Dutch Water Operators

Debriefing on Wednesday 10 November 2021
FSM mission WWX (Lawrence / Jan)
1 November – 10 November 2021

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Faecal Sludge Management (FSM) Needs Assessment Intervention strategy IWRM-4-WASH and WWX2 Projects

2

Policy, Regulatory and Strategic Framework

The Constitution of the Federal Democratic Republic of Ethiopia : Article 90.1 and 91.2 …"to the extent the country's resources permit, policies shall aim to provide all Ethiopians access to public health, clean water... ensure that all Ethiopians live in a clean and healthy environment'.

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Policy, Regulatory Strategic and Institutional Framework

- Available numerous policies, strategies and institutional framework
- Urban sanitation and especially FSM has no clear institutional 'home,' which means responsibilities are diffused amongst several agencies, indicating gaps existing in policies, strategies, plans, duties and responsibilities, and overlapping authority.
- Thus, no clear implementation approach.

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Policy, Regulatory and Strategic Framework

1) The National Hygiene & Sanitation Strategy (December 2005)
2) National Protocol for Hygiene and "On-Site" Sanitation (June 2006)
3) National Manual on Latrine Technology Options
4) WASH Memorandum of Understanding-signed among Ministries of Health, Education, Water, Irrigation & Energy; and Finance & Economic Development
5) Environmental Policy of Ethiopia
6) National Guideline for Environmental Impact Assessment (July 2000)
7) National Guideline for Urban Water Utilities Tariff Setting
8) National Integrated Urban Sanitation and Hygiene Strategy
9) Proclamation 300/2002, Environmental Pollution Control
10) Solid Waste Management Proclamation No. 513/2013
11) Water Supply and Sanitation Policy 2001
12) Waste Management and Green and Beautification Draft Strategy

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Institutional Framework

- Addis Ababa Water and Sanitation Authority (AAWSA)
- Ministry of Water and Energy
- Ministry of Health
- Ministry of Agriculture
- Ministry of Environment and Forestry
- Environmental Protection Authority
- Ministry of Urban Development and Construction
- Urban Agriculture Department under the Addis Ababa City Administration
- Solid Waste Management Agency of Addis Municipality

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Recommended Action to Address Onsite Sanitation Challenges

1. Propose and execute a **Sanitation Levy** to incentivize sanitation as a business;
   a) It ensures that everybody who has access to water can pay something towards onsite sanitation
   b) Water utility guarantees collection (MDU hiring/SLA), transportation, disposal and treatment
   c) Private sector engagement is encouraged i.e. pit emptying (formalise pit emptying/regulation)
2. Establish an **Onsite Sanitation Unit**
3. Develop and utilize **Social Connection Policy** to increase sanitation coverage;
   a) Utility loans material and provides labor to their existing or new customers living along the sewer lines to connect to sewer.
   b) The recovery of the loan is through the monthly water bill. The repayment period least 3-6 months

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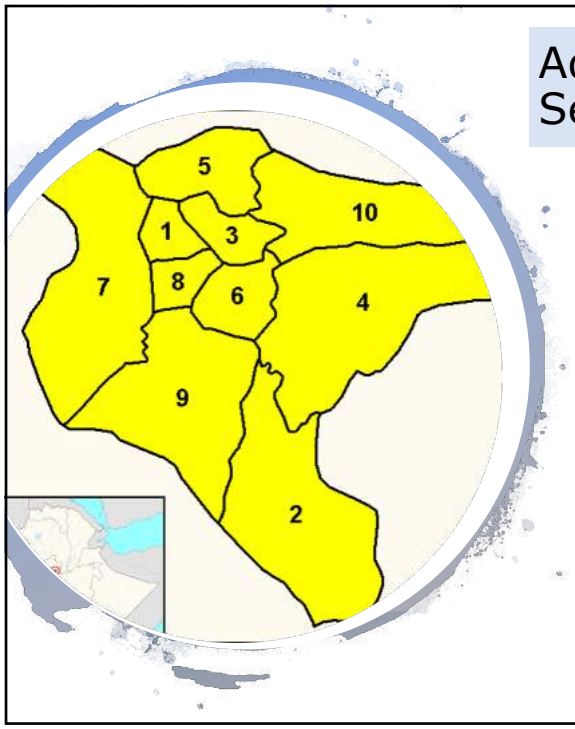

Addis Ababa Water and Sewerage Service Authority (AAWSA)

- 5 million inhabitants
- Power and responsibility to supply safe and adequate water as well as manage wastewater (sewage) and sludge collection as well as disposal for the Addis Ababa City.
- At least 600,000 connections to Water
- At least 15% connected to sewer
- Two wastewater treatment facilities (Kaliti and Kotebe)
- Provide septage services

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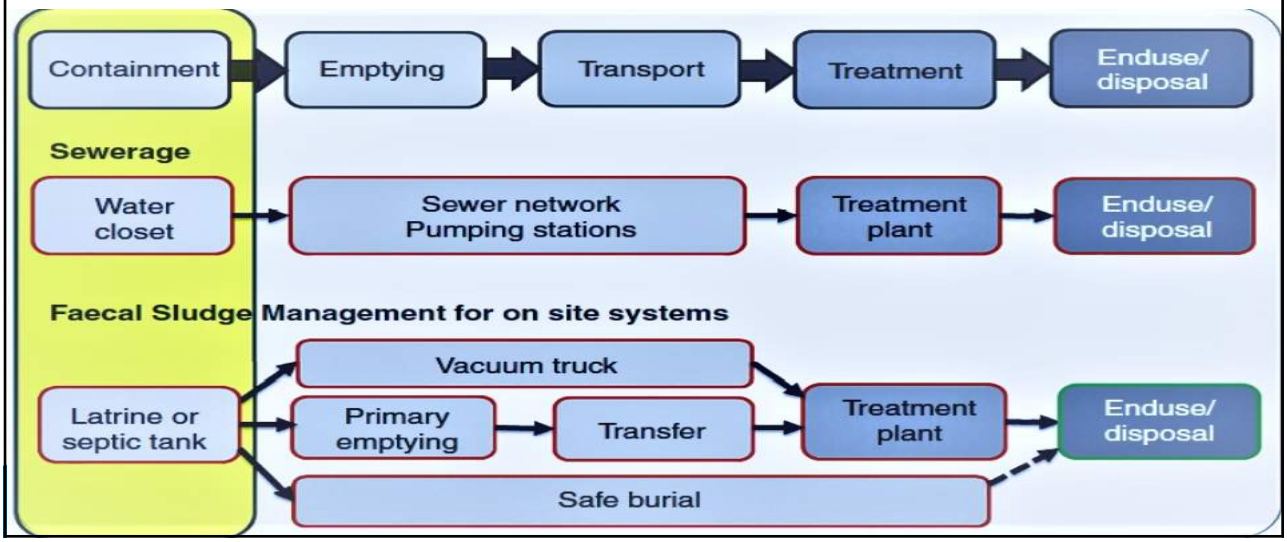
FSM: from toilet to garden



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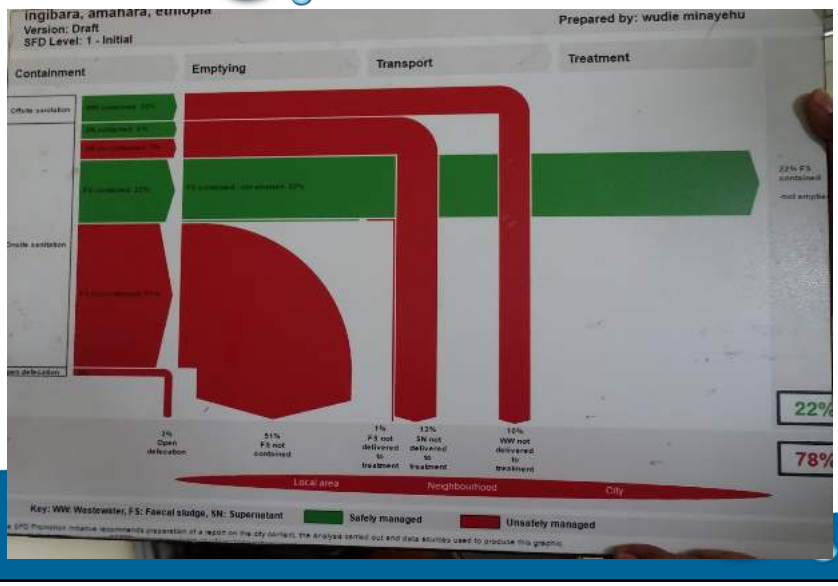
Only 22% is managed safely

SFD to be done for Addis Ababa



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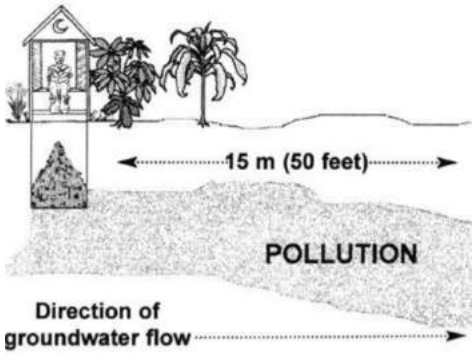
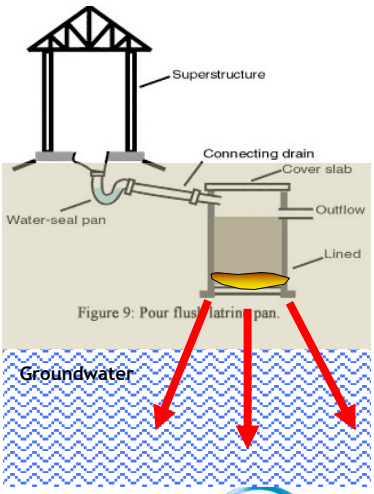
GROUND WATER POLLUTION DUE TO INADEQUATE ONSITE SYSTEMS





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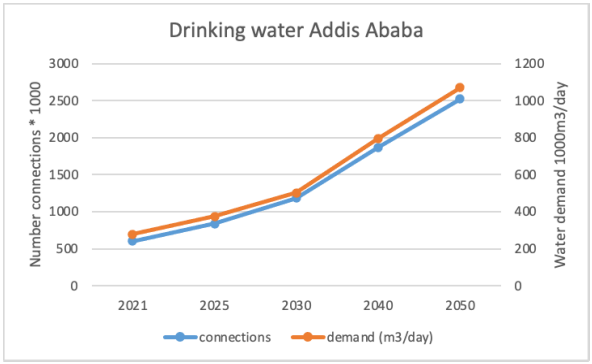
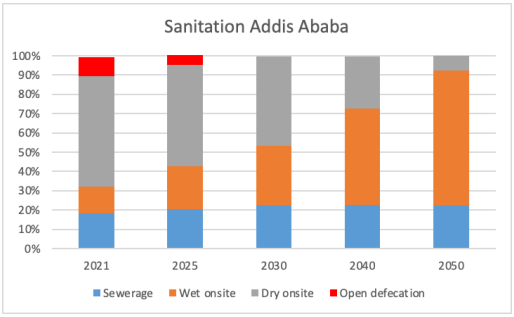
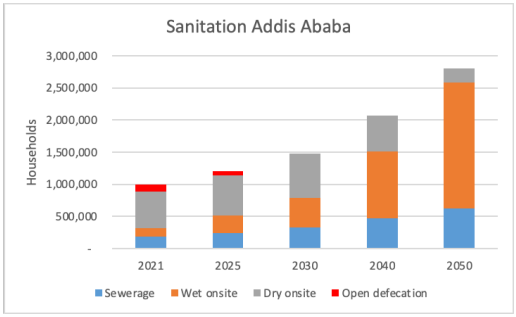
Basic assumptions







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INTERVENTIONS AT OFF-SITE WWTPs

Kality:

- O&M contract ends soon, training not done → engage on-the-job trainers from NL (e.g. PUM program)
- Biogas flared at the moment → use biogas to produce electricity for the plant
- Effluent discharged into the river → use for fish production followed by irrigation

Kality and Kotebe:

- Sludge is disposed of freely → add value: co-compost, vermicompost or Black Soldier Flies

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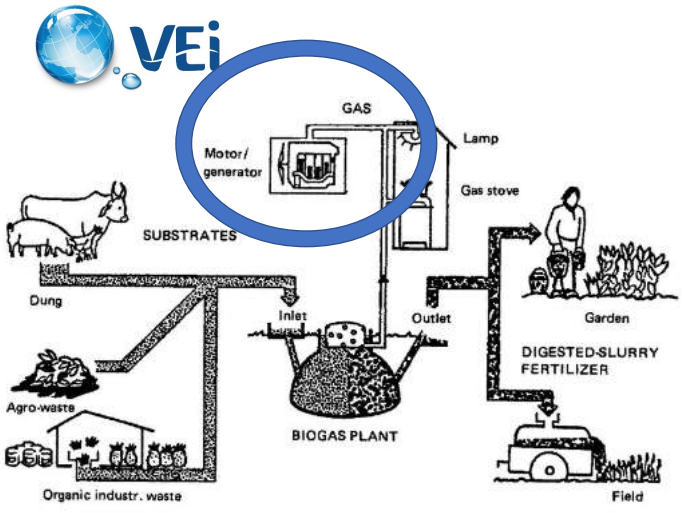
Use of biogas at Kality



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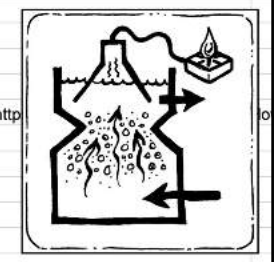
Potential savings at Kality: €340k → € 930k

Generate electricity from Biogas UASB Kality

Description	Unit	2021	2030	2040
Daily Capacity	[m3/day]	50,000	100,000	150,000
Gas production	[m3/day]	8,000	15,000	22,000
Methane content biogas	[% biogas]	58%	58%	58%
Biogas	[m3/day]	4,640	8,700	12,760
Heating value biogas	[kWh/m3]	10	10	10
Heating value per year	[kWh/year]	16,936,000	31,755,000	46,574,000
Efficiency generator	[%]	40%	40%	40%
Electricity per year	[kWh/year]	6,774,400	12,702,000	18,629,600
Power	[kW]	773	1,450	2,127
Purchase price kWh (factor 60)	[Birr/kWh]	ETB 2.7	ETB 2.7	ETB 2.7
Purchase price kWh (factor 200)	[Birr/kWh]	ETB 10.8	ETB 10.8	ETB 10.8
Exchange rate	[Birr/Euro]	ETB 53	ETB 53	ETB 53
Purchase price kWh (factor 60)	[Euro/kWh]	€ 0.05	€ 0.05	€ 0.05
Purchase price kWh (factor 200)	[Euro/kWh]	€ 0.20	€ 0.20	€ 0.20
Savings for electricity at factor 60	[€/year]	€ 340,000	€ 630,000	€ 930,000
Unit price investment	[€/kW]	€ 1,000	€ 1,000	€ 1,000
Investment biogas GenSet	[Euro]	€ 800,000	€ 1,500,000	€ 2,100,000
Repayment period	[years]	2.4	2.4	2.3



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Fish farming in the effluent €850k – €2.6mln./year

Fish farming in effluent UASB Kality

Description	Unit	2021	2030	2040
Retention time	[days]	7	7	7
Volume	[m3]	29,780	59,559	89,339
Effective depth	[m']	1.50	1.50	1.50
Surface area	[m2]	20,000	40,000	60,000
Surface area	[ha]	2.0	4.0	6.0
BOD removal lower layers	[%]	0%	0%	0%
Remaining BOD	[mgBOD/l]	50	50	50
Breakdown rate BOD 22degr.	[1/day]	0.42	0.42	0.42
BOD effluent	[mg/l]	12.8	12.8	12.8
Efficiency BOD removal	[%]	76%	76%	76%
Fish production	[kg/month]	18,000	36,000	54,000
Sales price fish	***[Euro/kg]***	***€ 4.00***	***€ 4.00***	***€ 4.00***
Revenues fish per year	Euro	€ 864,000	€ 1,728,000	€ 2,592,000

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Fish farming at Kality

Biogas in Addis

Benefits of Backpack Biogas

Selome Zemeuloa carries a (B)energy backpack filled with biogas through the streets of Addis Ababa. Credit: James Jeffrey/IPS

ADDIS ABABA, Ethiopia, Mar 31 2016 (IPS) - Billions of dollars of aid has been pumped into Africa. Yet effective change has often remained an elusive outcome, leading to a vicious cycle: more needs, more aid but still little change. How to resolve this seemingly intractable dilemma?

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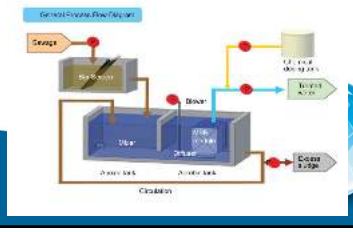
INTERVENTIONS AT DECENTRALIZED TREATMENT OF CONDOMINIUM SEWERAGE

Concept

- 'Temporary' treatment into rivers
- Connect to trunk sewers later

Future: use also 'temporary' structures

- Use Glass Fibre Reinforced Plastic (GRP) Anaerobic Baffle Reactor and move to new site after service (instead of 'permanent' concrete)



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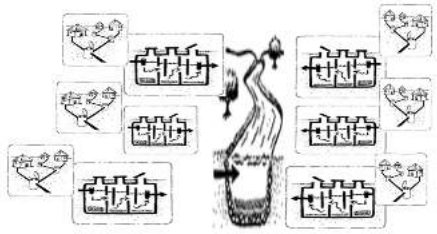
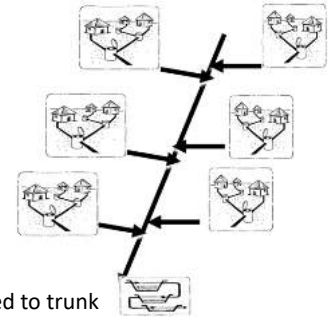
CONCEPT 'TEMPORARY' TREATMENT (1)



Now: condominium sewerage, decentralized treatment and discharge into the river



Future connected to trunk sewers & WWTP

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CONCEPT 'TEMPORARY' TREATMENT (2)

GRP ABR (Source: BORDA, 2012)

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INTERVENTIONS AT ON-SITE SANITATION

Toilets

- Good toilets are scarce → engage in toilet construction (emptiable)

Emptying

- Septic tanks emptied by vacuum trucks → no problem
- Pit latrines many challenges: thickness sludge, rubbish, accessibility
- Good examples are there but not much used:
- → Bajaj through Emmanuel
- → MDU through WASTE / ViaWater

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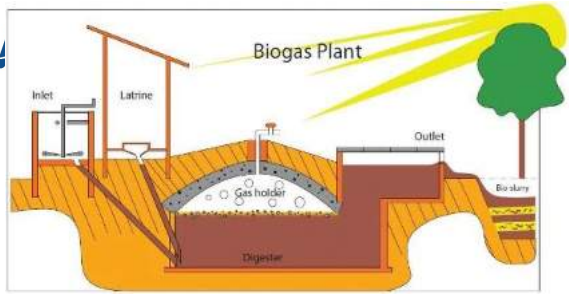
Emmanuel feeds contents into biogas toilets https://edaethiopia.org



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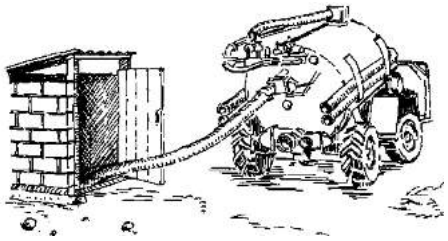
WASTE has developed an Ethiopian Mechanical Desludging Unit with Yassin Industries



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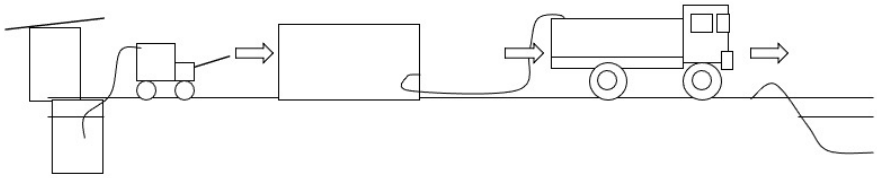
MOTHER AND CHILD SOLUTION IN HIGH DENSITY URBAN AREAS



Latrine | Pump | Transit Tank | Truck | Treatment

5 m^3 6-10 m^3

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MOTOR / MDU IN LOW-MEDIUM DENSITY URBAN AREAS

Latrine | Pump | MDU / motor | Treatment

800-2000 litres

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Potential market MDUs in Addis Ababa: 15-87 units

Description	units	2021	2025	2030	2040	2050
Volume MDU	m3	3	3	3	3	3
Number of MDU trips per year	trips/year	5,700	31,500	69,000	56,000	22,000
Number of MDU trips per day	trips/day	2	4	4	4	4
Number of MDUs	nrs	15	40	87	71	28

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INTERVENTIONS VALORIZATION

- **Current valorisation**
  - Emmanuel: biogas & cooking & sludge in gardens
  - WaterAid: planning a co-composting plant
- **Options**
  - Co-composting
  - Vermicomposting
  - Black Soldier Flies

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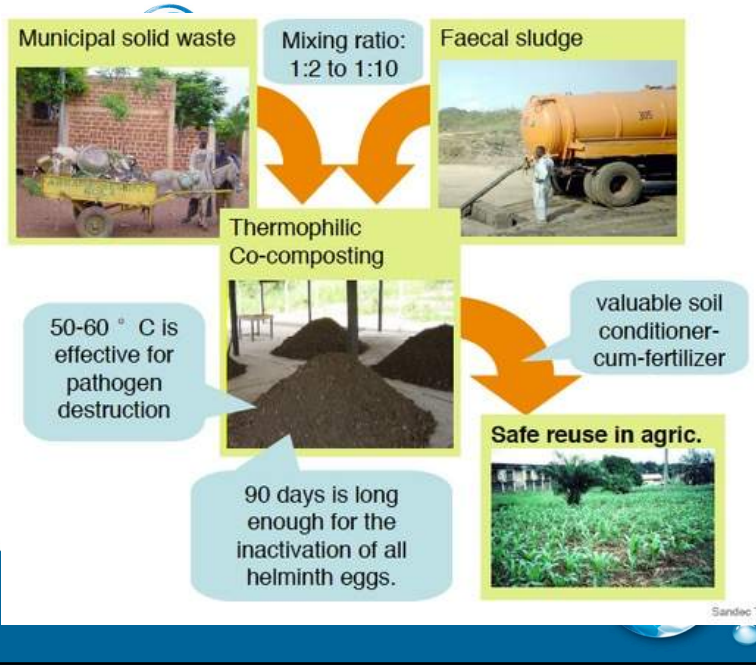
What is co-composting?



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Potential market co-compost from wet onsite systems €0.3 -2.0 mln/year

Description	Unit	2021	2025	2030	2040
Discharge septage	[m3/y]	70,000	135,000	230,000	520,000
% solids before thickening & drying	[% solids]	2%	2%	2%	2%
solids	[tonnes/y]	1,400	2,700	4,600	10,400
% solids after drying	[% solids]	60%	60%	60%	60%
Dried sludge	[m3/y]	2,330	4,500	7,670	17,330
Effluent	[m3/y]	67,670	130,500	222,330	502,670
Sales price dried sludge	***[€/ton]***	***€ 1.50***	***€ 1.50***	***€ 1.50***	***€ 1.50***
Revenues dried sludge per year	[€/year]	€ -	€ 10,000	€ 10,000	€ 30,000

Co-composting

Description	Unit	2021	2025	2030	2040
Dried sludge	[m3/year]	2,330	4,500	7,670	17,330
Biodegradable solid waste / dried sludge	[1:1]	5	5	5	5
Biodegradable solid waste required	[m3/year]	11,650	22,500	38,350	86,650
Co-composting volume	[m3/year]	13,980	27,000	46,020	103,980
Loss during composting process	[%]	50%	50%	50%	50%
Co-compost per year	[m3/year]	6,990	13,500	23,010	51,990
Volumetric weight compost	[kg/l]	0.50	0.50	0.50	0.50
Co-compost per year	[tons/year]	3,495	6,750	11,505	25,995
Sales price co-compost	***[€/ton]***	***€ 80***	***€ 80***	***€ 80***	***€ 80***
Revenues co-compost per year	[€/year]	€ 280,000	€ 540,000	€ 920,000	€ 2,080,000

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Potential market co-compost from dry onsite systems: €0.5–5.0 mln/year

Mass balance sludge drying

Description	Unit	2021	2025	2030	2040
Discharge sludge	[m3/y]	17,100	94,500	207,000	168,000
% solids before drying	[% solids]	15%	15%	15%	15%
Solids	[tons/y]	2,565	14,175	31,050	25,200
% solids after drying	[% solids]	60%	60%	60%	60%
Dried sludge	[m3/y]	4,275	23,625	51,750	42,000
Effluent	[m3/y]	12,825	70,875	155,250	126,000
Sales price dried sludge	***[€/ton]***	***€ 1.50***	***€ 1.50***	***€ 1.50***	***€ 1.50***
Revenues dried sludge per year	[€/year]	€ 10,000	€ 40,000	€ 80,000	€ 60,000

Co-composting

Description	Unit	2021	2025	2030	2040
Dried sludge	[m3/year]	4,275	23,625	51,750	42,000
Biogradable solid waste / dried sludge	[1:1]	5	5	5	5
Biogradable solid waste required	[m3/year]	21,375	118,125	258,750	210,000
Co-composting volume	[m3/year]	25,650	141,750	310,500	252,000
Loss during composting process	[%]	50%	50%	50%	50%
Co-compost per year	[m3/year]	12,825	70,875	155,250	126,000
Volumetric weight compost	[kg/l]	0.50	0.50	0.50	0.50
Co-compost per year	[tons/y]	6,413	35,438	77,625	63,000
Sales price co-compost	***[€/ton]***	***€ 80***	***€ 80***	***€ 80***	***€ 80***
Revenues co-compost per year	[€/year]	€ 510,000	€ 2,840,000	€ 6,210,000	€ 5,040,000

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What is vermicomposting?

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What is Black Soldier Fly Production?

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Overview valorisation potential Addis Ababa onsite systems: co-compost least risky and good potential revenues

Overview potential revenues

Description	Unit	2021	2025	2030	2040
Revenues dried sludge per year	[€/year]	€ 10,000	€ 50,000	€ 90,000	€ 90,000
Revenues co-compost per year	[€/year]	€ 790,000	€ 3,380,000	€ 7,130,000	€ 7,120,000
Revenues vermicast per year	[€/year]	€ 990,000	€ 4,220,000	€ 8,910,000	€ 8,900,000
Revenues BSF larvae per year	[€/year]	€ 2,860,000	€ 12,150,000	€ 25,670,000	€ 25,630,000
Revenues bio fuel per year	[€/year]	€ 280,000	€ 1,310,000	€ 2,810,000	€ 2,560,000

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Recommendations onsite systems

- Test different emptying options (Bajaj, MDU)
- Market study products (co-compost, BSF, fuel)
- Monitor and evaluate co-composting WaterAid
- Visit Faecal Sludge Treatment Plant in Kampala
- Visit Emptying and fuel production in Nakuru and BSF in Nairobi

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REQUIRED INVESTMENTS FIRST STEP ~ €1.7 million against revenues of ~€1 million/ year

Costs					
Unit prices to be confirmed	**units**	**2021**	**1st step**	**Cost**	**Revenue/year**
Improvement pit latrines through Finish Mondial	Euro/unit	€ 20	10,000	€ 200,000	
Septage treatment capacity	Euro/m3/d	€ 1,500	50	€ 80,000	€ 40,000
Faecal Sludge Treatment capacity	Euro/m3/d	€ 5,000	100	€ 500,000	€ 600,000
MDUs 3m3	Euro/unit	€ 7,500	15	€ 110,000	€ 30,000
GenSet Biogas	Euro/kW	€ 1,000	800	€ 800,000	€ 340,000
Total				**€ 1,690,000**	**€ 1,010,000**

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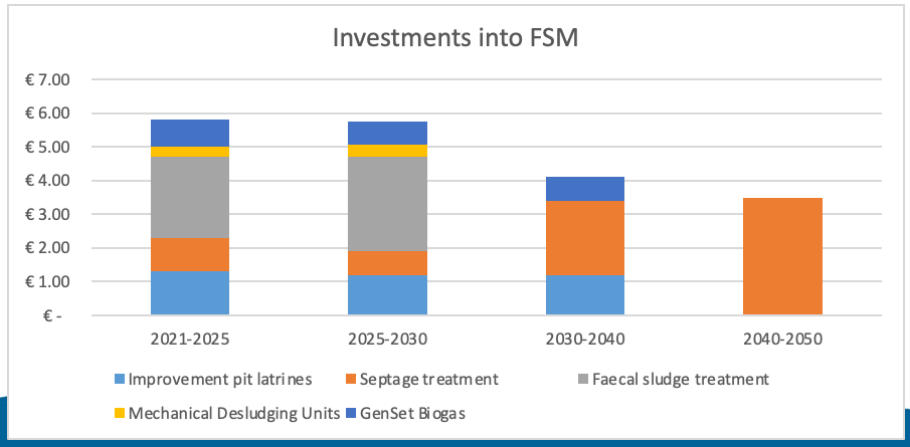
INVESTMENTS UP TO 2021-2050 ~ € 20 MILLION



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ROADMAP

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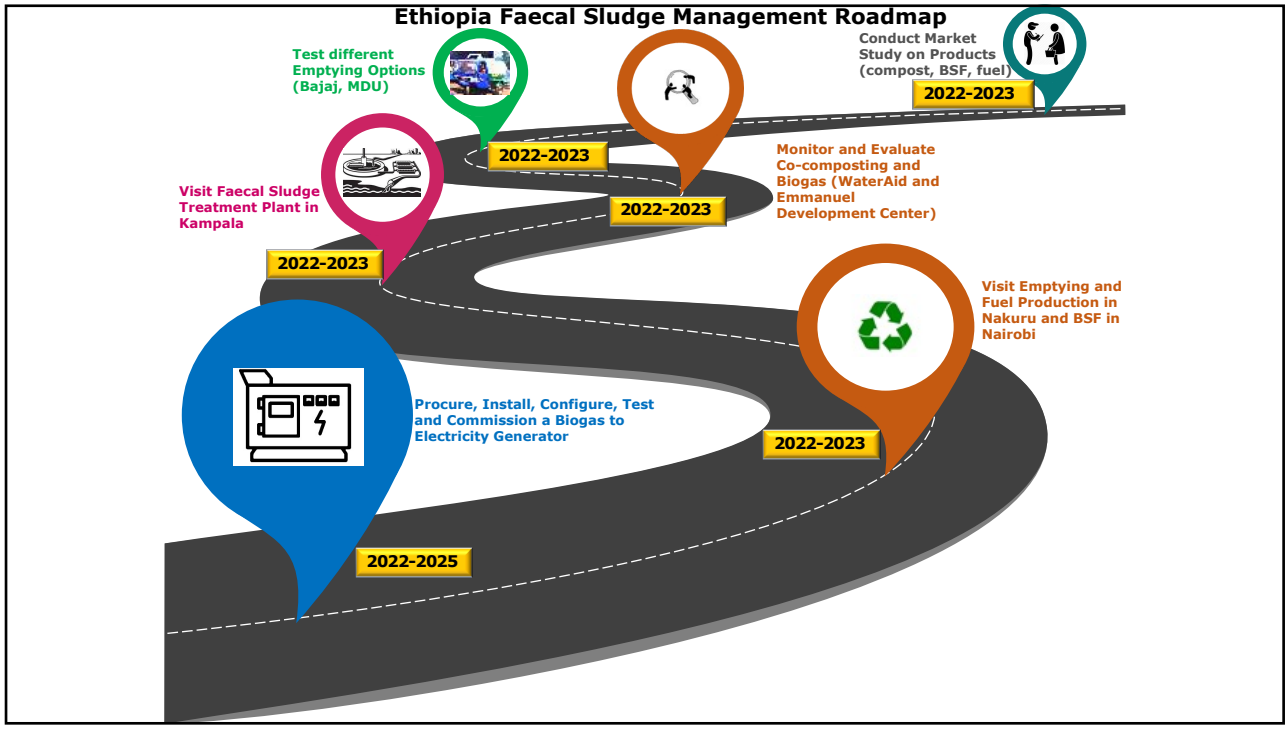

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THANK YOU FOR YOUR INPUT!!!

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