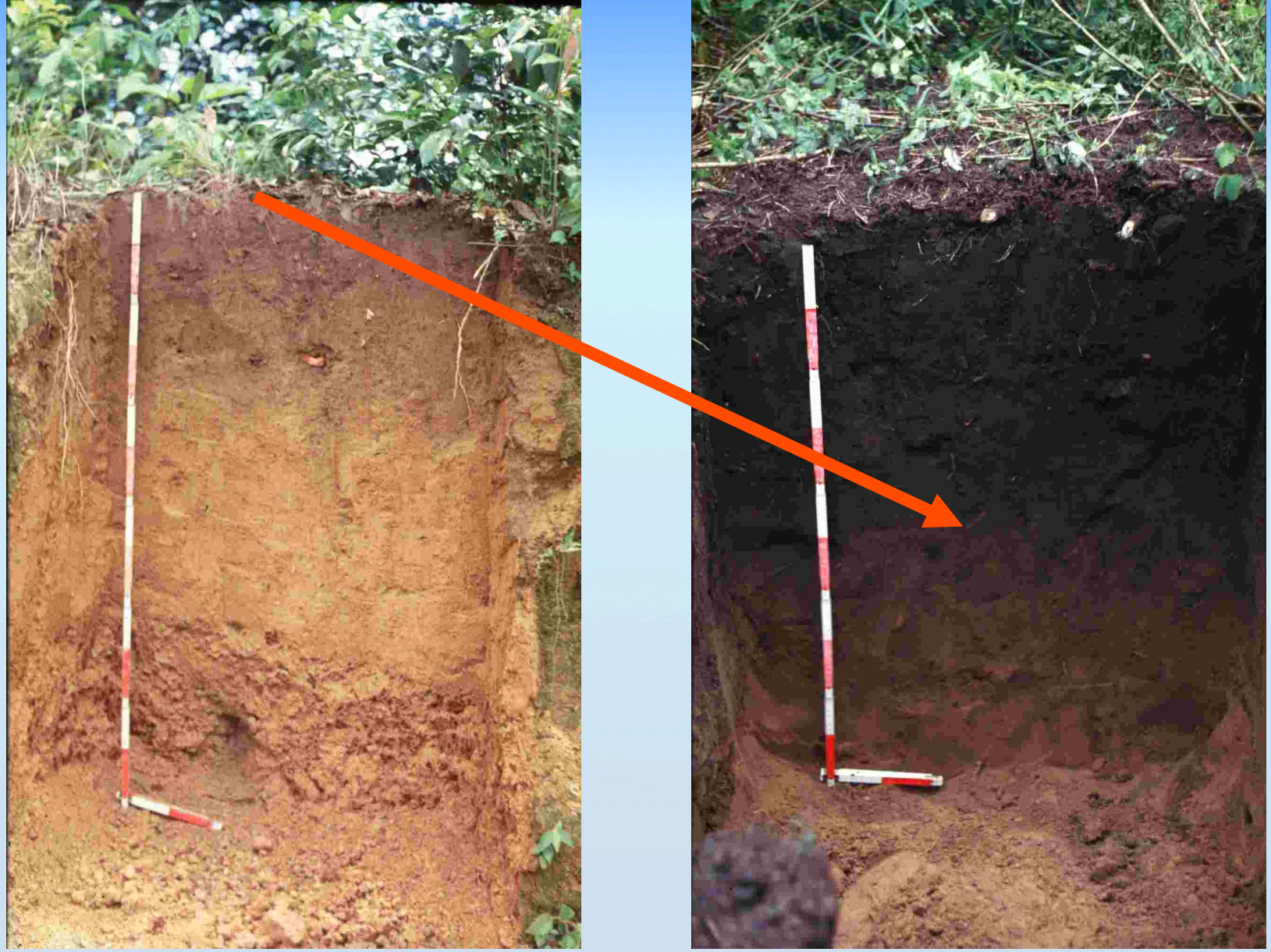
Terra Preta Sanitation

Toilets that make Good Soil

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



GEO, March 2009



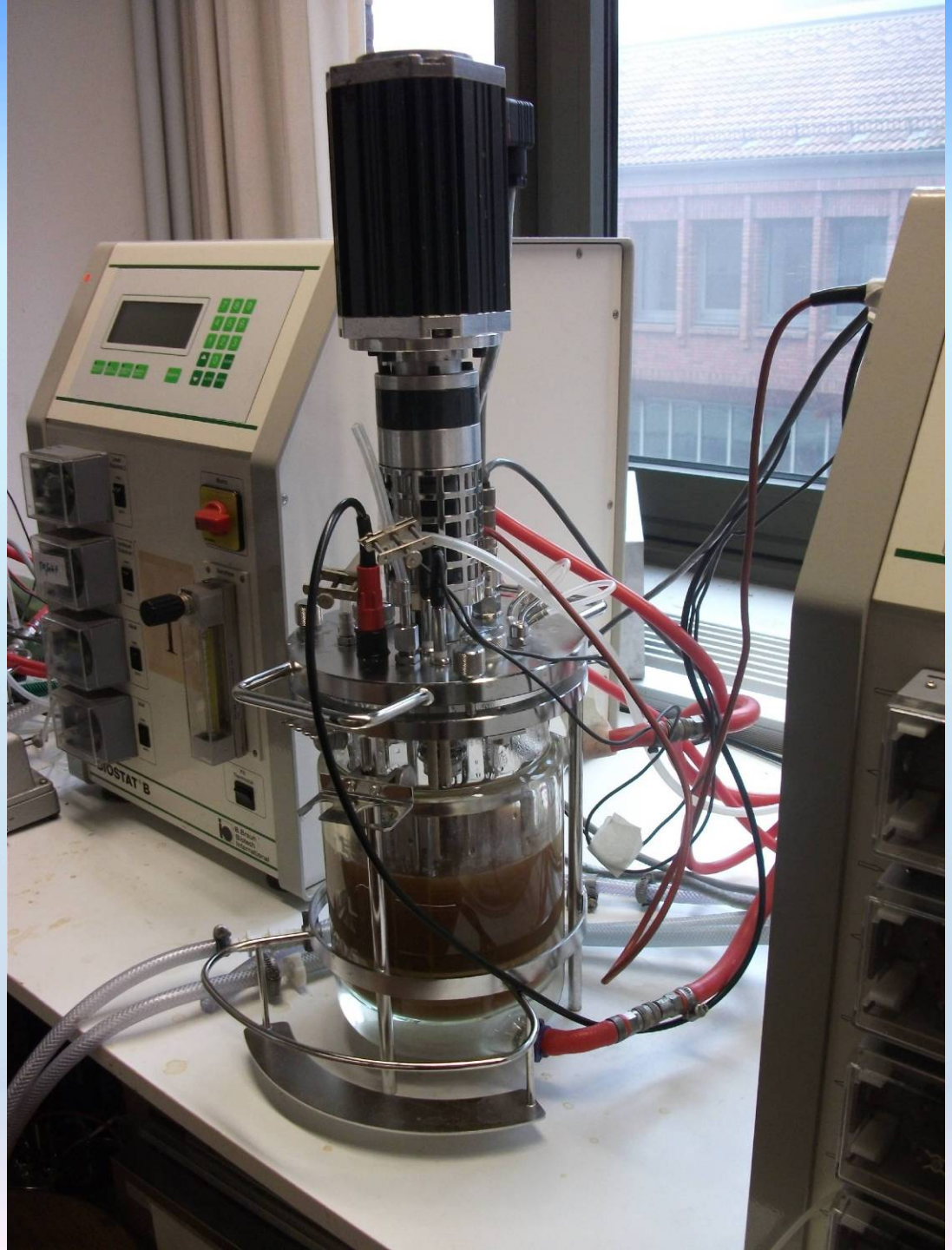
Poor soil can become highly fertile with clever management of biowaste and sanitation

Terra Preta do Indio

Sanitation with lactic acid fermentation in pots:
Hypothesis of Dr. Haiko Pieplow, Ministry of the Environment, Germany

TERRA PRETA Sanitation: Ecosan for making rich soils

- Solves the odour problems far better than desiccation
- Only one vault needed
- Anearobic collection without smell
- Closing toilet and chamber after usage is possible
- Leads to black soil production
- Can upgrade pit latrines at almost no costs



Terra Preta Sanitation

Cleansing of bowl with spray bottle or spray hose, also suitable for anal cleansing
Low dilution is needed
The toilet gets lactic acid bacteria with some sugar sourse to make it smell free
Collection once per week and transport to composting site where the compost can be used

The winner of the TUHH-WTO ,
TPS Toilet Design Award
Triften Design, Sabine Schober, Hamburg, 2012

Terra-Preta-Sanitation.net **www.tuhh.de/aww**

Options for Terra Preta Sanitation 1

Cleansing with Spray Bottle or Spray Shower

LAB can be added (Food Quality)

Lactic Acid Bacteria

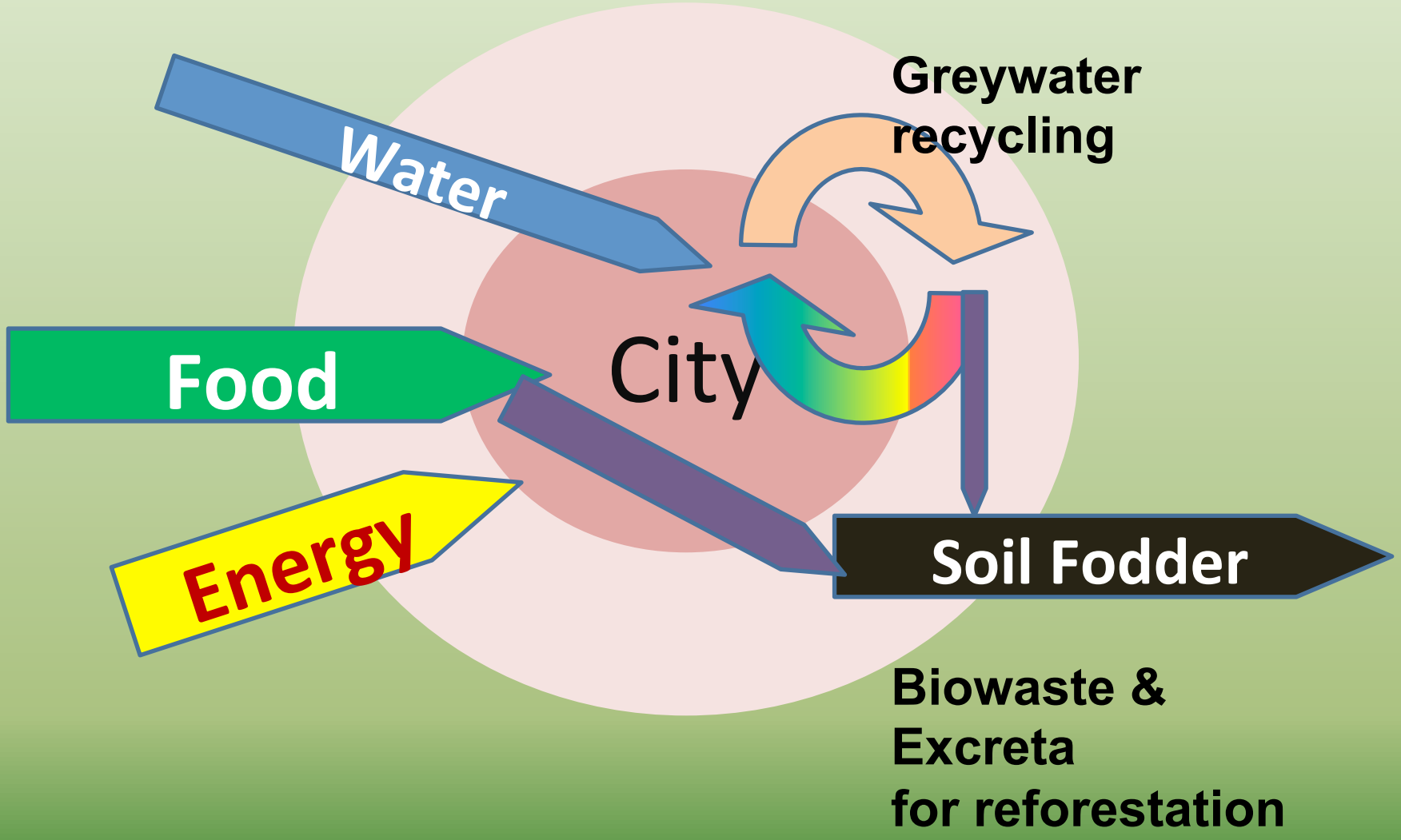
add 500ml concentrated LAB
plus plenty of waste Sugar
(2-3g/Person/year)

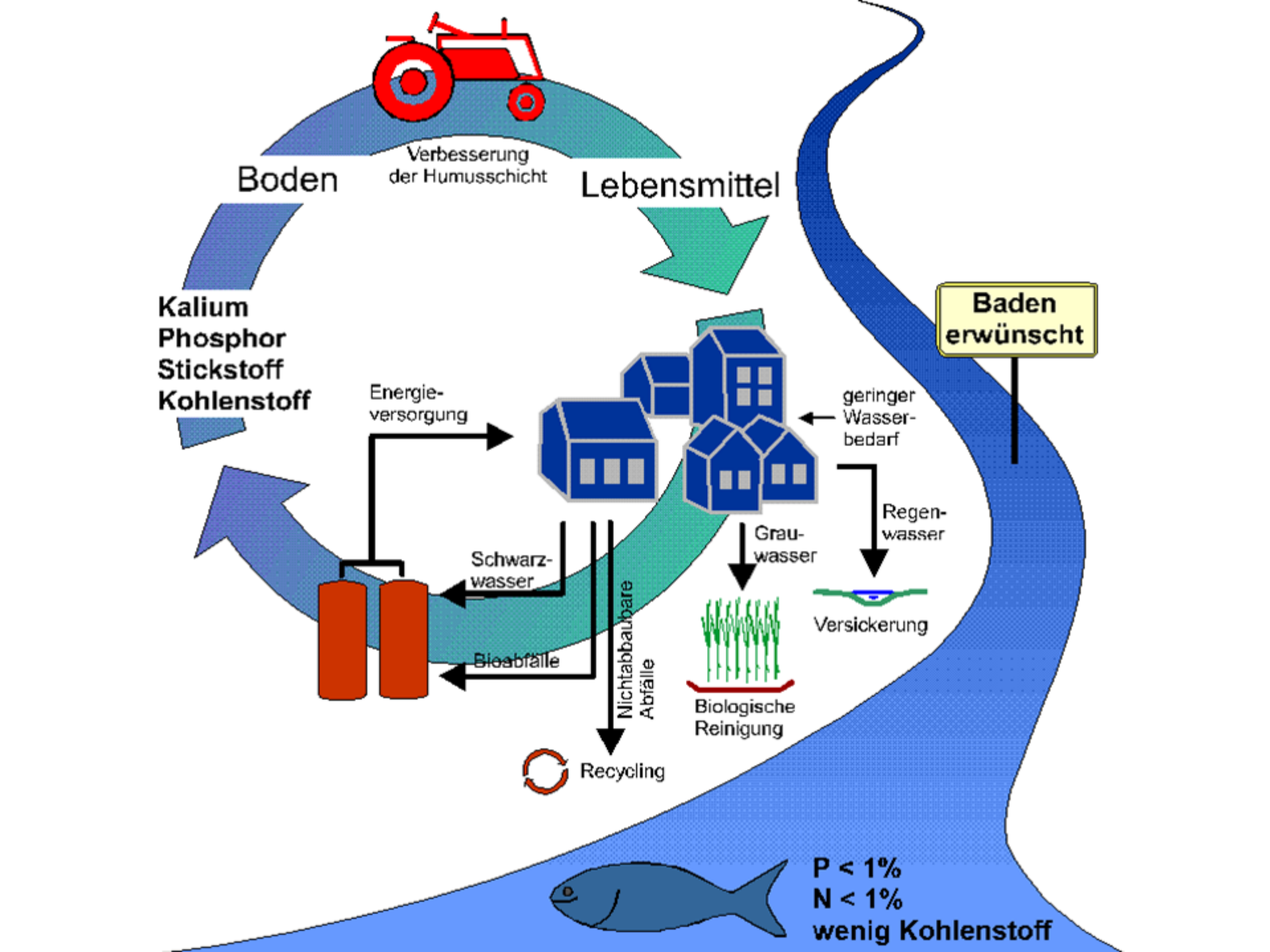
Tanc Transport or or Suction Truck or Mazerator Pump

Composting Unit where compost can be utilized!!

Terra Preta Composting of feacal matter, TUHH for City of Hamburg, BSU

Fig. 1: Set up for vermicomosting composting with 5 Compartments of 1 m^2


Water
Food
Energy
City
Greywater
recycling
Soil Fodder
Biowaste &
Excreta
for reforestation


Boden
Verbesserung der Humusschicht
Lebensmittel
Kalium
Phosphor
Stickstoff
Kohlenstoff
Baden erwünscht
Energie-versorgung
geringer Wasser-bedarf
Regen-wasser
Grau-wasser
Schwarz-wasser
Bioabfälle
Nichtabbaubare Abfälle
Versickerung
Biologische Reinigung
Recycling
P < 1%
N < 1%
wenig Kohlenstoff

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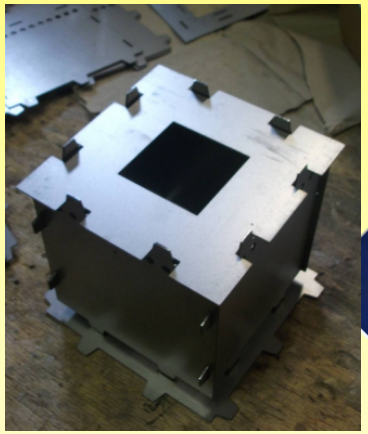
- Terra Preta Sanitation

Energy - Water - Soil

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

Conclusions

Building living Humus-Soils:



woody waste
to woodgas

stoves produce charcoal

compost with charcoal

Terra Preta Systems..

Jörg Fingas, Climatefarming

Stoves: Clean and very Efficient by Jörg Fingas Climatefarmi

λT 2.1 Développement du foyer
λquelque étapes






Woodgas Stoves: Clean and very Efficient
by Jörg Fingas Climatefarming, Germany

Soil improvement is needed: Clean charcoal can help

Good Luck:

Power, Heat, Cooling and charcoal can come together

Rice Husc to Power and charcoal
Senegal, Climatefarming, Jörg Fingas

Rice Husc to Power and charcoal
Senegal, Climatefarming, Jörg Fingas


CHECK
OIL LEVEL
2011/5/20

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

grow Bamboo with greywater treatment


E L'ENVIRONNEMENT
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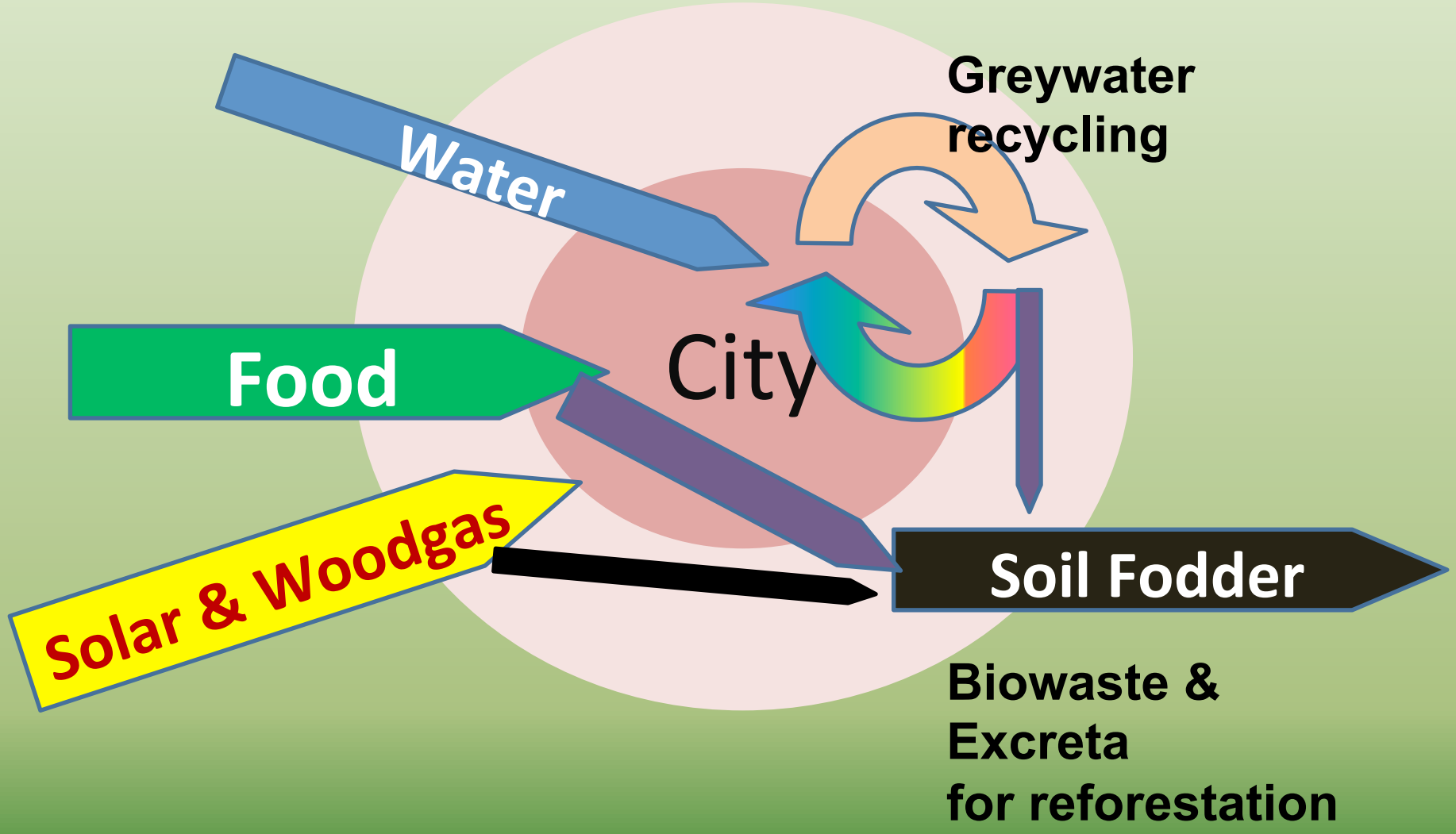
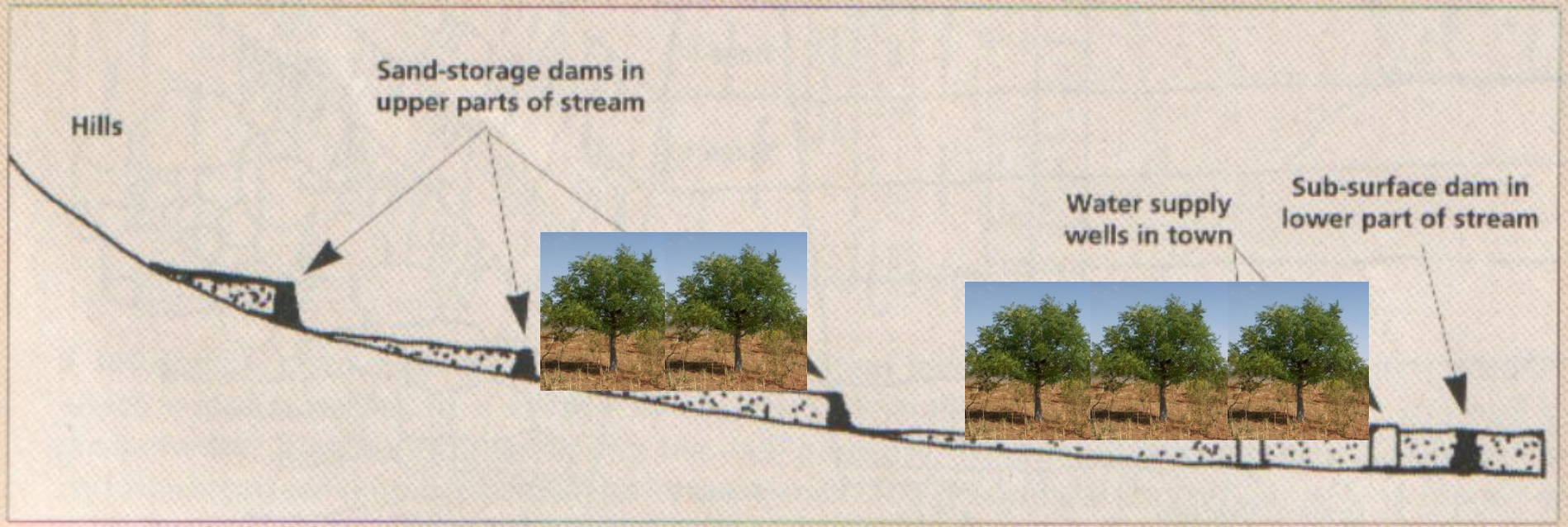

Water
Greywater
recycling
Food
City
Solar & Woodgas
Soil Fodder
Biowaste &
Excreta
for reforestation

Productive Water Catchment

Starting tree nursery with Terra Preta Compost from Biowaste and Sanitation

Moringa for soil building and fodder production

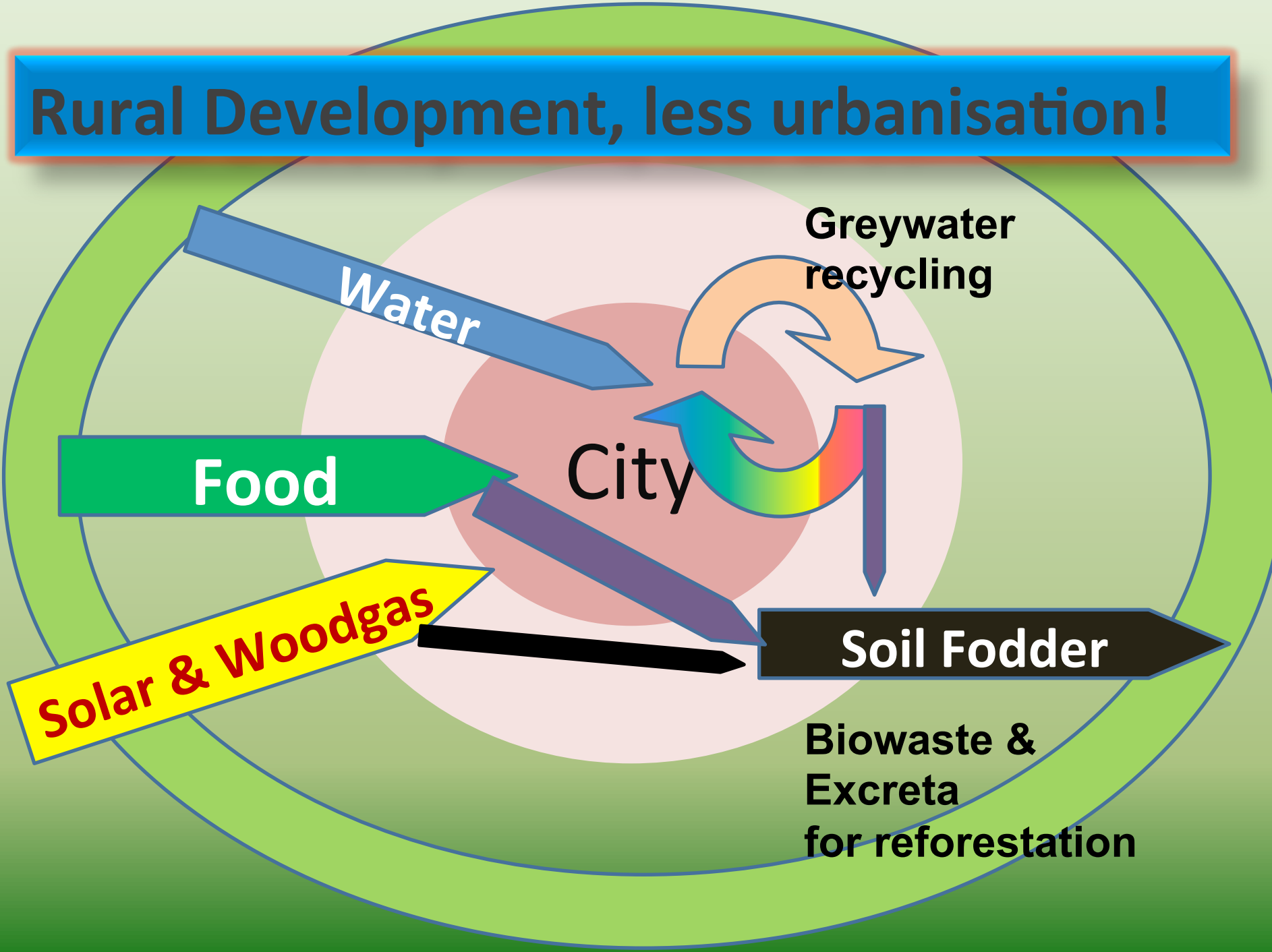


Combined use of sand-storage and sub-surface dams on the eastern slopes of the Western Ghats.

Check dams for erosion prevention capture soil and water

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

Rural Development, less urbanisation!



Final recall

Water Key Issues: Soil 1st!

- Humus rich soil Soil has a very high water uptake, cleans it, stores it, keeps moisture for plants
  - Rainwater Harvesting and Reuse,
  - How to convert dryland to green land

Innovative Sanitation

- Pollution to be avoided at the source: Water Protection
- Efficiency of water utilisation: irrigation, households
- Blackwater Loop: Sanitation as fertiliser and humus factory
- Terra Preta Sanitation

Energy - Water - Soil

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

Conclusion

We need to get away from mainstream and look at the systems and their interactions to optimize them for all people

- www.tuhh.de/aww
- www.terra-preta-sanitation.net
- www.anamed.net
- www.rainwaterharvesting.org

Books: David Montgomery: "Dirt"
He shows scientifically correct that many civilizations went down after soil detoriation