Shit to Brown Gold: Safe recovery of faecal sludge and Municipal solid Organic waste through co-composting

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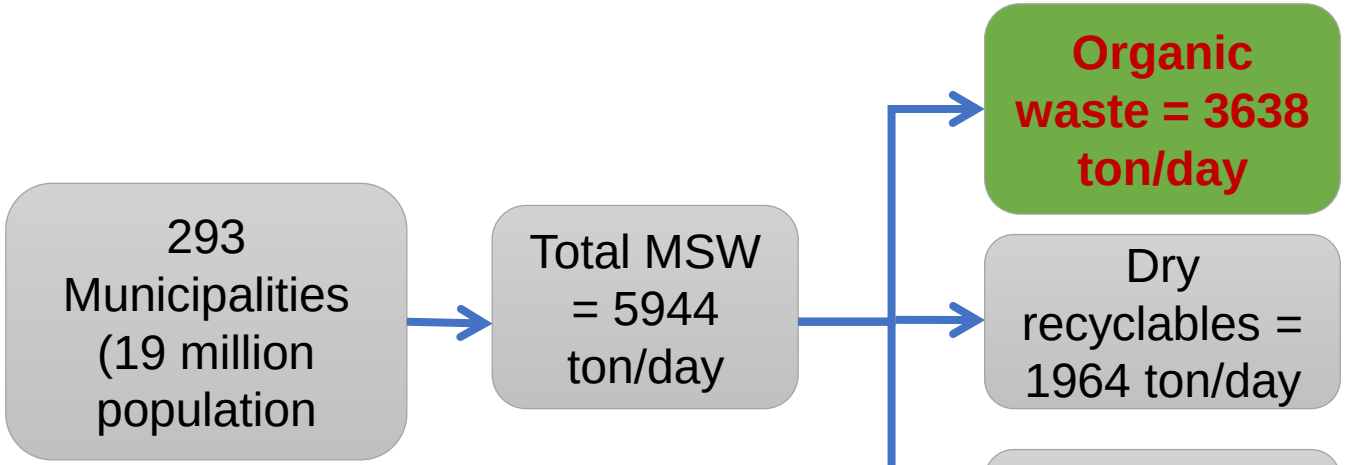
Background and Importance of Study

- As much as 89% of Nepal's population relies on on-site sanitation which means that nearly 3000 cubic meters of fecal sludge per day are ineffectively contained underground, informally emptied and transported, and disposed of without treatment in the nearby rivers or marginal lands (Adhikary & Sharma, 2021, ADBI)
- 293 municipalities of Nepal generates 1.3 million ton organic waste annually, the highest fraction (more than 60%) in municipal solid waste shows highest potential of organic waste recovery
- However, this important resources is currently mostly open dumped and has become a major sources of GHG (methane) emissions

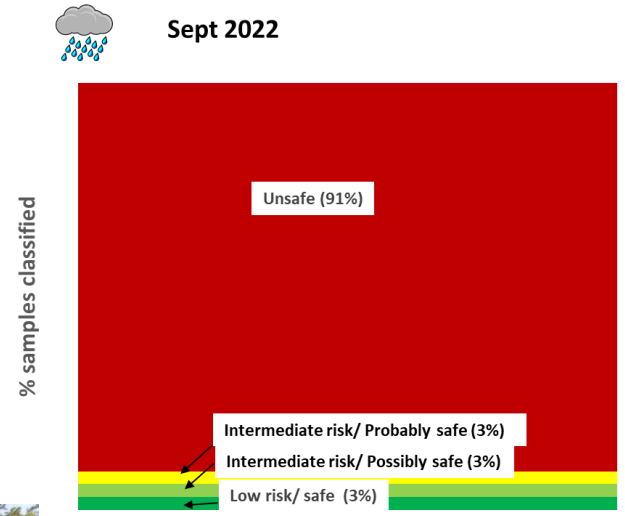


Estimated based on (Pathak et al., 2020, WM&R; ADB (2013)

Background and Importance of Study

- Water Quality Findings and Field study in Gulariya, Nepal confirmed the inadequate containment of Faecal Sludge and mismanagement of solid waste causes surface, groundwater and air pollution, that poses a risk to public health and environment (Diogo et al., 2024, under preparation)

- The integrated waste treatment centre (IWTC) at Gulariya, Nepal could serve as a model of good practice for sustainable waste management, but is not fully operational.



ISWM center, including Biogas dome and FS treatment facilities

So, proper management and safe recovery of both FS and MSOW is urgent needed.

CO-COMPOSTING can be the appropriate option in the municipalities of Nepal for the sustainable management and recovery of MSW and faecal sludge as safe use of fertilizers.

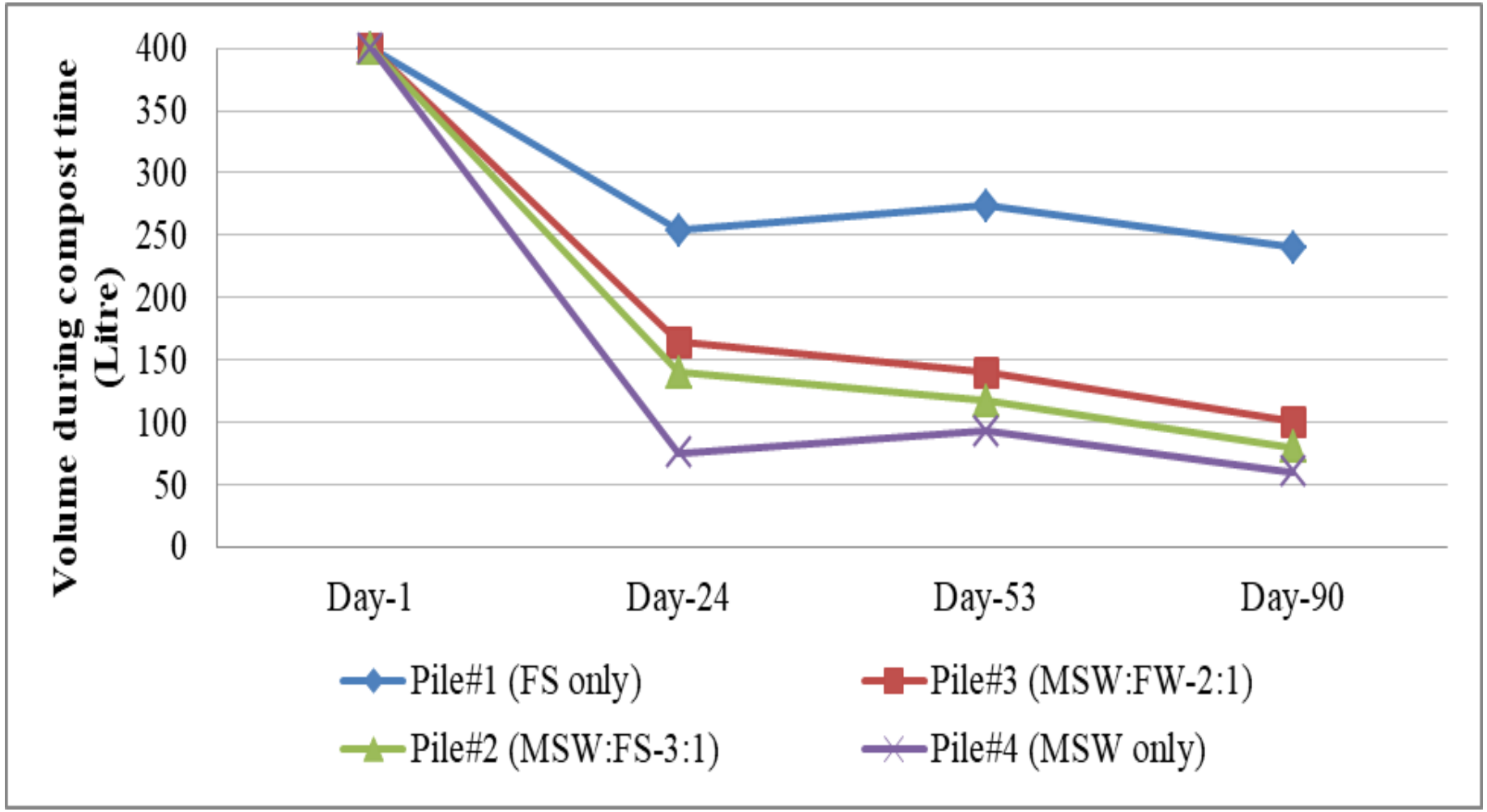
Field Trials for Co-composting at Gulariya, Nepal

- In August 2022, First experiments trials started at the Gularyia
- Four separate piles were created to explore the composting process to compare quality parameters

- Oversize materials of biodegradable waste were shredded to optimize the mixing with the dewatered FS.
- Second trial at February, 2023 was conducted by addition of carbon-rich materials to achieve the required C/N ratio and to better understand pathogen inactivation during the co-composting process.

Reduction of mass and volume during co-composting

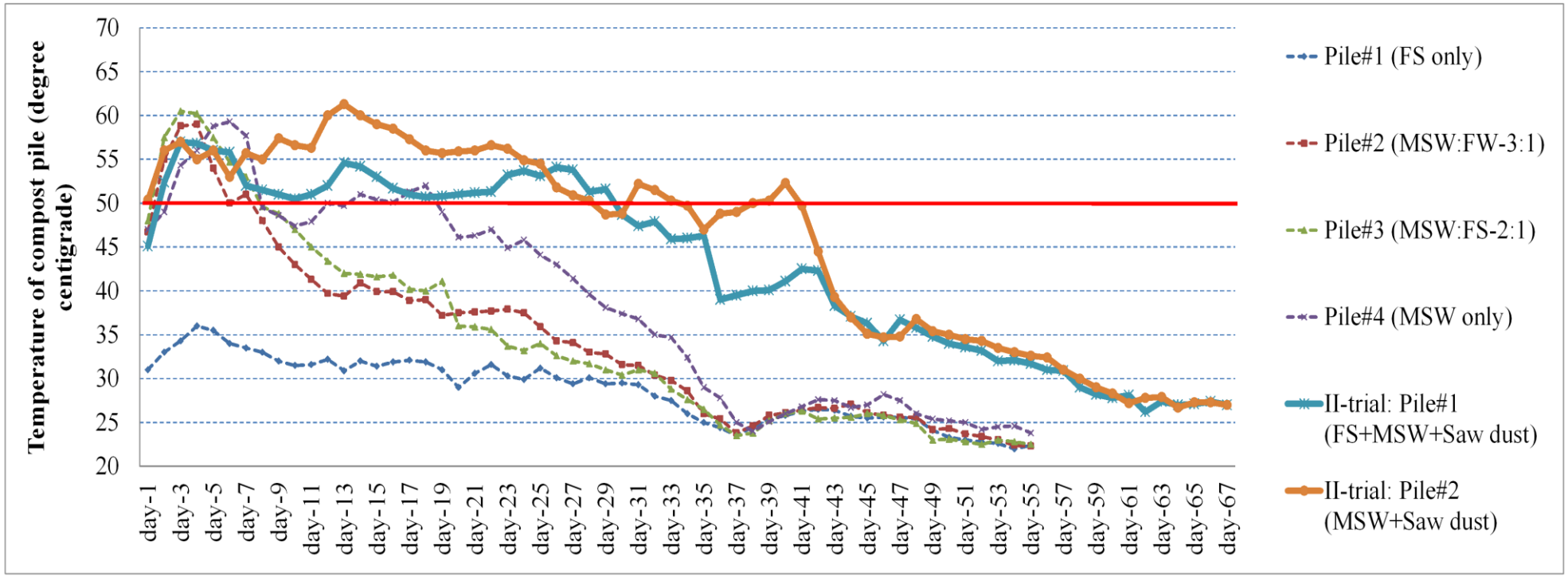
- The results also show how the decomposition process occurs, showing that the volume and mass reduce rapidly in the first 3-weeks, before stabilizing.



- When only MSOW was composted, the end-product comprised only 15% of the starting amount of raw material; while the finished compost comprised approx. 25% of the starting volume for the Dewatered FS + MSOW mix

Findings – Inactivation of pathogens in co-composting

- Co-composting raises and sustains the temperature (up to 60ºC- thermophilic stage) inside the pile to a level where pathogens can be inactivated, making the end-product safer for use as a fertilizer.
- The addition of carbon-rich material like SD in MSOW and DFS mixture increased the duration of high temperature i.e. > 50ºC inside the compost piles.



Compost quality parameters at different conditions

Parameters	First Experimental Trial				Second Experimental Trial		Nepal Standard (2021)
	Pile-1 (Dewatered FS)	Pile-2 (3 part MSW + 1 part DFS)	Pile-3 (2 part MSW + 1 part DFS)	Pile -4 (MSW)	Pile-1 (0.42 MSW+0.24 SD+0.34 DFS)	Pile-2 (0.66 MSW + 0.34 SD)	
pH	7.35	8	7.8	8.2	7.06	7.89	6.-8
MC (%)	31	35	32	35	32	30	25%
Nitrogen (%)	2	1.8	2.1	1.5	2.18	2.07	1 %
Phosphorous (%)	1.03	4.9	3.5	1.6	0.243	0.201	0.5 %
Potassium (%)	0.14	0.72	0.77	0.45	0.619	1.22	1 %
Organic Carbon	18.69	15.17	15.83	13.42	27.14	40.48	20%
C/N	9	8	8	9	12	20	20:1
Lead	24.79	23.79	18.52	21.15	7.77	40.5	<100
Cadmium	<2	<2	<2	<2	<1	<1	5
Chromium	22.24	22.15	24.74	24.31	5.71	6.4	<50
Arsenic	<1	1.72	2.09	1.5	4.6	1.2	<10
Mercury	<1	<1	<1	<1	<0.5	<0.5	<2
Helminthes	16	32	20	0	0	0	<1/g*
E. coli(CFU/gm)	14000	5000	17000	8000	800	700	<1000 CFU/g*

Key Messages

- The findings signified the scope of co-composting to identify the optimum blend of MSOW and FS required;
  - to produce a consistent and high-quality (valuable) compost product- one of the keys to circular economy
  - The heavy metal concentrations in the end-product were within the safe range for fertilizer use
  - Nutrient concentrations (N, P, and K) were shown to be sufficient for the germination and growth of the plants but needs to be added different bio-waste in co-composting for quality enhancement
  - Contributed to reduce GHG emissions

- The addition of sawdust helped to attain the optimal C/N ratio and increased the duration of the thermophilic phase, which in turn ensured the effective inactivation of pathogens, rendering the compost safer for downstream use.
- Findings provide useful guidance to operators of compost facilities tasked with safely recovering FS and MSOW in cities with off-grid sanitation systems.

Recommendations

- Political **will/vision/confident** to solve the problem of sanitation and waste management
- SW and FSM should recognize as **Urban Infrastructures** with realistic plans and targets – needs investment in both capacity building initiatives and recovery and treatment infrastructures **with safe containment, handling of FS and mandatory segregation of SW at source** and **financial sustainability** (provision of service fees and revenue generation plan),
- Private sector participation- **4P model** with inclusion of informal sector is crucial for sustainability in Global South,

- Subsidies to support co-composting and mandatory use of end-products for safer and sustainable waste management (*Local Government)*
- Standardize end products from fertilizer and public health perspectives

Thank You

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