SESSION 2
RESOURCE RECOVERY

sustainable sanitation alliance

A) INTRODUCTION + RESOURCE RECOVERY TOOLBOX

B) BIO-BASED CONDITIONER FOR DEWATERING

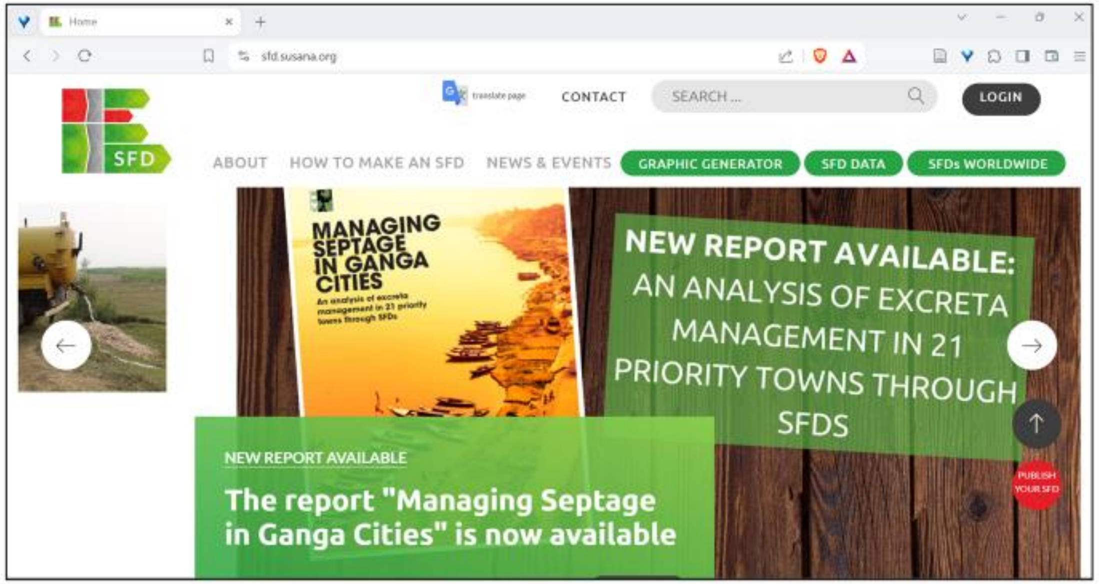
C) NUTRIENT RECOVERY IN BOLIVIA

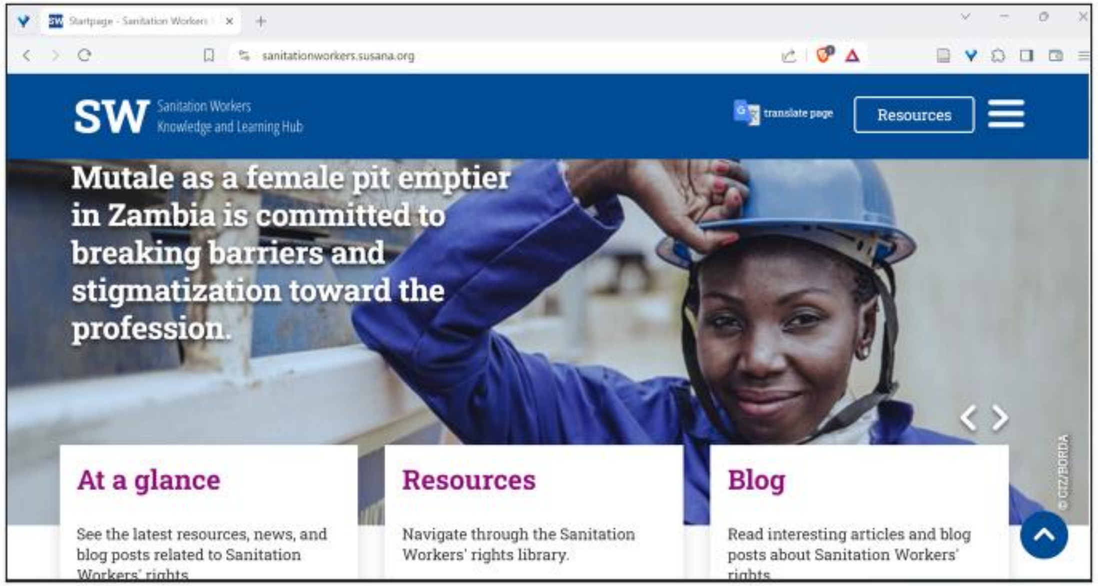
D) CLEAN AND GREEN VILLAGE FRAMEWORK

E) CAP COD'S URINE DIVERSION EFFORTS

What?

A hub for tools and resources related to planning and implementing resource recovery initiatives, in a somewhat similar fashion to other hubs on the SuSanA platform for other thematic areas.





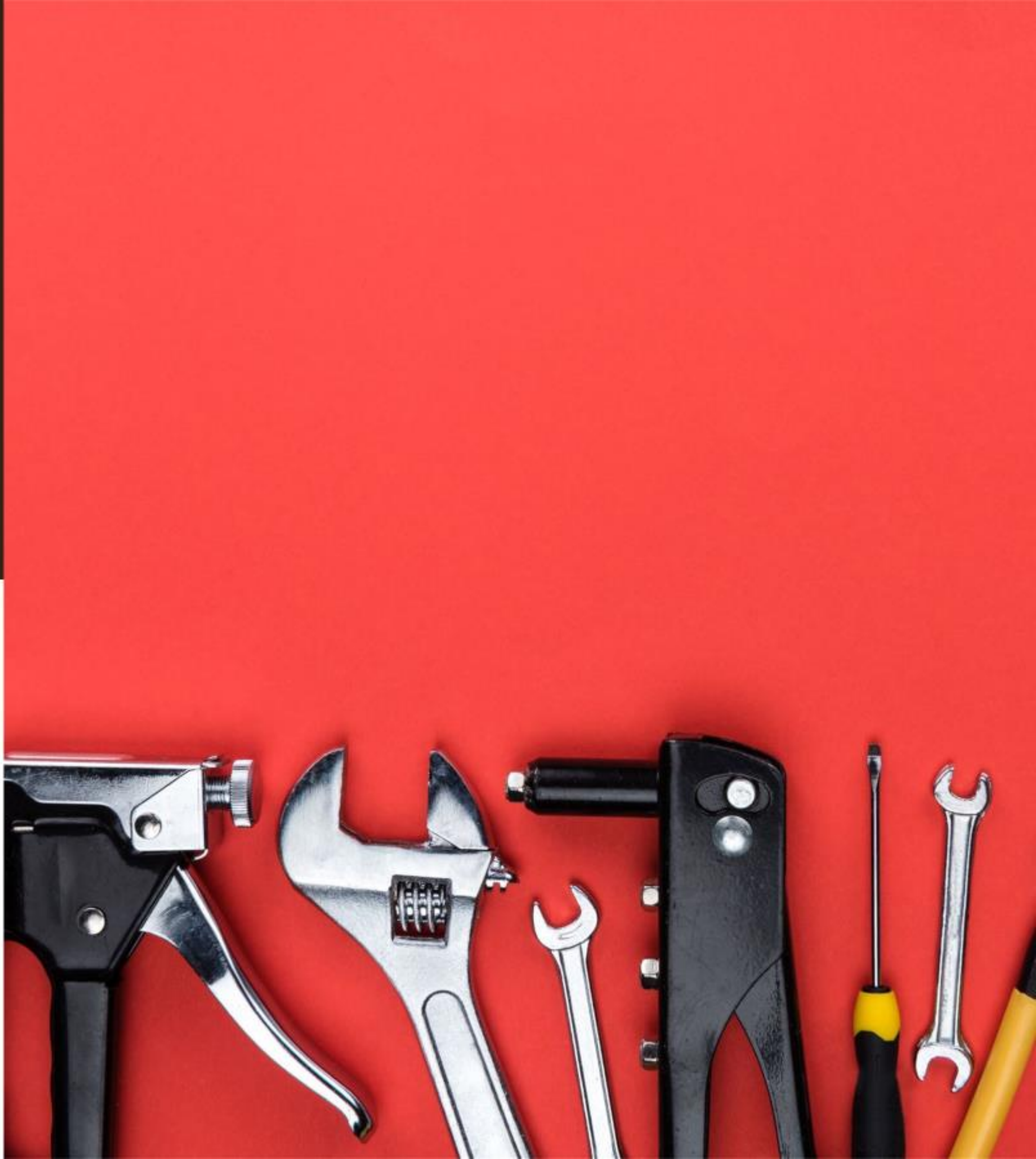
Why?

Link the work of various partners/members of WG5.

For developers of tools, the toolbox will boost the visibility of their work.

For (potential) users, this platform will provide discoverability and access.

The Toolbox will hence contribute to bridging between knowledge and action.



How can you get involved?

Daniel Ddiba
daniel.ddiba@sei.org

Project web-page
www.sei.org/projects/resource-recovery-toolbox/

With funding from Formas!

- September to December 2024
- Get in touch!
- Tool/Resource creator? Tell us about your tools so that we can include them
- Resource recovery enthusiast/practitioner? Express your interest in the platform and tell us how it would best serve your needs

Eawag
Swiss Federal Institute of Aquatic
Science and Technology

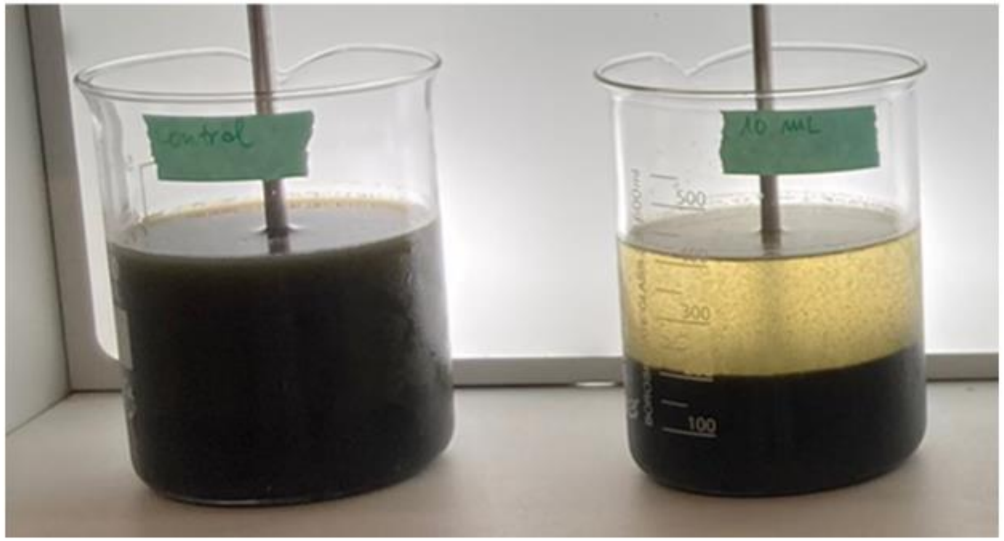
eawag
aquatic research

Local production of bio-based conditioners for improved dewatering of fecal sludge

Nienke Andriessen
nienke.andriessen@eawag.ch
Project manager - Management of Excreta, Wastewater and Sludge group

Improving dewatering efficiency

- **In dense cities, limited space for treatment**
- **Using conditioners can reduce footprint/increase capacity**
- **Conditioners = flocculants and coagulants**
- **However, existing (polyacrylamide) conditioners:**
    - Are expensive
    - Need to be imported
    - Uncertain effect on environment



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Locally produced bio-conditioners

- **Producing conditioners locally could alleviate supply chain issues**
- **Resource recovery using waste materials**
  - Modified cellulose from corn cob
  - Chitosan from shrimp shells

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Results

- **Modified cellulose best settling performance, clear supernatant**
- **Small flocs**
- **Higher dosage required than for commercial conditioners → Room for improvement?**

Conditioner	COD reduction	TSS reduction	Optimal dosage
Modified cellulose	91%	90%	26.8 kg/tonne TS
Chitosan from shrimp shells	79%	70%	11.2 kg/tonne TS
Commercial chitosan (Heppix A)	83%	70%	2.2 kg/tonne TS
Polyacrylamide conditioner (CP314)	80%	70%	10 kg/tonne TS

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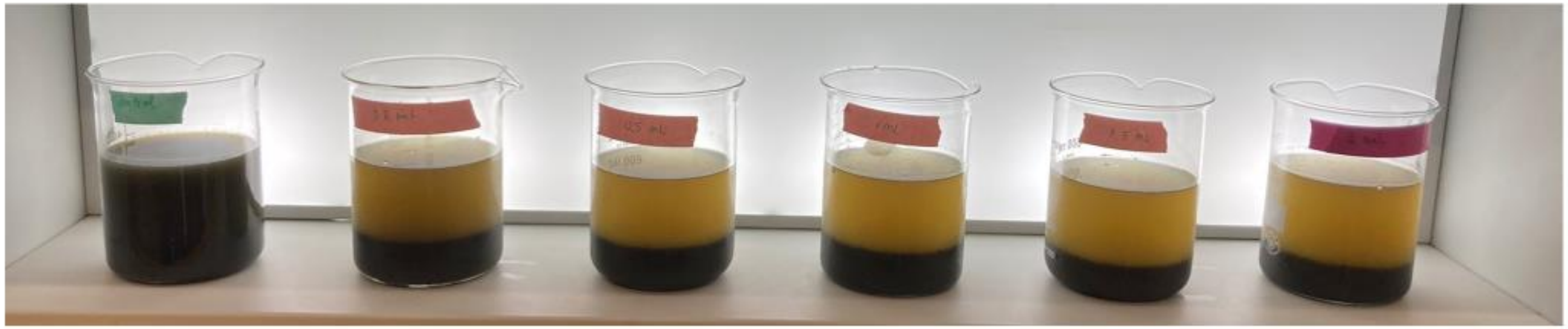
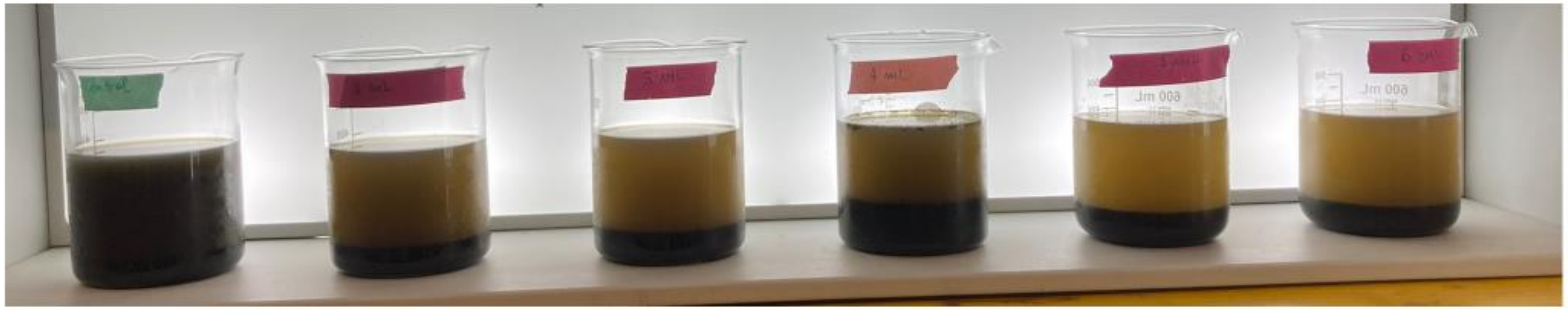
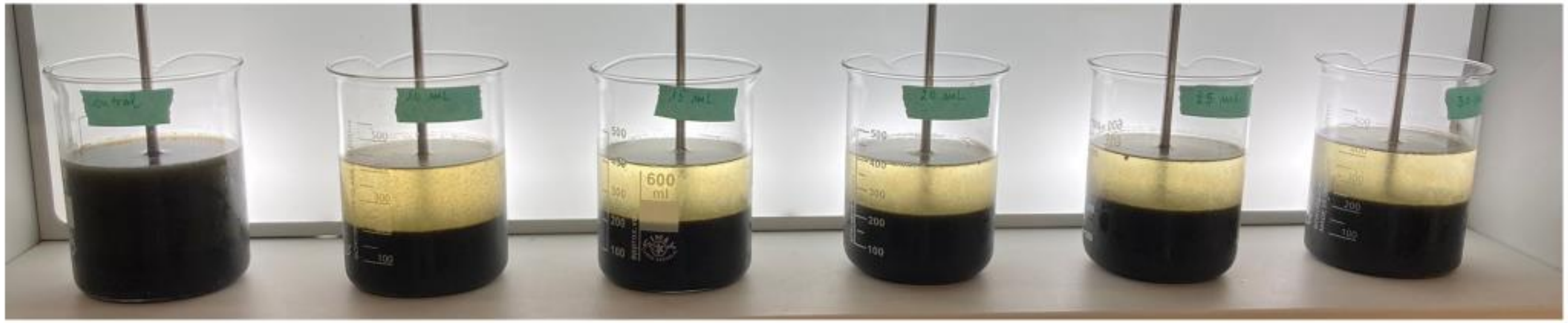
eawag aquatic research



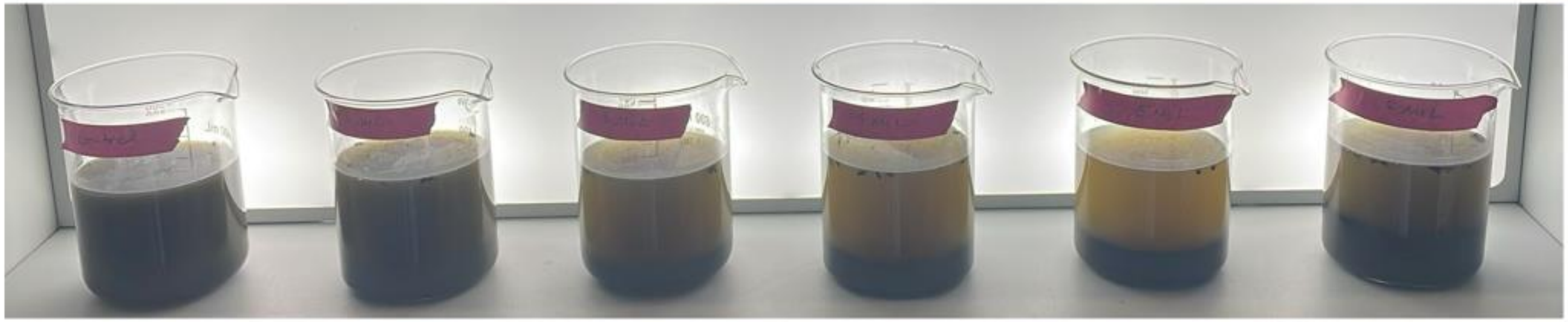
Commercial chitosan



Shrimp shell chitosan



Corn cob cellulose



PAM conditioner

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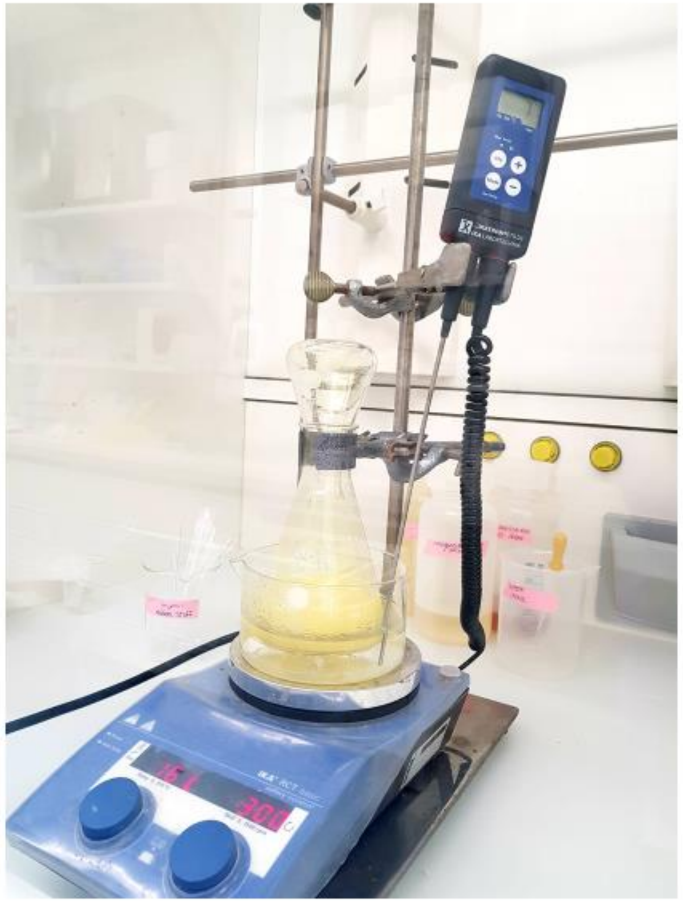
Further research

- **Floc strength**
- **Testing on a variety of sludge characteristics**
- **Are locally-made conditioners cheaper?**
- **Availability of chemicals**
- **Environmental impact**
- **Business model**



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Nutrient

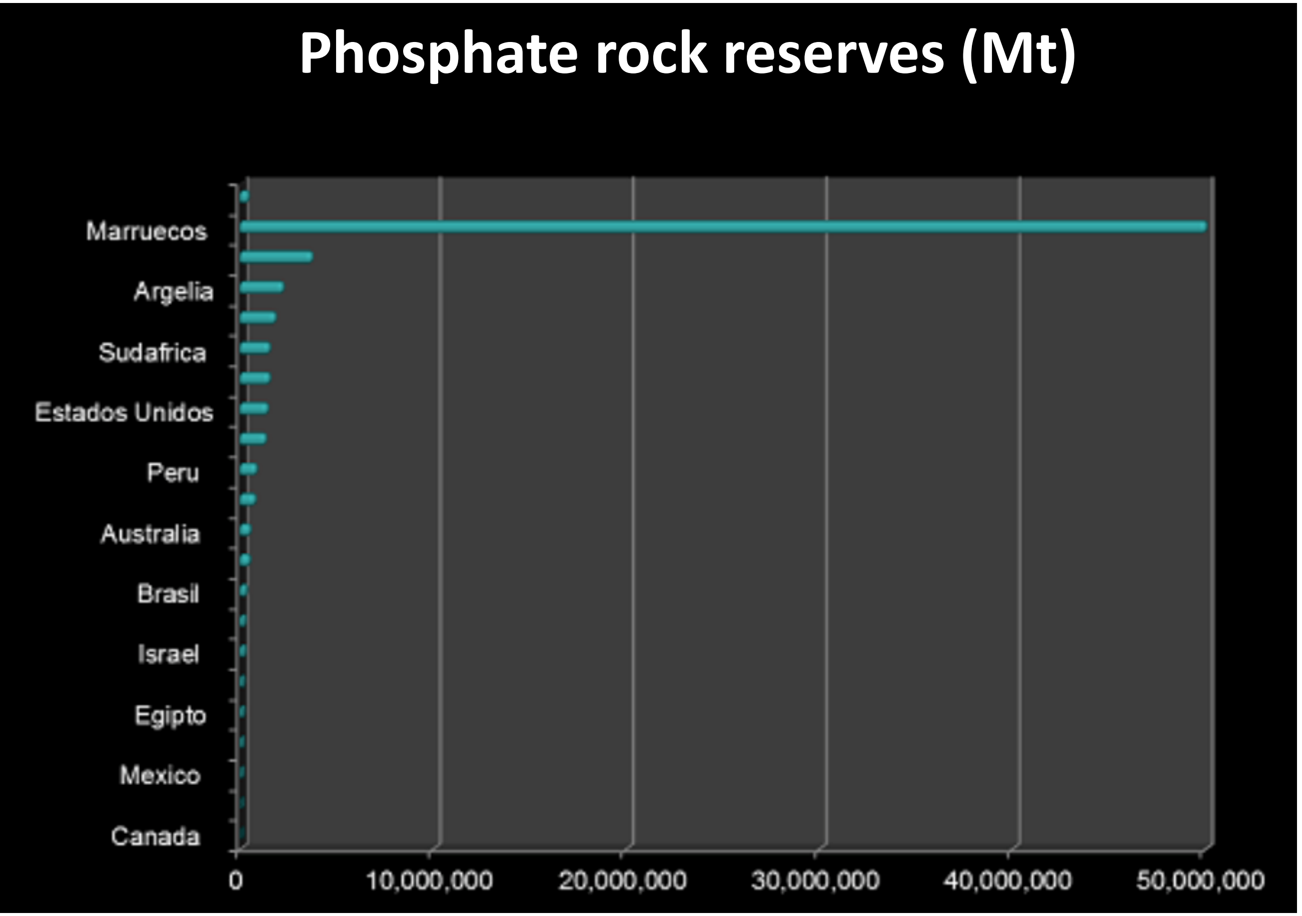
recovery and reuse

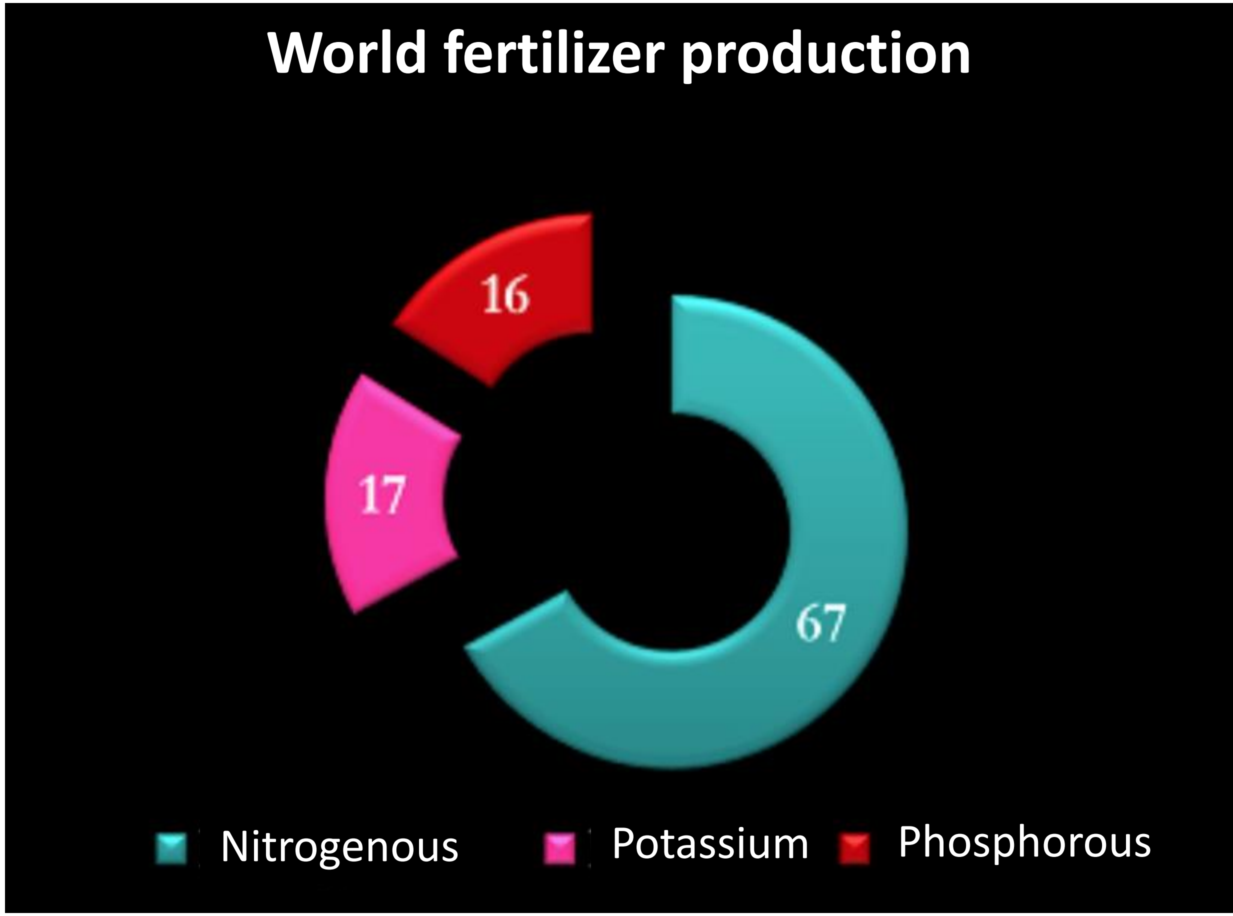
Programa:

“Modelos descentralizados de saneamiento en Bolivia”

Lourdes Valenzuela - Aguatuya

Phosphorus non-renewable resource



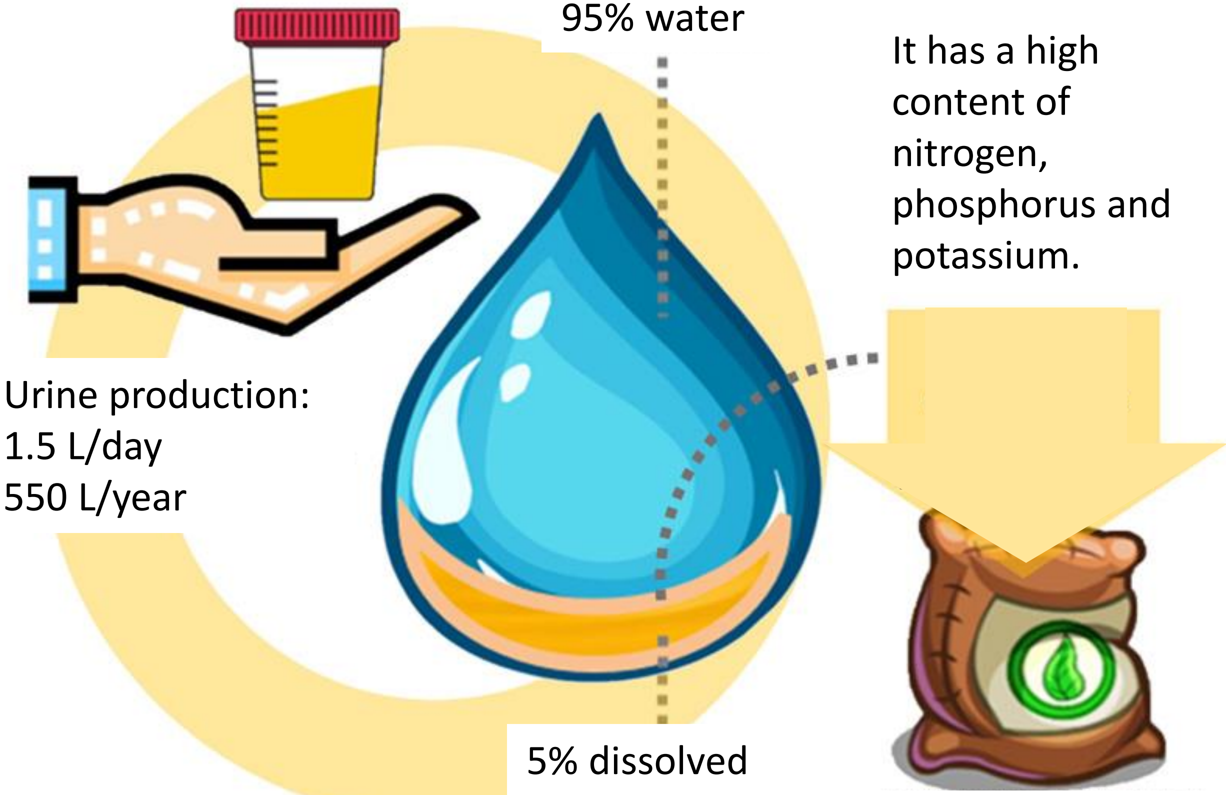


Recovery of 90% phosphorus in urine

human urine
abundant discharge

95% water

It has a high content of nitrogen, phosphorus and potassium.



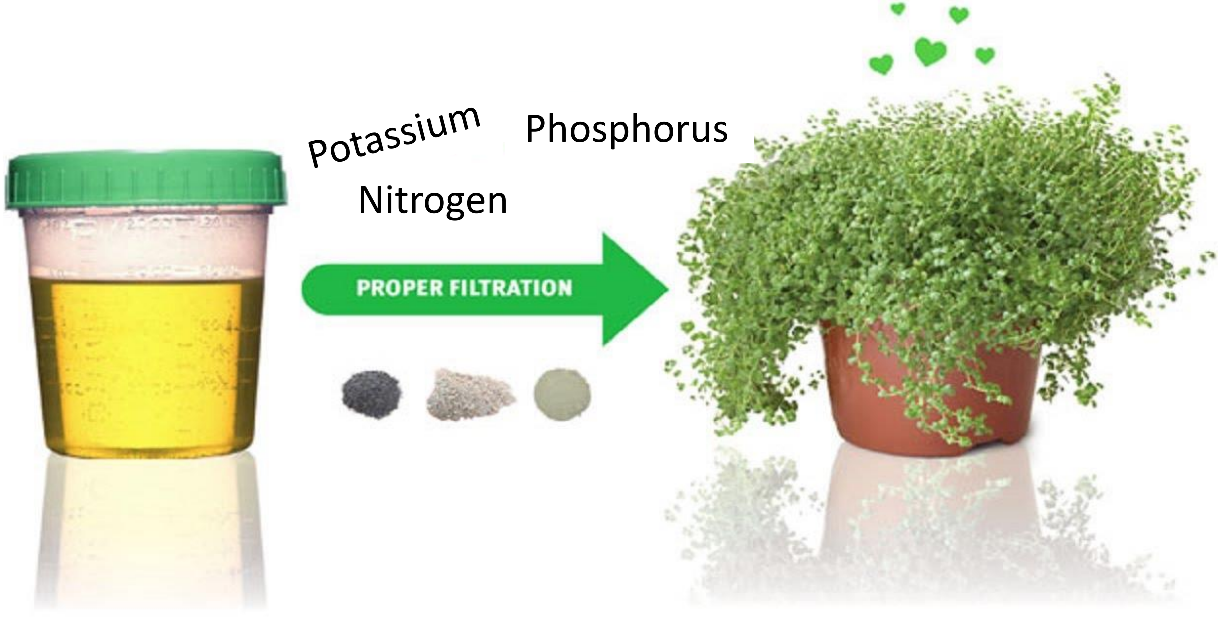
Urine production:
1.5 L/day
550 L/year

5% dissolved solids

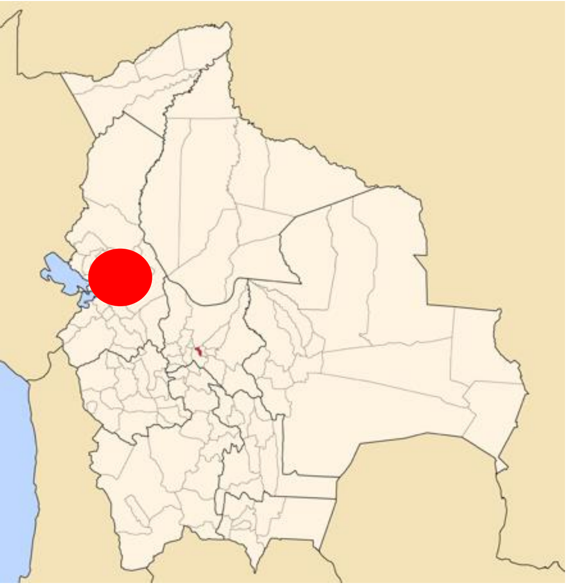
Dry fertilizer easy to market

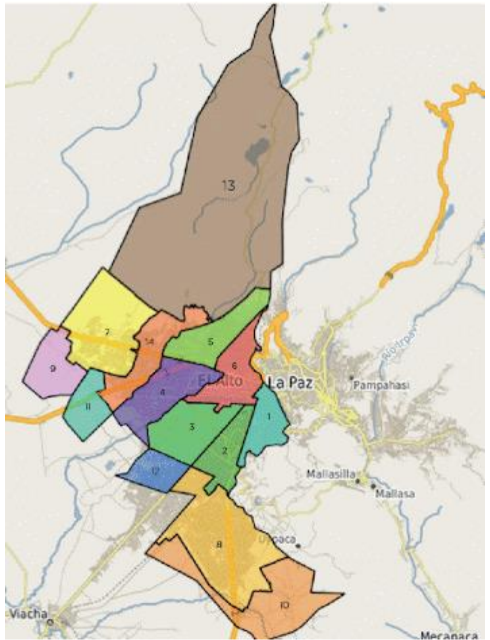
Urine can make a great plant fertilizer

Potassium
Phosphorus
Nitrogen



Location




El Alto
La Paz
Pampahasi
Mallasilla
Mallasa
Viacha
Mecapaca


Fotografia.
Daniel Condori

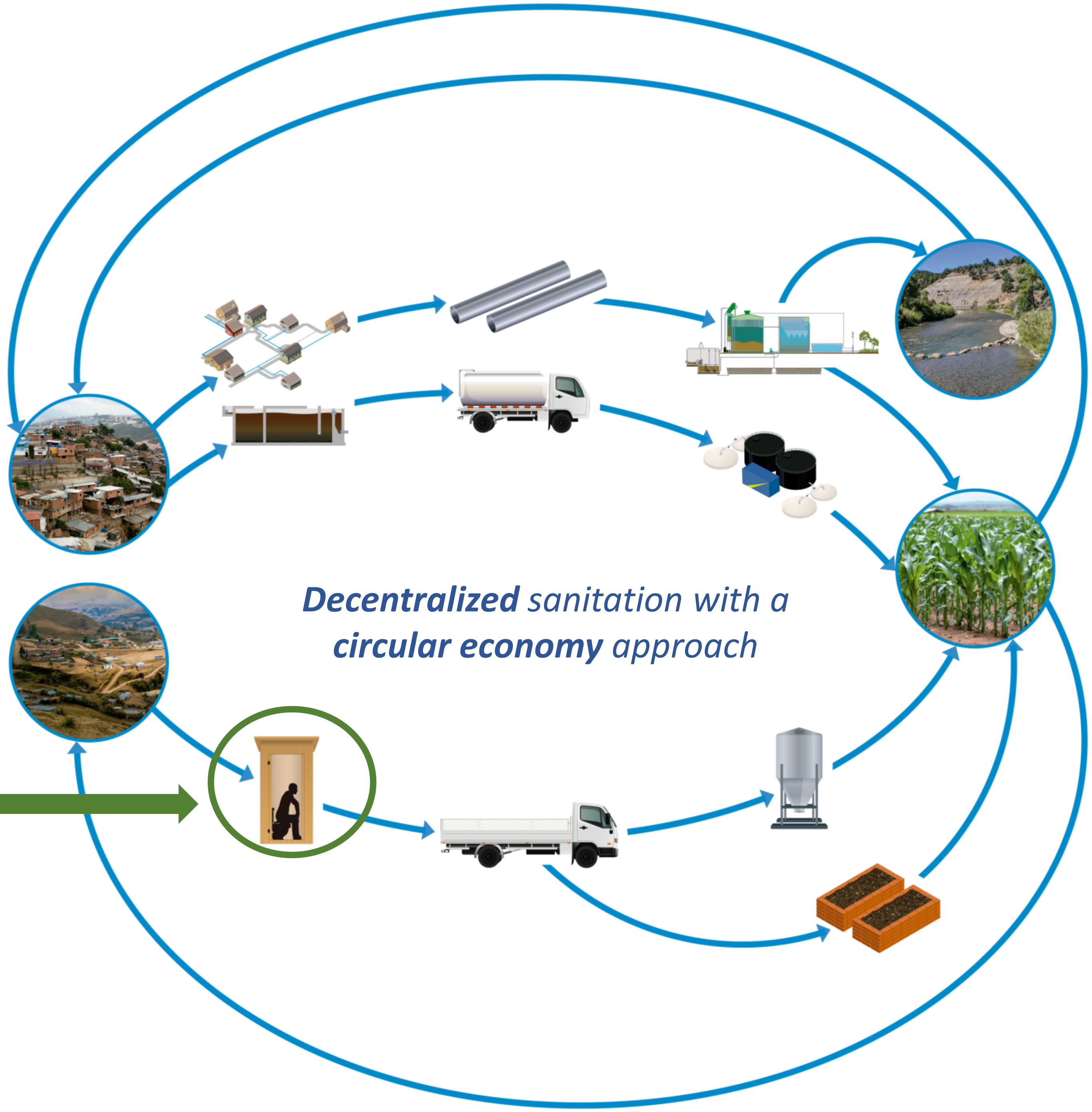
Background

Model

Suecia
Sverige

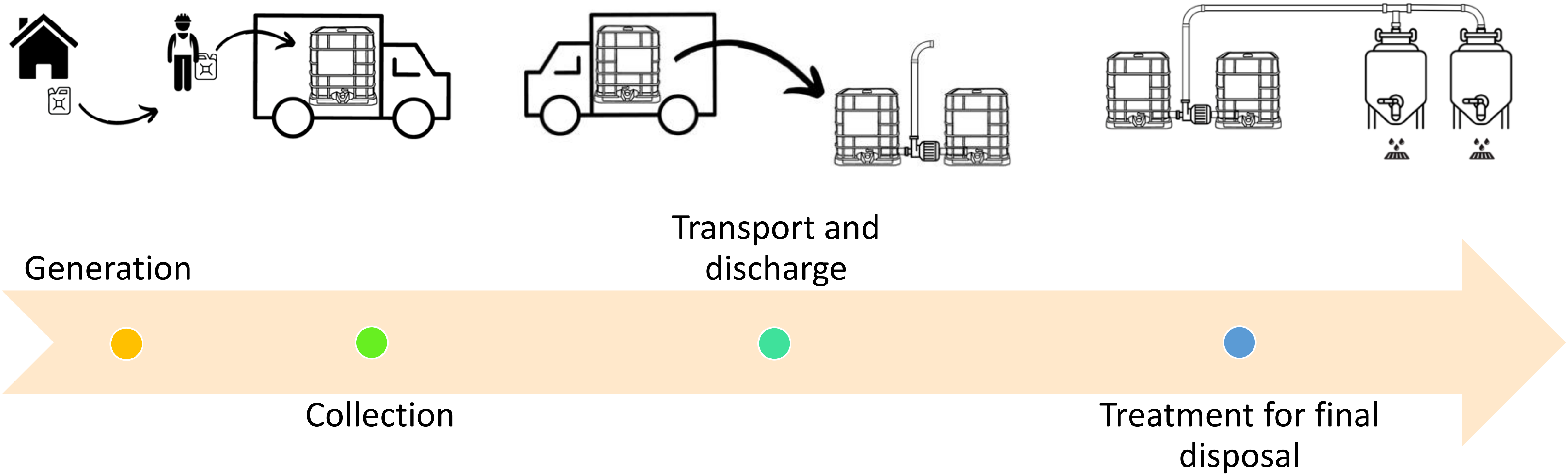
AGUATUYA
Ingeniería + Gestión

EPSAS
Empresa Pública Social de Agua y Saneamiento



Insite solutions
Ecological Sanitation

Sanitation service chain

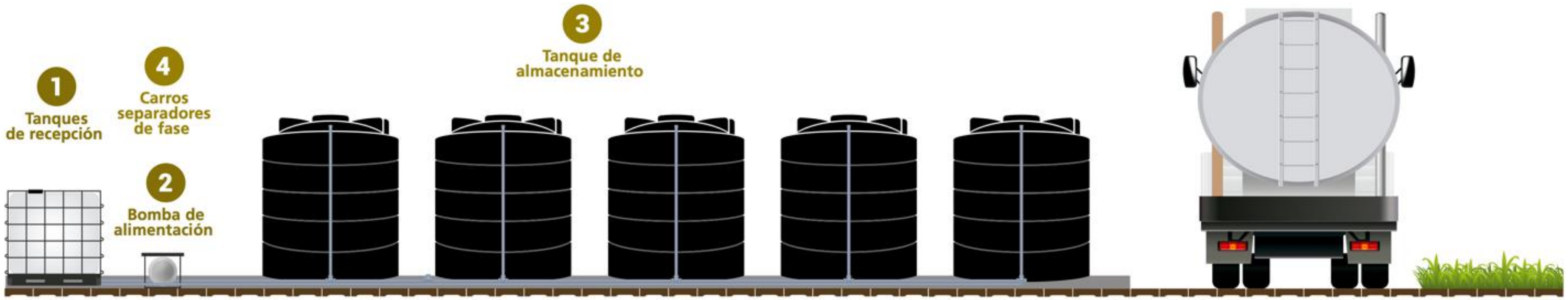


Option 1: Treatment by FERMENTATION

EPSAS
Empresa Pública Social de Agua y Saneamiento

PLANTA DE TRATAMIENTO DE ORINA
La Paz - El Alto

Guía de Operación y Mantenimiento

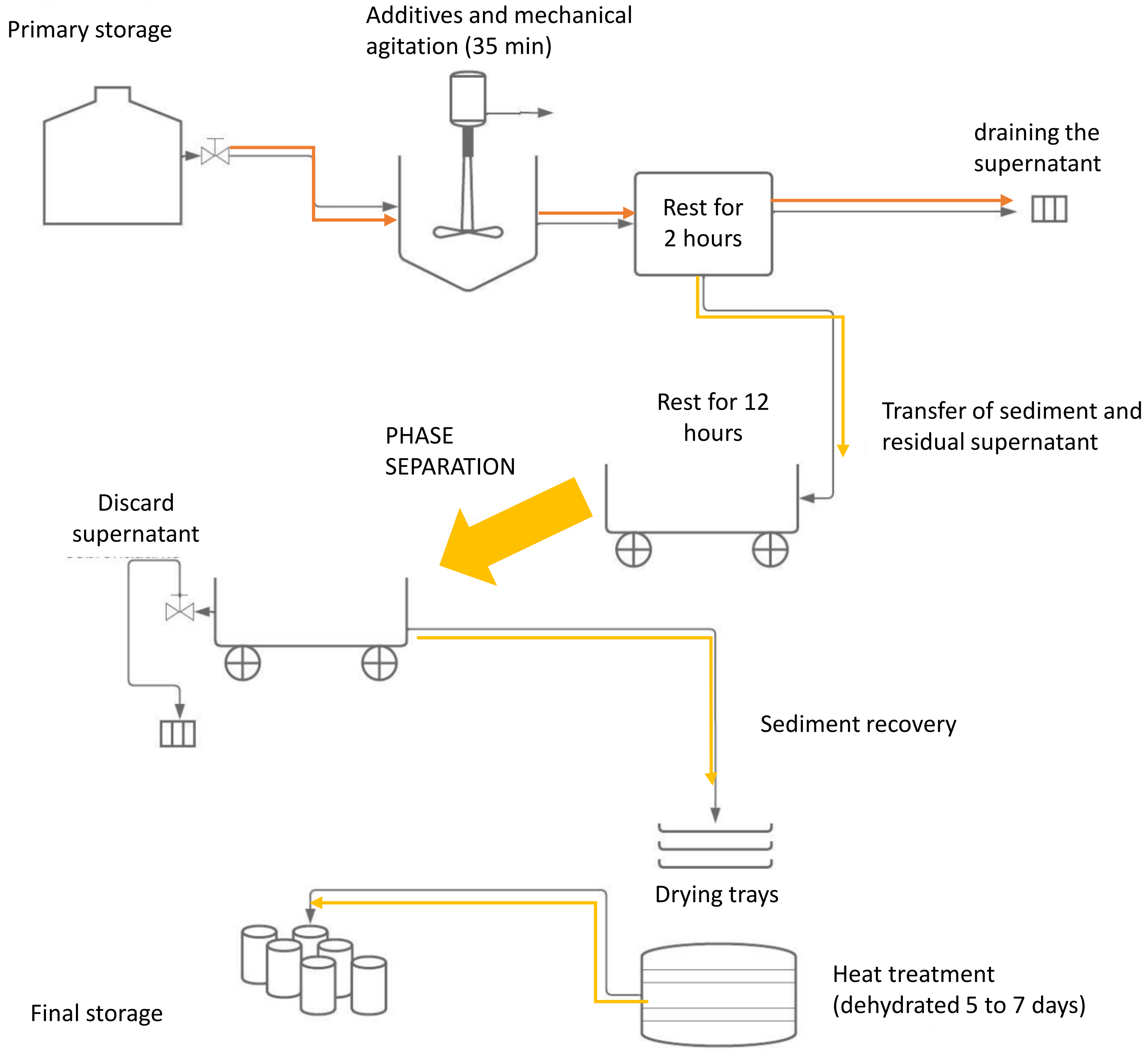


Tratamiento		Disposición final
1 **Tanque de recepción:** Recepción de la orina que llega en bidones de 20 l.	Verificación visual del nivel de orina. Limpieza cada **6 MESES**.	
2 **Bomba de alimentación:** Bombeo de orina desde tanque de recepción hacia tanques de almacenamiento.	De encendido manual, desde tablero. El operador debe verificar el volumen de orina en el tanque de recepción.	
3 **Tanque de almacenamiento :** Fermentación e higienización de la orina.	Almacenamiento durante **3 MESES.** Limpieza **ANUAL.**	
4 **Bomba de descarga:** Bombeo de la orina desde tanques de almacenamiento hacia disposición final.	Verificación visual del nivel de orina en tanques de almacenamiento.	Orina fermentada a reúso.

Suecia Sverige

AGUATUYA Ingeniería + Gestión

Flow chart Urine plant

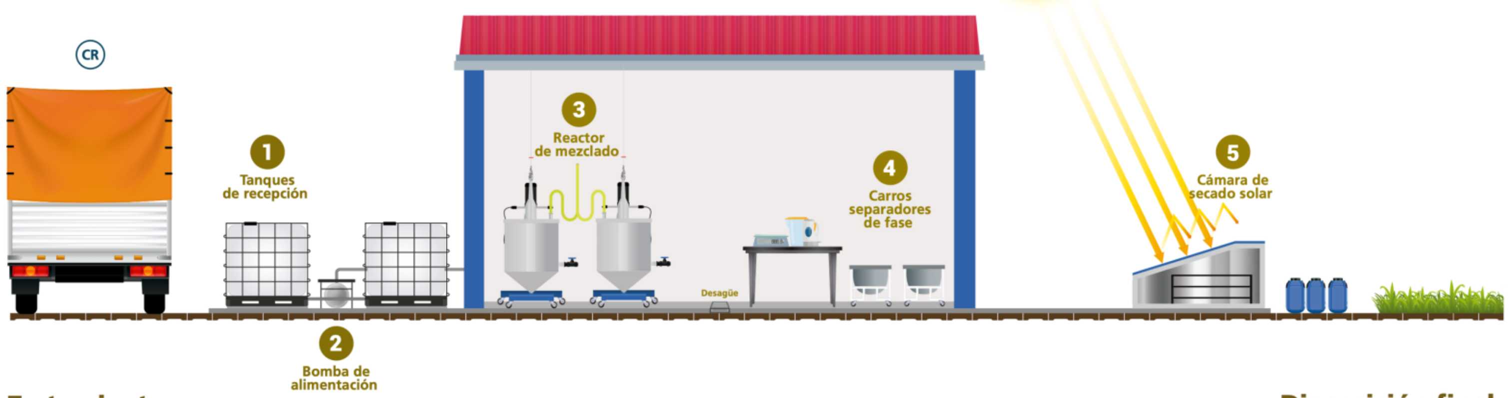


Option 1: Treatment by ADSORPTION

EPSAS
Empresa Pública Social de Agua y Saneamiento

PLANTA DE TRATAMIENTO DE ORINA
La Paz - El Alto

Guía de Operación y Mantenimiento



Tratamiento		Disposición final
1 **Tanques de recepción:** Recepción de la orina que llega en bidones de 20 l. Almacenamiento temporal de la orina, durante 2 semanas para su fermentación previa a su procesamiento.	Verificación visual del nivel de orina. Limpieza cada **6 MESES**.	
2 **Bomba de alimentación:** Bombeo de orina desde tanques de recepción hacia reactores de mezclado.	De encendido manual, desde tablero. El operador debe verificar le volumen de orina haciendo uso del nivel instalado en los reactores. Mantenimiento preventivo cada **6 MESES**.	
3 **Reactor de mezclado:** Mezcla de la orina con los aditivos (bentonita y óxido de magnesio), para precipitar estruvita.	Encendido del equipo mezclador durante **30 MIN**. Limpieza **DIARIA**.	
Separación previa de la fracción sólida y la fracción líquida.	Reposo por **2 HORAS**. (La fracción líquida es vertida al canal de desagüe y la fracción sólida pasa a los carros de separación de fases). Mantenimiento preventivo cada **6 MESES**, Limpieza **DIARIA**.	Fracción líquida a canal de desagüe.
4 **Carros separadores de fase:** Separación de la fracción sólida y la fracción líquida.	Reposo por **20 HORAS**. (La fracción líquida es vertida al canal de desagüe y la fracción sólida es vertida en las bandejas de secado).	Fracción líquida a canal de desagüe.
5 **Cámara de secado solar:** Secado completo de la fracción sólida para su envasado final y reúso.	Disposición de bandejas en cámara de secado solar durante **2 SEMANAS**.	Envase de producto final y reúso.

Suecia Sverige

AGUATUYA Ingeniería ✦ Gestión

Characteristics of the product obtained

Monitoreo 2023						
Parameter	Unit	August	September	October	Average not recovered	Percentage recovered
Total phosphorus	%	15	2	11	9	91
Total potassium	%	111	96	100	102	-2
Total nitrogen	%	93	69	107	90	10

Relationship **N-P-K = 9-4-1**

Cost of fertilizer production

First 6 months of operation				
Item	Description	Cost [$us]	Number	Cost [$us/year]
1	Energy consumption	7.14	12	85.71
2	Operator	89.28	13	1160.71
3	Inputs (MgO2 and Bentonite)	285.42	1	285.42
4	Minor tools and other inputs	71.42	1	71.42
5	Safety clothing and PPE	214.28	1	214.28

- The plant's capacity is 60,000 liters per year.
- The production cost was **3 [$us/kg]** of dry product (fertilizer).
- The market offers fertilizers from 0.50 to 3.00 [$us/Kg]
- Beneficiaries pay for collection service: 5 - 15 [Bs/month/family]

Conclusions

Sustainability of basic services:

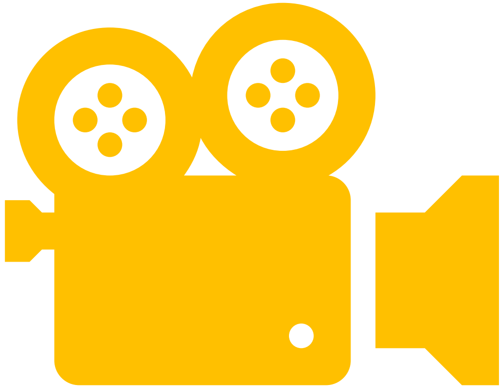
- Leaving no one behind
- Solutions tailored to needs and realities

Closing the loop

Cost-efficiency in the dependence on non-renewable fertilizers

Positive environmental impact:

- Prevents eutrophication of water bodies
- Reduces the carbon footprint (transfer of fertilizers)



Video 1 min

EPSAS, La Paz, a Green Company in action:

https://youtu.be/KiHZs2UhMiQ

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Tools for implementing rural RRR – insights from "Clean and Green Village" piloting in Burkina Faso

SEI Stockholm Environment Institute

Linus Dagerskog, Research Fellow

2024-08-24

Rural productive sanitation relevance

> 600 million family farms worldwide, 95% < 5 ha
(www.fao.org/family-farming-engagement/en)

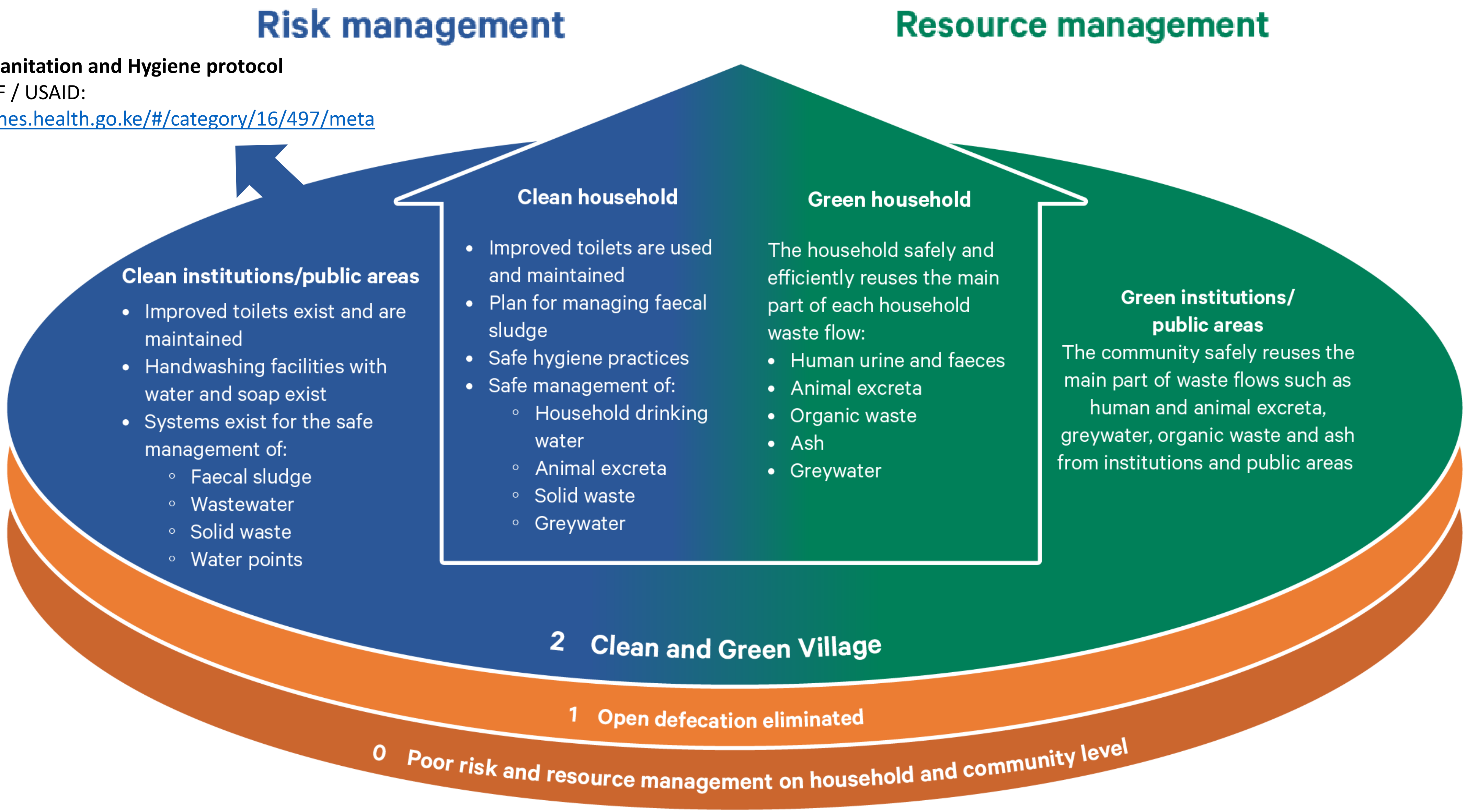
For SSA:

- 60% rural pop (FAO stat 2022)
- 22% undernourished (FAO stat 2022)
- 20% access to safely managed sanitation and 17% basic hygiene services (JMP 2022)

Human excreta contains nutrients to grow ~100 kg extra grain/person/yr
→ Capacity and choice to manage excreta and other local wastes safely and productively

The Clean and Green productive sanitation framework

Kenya Rural Sanitation and Hygiene protocol
MoH / UNICEF / USAID:
http://guidelines.health.go.ke/#/category/16/497/meta



The Clean and Green framework: from theory -> action in Burkina Faso

Step 1. Baseline study

Step 2. End open defecation using CLTS
(achieved beginning of 2022)

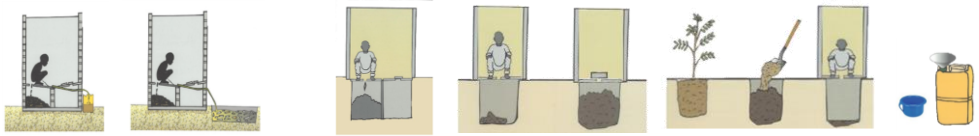
Step 3. Triggering event on ”waste resources”

Quantity and economic value of ”human fertilizer”

Step 4. Sensitization and training on managing local risks and resources

Step 5. Different options (technologies and practices) to protect health and increase safe reuse

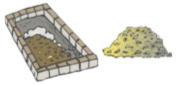
Urine and faeces options



Greywater

Livestock urine

Organic waste and ash



Step 6-8

The Clean and Green framework: from theory -> action

WaterAid eau vive Internationale SEI Suède Sverige

6. Farmer Fields Schools led by Agro-Action (NGO in Burkina Faso)

Soil/water conservation

Safe use of treated urine and feces

The Clean and Green framework: from theory -> action

Monitoring and certification – still to be tested IRL:

Step 7. Monitoring of progress

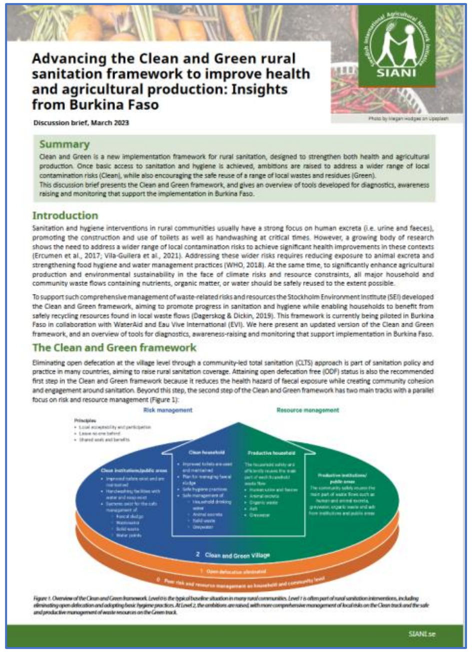
CLEAN				
1. Toilet use/sludge management	(9 indicators)			
2. Solid waste	(6 indicators)			
3. Animal excreta	(6 indicators)			
4. Greywater	(1 indicator)			
5. Drinking water	(5 indicators)			
6. Handwashing	(5 indicators)			
7. Food hygiene	(4 indicators)			
Summary				

GREEN				
1. Animal faeces	(5 indicators)			
2. Animal urine	(3 indicators)			
3. Human urine	(6 indicators)			
4. Human faeces	(6 indicators)			
5. Other organic waste	(3 indicators)			
6. Wood ash	(2 indicators)			
7. Greywater	(2 indicators)			
Summary				

Step 8. Recognition/certification for achieving Clean and Green status

Reports available on the Clean and Green project website

https://www.sei.org/projects/clean-and-green/#highlights



Clean and Green overview - *English*

Clean and Green overview - *Spanish* (Bolivia focus)

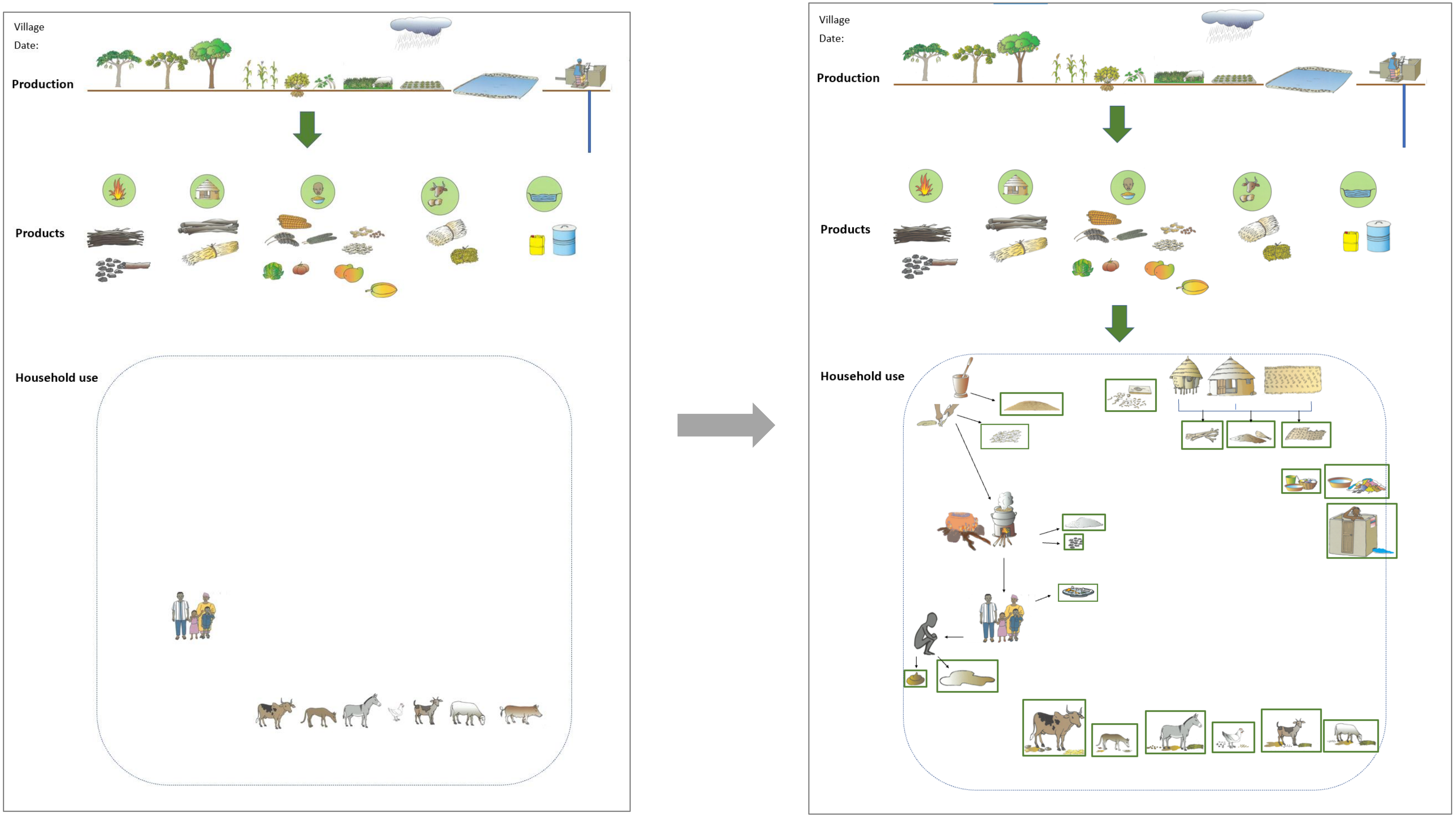
Clean and Green overview - *French* (Burkina Faso focus)

Resource flow mapping tool - *French*

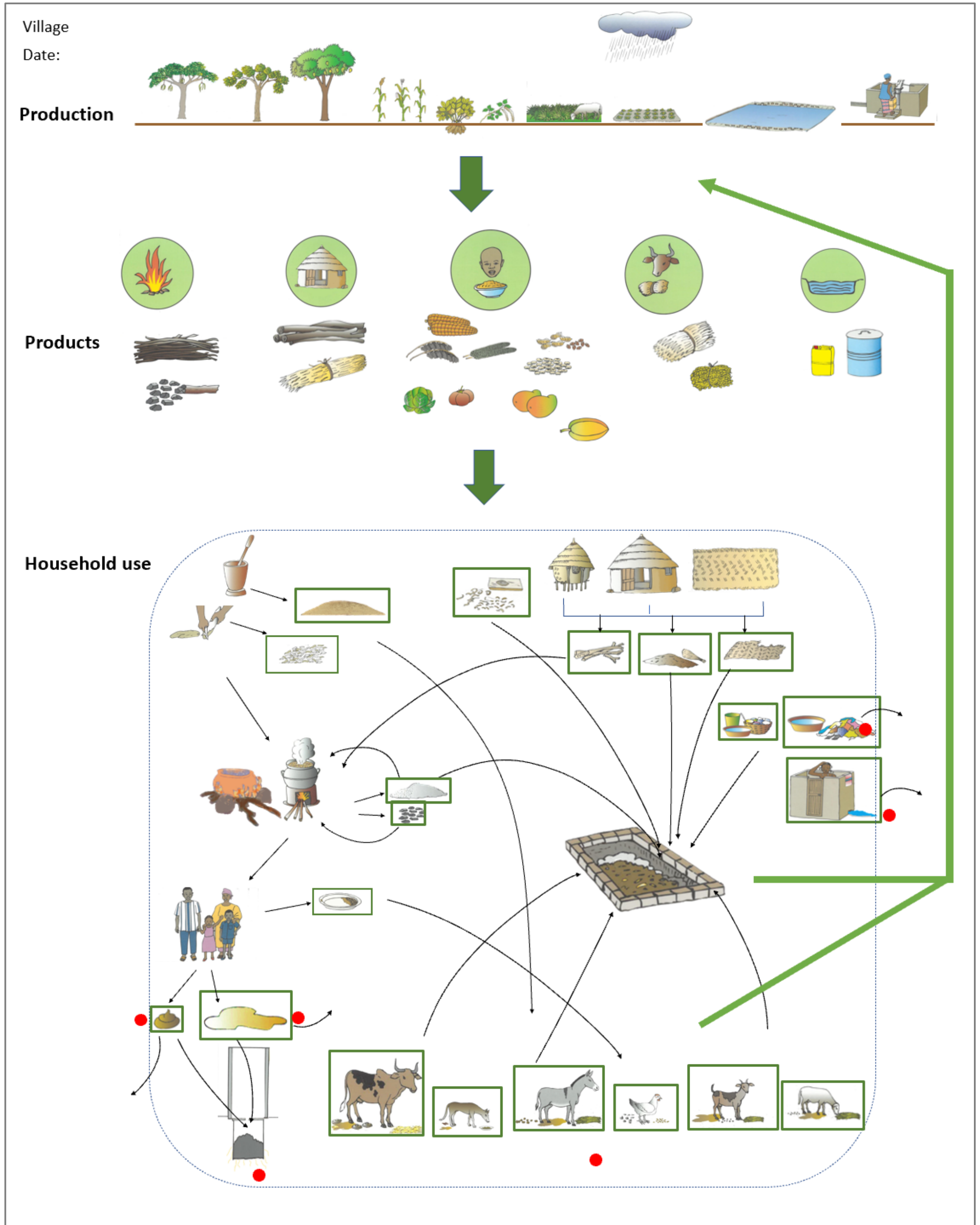
Monitoring framework - *French*

1. Resource flow mapping

- Diagnostic (focus group)
- Sensitization (focus or household) -> raise awareness on local agri-sanitation cycle and spark interest for improvement



Village
Date:
Production
Products
Household use
Village
Date:
Production
Products
Household use



Resource flow mapping outcomes

- Red dots mark non-reused waste = potential areas of improvement

→ **Discussions**

- Barriers for a better recovery and reuse of these waste resources?
- Existing solutions - traditional?
- Perception of different alternative solutions proposed

2. Green track monitoring (resource recovery and reuse)

GREEN	☺	😐	☹
1. Animal faeces (5 indicators)			
2. Animal urine (3 indicators)			
3. Human urine (6 indicators)			
4. Human faeces (6 indicators)			
5. Other organic waste (3 indicators)			
6. Wood ash (2 indicators)			
7. Greywater (2 indicators)			
Summary			

- **Quantity**: Collect the majority of each waste generated (targeting > 75%);
- **Safety**: Knowledge acquired and measures in place to reduce health risks.
- **Efficiency**: Knowledge acquired and measures in place to reduce nutrient losses and over fertilization

Example: Human urine

1	Q	Existence of urine collection device	Y	N
2	Q	Quantity collected > 10 l per person per month	Y	N
3	S	Latrines/urinals are clean	Y	N
4	S	Knowledge of safety measures for handling urine	Y	N
5	E	Knowledge on how to minimize nitrogen losses	Y	N
6	E	Knowledge of methods and doses of applying urine	Y	N

Perspectives

- Monitoring framework validation and application IRL → Clean and Green certification of households/villages
- Pursue activities in the pilot villages → impact evaluation
- Adapt framework and tools to other settings

Video presented during World Water Day 2023 at FAO event: https://www.youtube.com/watch?v=ncXabxRCH6A&t=3049s

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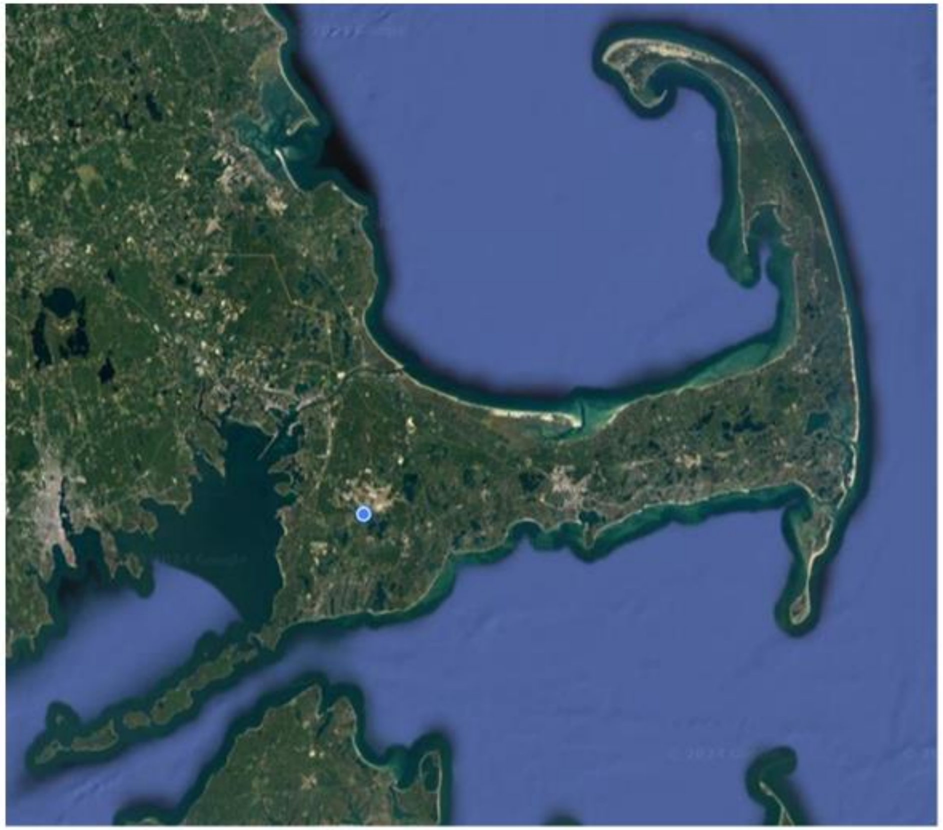


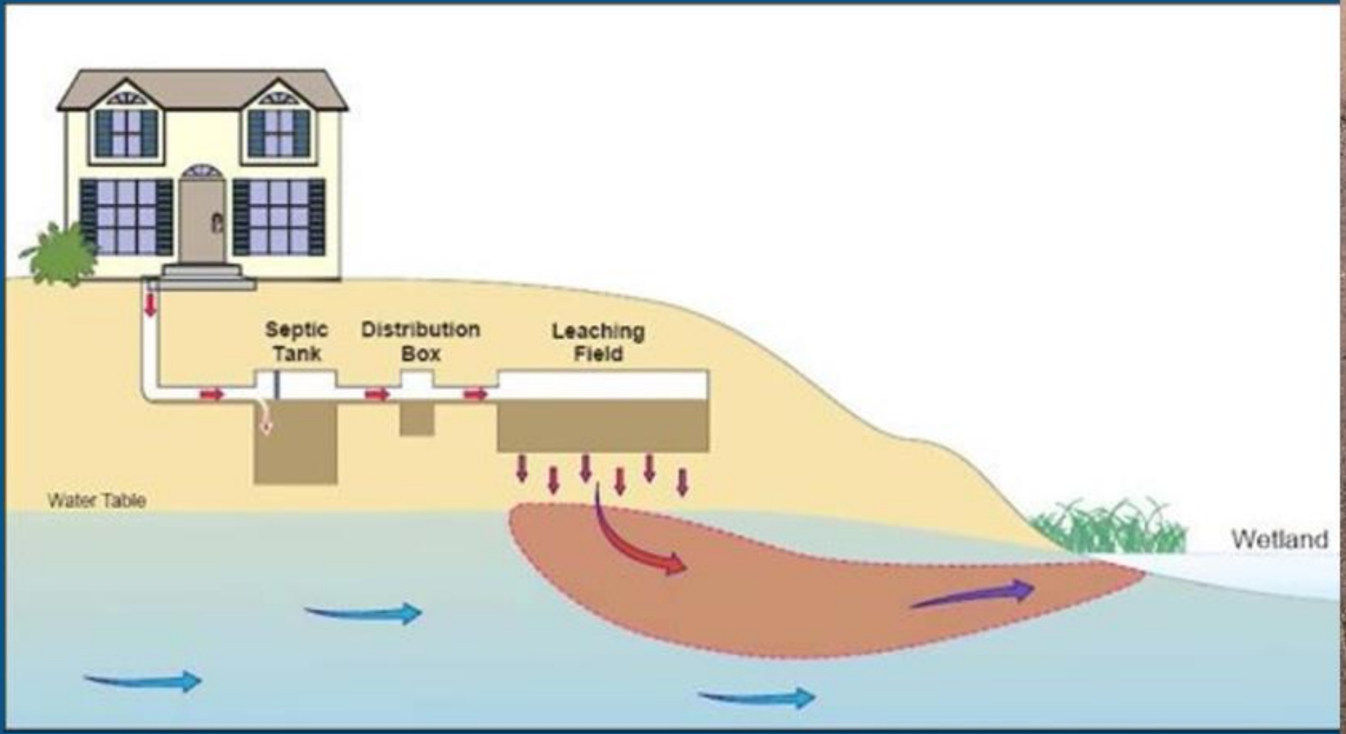
Considering Urine Diversion for Nutrient Pollution Control on Cape Cod, Massachusetts, USA

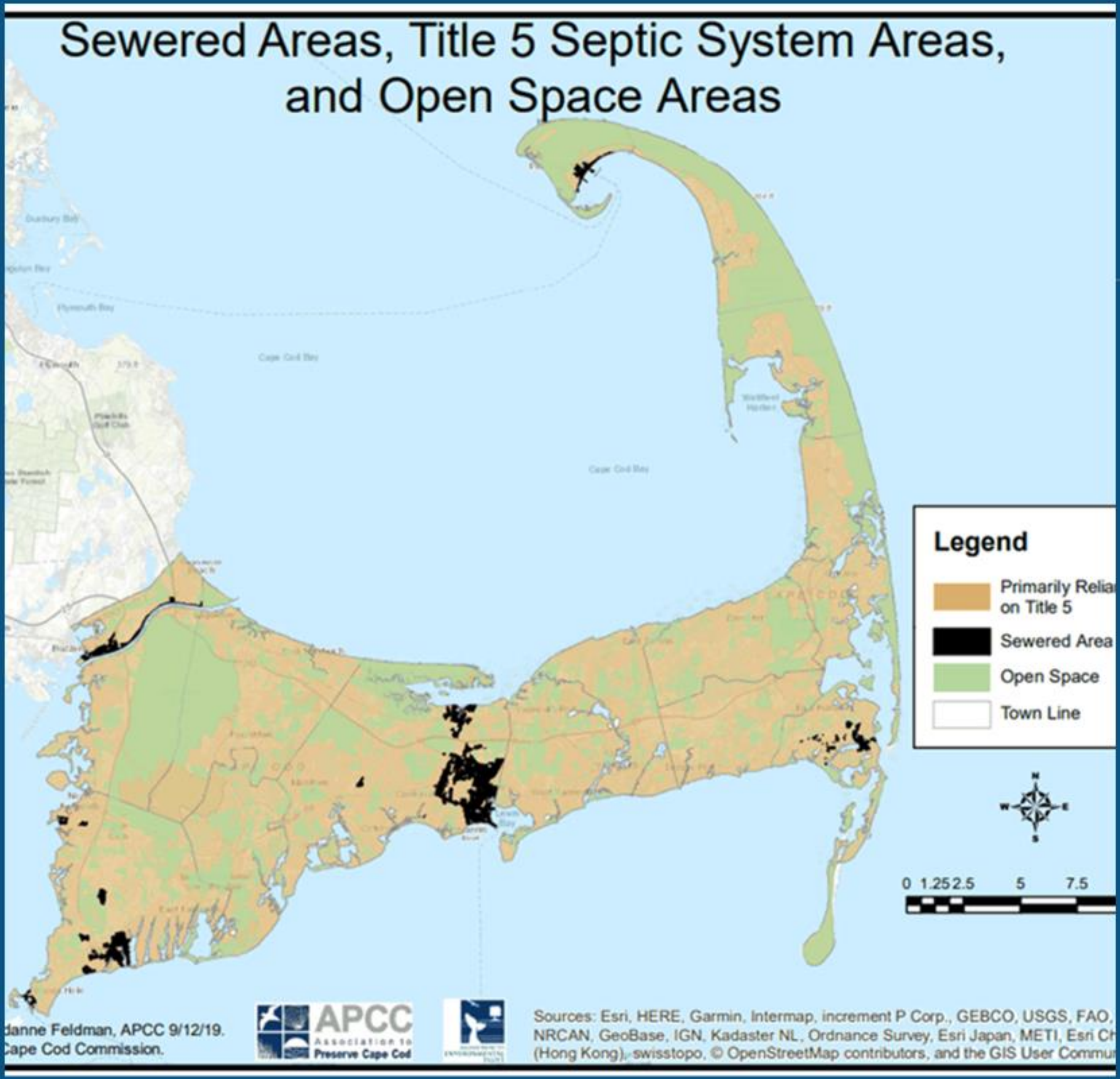
BRYAN HORSLEY

MASSACHUSETTS ALTERNATIVE SEPTIC SYSTEM TECHNOLOGY CENTER

BARNSTABLE COUNTY DEPARTMENT OF HEALTH AND ENVIRONMENT

Nutrient pollution





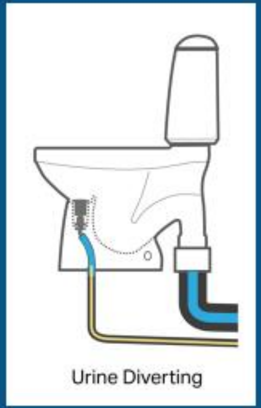
85% reliant on on-site septic systems

2023 Green Center UD pilot project

- 41 households (~60 people)
- 2-month collection period
- Used portable collection containers “cubies”
- Measured volume and analyzed nutrients collected
- Collected total of 1,003 gallons (avg. 29 gallons per household)
- Total nitrogen collected 30.2 kg (0.74 kg/household)
- Total phosphorus collected 2.0 kg (0.05 kg/household)
- Nitrogen removal rate of 4.41 kg-N/year per home!

Town of Falmouth UD pilot project

- Regulatory approvals needed
- MassDEP – performance evaluation
- State Plumbing Board – fixtures and collection systems
- Social acceptance?



Thank you!

bryan.horsley@capecod.gov

www.MASSTC.org

TIME FOR
Q&A

sustainable
sanitation
alliance