Eawag:
Swiss Federal Institute of Aquatic Science and Technology

eawag
aquatic research

End use and resource recovery from faecal sludge – focusing on solid fuels

BJ Ward, Dr. Linda Strande
Management of Excreta, Wastewater and Sludge research group
Sandec: Department of Sanitation, Water and Solid Waste for Development

Faecal sludge target treatment products


soil conditioner


solid fuel


insect protein


plants

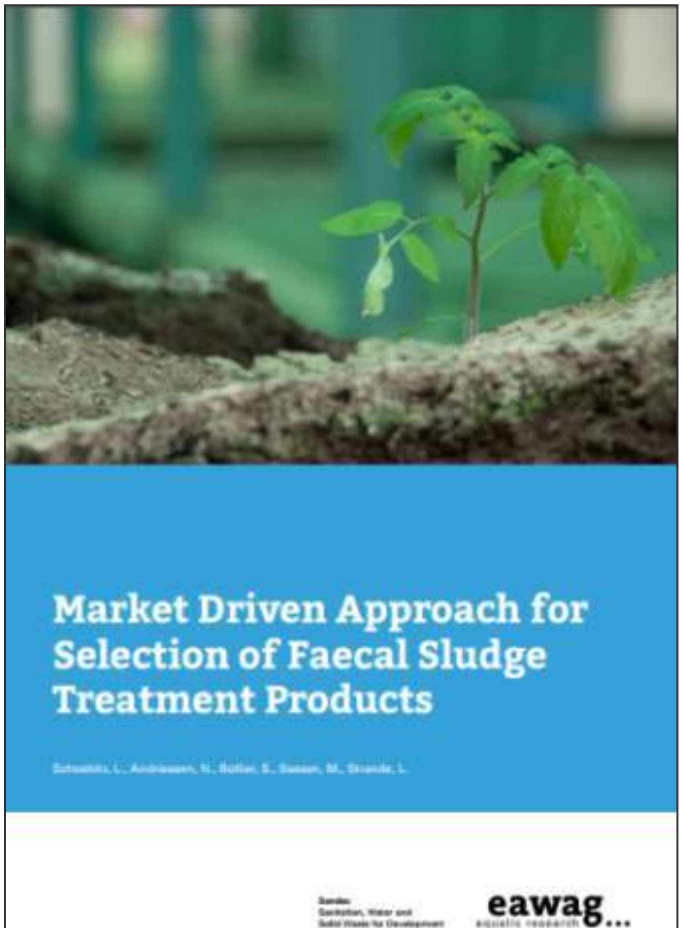

building materials components

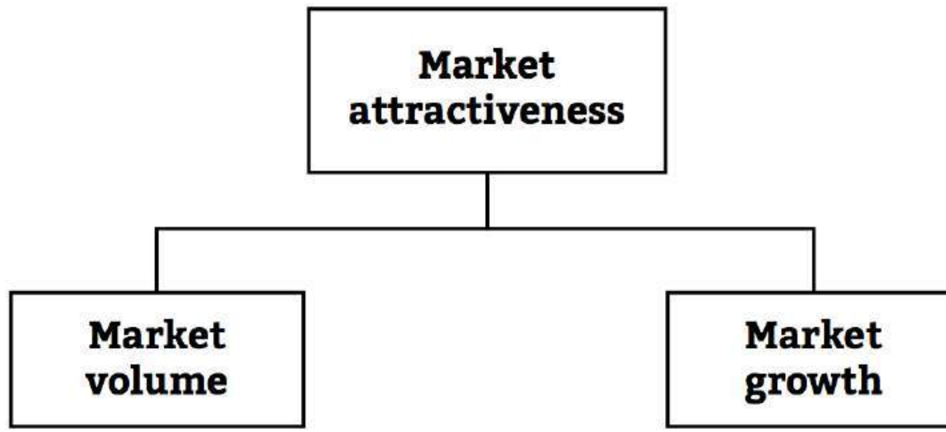

biogas feedstock


aquaculture

Selecting target treatment products

Market driven approach

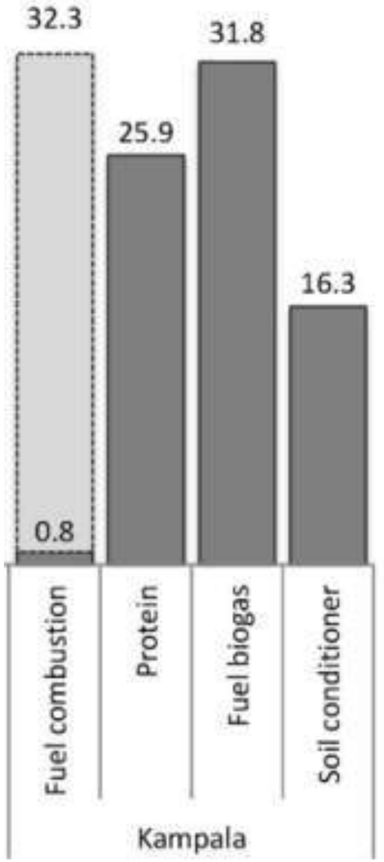




www.sandec.ch/fsm_tools

Faecal sludge as a solid fuel

Potential market values for treatment products (USD/ton)



- Solid fuel has highest revenue potential
- Large industrial markets
  - exist within urban areas
  - have large and consistent demands

Diener et al. (2014) A value proposition: Resource recovery from faecal sludge - Can it be the driver for improved sanitation? Resources, Conservation & Recycling, 88(0), 32-38.

www.sandec.ch/fsm_tools

Treatment technology considerations

Dewatering and drying are key

> 95% water

50% water

< 10% water

Treatment technology considerations

Getting from 50% to <10% water

Bioburn pelletizer decreases time and space for sludge drying

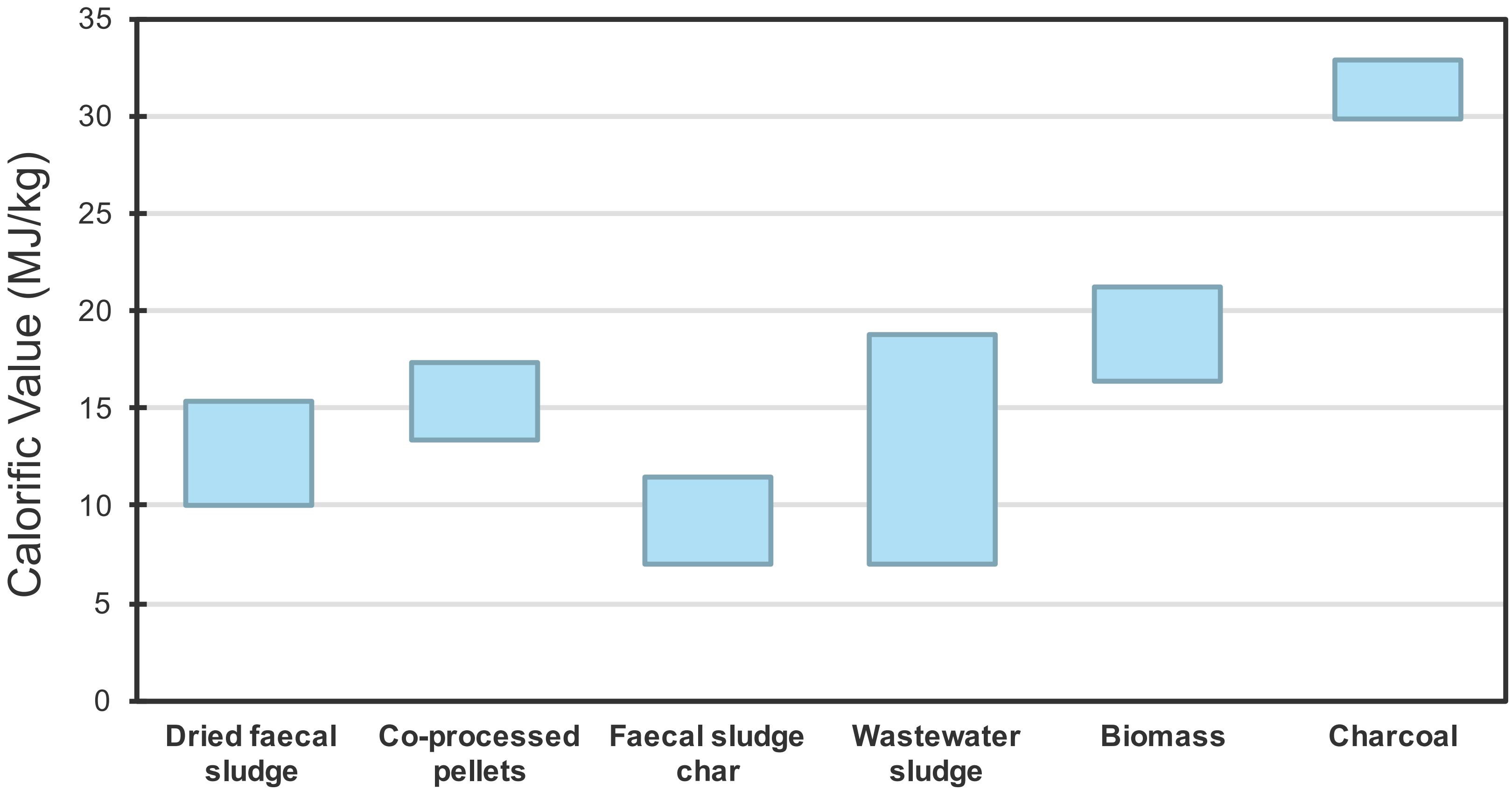
Solid fuel treatment products

Important parameters:

- Calorific value
- Ash fraction
- Heavy metals
- Emissions

Solid fuel characterization

Calorific value and ash



30 - 60% ash   55 - 70% ash   < 5% ash

Gold et al., 2017, Englund et al., 2016, Hafford et al., 2017, Muspratt et al., 2014

Solid fuel characterization

Heavy metals and emissions

		Faecal sludge					
		Kampala		FS Dakar		Wastewater	Industrial
Parameter	Unit	Mean	SD	Mean	SD	sludge[a,b,c,d]	limits[j,k,l,m,n]
Carbon	%	27.8	3.1	28.8	3.4	16.9–31.6	–
Hydrogen	%	4.2	0.5	4.2	0.4	3.3–7.6	–
Nitrogen	%	3.2	0.4	3.0	0.6	0.4–4.2	–
Sulfur	%	0.7	0.1	1.7	0.0	0.7–1.6	<2.5–0.5
Chlorine	%	0.04	0.01	0.14	0.03	0.07–0.4	<0.5–0.2
Phosphorus	%	1.4	0.4	1.0	0.1	3.1	<1.0
Arsenic	ppm	0.6	0.4	2.8	0.5	<0.3–14	–
Cadmium	ppm	<2.0	0.0	<1.8	0.4	4–10.1	–
Chromium	ppm	485	298	401	212	190–530	–
Copper	ppm	114	12	216	47	5.3–400	<3,000–1,000
Mercury	ppm	<0.9	0.5	<0.8	0.4	2.1–5.4	<10
Nickel	ppm	24	4	30	1	40–45	–
Lead	ppm	28	8	59	14	220–365	–
Zinc	ppm	646	56	918	257	1,132–4,900	–

Proximate analysis values comparable to wastewater sludge - below industrial limits for emissions

Faecal sludge fuels have lower heavy metals than wastewater sludge – meet industrial limits

Gold et al., 2017

Pilot-scale testing

Brick-firing kiln, Kampala
Dried sludge

Gasifier, Kampala
Pellets

Waste oil regeneration kiln, Dakar
Pellets and briquettes

- Faecal sludge worked well in kilns
- Gasifier performance limited by ash fraction
- Negligible odor during combustion

Barriers to progress

- High ash fraction
- Inefficient dewatering
- Insufficient quantity of sludge fuels produced to meet industry requirements

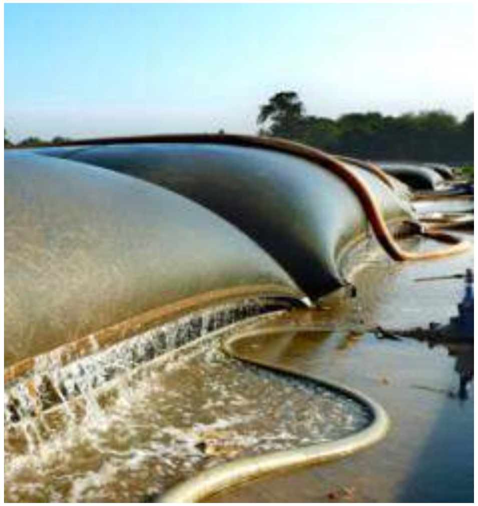
Clinker deposit from gasifier

Improving faecal sludge fuels

- Co-processing with biomass
  - Ash reduction and increased fuel volume
- Improved dewatering is major research focus
  - Bioburn pelletizer, geotextiles, locally-available conditioners
- Pyrolysis not recommended for industrial fuels

Coffee husks

Co-pelletizing with sawdust



Geotextile dewatering

Check out Sandec's new MOOC for more information about faecal sludge fuels and innovative options of resource recovery!

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WHO Collaborating Center for Sanitation and Water in Developing Countries

EPFL
ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

Mariska Ronteltap
Senior Lecturer, IHE Delft Insitute for Water Education

Mariska Ronteltap has worked as a Senior Lecturer in Sanitary Engineering at IHE Delft Institute for Water Education for the last 10 years. Her research focuses mainly around non-sewered sanitation: faecal sludge management, source separation of waste streams and resource recovery in sanitation. She is one of the authors of the IWA Publication called Faecal Sludge Management - an integrated systems approach. She teaches these topics at IHE Delft as well as in short courses and other trainings. Next to that she supervises research, develops teaching material, and is developing a new Master Program in Nonsewered Sanitation.

Pathogens in human excreta management

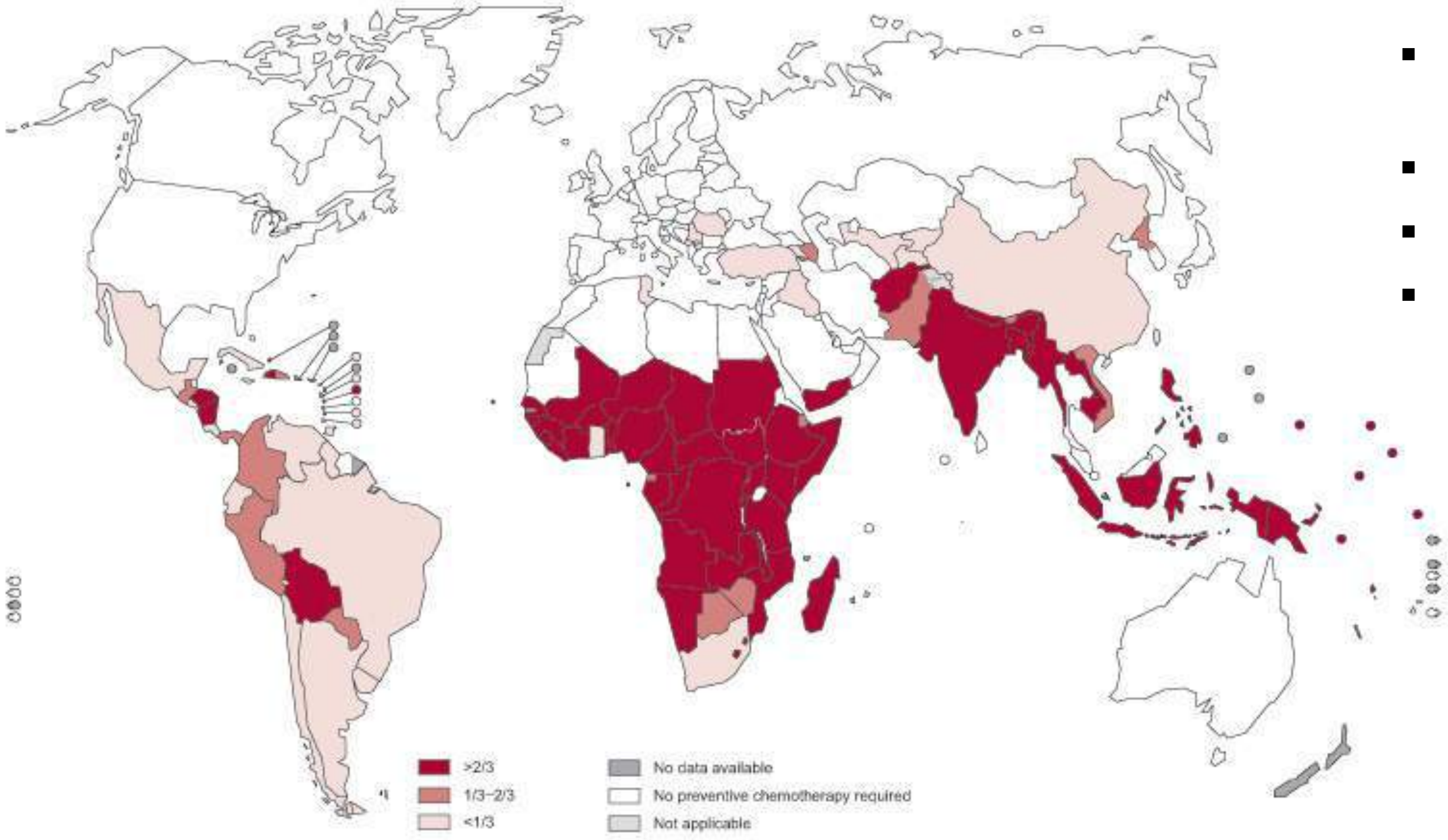
What to look for, and how?

Claire Furlong, PhD
Mariska Ronteltap, PhD
Environmental Engineering and Water Technology Department
IHE Delft Institute for Water Education

UNESCO IHE DELFT

Why focus on pathogens?

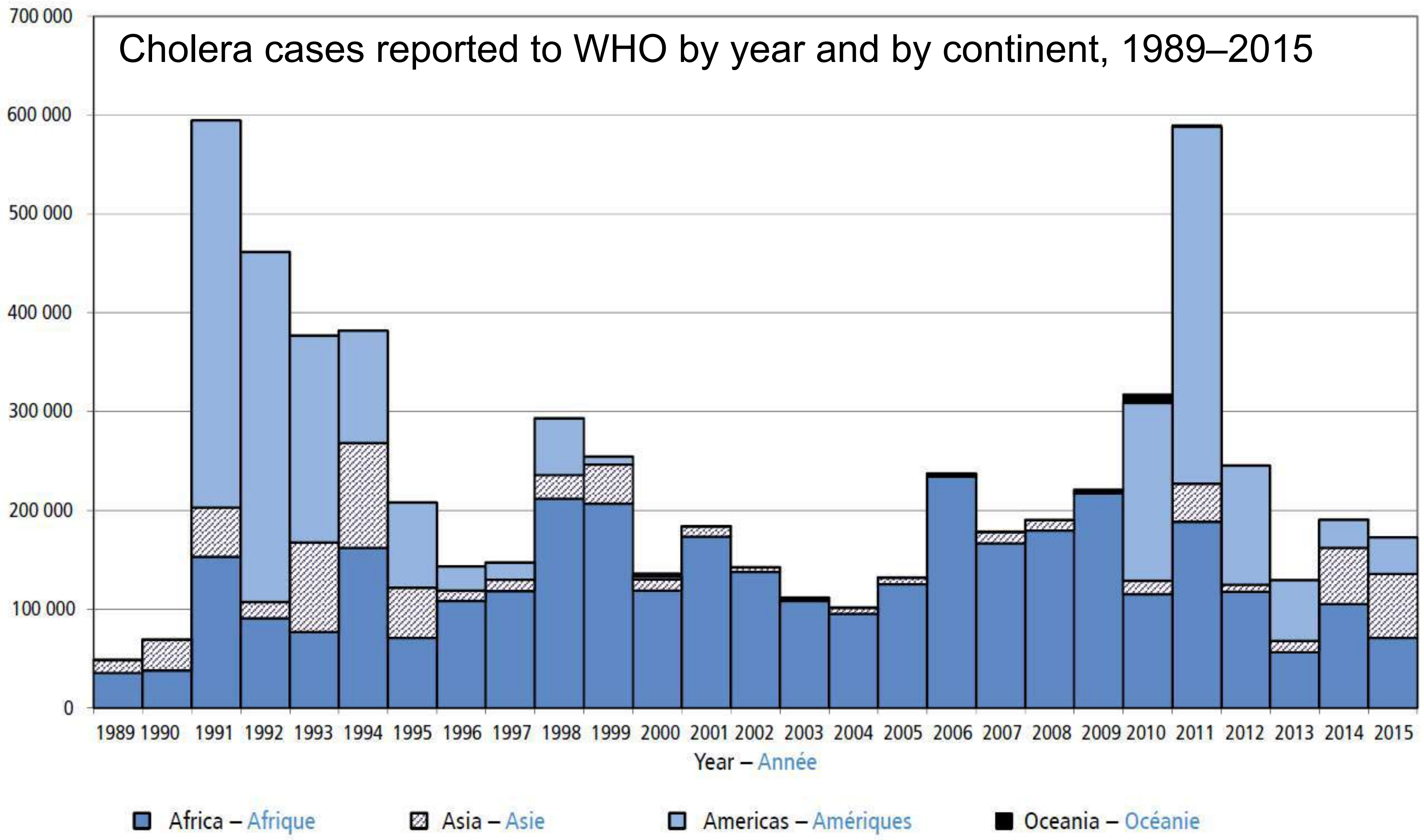
Ascariasis: global spread - particularly kids



- Ascariasis: most common soil transmitted worm infection
- 1 in 7 infected
- > 60,000 deaths annually
- Associated with poor WASH and using faeces as a fertilizer (CDC 2017; GNNTD2017)

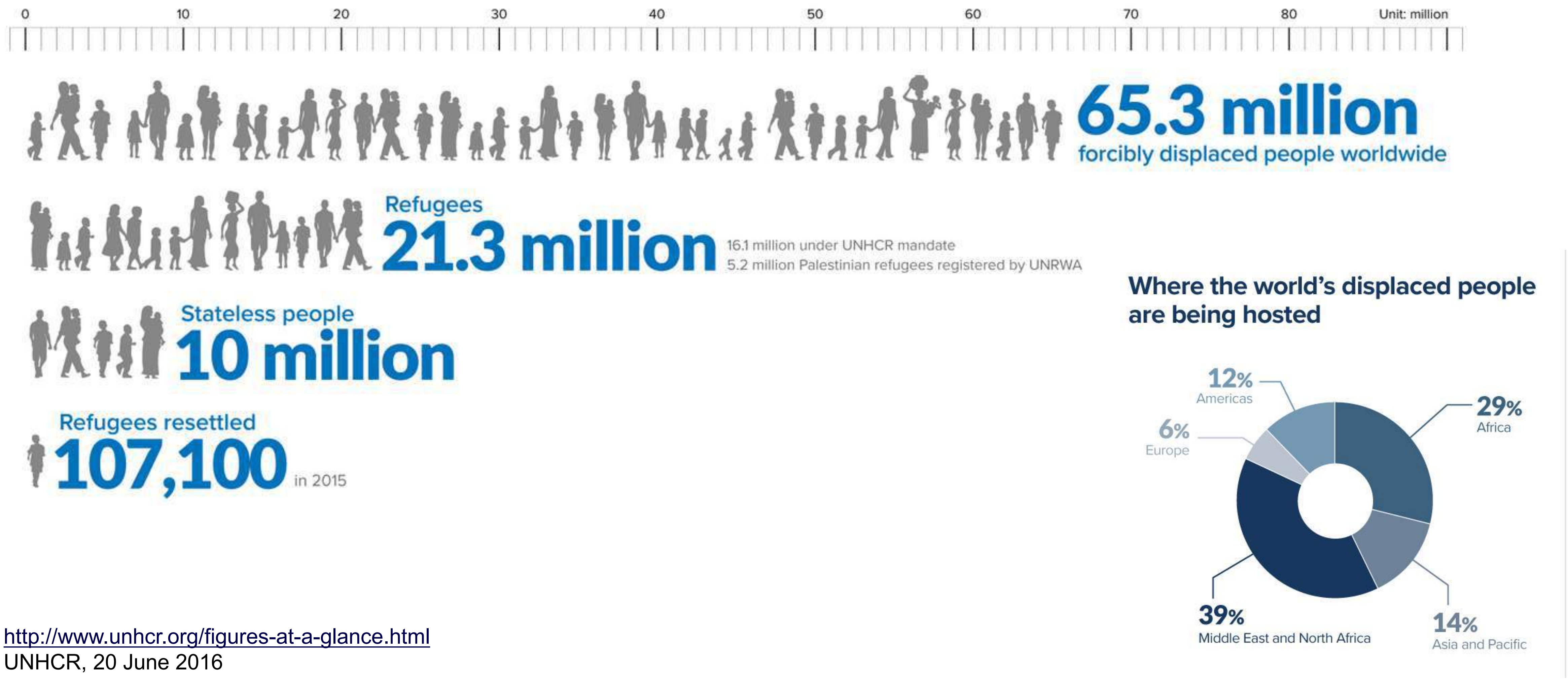
Proportion of children aged between 1 and 14 who are infected with soil transmitted helminths (WHO, 2017)

Cholera – bacterial infection



- acute enteric infection
- caused by ingesting *Vibrio cholera*
- Primarily linked to insufficient access to safe water and proper sanitation
- 1.3 - 4.0 million cases
- 21 000 to 143 000 deaths worldwide

Extra risk: exponential growth #refugees



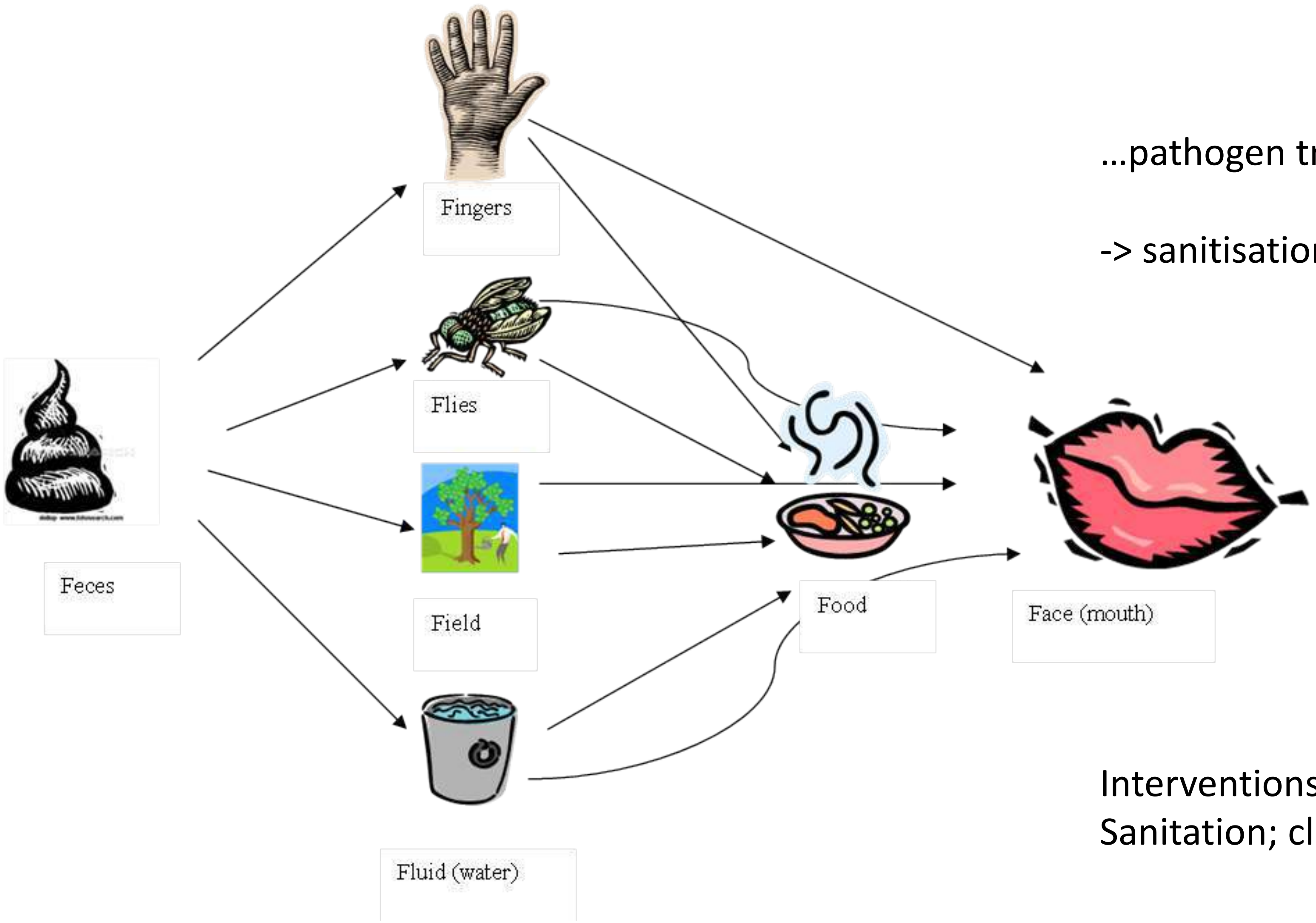
http://www.unhcr.org/figures-at-a-glance.html
UNHCR, 20 June 2016

MDGs: more toilets means more FS

The world has missed the MDG target for sanitation by almost 700 million people

- 68 per cent of the global population now uses an improved sanitation facility
- 2.1 billion people have gained access to an improved sanitation facility since 1990
- In 2015, 47 countries have less than 50% coverage of improved sanitation
- Half the rural population uses improved sanitation facilities compared with four out five people in urban areas
- One in three (2.4 billion) people still lack improved sanitation facilities and one in eight people (946 million) practice open defecation

Typical representation: F-diagram



…pathogen transfer - even post-technology!

-> sanitisation crucial

Interventions:
Sanitation; clean water; barrier approach; hygiene

Pathogen types found in sludge

Pathogen group	Illness	Syptoms
Bacteria	Cholera *E. Coli* infection Typhoid fever	Watery diarrhea, severe dehydration Mild to severe diarrhea Headache, fever, nausea, vomiting, paralysis
Viruses	Hepatitis A and E Rotavirus	Fever, nausea, stomach pain, jaundice, anemia Nausea
Protozoa	Cryptosporidiosis Giardiasis	Watery diarrhea, stomach cramps and pain Diarrhea, abdominal cramps and pain
Helminths	Asciariasis Hookworm Schistosomiasis	Abdominal pain, coughing, or no symptoms Stomach pain, anemia, local itching, or no symptoms Stunting and anemia in children; flu-like symptoms, painful urination, liver and intestinal pains

Source in FS

- Excretion of organisms: mainly in faeces, some in urine
- Excreted amounts pathogens per g faeces
  - Bacteria 10^{6-8}
  - Viruses 10^{8-10}
  - Parasites 10^{3-5}

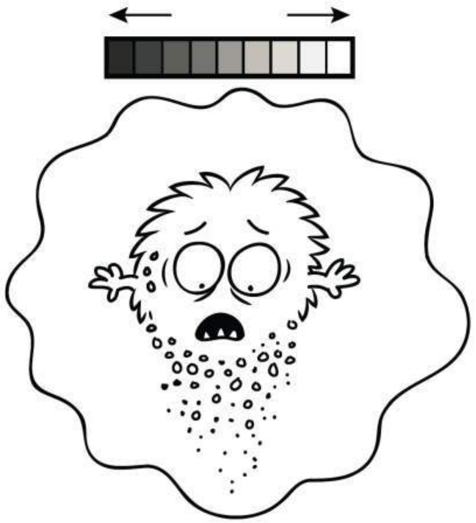
Typical disinfection mechanisms

Chemical treatment or dehydration

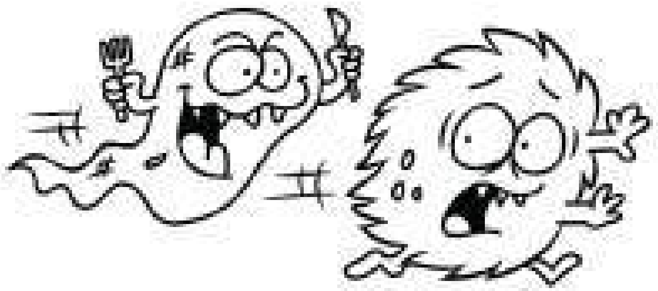
Ageing

Competition

Temperature increase



pH increase or decrease



Predation / defense system

UV

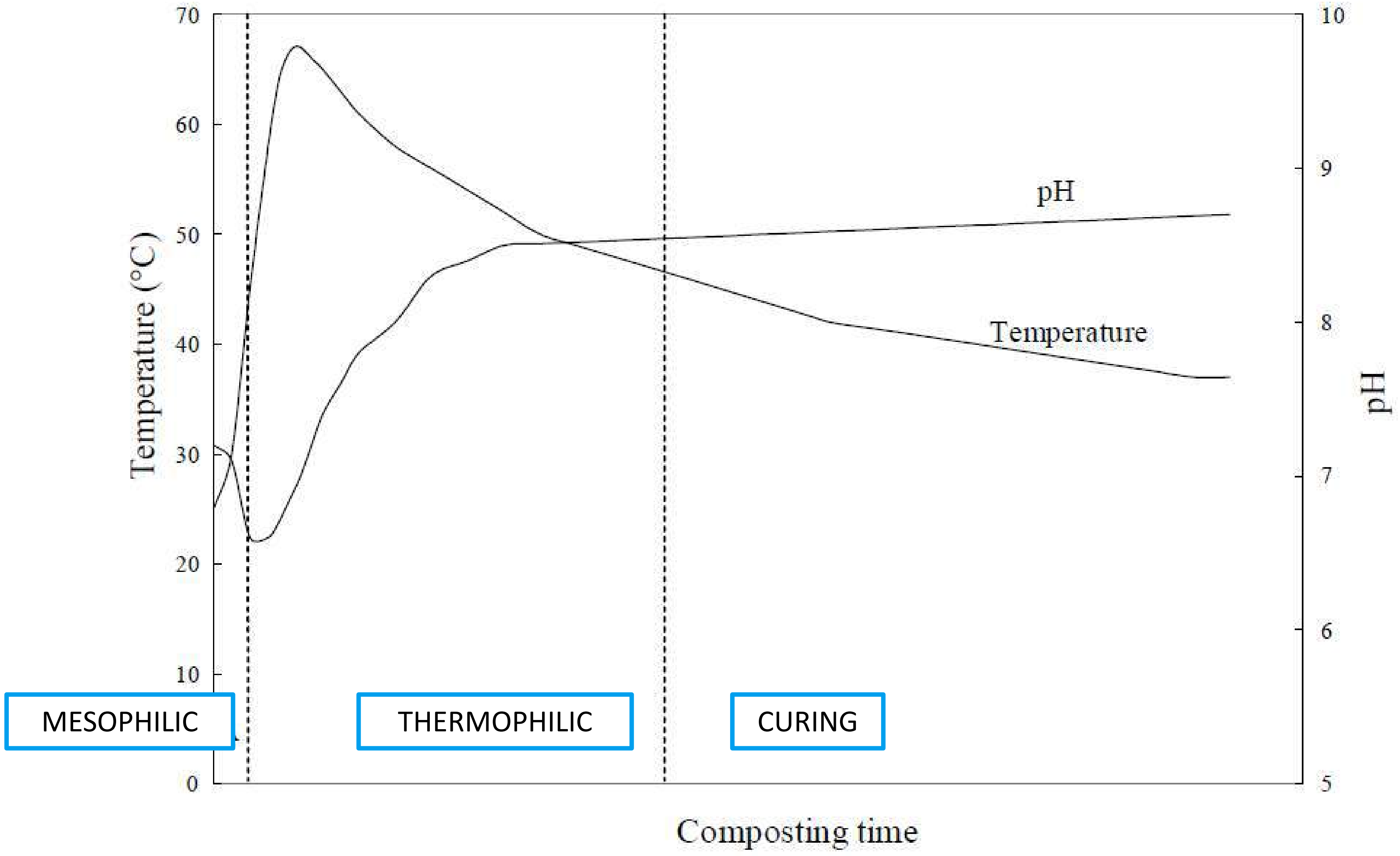
Disinfection methods: biological + chemical

- Biological treatment
  - Storage
  - Composting
  - Anaerobic digestion
- Chemical treatment
  - Lime
  - Ash
  - Acid
  - Ammonia
  - Oxidation

Heat treatment:
pasteurization 70° C, 1 hour (or similar)

- 5log10 Salmonella
- 5log10 Enterococcus
- 3log10 Heat stable virus
- 3log10 Ascaris (chemical heating through lime, acids)

Composting: very effective heat treatment



Lactic acid fermentation

- Obtained by storing organic waste together with lactic acid bacteria
- No biogas; lactic acid instead; product = fertile soil
- Process also inactivates pathogens (though further processing needed)

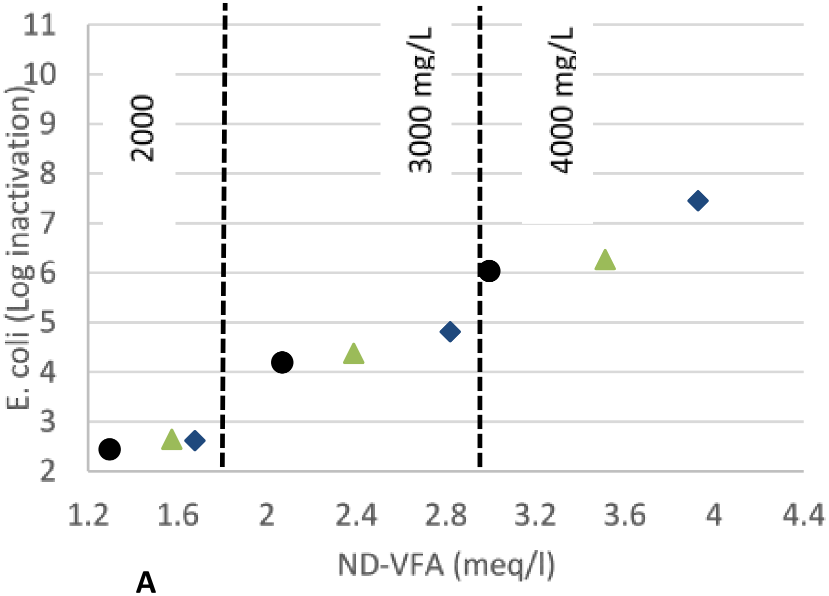
Lactic acid fermentation

Table 3.4 - Density of pathogen indicator organisms in faeces: biowaste mix before treatment, after lactic acid fermentation and combined lactic acid fermentation/thermophilic composting or vermi-composting (average values of the samples analysed during 2013-2014).

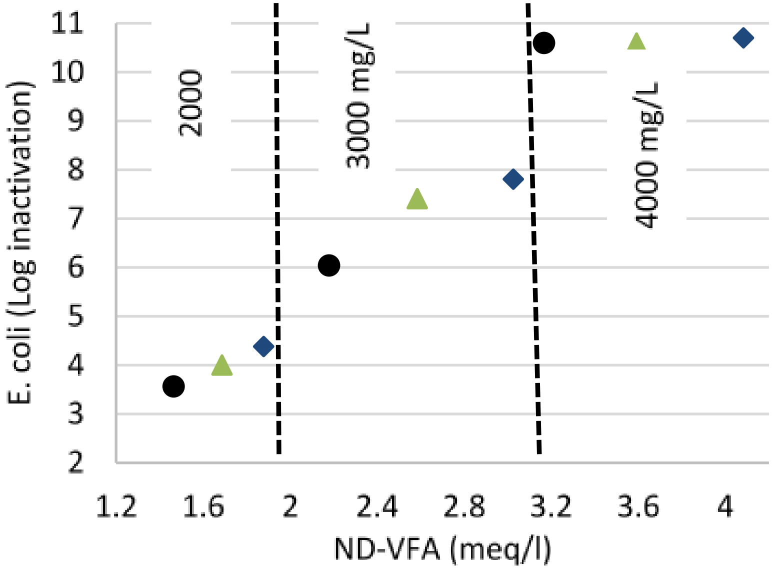
Pathogen indicators	Bacterial density $\log_{10}$ $CFUg^{-1}$			
	Raw material	LAF[1] (10 days)	LAF+TC[2]	LAF+VC[3]
2013				
coliforms	7.09±0.5	3.9±2.6	2.7±0.6	5.2±1.0
E. coli	6.7±1.2	3.2±1.6	2.3±0.6	2.0±0.0
E. faecalis	7.2±0.4	5.0±1.7	2.0±0.0	3.7±0.0
C. perfringens	5.0±0.0	2.5±0.7	2.0±0.0	2.0±0.2
2014				
coliforms	5.3±0.5	4.5±2.1	3.0±0.0	4.9±0.5
E. coli	4.6±0.0	4.5±2.1	3.0±0.0	3.0±0.0
E. faecalis	6.7±0.0	5.5±0.2	2.0±0.0	2.0±0.0
C. perfringens	1.0±0.0	4.5±0.7	1.5±0.7	2.3±1.0

[1]LAF - lactic acid fermentation; [2]LAF+TC - combined lactic acid fermentation and thermophilic composting; [3]LAF+ VC - combined lactic acid fermentation and vermi-composting.

Non-dissociated VFAs during anaerobic digestion



A



B

Most excreta technologies: products, not effluent..

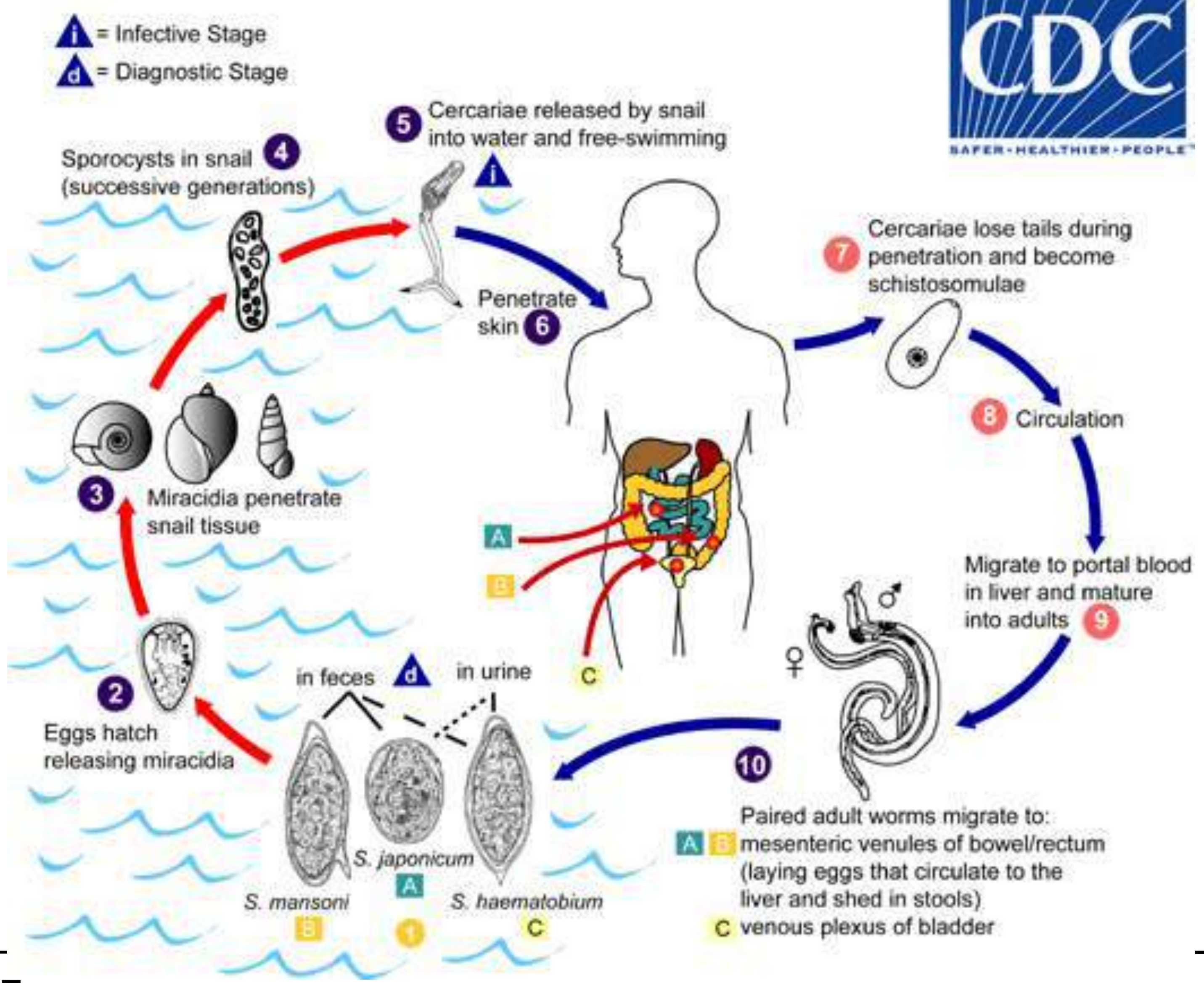
- Standard methods….
- Pathogen analysis not really included
- How to define limits for different products? [ISO]
- Safety strongly depending on final use
- Qualified labs..

Current developments

- Standard methods for FS
- Standards for the products
- Adaption of methods for products
- Development in testing kits
- Development of regional FS labs
- Qualified FS labs:
  - UKZN; CSE; AIT; Eawag & partners; IHE Delft & Blue innovations

Thank you for your attention..!

Schistosomiasis



Pradeep Mohanty
CEO, FSMC

Pradeep Mohanty is a social entrepreneur associated with semi-urban, rural & tribal community development of India, particularly the state of Odisha, since the year 1994. Pradeep worked with the local community for social development and economic empowerment through an integrated approach. His experience spans across compost, plantation, sanitation, hygiene, water, micro finance and micro insurance.

Finish Services Management Company
(FSMC)
promoted
Co-Compost Unit

Brief Introduction

- FSMC is a for profit company registered in India.
- Registered in the year 2014 at Ahmedabad, Gujurat.
- Operates in 2 states of India, Odisha, Maharashtra.
- Operates as a supply chain service provider in the WASH & allied sector.


Vermibed-3
Vermicompost Project
by
FSMC Pvt Ltd.
Lumbini Vihar, Kulei
Parjang, Dhenkanal, Odisha

Community Awareness

Co-Compost Input


ORGANIC FARM


TERI

Co-Compost Process

Co-Compost

Co-Compost Application

Financials

Item of Expenses	**Cost Per Unit** (Euro) (3 Beds)
Fixed Capital	9300
Working Capital	6616
Total Unit Cost	15916

Financials

Cost Benefit Analysis (Euro)			
	Year-1	**Year-2**	**Year-3**
Revenue	9771	9771	9771
Cost	15916	6616	6616
Profit / Loss	**-6145**	**3155**	**3155**

Challenges

Social Stigma - Labour / Usage
Demand Generation - Competition with subsidised product
Government Acceptance - Reuse of Fecal Sludge in Agri

Thank You..

Pradeep Kumar Mohanty
Finish Services Management Company Pvt. Ltd. (FSMC)
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+919776080273.

Aart-Willem van den Beukel
Managing Director,
Safi Sana Holding BV

In 2007 Aart started working for Ecoventures, an incubator for business start-ups in the renewable energy sector. Aart was responsible for developing a business in small-scale household biogas systems for the Asian and African market. In 2009 the holding company (Econcern) had to terminate Ecoventures because of the world wide economic crisis. Aart decided to pitch the biogas concept to investors to further develop the concept. He got in contact with a Dutch NGO called Aqua for All. They had developed a business plan for what is now called Safi Sana, but they lacked an entrepreneur to set up the business. Aqua for All had already formed a consortium with Shell, Rabobank and DHV (now known as Royal HaskoningDHV) to further develop the concept. Aart was recruited to grow the Safi Sana concept into a success with an initial start capital by all consortium partners. In 2010 Aart founded the Safi Sana Holding BV and Safi Sana Ghana Ltd. The initial focus was on testing the concept on technology and market potential for waste sourcing and sale of bio-fertiliser and energy. Ghana was selected as pilot country. Since then the Safi Sana model has been tested and in September 2016 the first commercial factory was opened with a treatment capacity of 25 tonnes of waste daily. The team in The Netherlands has 3 fulltime staff and the team in Ghana has 20 people staff. Currently the project is rolled out with support of the African Development, the Dutch government and a small group of investors.

safisana

Waste to energy and compost
financially sustainable & high impact

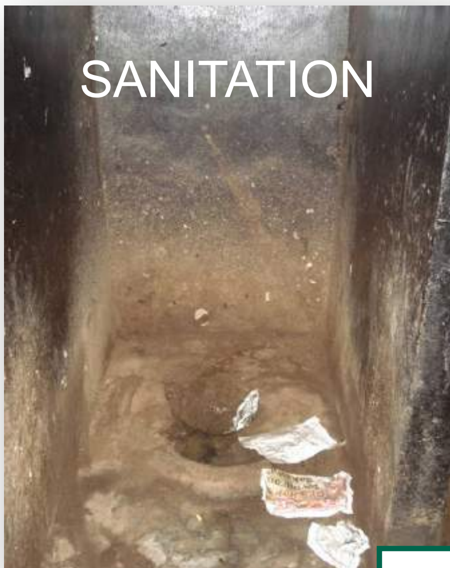
15/05/2017

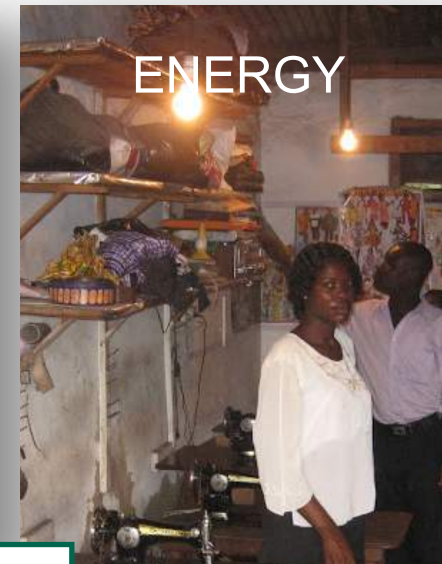
Aart van den Beukel

New challenges

safisana

URBANISATION

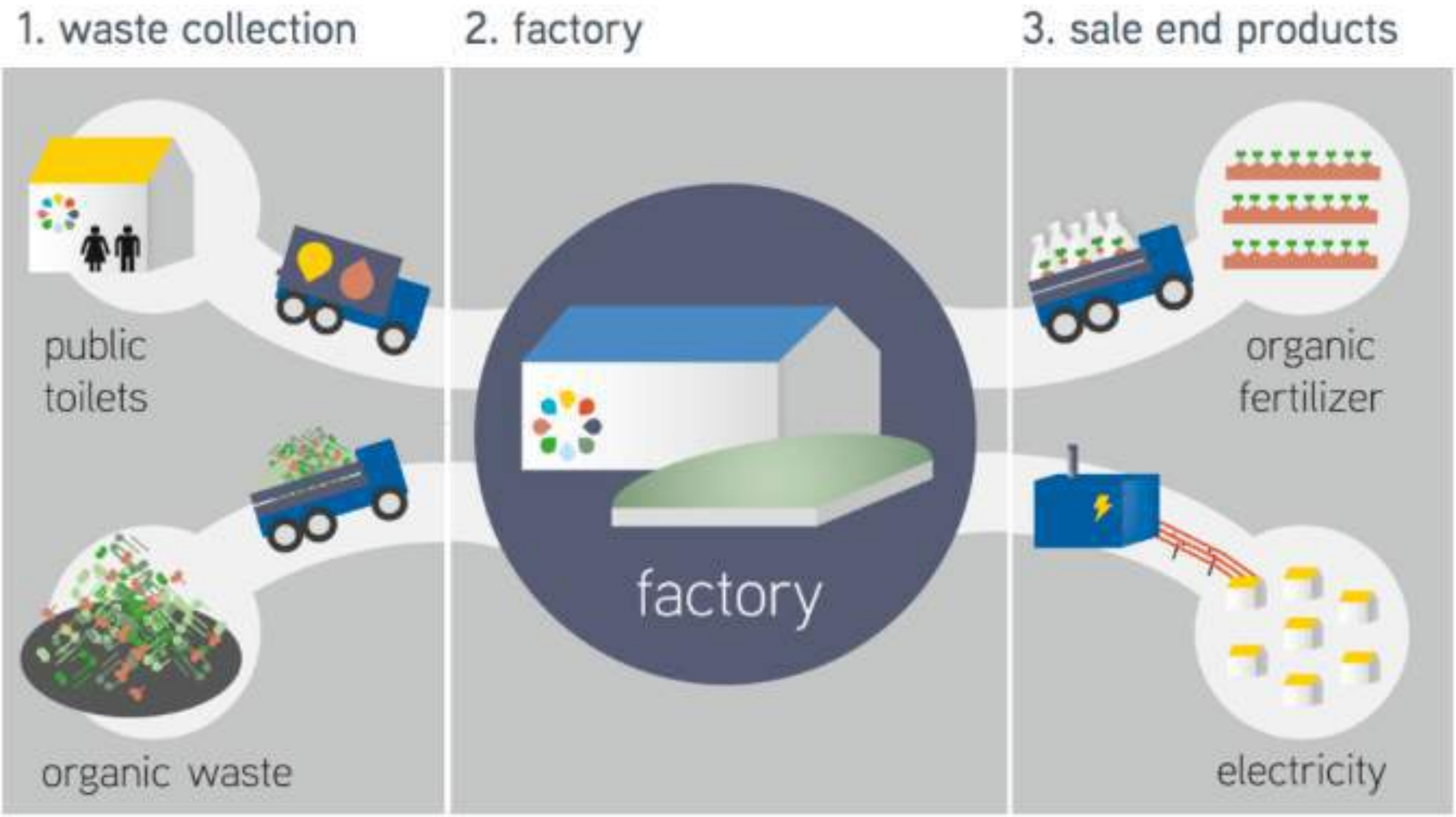




Negative impact:

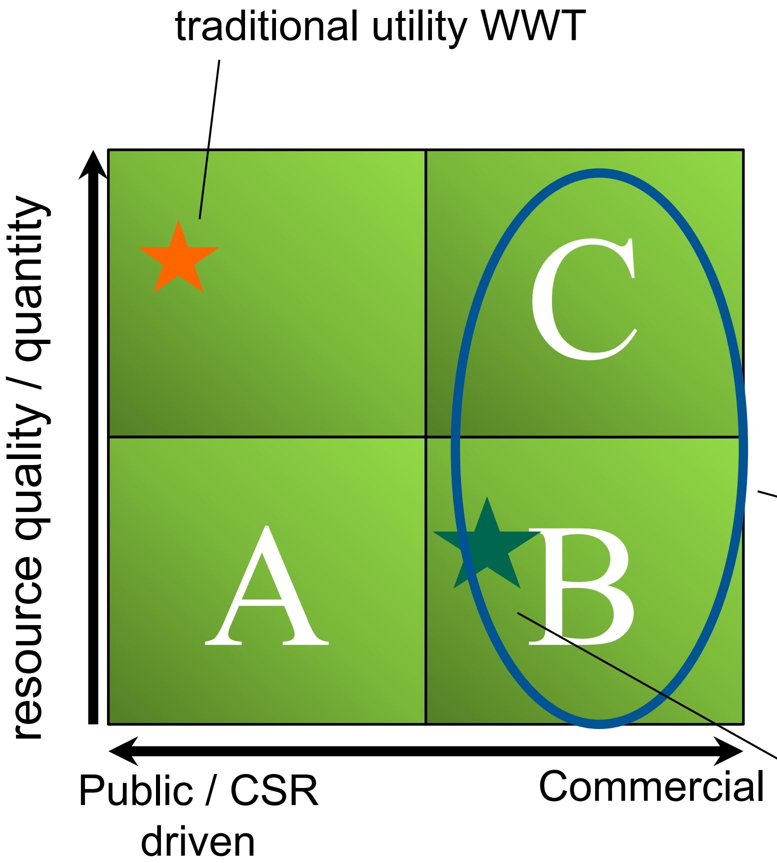
economic, environmental, social

A business approach



Market segmentation

safisana



A. CAPEX & OPEX subsidized / public funded

B. CAPEX public or CSR funded; OPEX covered with operational revenues.

C. Full Commercial

FINANCIALLY SUSTAINABLE & HIGH IMPACT

Safi Sana plant Ashaiman

Operations

safisana

Power to grid

safisana

Compost and seedlings

safisana

Composition

N	17 – 22 (gkg-1)
P205	10 – 24 (gkg-1)
K20	10 – 24 (gkg-1)
Ca	1.6 – 3.0 (gkg-1)
Mg	10 – 1.4 (gkg-1)
Fe	5000 (mg kg-1)
Zn	140 (mg kg-1)
Pb	200 (mg kg-1)
Ni	180 (mg kg-1)
Cr	10 (mg kg-1)
Cd	51 (mg kg-1)
EC	1.5 – 2 (mg kg-1)
pH	8

Where and how to buy?

Visit http://asasegyefo.com.gh/ for information or orders

CONTACT Sonia Folikumah
sales@asasegyefo.com.gh
Tel. 030 297 2380

VISITOR ADDRESS
Location: 200 meters away from Tema-Motorway underbridge, Adjei-Kojo Ashaiman
GPS coordinates: 5.68345, -0.04932

asase gyefo®

Love your land

Asase Gyefo® Organic Fertizer

- optimized for use in all types of crop production
- increases yields by more than 20%
- improves soil structure and porosity
- enhances soil fertility
- offers high quality – every time

asase gyefo®

Love your land

How to order:

CONTACT Sonia Folikumah

sales@asasegyefo.com.gh

Tel. 030 297 2380

Visitor address:

Location: 200 meters away from Tema-Motorway underbridge,

Adjei-Kojo Ashaiman

GPS coordinates: 5.68345, -0.04932

PS. Also try Asase Gyefo® Organic Fertilizer

www.asasegyefo.com.gh

Capacity building

safisana

new sanitation | organic farming | renewable energy

Process and impact monitoring

safisana

new sanitation | organic farming | renewable energy

Business model Safi Sana

safisana

1. Project development (government, corp.)
2. Services
3. Gains ownership

Roadmap

safisana

1. Expand to new locations internationally
2. Develop project finance strategies
3. Knowledge building

Unilever

TATA TRUSTS

TATA

ANGLOGOLD ASHANTI

GMC

Safi Sana and partners

safisana

Royal HaskoningDHV
Enhancing Society Together

Wageningen UR
For quality of life

sustainable sanitation alliance

wereld waternet

LEAF

SNV Ghana

IFDC

University of Ghana

WASTE

aidenvironment

Aqua for All

CGI

Simavi
Iedereen een gezonde basis.

Sarphati Sanitation Awards 2015

Ministry of Foreign Affairs of the Netherlands

Bill & Melinda Gates foundation

dimagi

TOILET BOARD COALITION

The Stone Family Foundation

Ghana-Netherlands WASH Programme GNWP

DASUDA
Dutch Alliance for Sustainable Urban Development in Africa

Unilever

VIA Water

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Andreas Schmidt
Representative
Southern Africa,
BORDA

Andreas Schmidt is a Senior Technical Expert holding a Postgraduate Diploma in Water Resources Management, a Master degree in Environmental Process Engineering and a Bachelor degree in Mechanical Engineering with 15 years of professional experience in IFI-financed international projects in the field of sanitation with project cycle experience comprising of identification, feasibility studies and design, appraisals, implementation planning and management, operation and maintenance and sustainability, monitoring and evaluation.

BORDA

Beyond development aid:

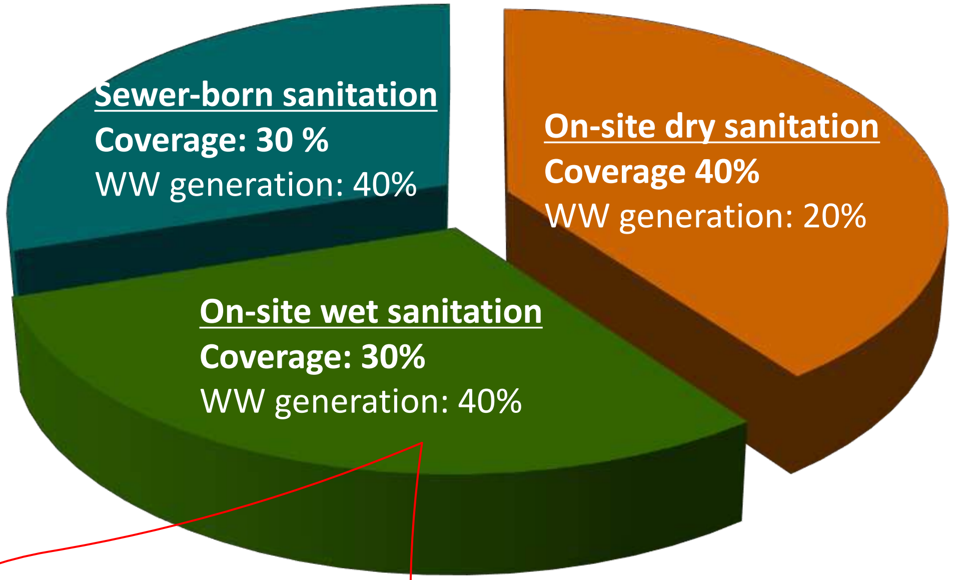
Sanitation financing & revenue models in reuse (human) waste

Pre-Fabricated DEWATS

Andreas Schmidt

May 15th, The Hague

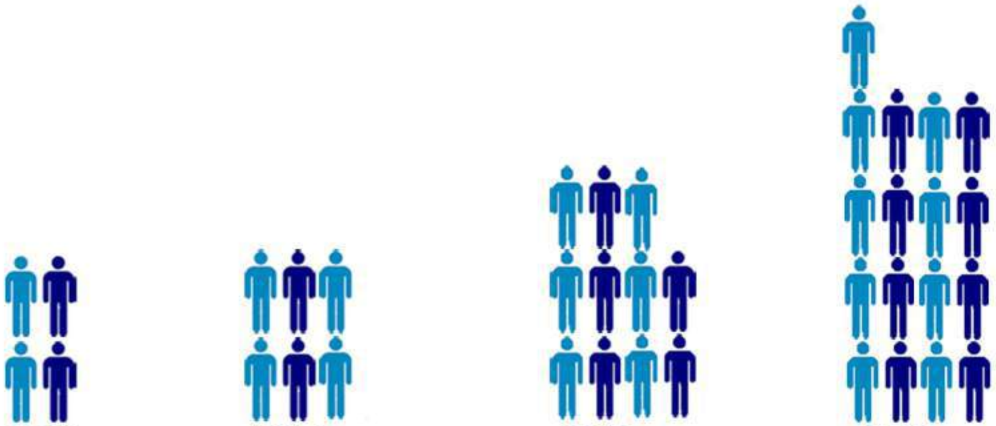
Demand



Decentralized wastewater treatment capacities needed for ca. 220,000 m³ per day or 22,000 plants to be installed

Case study Dar es Salaam 2022

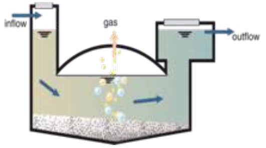
Data estimated by BORDA

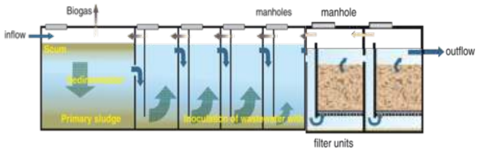


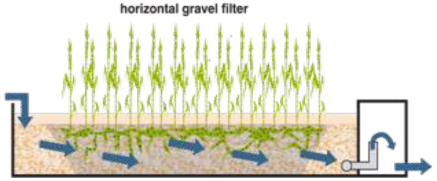
Year	1992	2002	2012	2022
Population in million	1,62	2,45	4,36	7,00
Total water demand (m3/d)	290,000	345,000	496,000	703,000
Total sludge generation (m3/y)	105,000	144,000	200,000	268,000
Total waste generation (t/d)	1700	2250	3899	7631

What is DEWATS?

A technical concept that provides safe & sustainable wastewater treatment solutions according to the local socio-economic condition







What is pre-fab?

Industrial fabricated wastewater treatment plants as a instrument to scale up DEWATS dissemination and to develop the wastewater industry in developing countries

Pre-fab features

Application

Residential households and institutions

5 – 10 m³ WW per day per unit, up to 50 m³ WW per day in parallel modules

Advantage towards conventionally built systems

Construction cost: + 20% more

Project management cost: - 80% less

Implementation time: - 80% less

Demand = Market ?

Market barriers for the private sector in developing countries

- *Un-regulated or wrongly regulated environmental sector (technical & environmental standards only paper or don't relate to socio-economic situation, weak law enforcement)*
- *Technologies or row-materials need often to be imported and import taxes increases the product costs*
- *Ineffective technical standards leads to lowest quality = lowest cost = wins the tender*
- *Too little technical and financial support by the government for the environmental industry*
- *High product promotion and marketing cost in order to develop awareness and the market*

BORDA

Break-out session: remaining challenges

Besides the market entry challenges, new technologies face additional barriers when entering developing markets (esp. in **immature** sectors such as sanitation)

Lead questions:

- *How can we facilitate technology transfer?*
- *How can we empower investors and entrepreneurs in the target markets?*

Mary Roach
Head of Global Partnerships, Loowatt

Mary Roach is the Head of Global Partnerships at Loowatt, a waterless toilet company based in the UK. Mary joins Loowatt from Ceniarth, a single-family office, where she was responsible for their energy access portfolio. Prior to joining Ceniarth in 2015, Mary was responsible for the GSMA's M4D Utilities Innovation Fund supporting organizations leveraging mobile technology to improve access to energy, water and sanitation. Mary's interest in the role that infrastructure can play in development emerged from her combined experiences working on the first pilot of M-KOPA's pay-as-you-go product, 5-years working with GE Power Generation, and a decade of involvement with Engineers without Borders Canada at home and abroad. She holds an MBA from Oxford University and a Bachelors in Chemical Engineering from McGill University.

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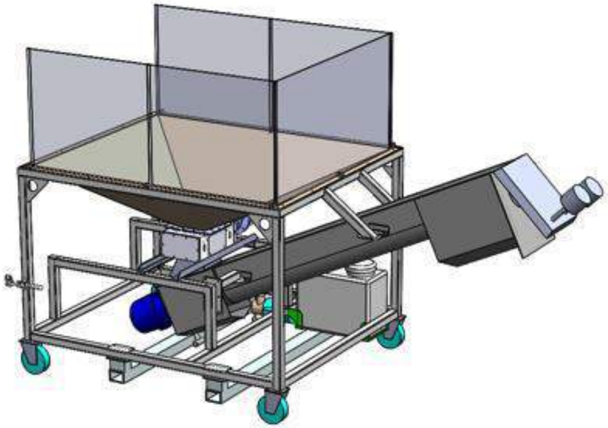
Sanitation Solutions for a Water Scarce World

Making money from waste?



Powerful Motivation

Mission

Loowatt develops safe, closed-loop sanitation solutions that provide high-quality access for all

Sanitation Solutions for a Water Scarce World

Product

"A toilet experience like no other. Very impressed indeed."

–UK customer, 2016

Biopolymer film refill passes through patented sealing technology for a **waterless, odourless, clean** "flush."

Waste and film are contained beneath toilet in a sealed cartridge which is emptied into an anaerobic digester, where waste and film are converted to **energy**.

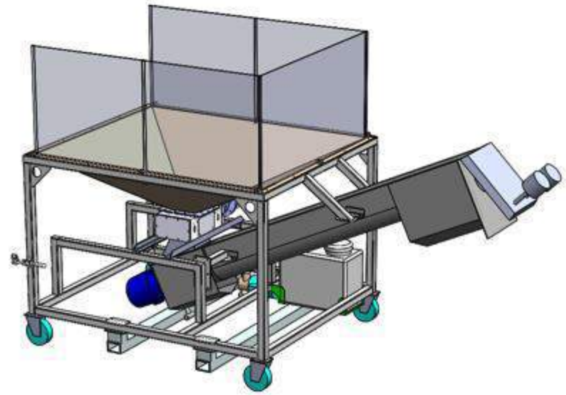
"Loowatt changed my life. I can even read magazines in the toilet!"

–Madagascar customer, 2016

21st Century Sanitation Value Chain

Every stage solution

Toilets, Refills and Containers



Waste pre-processing equipment

Mobile app & web platform

Capture → Storage → Transport → Treatment → Reuse

Expertise and Standard Operating Procedures Across Value Chain

Route to Market

Global Underserved

Build Technology	Generate Demand	Transition to Sales
Proof of concept: end-to-end toilet and waste to value system proves technology to end users, funders and municipalities	Develop business model for household serviced toilets. Create SOPs that utility partners will customise to meet their needs.	Transition into sales of toilet hardware, toilet refills, waste to value technology. First such sale to Laguna Water (Philippines) in 2017.

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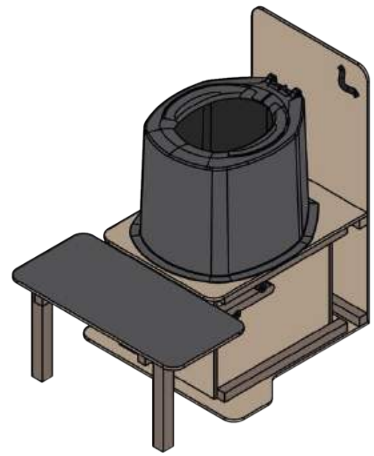
Products

Global Underserved

Suite of product solutions to meet price points and needs of global users.

Roso: existing solution in operation in Madagascar.



Laguna: 2017 pilot in the Philippines adapted for easy installation and washers

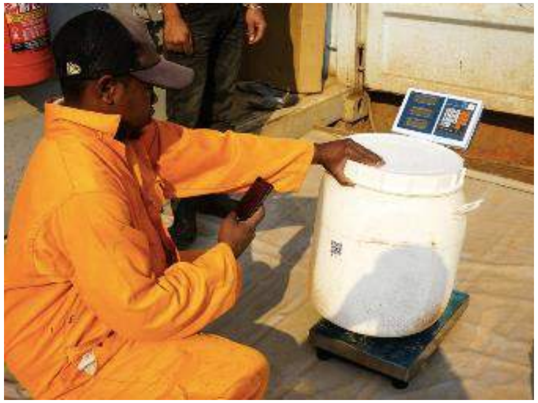
Economy: create ultra-affordable "Better than bucket" service

Proof of Concept

Global Underserved

Urban pilot system in Antananarivo, Madagascar:

- 100 household toilets installed, 600 toilet users a day
- 25 m^3 anaerobic digester including CHP generator, pasteurisation system, and net energy yield of 40 kWh/day, and vermicompost
- 1.4 tons household toilet waste processed every week
- >95% Roso toilet customers purchase a refill every week for c. US$ 1.00
- 75% contract holders are women



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Important points about Tana/Madagascar

- Some existing AD infrastructure in high-density areas limiting need to transport FS long-distances
- Flood-prone!!
- LDC country with HDI ranking of 158 of 188 countries

Making sanitation financially sustainable

Questions we need to answer:

- Who pays?
- Can we create a model that can recover the CAPEX and OPEX?
- How do we create a service model that is attractive to 3rd party servicers?
- How can we generate additional revenues?
- Do we need to create the systems/processes/vehicles to support the deployment of appropriate subsidies (if needed) and help 3rd party service providers gain access to funding?

Results from our vermi-compost trials

Organic Material + Digestate + Worms = Vermicompost

Insights:

- Vermicompost is of higher quality than traditional FS-derived compost
- Vermicomposting is quicker!
- While localized AD is useful for FS treatment, composting only becomes significantly profitable at scale
- Digestate sales can also be lucrative!
- Things to consider: how to control digestate quality, “transport” is a significant cost, seasonality of organic material supply

Questions?

Contact Us

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Prof. Dr. Grietje Zeeman
Emeritus Professor, Wageningen University and Research

Prof. Dr. Grietje Zeeman, has more than 35 years of experience in R&D and application projects in the field of treatment of waste, wastewater and sanitation, with a specialization in anaerobic treatment. Since March 2012 she is appointed as Endowed Professor in 'New Sanitation' at the department of Environmental Technology of Wageningen University and Research (WUR-ETE). Since October 2016, she is emeritus professor. She still works with LeAF, a spin-off company of Wageningen University, to bring New Sanitation to practice. Grietje initiated projects on Decentralised Sanitation, aimed at recovery of energy, organics, nutrients and water, from 1999 onwards. She was able to develop and demonstrate that Decentralised Sanitation is a feasible alternative for conventional sanitation concepts. As a result of the scientific, technological research the DeSaR (Decentralised Sanitation and Reuse) concept was developed and applied in a new housing estate of 32 houses, in Sneek, The Netherlands since 2006. The concept is now applied in full scale at 5 locations. She was and is (co)promotor of more than 25 PhD students and published more than 100 peer reviewed papers.

Pim van der Male
Senior Policy Officer Water Management, DGIS Foreign Affairs Ministry

Pim van der Male is a Senior Policy Officer Water Management, at DGIS Foreign Affairs Ministry. Human Geographer by trade, Pim has been working with organisations like SNV, UNFPA and UNDP in a range of countries (e.g. Papua New Guinea, Sudan and Tanzania). He joined the Ministry of Foreign Affairs in 2005 and has been involved in the water sector for 7 years. Planning, Monitoring and Evaluation (PME) and results based management have been a common factor in his assignments; current focus is on programming for the new WASH strategy which includes financing for WASH.