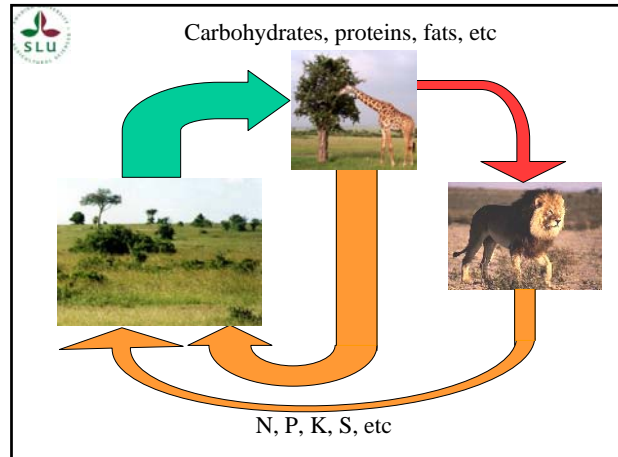


Urine diversion – technology & installation

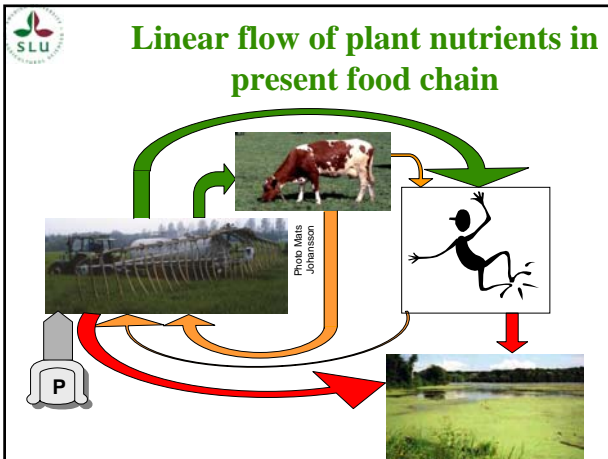
Håkan Jönsson
Associate professor

Hakan.Jonsson@bt.slu.se

Swedish University of Agricultural Sciences



Linear flow of plant nutrients in present food chain



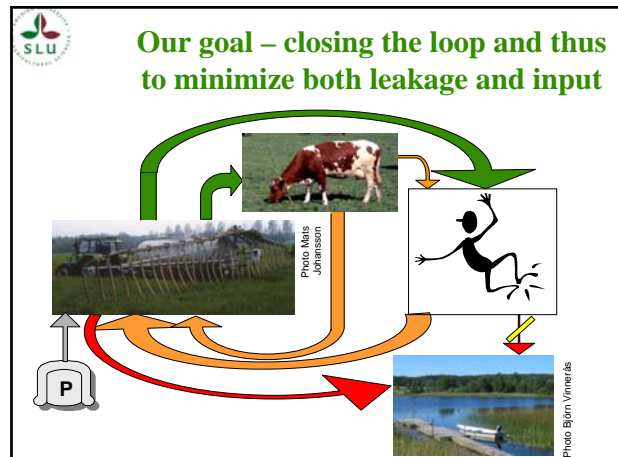
Problems with wastewater emission to water:

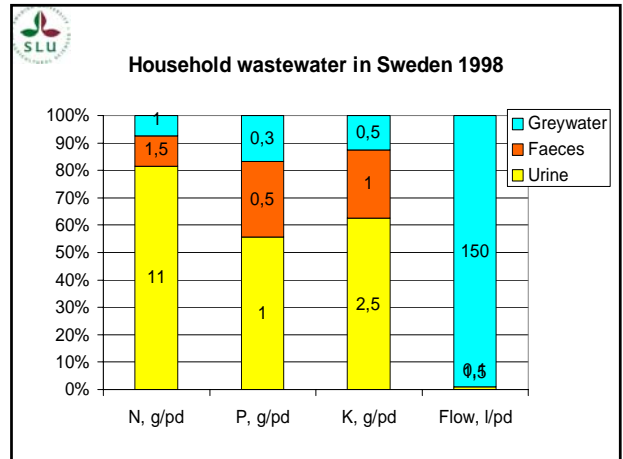
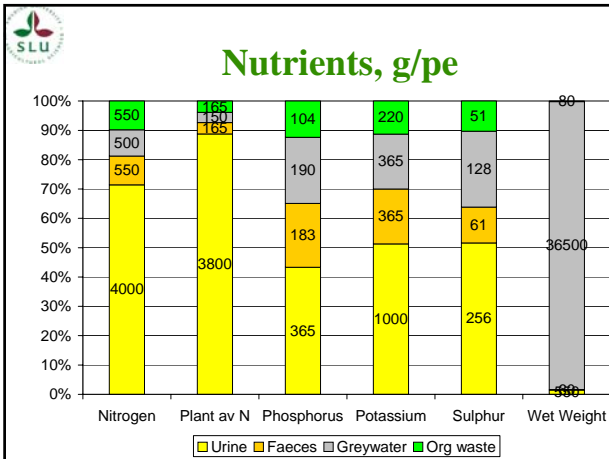
- Pathogens
- Hazardous substances (heavy metals, persistent organic pollutants, endocrine disruptors, medical residues)
- **Surface water:** Oxygen deficiency (org. matter [BOD], N, P, algae, water hyacinths etc.)
- **Ground water:** Nitrate pollution, NO_3^- ,

Impoverishment of farming land:

- Organic matter, humus – BOD
- Macro nutrients: N, P, K, S, Ca, Mg
- Micro nutrients: Fe, Mn, B, Cu, Zn, Mo, Co

Our goal – closing the loop and thus to minimize both leakage and input





Urine diversion and dry sanitation

- Enables keeping the surface of the faeces dry
- Minimizes the risk of flies
- Minimizes the risk of odour

Gustavsberg

Dubblotten -floor

Dubblotten

WME DS

WME ES

Kimberley, South Africa

Tepoztlán, 2004

Harare, Zimbabwe, 2001

China

Kisoro, Uganda 2002

Johannesburg, South Africa

Photo: T.A. Steinerlin (left column), Photo: B. Vinnerås (right column)

Muzika primary school, Zimbabwe 2001



User experiences & problems

Questionnaire 1997- 96 households

BB Dn	WM DS:
<i>Understenshöjden</i>	<i>Smeden</i>
<i>Palsternackan</i>	<i>Svedden</i>
<i>Ekoporten</i>	<i>Hushagen</i>
<i>1999 Miljöhuset</i>	<i>2004 Hylde-spælet</i>

Different types – unstructured observations

Stoppages in the toilet u-bend (seal)

- Increased need of **cleaning**
- Odour in some cases
- Inadequate **flushing**
- **Urine** separation not always efficient



Stoppages in toilet seal

- **Once - a few times a year**
 - Hairs, fibres, material from brushes
 - Precipitation (phosphorous, calcium, magnesium)
- **76% soft** - hair etc \Rightarrow rodding iron (mechanical snake) or NaOH
- **24% hard** \Rightarrow NaOH (Caustic soda)



Sewage auger - Rodding iron - Mechanical snake



Toilet

- **Comfortable** and easy to use
- Allow **men standing up**
- **Unhindered urine flow**
- **Mechanical snake usable**
- **Urine u-bend easy to access** and disassemble
- **No metal** in contact with urine
- Surfaces above u-bend **easy to clean**
- **Effective flush** (≤ 0.1 l/flush)



Urine pipe sludge



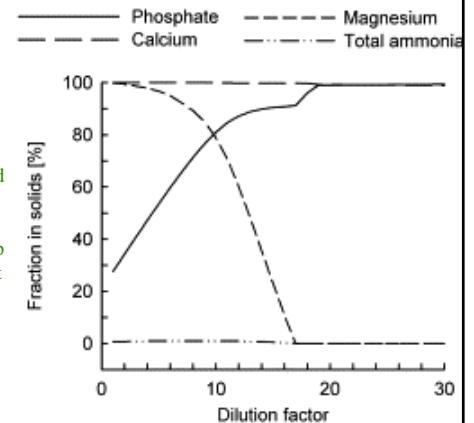
Urine pipes

- Video, bare eye inspections of 2 installations after 2.5 and 8 years + accounts from small installations
- **Water TIGHT** - water leaking in is a frequent problem
- Sludge is formed if urea is broken down in pipe
 - $\phi \geq 75$ mm (50 mm acceptable if easy to access and dismount and perfectly installed and preferably 110 mm in ground) – horizontal minimum **1% slope**, preferably 2%
 - if no u-bend $\phi \geq 25$ mm – horizontal minimum **4% slope, max 10 m system.**
- Good opportunities for **inspection & cleaning**
- **Not ventilated** – **pressure equalised** (small ϕ 2-5 mm)
- **Minimise piping!!**



Collection & Storage

- Urea \Rightarrow ammonium/ammonia
- $\text{CO}(\text{NH}_2)_2 + 3 \text{H}_2\text{O} \Rightarrow 2 \text{NH}_4^+ + 2 \text{OH}^- + \text{CO}_2$
- pH 6 – 7 \Rightarrow 9 – 9.4
- Precipitation MgNH_4PO_4 & $\text{Ca}_x(\text{PO}_4)_z$
- $\text{NH}_4^+ + \text{OH}^- \Leftrightarrow \text{NH}_3(\text{aq}) + \text{H}_2\text{O}$
- $\text{NH}_3(\text{aq}) \Leftrightarrow \text{NH}_3(\text{g})$
- \Rightarrow **Minimum ventilation!!** (No pressure \varnothing 2-5 mm)



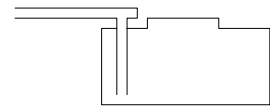
Maintenance - toilet & pipe

- **If u-bend**
 - Mechanical and/or chemical cleaning initially 2-3 times per year
 - Chemical 1 – let strong caustic soda (1:2 parts of water dissolved beforehand) sit in the pipe overnight – flush with 3-5 litres of water in the morning
 - Chemical 2 – let strong acetic acid (preferably 25-60%) sit in the pipe overnight – flush with 3-5 litres of water in the morning
 - Alternative use of caustic soda and acetic acid recommended
- **If no u-bend**
 - Flush the pipe with 1 litre of water every 1-2 weeks
 - If odour pour slowly 1-2 dl of strong acetic acid down the pipe



Tanks

- Ventilation measured in 2 tanks * 2 regimes
- $\leq 0,1\%$ N-loss (no ventilation, airtight manhole) \Rightarrow air flow < 50 times urine flow
- Filled from the **bottom**
 - Low losses
 - Avoids smell
- Manhole at incoming pipe
- Risk of high ground water \Rightarrow completely tight, tied down
- Bottom sludge rich in phosphorus is formed
- **Are jerry cans enough?**

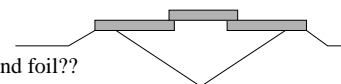


Urine tanks



Urine storage

- Is storage necessary? Not needed for small systems! Are jerry cans for collection enough?
 - Crops for fertilisation available all year?
 - Store in field during dry season - before sowing, planting
- Plastic tanks - expensive
- Concrete - durable?
- Metals - NO!
- Plastic/rubber/bitumen foil + concrete slab/second foil??
- Fill from bottom
- Emptying through manhole
- Incoming pipe close to manhole





Urine tanks – Uganda



Recommendation

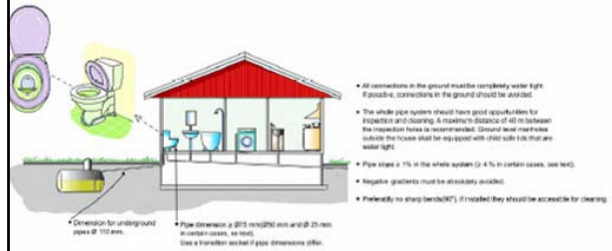


Figure 27. Urine diversion in the home, toilet and tank. Picture by J. Polmerantz & Co.

Kvamström et al. 2006. Urine diversion – one step towards sustainable development. www.ecosanres.org



Recommendation



Figure 28. Instructions for filling and emptying of tanks. Picture by Polmerantz & Co.

Kvamström et al. 2006. Urine diversion – one step towards sustainable development. www.ecosanres.org