Developing an Evaluation Protocol for Composting Toilet Systems

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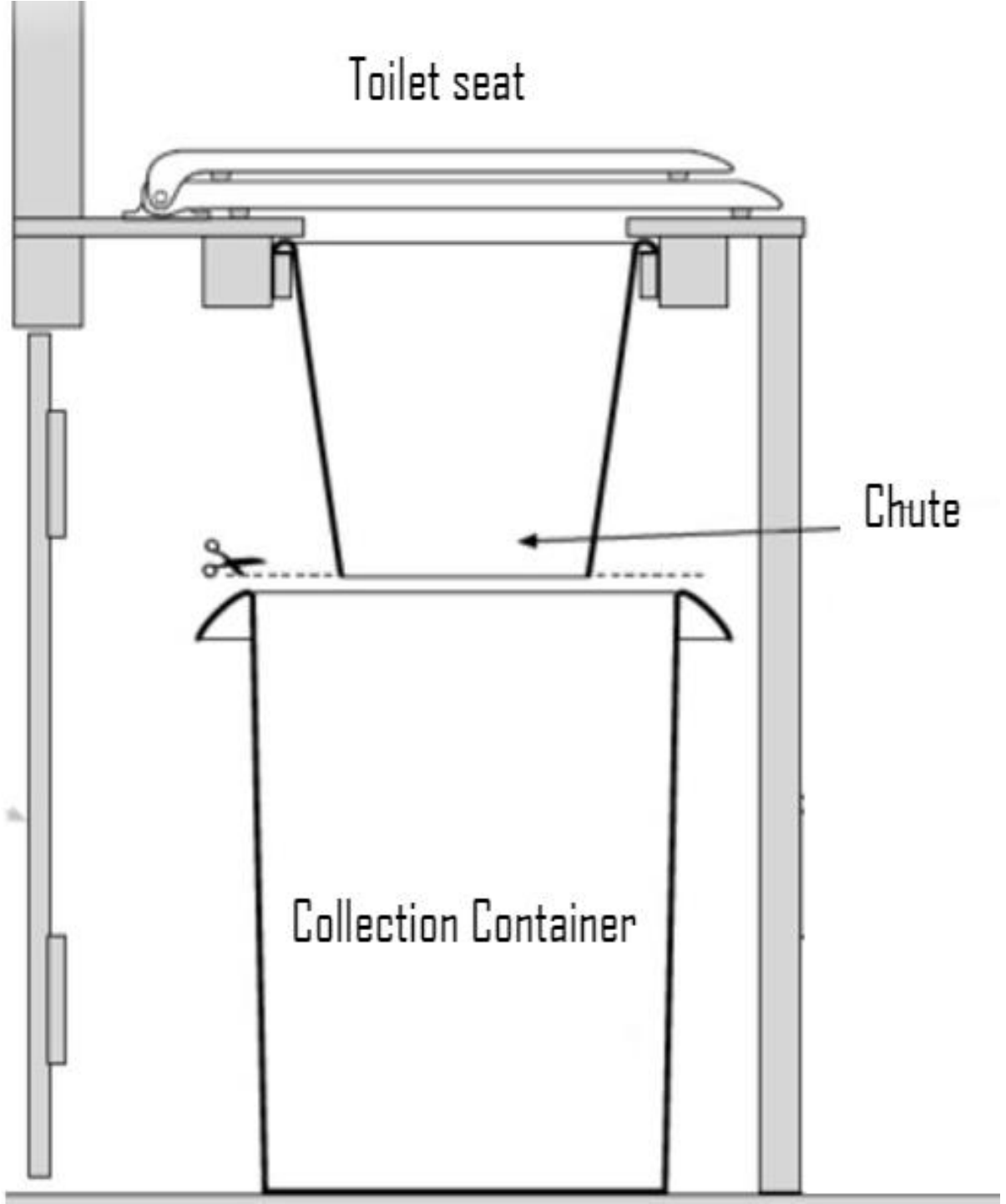
2 billion people

lack access to

sanitation facilities.



Composting toilet systems help combat the Global Sanitation Crisis by providing containment of human waste.

Pros:

- No energy required
- Waterless
- Provide fertilizer

Cons:

- Lack of practical evaluation protocol

Our goal was to develop a practical protocol for evaluating composting toilets.

Identify variables

Develop protocol

Trial protocol at Lotan

Improve protocol

Identified variables

Functional Variables

Bacterial Conditions

- Temperature
- pH
- Moisture

Bacterial Efficiency

- Input Volume
- Output Volume
- Time

Benefit of Compost

- NPK

Health Risk

- E. Coli

Usage Variables

Use per week?

User comfort?

Preference?

First impressions?

System conditions?

Recommended improvements?

Prior experiences?

Community perception?

Maintenance Variables

Maintenance...		
Frequency	Difficulty	Challenges

Specifics of...		
Once a Day	Once a Week	Once a Month

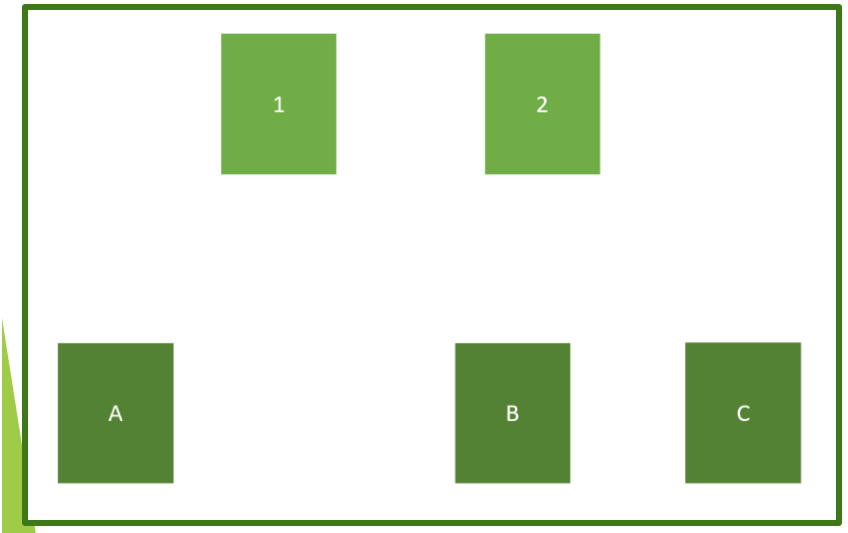
Improvements to...		
Design	Use	Maintenance

Developed protocol

Trialed protocol at Lotan

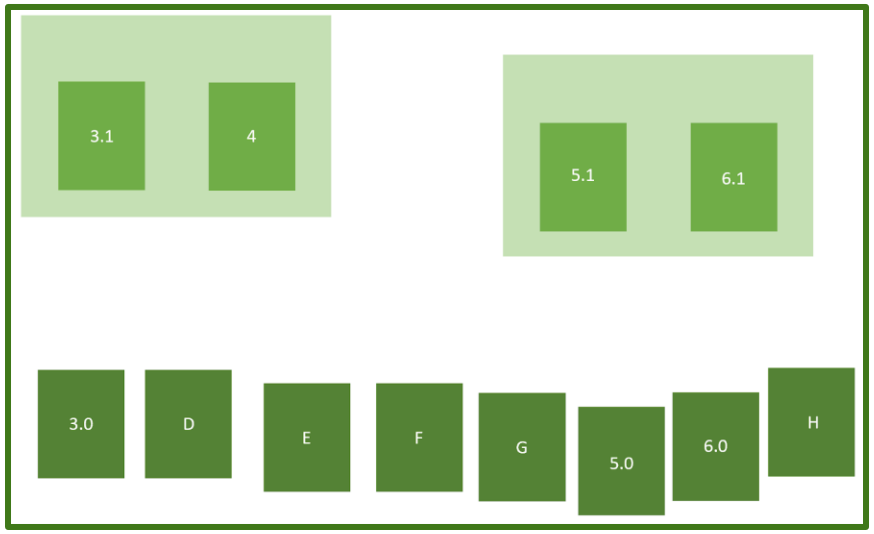
Lotan Systems

Square Dome Private Toilets



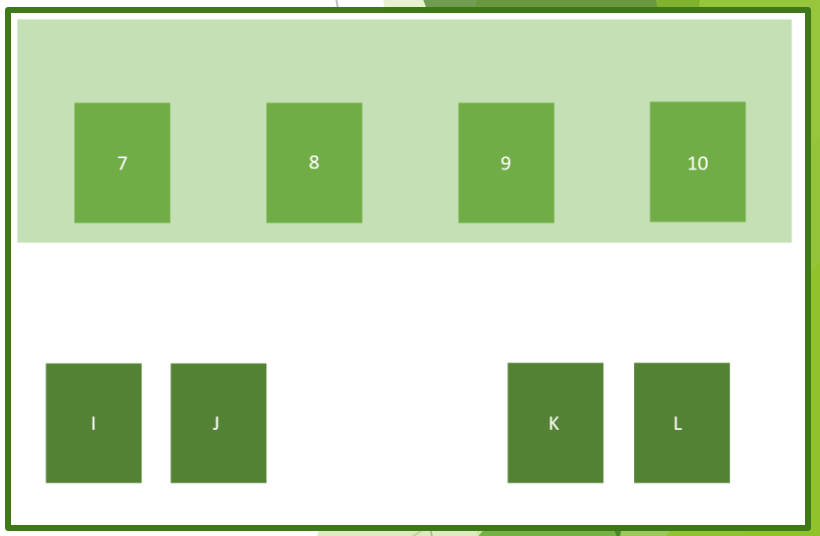
2 Active Bins
3 Inactive Bins

EcoCampus Communal Toilets



4 Active Bins
8 Inactive Bins

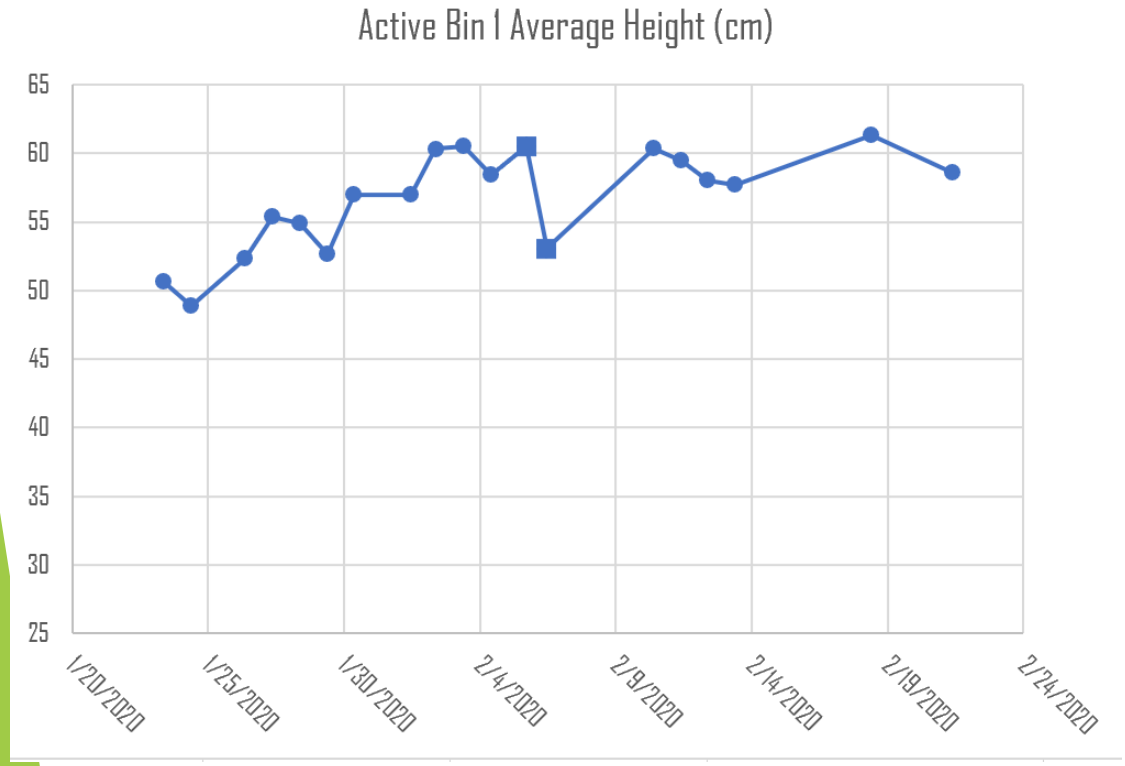
EcoKef Public Toilets

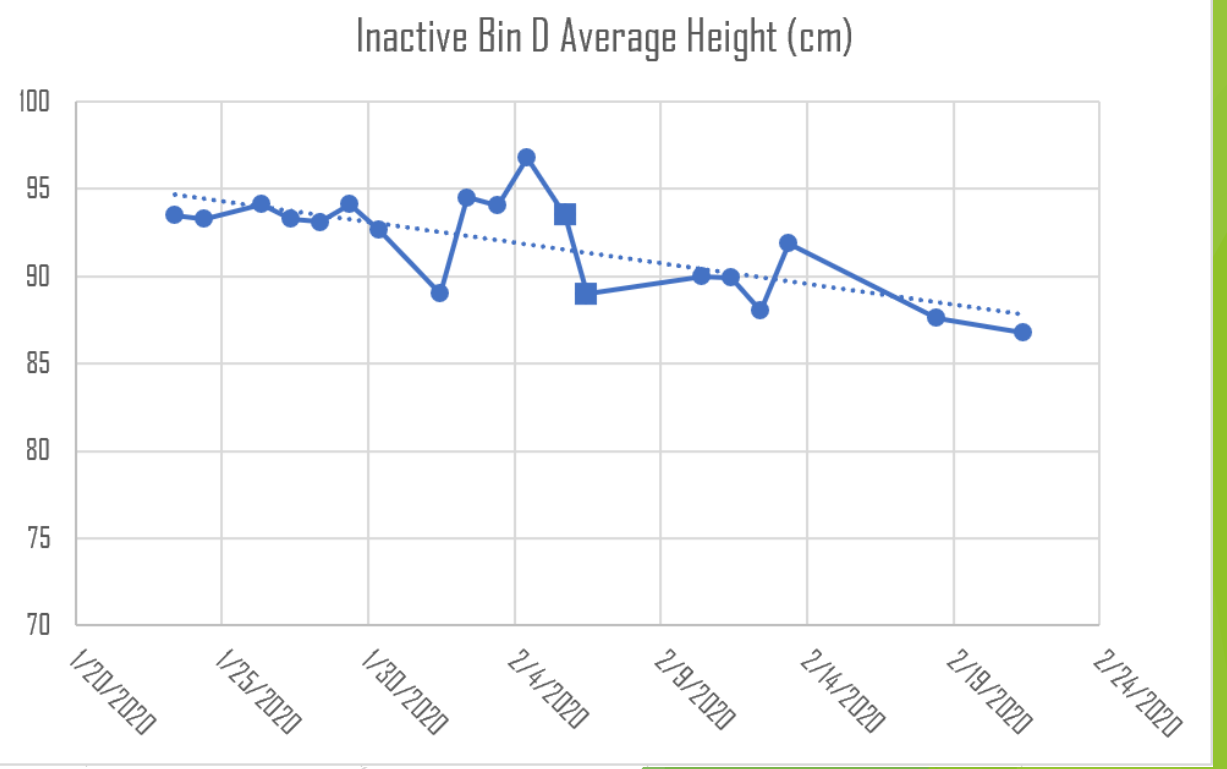


4 Active Bins
4 Inactive Bins

Functional Results

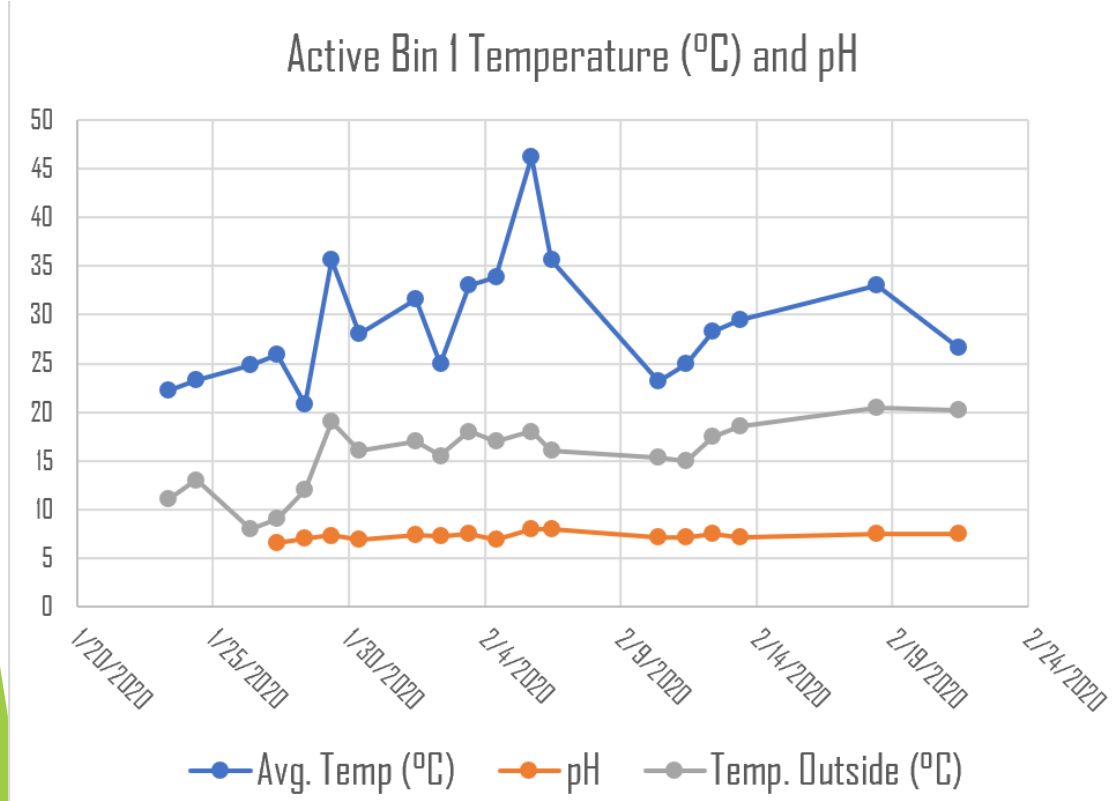
Inactive bins are decreasing in volume, meaning decomposition is taking place.

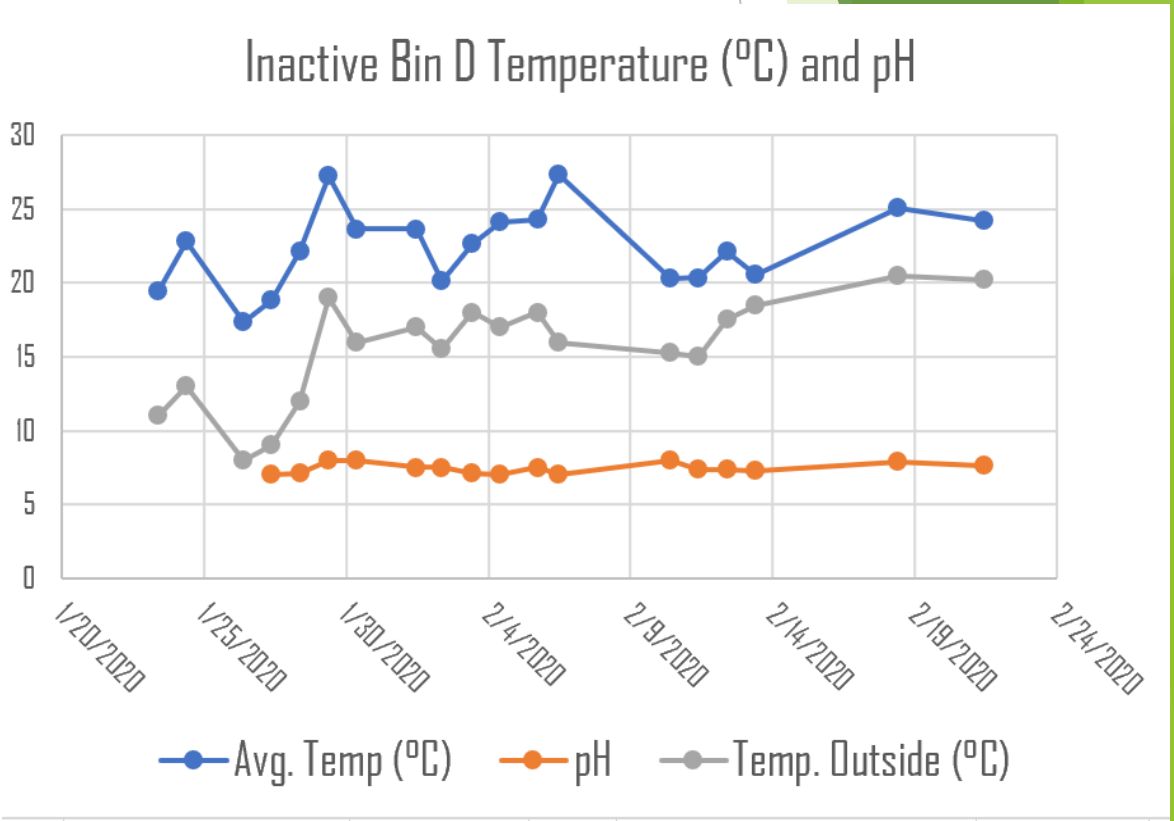




Functional Results

Temperatures are low, but do not seem to be affecting the efficacy of the system.





Functional Results

The composting process is eliminating E. coli, but long-term storage is contaminated.

Active

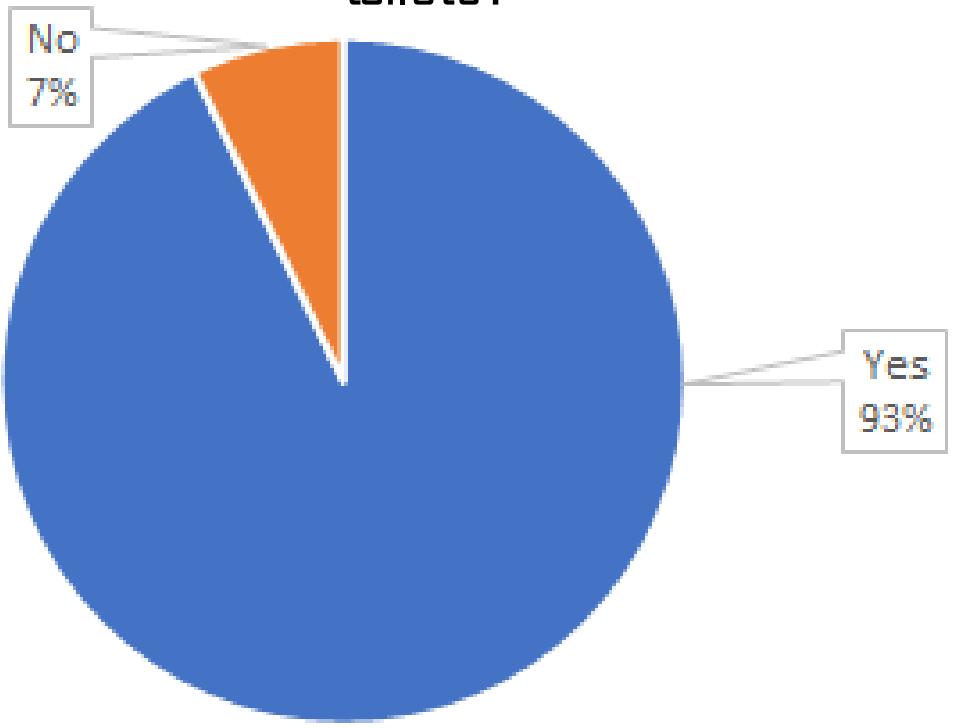
Inactive

Storage

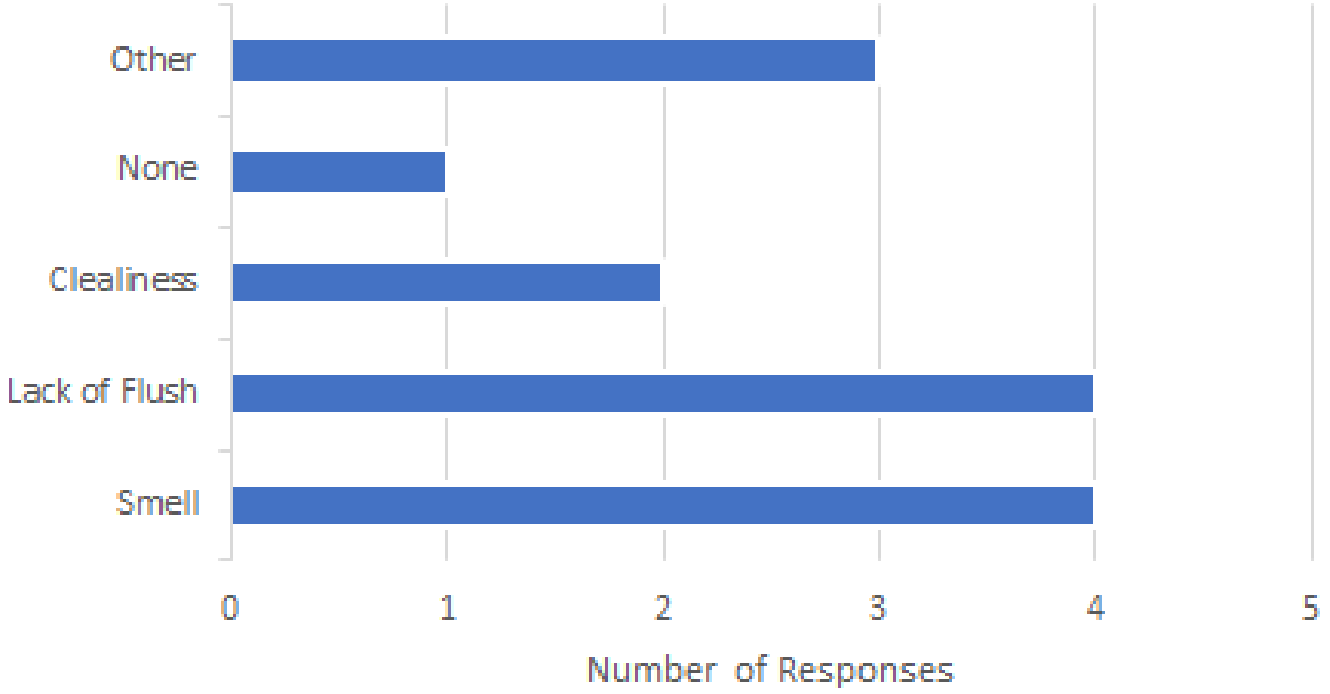
Usage Results

Users accept the system, though comment about the smell.

Are you comfortable using the composting toilets?



What are the differences from a flush toilet?



Maintenance Results

"The most challenging part of maintaining [the composting toilets] is **draining the leachate**." - Eran Meiri

"The biggest challenge in maintenance is the **leachate**." - Mike Kaplin

Recommendations for Lotan

Functional

- Keep bins warm
- Enclose long-term storage

Usage

- Reconnect fans at EcoCampus
- Engineer dry material "flush"

Maintenance

- Drain leachate every week
- Seal leaking bins

Improved protocol

Functional:

Giving alternative measurement tool suggestions for under-resourced areas

Usage:

Diversifying survey subjects

Maintenance:

Recording observational data (if bins are leaking, cracked, etc.)

Acknowledgements

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Variable	What is its importance?	What is the ideal measurement?	What is the measurement tool?
Input/Output volumes	Measures bacterial efficiency	The output is 30% of input	Meter stick
Microorganism presence	Measures bacterial presence	N/A, dependent on the size of the system	Culture Counting
Temperature	Measures system conditions	60°C	Thermometer
pH	Measures system conditions	6.5 to 7.5	pH meter
Moisture	Measures system conditions	40% to 70% moisture concentration	Moisture meter
NPK	Measures benefit of compost	N/A, dependent on the desired use of compost	NPK test kit
. coli	Measures health risk	0	Compartment Bag Test by Aquagenex
me	Measures bacterial efficiency	N/A	Clock and calendar

Variable	Type of response	Importance
Use per week	Number	How frequently they use the composting toilet
User comfort	Y/N	Whether or not they feel comfortable using the composting toilets
Preference for composting toilets	Y/N	Do they prefer to use the composting toilets over flush ones
First impressions of the system	Long answer	How the user felt using the composting toilet system for the first time
Perception of system conditions	Long answer	How they feel the conditions of the composting toilets are
Differences from flush toilets	Long answer	Differences from flush toilets
Community perception	Long answer	How does their community perceive composting toilets
Prior experience with a composting toilet system	Long answer	Other places they have used a composting toilet system and what their experience was like there
Recommended improvements	Long answer	Things they think could be improved

Variable	Importance
Frequency of maintenance	How well the system is looked after
Difficulty of maintenance	The burden on those doing maintenance
Challenges of maintenance	Potential problems, room for change
Specifics of once a day maintenance	Most important or sensitive components
Specifics of once a week maintenance	Secondarily important or sensitive components
Specifics of once a month maintenance	Tertiarily important or sensitive components
Ideal improvements to maintenance	Areas long-term personal found unsatisfactory in work being done
Ideal improvements to the design	Areas long-term personal found unsatisfactory in problems or required labor
Perception of safety	Comfort and willingness to perform maintenance