International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2019): 7.583

Functionality Analysis of Sanitation Options in Rohingya Camps in Cox's Bazar of Bangladesh

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Abstract: ***In august 2017, over 788,901 refugees, who are known as "Rohingya", were forced to take refuge in Bangladesh from Myanmar, resulting in the fastest growing forced displacement crisis in the world. The majority of these refugees now live in 34 Camps in Cox's Bazar and around 45 agencies and government build 26,000 temporary emergency latrines at very initial stage of response, which became broken or overflowing within three months. In the later stage sector proposed unified design to overcome the challenges of not addressing the quality, standard and other perspectives issues. The major activity in this later stage became decommissioning and end of the first year of response desludging and fecal sludge management. Although the initial WASH sector strategy for these Rohingyas focused on the emergency provision, in the next phase of the emergency the strategy is changing to reflect on the more settled position that needs to identify more sustainable sanitation options. To support this objective, this study assesses functionality of different sanitation options based on user perspective, hardware conditions, performance, cost effectiveness and suitability, which helps to identify the most sustainable options in refugee camps and also taking into account the first year experience and recommendation from experts.More specifically, the survey was used conducted on 115 most common latrine types which has been using at least six months in highly populated ten camps and WASH specialist of ten different organization and coordination body. Functionality based on user perspective and hardware condition. Almost all small children went for open defecation, which is similar to their previous practice. Very few are facing challenges of distance and overcrowding but 36% raised the issue with privacy. 85% mentioned about odour problem and although there is enough ventilation. 71% mentioned about lack of lighting facilities to access latrine during night (not inside the latrineon the way to latrine). Less than 70% of the useable latrines are hygienic considering all indicators of proper water seal, leaking of fecal containment or pit, odour and flies as problems. 80% of the major components of superstructure (Stairs, Doors, Inside floor, Padastral/foot raise, Squatting pan, Roof, Gas pipe) were found working. 23% does not has proper soak pit and majority soak pits are not working properly and user believe this latrine create environmental pollution. 13% latrine became flooded and polluted water during monsoon.64% latrine surroundings were found clean and 56% mentioned that both men and women contribute to clean latrine once in every three days with water. Only a very small percentage of latrine has arrangement of water storage, basic hygiene items like soap and 41% has facilities like handwashing place available near the latrine. 67% latrine needed desludging after every two months which is not happing when it required and sometimes it takes more than two weeks. Around 42% received training on O&M and received latrine cleaning kit. 85% mentioned that monitoring was done by different agencies. Majority collect water from tap stand or tubewell for drinking and cooking purposes and only 3% use chemical (purification tablet) when it's required. Less than 50% of the family member has practice of hand washing in critical times. First one year Diarhhea, Loose motion, Dysentery, Stomach ache were the most common water relateddiseases in the family in, but these incidence were found much less in last two months. Functionality based on performance and cost-effective: Refugee Relief and Repatriation Commission (RRRC) and sector recommended four options seven types and out of themthree types and different other options as piloted by different agencies mostly installed after three months' operation. Considering the cost effectiveness twin pit (5.9 USD/person/year), sceptic tank (4.4 USD/person/year), Biogas (4.9USD/person/year) and biofilsingle pit (10.9 USD/person/year) and biofil twin pit (4.4 USD/person/year) are considerable. Similarly,the main cost for longer operation and associated O&M cost, Bio-fil Twin Pit (0.89 USD/year), Bio-fil single Pit (2.01 USD/year), septic tank (2.33 USD/year) and twin-pit (2.97 USD/year) are found best option based on the performance and cost effectiveness. Sustainability of different options: Considering sustainability indicator of Sustainable Sanitation Alliance (SuSanA), Biofil and Biogas reactors carry more positive points and next options are twin pit and septic tank. Recommendation: Unified design need to reviewed based on space, topography, soil permeability, sub-surface water level and user number which are the key influencing factors for functionality. Expert recommended twin-pit with larger depth (10') and bigger dia ring (48") with proper "Y" junction and similarly forBiofil and Septic tank as third option.At the same time regular monitoring and timely desludging by agencies is most essential and need to ensure user engagement for clearing and day to day maintenance and establishing complain response mechanism (CRM) is highly recommended.***

Keywords: Functionality, Sanitation, Performance, Cost Effectiveness, Sustainability

1. Background

The Violence in Rakhine State, Myanmar, which began on 25 August 2017, has driven an estimated 646,000 people to seek sanctuary in Cox's Bazar, Bangladesh. [Wash Sector Strategy for Rohingyas Influx - 2018] Over 700,000 refugees, including more than 380,000 children, followed those first arrivals over the subsequent four months, making this the largest and fastest refugee influx– the fastest growing forced displacement crisis in the world and the majority of the refugees now live in 34 Camps in Ukhiya and Teknaf Upazilas that, by May 2018, had been formally designated by the Government of Bangladesh. [Joint Response Plan for Rohingya Humanitarian Crisis (March - December 2018) Mid-Term Review] Ninety-eight percent of households reported that adult household residents "usually" defecate in a latrine, with 6% "sometimes" resorting to open defecation. However, 65% of households reported that children under 5 "usually" defecate in the open, with 95% reporting that this "sometimes" happened. [Bangladesh Cox's Bazar, Rohingya refugee response April 2018 Water, Sanitation and Hygiene baseline assessment]

1.05 Million in need of immediate WASH support. 788,901 women, men, children in settlements who are benefitting from functional latrines to agreed standards and 740, 461 peoples in the camps and 48,440 people from Bangladeshi host community continue to access a functional latrine, inclduing care and cleaning. The Sector desludged 12,079 latrines during the reporting period (cumulative total: 86,033). [Cox's Bazar WASH Sector Operational Presence November 2018] Acute Watery Diarrhea (AWD) 5.4 % was the one of the leading illnesses in the area for week 36. AWD cases remain fairly low currently compared to annual average. It is expected that an increase may happen post-monsoon season. [Rohingya Refugee Crisis - WHO Bangladesh Weekly Situation Report #43, 13 September 2018]

The initial Sector strategy focused on the emergency provision of water, emergency latrines and the distribution of hygiene materials, supported by promotion activities. Into the next phase of the emergency the strategy is changing to reflect the more settled position of the Rohingya. Focus will change to the rationalization and improved construction of the construction of semi-permanent toilets, operation and maintenance of these facilities including sludge treatment, a greater emphasis on hygiene and community engagement. Without immediate, adequate water, sanitation and hygiene, preventable disease outbreaks will continue and worsen. Acute watery diarrhea is endemic in Bangladesh, and a dangerous combination with the high malnutrition rates of Rohingya populations. At the current density of population, any outbreak has the potential to kill thousands.

More than 26,000 temporary emergency latrines have been built so far — but “there are concerns regarding the quality, durability and the geographic distribution of the infrastructure,” according to the report. Meanwhile, broken or overflowing latrines — as many as 36 percent of constructed latrines were about to get full, according to a Nov. 05,2018 WASH sector report — take up valuable space that could potentially be used for other services. Many organizations have continued to dig shallow tube wells, which are cheaper and quicker to construct at less than 300 feet, but these will likely need to be converted into deep tube wells in order to provide safer drinking water. Very few groups have been chlorinating the wells after construction to protect against fecal contamination. [In Bangladesh, did groups build emergency latrines for Rohingya refugees — or for donors? By Kelli Rogers // 17 November 2017]

1.1 Objective of the study

This study is carried out having the following objectives:

a) To assess technological effectiveness of different sanitation options in Rohingya camp perspective
b) To identify most sustainable sanitation options for scaling up in refugee camp perspective

1.2 Specific Objectives

a) To assess functionality of different sanitation options based on user perspective
b) To assess functionality of different sanitation options based on hardware condition
c) To assess performance of different sanitation options based on cost effectiveness
d) To assess functionality of different sanitation options based on expert opinions

1.3 Outcomes

It was intended that following outcomes would be achieved after the study

a) Functionality of installed different sanitation options based on both the technical and user prospective
b) Identify sustainable sanitation options for camp perspective.

1.4 Methodology

The study has mainly concentrated on functionality analysis based on both technological and user prospective of different sanitation options in ten camps with highest population and asses the sustainability based on the four different major aspect covering area under the dimensions of sanitation 1) sociocultural and institutional, 2) financial and economic, 3) technology and operation aspect and 4) environmental and health.

A survey was conducted on 115 most common latrine types which has been using more than six months in highly populated ten camps and the survey was done through questioner survey for user community, latrine physical checking checklist and key informants' interviews (KII) was conducted with ten sector professionals of different humanitarian organization, coordination body (ISCG and WASH Cluster) and government department DPHE. Secondary information has been collected from published and unpublished governmental, international agency, WASH and Health cluster, ISCG reports, studies of consultants also used to fulfil the study.

2. Introduction

In the initial stage 66% (693,123) of targeted women, men, children in settlements who are benefitting of functional latrines of agreed standards twelve months into the response, 55% of households use a communal latrine while shared and single household latrines account for about 48% of infrastructures built. Latrine facilities functionality status recorded in the infrastructure mapping conducted by REACH shows that 83% functional.

According to 4W metrics January 2019 only functional latrine 41,088 (70.43%), latrines decommissioned 7,706 (13.20%) and need to be decommissioned 9,548 (16.37%). Among the functional latrine 15% needed to be desludge in a regular basis otherwise it increases risk of over using functional latrine or adopting people coping negative mechanism like going for open defecation. The 30% of current latrine are mostly the emergency phase latrine with low capacity with temporary structure. Lack of space, topography and soil permeability are the main factor which influence the quick filling up of the latrine pits and socking of wastewater beside the uncontrolled use of latrine. Currently desludging became one of the main activity which agency are struggling to operate.

After six months of influx most of the agencies started following the unified design latrine which approved by 3RC and Cluster and three of them mostly installed. Beside the unified design some agency try several other options to understand the functionally under this context. This study tried to find out the functionality of those mostly installed options and best suitable option for scaling up.

2.1 Functionality based on user perspective

Previous Practice

User reported that both male and female (95%) previously used their own latrine and only 5% used their neighbour's latrine. But 95% children had the practice of doing open defecation. 80% used single pit latrine and use water to keep the latrine clean.

Accessibility, Privacy and Convenience

A combined 53% of households continue to have access challenges including distance, overcrowding, and location and overflowing due to high water table and construction challenges.[1] According to the study only 9% are facing challenges of distance and overcrowding and 88% reported feel comfortable using the current latrine, but 36% raised the issue with privacy. 89% mentioned that even in monsoon they could able to access latrine.

In 57% of households, women reported feeling unsafe using latrine facilities at night.[7] About 95% female use latrine when they needed and 92% mentioned that they feel safe to go to latrine. Except the small kids all family member use latrine.

85% responded mention they don't face any kind of odor problem which made uncomfortable to use the latrine.

Ventilation and light

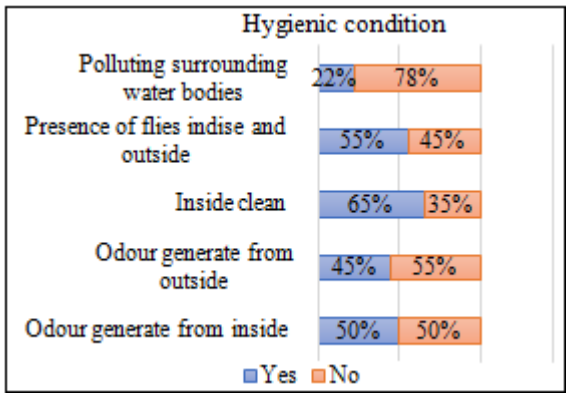
97% and 89% respectively has considered proper ventilation and light inside the latrine and also71% mentioned that there is lighting facilities to access latrine for night use (not inside the latrine).

[1] Mid-Term Review, Joint Response Plan (March - December) 2018

2.2 Functionality based on hardware condition

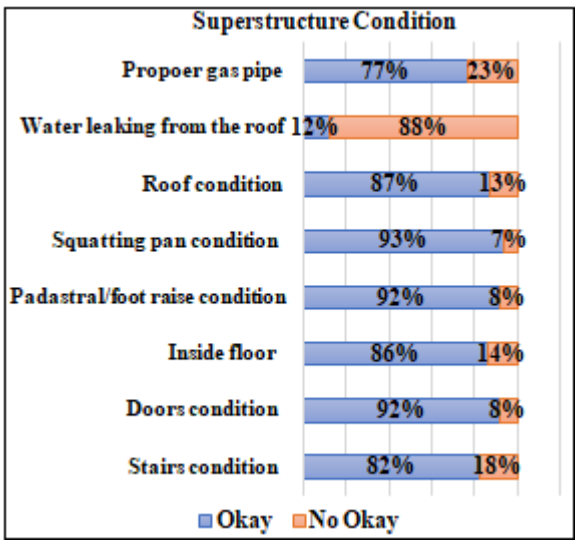
Hygienic Condition

Less than 70% of the functional latrine are hygienic considering all indicators. 65% water seal is working properly and there 22% leaking of fecal containment pit which pollute the surrounding water bodies/environment. Odour and files are common problem which are respectively 50% and 55%.



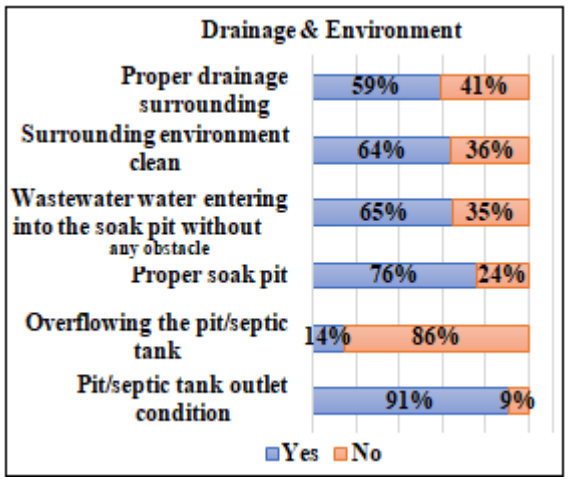
Condition of superstructure

More than 26,000 temporary emergency latrines has been built so far —meanwhile, broken or overflowing latrines — as many as 36 percent of constructed latrines were about to get full and dad to desludged 12,079 latrines in two weeks' time (cumulative total: 86,033).[2]According to the study major component of superstructure (Stairs – 82% , Doors – 92%, Inside floor – 86%,Padastral/foot raise- 92%, Squatting pan – 93%, Roof –87%, Gas pipe – 77%) condition found working relatively in better position.



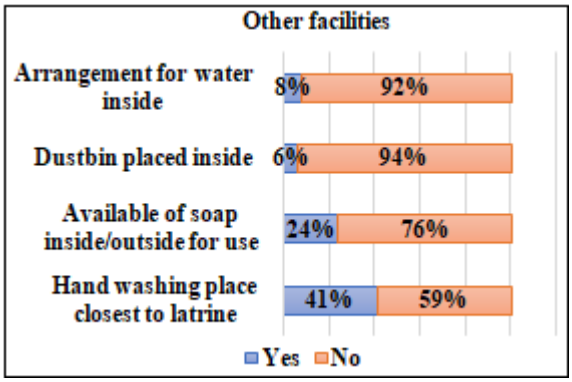
Drainage and Environment

Drainage and environment are the dominating factors for all type of option's functionality. 23% don't has proper soak pit and 86% soak pit are in an environment where its works properly. 45% user believe this latrine create environmental pollution and 13% latrine became flooded and pollute water during monsoon. But 64% latrine surroundings found clean but 59% has some kind of drainage system which doesn't allow water keep stagnant.



Other facilities

Only 8% latrine has arrangement of water storage and 24% basic hygiene item like soap is available inside or close to latrine for use. 41% has facilities like handwashing place available inside or near the latrine has been address. In 6% dustbin is found inside the latrine.



Operation & Maintenance

56% mentioned that both man and women clean latrine when its required. 29% and 17% respectively are only women and man clean latrine in every three days. Also in some cases agency providing cleaning facilities for the communal latrine. Water is commonly used for regular cleaning and only 10% using cleaning agent and 16% respondent believe cleaning is labour intensive. For cleaning 77% used only water and rest use cleaning agent.

67% respondent said the latrine they are using needed to desludging every two months, 25% within 3-5 months of time. According to respondent desludging is not happing when it required and sometimes it takes two weeks' time.

Desludging Frequency in Month (within)	Latrine (in %)
1	41
2	26
3	14
5	11
8	5
12	3

[2] November 2018 WASH sector report

42% mentioned that they received training on O&M for latrine but only 30% received latrine cleaning kit. 85% mentioned that monitoring is done by proving organization or by other agency and 35% mentioned that when agency is doing the desludging they support the team.

83% user collect water from different sources for latrine use and remaining 17% use water from storage of own or neighbour. 38% female or children and 52% male collect water from source. There is no kind of good practice or facilities found of storing water near the latrine.

Advantages
According to the respondents about the advantages of the current latrine weremaintenance is easy (74%), east wastes of water/ less water needed for keep it clean (26%), take long time to fill up (33%), cleaning not required frequently (30%), no cost is involved for emptying the pit of latrine (24%), It is usable during monsoon (42%) and all of them (15%). Only 17% of the respondent mentioned that generally they don't face problem which hinder using latrine.

Satisfaction
Considering the advantages and hygienic condition Biofil, Septic Tank and Twin pit are three options user satisfaction level is high.

Functionality based on performance

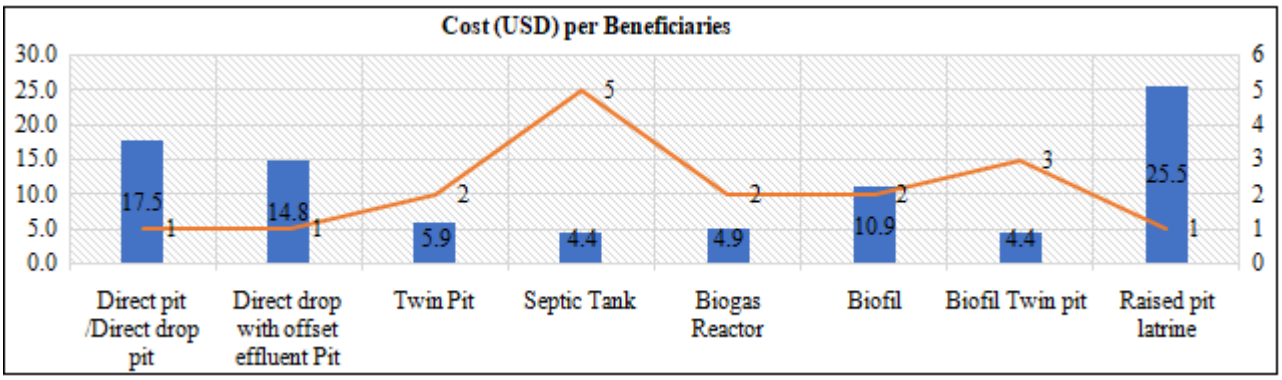
According to the 4W matrix February 2019 total 52,310 latrine has been installed and according to Refugee settlement infrastructure round 9 November 2018 (Annex - 3) out of which 86% were functional and 26 people per latrine which were functional and safe (81%). There are four option which has been mostly installed by the different agencies and also there are few other option which has been tested/promoted.

Table 3: Performance of different options

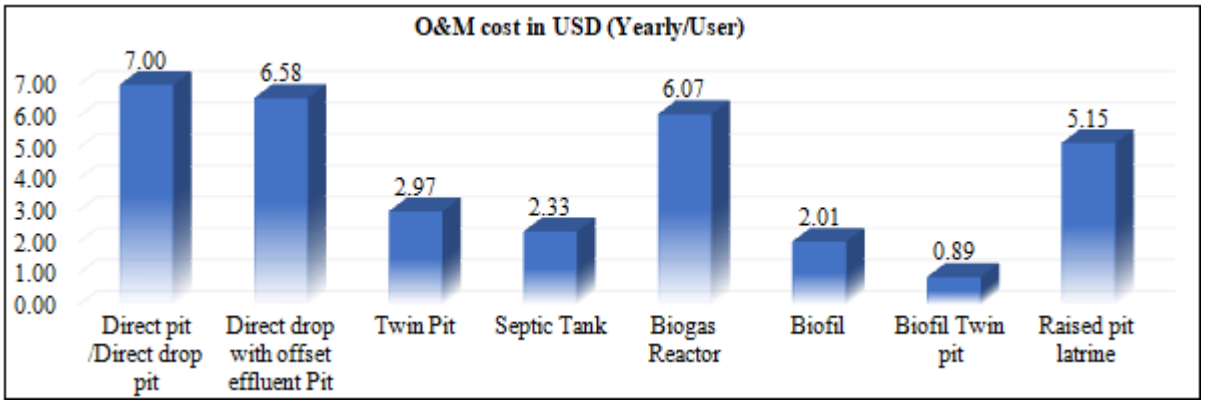
Sanitation Option	Number / % of installed	Number / % functional	Installation cost (BDT)	User Number	Regular O&M cost (BDT)	Desludging frequency	Desludging Cost (per year)	Durability (Year)	Common Problem
Direct pit /Direct drop	7 - 15%	50%	12,000 – 37,000	45	80	20 - 25 days	1500 X 17 = 25,500	1	• Its filled very frequently.
Direct drop with offset effluent Pit	0 - 25%	50%	57,000 – 60,000	94	120	20-25 days	3000 X 17= 51,000	1	• Squatting slab & water seal not working properly.
Twin Pit	40 - 60%	85%	27,000 – 60,000	94	150	45-50 days	3000 X 7.5 = 22,500	2	• Squatting slab & water seal not working properly. • Pipe slopping Problem. • Bad small, required lot of water for flushing
Septic Tank	5 - 10%	95%	120,000	100	175	45 - 90 days	3000 X 7.5 = 22,500	5	• After few months, the sock pit don't work.
Biogas Reactor	66	40%	350,000	275	350	15 days	2000 X 25 = 50,000	2	• Discharge pit filled very frequently & sludge's overflowing.
Biofil	2000	95%	25,500 – 54,000	38	50	60 - 180 days	2500 X 3 = 7,500	2	• Desludging is critical and cost is high, which has to be done by service provider agency.
Raised pit latrine	40	97%	75,000	60	150	20 - 25 days	1500 X 17 = 25,500	1	• Need repair of latrine protection frequently.

Cost Efficiency Analysis

Value for money is essential but considering the first phase of the emergency which is generally overlooked because of "saving life" is the first priority and secondly availability of materials within short period of time within limited resource and accessibility. But gradually the analysis for cost efficiency become primary for second or intermediate phase of emergency, for better design and effective response program. Considering all the factors like installation cost, management cost, monitoring & hygiene promotion cost, regular O&M cost, desluding cost, durability and number of user cover by the option.



It is apparent that only three option twin-pit, septic tank and biofil are more cost efferective considering cost per benificary incuding the yearly O&M cost. Simialry as the O&M is the main cost longer operation considering that Biofil (0.89 USD/user), septic tank (2.33 USD/user) and twin-pit (2.97 USD/user) are the best option.



Hygiene Behaviour & Disease Trend

97% mentioned that they collect water from tape stand or tubewell for drinking and cooking purposes and only 3% use chemical for water purification when needed. Only in 41% case there is some facilities near the latrine for handwashing. Less than 50% of the family member of the respondent have practice of hand wash in critical times (Before cooking51.52%, after defecation46.97%, after cleaning the baby's faeces 37.88%, before taking meal 34.85%, before feeding babies33.33%, before serving foods30.3%).

78% water points (tubewell) are in the safe distance from closest latrine. According to respondent (Diorhhea 54%, Skin diseases22%, Loose motion17%, Dysentry13%, Jaundice/Hepatitis-A 12%, Stomachache11%, Others19%) that the water related diseases are the most common in their family in last one year. In last two months, there is no significant diseases effected family members and they believe there is some positive impact due to access to improvelatrine and safe water.

Sustainability of different sanitation options

The main objective of a sanitation system is to protect and promote human health by providing a clean environment and breaking the cycle of disease. In order to be sustainable a sanitation system has to be not only economically viable, socially acceptable, and technically and institutionally appropriate, it should also protect the environment and the natural resources. When improving an existing and/or designing a new sanitation system, sustainability criteria related to the following aspects should be considered:

Health and hygiene: Include the risk of exposure to pathogens and hazardous substances and improvement of livelihood achieved by the application of a certain sanitation system.

Environment and natural resources: Involve the resources needed in the project as well as the degree of recycling and reuse practiced and the effects of these.

Technology and operation: relate to the functionality and ease of constructing, operating and monitoring the entire system as well as its robustness and adaptability to existing systems.

Financial and economic issues: Include the capacity of households and communities to cover the costs for sanitation as well as the benefit, e.g. from fertilizer and the external impact on the economy.

Socio-cultural and institutional aspects: refer to the sociocultural acceptance and appropriateness of the system, perceptions, gender issues and compliance with legal and institutional frameworks.

Table 3: Qualitative indication of sustainability of system. A cross in the respective column shows assessment of the relative sustainability of project ('+' means: strong point of project; 'o' means: average strength for this aspect and '–' means: no emphasis on this aspect for this project).

Table 4.19: Expert analysis using sustainability criteria developed by the Sustainable Sanitation Alliance (SuSanA)

		Direct pit /Direct drop pit	Direct drop with offset effluent Pit	Twin Pit	Septic Tank	Biogas Reactor	Biofil	Raised pit latrine	Standard for Bangladesh Code based on expert opinion
(1) Health:									
A	Risk of exposure to pathogens	+	+	+	+	+	+	+	+
B	Risk of exposure to hazardous substances	+	+	+	+	+	+	+	+
C	Hygiene	+	+	++	++	++	++	+	+
D	Nutrition	0	0	+	0	+	+	0	+
E	Improvement of livelihood	0	0	0	0	+	+	0	++
F	Downstream effects.	+	+	+	++	++	++	+	+
(2) Environment and natural resources:									
A	Required energy	0	0	0	0	+	0	0	0
B	Required water	+	+	+	+	+	+	+	+
C	Other natural resources for construction	0	0	0	0	0	+	0	0
D	Other natural resources for operation	0	0	0	0	0	+	0	+
E	Other natural resources for maintenance	0	0	0	0	0	+	0	0
F	Potential emissions from use	0	0	0	0	+	+	0	+
G	Degree of recycling practiced and the effects of these	0	0	0	0	+	+	0	+
H	Degree of reuse practiced and the effects of these	0	0	0	0	0	0	0	+
(3) Technology and operation:									
A	Functionality	+	+	++	++	+	++	+	+
B	Ease regarding construction,	++	+	+	+	0	+	+	+
C	Operation and monitoring	0	0	+	++	-	++	0	+
D	Suitability to achieve an efficient substance flow management	+	+	+	+	0	+	+	+
E	Robustness of the system	-	-	+	+	+	+	-	+
F	Vulnerability towards disasters	-	-	+	+	+	0	-	+
G	Flexibility and adaptability of the system	0	0	0	0	0	++	0	+
(4) Financial and economic issues:									
A	Investment costs	+	+	++	++	++	0	++	-
B	Operation costs	-	-	++	++	-	++	-	0
C	Maintenance costs	-	-	++	++	-	++	-	0
D	Economic benefits in “productive” sanitation systems	-	-	-	-	++	++	-	+
(5) Socio-cultural and institutional aspects:									
A	Socio-cultural acceptance	+	+	+	+	+	++	+	++
B	Appropriateness of the system	+	+	++	++	++	++	+	++
C	Convenience	+	+	++	++	+	++	+	+
D	Gender issues	+	+	+	+	+	+	+	+
E	Impacts on human dignity	++	++	++	++	++	++	++	++
F	Contribution to subsistence economies	0	0	0	0	+	+	0	+
G	Food security	0	0	+	0	++	+	0	+
H	Legal and institutional aspects	+	+	+	+	+	+	+	+

Most sanitation systems have been designed with these aspects in mind, but in practice they are failing far too often because some of the criteria are not met. In fact, there is probably no system which is absolutely sustainable. The concept of sustainability is more of a direction rather than a stage to reach. Nevertheless, it is crucial, that sanitation systems are evaluated carefully with regard to all dimenions of sustainability. Considering sustainability indicator of SuSanA, Biofil and Biogas reactor carry more positive points and next options are twin pit and septic tank.

Experience from first year of response

- Space, topography, soil permeability, sub-surface water level and user number are the key influencing factor which govern the option to be functional technically.
- Latrine in low lying land and less soil permeability requires frequent desludging (20%) and increase the burden on operation cost.
- Unplanned distribution of latrine and not selecting proper option becoming big challenge for current phase.
- Not properly engaging user in the operation and management increase number of non-functional latrine.
- Option which used U-bend trap for water sealing, connection in junction pitor system required more water flushing became more non-functional quickly.
- Regular close monitoring by the technical person is needed for complex option like biogas, otherwise that create risky environment although it has lots of benefits.
- Accessibility and provision of water for use in latrine influence the latrine functional and useable.
- Low hygiene practice and less interest in cleaning communal latrine is the main factor influence to keep the latrine clean.
- Lack of proper monitoring and hygiene promotion work has some effect on functionality of latrine.
- Proper feedback mechanism not yet established to keep latrine functional.
- Space occupied by the decommissioned latrine and potential risk factor of spreading

3. Recommendation

- Need to review the unified sanitation options and need to modify design considering the common problem.
- Considering soil permeability, sub-surface water availability and topography sanitation options need to be proposed.
- Ensuring proper community engagement in case of shared latrine for new settlement which help in regular O&M.
- Establish proper community feedback mechanism and help to address quick O&M service to keep the latrine functional.
- Include all the inclusive feature in newly constructed latrine and if possible renovating old latrines.
- For host community, the process should with community engagement / modified CLTS in order to reduce the sanitation coverage gap and Twin-pit, septic tank and Biofil are recommend by DPHE. Biofil also recommend for the host community by the sector.
- Controlling user number was difficult in initial stage which need to address in this phase and community engagement in O&M.
- Expert recommended twin-pit with larger depth (10') and bigger dia ring (48") with proper "Y" junction and similarly for Biofil and Septic tank as third option.
- Regular monitoring and timely desludging by agencies is most essential for keeping latrine functional.

4. Conclusion

One year into the crisis, the humanitarian community is still delivering emergency aid largely in the framework of "temporary" assistance and now is the time for review current response and need to plan considering sustainability for medium-term assistance using the past one year experience. Modified design of three options (Biofil, Septic Tank and Twin pit) needed to be consider at this stage to reduce 15% cost of desludging operational cost.

APPENDIX – A: Questionnaire For Latrine Users Communities

Questionnaire survey for "Functionality Analysis of Sanitation Options in Rohingya Refugee Camps in Cox. Bazar of Bangladesh: Based on Environment and Health Aspects"

	Date	Address Camp No:				
	Type of latrine	1. Single pit direct – HH shared (1/2 cubicles)				
		2. Single pit offset - HH shared (1/2 cubicles)				
		3. Twin pit – HH shared or communal latrine (1/2/3/4 cubicles)				
		4. Latrine with septic tank (2/3/4 cubicles)				
		5. Biofil – HH shared (1/2 cubicles)				
		6. Biofil – Communal latrine HH shared (2/3/4 cubicles)				
		7. Latrine with Biogas plant				
	User Number					
A	**Respondent information**					
1	Name of the respondent					
2	Cell phone No.					
3	Age of the respondent					
4	Sex of the respondent	1. Male			2.Female	
B	**Information about previous practice and latrine**					
1	What did your family members practice of defecation before coming here?			Male	Female	Children
		a. open defecation				
		b. used other's latrine				
		c. used own latrine				
2	What type of latrine did you use earlier?	a. hanging latrine				
		b. ring less pit latrine				
		c. ring-slab latrine				
		d. twin pit latrine				
		e. septic tank latrine				
3	What were the advantages of this latrine?	1. Maintenance is easy				
		2. Can be used by all members of family				
		3. No odor				
		4. Take long time to fill up the pit				
		5. Cleaning requirement is not frequent like other latrine				
		6. Others				
4	What are the disadvantages of this latrine?	1. Wastes of water/ need much water to keep it clean				
		2. Blocked by faeces/fecal matters				
		3. Evacuation/pit cleaning cost high				
		4. Can not be use during flood/monsoon time				
		5. Odour problem				
		6. Others (please write)				
5	Did you use Harpic/cleaning agent for cleaning the latrine?	1. Yes		2. No		
C	**Socio-ethical aspects**					
1	Has the community/user positive attitude towards this latrine?	1. Yes	2. No	3. Somebody		

2	Do the community/user know about advantage of your latrine and they visit it?	1. Yes	2. No	3. Somebody
3	Isthe toilet type similar to your previously used toilet and accepted by thecommunity?	1. Yes	2. No	3. Somebody
D	**Information about the uses & maintenances of latrine**			
1	What are the frequency of cleaning of existing latrine?	….days		
2	Who cleans the latrine now?	1. Men		
		2. Women		
		3. Both men and women as and when required		
		4. Anybody of the family		
3	What material is used to clean the latrine now	1. Harpic /latrine cleaning agent or powder		
		2. Only water		
		3. Ash		
4	Do you think the cleaning is not labour intensive?	1. Yes, labour intensive		
		2. No		
		3. Moderate		
E	**Technological**			
1	How many months have you been using this toilet?	….....months		
2	What are the advantages of toilet	1. Maintenance is easy		
		2. Least wastes of water/ less water needed for keep it clean		
		3. Take long time to fill up		
		4. Cleaning not required frequently		
		5. No cost is involved for emptying the pit of latrine		
		6. It is usable during monsoon		
		7. Others		
3	Do you facing any problem to use the toilet now?	1.Yes	2.No	3.Significant
4	What initiative is taken to solve the problem?			
5	Do you feel that odour or fly are problem?	1. Frequent		
		2. Less than previous		
		3. There is no problem regarding this		
6	Who use the latrine?	1. Everybody (all members of family)		
		2. Women		
		3. Only men		
7	When do the women use the toilet?	1. Any time, when its needed		
		2. At night only		
8	Which persons do not use the toilet?	1. Old aged		
		2. Kids		
		3. Handicapped		
		4. Others		
9	Why they do not use the toilet?			
10	Do the women& children feel safe to use the toilet?	1.Yes		2.No
11	Do the women & children feel comfort to use the toilet?	1.Yes		2.No
12	What kinds of problem did you face during using the toilet?			
13	Which problems were very frequent?			
14	Do you always suffer from the odour of latrine?	1.Yes	2.No	3. Occasionally
15	What do you think about the reason of odour?			
16	If any problem, how to address the problem?			
17	What are reasons of feeling discomfort?	1. The kids are afraid		
		2. Old aged members prefer do not latrine closed latrine		
		3. Old men prefer open latrine		
		4. Others.....		
18	Have you been facing any problem since to date using this latrine?			
19	Do you think, the problem created due to faulty design/structure?			
20	Do you think, the ventilation and light is enough?			
21	Have you any recommendation to improve the structure of the latrine			
22	How far is the water source to bring it for latrine?	…….ft		
23	From where do you collect water for latrine?	1. Own source		
		2. From neighbor's		
		3. From neighbours, if not available		
		4. From source lake/tapstand/Tubewell		
24	Who bring the water for latrine use?			
25	What is your opinion regarding the longevity of this latrine	……years		
F	**Information related to desludging**			
1	What is the frequency of pit cleaning/ desludging?			
2	How long it takes for pit cleaning/ desludging?			
3	Do you help in doing pit cleaning/ desludging?	1.Yes		2.No

G	Health related information				
1	How many family members were affected by diarrhea before using this latrine?	.....person			
2	How many family members were affected by diarrhea during last two months?	.....person			
3	Do you think this type of latrine helped to reduce the diarrheainfectionin your family?	1.Yes	2.No	3. Seems to be	
4	What types of diseases have been affected your family members last one year?	Name of the diseases	Winter	Summer	Monsoon
		1. Diorhhea			
		2. Cholera			
		3. Loose motion			
		4. Dysentry			
		5. Jaundice/Hepatitis-A			
		6. Skin diseases			
		7. Stomachache			
		8. Others			
5	When do you family members wash their hands with soap or ash?	1. After defecation			
		2. Before meal			
		3. After cleaning the babiesfaeces			
		4. Before feeding the babies			
		5. Before serving foods			
		6. Before cooking			
6	From where do you collect drinking water?	1. Tube-well			
		2. River/pond			
		3. Tap stand			
7	From where do you collect cooking water?	1. Tubewell			
		2. River/pond/wetland			
		3. Tapstand			
8	If there any hanging/unhygienic latrine close to your water sources	1.Yes		2.No	
9	Do you drink boiled water or add chemical to purify?	1.Yes		2. No	
10	Is flies found in and surrounding of this latrine?	1. Less	2. Occasionally	3. Frequently	
H	Environment related				
1	Do you think your toilet not creating any problem in environment?	1.Yes		2.No	
2	How it is Yes and or No, please explain	1.Yes		2.No	
3	Does the fecal matter inside the chamber usually pollute the surroundings?	1.Yes		2.No	
4	Do you think during in monsoon this latrine is being usable?	1.Yes		2.No	
5	Do you think the latrine will last long due to its good structure?	1.Yes		2.No	
8	Did the water enter into the faeces-chamber/pit/septic tank of latrine during flood/monsoon?	1.Yes		2.No	
9	Did the faeces-chamber pollute the environment during flood?	1.Yes		2.No	
I	Institutional information				
1	Did you receive any training on operation and maintenance of the latrine?	1.Yes		2.No	
2	Has the assisting organization yet been monitoring?	1.Yes		2.No	
3	Has the assisting organization yet been helping to repair the latrine?	1.Yes		2.No	
4	Has the assisting organization yet been helping in desludging the latrine?	1.Yes		2.No	
J	Others				
1	Do you have any comments on this toilet?				

Signature of the interviewer
Date:

Signature of respondent
Date:

APPENDIX – B :Check List To Determine The Proper Functioning Of Latrine

Questionnaire survey for "Functionality Analysis of Sanitation Options in Rohingya Refugee Camps in Cox. Bazar of Bangladesh: Based on Environment and Health Aspects"

	Address:	User Name:	User Contact Number:	
1	Type of latrine	A	Is it emergency latrine and less durable?	
		B	Is it emergency latrine more durable?	
		C	Is it sustainable latrine and durable?	
2	What type of latrine	1. Single pit direct – HH shared (1/2 cubicles) 2. Single pit offset - HH shared (1/2 cubicles) 3. Twin pit – HH shared or communal latrine (1/2/3/4 cubicles) 4. Latrine with septic tank (2/3/4 cubicles) 5. Biofil – HH shared (1/2 cubicles)	6. Biofil – Communal latrine HH shared (2/3/4 cubicles) 7. Latrine with Biogas plant	

3	Super structure is made of which material?				
4	Closet water point (TW/Tap stand/ stream/pond) A) Within 10 feet, B) Within 20 feet, C) Within 30 feetD)More than 30 feet				
5	Is the latrine constructed in no flooded/high land?	1	Yes	2	No
6	Is there enough ventilation?	1	Yes	2	No
7	Is there enough light inside?	1	Yes	2	No
8	Is the inside door locking system works properly?	1	Yes	2	No
9	Is there proper privacy? No one can see outside?	1	Yes	2	No
10	Is the proper access road and is fine with user?	1	Yes	2	No
11	Is the access road inundated during rain/monsoon?	1	Yes	2	No
12	Is there any lighting system for night use?	1	Yes	2	No
13	Is there any flies inside or outside?	1	Yes	2	No
14	Is there any hand washing place closest to latrine?	1	Yes	2	No
15	Is there any soap inside/outside the latrine for use after defecation?	1	Yes	2	No
16	Is there any dustbin placed inside the latrine?	1	Yes	2	No
17	Is there any odour generate from inside the latrine?	1	Yes	2	No
18	Is there any odour generate from outside the latrine?	1	Yes	2	No
19	Are the stairs OK?	1	Yes	2	No
20	Are the doors OK?	1	Yes	2	No
21	Is the inside floor of the latrine OK?	1	Yes	2	No
22	Is the Padastral/foot raise areOK?	1	Yes	2	No
23	Is the squatting pan, is OK?	1	Yes	2	No
24	Is the pit/septic tank for faeces outlet OK?	1	Yes	2	No
25	Is the faecesoverflowing the pit/septic tank OK?	1	Yes	2	No
26	Is there any proper soak pit?	1	Yes	2	No
27	Is wastewater water entering into the soak pit without any obstacle?	1	Yes	2	No
28	Is wastewater water overflowing the soak pit?	1	Yes	2	No
29	Is the roof of the latrine OK?	1	Yes	2	No
30	Is the water leaking from the roof?	1	Yes	2	No
31	Is there proper drainage surrounding the latrine?	1	Yes	2	No
32	Is the gas pipe OK?	1	Yes	2	No
33	Is there any arrangement for water inside the latrine?	1	Yes	2	No
34	Is the surrounding environment clean?	1	Yes	2	No
	Signature of the interviewer: Date:				

APPENDIX – C :KII - Questionnaire For Sector Professional

Questionnaire survey for "Functionality Analysis of Sanitation Options in Rohingya Refugee Camps in Cox. Bazar of Bangladesh: Based on Environment and Health Aspects"

	Date	
A	**Respondent information**	
1	Name of the respondent	
2	Cell phone No.	
3	Designation and Organization	
B	**Frist Phase/Initial stage of response**	
1	Which are the mostly installed/constructed latrine in initial phase with percentage? (in %)	
2	Which types of options are most best options for initial phase? (in sequence)	1. 2. 3. 4.
3	Why they are best options?	1. 2. 3. 4.
4	Why other options are not good/suitable for initial stage?	
5	Which type of latrine became non-functional in short time? And the reason?	
6	Which type of latrine required desludging in short time? And the reason?	
7	What were the biggest changeless of sanitation activity under first phase/initial stage? (in %)	1. (%) 2. (%) 3. (%) 4. (%)
8	Which options are best considering no negative impact on health and environment?	
9	O&M cost for different options?	
10	O&M (in %) for desludging operation?	
11	Desludging cost for different options?	
12	Budget (in %) desludging operation?	
13	According to user which options are user friendly?	
14	Recommended options for this stage?	
C	**Second Phase/ longer stage of response**	
1	Which are the mostly installed/constructed latrine in after the initial phase with percentage? (in %)	
2	Which types was most best options for new phase/ more sustainable? (in sequence)	1. 2. 3. 4.

3	Why they are best options?	1. 2. 3. 4.
4	Why other options are not good/suitable for initial stage?	
5	Which type of latrine became non-functional in short time? And the reason?	
6	Which type of latrine required desludging in short time? And the reason?	
7	What were the biggest changeless of sanitation activity under first phase/initial stage of sanitation? (in%)	1. (%) 2. (%) 3. (%) 4. (%)
8	Which options are best considering no negative impact on health and environment?	
9	O&M cost for different options?	
10	O&M (in %) for desludging operation?	
11	Desludging cost for different options?	
12	Budget (in %) desludging operation?	
13	According to user which options are user friendly?	
14	Recommended options for this stage?	
J	**Others**	
1	Do you have any comments on this sanitation program?	

Signature of the interviewer
Date:

Signature of respondent
Date:

APPENDIX – D : All Camp Latrine Information

Table 5: Refugee settlement infrastructure round 9 (November 2018)

Camp Name	Number of families (UNHCR population data as of 30 September 2018)	Number of individuals (UNHCR population data as of 30 September 2018)	Number of shelters (OpenStreetMap Export as of 30 October 2018)	# Latrines	# Latrines destroyed (lost roof, side wall, or door)	# Damaged latrines (structural damage, but still with roof, side walls and door)	# Full latrines (excluding destroyed)	# Functional latrines (not destroyed, not full)	# Latrines with locks (excluding destroyed)	# Latrines labelled "female only" (excluding destroyed)	# Latrines lit by a functional light (a light that is not visibly broken within 10m of the latrine) (excluding destroyed)	# Functional and safe latrines (not full, with four walls, a roof, and a lockable door)	% Functional latrines (not destroyed, not full)	% Functional and safe latrines (not full, with four walls, a roof, and a lockable door)	% Female-only latrines (excluding destroyed)	% Latrines lit by functional lights (excluding destroyed)	# People per functional and safe latrine (not full, with four walls, a roof, and a lockable door)	# People per functional latrine (not destroyed, not full)	# People per safe latrine (with four walls, a roof, and a lockable door)	# Shelters with at least one functional and safe latrine block within 50m	% Shelters with at least one functional and safe latrine block within 50m
Camp 01E	9,086	39,481	5,222	1,543	73	73	186	1,341	1,431	191	19	1,284	87%	83%	13%	1%	31	29	28	5,205	100%
Camp 01W	9,342	40,480	6,842	1,369	76	76	170	1,069	1,122	228	51	979	78%	72%	18%	4%	41	38	36	6,831	100%
Camp 02E	6,949	28,882	4,437	709	38	38	46	587	576	62	19	541	83%	76%	9%	3%	53	49	50	4,104	92%
Camp 02W	5,748	25,130	4,684	632	25	25	48	579	588	93	34	551	92%	87%	15%	6%	46	43	43	4,652	99%
Camp 03	9,021	38,810	7,031	1,668	64	64	184	1,381	1,485	297	42	1,327	83%	80%	19%	3%	29	28	26	7,031	100%
Camp 04	7,531	30,600	7,894	2,363	60	60	227	1,894	1,997	458	60	1,803	80%	76%	20%	3%	17	16	15	7,869	100%
Camp 04 Ext	1,046	4,328	819	370	1	1	3	362	367	90	1	359	98%	97%	24%	0%	12	12	12	808	99%
Camp 05	6,028	25,075	6,641	1,677	83	83	174	1,414	1,442	177	27	1,287	84%	77%	11%	2%	19	18	17	6,628	100%
Camp 06	5,721	24,564	4,919	925	80	80	146	727	771	66	6	651	79%	70%	8%	1%	38	34	32	4,903	100%
Camp 07	9,156	38,488	7,521	1,507	61	61	116	1,301	1,333	223	65	1,234	86%	82%	15%	4%	31	30	29	7,158	95%
Camp 08E	7,291	31,624	8,077	1,475	127	127	170	1,243	1,238	113	9	1,118	84%	76%	8%	1%	28	25	26	7,602	94%
Camp 08W	7,519	32,672	7,923	1,766	170	170	166	1,517	1,485	156	16	1,380	86%	78%	10%	1%	24	22	22	7,899	100%
Camp 09	8,601	36,475	6,983	998	66	66	86	874	839	198	45	775	88%	78%	21%	5%	47	42	43	6,931	99%
Camp 10	7,575	32,667	7,526	1,189	86	86	143	965	1,000	89	42	887	81%	75%	8%	4%	37	34	33	7,520	100%
Camp 11	7,069	31,164	6,837	1,335	136	136	175	1,093	1,094	152	34	963	82%	72%	13%	3%	32	29	28	6,817	100%
Camp 12	4,905	22,136	4,953	1,557	55	55	134	1,279	1,275	87	39	1,161	82%	75%	6%	3%	19	17	17	4,947	100%
Camp 13	9,618	41,056	7,706	1,932	116	116	187	1,631	1,653	194	10	1,521	84%	79%	11%	1%	27	25	25	7,648	99%
Camp 14 (Hakimpara	6,904	31,357	7,553	2,162	105	105	200	1,879	1,872	109	8	1,698	87%	79%	5%	0%	18	17	17	7,539	100%
Camp 15 (Jamtoli)	11,174	49,442	11,783	2,793	158	158	254	2,422	2,514	246	21	2,303	87%	82%	9%	1%	21	20	20	11,768	100%
Camp 16 (Potibonia)	4,839	21,639	5,017	1,015	21	21	47	954	952	81	6	908	94%	89%	8%	1%	24	23	23	4,954	99%
Camp 17	3,649	15,472	3,840	1,389	22	22	29	1,342	1,316	300	53	1,297	97%	93%	22%	4%	12	12	12	3,827	100%
Camp 18	6,655	27,220	7,635	2,023	116	116	114	1,702	1,681	215	69	1,585	84%	78%	11%	4%	17	16	16	7,597	100%
Camp 19	4,816	20,852	3,932	1,767	80	80	126	1,504	1,520	171	18	1,412	85%	80%	10%	1%	15	14	14	3,929	100%
Camp 20	1,735	7,180	1,797	555	28	28	48	499	512	111	67	474	90%	85%	21%	13%	15	14	14	1,787	99%
Camp 20 Ext	976	3,992	558	436	6	6	5	431	425	27	30	422	99%	97%	6%	7%	9	9	9	538	96%
Camp 21 (Chakmark	3,011	12,281	2,350	629	14	14	18	603	604	82	13	587	96%	93%	13%	2%	21	20	20	2,350	100%
Camp 22 (Unchipran	4,583	22,206	3,876	868	12	12	25	832	841	35	2	819	96%	94%	4%	0%	27	27	26	3,808	98%
Camp 23 (Shamlapu	2,672	11,012	1,694	647	46	46	40	587	527	86	7	510	91%	79%	14%	1%	22	19	21	1,088	64%
Camp 24 (Leda)	7,800	33,714	3,900	1,279	21	21	32	1,041	1,025	195	13	999	81%	78%	16%	1%	34	32	33	3,670	94%
Camp 25 (Ali Khali)	2,183	9,697	1,928	431	22	22	15	408	396	74	10	387	95%	90%	18%	2%	25	24	24	1,681	87%
Camp 26 (Nayapara)	9,493	41,475	6,521	1,559	50	50	86	1,393	1,379	212	1	1,317	89%	84%	14%	0%	31	30	30	6,158	94%
Camp 27 (Jadimura)	3,172	14,354	3,243	743	25	25	32	704	672	80	42	646	95%	87%	11%	6%	22	20	21	2,800	86%
Kutupalong RC*	3,786	19,007	3,708	352	5	5	3	305	297	116	1	294	87%	84%	33%	0%	65	62	64	1,770	48%
Nayapara RC	5,732	27,032	781	811	16	16	18	788	742	262	17	729	97%	90%	33%	2%	37	34	36	757	97%
All Camps	205,386	891,564	176,131	42,474	2,064	2,064	3,453	36,651	36,971	5,276	897	34,208	86%	81%	13%	2%	26	24	24	170,574	97%

* Only partially assessed due to security concerns

APPENDIX –E: Surveyed Camp and Latrine Information

Camp No.	Population in Camp	Number of Latrine Survey
15	49,442	15
12	22,136	10
3	38,810	10
19	20,852	10
8w	32,672	10
10	32,667	10
26	41,475	10

22	22,206	10
17	15,472	10
4F	30,600	10
27	14,354	10
		115

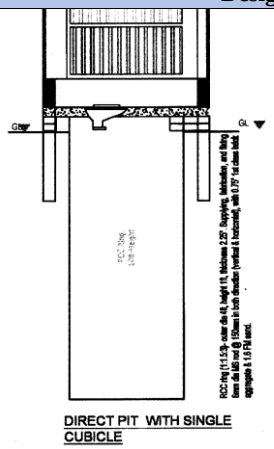
Sanitation Option	Number /% of installed in different camps	Number latrine surveyed
Direct pit /Direct drop pit	7 - 15%	25
Direct drop with offset effluent Pit	0 - 25%	20
Twin Pit	40 - 60%	25
Septic Tank	5 - 10%	20
Biogas Reactor/ Bio Gas Mobile Latrines	66	3
Biofil	2000	20
Raised pit latrine	40	2
		115

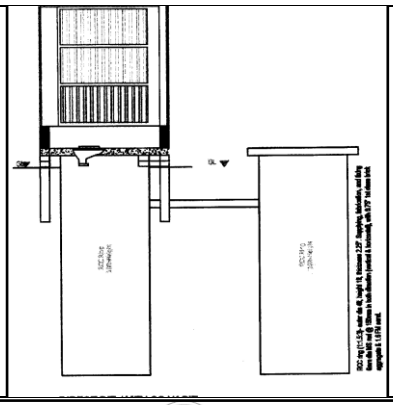
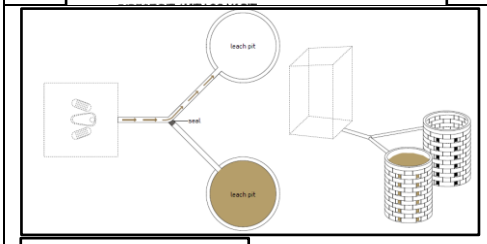
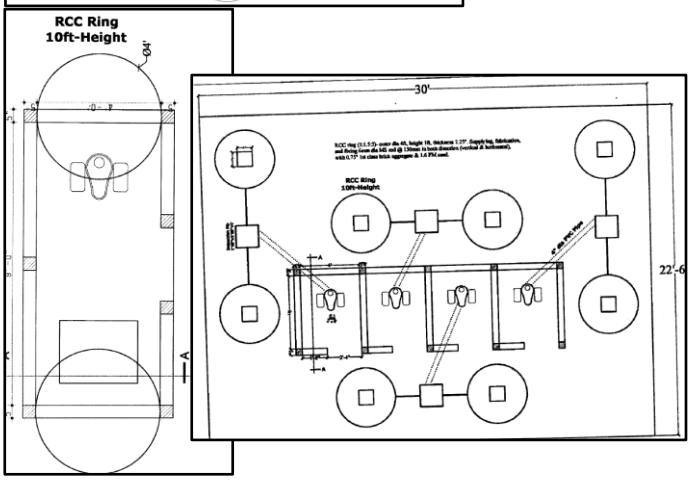
APPENDIX – F :List of key WASH expert interviewed

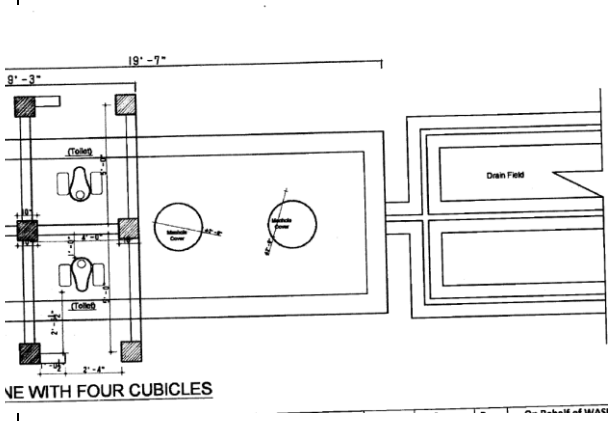
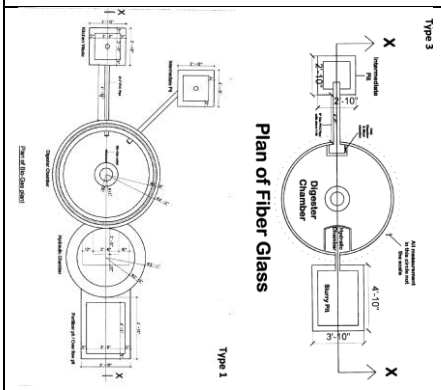
1) Md. Moniruzzaman, Coordinator and Sector Specialist -WASH, CAID
2) Shofiqur Rahman Shopon, WASH Specialist, BRAC
3) Soharab Rubel, World Vision, WASH Coordinator
4) Md Asif Arafat, WaSH Sector Coordinator – WASH Cluster, ACF
5) AbdusSobhan, HSP - Water & Sanitation Engineer, GHT, Oxfam
6) Mohammad Rafiqul Islam, Sector Lead – WASH, Email: Rafiqul.islam2@care.org
7) A.B.M. Sadiqur Rahman, WASH Officer, UNHCR, Email: rahmanab@unhcr.org
8) Abu Naim Md. Shafiullah Talukder, National Field Coordination Officer, ISCG, Email: field.coord5@iscgcxb.org
9) Zahidul Islam Mamun, WASH Specialist, UNICEF, Email: zmamun@unicef.org
10) Engr. Rittick Chowdhury, Executive Engineer, DPHE, Email: chowritthick@gmail.com

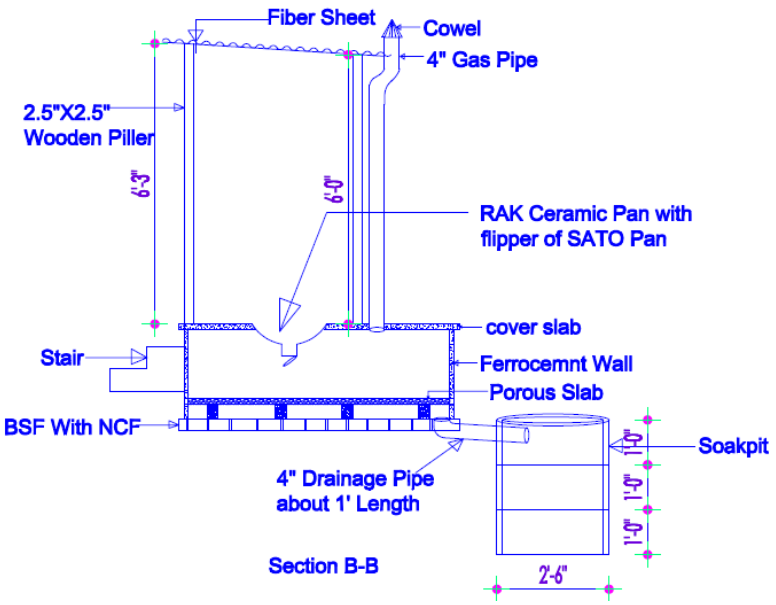
Appendix – G :Latrine Options and Technical Details

List of options

Design	Features	Strengths and Weaknesses
 DIRECT PIT WITH SINGLE CUBICLE	**Direct pit single cubicle/Direct drop pit** **Phase of Emergency** * Acute Response ** Stabilisation ** Recovery **Cost:** **User Number:** **Volume of pit:** **Application Level / Scale** ** Household ** Neighbourhood City **Management Level** ** Household ** Shared * Public **Objectives / Key Features** Excreta containment, Sludge volume reduction, Reduction of odour and flies **Space Required:** Little **Technical Complexity:** Low **Inputs:** Excreta, Faeces, Blackwater,	+ Flies and odours are significantly reduced(compared to non-ventilated pits) +Can be built and repaired with locally availablematerials +Low (but variable) capital costs depending onmaterialsand pit depth +Small land area required -Low pathogen reduction with possible contamination of groundwater - Costs to empty may be significant compared to capital costs -Sludge requires secondary treatment and/or Appropriate discharge

	(Anal Cleansing Water) **Outputs:** Sludge	
	**Direct drop with offset effluent Pit**	
 	**Twin Pit** **Phase of Emergency** Acute Response * Stabilisation ** Recovery **Application Level / Scale** ** Household ** Neighbourhood City **Management Level** ** Household ** Shared * Public **Objectives / Key Features** Excreta containment, Sludge volume reduction, Extended treatment time **Space Required:** ** Medium **Technical Complexity:*** Low **Inputs:** Blackwater, (Grey water) **Outputs:** Pit Humus	**Strengths and Weaknesses:** +Because double pits are used alternately, they can have a long life +Potential for use of stored faecal material as soil conditioner +Flies and odours are significantly reduced (compared to pits without a water seal) +Can be built and repaired with locally available materials -Manual removal of humus is required -Clogging is frequent when bulky cleansing materials are used -Higher risk of groundwater contamination due to more leachate than with waterless systems

	**Septic Tank (with Drain Field)** **Phase of Emergency** * Acute Response ** Stabilisation ** Recovery **Application Level / Scale** ** Household ** Neighbourhood City **Management Level** ** Household ** Shared ** Public **Objectives / Key Features** Excreta containment, Solid / liquid separation **Space Required:** ** Medium **Technical Complexity:** * Low **Inputs:** Black water, Grey water **Outputs:** Effluent, Sludge	**Strengths and Weaknesses:** +Simple and robust technology +No electrical energy is required +Low operating costs and long service life +Built underground -Low reduction in pathogens, solids and organics -Regular desludging must be ensured -Effluent and sludge require further treatment and/or appropriate discharge
	**Biogas Reactor** **Phase of Emergency** Acute Response * Stabilisation ** Recovery **Application Level / Scale** ** Household ** Neighbourhood City **Management Level** ** Household ** Shared ** Public **Objectives / Key Features** Excreta containment, Stabilisation of sludge, Biogas recovery **Capacity:** $2m^3$, $4m^3$ **Space Required:** ** Medium **Technical Complexity:** ** Medium **Inputs:** Excreta, Blackwater, Sludge, Organics **Outputs:** Biogas, Sludge	**Strengths and Weaknesses:** +Reduced solid waste management cost and faecal sludge transportation costs +Generation of useable products – gas and fertiliser +Long service life (robust) -Requires expert design and skilled construction Incomplete pathogen removal, the digestate might require further treatment -Limited gas production below 15 ˚C and when using only blackwater -Medium level investment cost
	Raised Latrine **Phase of Emergency** ** Acute Response * Stabilisation * Recovery **Application Level /**	**Strengths and Weaknesses:** +Applicable in areas with challenging ground Conditions and frequent flooding

	Scale ** Household ** Neighbourhood City **Management Level** ** Household ** Shared ** Public **Objectives / Key Features** Excreta containment, Alternative for challenging ground conditions **Space Required:** * Little **Technical Complexity:** * Low **Inputs:** Excreta, Faeces,(Anal Cleansing Water) **Outputs:** Sludge	+Low (but variable) capital costs +Small land area required -Inclusive design is more difficult than for technologies that are not raised -Emptying costs may be significant compared to capital costs -Collected sludge requires further treatment -For above ground facilities emptying service needs to be in place from the design stage
	**Biofil -Worm-Based Toilet (Emerging Technology)** **Phase of Emergency** Acute Response * Stabilisation ** Recovery **Application Level / Scale:** ** Household * Neighbourhood City **Management Level:** ** Household ** Shared Public **Objectives / Key Features:** Excreta containment, Sludge volume reduction, Pathogen reduction **Space Required:** * Little **Technical Complexity:** ** Medium **Inputs:** Urine, Faeces, (Dry Cleansing Materials), (Anal Cleansing Water), Flush water **Outputs:** Vermi-Compost, Effluent	**Strengths and Weaknesses:** +No odour +Design is adaptable to locally available materials +Low emptying frequency (> 5 years of use) +Easier and more pleasant to empty -Requires water for flushing (min 200 ml) and compostingworms (100 g per person) -Unclear if menstrual hygiene products can be Digestedby the worms -Bleach or other chemicals cannot be used to clean the toilet -Lack of evidence on O & M