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Analysing the cost-effectiveness of using 'LaDePa' agricultural pellets and struvite as new fertilizers: Experimental evidence for maize, wheat and sugarcane in KZN, S.A.

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Presentation outline

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

Introduction

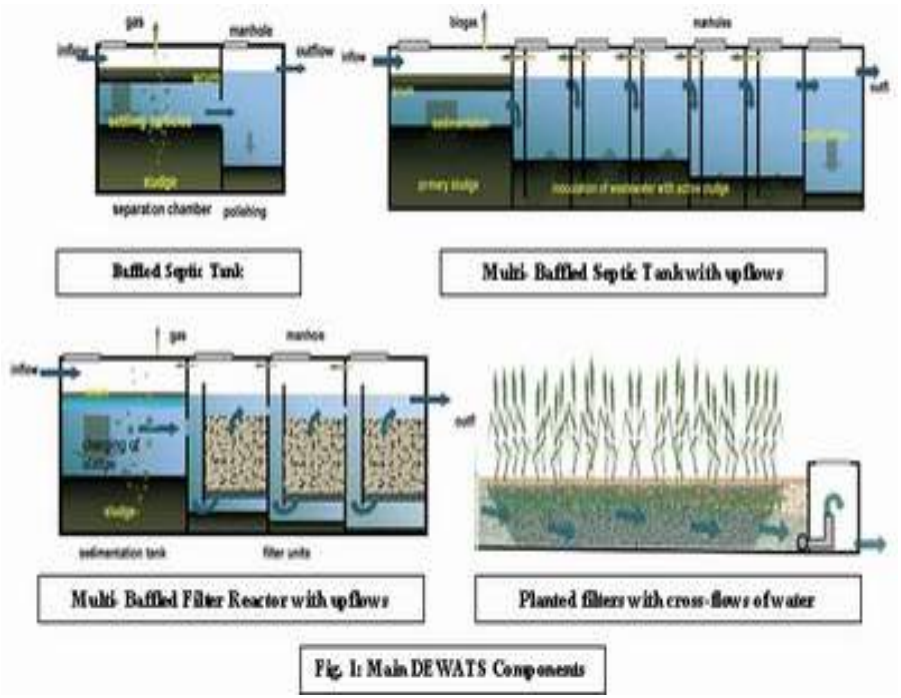
- Sanitation provision challenge in urban municipalities
  - increasing urban population
- Waterborne sewer systems
  - Centralized
- High costs of proper sanitation provision
- Special chemicals and power required
  - nitrogen and phosphorus present in the effluent

Problem statement

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

Alternatives

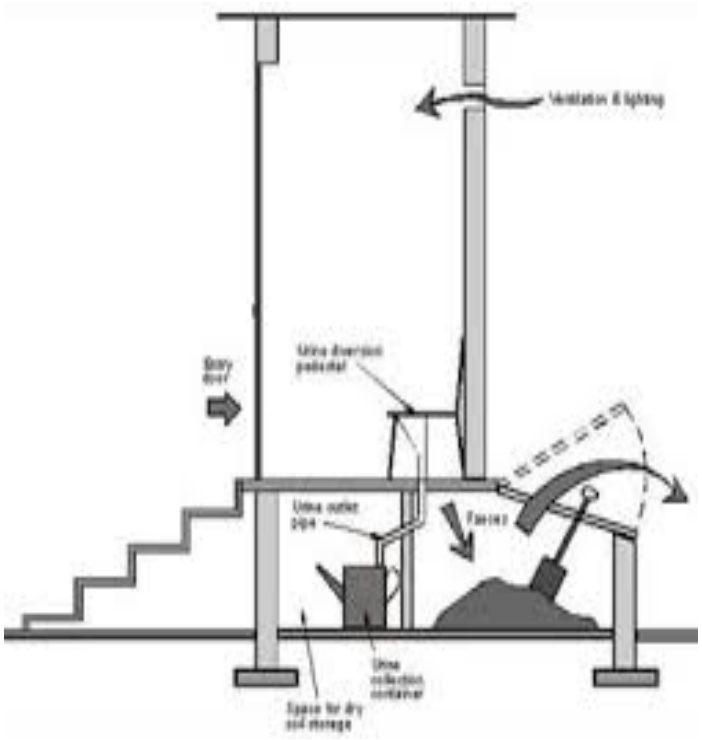
- Decentralized sanitation systems
  - DEWATS



Alternatives cont....

Dry (waterless) systems

VIP toilets (sludge)



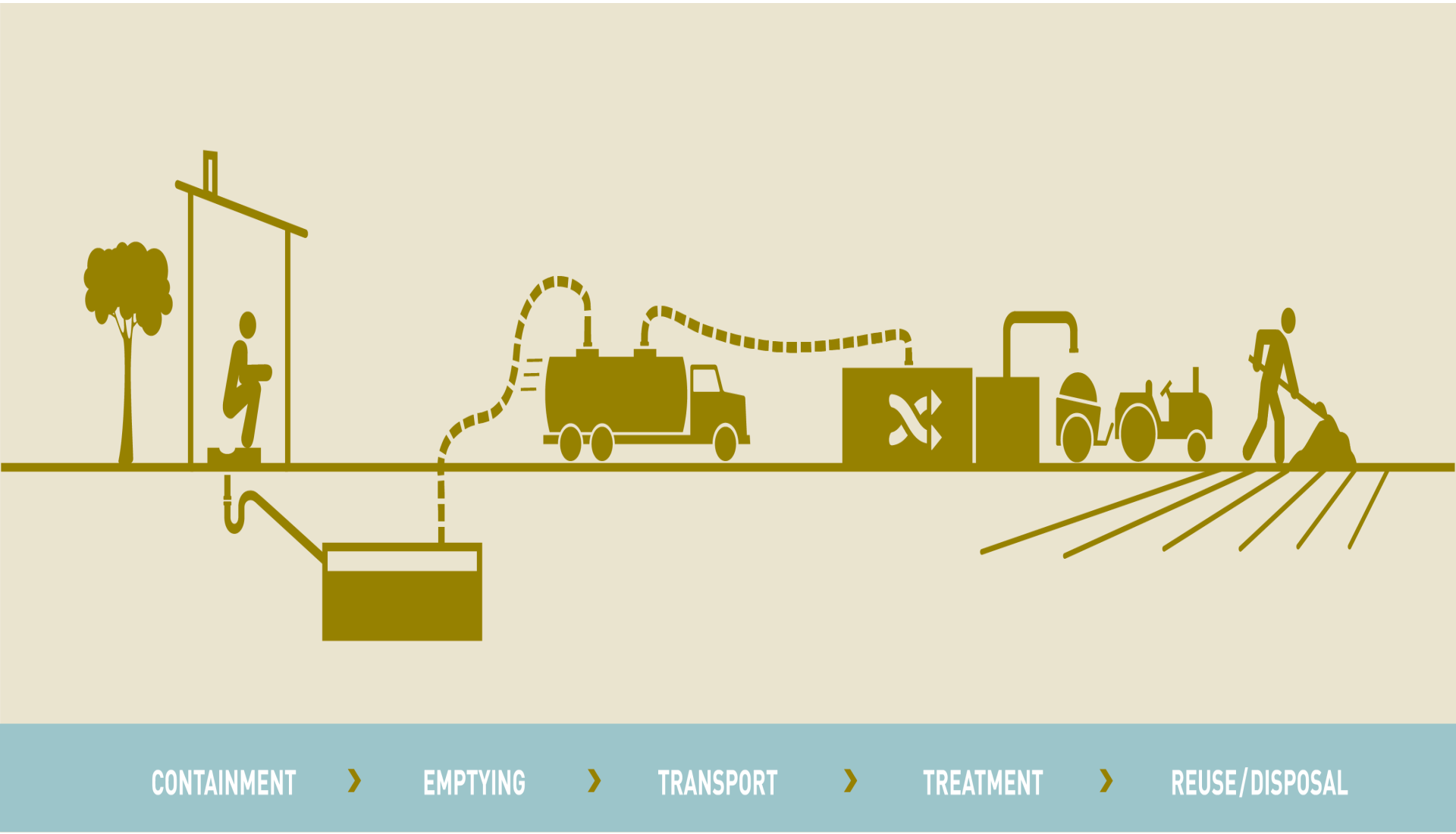
UDDT (urine)

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

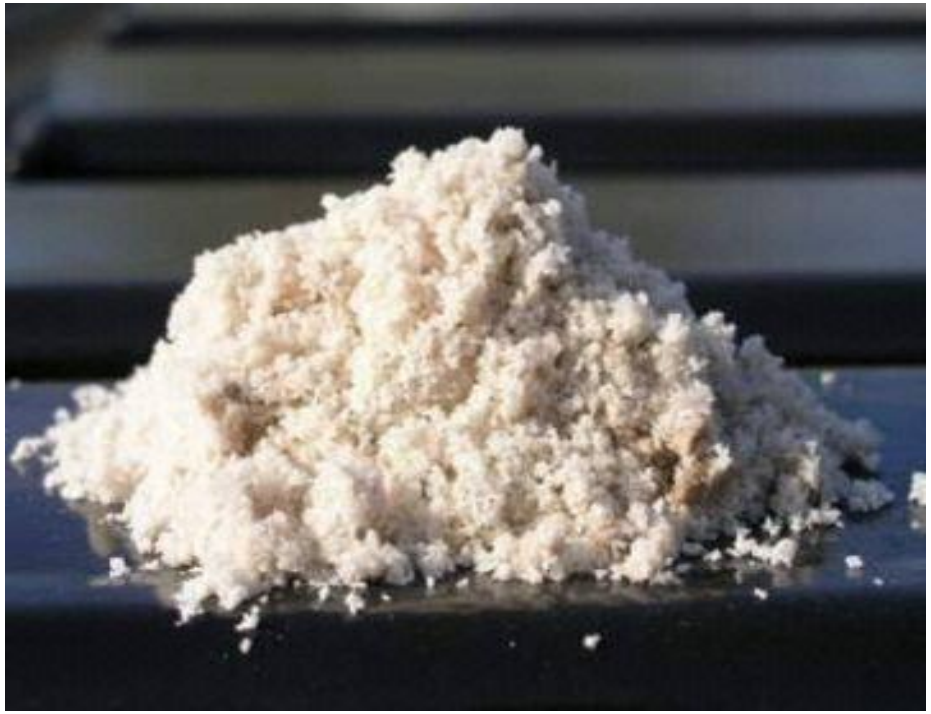


Current Initiatives

- 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
  - 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 for maize

	Plant Nutrient Source	Cost per unit area (R/ha)
1	MAP (inorganic)	**4 921.96**
2	N:P:K_3:2:1 (25) (inorganic)	5 281.47
3	N:P:K_2:3:2 (22) (inorganic)	5 783.59
4	Pure Fertilisers (inorganic)	5 977.14
5	**LaDePa (organic)**	5 998.31
6	**Struvite (inorganic)**	**6 042.06**
7	Gromor Accelerator (organic)	13 542.86

Source: Author's compilation

Empirical results for sugarcane

	Plant Nutrient Source	Cost per unit area (R/ha)
1	MAP (inorganic)	**5 707.55**
2	N:P:K_3:2:1 (25) (inorganic)	5 887.28
3	N:P:K_2:3:2 (22) (inorganic)	6 018.46
4	Pure Fertilisers (inorganic)	6 235.12
5	**Struvite (inorganic)**	6 237.13
6	**LaDePa (organic)**	**6 242.82**
7	Gromor Accelerator (organic)	11 278.94

Source: Author's compilation

Empirical results for wheat

	Plant Nutrient Source	Cost per unit area (R/ha)
1	MAP (inorganic)	**5 314.05**
2	N:P:K_3:2:1 (25) (inorganic)	5 649.78
3	N:P:K_2:3:2 (22) (inorganic)	5 894.63
4	**LaDePa (organic)**	6 115.18
5	Pure Fertilisers (inorganic)	6 298.90
6	**Struvite (inorganic)**	**6 302.41**
7	Gromor Accelerator (organic)	15 713.99

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: Authors' 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		LaDePa		5 036.12	Acceptable
	11 278.94		6 242.82		
Gromor		Struvite		5 041.81	Acceptable
	11 278.94		6 237.13		
MAP		LaDePa		(-) 535.27	Unacceptable
	5 705.55		6 242.82		
MAP		Struvite		(-) 529.58	Unacceptable
	5 705.55		6 237.13		

Source: Authors' 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		LaDePa		9 598.81	Acceptable
	15 713.99		6 115.18		
Gromor		Struvite		9 411.58	Acceptable
	15 713.99		6 302.41		
MAP		LaDePa		(-) 801.13	Unacceptable
	5 314.35		6 115.18		
MAP		Struvite		(-) 988.36	Unacceptable
	5 314.05		6 302.41		

Source: Authors' compilation

Fertiliser combinations for maize costs

	Nutrient combination	Cost per hectare (R)
1	LAN + SSP	5 777.14
2	LaDePa + SSP	5 874.80
2	LaDePa + Struvite	5 874.80
4	LAN + Struvite	5 981.32
5	Gromor + SSP	13 542.86
6	Gromor + Struvite	13 543.81

Source: Authors' compilation

Discussion

- Both LaDePa and struvite were cost competitive in terms of cost per hectare
- Gromor, the commercial organic fertilizer was the most expensive to use
- High costs in the use of struvite are mainly attributed to its high presumed market price
  - though high P concentration
  - can replace Gromor but not MAP in all enterprises
- High costs in the use of LaDePa are mainly attributed to its low nutrient concentration
  - low price but low nutrients concentration
  - can also replace Gromor but not MAP in all enterprises

Discussion cont….

- LAN + SSP lowest costs
  - High concentration of chemical fertilisers
- LaDePa + Struvite = LaDePa + SSP
  - Struvite a very good phosphorus source
    - Can compete with commercial fertilisers
- All combinations containing Gromor were the most expensive
  - Low nutrient concentration causes higher prices
- LaDePa + Struvite a very competitive combination
  - +R97.66 difference from chemical fertilisers combination

Study Limitations

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

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

Conclusions

- LaDePa and Struvite were economically viable
  - Struvite can solve the phosphorus challenge
  - LaDePa can also 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

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Thank you

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