‘New Sanitation’ a challenge for developing & developed countries

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New Sanitation

EcoSan (Ecological Sanitation)

DeSaR (Decentralized Sanitation and Reuse)

ROSa /Resource Oriented Sanitation

collection, *transport* and *treatment* of source separated domestic waste(water)

objectives

- minimize use of resources;
- maximize recovery and reuse of resources;
- reduce emissions to the environment.

Developed countries
'New Sanitation' versus *'old' highly centralized sanitation*

- **Complying with environmental & hygienic objectives;**
- **Not complying with sustainability objectives;**
- **Not economical feasible in large parts of the world.**

Developing countries
'New Sanitation' versus *'no/hardly any sanitation'*

- **Not complying with hygienic objectives;**
- **not complying with environmental & sustainability objectives.**

Nairobi, Kenya 2004: Sixty per cent of the city's people live in slum areas.
Photo : ©AFP / Getty Images / Marco Longa ; Gumisai Mutume (*2004).*

Basic definition of sanitation:

'the use of sanitary measures to maintain public health'

****(http://www.thefreedictionary.com/sanitation).***

'New Sanitation' in *developed* countries

Promotion of health:
precondition rather than an objective;

Sustainability is the **main objective**

'New Sanitation' in *developing* countries

Promotion of health:
in general the **main objective;**
while
Sustainability
should become a
p**recondition!**

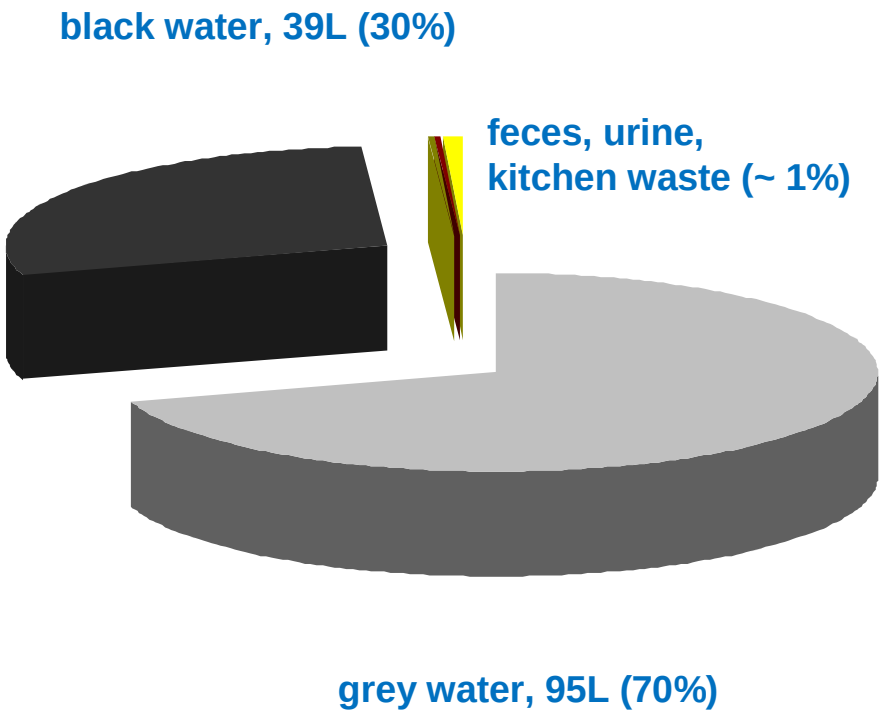
Definition of sanitation should become:

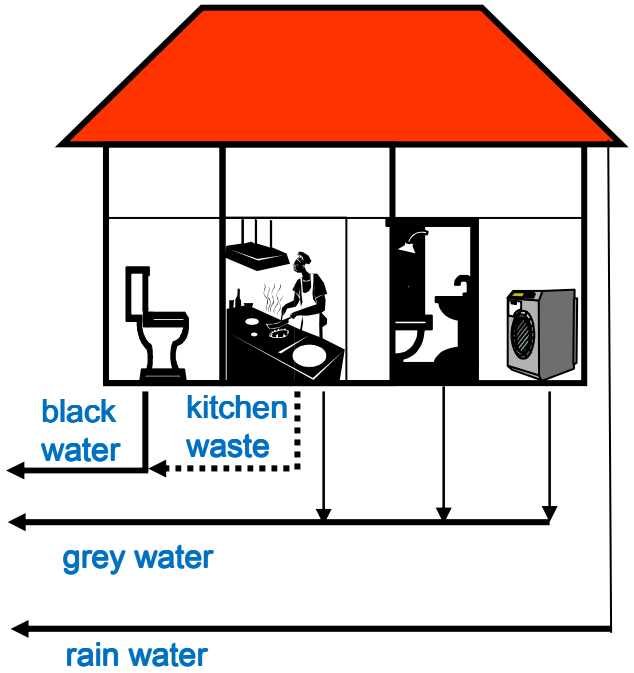
‘the use of sanitary measures to maintain public health *and provide sustainability*’

‘New Sanitation’ versions/concepts will differ:

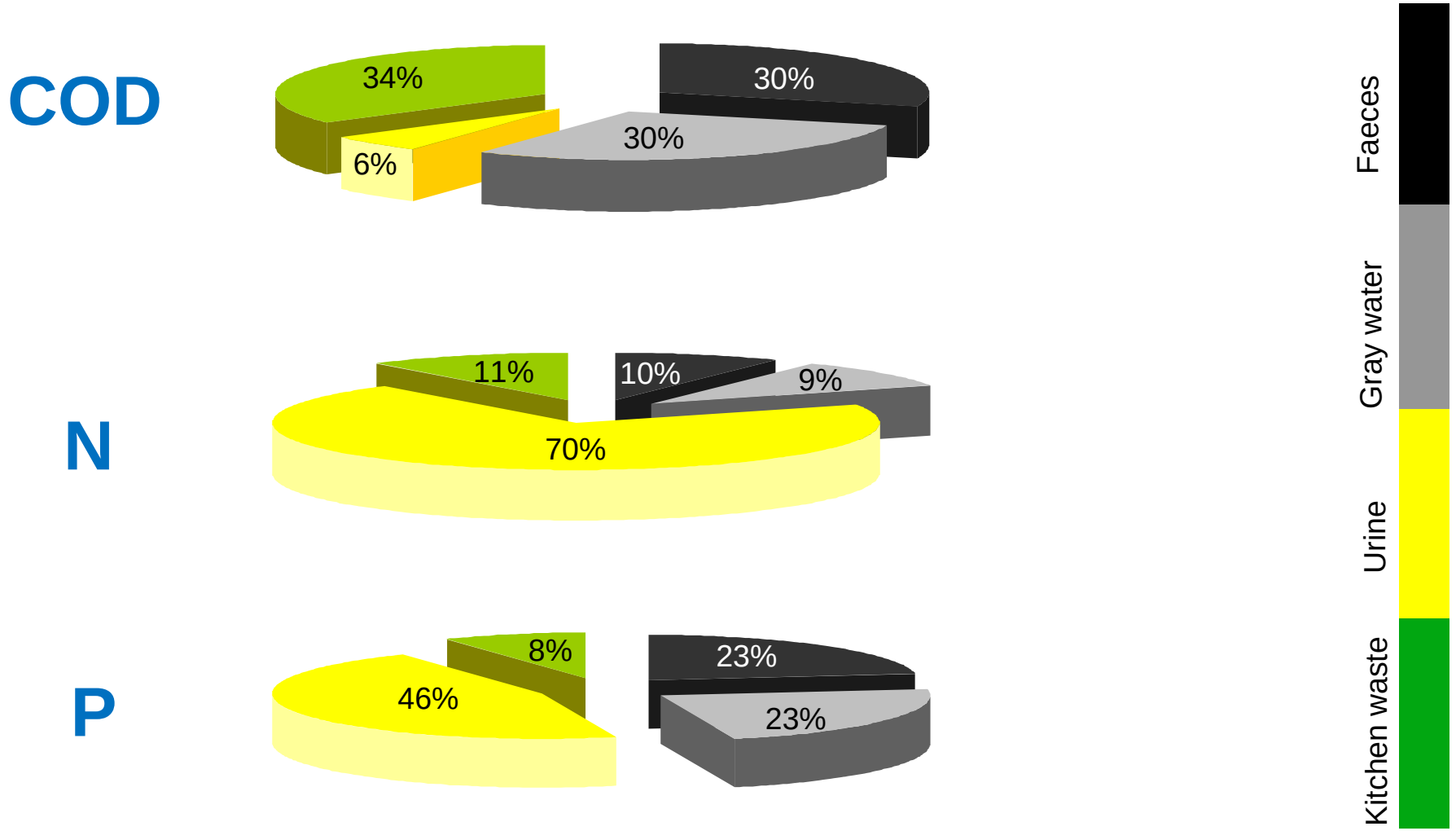
- Location;
  - Urban ⟺ rural;
- Existing infrastructure, i.e.
  - septic tanks;
  - sewerage;
- Cultural and social aspects & demands;
  - Gender;
  - Routine and Comfort; i.e.
    - Use of toilets;
- Economical constraints.

Separation at source, Unavoidable for a sustainable sanitation





Composition of household (waste)water



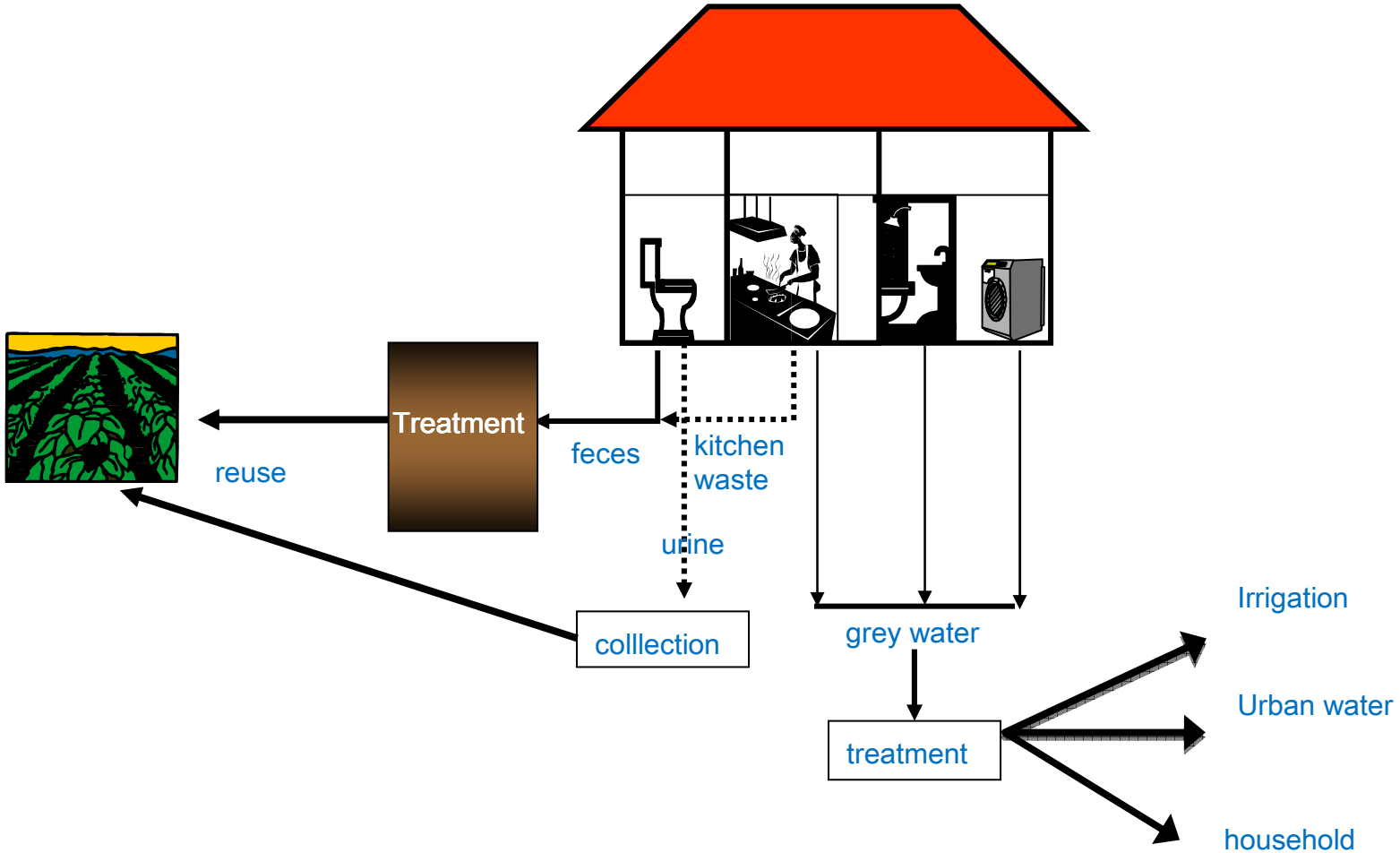
Faeces plus Urine plus kitchen waste

- A human being produces *ca.* **1.5** litres faeces plus urine plus kitchen waste;
  - **91%** of the nitrogen;
  - **70%** of the COD;
  - **69%** of the phosphate;
  - **Main** part of the pathogens;
  - **All** medicine rest and hormones.

Separate collection of Black (Feces & urine) plus kitchen waste & grey water

- leads to:
  - easy recovery of a large pool of relatively clean water (grey water) ;
    - treatment to comply with a quality for irrigation, second quality water in the household or urban water.
  - controlled collection of hazardous waste (Black (waste)water);
    - Low dilution results in:
      - possibilities of recovery of energy, compost and nutrients;
      - and removal of pathogens and micro-pollutants

Separate collection, transport and treatment of Black (feces & urine) + kitchen waste & grey water



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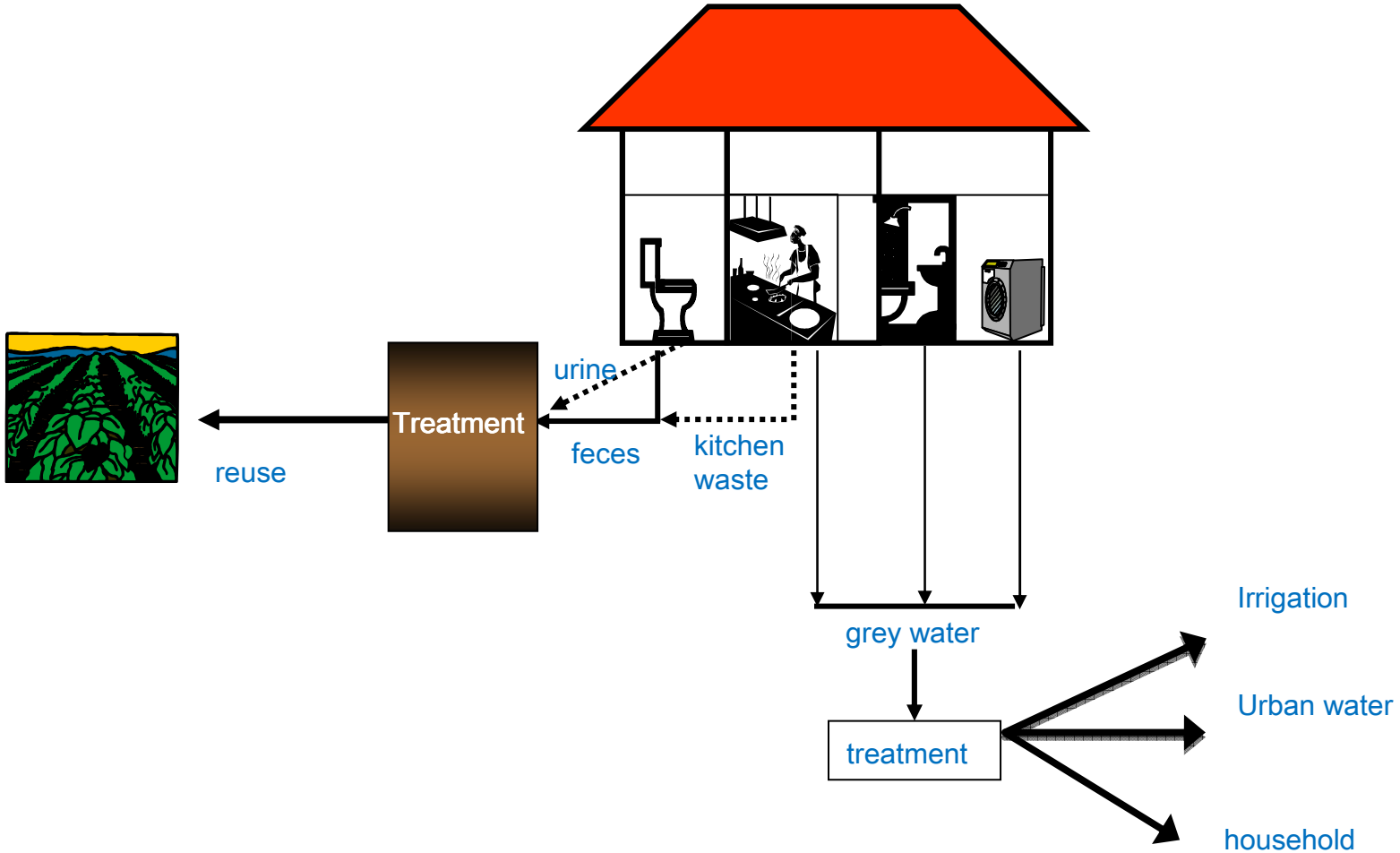

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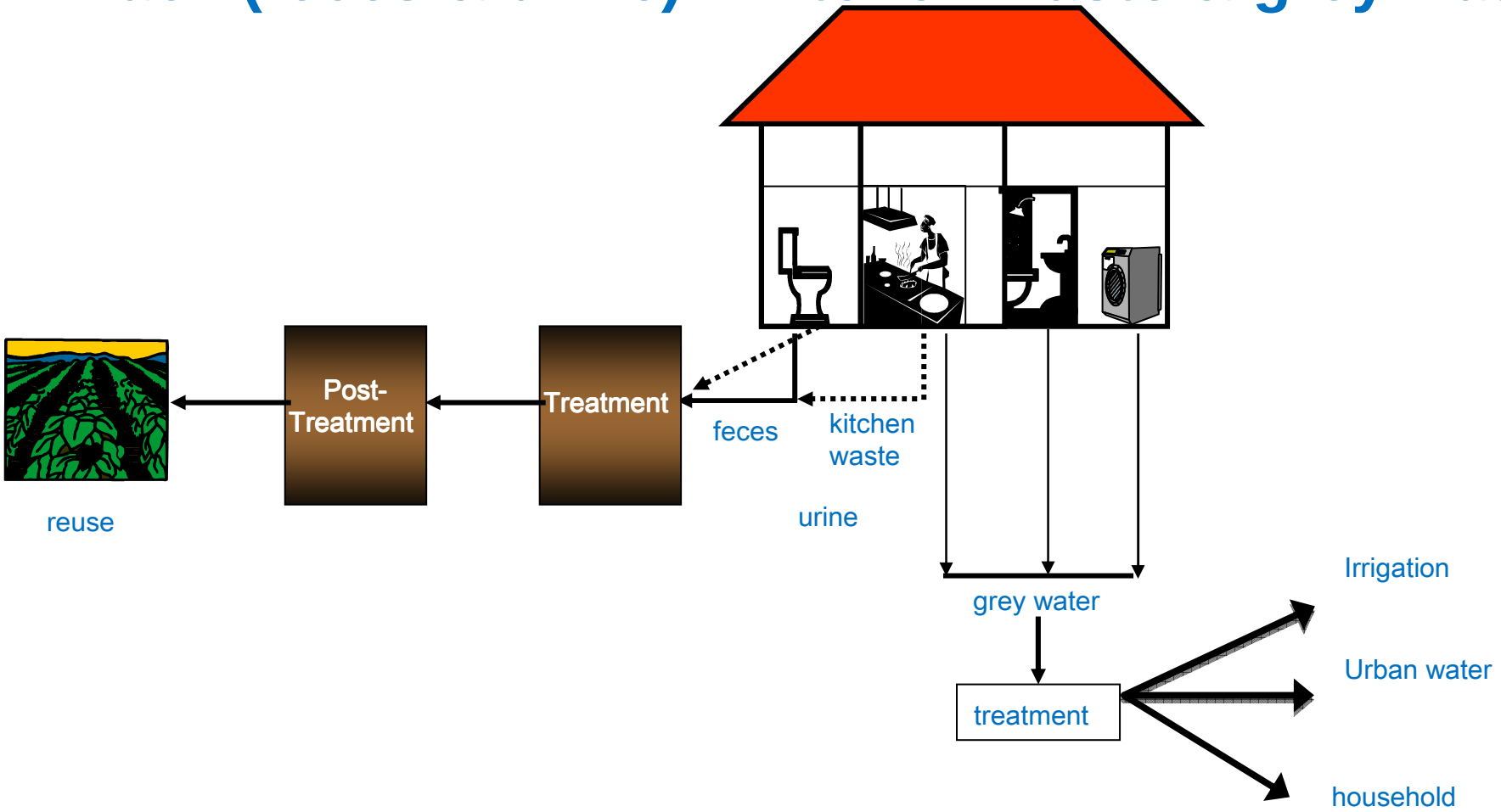


Grey water treatment

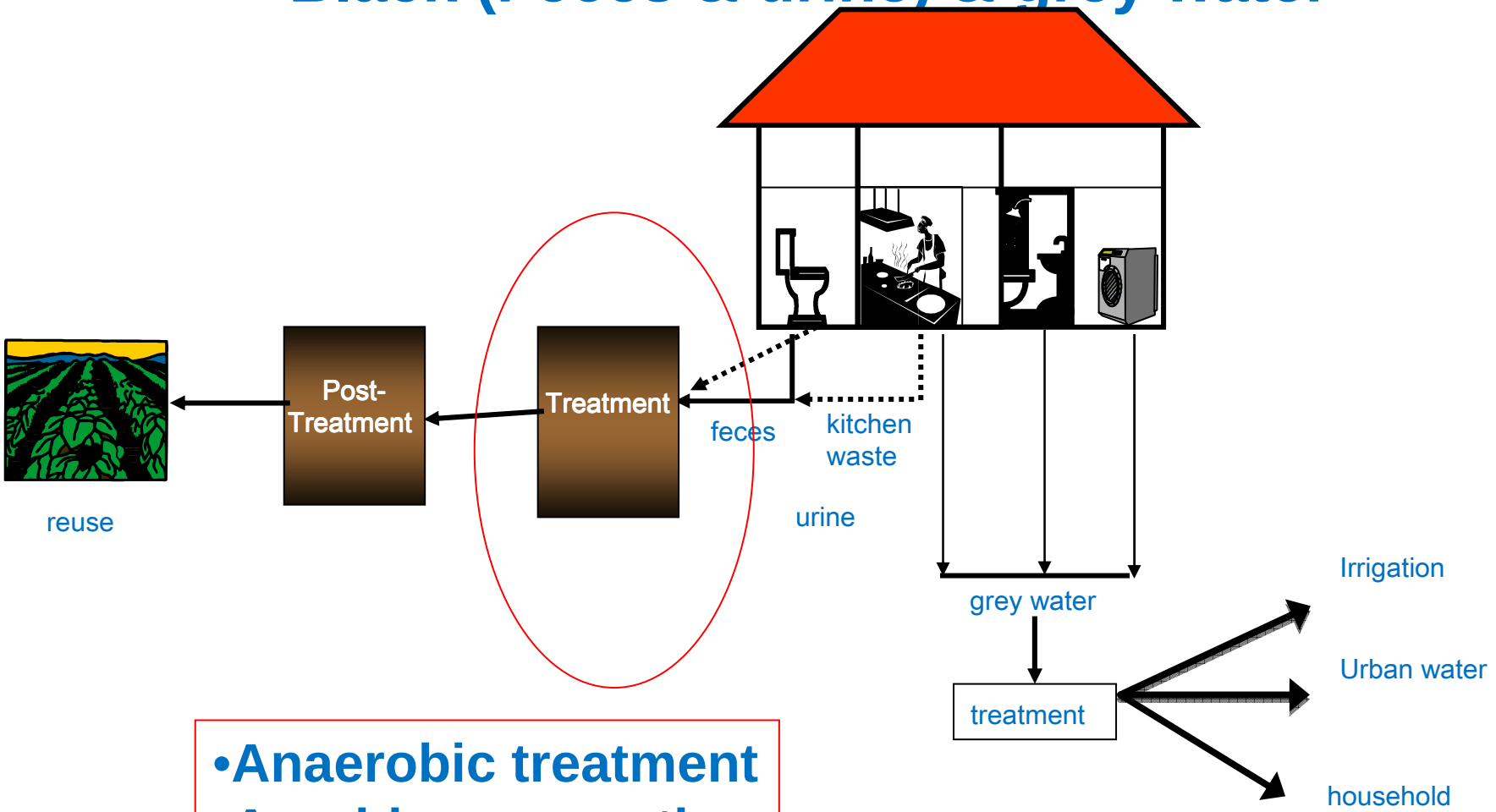
• Grey water (2/3 of total wastewater) is relatively clean and can be treated locally;

• Treated water can be used for ground water recharge, local water systems (attractive urban environment), irrigation or in the household (laundry, toilet);

• Application of constructed wetlands in urban residential areas in Europe is mainly applied;

•Two PhD researches in development of compact treatment system
    •Lina Abu-Ghunmi & Lucia Hernandez.

Separate collection, transport and treatment of Black (Feces & urine) & grey water



- Anaerobic treatment
- Aerobic composting

Collection (toilet) and transport system

- Determines for a great deal the treatment and recovery posiibilities:

– No water use and separation of urine:
  - » Composting toilets;
  - » Nonolet;
– Some water use and no urine separation:
  - » vacuum toilets; (1liter per flush);
– Some water use and urine separation:
  - » Urine diverting systems;

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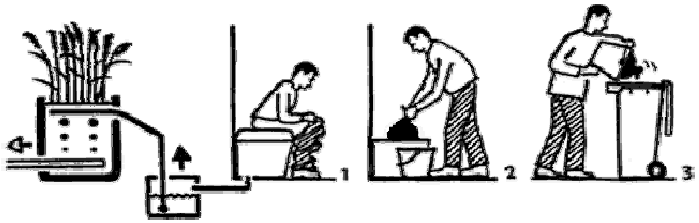

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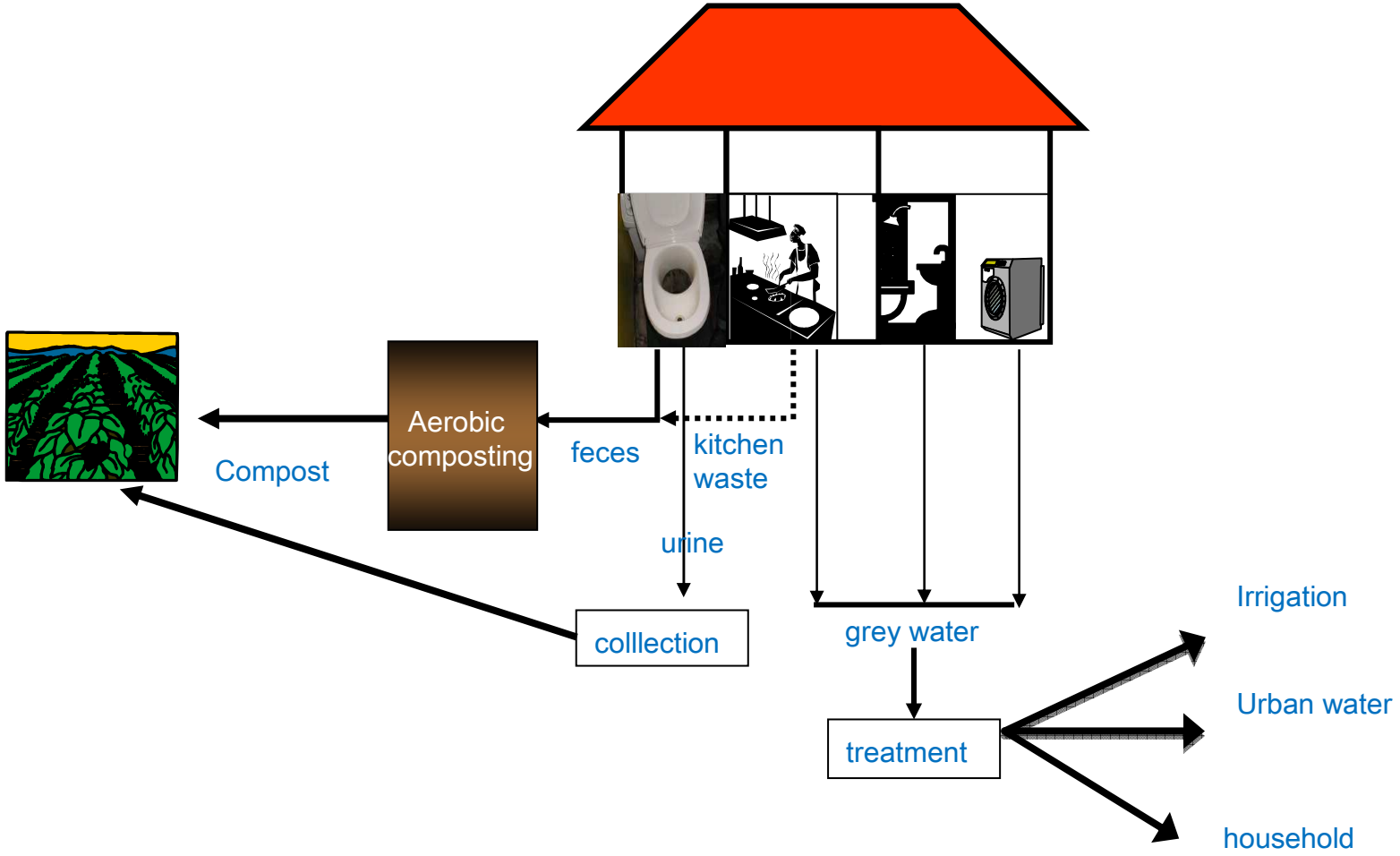
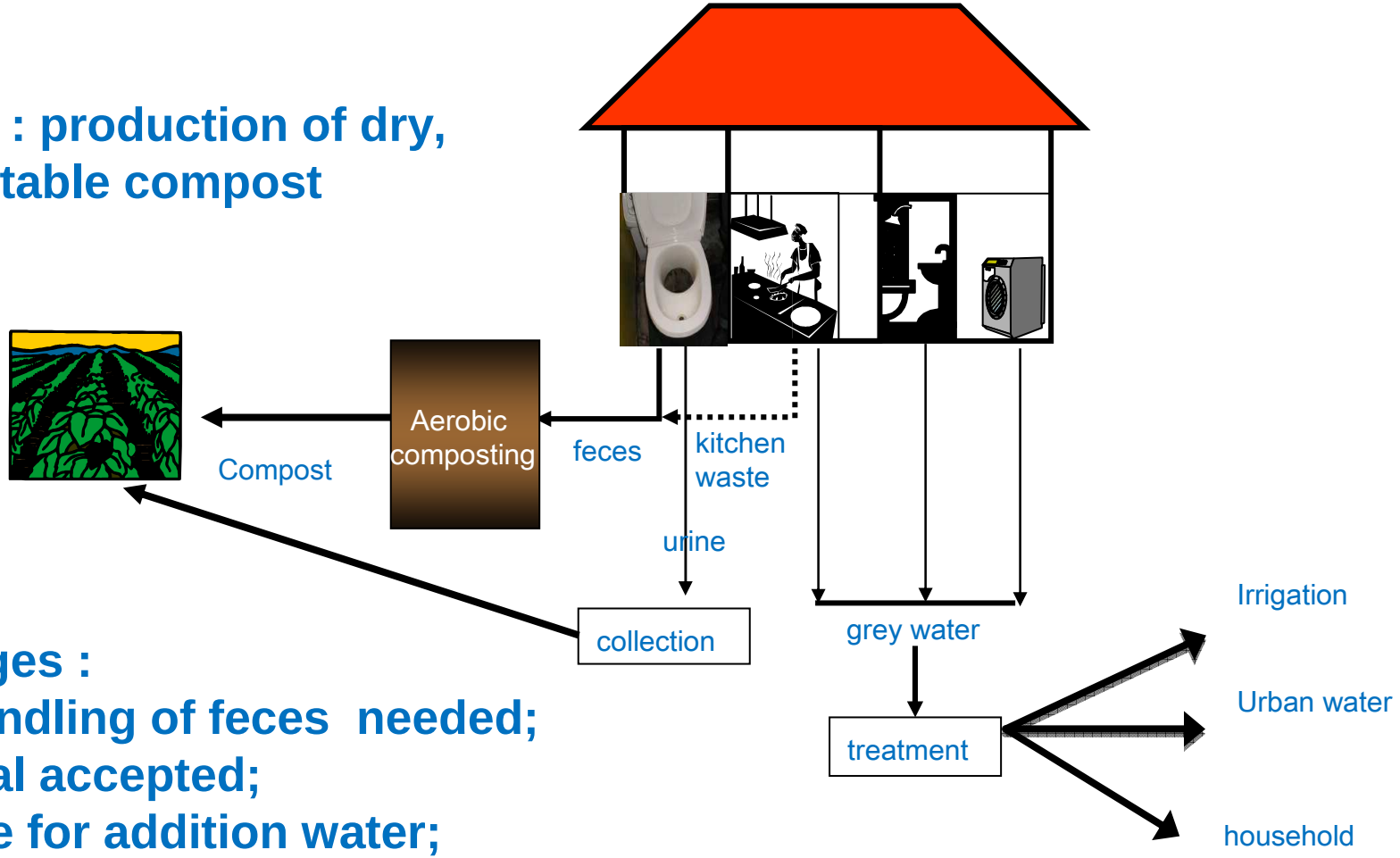
composting of feces; separation of urine - house on-site;



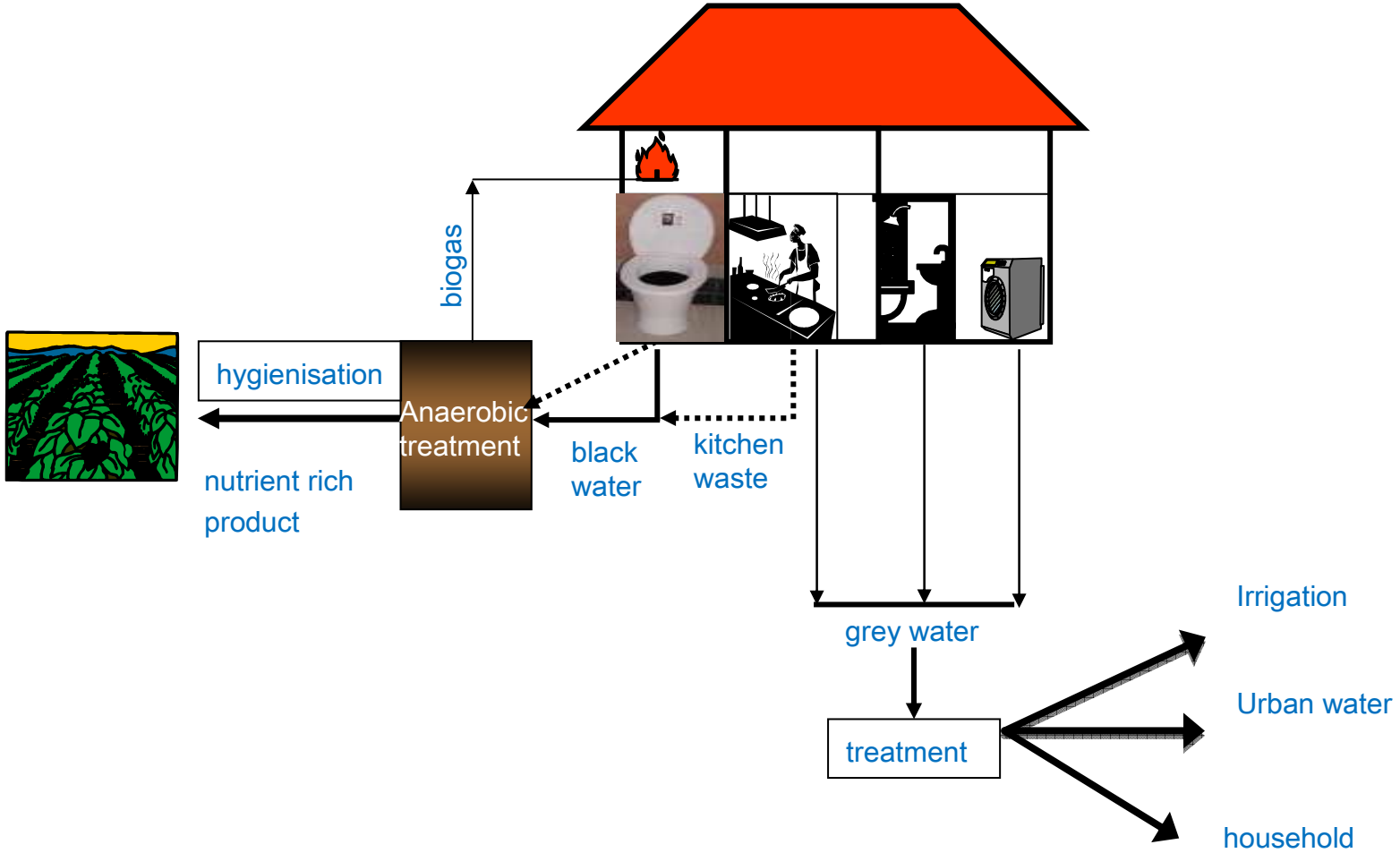
composting of feces; separation of urine - house on-site;

Advantage : production of dry, hygienic, stable compost



Disdvantages :
-(some) handling of feces needed;
-not general accepted;
•Vulnerable for addition water;

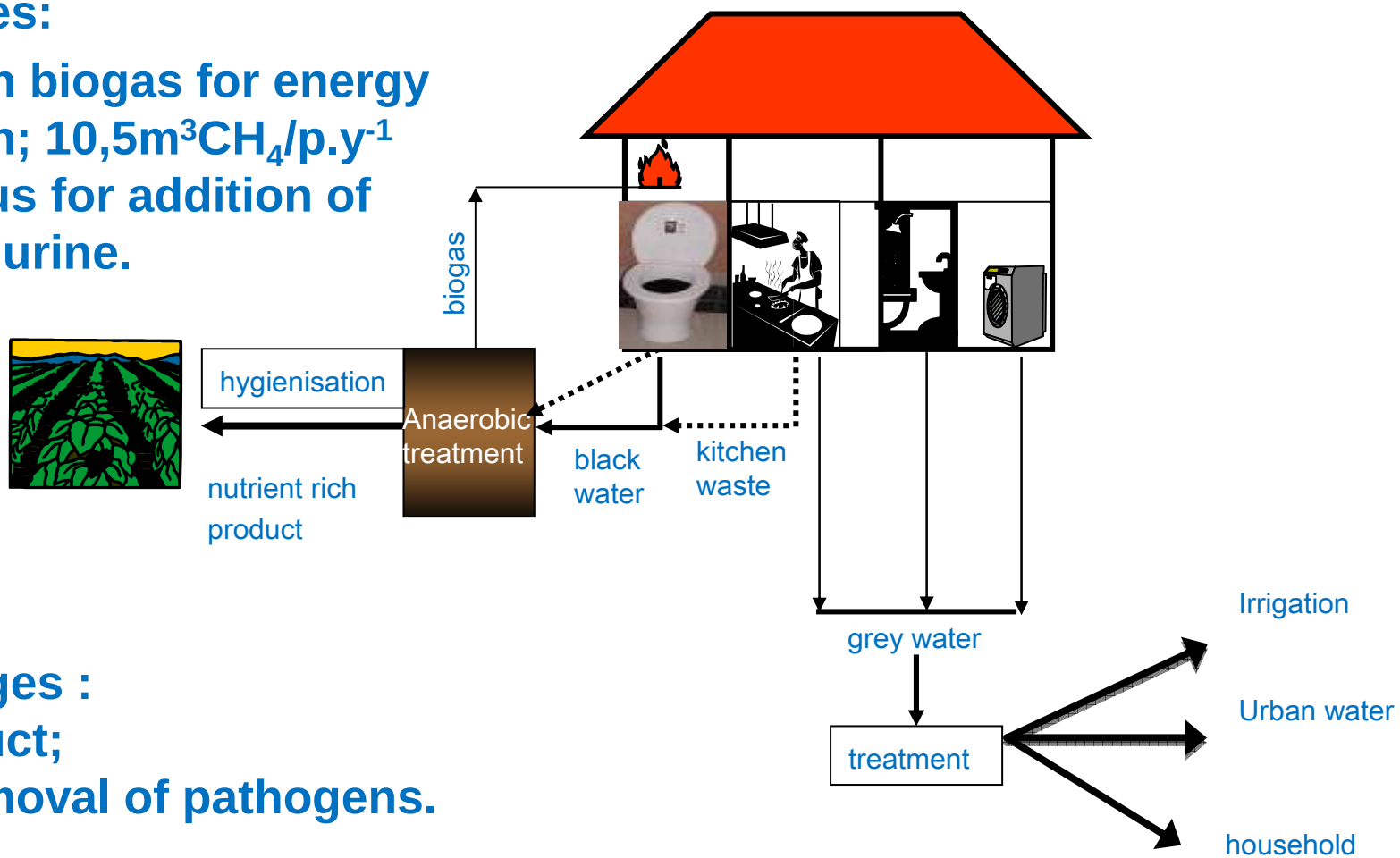
Anaerobic treatment of black waste(water); separation of urine not needed house on-site;



Anaerobic treatment of black waste(water); separation of urine not needed house on-site;

Advantages:

production biogas for energy production; 10,5m^{3}CH$_4$/p.y^{-1}
•impervious for addition of water and urine.



Disdvantages :

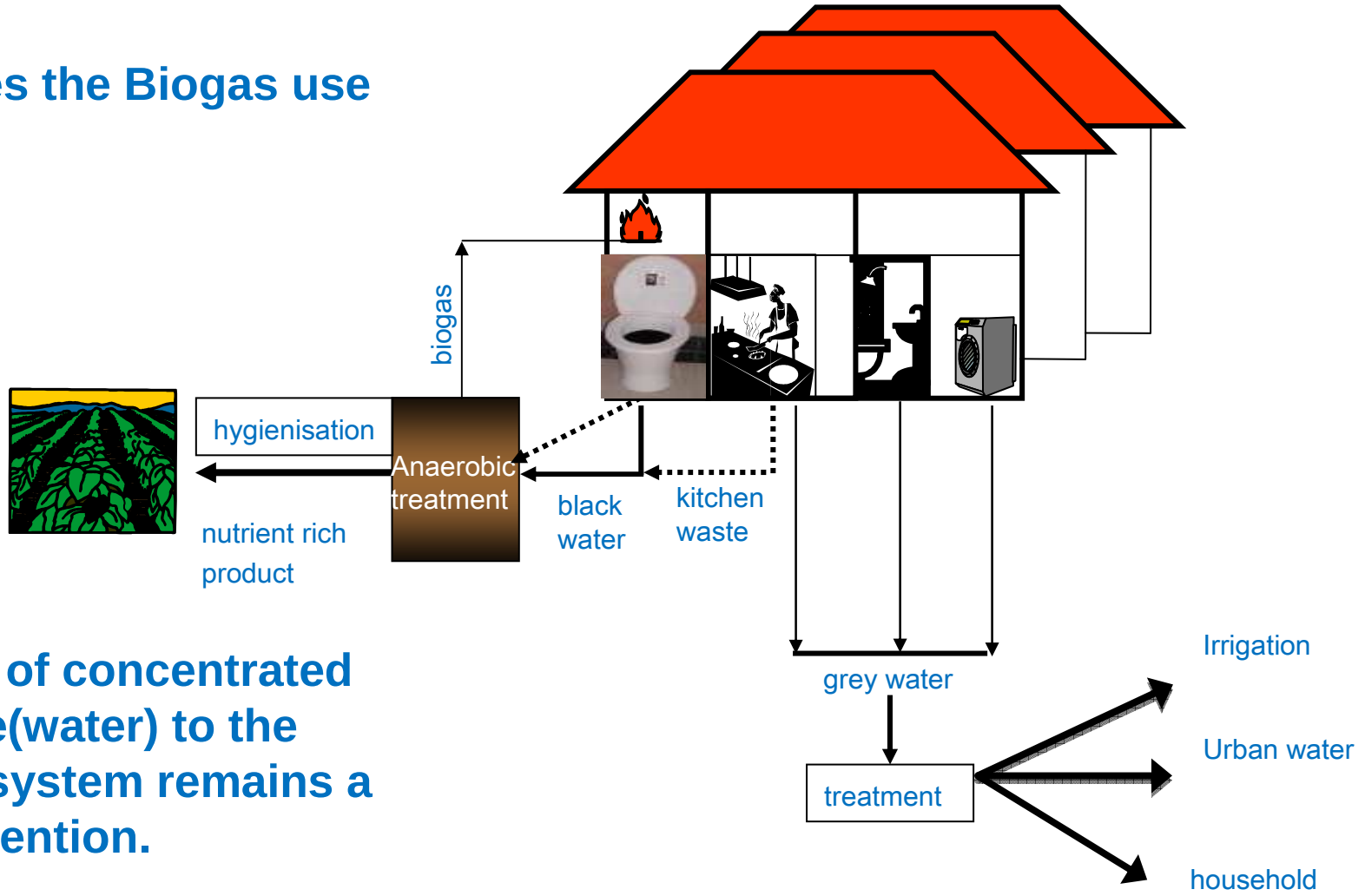
•Wet product;
•Partial removal of pathogens.

Anaerobic treatment of black waste(water) in Tanzania

Sustainable environmental protection using modified pit-latrines (PhD thesis, WUR-ETE)
Chaggu, E.J. \ 2004

Anaerobic digestion of black waste(water); community-on-site;

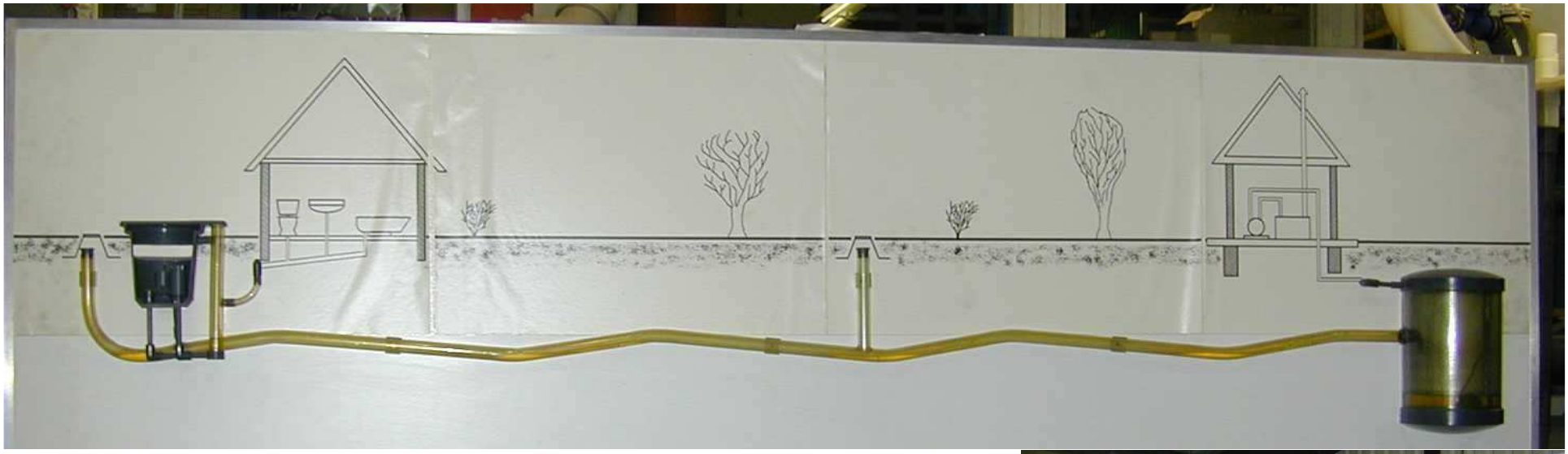
- **Facilitates the Biogas use**



- **Transport of concentrated blackwaste(water) to the treatment system remains a point of attention.**

Vacuum collection & transport use 1 liter for flushing

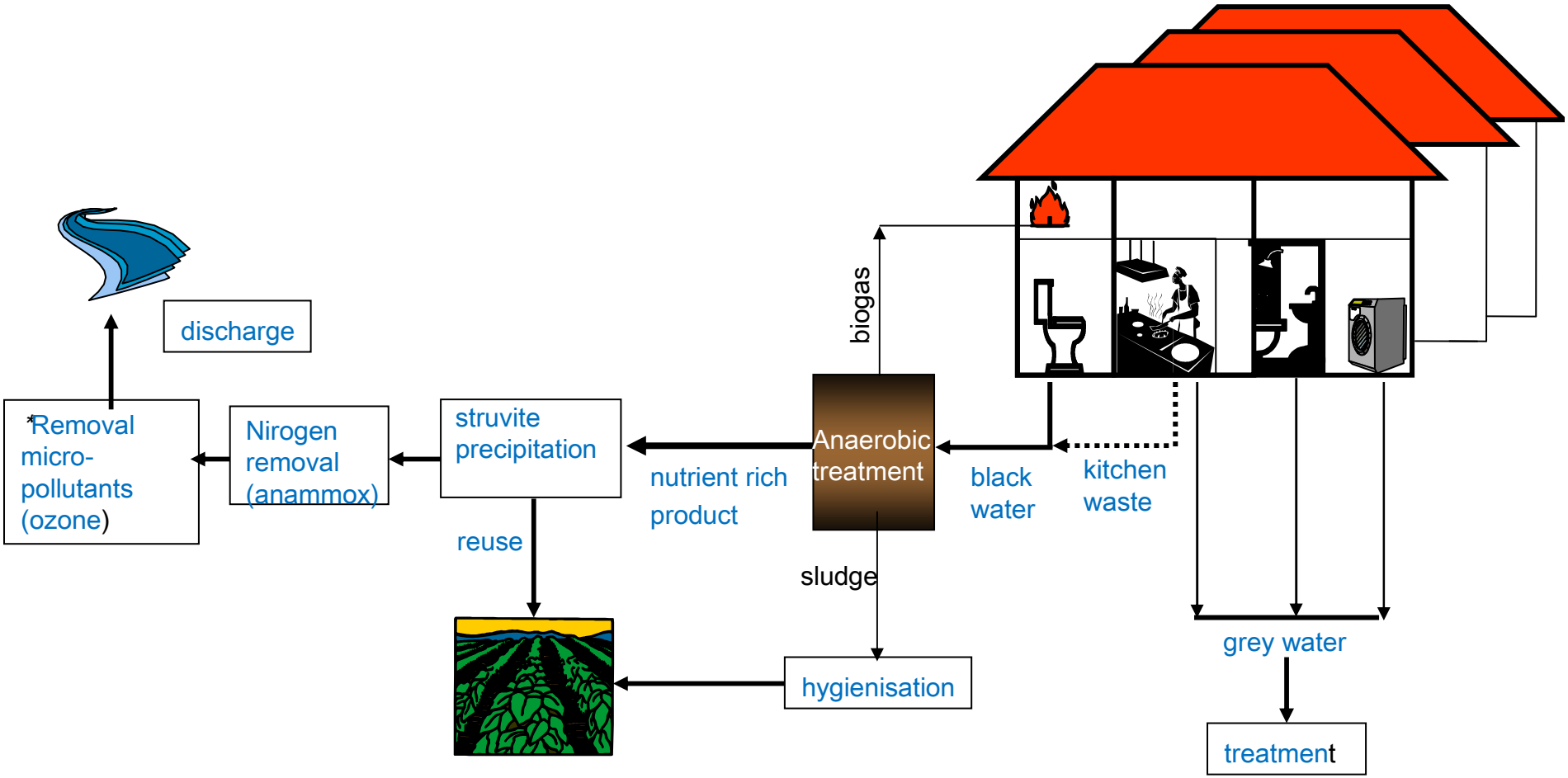
- **Producing 7l/p.d^{-1} concentrated black water;**
- **saving 30-42 l/p.d^{-1}**



- Vacuum station and sewer in Lubeck (Germany) for blackwater;
- small diameter flexible pipes

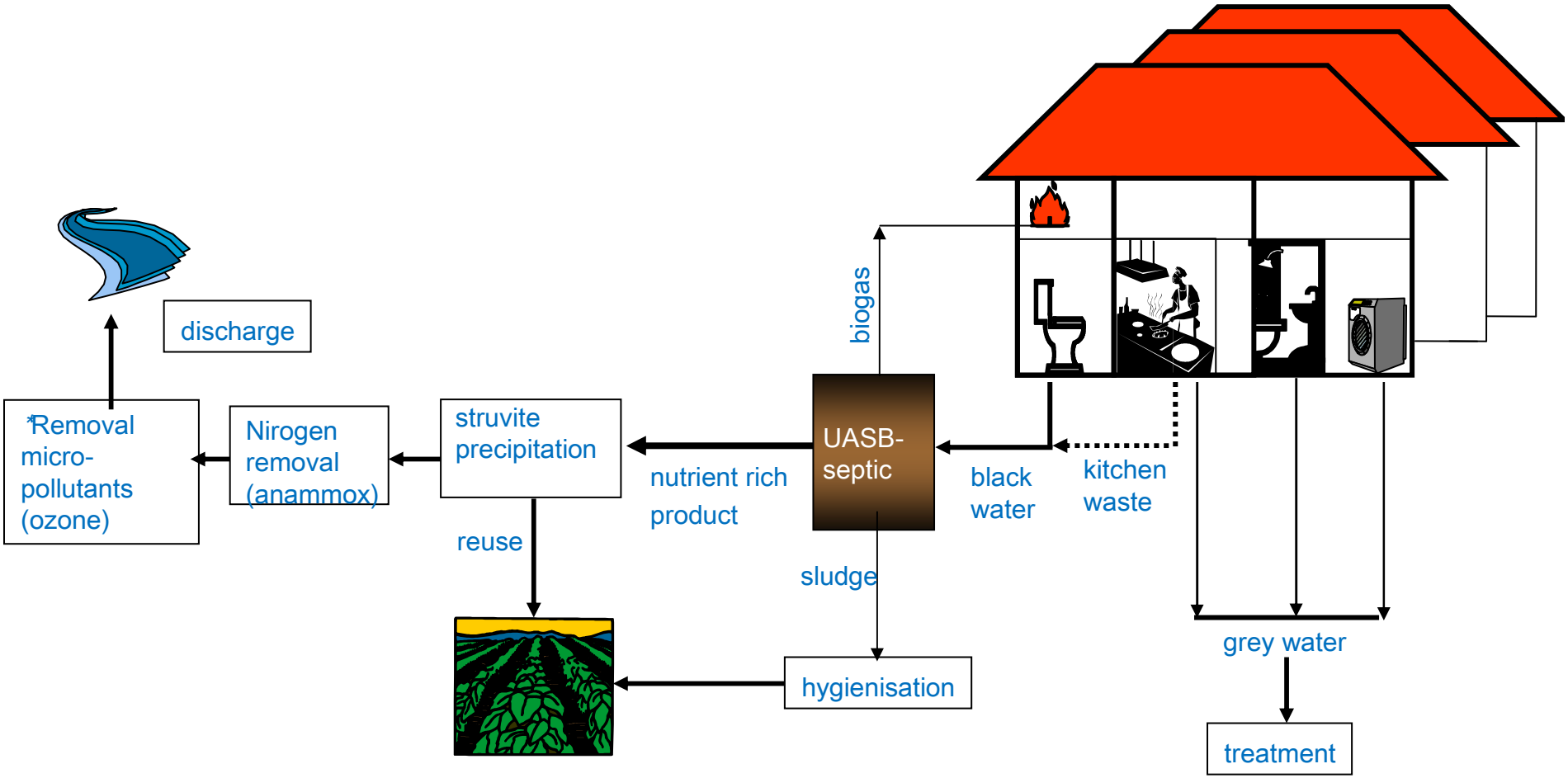
Prototype vacuum kitchen grinder

Separate collection, transport and treatment of black waste(water) & grey water (DeSaR)



*not yet realised

DeSaR concept demonstrated for 32 houses in Sneek



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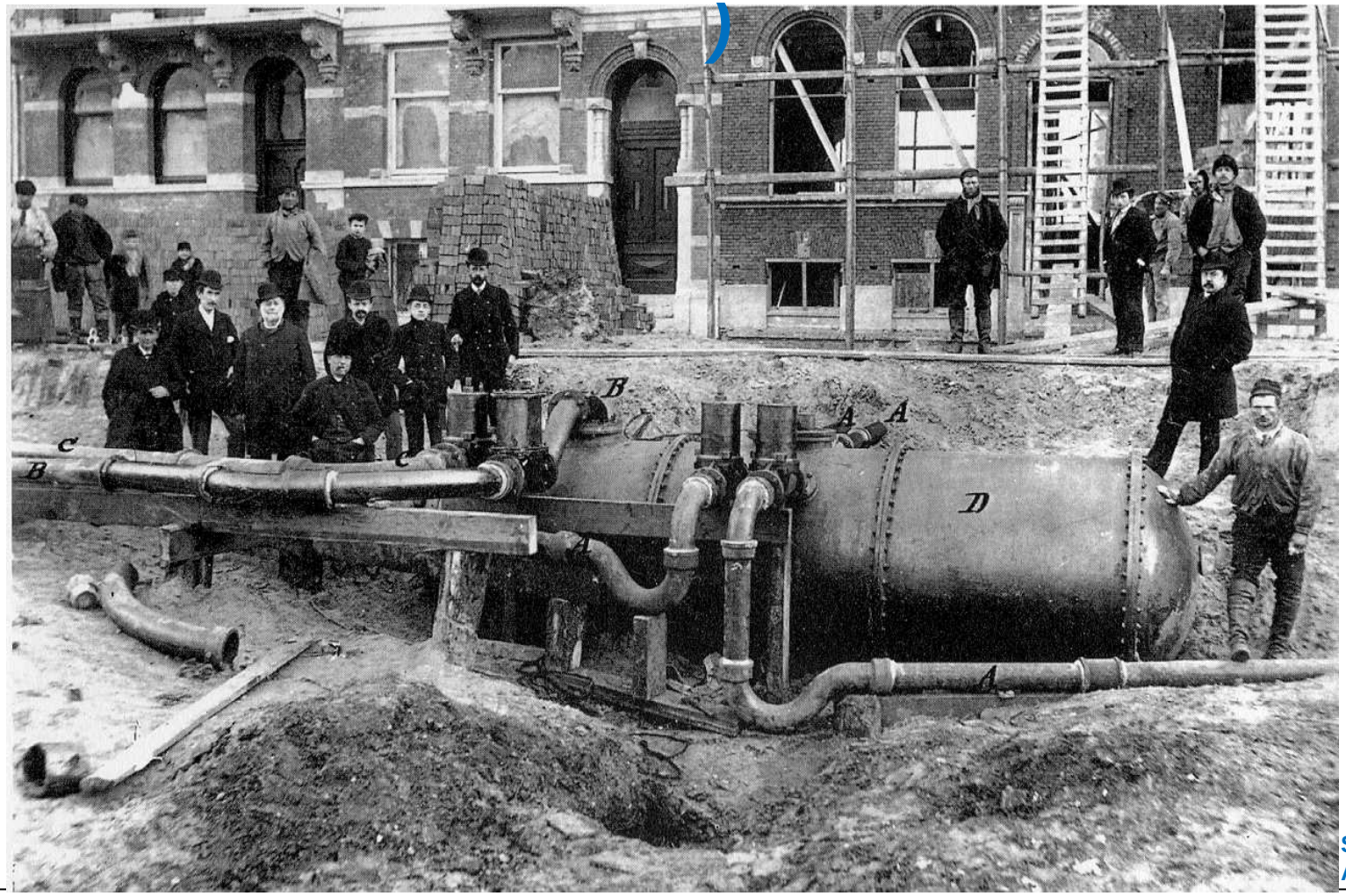
Letting Associates
Foundation

Development of vacuum sewerage in the 1870's

(Liernur system)



Slide:
Adriaan Mels

First vacuum sewerage (Liernur system)

source: een zeer onfrisse geschiedenis, Henk van Zon, RUG)

- Developed by Charles Liernur in 1867 as alternative to waterborne sewerage;
- Basic idea: reuse of concentrated black water in agriculture;
- Collection via subsurface iron pipes by application of vacuum suction through ‘locomobile’;
- Human manure was directly used, dried or used for production of ammonium sulphate (Amsterdam);
- Exploitation was in most cases cost effective (gains = costs**).**

Slide:
Adriaan Mels

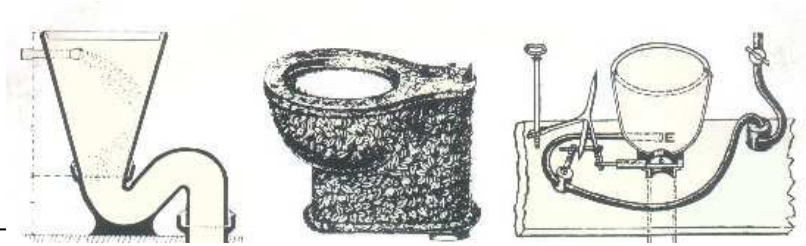
Liernur system was applied in:

- Leiden (1200 persons 1870-1915);
- Dordrecht (800 persons; 1872-1887);
- Amsterdam (1700 persons; 1872-1912);
- Prague (15.000 persons);
- St. Petersburg (20.000 persons);
- Luxembourg.

Slide:
Adriaan Mels

More than 40 years of well functioning; why did it disappear?

- More water closets connected to the system (more dilution, more energy to manufacture the product);
- International rise of water based sewerage;
- Vacuum was unknown / new;
- Less interest in agricultural value of nutrients due to development of chemical fertilizers.



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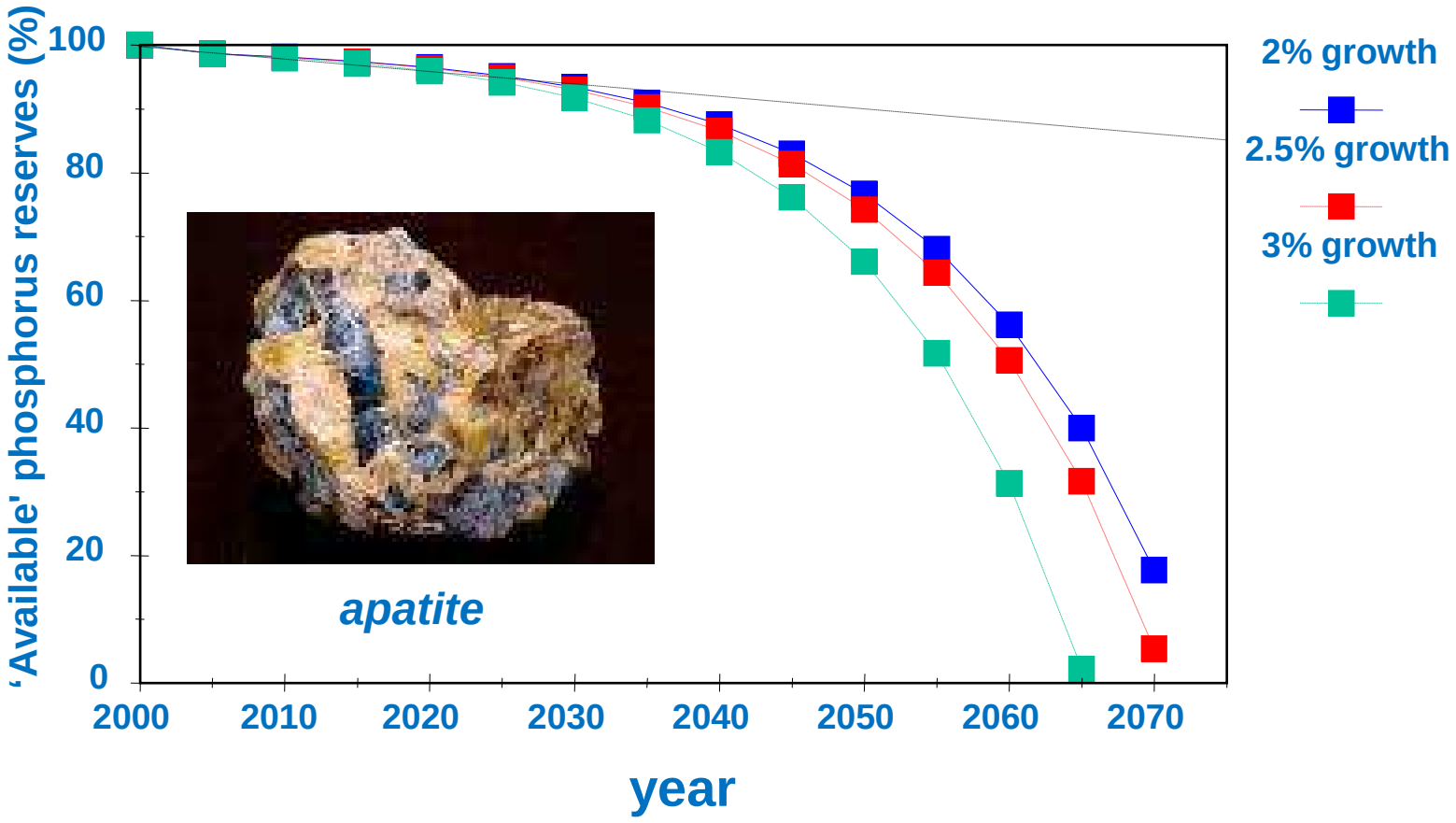
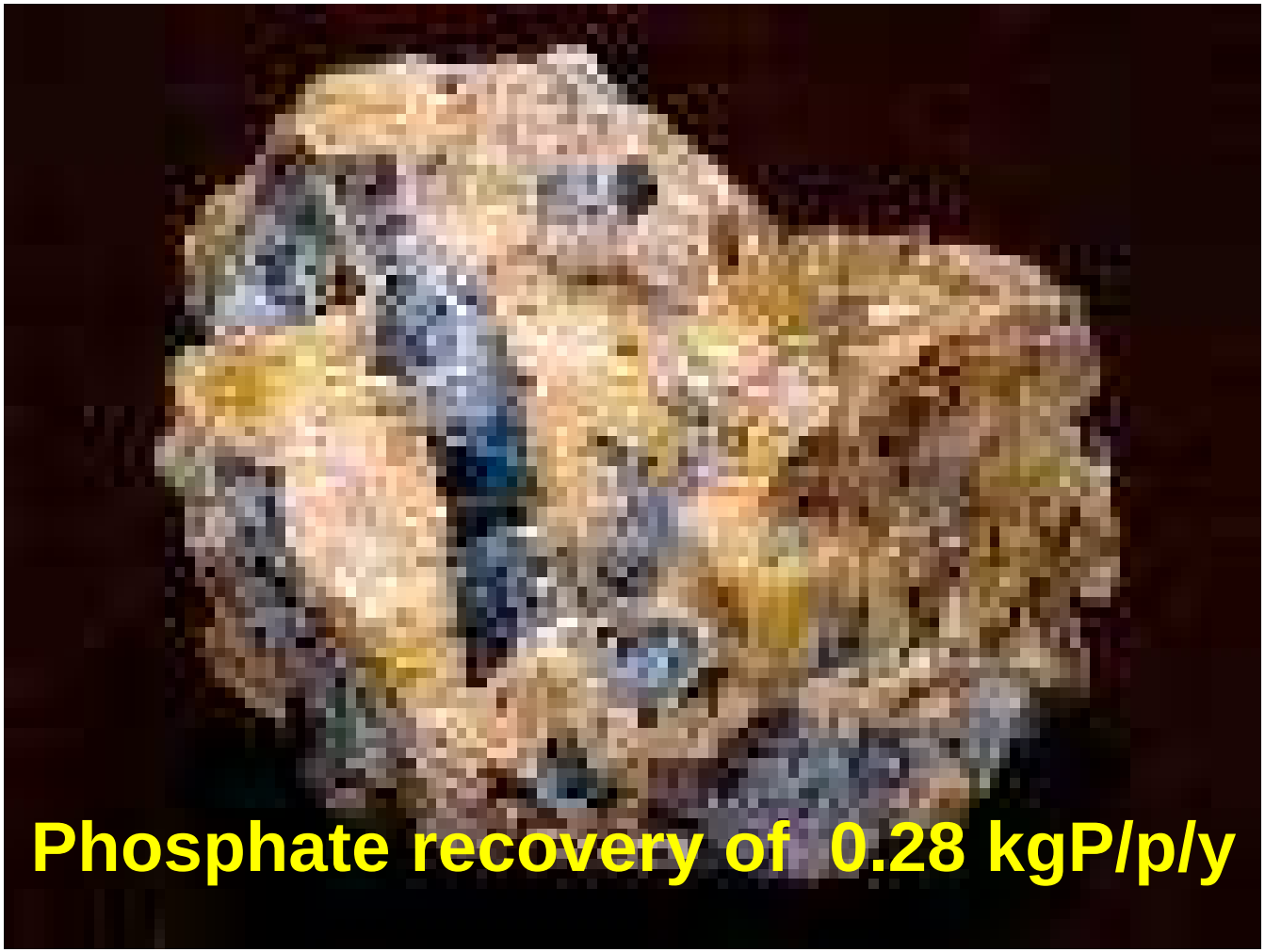
Global depletion of resources



Source: Driver *et al.* (2001)

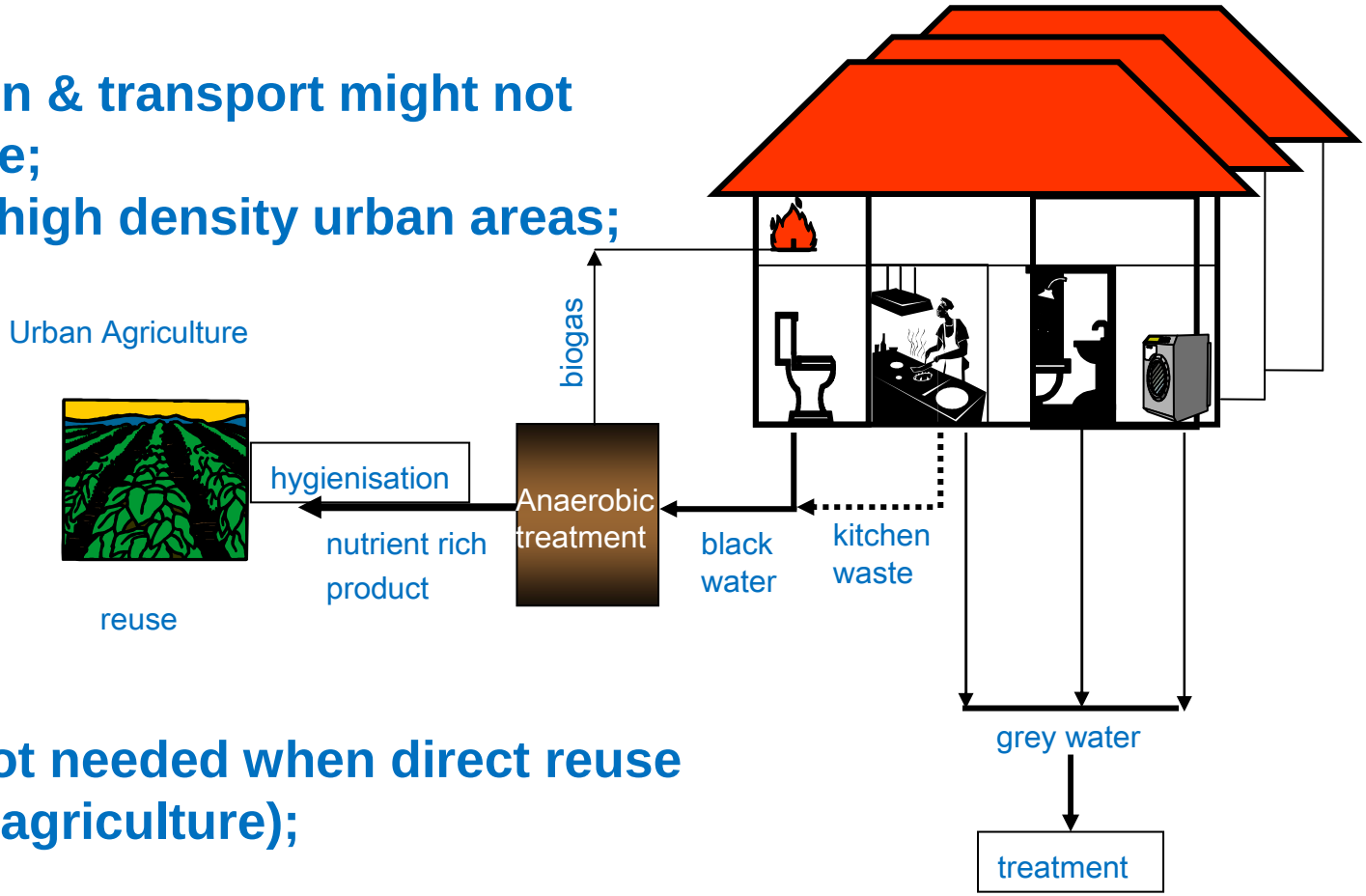
Slide:
Jules van Lier

Black waste(water) treatment; struvite precipitation



Separate collection, transport and treatment of black waste(water) & grey water

- Vacuum collection & transport might not always be possible;
- Toilets blocks in high density urban areas;

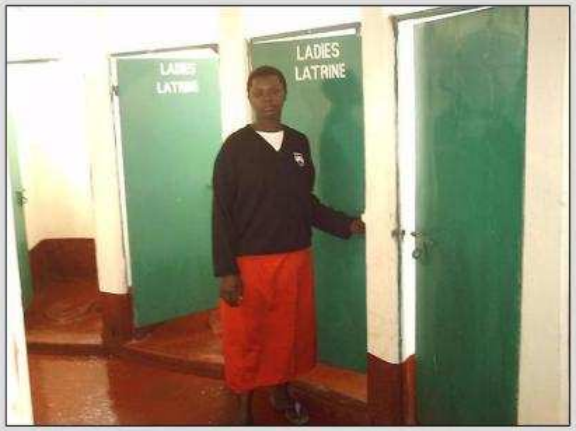


- Post-treatment not needed when direct reuse is possibe (urban agriculture);

The SPARC-style sanitation block in Gatwekera village in Kibera, Nairobi, managed by the community women

General view (top floor women's meeting room)

Women's toilets

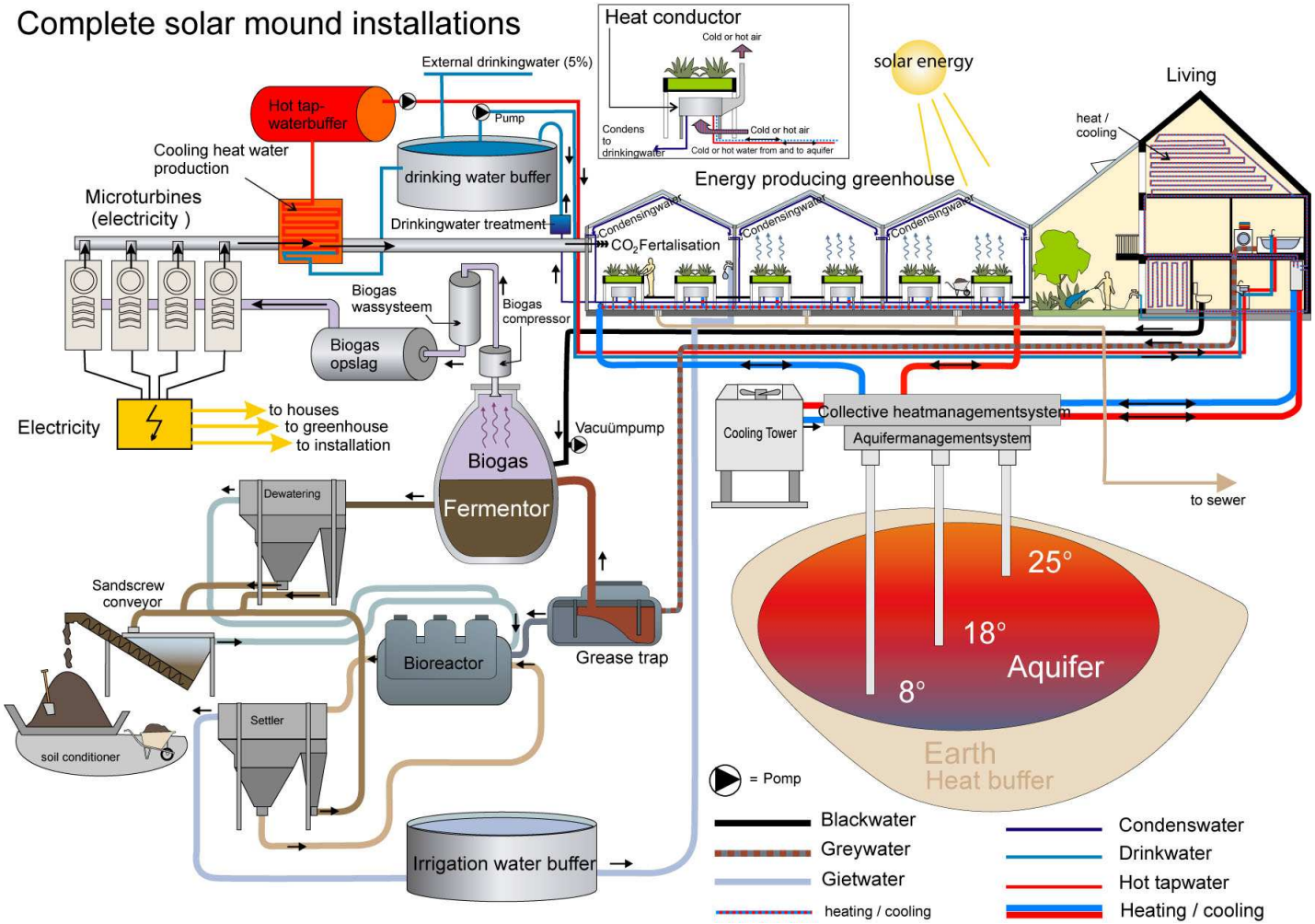


Anaerobic digester beneath the toilets;

Biogas for cooking.

Photographs courtesy of Rob Clarke, Halcrow/Water and Sanitation for the Urban Poor.

Greenhouse village (http://www.zonneterp.nl/zonneterp.pdf)



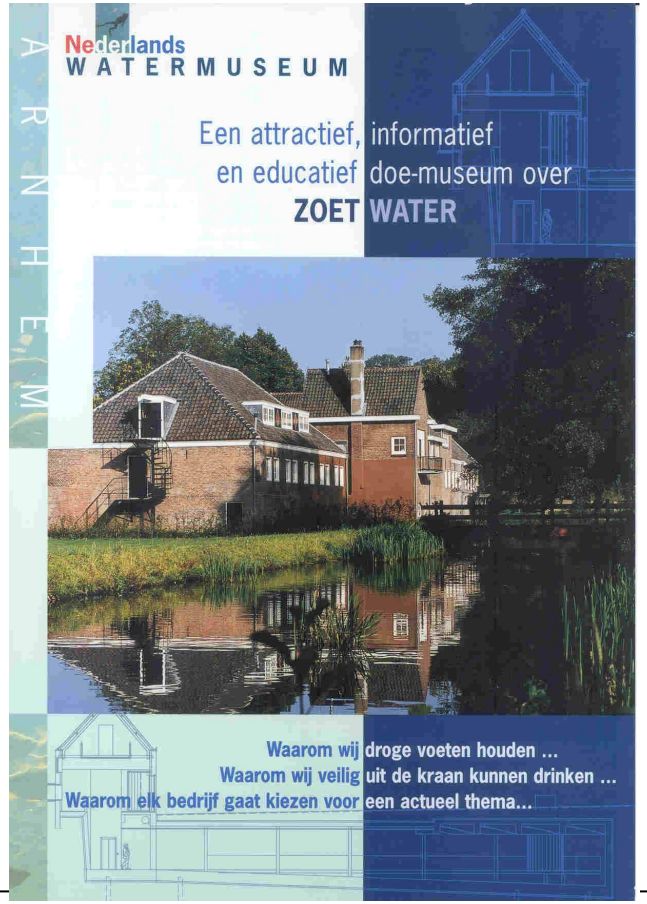
Technical lay-out of Greenhouse Village

A.R. Mels, N. van Andel, E. Wortmann, J. Kristinsson, P. Oei, J. de Wilt and G. Zeeman (2006)

Separate collection of urine

- ca. 1-1.5 l/p.d urine production containing main fraction of N, P & K;
- Separate collection is possible through special 'No Mix' toilets;
- Direct use as a fertilizer or recovery of minerals;
- Application started in Europe
  (Sweden, Germany, Switzerland and The Netherlands)
  - to reduce Nitrogen load to *centralized* WTPs
    - saves space and energy;
  - To recover Phosphorus;
  - Reduce emission of hormones and medicine rests;
    - hospitals

Demonstration urine separation toilets in Watermuseum, Arnhem



Future in The Netherlands (2009)

- 200 houses (renovation) in Sneek equiped with vacuum toilets;
  - Treatment of blackwater ;
  - Treatment of greywater;

- Greenhouse Village, Zonneterp; (urban agriculture for low temperature countries);
    - Integration urban enviroment and food production in greenhouses (http://www.zonneterp.nl/zonneterp.pdf);

- Several urine separation projects

Conclusions

- Different versions of ‘New Sanitation’ can comply with:
  - Hygienic, environmental & sustainabilty objectives;
  - Are available for different circumstances both in developing and developed countries.

Conclusions

- Developed countries are challenged to accomplish a transition from:
  - highly centralised systems, not based on resource recovery;

  to:
  - Decentralised concepts based on source separation, resource recovery and reuse.

Conclusions

- Developing countries are challenged to bypass highly centralised systems, not based on resource recovery;

  And directly apply:

- Decentralised concepts (‘New Sanitation’) based on source separation, resource recovery and reuse.

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stowa

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Hogeschool VAN HALL LARENSTEIN
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Patrimonium SNEEK
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