UNIVERSITY OF KWAZULU-NATAL ™

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Economic evaluation of using human excreta and urine derived materials as agricultural fertilizers

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Presentation outline

- Introduction
- Problem statement
- Research objectives
- Empirical methods
- Results and discussion
- Conclusions and recommendations
- Directions of future research

Introduction

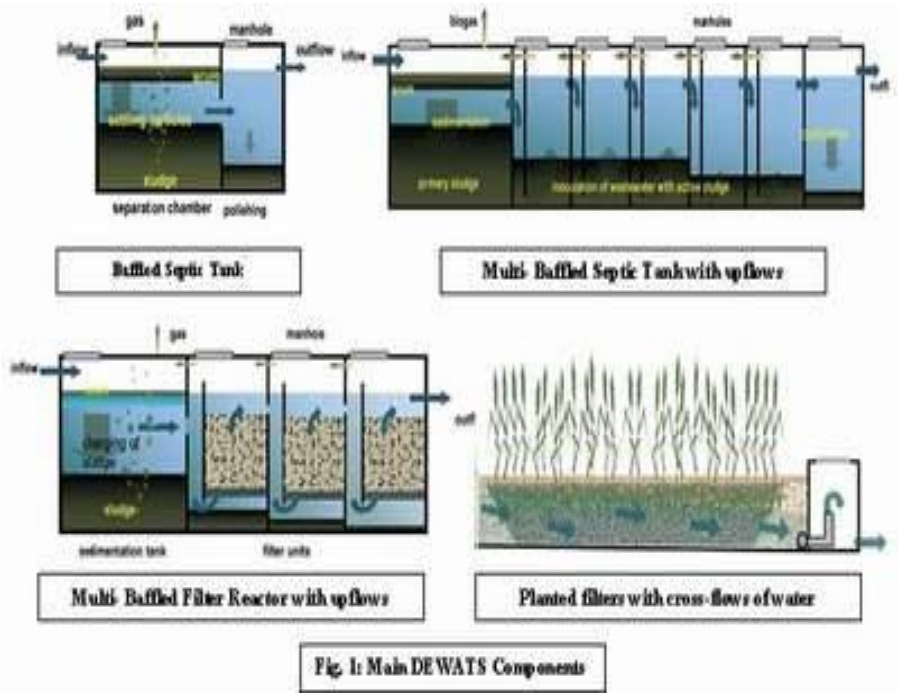
- Sanitation provision challenge in urban municipalities
  - increasing urban population
- Waterborne sewer systems
  - Centralized
- High costs of proper sanitation provision
- Special chemicals and power required
  - nitrogen and phosphorus present in the effluent

Problem statement

- Sanitation provision
  - High expenses
- Waste disposal
  - sustainable waste disposal
    - using waste as inputs in agriculture

Alternatives

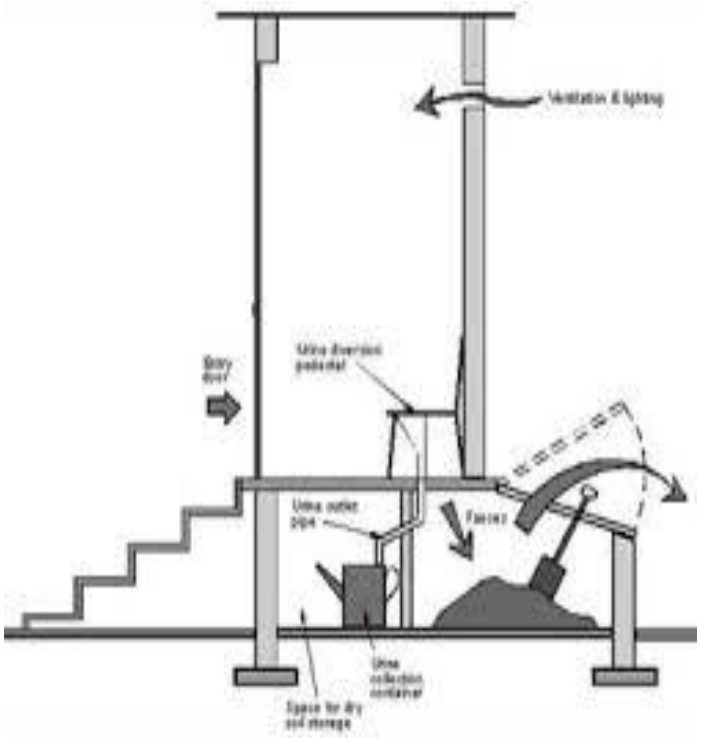
- Decentralized sanitation systems
  - DEWATS



Alternatives cont....

Dry (waterless) systems

VIP toilets (sludge)



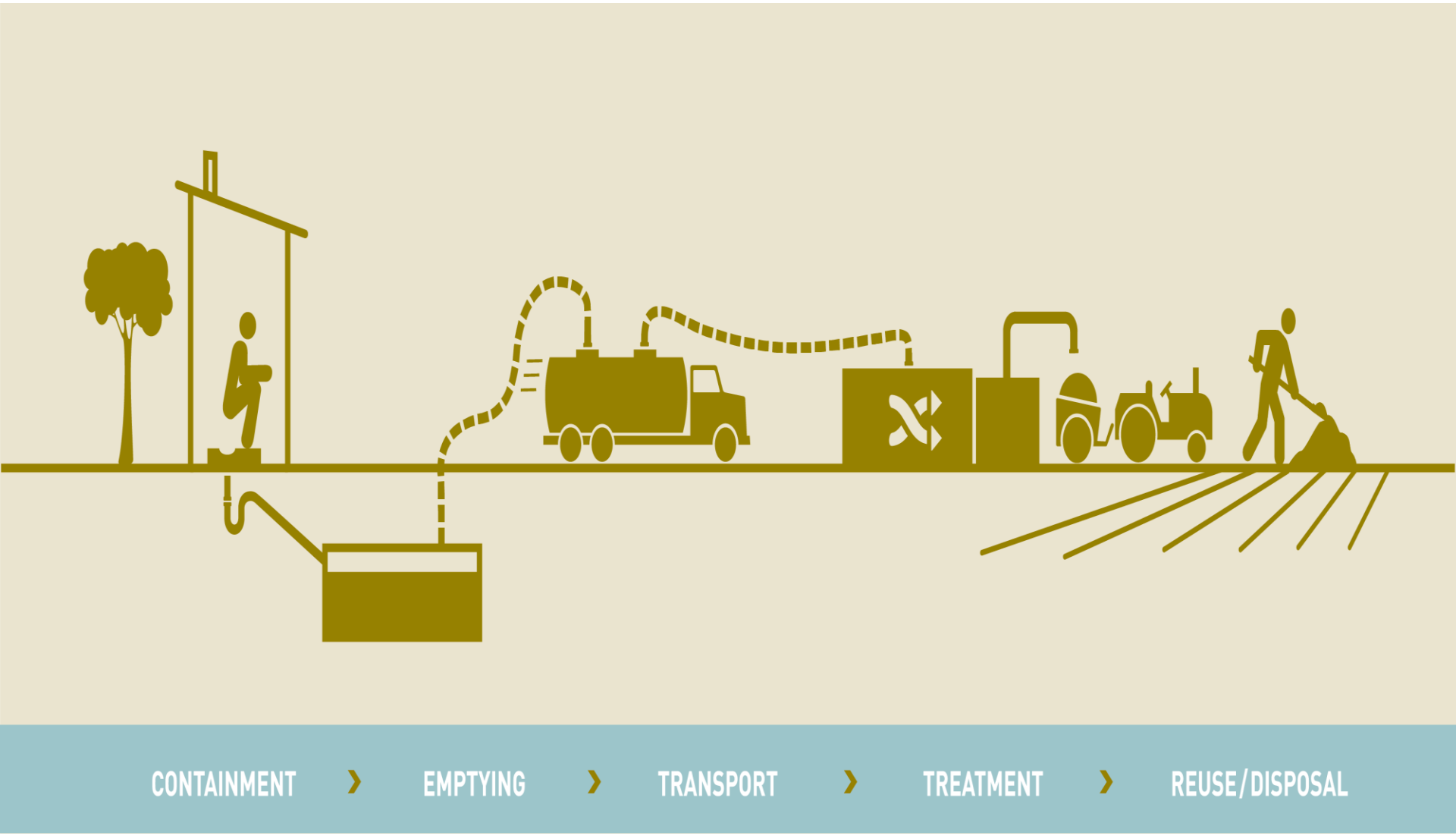
UDDT (urine)

Dry systems

- Waste disposal remains a problem

- Opportunity
  - converting the waste into usable waste products
    - agricultural inputs (fertilisers)
    - fertiliser use in South Africa and SSA
    - global phosphorus crisis
  - sustainable environmental management

Converting waste into wealth

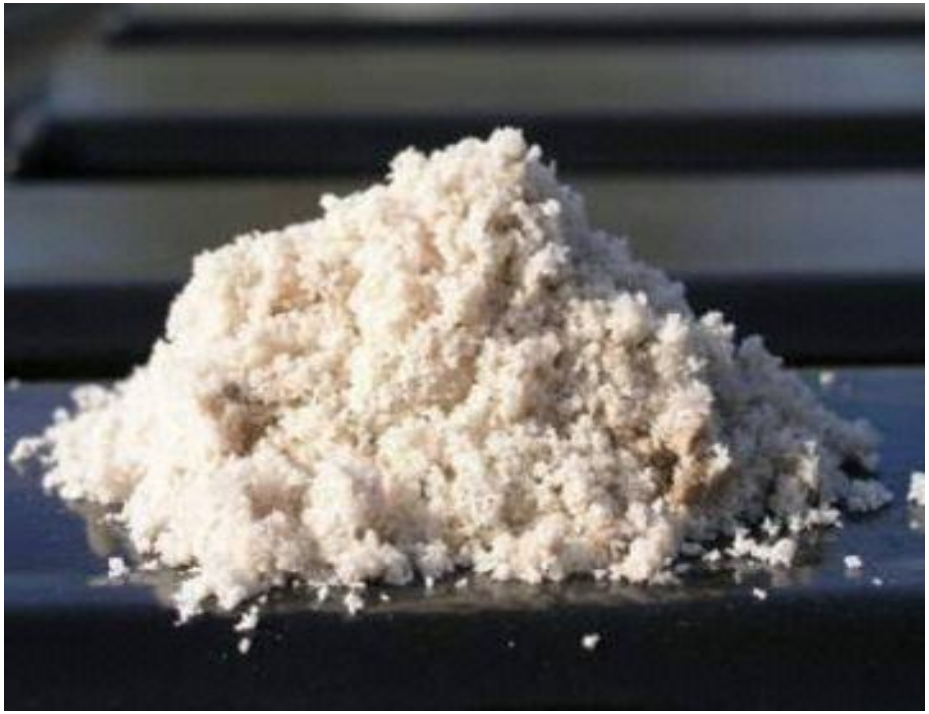


Current Initiatives

- LaDePa from VIP latrines faecal sludge
- Struvite from urine collected from UDDTs
  - Both contain the basic N,P,K

LaDePa (organic)

Struvite (inorganic)



LaDePa and Struvite

- Undergo full treatment
- LaDePa
  - nitrogen source (3%N); soil amendment
- Struvite
  - phosphorus source (12% P)
- Can replace commercial fertilisers
  - readily available low cost fertilisers
  - potential yields increase
  - increasing food security
  - reduced fertiliser imports

Objectives

- Assessing the financial viability of using LaDePa and struvite for crop production

- Specific objectives
  - determining the quantities of LaDePa, Struvite and other selected commercial fertilisers to be applied on a per hectare basis
    - meeting the nutrient requirements of maize, wheat and sugarcane,
  - analysing the cost-effectiveness of replacing the least cost commercial organic and inorganic plant nutrient sources with LaDePa and Struvite.

Fertiliser value

- Can be quantified
  - yield produced
  - WTP
  - costs saved from replacing commercial fertilisers with them
- Economic value of the fertilisers was assessed
  - quantitative, empirical study

Empirical methods

- Costs of using each of the fertilizers per hectare
  - LaDePa, Struvite and other commercial fertilisers
  - maize, wheat and sugarcane
  - producing a fixed yield under the same conditions

- Least cost commercial organic and inorganic
  - vs. LaDePa and struvite

Economic feasibility

- Financial Cost-Benefit analysis
  - partial budgets
  - the relative change in farm profitability as a result of a change in the input use

Reduced costs for not using		Additional costs of using			
The lowest cost Organic or Inorganic Fertiliser	Cost (R/ha)	**The plant nutrient sources LaDePa or Struvite**	Cost (R/ha)	**Income Change (R/ha)**	**Comment**
x	**b**	**y**	**d**	**b - d**	**Acceptable/Unacceptable**

Source: Adapted from SBSA (2005)

Empirical results

Plant Nutrient Source	Cost per unit area (R/ha)		
	Maize	Sugar Cane	Wheat
Gromor Accelerator (organic)	13 542.86	11 278.94	15 713.99
N:P:K_3:2:1 (25) (inorganic)	5 281.47	5 887.28	5 649.78
LaDePa (organic)	**5 998.31**	**6 242.82**	**6 317.58**
Struvite (inorganic)	**6 072.06**	**6 237.13**	**6 302.41**
Pure Fertilisers (inorganic)	5 977.14	6 235.12	6 298.90
N:P:K_2:3:2 (22) (inorganic)	5 444.06	6 018.49	5 894.63
MAP (inorganic)	4 921.96	5 707.55	5 314.05

Source: Author's compilation

The maize enterprise

Reduced Costs for not Using		Additional Costs of using		Income Change (R/ha)	Comment
Nutrient Source	Cost (R/ha)	Nutrient Source	Cost (R/ha)		
Gromor		LaDePa		7 544.55	Acceptable
	13 542.86		5 998.31		
Gromor		Struvite		7 500.80	Acceptable
	13 542.86		6 042.06		
MAP		LaDePa		(-) 1 076.35	Unacceptable
	4 921.96		5 998.31		
MAP		Struvite		(-) 1 120.10	Unacceptable
	4 921.96		6 042.06		

Source: Author's compilation

The sugarcane enterprise

Reduced Costs for not Using		Additional Costs of Using		Income Change (R/ha)	Comment
Nutrient Source	Cost (R/ha)	Nutrient Source	Cost (R/ha)		
Gromor	11 278.94	LaDePa	6 242.82	**5 036.12**	Unacceptable
Gromor	11 278.94	Struvite	6 237.13	**5 041.81**	Acceptable
MAP	5 707.55	LaDePa	6 282.42	**(-) 535.27**	Unacceptable
MAP	5 707.55	Struvite	6 237.13	**(-) 539.58**	Unacceptable

Source: Author's compilation

The wheat enterprise

Reduced costs for not using		Additional costs of using		Income Change (R/ha)	Comment
Nutrient Source	Cost (R/ha)	Nutrient Source	Cost (R/ha)		
Gromor	15 713.99	LaDePa	6 317.58	**9 396.41**	Acceptable
Gromor	15 713.99	Struvite	6 302.41	**9 411.58**	Acceptable
MAP	5 314.05	LaDePa	6 317.58	**(-) 1 003.53**	Unacceptable
MAP	5 314.05	Struvite	6 302.41	**(-) 988.36**	Unacceptable

Source: Author's compilation

Discussion

- Both Struvite and LaDePa were cost competitive
  - Fertiliser cost per hectare was un the range of other commercial fertilisers
  - can replace any other fertilisers except MAP
    - reduces production costs

- Struvite has a high P concentration

- LaDePa has a very low price

- Limitation
  - evaluation was done on experimental data,
    - the results of this study could differ from the actual field trials

Discussion cont....

- Maize pot experiment using Catref soil
  - LaDePa and Struvite produced high yields than most commercial fertilisers
  - They also had the highest income per hectare after accounting for the fertiliser costs

- Production costs for using LaDePa and struvite may decline with increasing farm size
  - economies of scale and size

Conclusions

- Both LaDePa and Struvite are economically viable
- Struvite can solve the phosphorus challenge
- LaDePa can be used as a soil amendment
- Dry sanitation cheap solution

Recommendations

- Product market success
  - the organic fertilizer and marketing policy framework
  - infrastructural development
  - market information on demand
  - cost competitiveness
  - product branding
- Good opportunity for scaling
  - replicating the number of treatment reactors
  - social acceptance
- Business opportunity
  - job creation
- Reduced public service and environmental costs

Directions for future research

- Valuing the environmental benefits of using LaDePa and struvite
- Also value the environmental costs from chemical use in agriculture
- Development of concentrated products
- Creation of other products
  - incinerated ash, bio oil from faecal sludge
  - NCU (21%N)
  - recycled/reclaimed water
  - power generation (urinetricity)
- Sensitivity analysis on cost and benefit outcomes

Acknowledgements

- UKZN PRG
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- UKZN

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Thank you

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