



Qualitative Comparative Analysis



Determining Condition Combinations for Successful Sanitation Systems

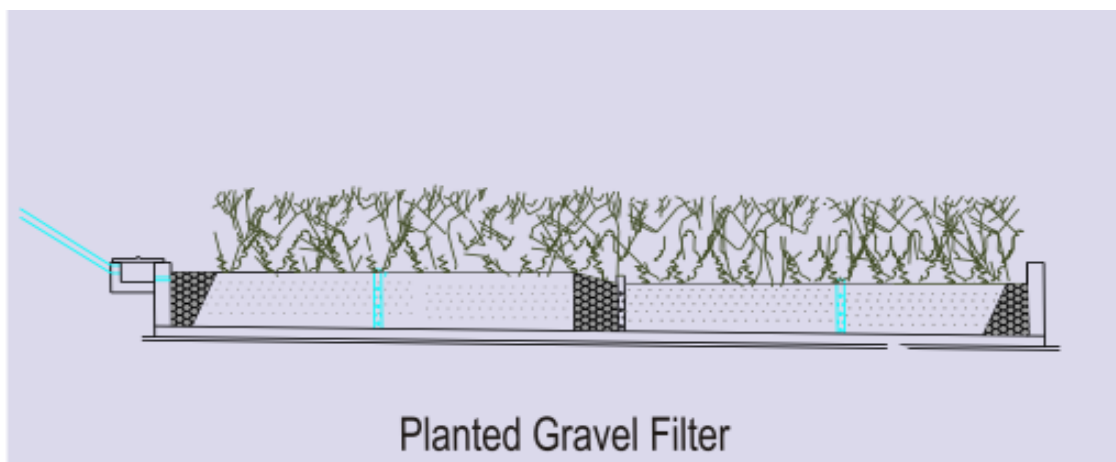
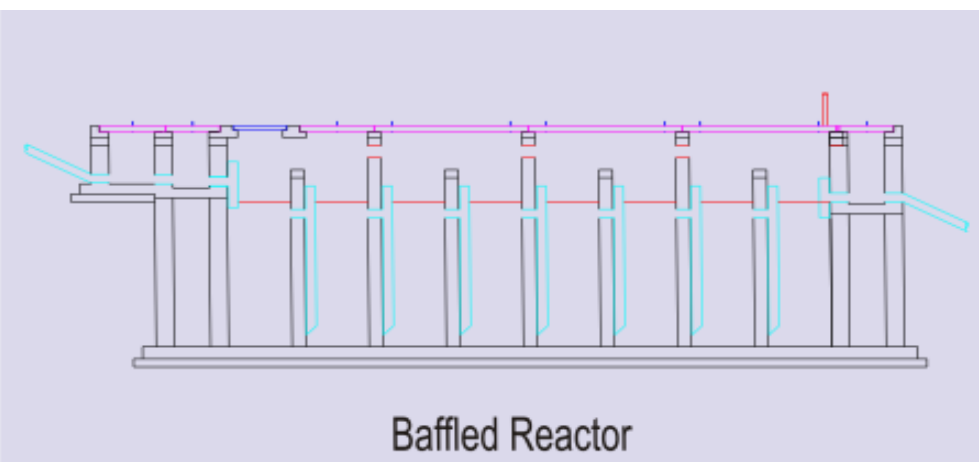
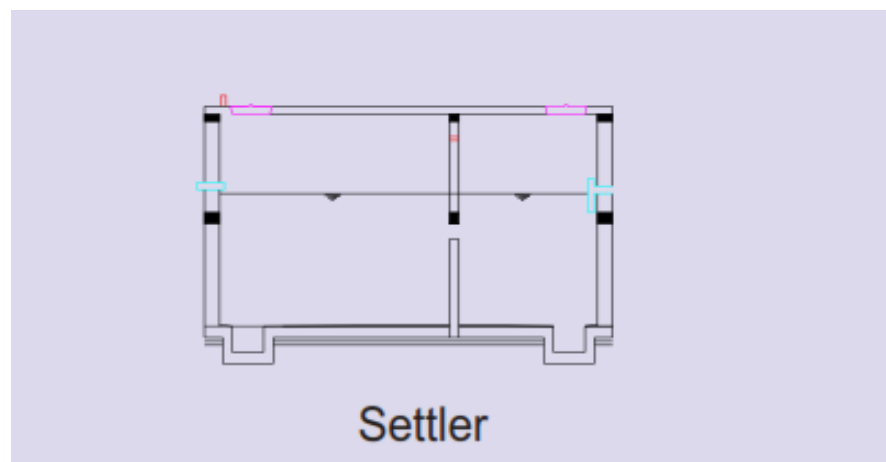
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Background and Motivations

Legislative Motivations

- Swachh Bharat Mission aims to end open defecation in India by 2019, motivating studies for EDC in India
- World Health Organization Sustainable Development Goals aim to end open defecation around the world by 2030



Motivations for Method

- Previous research in small sanitation systems in developing communities focuses on one condition for success of system at a time
- There is a need for studies that look at condition combinations that can be generalized to more systems in more locations
- fsQCA allows for a case community to have a working sanitation system that community members do not use
- What combinations of conditions are important for successful sanitation systems?

Method

Data Collection

- 20 site locations in India, 10 successful and 10 failed systems
- Data types:
 - Interviews (community members, NGOs, Gov)
 - Photovoice interviews: community member provides photo with explanation
 - Memorandums, Drawings and Handovers for systems
 - In-person inspections

Allie Davis: they did? Or what they said to have happened?
Sridhar: Thanks. So what is she saying about the association and what she said to have happened? Like whenever they complained to the association. They just come, bring a person to clean it and tell him that do this.



Data Organization

Create condition definition matrix		
20	Community Participation	The ways in which community members were involved with, helped, and participated in all phases of the sanitation project.
21	Community Participation in Operation and Maintenance	What the community has done post-implementation: meetings, managing the system, collecting fees, performing operation and maintenance, etc.
22	Community Contributions	Financial or in-kind contributions made specifically for the sanitation project.
23	Community Participation in Construction	What the community did during the construction of the system, including manual labor and construction supervision.
24	General Women's Participation	The specific roles of women in the planning, design, construction, and maintenance phases of the sanitation project, distinct from male participation.

Condition definition example from matrix.

Condition: A factor to be studied for its potential influence on system success in combination with other factors

- Input conditions into NVivo
- Categorize collected data into conditions



Data Analysis

- fsQCA method:** Fuzzy set Qualitative Comparative Analysis, discovers combinations of conditions that lead to success using set theory and fuzzy logic
 - Allows for each case to be partially in or out of the set (uniqueness of each system)
 - Conditions necessary to success (e.g., financial stability) are defined as present after individual system knowledge
- Steps:
 - Summarize conditions for each sanitation system
 - Calibrate fuzzy-set scores for conditions
 - Generate truth table
 - Iterative fs-QCA process and refining

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
CaseName	addsnpri	compmpart	compmpart	cbopart	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	use	maintenance	performance		
1 East Devadahanam	0.815	1	1	1	0.67	1	0	0.67	1	0.96	1	0.67	1	1	1	1	1
2 Beedi Workers Colony	0.602	0.67	0.33	0.67	0	1	0	0.33	0.7	1	0.67	1	1	1	1	1	1
3 Seeghull	0.425	0.33	0.67	0.67	0.67	0.33	0.7	0.33	0	0.99	0	0.33	0.33	0.33	0.07	0	0
4 Uthulu	0.11	1	1	1	0.67	0.33	1	0	1	1	0.67	1	0.67	0	0	0	0
5 Musiri Resource Recovery Park	0.781	0.33	0.67	0	0.33	1	0	1	1	1	1	0.67	1	0.93529	1	1	1
6 Salyer Street	0.596	0.33	1	0	0.33	0.67	0	0.33	1	1	1	1	1	0.934119	1	1	1
7 Kechcheruwa	0.156	0	0	0	0	0	0	0.33	0	0.269978	0.67	0	0	0.225	0	0.3	0
8 Kaveri Nagar	0.191	0.33	0.33	0	0.33	0	0.7	0	0	0.86	0.33	0	0	0	0	0	0
9 H&A Block	0.296	0.67	0.33	0.67	1	0.33	0.7	0	0.7	0.21	0.67	0.33	0.33	0.48	0.07	0	0
10 Rupa Nagar	0.322	0.67	0.67	1	1	0.67	1	0	0.7	0.07	0.67	0.33	0.33	1	0.2	0	0
11 Alanganpappam	0.83	0.33	0.67	0.33	0.67	0.67	0	1	1	1	1	1	0.67	0.945122	1	1	1
12 Mandaviluppam	0.297	0.33	0.67	0.33	0.67	0.67	0	1	1	1	0.67	1	0.67	0.910588	0.82	1	1
13 Kadiyakkalappam	0.032	0	0	0	0	0	0.7	0	0.88	0.33	0.33	0	0.062963	0	0.3	0	0
14 Urukuthaammam	0.35	0	0.33	0.33	0	0	0.7	0.67	0	0.481065	0.33	1	0	0.5	0.05	0.3	0
15 Muzukuthural	0.099	0	0	0.33	0	0	1	0	0	0	0.33	0.33	0	0.310559	0.03	1	1
16 Kuttyandiyar	0.452	0.33	0	0.33	0.67	1	0	1	1	1	0.67	1	1	0.807143	1	1	1
17 Swaratra Nagar	0.139	0.33	0	0	0.33	0	0	0	0	0	0	0.33	0	0.88	0.2	0	0
18 Kadampadi	0.164	0	0.33	0.33	0	0	0.7	0	0	0.56	0	0	0	0.822	0.6	0	0
19 Kootumangalam	0.298	0	0.33	0	0.67	0.67	0	0.67	1	1	1	1	1	1	1	0.91	1
20 Veluguttal	0.259	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1

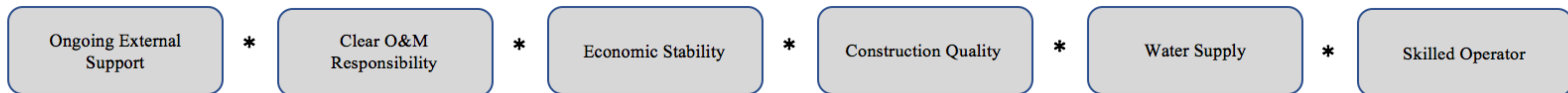
Original Truth Table, all cases and all conditions.

2	addsnpri	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	0.223999	0.0721512	0.945274	
3	addsnpri	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	0.307232	0.152437	1	
solution coverage: 0.717857													
solution consistency: 0.982255													
17	compmpart	compmpart	cbopart	bechangeduc	ongextsup	clearomresp	econstab	constrqual	watersup	skillop	0.313598	0.0801679	
18	compmpart	compmpart	cbopart	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	0.393766	0.199241
19	compmpart	compmpart	cbopart	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	0.0789891	0.00084
20	compmpart	compmpart	cbopart	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	0.274693	0.156881
solution coverage: 0.749807													
solution consistency: 1													
21	compmpart	compmpart	cbopart	bechangeduc	ongextsup	clearomresp	econstab	constrqual	watersup	skillop	0.313598	0.0801679	
22	compmpart	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	0.393766	0.199241		
23	compmpart	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	0.471577	0.196883		
24	compmpart	compmpart	cbopart	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	0.0789891	0.00084
solution coverage: 0.749807													
solution consistency: 1													
25	compmpart	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	0.471577	0.196883		
26	compmpart	compmpart	cbopart	bechangeduc	ongextsup	govplan	clearomresp	econstab	constrqual	watersup	skillop	0.0789891	0.00084
solution coverage: 0.749807													
solution consistency: 1													

Right: Iterations of fsQCA software. Analysis of the truth table occurred iteratively, where possible combinations of conditions were examined for their consistency and coverage. Consistency allowed us to determine how *consistently* a given combination resulted in success; coverage reflected the percent of successful cases explained by that combination. We used these metrics to determine whether removing conditions increased scores and resulted in better explanations or reduced scores and resulted in incomplete explanations.

Results and Discussion

Preliminary Results



Final Pathway, all conditions shown had necessity scores greater than 0.9.
Overall solution combination coverage of cases was close to 75% of all systems studied.
Overall solution combination consistency score of 1.

- These six conditions were necessary and present in all successful sanitation systems
- Further Iterations:** Cases where government participation in planning was absent, community participation in operation and maintenance could overcome that to ensure the system would be successful and used.
 - This was also true in reverse
- Necessity, Consistency and Coverage** were used to determine condition or the combination of conditions set participation. Results presented had high numerical scores (close to 1) in each of these categories, denoting conditions that are necessary and in combination consistently cover the fuzzy outcome of success.
 - Necessity:** How necessary a condition is to the fuzzy outcome of success. Necessity scores equal or greater to 0.9 indicate that nearly all instances of success show this condition is present.
 - Consistency:** A numerical measure of how consistently the condition led to success. Consistency scores equal or greater to 0.8 show the condition or combination consistently leads to the desired outcome.
 - Coverage:** A numerical percentage of successful sanitation systems covered by the condition. A numerical metric for generalizability.
- For the Future:** Iterations continue until all finalized findings are obtained.
- This combination validates intuitive sense about infrastructure, and conditions shown in the combination often rely on each other. For example, Economic Stability and Construction Quality are closely tied in most systems, and a Skilled Operator will need a clear O&M plan. An intriguing finding is that community participation in operation and maintenance doesn't have to be present for the community to use the system, and neither does behavior change education for community members. However, these findings are purely the base case of absolute necessity, and many successful systems had these other conditions involving the community present. This solution is the most generalizable, and future solutions will provide options for pathways that stakeholders can take to ensure successful sanitation systems are built in the future.
- Allows for flexibility in system planning and operation by government agencies, NGOs and communities in global development settings.

Acknowledgements



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