

Figure 3 Thematic diagram of ST and SW (Source: Advisory on On-site & Off-site Sewage Management Practices)

A septic tank is an underground waterproof tank generally made of concrete and brick masonry where black water from toilet and greywater from kitchen and bathing place is stored for a certain period and is partially treated by biological process. In addition, the settling process causes the solid part to accumulate at the bottom and the liquid part to flow out through the outlet into the soak well, where it is filtered and absorbed by the soil. The accumulated solids at the bottom of the septic tank need to be emptied according to the design period. According to BNBC, below are the characteristics of a good septic tank [1].

Parameter	Description
Watertightness	Must be watertight
Volume	Volume is directly related to retention time. BNBC recommended that the minimum liquid retention time should be 24 hours to ensure settling, aerobic and anaerobic digestion. Though the actual volume is a calculated parameter according to the number of users, desludging frequency and liquid retention time but BNBC recommends a minimum volume (2m^3) to ensure minimum desludging frequency (6 months) and retention time (24 hours).
Liquid depth	The minimum liquid depth should be 1m to ensure the required space for digested sludge, sludge digestion, liquid retention and scum accumulation. If the minimum depth is not maintained, the microbial and settling process will hamper which makes the septic tank unsafe.
Minimum width	The minimum width should be 1m to maintain the length-width ration and the minimum volume. Also, it helps the mason in construction and repair work.
Length-width ratio	The ratio should be 2:1 for one chamber and 3:1 for two chambered septic tanks. The ratio should not be more than 4:1. Less than 2:1 will hamper the settling and more than 4:1 will increase the risk of structural failure.



Parameter	Description
Baffle wall	Up to 3m ³ one chambered septic tank is acceptable but above 3m ³ two chambered septic tank is recommended. That means a baffle wall should be provided in between inlet and outlet wall if the volume of septic tank is more than 3m ³ . It resists the direct flow and provide more surface area to grow bacteria. Also, it increases the structural strength against soil pressure.
“T” trap	Without T trap, the inlet flow will break down the scum layer and allow the unwanted material (Sanitary napkin, shampoo packet, condom etc.) directly to the outlet. Which will hamper the anaerobic process and clog the soak well.
Freeboard	The freeboard prevents overflow of septic tank when it is filled up. Also, it helps in ventilation by providing space for produced gas. The freeboard should be at least 300mm
Ventilation	It allows the produced gas to pass out which reduces the risk of blasting. Also, it reduces the risk of death during emptying. So, Proper ventilation should be provided for passing out harmful gas.
Soak well	It is the most important part of safe onsite sanitation system. Actually, it provides the safe disposal of partially treated effluent discharging from septic tank.

Table 1 Criteria of a septic tank according to BNBC

OBJECTIVE

The objective of the study is to find out the specific gaps of existing containment (septic tank) system in Khulna City Corporation and Jashore Paurashava according to BNBC.

MATERIALS AND METHODS

This study was conducted in Khulna City Corporation and Jashore paurashava in 2022. 60 septic tanks from KCC and 30 septic tanks from JP were randomly selected which covered different categories of building.

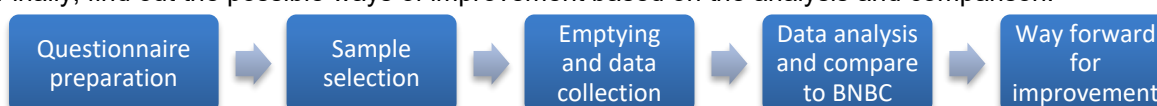
Jashore Paurashava			Khulna City Corporation		
Serial No.	Types of building	Number of septic tank	Serial No.	Types of building	Number of septic tank
1	Single-family residence	9	1	Single-family residence	42
2	Multifamily residence	14	2	Multifamily residence	17
3	Mixed-use	1	3	Mixed-use	0
4	Institutional	6	4	Institutional	1
Total=		30	Total=		60

A questionnaire containing 50 questions was prepared to observe the existing condition of the selected septic tanks. Then every selected septic tank was emptied by a municipal vacutug, observed the existing condition and recorded according to the questionnaire. The recorded data was analyzed by Microsoft Excel and compared with the characteristics of a good septic tank mentioned in the BNBC. For calculating required volume of a septic tank, we use the below formula that is also mentioned in the BNBC.

$$V=PQ+PSY [2]$$

Where, V=Volume of ST, P=Number of users, Q=Flow (litre/capita/day, lpcd) Volume required for sludge and scum (0.04 m³/capita/year), Y=Desludging frequency, year (Minimum 1 year). The minimum volume is considered 2m³ where the calculated volume was less than 2m³

Finally, find out the possible ways of improvement based on the analysis and comparison.



FINDINGS AND DISCUSSION

In Khulna, four septic tanks are undersized, one doesn't have the minimum liquid depth, two doesn't have the baffle wall and thirteen doesn't have the proper ventilation system. But the major problem is with the length-width ratio, T-trap and soak well. Only three septic tanks were okay with the length-width ratio but no T-trap and no soak well were found.

Parameter	Khulna City Corporation		Jashore Paurashava	
	No. of ST fulfil the criteria	No. of ST did not fulfil the criteria	No. of ST fulfil the criteria	No. of ST did not fulfil the criteria
Volume	56	4	28	2
Liquid depth	59	1	29	1
Minimum width	60	0	30	0
Length-width ratio	3	57	4	26
Baffle wall	58	2	27	3
"T" trap	0	60	0	30
Freeboard	60	0	30	0
Ventilation	47	13	21	9
Soak well	0	60	4	26

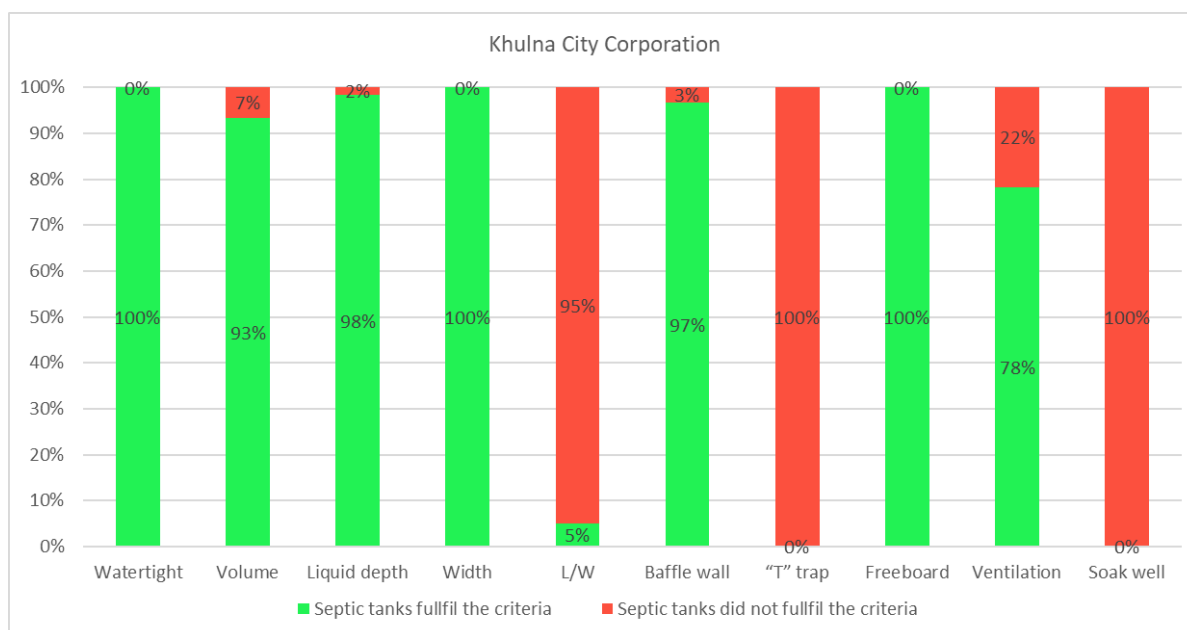
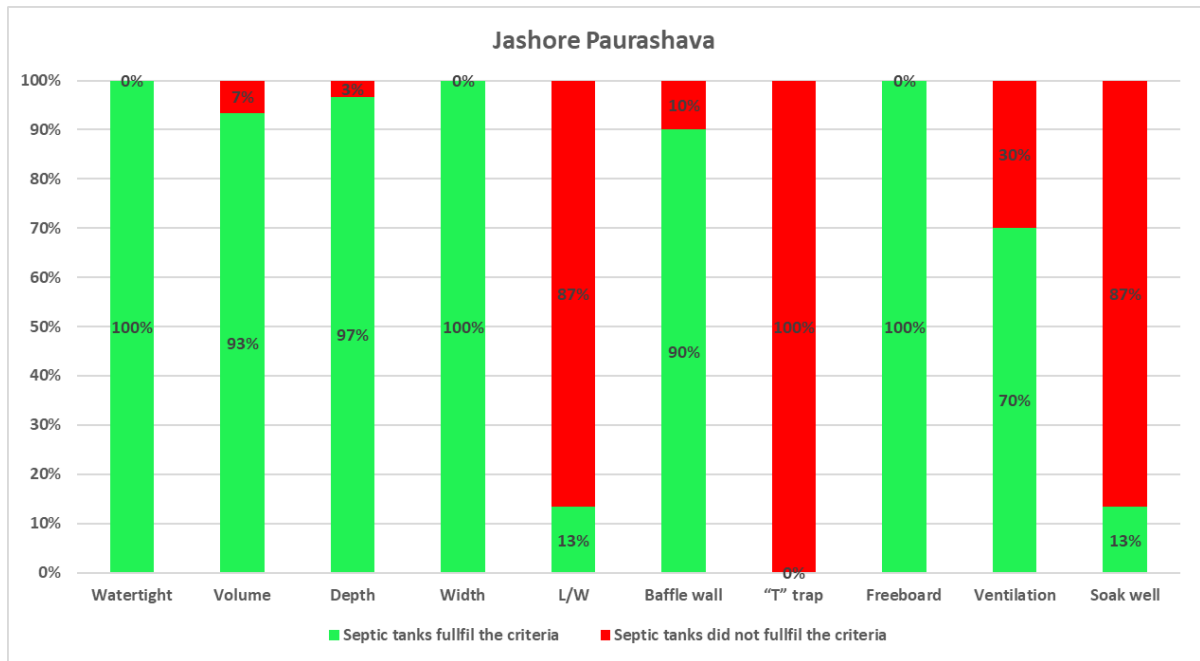


Figure-3 Survey result-KCC

The situation of Jashore is almost the same. Two septic tanks are undersized, one doesn't have the minimum liquid depth, three doesn't have the baffle wall and nine doesn't have the proper ventilation system and the major problem is also with the length-width ratio, T-trap and soak well. Only four septic tanks were okay with the length-width ratio but no T-trap were found. In terms of soak well Jashore is better than Khulna, 4 soak well found out of 30 that 13% septic tank has soak well.



In absence of T trap, the septic tanks do not function as septic tank. These are just holding tanks and the solid part passes through the outlet (figure-6) and finally goes to the environment through the drainage system (as there is no soak well).

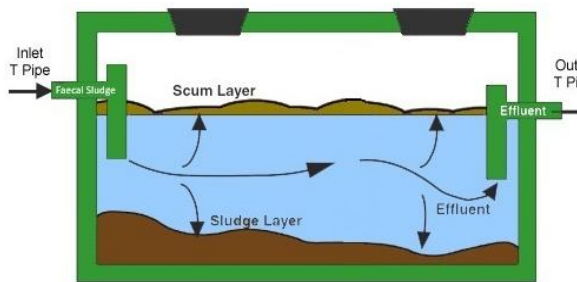


Figure 5 Septic tank with T trap

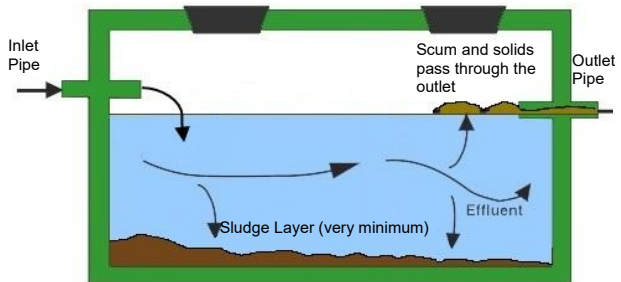


Figure 6 Septic tank without T trap

RECOMMANDATION

Changing the length-width ratio of the existing septic tank is quite impossible but adding T trap, ventilation and soak well or any other effluent treatment unit is possible. To improve the existing containment system, KCC and Jashore Paurashava should focus on T-trap, ventilation system and soak well which will ultimately contribute to safely managed sanitation in these cities.

STUDY LIMITATIONS

For time and budget constraints the total sample size was limited to 90 instead of following statistical formula.

ACKNOWLEDGEMENTS

Geo Planning for Advanced Development (GPAD) was conducted the survey and collect field data. The conservancy section of Jashore Paurashava and the waste management department of Khulna City corporation was supported a lot.

References

- [1] B. N. B. C. 2020 ed., vol. Chapter 6, Ministry of Housing and Public Works, 2020, pp. 4886-4887.
- [2] B. N. B. C. 2020 ed., vol. Appendix S, Ministry of Housing and Public Works, 2020, p. 4995.