



WEBINAR · WEBINAIRE

FSM ACTION RESEARCH PROJECT WEBINAR

A practical review of pit latrine emptying
technologies

Revue pratique des technologies de vidange des latrines à fosse



THE FSM ACTION RESEARCH PROJECT

Field experience from **Kisumu, Kampala, Kigali and Lusaka** on seven pit emptying technologies.

Local teams worked with utilities, city authorities and emptying businesses to time, cost and compare each technology in daily commercial use.

Funded by the Gates Foundation.

Today's question: do pit latrine emptying technologies actually add value?

QUESTIONS, RECORDING AND INTERPRETATION

Questions in the Zoom Q&A; recording on the project website.

4

cities

7

technologies

~750

field observations

19

months

HOSTS AND PROJECT PARTNERS



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ZAMBIA

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Washington



THE GUIDE · OCTOBER 2026

FEEDBACK FROM THE FIELD

A practical guide to pit emptying technologies

*Retours du terrain : guide pratique des technologies de
vidange des fosses*

SEVEN TECHNOLOGIES IN THE GUIDE



Improved manual



Gulper



Gulper 4 **EMERGING**



PitVaq



PuPu Pump



Trash pump



Vacuum truck



TECHNOLOGY 01 OF 07

IMPROVED MANUAL EMPTYING

HOW IT WORKS

- Long-handled scoops, forks and hooks
- Sludge lifted into 60-litre drums
- No one enters the pit

\$40

tool kit

4

workers

\$30

cost per job

BEST SUITED TO

- Thick sludge, heavy trash
- Unlined pits
- No road access

CONSTRAINED BY

- Hard physical work
- Every drum carried by hand
- Slow in liquid pits

EN FRANÇAIS

Vidange manuelle améliorée

Fonctionnement : outils à long manche, boues versées en fûts de 60 litres ; personne ne descend dans la fosse.

Adapté à : boues épaisses, fosses non revêtues • **Limites** : travail pénible, fûts portés à la main.



TECHNOLOGY 02 OF 07

THE GULPER

HOW IT WORKS

- Hand pump on a 2 m riser inside the pit
- About 3 litres per stroke into drums
- No fuel; carried to any site

\$250

unit

3

workers

\$30

cost per job

BEST SUITED TO

- Wet, semi-liquid sludge
- Shallow pits
- Low-budget operators

CONSTRAINED BY

- Thick sludge
- Deep pits
- Hard-to-reach pits

EN FRANÇAIS
Le Gulper

Fonctionnement : pompe manuelle sur un tube de 2 m, environ 3 litres par coup, sans carburant.

Adapté à : boues liquides, fosses peu profondes · **Limites** : boues épaisses, fosses profondes ou peu accessibles.



TECHNOLOGY 03 OF 07 **EMERGING**

THE GULPER 4

HOW IT WORKS

- Pump stands beside the pit
- Suction hose in, discharge hose out
- Still under test in Kigali

\$510

unit

4

workers

\$50

cost per job

BEST SUITED TO

- Liquid sludge
- Small volumes
- Less contact with sludge

CONSTRAINED BY

- Fast piston and valve wear
- Large volumes
- Pits beyond 20 m of hose



TECHNOLOGY 04 OF 07

THE PITVAQ

HOW IT WORKS

- Petrol engine drives a vacuum pump
- Fills a 60-litre vessel, emptied into drums
- Carried to site by two or three people

\$3,500

ex-factory

4

workers

\$32

cost per job

BEST SUITED TO

- Deep pits
- Wet to medium sludge
- No road access

CONSTRAINED BY

- Drum handling
- Very thick or dry sludge
- 3-month lead time on order

EN FRANÇAIS
Le PitVaq

Fonctionnement : moteur à essence et pompe à vide ; cuve de 60 litres vidée en fûts ; portable.

Adapté à : fosses profondes, boues liquides à moyennes · **Limites** : fûts, boues très épaisses, délai de 3 mois.



TECHNOLOGY 05 OF 07

THE PUPU PUMP

HOW IT WORKS

- Compressed air sucks sludge in, then pushes it out
- 1–7 m³ per hour, from up to 8 m deep
- Up to 100 m of hose, straight into a tank

\$4,500

ex-factory

3

workers

\$43

cost per job

BEST SUITED TO

- Wet to medium sludge
- Waterlogged areas
- Pits far from the road

CONSTRAINED BY

- Very thick or dry sludge
- Heavy trash
- Imported unit and spares

EN FRANÇAIS
La pompe PuPu

Fonctionnement : l'air comprimé aspire puis refoule les boues ; 1 à 7 m³/h ; jusqu'à 100 m de tuyau.

Adapté à : boues liquides à moyennes, zones inondables · **Limites** : boues très épaisses, déchets, pièces importées.



TECHNOLOGY 06 OF 07

THE TRASH PUMP

HOW IT WORKS

- Engine-driven centrifugal pump
- Moves watery sludge fast
- Bought off the shelf

\$460

unit

3

workers

\$28

cost per job

BEST SUITED TO

- Very liquid sludge
- Shallow, waterlogged pits

CONSTRAINED BY

- Thick sludge
- High solids content
- Stringy trash

EN FRANÇAIS

**La motopompe à
débris**

Fonctionnement : pompe centrifuge à moteur, achetée dans le commerce ; évacue vite les boues liquides.

Adapté à : boues très liquides, fosses peu profondes · **Limites** : boues épaisses, solides, déchets filandreux.



TECHNOLOGY 07 OF 07

THE VACUUM TRUCK

HOW IT WORKS

- Truck-mounted pump and sealed tank
- Hose reaches up to about 100 m
- Fastest, highest-capacity option

\$38,000+

new truck

2

workers

\$47

cost per job

BEST SUITED TO

- Septic tanks
- Accessible pits, liquid sludge

CONSTRAINED BY

- Road access
- Thick sludge
- Solid waste in the pit

EN FRANÇAIS

**Le camion
vidangeur**

Fonctionnement : pompe et citerne étanche sur camion ; tuyau jusqu'à 100 m ; l'option la plus rapide.

Adapté à : fosses septiques, fosses accessibles • **Limites** : accès routier, boues épaisses, déchets solides.

TIME ON SITE BY STAGE (MINUTES)

- Set-up
- Trash removal
- Extraction
- Cleaning
- Drum transport

TECHNOLOGY	MINUTES PER STAGE				JOBS (n)	MIN / JOB	JOB SIZE	m³/h
Improved manual	66 47 11 31				150	101	2,000 L	1.2
Gulper	10 28 20 21				21	108	1,200 L	0.7
Gulper 4	34 20 31 30 27				48	140	700–1,300 L	0.3–0.6
PitVaq	30 10 32 25 31				171	112	1,500–3,000 L	0.8–1.6
PuPu Pump	28 8 29 29				225	104	1,500–3,000 L	0.9–1.7
Trash pump	23 9 34 21 18				37	110	2,000 L	1.1
Vacuum truck	15 11 17 13				121	63	4,000–10,000 L	4–10

KEY NOTE Every technology still needs a separate, manual trash removal stage.

NOTE Bars show total time on site; some stages overlap. m³/h is indicative: typical job size ÷ mean time on site.

EN FRANÇAIS

Durée sur site par
étape

Minutes par étape : installation, déchets, extraction, nettoyage, portage des fûts. Chaque technologie exige encore un retrait manuel des déchets, très salissant.

Les étapes se chevauchent : le portage se fait pendant le pompage. Moyennes des quatre villes ; trajet jusqu'au dépôtage non compris.

PERFORMANCE RATINGS

Strength

Moderate

Limitation

TECHNOLOGY

	Access	Thick sludge	Trash	Speed	Capital cost	Spares
Improved manual	Any	Good	Good	Moderate	Low	Local
Gulper	Any	Poor	Poor	Slow	Low	Local
Gulper 4	Any	Moderate	Poor	Slow	Low	Limited
PitVaq	Any	Moderate	Moderate	Moderate	Moderate	Partial
PuPu Pump	Any	Moderate	Moderate	Fast	Moderate	Imported
Trash pump	Any	Poor	Poor	Fast	Moderate	Local
Vacuum truck	Road only	Poor	Poor	Fast	High	Partial

EN FRANÇAIS Évaluation des performances

Accès, boues épaisses, déchets, rapidité, coût d'achat, pièces de rechange, pour les sept technologies.

Vert : atout · jaune : modéré · rouge : limite. Les notes reflètent un usage courant et varient selon le terrain.

FINDINGS AND GUIDANCE FOR CITIES

1 Poor containment defeats every machine; equipment works mainly on improved pits.

FOR CITIES

- | Invest in lined, accessible pits before new equipment.
- | Regulate manual emptying, and allow it where pits need it.

2 Trash slows every job and blocks pumps; no machine removes it.

FOR CITIES

- | Keep trash out of pits through household bins and awareness.
- | Budget time and tools for trash removal on every job.

PIT CONDITIONS

CONTAINMENT QUALITY AND EMPTYING PERFORMANCE



An “LSP Toilet” being emptied in Lusaka – the toilet is lined and the pit is easily accessed. The pit volume is 4 m³.

FINDINGS AND GUIDANCE FOR CITIES

3 Transport often costs more than the emptying itself.

FOR CITIES

- | Make disposal free or low cost for manual and semi-mechanised emptiers.
- | Support transport and scheduled emptying.

4 Emptiers switch only when equipment is faster or pays more.

FOR CITIES

- | Build on existing operators; add equipment as demand grows.
- | Put licensing, disposal access and a service model in place first.

5 Every machine needs a workshop, a mechanic and spare parts.

FOR CITIES

- | Include training, spare parts and a workshop in every purchase.
- | Base repair skills in a permanent local workshop.

CITY INSIGHTS



LUSAKA

Chaiwe S. Mushauko
CaDev

Cholera risk; high water table



KIGALI

Nicholas Kuria
Pit Vidura

Steep terrain; manual emptying banned



KAMPALA

Charles Niwagaba
SSWARS-IC

Dense city; active emptying market



KISUMU

Edwin Mariita
Opero Services

High water table; seasonal floods

EN FRANÇAIS Les quatre villes

Lusaka, Chaiwe S. Mushauko : risque de choléra, nappe haute · Kigali, Nicholas Kuria : relief accidenté, vidange manuelle interdite.

Kampala, Charles Niwagaba : ville dense, marché de la vidange actif · Kisumu, Edwin Mariita : nappe haute, inondations saisonnières.



Lusaka Sanitation Program toilets: lined, easy to reach

POPULATION

2022 census, ZamStats

3.0 m

VACUUM TRUCKS

+15 NSS providers

60

EMPTYING PRICE

per m³

USD 22.67

DISPOSAL

per m³

USD 2.52

HISTORY

Mechanised emptying from 2017; manual still most used.

DEMAND

Shared pits, seasonal rain; rocky ground limits pit depth.

TREATMENT

Two FSTPs: screening, dewatering, stabilisation.

EN FRANÇAIS

Contexte : Lusaka

Toilettes du Lusaka Sanitation Program : revêtues et accessibles.

3,0 M d'habitants · 60 camions, 15 autres prestataires · vidange 22,67 USD/m³ · dépotage 2,52 USD/m³.



Improved manual emptying: long-handled tools, no one enters the pit

69 MIN

per manual job in Lusaka; 122 in Kisumu, 145 in Kampala

70 JOBS

observed, on lined Lusaka Sanitation Program toilets

Use in the research, Lusaka

TECHNOLOGY	JOBS OBSERVED	MIN PER JOB
PitVaq	75	70
PuPu Pump	74	77
Improved manual	70	69

On lined, accessible toilets, improved manual emptying is as fast as the pumps (69 min, against 70 and 77).



Steep hills: many pits sit far below the road

POPULATION

2022 census, NISR

1.7 m

VACUUM TRUCKS

no other providers

42

EMPTYING PRICE

per job

USD 61–81

DISPOSAL

per trip

USD 3

HISTORY

Evac pump from 2016; the PitVaq replaced it.

DEMAND

No land for new pits; upgrades costly and regulated.

TREATMENT

24/7 dumpsite; Masaka plant ready to open

EN FRANÇAIS

Contexte : Kigali

Collines escarpées, fosses loin sous la route · 1,7 million d'habitants · 42 camions, aucun autre prestataire · 61 à 81 USD par vidange · dépotage 3 USD par voyage.

Pompe Evac dès 2016, remplacée par le PitVaq · pas de place pour de nouvelles fosses · dépotage 24h/24 ; station de Masaka bientôt prête.



PitVaq moved on foot along paths too narrow for a truck

164 MIN

per PitVaq job in Kigali; 70 in Lusaka

SINCE 2017

Pit Vidura has kept its PitVaq units running with in-house mechanics

Use in the research, Kigali

TECHNOLOGY	JOBS OBSERVED	MIN PER JOB
Vacuum truck	50	108
PuPu Pump	50	156
PitVaq	50	164
Gulper 4	48	140

The PitVaq is portable and reaches pits off the road, but steep ground makes jobs more than twice as long as in Lusaka.

QUESTION

What are the strengths and limitations of the PitVaq in the Kigali context?

Quels sont les atouts et les limites du PitVaq dans le contexte de Kigali ?



Dense, traffic-heavy city with an active emptying market

POPULATION 2024 census, UBOS	1.8 m
VACUUM TRUCKS +35 other NSS providers	173
EMPTYING PRICE per trip, vacuum truck	USD 19–83
DISPOSAL per 4 m³ truck trip	USD 3

HISTORY
Gulper from 2010; KCCA pilot in 2016. Trucks lead today.

DEMAND
High water table, shallow pits; more emptying in the rains.

TREATMENT
Lubigi and Nalukolongo plants; Bugolobi as backup.



Gulper: a hand pump lifting sludge into drums, about 3 litres per stroke

10 JOBS

Gulper jobs observed in Kampala, against 46 for the PuPu Pump

SINCE 2010

the Gulper has been known in Kampala, with a Gulpers Association

Use in the research, Kampala

TECHNOLOGY	JOBS OBSERVED		MIN PER JOB
PuPu Pump		46	117
Vacuum truck		31	51
PitVaq		28	137
Improved manual		28	145
Gulper		10	68

The guide rates the Gulper poor on thick sludge and trash, and slow.

QUESTION

We thought the Gulper was widely used in Kampala, but the research showed it was not. What is the reality of Gulper use?

Nous pensions le Gulper très utilisé à Kampala, mais la recherche a montré le contraire. Quelle est la réalité de son usage ?



Lake Victoria: high water table and seasonal floods

POPULATION	0.52 m
2019 census	
VACUUM TRUCKS	18
+6 formal emptying groups	
EMPTYING PRICE	USD 34–39
per trip, manual	
DISPOSAL	USD 115
per truck per month; free for manual	

HISTORY
Opero introduced the PuPu Pump in 2021.

DEMAND
Shallow pits, high groundwater, shared toilets.

TREATMENT
Nyalenda ponds, not designed for pit sludge.



Edwin Mariita

Kisumu Technical Engineer, Opero Services



PuPu Pump: sludge pumped straight into a tank, no drums to carry

83 MIN

per PuPu Pump job in Kisumu; 122 for manual emptying

SINCE 2021

Opero introduced the PuPu Pump in Kisumu

Use in the research, Kisumu

TECHNOLOGY	JOBS OBSERVED		MIN PER JOB
PuPu Pump		55	83
Improved manual		52	122
Vacuum truck		40	15
Trash pump		37	110
PitVaq		18	97
Gulper		11	145

Pumping straight to a tank cuts drum carrying to about 2 minutes per job, against 31 for manual emptying.

QUESTION

You set up an equipment rental scheme after the research. Are the teams actually renting the equipment?

Vous avez mis en place un système de location d'équipement après la recherche. Les équipes louent-elles réellement l'équipement ?

RECOMMENDATION FOR CITIES

SAFELY MANAGED SANITATION REQUIRES SAFELY EMPTIABLE TOILETS.

Technologies add value

Most of the seven improve extraction on the pits they suit.

Containment is the constraint

Unlined pits, thick sludge and trash defeat every machine. Toilets come first.

Manual emptying is necessary

Many households depend on it. License, protect and equip its workers.

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11 NOVEMBER 2026

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Prochain webinaire

Le prochain webinaire de la série aura lieu le 11 novembre 2026. Abonnez-vous à la lettre d'information et suivez-nous sur LinkedIn, Facebook, YouTube et TikTok pour vous inscrire.

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