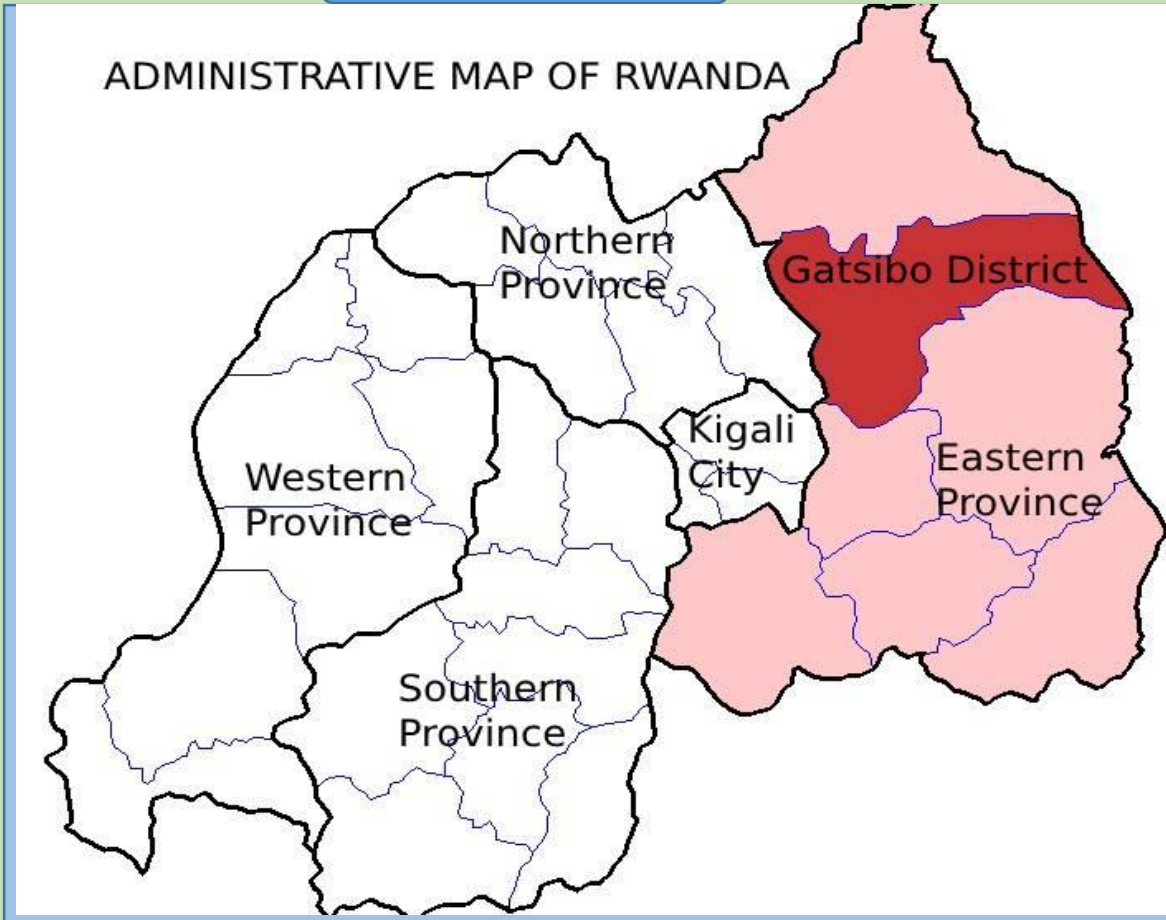


## INTRODUCTION

It is necessary to understand the characteristics and quantities of fecal sludge from on-site sanitation technologies, like a pit latrine or septic tank. This information is essential to plan and design appropriate fecal sludge management options.

## LOCATION MAP



## OBJECTIVES & BENEFITS OF FSM

The Objective of Feecal Sludge Management is the protection of public and environmental health. The goal of vermicomposting of fecal sludge is to produce a high-quality fertilizer that is safe to use in the soil and reduces the amount of pathogens in the sludge.

## FS ILLEGAL DUMPING



## ILLEGAL DUMPING OF FEACAL SLUDGE

Factors accelerating illegal dumping of fecal sludge are:

- **Lack of sanitation facilities:** If there aren't enough sanitation facilities, like septic tanks, people may dump fecal sludge illegally
- **Lack of water supplies:** If there aren't enough water supplies, people may dump fecal sludge illegally
- **Low economic status:** If people have a low economic status, they may dump fecal sludge illegally
- **Lack of appropriate technologies:** If there aren't the right technologies, it can be difficult to manage fecal sludge
- **Lack of management policies:** If there aren't the right management policies, it can be difficult to manage fecal sludge
- **Limited treatment plants:** If there aren't enough treatment plants, it can be difficult to manage fecal sludge.

## BENEFITS OF FSM

- ✓ Reduce the potential for human contact with fecal-borne pathogens by improving the functioning of onsite sanitation systems;
- ✓ Minimize odors and nuisances, and the uncontrolled discharge of organic matter from overflowing tanks or pits;
- ✓ Reduce indiscriminate disposal of collected fecal sludge;
- ✓ Production and sale of the end-products of the sludge treatment process. These products may include recycled water for agriculture and industry, soil conditioners from composting or co-composting materials, and energy products such as biogas, biodiesel, charcoal pellets, industrial powdered fuel, or electricity.
- ✓ Stimulate economic development, and job creation for sanitation workers (Emptiers, FSTP Operators, Drivers, Contractors, Equipment installers...) and livelihood opportunities, while addressing the issues of the social stigma and operator health and safety that continue to impact informal workers.

## POPULATION FORECAST

Year 2022	Annual Population Growth Rate (%)	Year 2024	Year 2029	District/Sector	Urban Rate (%)	Year 2024	Year 2029
551,164	2.4%	578,921	623,489	Gatsibo	10.0%	58,021	520,900
20,725	1.5%	21,351	22,327	Gasange	0.0%	0	21,351
40,940	1.1%	41,846	43,242	Gatsibo	16.0%	6,695	35,150
43,414	2.6%	45,701	49,359	Gitoki	15.0%	6,855	38,846
71,769	3.6%	77,029	85,652	Kabarore	21.0%	16,176	80,853
24,702	1.4%	25,398	26,480	Kageyo	0.0%	0	25,398
40,028	2.6%	42,137	45,509	Kiramuruzi	27.0%	11,377	30,760
39,757	2.9%	42,096	45,866	Kiziguro	14.0%	5,893	36,203
33,325	1.2%	34,130	35,373	Muhura	0.0%	0	34,130
38,498	2.9%	40,763	44,414	Murambi	0.0%	0	40,763
38,006	2.3%	39,774	42,582	Ngarara	19.0%	7,557	32,217
28,812	1.8%	29,859	31,500	Nyagihanga	0.0%	0	29,859
31,771	2.0%	33,055	35,078	Remera	0.0%	0	33,055
49,442	2.9%	52,351	57,039	Rugarama	5.5%	2,879	49,472
49,975	3.4%	53,431	59,068	Rwimbogo	1.1%	588	52,043
14,500	0.0%	14,500	14,500	Refugee Camp	100.0%	14,500	0

District	Sector	Pop 2024		Pop 2029		FS production (tons/d)									
		Urban	Rural	Urban	Rural	TOT	2024 U	2024 R	2029 U	2029 R	2024 U	2024 R	2029 U	2029 R	
Gatsibo		72,521	520,900	593,421	77,396	560,593	637,989	36.3	260.5	38.7	280.3	33.0	236.8	35.2	254.8
1	Gasange	0	21,351	21,351	0	22,327	22,327	0.0	10.7	0.0	11.2	0.0	9.7	0.0	10.1
2	Gatsibo	6,695	35,150	41,846	6,919	36,323	43,242	3.3	17.6	3.5	18.2	3.0	16.0	3.1	16.5
3	Gitoki	6,855	38,846	45,701	7,404	41,955	49,359	3.4	19.4	3.7	21.0	3.1	17.7	3.4	19.1
4	Kabarore	16,176	80,853	77,029	17,987	67,665	85,652	8.1	30.4	9.0	33.8	7.4	27.7	8.2	30.8
5	Kageyo	0	25,398	25,398	0	26,480	26,480	0.0	12.7	0.0	13.2	0.0	11.5	0.0	12.0
6	Kiramuruzi	11,377	30,760	42,137	12,288	33,222	45,509	5.7	15.4	6.1	16.6	5.2	14.0	5.6	15.1
7	Kiziguro	5,893	36,203	42,096	6,421	39,445	45,866	2.9	18.1	3.2	19.7	2.7	16.5	2.9	17.9
8	Muhura	0	34,130	34,130	0	35,373	35,373	0.0	17.1	0.0	17.7	0.0	15.5	0.0	16.1
9	Murambi	0	40,763	40,763	0	44,414	44,414	0.0	20.4	0.0	22.2	0.0	18.5	0.0	20.2
10	Ngarara	7,557	32,217	39,774	8,091	34,492	42,582	3.8	16.1	4.0	17.2	3.4	14.6	3.7	15.7
11	Nyagihanga	0	29,859	29,859	0	31,500	31,500	0.0	14.9	0.0	15.8	0.0	13.6	0.0	14.3
12	Remera	0	33,055	33,055	0	35,078	35,078	0.0	16.5	0.0	17.5	0.0	15.0	0.0	15.9
13	Rugarama	2,879	49,472	52,351	3,137	53,902	57,039	1.4	24.7	1.6	27.0	1.3	22.5	1.4	24.5
14	Rwimbogo	588	52,043	53,431	650	58,419	59,068	0.3	26.4	0.3	29.2	0.3	24.0	0.3	26.6
15	Refugee Camp	14,500	0	14,500	0	14,500	0	7.3	0.0	7.3	0.0	6.6	0.0	6.6	0.0

## FEACAL SLUDGE PRODUCTION

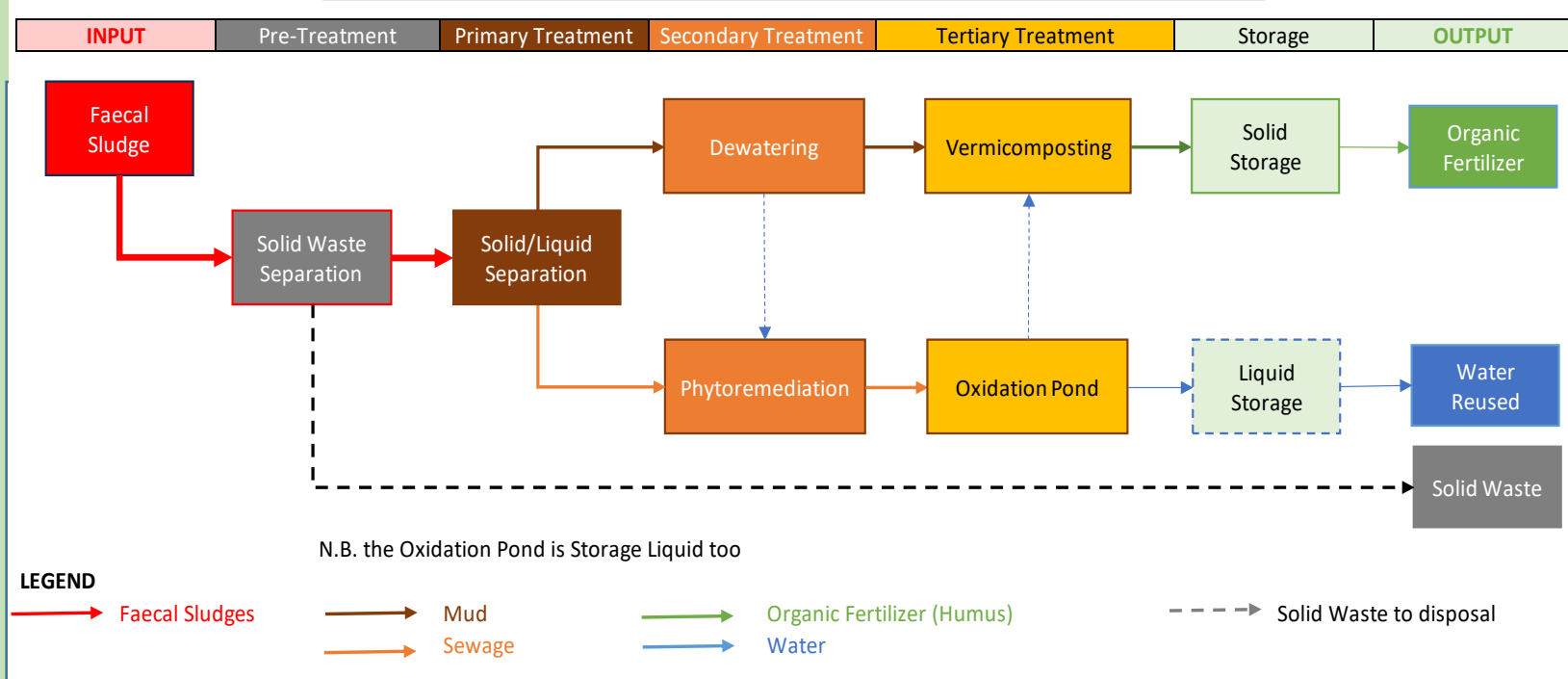
## EMPTYING CONTAINMENT



## RECEIVING CHAMBER



## FEACAL SLUDGE TREATMENT PROCESS



## PRECAUTIONS FOR VERMICOMPOSTING

There are some precautions to be taken such as

- Using plastic sheets to cover beds/heaps is not recommended because it may create a greenhouse effect causing air and gases to entrap in the vermicompost bed/heap. However overloading them can increase their temperature, which is harmful to the worms.
- The worms die out in the dry conditions and they simply move away when the ground becomes waterlogged.
- In June, July, and August during summer daily watering is ideal while in the rainy season (December to February) once a week whereas in winter every third day.
- In rainy weather, this can avoid the accumulation of water, and especially in areas with high rainfall during that season you will need to build a drainage channel around the heap.

## FINDINGS

From the analysis of the studies presented in this review, regarding the effects of the actions of worms *Eisenia fetida*, on the sewage sludge can be seen as follows: they biopurify the sewage sludge by accumulating heavy metals through the skin, through food, and through absorption. The sludge was cleaned of pathogenic bacteria, transforming the sludge into a quality fertilizer, rich in nutrients that benefits the soil and crops. In the case of vermicomposting with *Eisenia fetida*, the parasite eggs were removed after 21 days, and after 120 days pathogens have been reduced. Through vermicomposting, the volume of fecal sludge is reduced.

## EXPECTED OUTPUT

- Production of nutrient-rich, fine-grained compost that can be used as fertilizer.
- The process eliminates the unpleasant smell associated with fecal sludge,
- The process increases the amount of water-resistant aggregates in the vermicompost,
- Production of worm flavor protein-rich for fishery,

## MIXING DEWATERED SLUDGE WITH COW DUNG FOR VERMIBEDS

Mixing fecal sludge with cow dung during vermicomposting can significantly improve the quality of the final vermicompost by enhancing nutrient content, reducing pathogen levels, and promoting better earthworm activity, as the cow dung acts as a bulking agent and helps balance the carbon-to-nitrogen ratio, making the sludge more readily digestible for the worms.

## CROPS IN FERTILIZED SOIL



## Expected Output

- Increase in crop yield,
- The process reduces the number of pathogens, such as bacteria, viruses, and parasitic worms,
- Vermicomposting is in line of circular as it valorize treatment end-products,
- Fertilization is higher and the growth hormone (kinetin) content of plants is higher.

## SLUDGE THICKENING TANK



## VERMIBEDS



## TIGER WORMS



## SLUDGE DRYING BED



## CONSTRUCTED WETLAND



## TREATED WATER FOR CROP IRRIGATION



## OXIDATION POND



## VERMICOMPOST STORED IN WAREHOUSE



## VERMICOMPOST PACKED IN BAG



## VERMICOMPOST



## CONCLUSION

Vermicomposting of fecal sludge with *E. fetida* is a sustainable, economical, and practical method of fecal sludge management. *E. fetida* is a worm very often used in vermicomposting. Based on what is presented in this review, we believe that by using this ecological method of recovery of the sewage sludge, we protect the environment, we obtain pollutant-free agricultural crops, and ensure proper fecal sludge management.