

**Sustainable Rural Development – Reaching the  
MDGs in Armenia**

**Risk based approaches towards rural management  
for sanitation**

Conference, Yerevan, Armenia

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# 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

# The World Health Organization

## WHO

- *Infectious diseases caused by pathogenic bacteria, viruses, and protozoa or by parasites are the most common and widespread health risk associated with drinking-water.*

# EU Artikel 152

1. A high level of human health protection shall be ensured in the definition and implementation of all Community policies and activities.

Community action, shall complement national policies,

shall be directed towards improving public health, preventing human illness and diseases,

and obviating sources of danger to human health.

## **MDGs Goals and Targets**

## **Environmental Health/Sanitation**

**Goal 1.** Eradicate extreme poverty and hunger

A healthy environment means healthy people.

- Ability to improved livelihoods
- Break cycle of poverty/ill-health

**Goal 2.** Achieve universal primary education

Reduction in diarrhoeal and parasitic disease will result in increased attendance and participation in school.

- School sanitation an important determinant of girls' attendance.

**Goal 3.** Promote gender equality and empower women.

Environmental health risks falls disproportionately on women

- effective interventions help to improve women's lives
- empower-increased participation.

**Goal 4.** Reduce child mortality

Appropriate environmental health interventions significantly reduce the deaths of children < 5 as a result of unsafe water, sanitation and hygiene.

**Goal 6.** Combat HIV/AIDS, malaria and other diseases

Preventive environmental health measures are as important and at time more cost-effective than health treatments

**Goal 7.** 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.

Expressed in terms of environmental health improvements;

- environmental health measures such sanitation contributes to the MDGs directly
- to these targets as described above.



# WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater

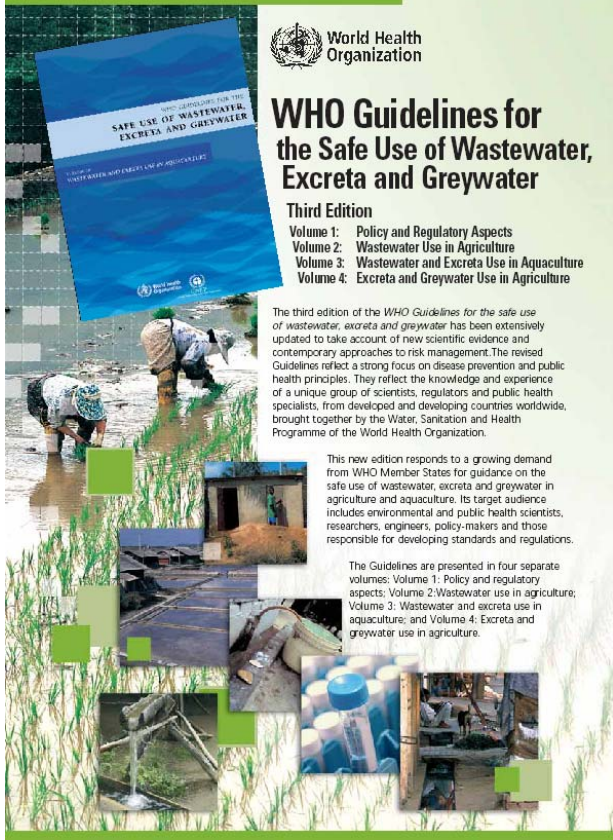
Third Edition

- Volume 1: Policy and Regulatory Aspects
- Volume 2: Wastewater Use in Agriculture
- Volume 3: Wastewater and Excreta Use in Aquaculture
- Volume 4: Excreta and Greywater Use in Agriculture

The third edition of the WHO Guidelines for the safe use of wastewater, excreta and greywater has been extensively updated to take account of new scientific evidence and contemporary approaches to risk management. The revised Guidelines reflect a strong focus on disease prevention and public health principles. They reflect the knowledge and experience of a unique group of scientists, regulators and public health specialists, from developed and developing countries worldwide, brought together by the Water, Sanitation and Health Programme of the World Health Organization.

This new edition responds to a growing demand from WHO Member States for guidance on the safe use of wastewater, excreta and greywater in agriculture and aquaculture. Its target audience includes environmental and public health scientists, researchers, engineers, policy-makers and those responsible for developing standards and regulations.

The Guidelines are presented in four separate volumes: Volume 1: Policy and regulatory aspects; Volume 2: Wastewater use in agriculture; Volume 3: Wastewater and excreta use in aquaculture; and Volume 4: Excreta and greywater use in agriculture.





**Volume 1** of the Guidelines presents policy issues and regulatory measures distilled from the technical detail found in volumes 2, 3 and 4. Those faced with the need to expedite the development of policies, procedures and regulatory frameworks, at national and local government levels, will find the essential information in this volume. It also includes summaries of the other volumes in the series and an index for all four volumes.

**Volume 2** of the Guidelines explains requirements to promote safe use concepts and practices, including health-based targets and minimum procedures. It also covers a substantive revision of approaches to ensuring the microbial safety of wastewater used in agriculture. It distinguishes three vulnerable groups: agricultural workers, members of communities where wastewater-fed agriculture is practiced and consumers. It introduces health impact assessment of new wastewater projects.

**Volume 3** of the Guidelines informs readers on the assessment of microbial hazards and toxic chemicals and the management of the associated risks when using wastewater and excreta in aquaculture. It explains requirements to promote safe use practices, including minimum procedures and specific health-based targets. It puts trade-offs between potential risks and nutritional benefits in a wider development context. Special reference is made to food-borne trematodes.

**Volume 4** of the Guidelines focuses exclusively on the safe use of excreta and greywater in agriculture. Recent trends in sanitation, including ecological sanitation, are driven by rapid urbanization. The momentum created by the Millennium Development Goals is resulting in dramatic changes in human waste handling and processing. New opportunities enable the use of human waste as a resource for pro-poor agricultural development, particularly in periurban areas. Best practice to minimize associated health risks is at the heart of this volume.

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# WHO Guidelines on sanitation

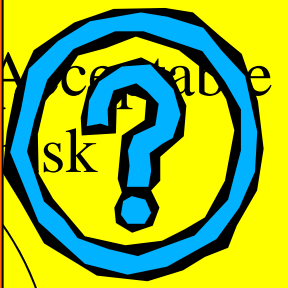
- Protection of human health
- **Advisory** to national standard setting – flexible to account local social, cultural, economic & environmental context
- Risk-benefit - adaptation to local priorities
- Best available evidence - science and practice
- Scientific consensus
- Use global information and experience

# Approaches – Evidence based or Predictive – Based on WHO Stockholm Framework

## Manage SANITATION

ID 45	House no VN-142	Basti Name New Sanjay Anes Colony
	<b>Water Source</b> Community Tap Individual Tap Handpump Other	<b>If Individual : Tap Connection</b> Lead Tape
<b>Water Quality</b> Satisfactory Non Satisfactory	<b>User charges per mo</b> <=10 >=10	<b>Payment made to</b> N/A Local Contractor
<b>Supply_line (hours in a day)</b> 2	<b>Collection Responsibility</b> Adult Child	<input type="checkbox"/> Male <input type="checkbox"/> Female
<b>Time taken to collect water (minutes)</b> 45		

Can we manage the risks?



ASSESSMENT

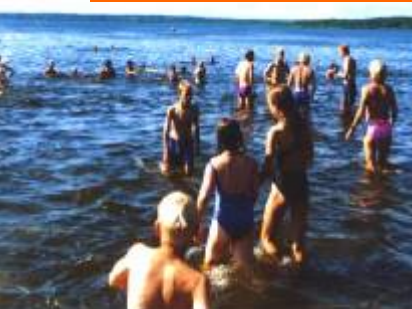


EXPOSURE



Keypoints and audits

HEALTH OUTCOME



# Microbial Risk Assessment

- Hazard Identification
  - All entero-pathogens potentially in excreta
- Exposure assessment
  - Exposure points, Site-specific data on removal
- Risk characterisation
  - Risk of infection per exposure and yearly.
  - Comparison with endemic level of disease

# The first thing is to assemble a suitable team for an assessment

- How do you select and which ones is the essential player?
- Which is the institutional framework that you may work within?
- Are personal suitable trained and in tune with each others?

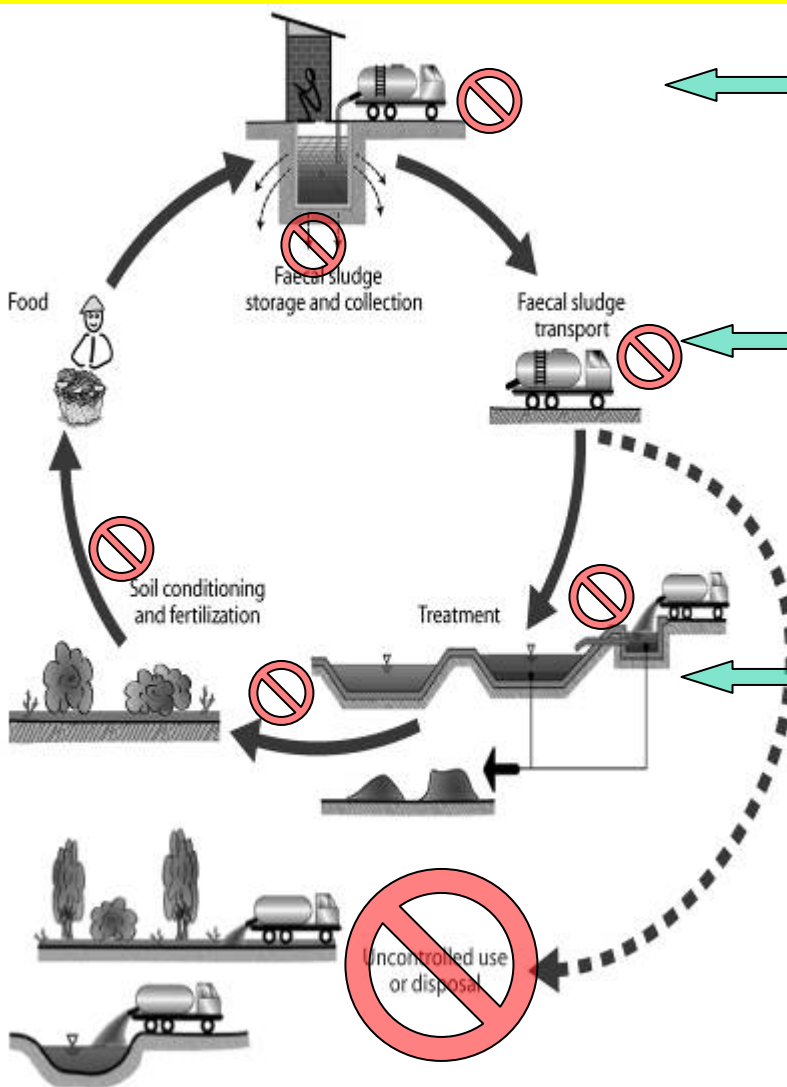
# Institutional Arrangement of Facilitator

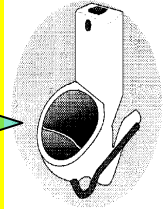
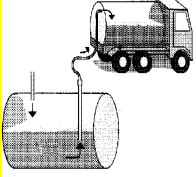
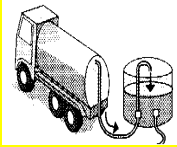
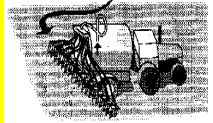
Different levels  
Different focuses

# Pathogen reductions (log units) achieved by health-protection control measures

<b>Control measure</b>	<b>Pathogen reduction (log units)</b>	<b>Notes</b>
<b>Excreta &amp; urine treatment</b>	<b>2–6</b>	<b><u>The required pathogen removal depends on the combination of the treatment and selected health-protection control measures</u></b>
<b>Crop selection and means of application</b>	<b>2-4</b>	<b><u>Higher risk:</u> Root crops and crops that grow just above (lettuce) and in partial contact with the soil. <u>Lower risk:</u> Crops with the harvested parts not in contact with the soil.</b>
<b>Pathogen die-off</b>	<b>2-4</b>	<b>Die-off on crop surfaces that occurs between application and consumption. The log unit reduction achieved depends on climate (temperature, sunlight intensity), crop type, etc. <u>With-holding time essential in risk reduction</u></b>
<b>Produce washing with water</b>	<b>1</b>	<b>Washing salad crops, vegetables and fruit with clean water.</b>
<b>Produce peeling</b>	<b>2</b>	<b>Fruit, root crops.</b>
<b>Produce cooking</b>	<b>5–6</b>	<b>Immersion in boiling or close-to-boiling water until the food is cooked ensures pathogen destruction.</b>

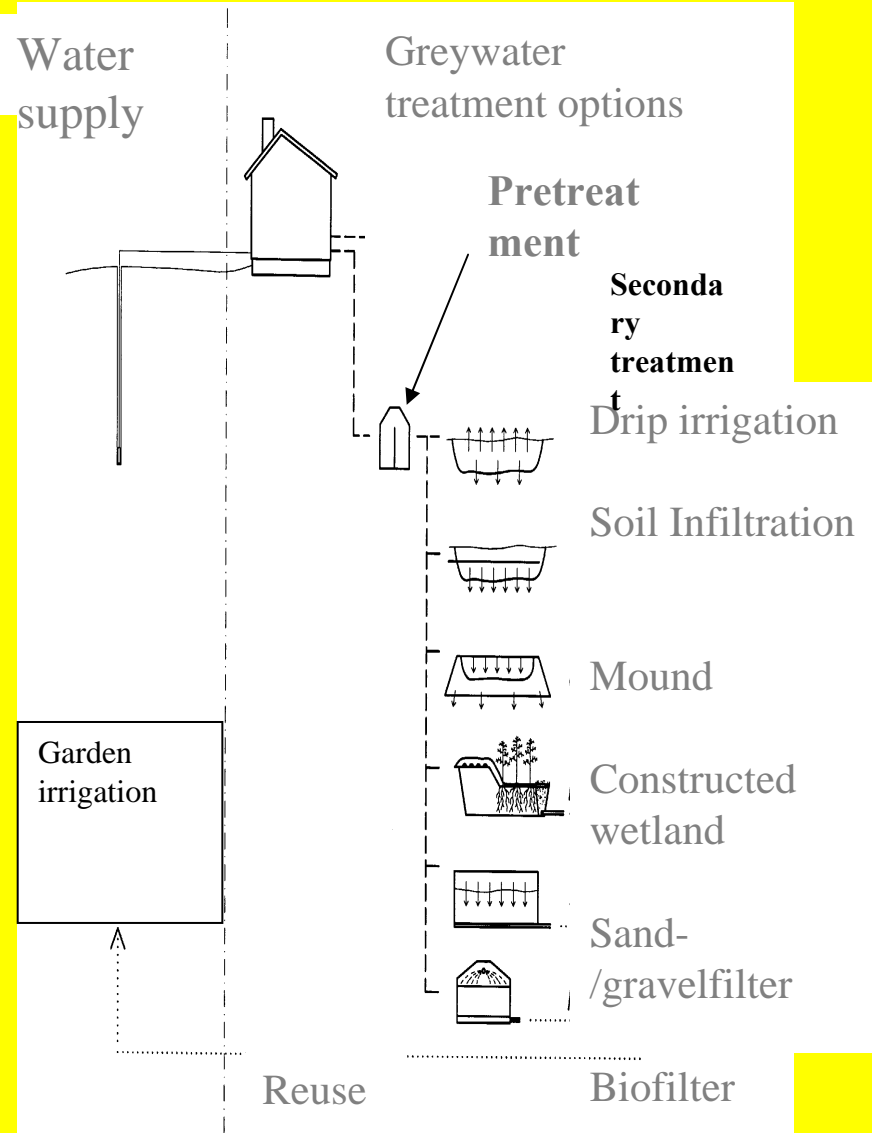
# Example of Excreta Systems



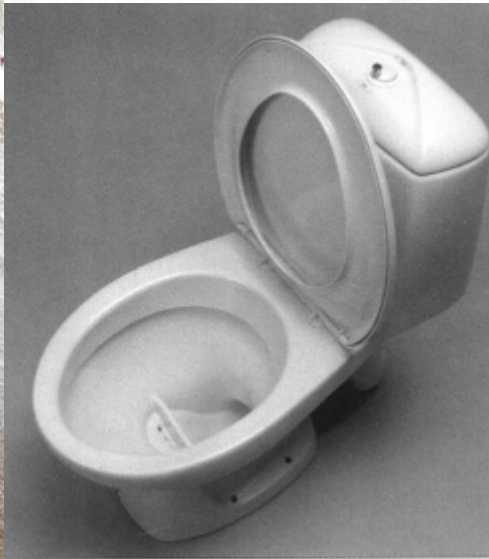
	Exposure	Risk
	Clearing of blocked pipes	Ingestion of pathogens
	Accidental ingestion when handling unstored urine	Ingestion of pathogens
	Accidental ingestion when handling stored urine	Ingestion of pathogens
	Inhalation of aerosols created when applying urine	Inhalation of pathogens
	Consumption of crops fertilised with urine	Ingestion of pathogens

# Greywater – same principals

**Faecal input crucial to assess risk!!**



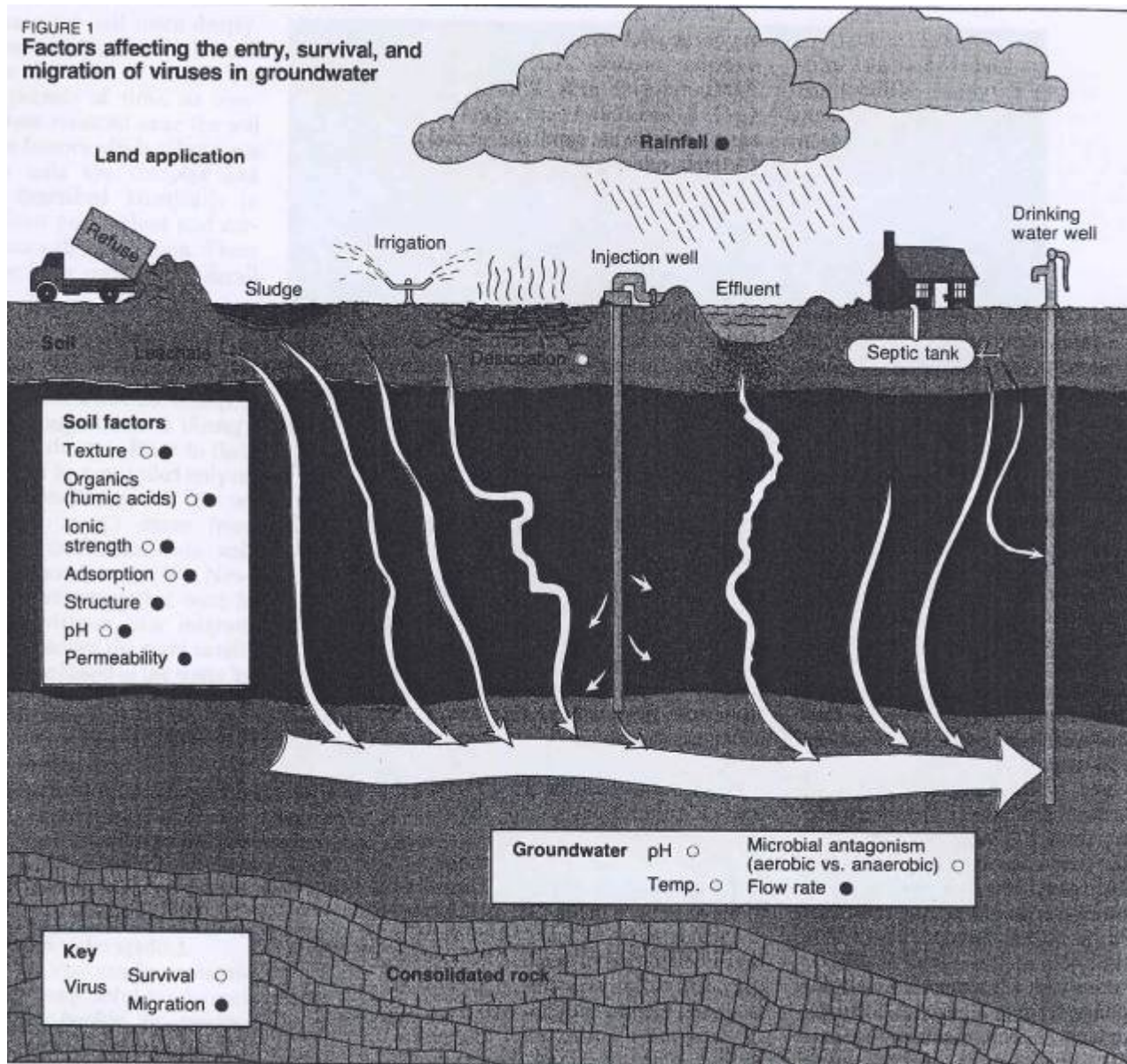
YOUR PREFERENCE?



# Assessments

- Assess the exposure in the full handling chain.
- Assess the human environment in light of danger to human health.
- Account for other factors that as well that may impact – not just "one-eyed" on water or sanitation.

# Contamination of groundwater



# A new compact greywater treatment plant developed at IMT/UMB



# Documentation and Monitoring

- Establish a documentation system!
- Establish monitoring requirements!

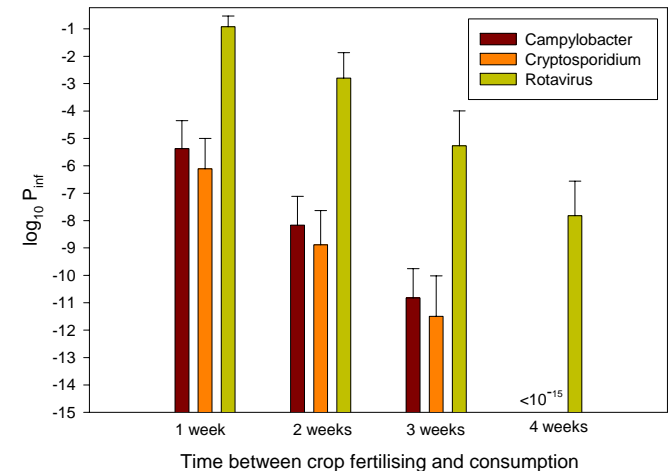
# Definition of Monitoring Functions

<b>Function</b>	<b>Definition</b>
<i>Validation</i>	Testing the system or components thereof to ensure if it is meeting e.g "microbial reduction targets". Mainly relates to new systems/components.
<i>Operational monitoring</i>	Relates to "design specifications" e g turbidity. Indicate proper functions and variations and is the base for "direct corrective actions"
<i>Verification</i>	Methods, procedures and tests to determine compliance with design parameters AND specific requirements (GL values, E coli, helminth eggs, microbial and chemical analysis of crops.

# Microbial GL values

- Mainly applicable for verification monitoring in larger systems
- Design criteria (system validation) - the main factor in addition to exposure control to counteract risks and variabilities.
- **Storage and treatment** additives as aid in the barrier efficiency.

	Helm. Eggs	E. coli
<b>Treated fecals</b>	< 1/ g TS	Helminths. Low incidence <i>E coli</i> < 1000/g TS
<b>Greywater:</b>	< 1/L	< 10 <sup>5</sup> Relaxed 10 <sup>6</sup> <exposure >regrowth
• Unrestricted	< 1/L	< 10 <sup>3</sup>



# Recommendations for faeces – household level

Treatment	Criteria	Comment
Storage (only treatment); Ambient temperature 2-20°C	1.5 - 2 years	Will eliminate most bacterial pathogens; regrowth of <i>E coli</i> and <i>Salmonella</i> not considered if rewetted; will substantially reduce viruses, protozoa and parasites. Some soil-borne ova may persist
Storage (only treatment) Ambient temperature 20-35°C	> 1 year	As above
Alkaline treatment	pH >9 during > 6 months	If temperature >35°C and moisture <25%. Lower pH and/or wetter material will prolong the time for absolute elimination.

# Exposure central

- What is the volume that individual are exposed to?
- What is the likely frequency of exposure?
- How many people are exposed? (directly; indirectly)

# Implementation

- Establish an implementation procedure.
- Look into the questions of compliance.
- Who can monitor/check at the local scale?
- What is the likelihood of sustainability of the installation and system?
- Maintenance?

# Implementation approach

- Incidence of different disease in local context?
- Treatment efficiency and variability?
- Exposure; Who? How many? How often?

# Implementation approach

- What crops are wastewater/sludge/excreta applied to?
- When in the crop cycle is it applied? What is the waiting period between last application and harvest?
- Who are exposed? Farmers – Consumers – Others?
- How often? How many? How frequently? Likely volumes of wastewater/sludge/excreta?
- How are the products handled after harvest and before consumption?

# Control measures

- Exposure 6

- Fence storage area
- Optimisation of sludge treatment



- Exposure 7

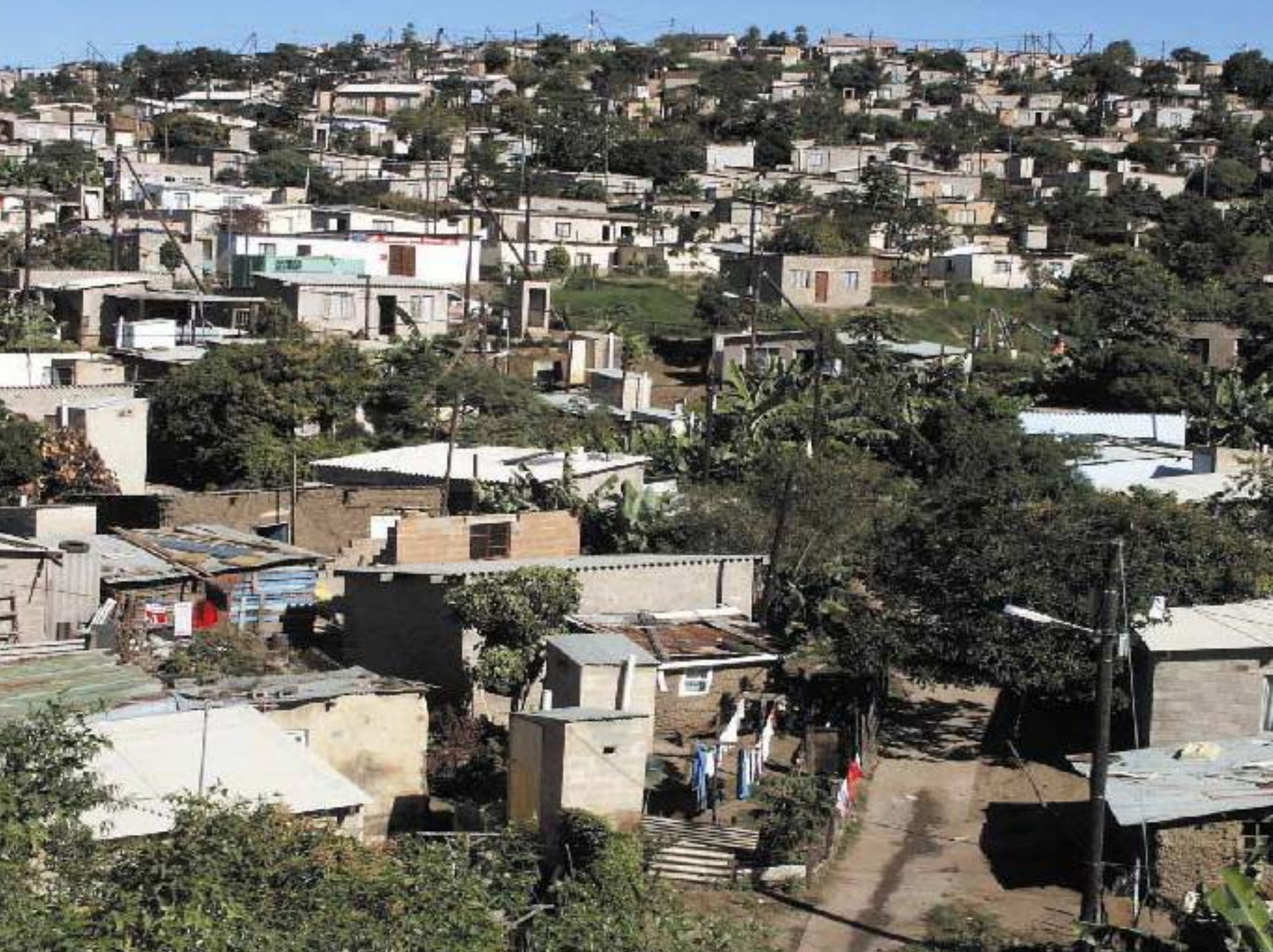
- Use of PPE
- Optimisation of sludge treatment
- Prolonged sludge storage



# Control measures

- Exposure 8
  - Crop restrictions
  - Minimum time between fertilisation and harvest
  - Optimisation of sludge treatment
  - Prolonged sludge storage







# Evidence based epidemiological information.

## Durban; South Africa 2006

- A GIS-based randomized cohort study of **diarrhoeal and worm disease** in sanitary **source separation** interventions; and control areas.
  - 1337 households; >7000 individuals, repeated 6 times with 14 days interval.
  - Accounting for **water** and **hygiene** habits.
  - Total **demographic** and **socio-economic** information (Demographic site).
  - Database of 1 200 000 entries
  - Ethically approved
- Currently 47 000 UD toilets installed. An additional 50 000 planned.

**Acknowledgement:**  
EtheKwini Municipality (Water and Public Work)

Incidence Rate (IR) & Incidence Rate Ratio (IRR)  
of Diarrhoea and vomiting in Intervention & Control Areas

<b>Area</b>	<b>H/hold members</b>	<b>Episode</b>	<b>IR/1000 Pers/ d</b>	<b>Adjusted IRR</b>	<b>P value</b>
		<b>Diarrhea</b>			
<b>Intervention</b>	<b>3945</b>	<b>638</b>	<b>11.7</b>	<b>1.7 (1.2- 2.5)</b>	<b>0.003</b>
<b>Control</b>	<b>3254</b>	<b>903</b>	<b>16.0</b>		
Total	7199	1541	13.9		
		<b>Vomiting</b>			
<b>Intervention</b>	<b>3945</b>	<b>55</b>	<b>1.01</b>	<b>4.8 (1.5-15.9)</b>	<b>0.010</b>
<b>Control</b>	<b>3254</b>	<b>111</b>	<b>1.97</b>		
Total	7199	166	1.50		

Age	Area	N	Diarrhoea	IRR	Vomitting	IRR
Incidence Rate of Disease O		by Age				
>5	Inter	365	111	1.97	10	2.74
	Cont	375	223		28	
<b>Totals</b>		<b>740</b>	<b>334</b>		<b>38</b>	
5 to 59	Inter	3260	469	1.57	42	2.23
	Cont	2673	606		77	
<b>Totals</b>		<b>5933</b>	<b>1075</b>		<b>119</b>	
>=60	Inter	247	50	1.70	3	1.69
	Cont	192	67		4	
<b>Totals</b>		<b>439</b>	<b>117</b>		<b>7</b>	
<b>Total</b>	<b>Inter</b>	<b>3872</b>	<b>630</b>		<b>55</b>	
	<b>Con</b>	<b>3240</b>	<b>896</b>		<b>109</b>	
<b>Totals</b>		<b>7112</b>	<b>1526</b>		<b>164</b>	

# Percentage of individuals with Disease outcome by Drinking Water Safety

<b>Water safety</b>	<b>N</b>	<b>% Diarrhoea</b>	<b>% Vomitting</b>	<b>% Worms</b>	<b>% Skin sores</b>
Unsafe	372	32.5%	5.4%	10.5%	5.6%
Safe outside	4086	22.5%	2.7%	2.9%	4.3%
Safe inside	2755	18.2%	1.3%	2.1%	2.5%
<b>Incidence Rate Ratio &amp; Prevalence Ratio</b>					
Safe outside vs. safe inside		IRR 1.23	IRR 2.06	PR 1.38	PR 1.71
Unsafe vs. safe inside		IRR 1.44	IRR 3.31	PR 4.01	PR 1.82

# Approaches to show success in Armenia

- Identification of risk factors
- Map out sanitation related disease
- Show the impact of interventions
- Relate it to recommendations and national guidelines
- Adapt it to the relevant local situation

# Safe Use of Wastewater and Excreta

Management strategies to reduce health risks

- **Treatment of Wastes**
- **Crop Restriction**
- **Waste Application Methods**
- **Control of Human Exposure**



# WHO Guidelines. AIMS for the future.

- The guidelines a starting point for:
- Country-based system studies including risk/epi based approaches. (2006-2009)
- Comparative assessments with uses of WW/others
- Follow-up and implementation of WHO Guidelines site- or country based (2007-2009 and thereafter)



WHO do you choose?  
What is the relative  
risks?





Tack!



Lycka till!

Thor Axel