

Breaking the sanitation barriers:  
WHO Guidelines for excreta use as a  
baseline for environmental health

Thor Axel Stenström

Swedish Institute for Infectious Disease Control,  
Stockholm, Sweden

and

WHO, Water Sanitation and Health, Geneva

# Hurry up in the toilet: 2.6 Billions are waiting!!



- New safe sanitation to more than 360 000 every day to reach the MDGs.
- 4400 people every day dies due to bad water, sanitation and hygiene.
- 68 million DALYs are lost per year
- If MDGs were met for water and sanitation the saved costs equals 7.3 billion US Dollars per year

# Flooded with shit!

Water and foodborne diseases have implications for:

- The health of individuals and the communities
- The burden on health systems and the whole society
  - International trade and economy
  - Environmental impact.

## Norwalk and Norwalk Like Virus Statistics

- In the United States:
  - 3.5 million cases/yr. in infants leading to 500,000 office visits and 30 deaths
  - 9.2 million cases (of 12.7 mil.total)/yr. of food-related illness



## Just How Much Diarrhea is That?

- In the US:
  - 12.7 million cases
- International:
  - 200 million cases
- 12.7 million cases x 4 episodes/day x 3 days duration x 200ml/episode =  $3.6 \times 10^{11}$  ml of diarrhea or 105 million gallons or 6 minutes of flow over Niagara Falls

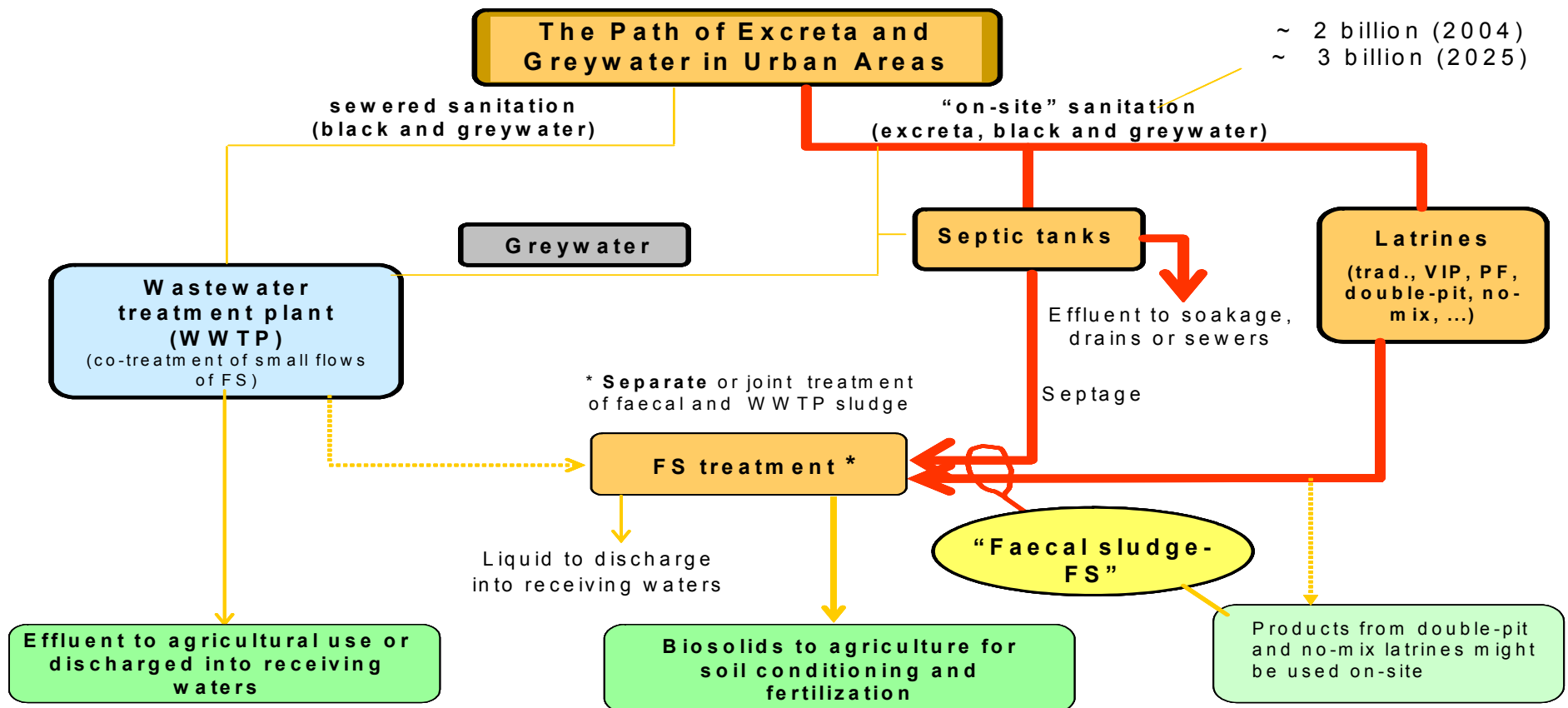


<b>MDGs Goals and Targets</b>	<b>Environmental Health/Sanitation</b>
<p><b><u>Goal 1.</u></b> Eradicate extreme poverty and hunger</p>	<p>A healthy environment means healthy people.</p> <ul style="list-style-type: none"> <li>• Ability to improved livelihoods</li> <li>• Break cycle of poverty/ill-health</li> </ul>
<p><b><u>Goal 2.</u></b> Achieve universal primary education</p>	<p>Reduction in diarrhoeal and parasitic disease will result in increased attendance and participation in school.</p> <ul style="list-style-type: none"> <li>• School sanitation an important determinant of girls' attendance.</li> </ul>
<p><b><u>Goal 3.</u></b> Promote gender equality and empower women.</p>	<p>Environmental health risks falls disproportionately on women</p> <ul style="list-style-type: none"> <li>• effective interventions help to improve women's lives</li> <li>• empower-increased participation.</li> </ul>

<p><b><u>Goal 4.</u></b> Reduce child mortality</p>	<p>Appropriate environmental health interventions significantly reduce the deaths of children &lt; 5 as a result of unsafe water, sanitation and hygiene.</p>
<p><b><u>Goal 6.</u></b> Combat HIV/AIDS, malaria and other diseases</p>	<p>Preventive environmental health measures are as important and at time more cost-effective than health treatments</p>
<p><b><u>Goal 7.</u></b> Ensure environmental sustainability.  2015: Half no. of people without access to safe drinking water and sustainable sanitation.  2020: A significant improvement in the lives of at least 100 millions slum dwellers.</p>	<p>Expressed in terms of environmental health improvements;</p> <ul style="list-style-type: none"> <li>• environmental health measures such sanitation contributes to the MDGs directly</li> <li>• to these targets as described above.</li> </ul>

# WHO Guidelines to be issued on sustainable sanitation

- Safe Use of Wastewater in Agriculture
- Safe Use of Wastewater and Excreta in Aquaculture
- Safe Use of Excreta and Greywater



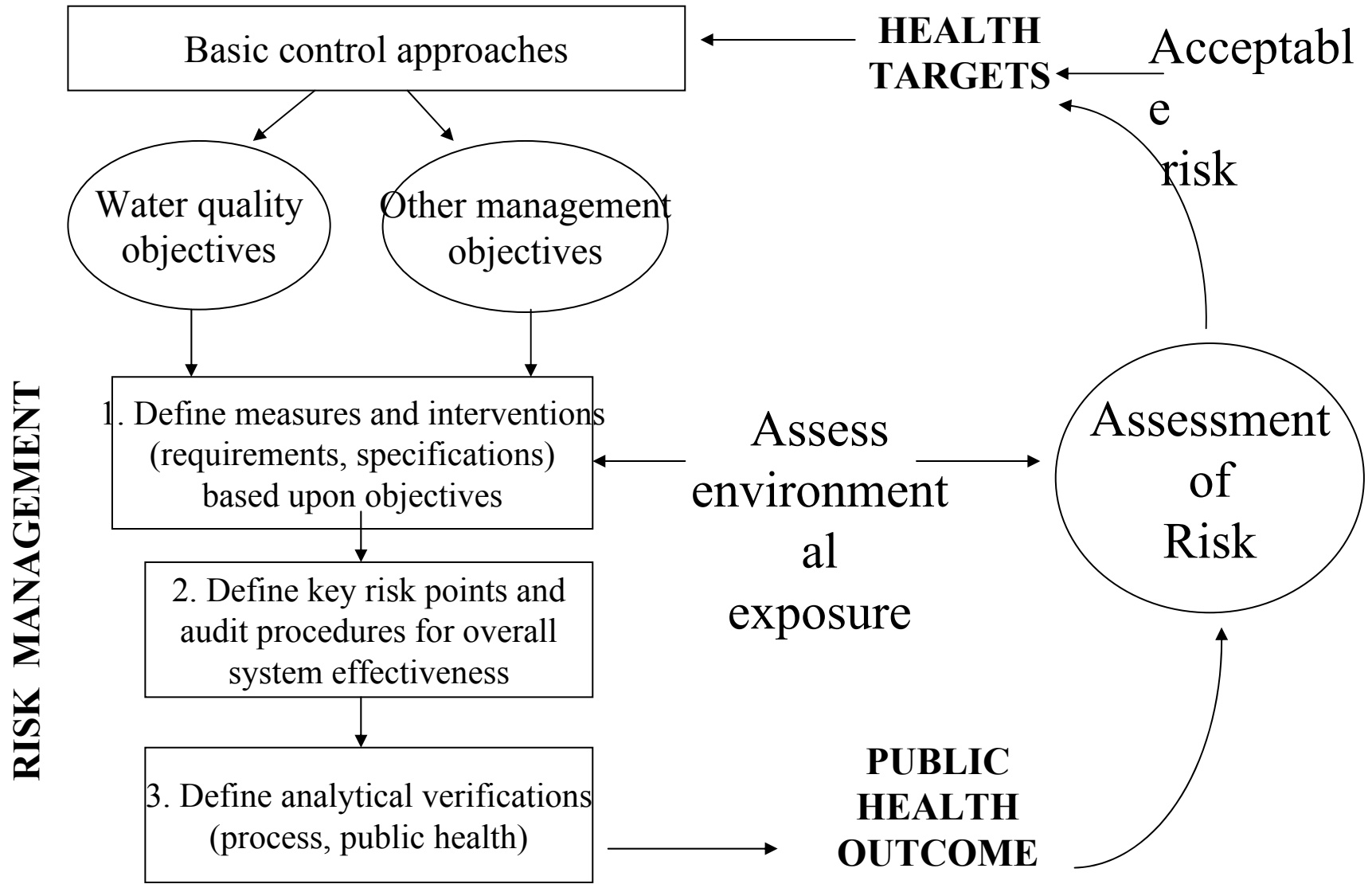
# Guidelines for safe use of excreta and greywater

- Guidelines household centered
- Resource use (optional)
- Based on practical/technical evidencies with multiple barriers.
- Exposure assessment – key issue
- User perceptions

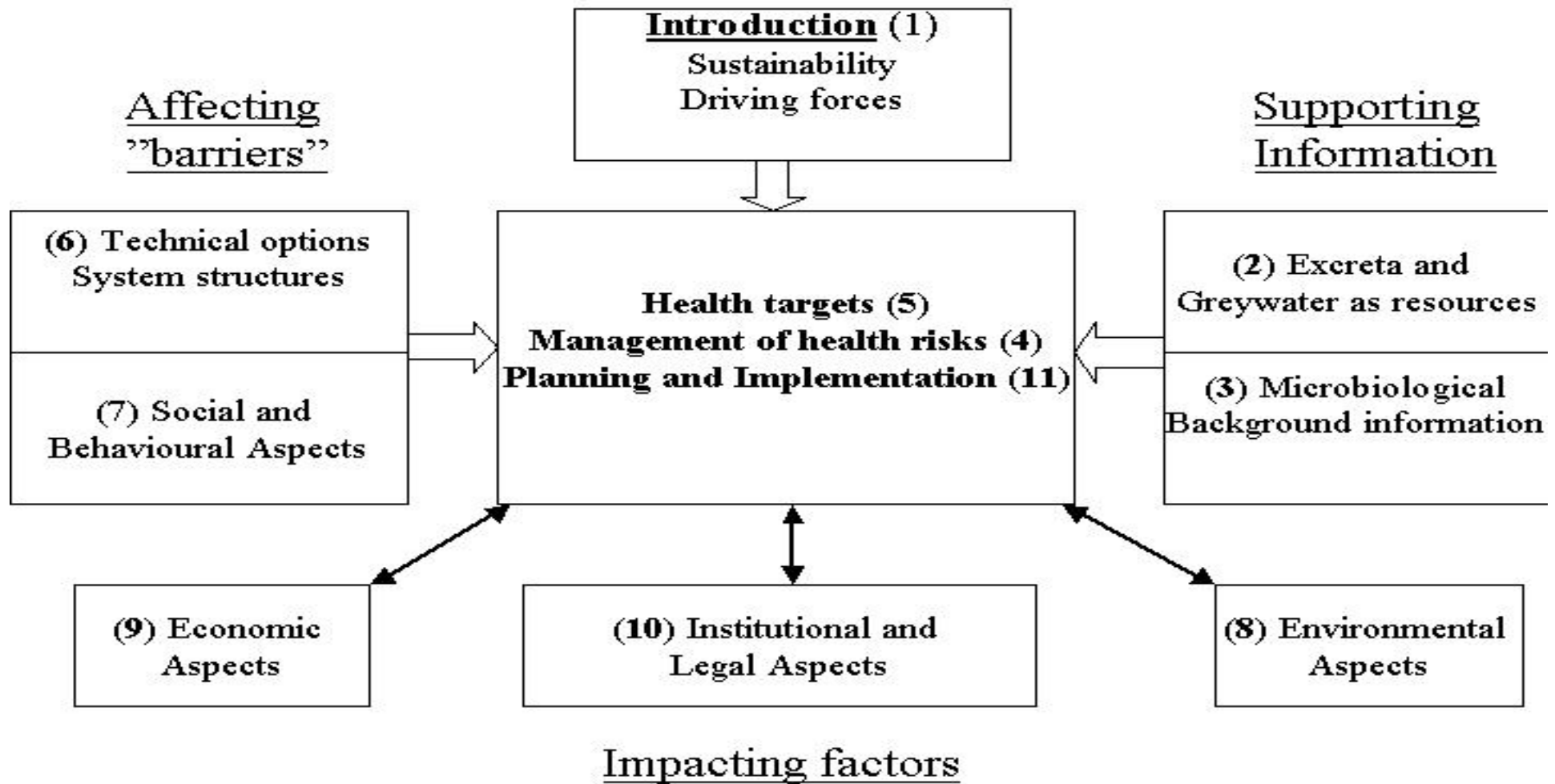
## *Irrigation with wastewater in Latin America*

<i>Country</i>	<i>Area (ha) irrigated with waste waters</i>	
	<i>Treated</i>	<i>Without treatment (*)</i>
<i>Argentina</i>	<i>3.070</i>	<i>n.a.i.</i>
<i>Chile</i>	<i>n.a.i.</i>	<i>74.000</i>
<i>Colombia</i>	<i>327.513</i>	<i>902.679</i>
<i>México</i>	<i>123.801</i>	<i>n.a.i.</i>
<i>Perú</i>	<i>2.420</i>	<i>4.766</i>
<i>Dominican Republic</i>	<i>60</i>	<i>n.a.i.</i>
<i>Total Latin America</i>	<i>456.864</i>	<i>981.445</i>

# WHO Proposed Framework



# Structure of WHO Guidelines for the safe use of Excreta and Greywater



# Nature, application and assessment of health related targets

Type of targets	Nature of targets	Application	Assessment
Health outcome; Epidemiology base	Reduction in disease incidence	Microbial with high measurable disease burden. Direct impact or food associated.	Health surveillance; An. epidemiology.
Risk assessment based	Tolerable risk level. Relation to local exposure / sanitation facilities	Microbial hazards Disease burden – indirectly assessed.	Quantitative microbial risk assessment

# Nature, application and assessment of health related targets

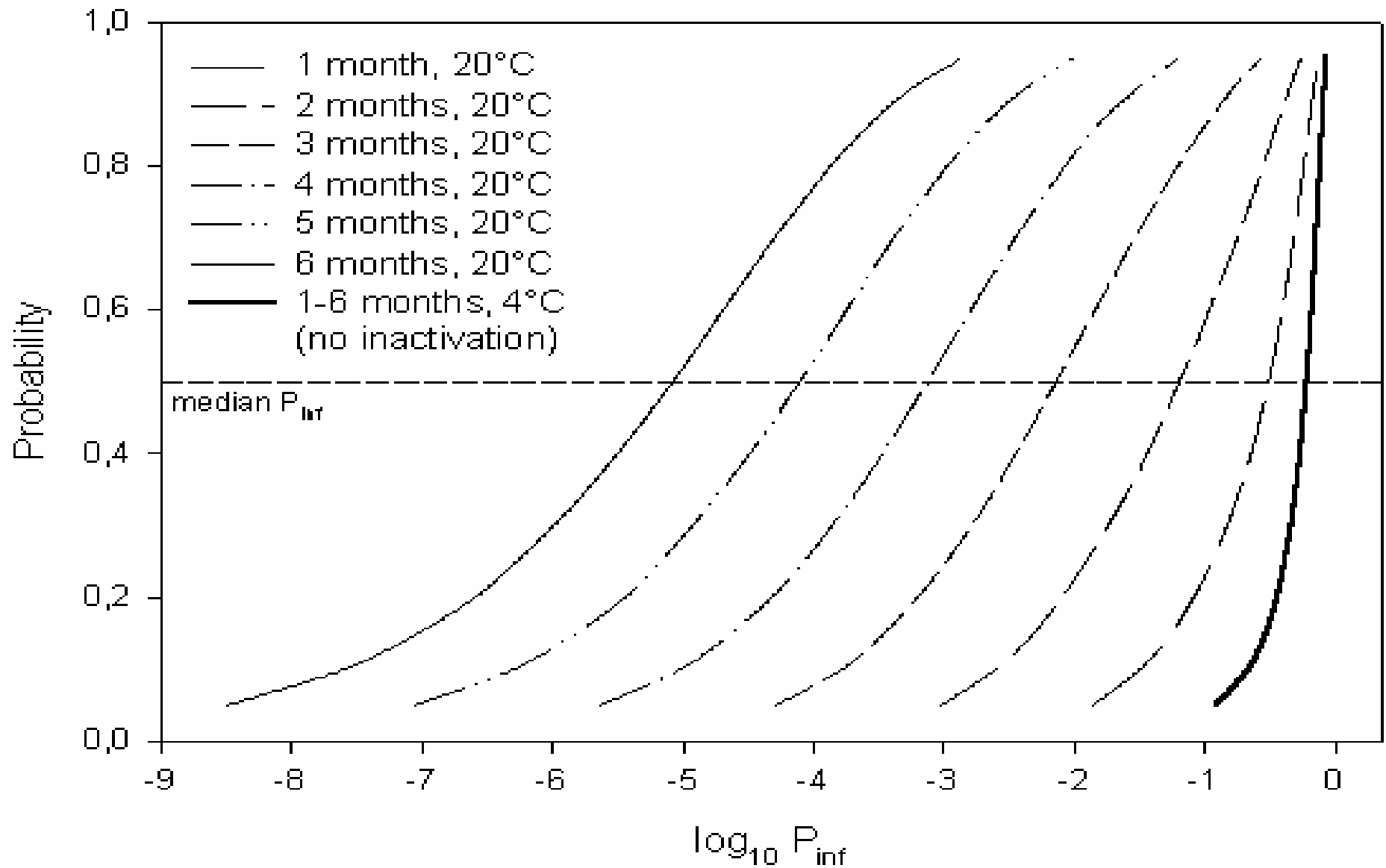
Type of targets	Nature of targets	Application	Assessment
Quality targets	Guideline values	Measurements <i>less applicable</i> in “Small scale application” Urine – die-off (-) Greywater – growth (+)	Measurements - assessment of technical performance. Applied as for the assessment of wastewater.
Performance targets	Removal of organisms Customized targets. Guideline values less applicable	Microbial contaminants	Compliance through system assessment Health authorities. Small systems

# Treatment as a barrier – reduction efficiency.

*Reduction in dry latrines, storage time 6 months, pH value around 9 or more. Based on added organisms, at time 0. Reduction given as  $\log_{10}$  values.*

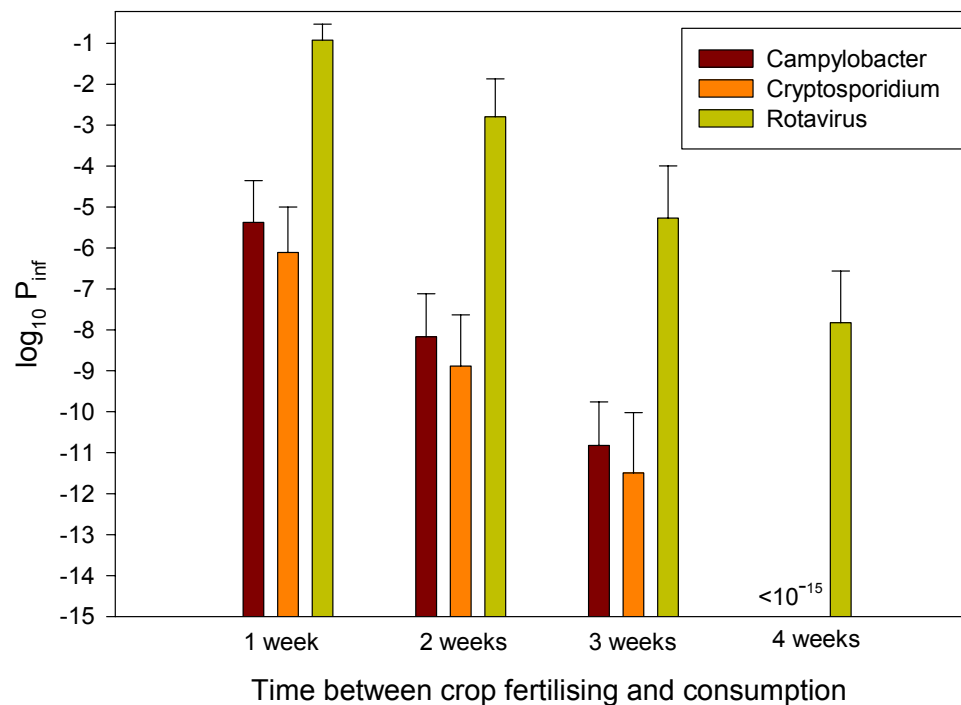
Parameters	Reduction efficiency	Remark
Bacteria (coliforms)	> 6 log	Chinese exp
Bacteria (fecal enterococci)	4-6 log	Extrapolations/Mexico
Bacteriophages (index virus)	5->6 log	Chinese exp Vietnamese exp Mexican extrapol
Ascaris ova (index parasite)	100% reduction of viability	Vietnamese exp Chinese exp

# Effect of storage time on rotavirus risk





## Risk from ingestion of 100 g crop



- Inactivation will continue in the field
- Risk dependent on time between fertilising and consumption

# **Risk management – minimising the risk**

- **Storage/Pre-treatment**
  - Reduction or elimination of pathogens
- **Fertilising technique**
  - Equipment
  - Working into the ground
- **Crop restrictions**
  - Fodder crops
  - Food crops raw/processed
- **Choice of location**
  - Exposure human/animals
  - Vector animals
- **The feature of the loop**
  - Small systems safer
  - Avoid risk groups

# WHO Guidelines for the safe use of excreta and grey water. TIMELINE

- 2004. Start - Background Preparation
- Aug . Preparatory Meeting
- Feb 05. Draft version for consultations and inputs.
- Feb-May Consultations and external inputs
- 13-17 June. Official consultation Geneva
- June – Sept Revisions/Editing
  
- End of 2005

/beginning of 2006 Publishing

# Input

- Consultations and regional input an essential part for balanced Guidelines
  - **Regional case studies**
  - **Acceptability and constraints (not anecdotal)**
  - **Epidemiological evidences/Risk Impact Studies**
  - **Comparative assessments WW/Manure**
  - **System analysis of risks and benefits**
  - **Assessment of acceptability and behaviour in different settings/regions**
  - **Institutional aspects**
  - **Implementation strategies**

# Safe Use of Excreta

## WHO Philosophy

Guidelines are:

- **Based on scientific consensus and best available evidence,**
- **Based on a risk/benefit approach developed around good practices and a multiple-barrier approach**
- **Meant to be adapted to local social, economic, and environmental factors**
- **The Guidelines strive to maximize overall public health benefits and the beneficial use of scarce resources**



## WHO Guidelines for the safe use of excreta and grey water. AIMS for the future

- The guidelines a starting point for:
- Country-based system studies including risk/epi based approaches. (2005-2007 and onwards)
- Comparative assessments with uses of WW/others
- Follow-up and implementation studies of WHO Guidelines site- or country based (2006-2008)

**Nr of organisms in treated effluent (n)**



**Volume of excreta/greyw (V)**

Nr of organisms applied (per gram)



**Fraction attached ( $\pi$ )**

Number of viruses attached (per gram)



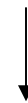
**Organism survival function  $S(t)$**

Number of organisms that remain infectious at consumption (per gram)



**Quantity of crop consumed (grams) (Q)**

# Conceptual model: Risks from wastewater/excreta on crops (Adapted from Ashbolt 2001)



**Number of viruses consumed**

$$Exposure = n \times V \times \pi \times S(t) \times Q$$

# Considerations and knowledge gaps (1)

- Epidemiological studies and integrated health impact studies weak or lacking.
- Input values for risk modelling in many instances based on assumptions
- System assessments virtually lacking (especially in urban and periurban settings).
- Relationship both with planning process for new areas and full or partial upgrading for existing areas
- Examples from agricultural evaluations mainly based on small scale experiments and logistic in a system frame not assessed
- Economic system comparisons including all components mainly lacking

# Considerations and knowledge gaps

- Linkages between social/behavioural factors and health poorly assessed.
- Technical considerations needs to take a holistic approach, with comparative assessments.
- Further pilot project essential – although more holistic
- Assessment needs within a legal/institutional setting
- Enforced capacity building within established educational structure.
- Comparative impact assessment with wastewater, sludge and biosolids – integrated approaches!

# Acknowledgements

- WHO acknowledge the financial support and good cooperation from:
  - Sida (and SEI)
  - Norad
  - GTZ
  - Waste (Dutch Government)
  - World Bank (East Africa)
- Substantial inputs in the drafting has among the present been recieved from: Aussie Austin, Anna-Richter Stinzing, Elisabeth Kvarnström, Patrick Bracken, Jan Olof Drangert, Petter Jenssen.
- Consultations with groups in India (New Dehli), East Asia (Guilin) and upcoming Kampala (East Africa). Inputs from international course participants (Africa) in Kimberley (SA) and Bangalore (Asia). Hopefully later also in South/Middle America.

# Final word

- If some of you would like to give a **constructive** input on specific parts, please contact me during the conference.
- Inputs need to be received before the 9th of June!!!
- Comments can be sent to thor-axel.stenstrom@smi.ki.se, or to carrr@who.int.