Electronic Supporting Information

A comparison of interviews, focus groups, and photovoice to identify sanitation priorities and increase success of community-based sanitation systems†

Allie Davis[1], Amy Javernick-Will[1], Sherri M. Cook[1*]

[1]Department of Civil, Environmental, and Architectural Engineering, University of Colorado Boulder, Boulder, CO 80309
*Email: sherri.cook@colorado.edu, Fax: +1 303 492 7211, Tel: +1 303 735 7288

15 Pages, 11 Tables, 6 Figures

Table of Contents

1.0 System Information and Respondent Demographics

Table S1. Summary of community and sanitation system information.

Community #	Technology Type	System Outcome	System Manager	Community Leader
1	DEWATS	Successful	Male Operator	None
2	DEWATS + Biogas	Successful	None*	Yes
3	DEWATS	Failed	None	Yes
4	Baffled Septic Tank + Gravel Filter	Failed	None	Yes
5	Baffled Septic Tank + Gravel Filter	Failed	None	Yes
6	DEWATS + Biogas	Failed	WSHG	Yes
7	Settling Tank + Single-Pass Intermittent Sand Filter	Successful	Male Operator	Yes
8	DEWATS	Successful	None*	Yes
9	DEWATS	Failed	WSHG	Yes
10	DEWATS	Successful	Male Operator	Yes
11	DEWATS + Biogas	Successful	WSHG	Yes
12	DEWATS + Biogas	Failed	Male Operator	Yes
13	DEWATS + Biogas	Successful	Male Operator	Yes
14	Community Ecological Sanitation System	Successful	None*	None
15	DEWATS	Successful	Male Operator	Yes
16	DEWATS	Failed	None	Yes
17	DEWATS	Failed	None	Yes
18	DEWATS + Biogas	Successful	WSHG	None
19	DEWATS	Failed	Male Operator	Yes
20	DEWATS + Biogas	Failed	WSHG	Yes

*These systems did not have operators from the community, but received maintenance assistance from the government or sanitation implementer.

Table S2. Participation demographics for all communities. Interviews, photovoice, and focus groups sought to identify community and sanitation priorities simultaneously.

	Interviews								Focus Groups							Photovoice						
		Sex			Role					Sex		Role					Sex		Role			
Community #	Number of Interviews	Male	Female	Mixed	Community Leader	Community Member	Operator	WSHG	Number of Participants	Male	Female	Community Leader	Community Member	Operator	WSHG	Number of Photovoice	Male	Female	Community Leader	Community Member	Operator	WSHG
1	11	36%	45%	18%	0%	91%	9%	0%	10	50%	50%	0%	100%	0%	0%	10	40%	60%	0%	100%	0%	0%
2	11	45%	45%	9%	9%	91%	0%	0%	9	44%	56%	0%	100%	0%	0%	8	38%	50%	0%	100%	0%	0%
3	11	55%	45%	0%	9%	91%	0%	0%	8	50%	50%	0%	100%	0%	0%	9	56%	44%	11%	89%	0%	0%
4	12	33%	50%	17%	8%	92%	0%	0%	10	50%	50%	0%	100%	0%	0%	8	50%	50%	0%	100%	0%	0%
5	12	50%	42%	8%	8%	92%	0%	0%	8	50%	50%	0%	100%	0%	0%	9	44%	56%	0%	100%	0%	0%
6	12	42%	42%	17%	8%	72%	0%	20%	10	50%	50%	10%	70%	0%	20%	9	44%	56%	11%	67%	0%	22%
7	13	38%	46%	15%	8%	77%	15%	0%	9	56%	44%	0%	89%	11%	0%	8	50%	50%	0%	88%	13%	0%
8	12	42%	42%	17%	8%	92%	0%	0%	12	50%	50%	0%	100%	0%	0%	8	50%	50%	13%	88%	0%	0%
9	12	42%	42%	17%	8%	72%	0%	20%	11	45%	55%	0%	73%	0%	27%	9	44%	56%	11%	56%	0%	33%
10	11	45%	55%	0%	9%	73%	9%	0%	11	45%	55%	0%	100%	0%	0%	8	38%	63%	13%	75%	13%	0%
11	11	36%	45%	18%	9%	71%	0%	20%	10	50%	50%	0%	80%	0%	20%	9	44%	56%	0%	67%	0%	33%
12	10	40%	40%	20%	10%	70%	10%	0%	8	50%	50%	13%	75%	13%	0%	8	38%	50%	13%	75%	13%	0%
13	12	50%	42%	8%	8%	83%	8%	0%	8	50%	50%	13%	75%	13%	0%	8	50%	50%	13%	75%	13%	0%
14	12	50%	50%	0%	0%	100%	0%	0%	8	50%	50%	0%	100%	0%	0%	8	50%	50%	0%	100%	0%	0%
15	14	43%	43%	14%	7%	86%	7%	0%	9	44%	56%	0%	100%	0%	0%	9	44%	56%	11%	78%	11%	0%
16	13	38%	54%	8%	8%	92%	0%	0%	8	50%	50%	13%	88%	0%	0%	8	50%	50%	13%	88%	0%	0%
17	10	40%	30%	30%	10%	80%	0%	0%	9	44%	56%	0%	100%	0%	0%	8	50%	50%	0%	100%	0%	0%
18	11	45%	45%	9%	0%	80%	0%	20%	12	50%	50%	0%	75%	0%	25%	10	50%	50%	0%	60%	0%	40%
19	11	55%	45%	0%	18%	73%	9%	0%	9	44%	56%	0%	100%	0%	0%	9	56%	44%	22%	78%	0%	0%
20	11	45%	55%	0%	9%	64%	0%	18%	10	50%	50%	0%	70%	0%	30%	8	38%	63%	0%	63%	0%	38%
Average	**11.60**	**44%**	**45%**	**11%**	**8%**	**83%**	**3%**	**6%**	**9.45**	**49%**	**51%**	**2%**	**90%**	**2%**	**6%**	**8.55**	**46%**	**53%**	**6%**	**82%**	**3%**	**9%**

Table S3. Participation demographics for AHP groups for all 20 communities.

		Sex		Role			
Community #	**Number of Participants**	**Male**	**Female**	**Community Leader**	**Community Member**	**Operator**	**WSHG**
1	10	40%	60%	0%	100%	0%[NO]	0%[NW]
2	8	63%	38%	0%	87%	13%	0%[NW]
3	12	58%	42%	0%	100%	0%[NO]	0%[NW]
4	10	50%	50%	0%	100%	0%[NO]	0%[NW]
5	8	50%	50%	0%	100%	0%	0%[NW]
6	9	56%	44%	0%	89%	11%	0%[NW]
7	9	56%	44%	0%	89%	11%	0%[NW]
8	12	42%	58%	0%	100%	0%[NO]	0%[NW]
9	11	45%	55%	0%	100%	0%[NO]	0%[NW]
10	9	44%	56%	0%[NL]	100%	0%	0%[NW]
11	9	56%	44%	0%	89%	11%	0%[NW]
12	11	55%	45%	0%	82%	0%[NO]	18%
13	10	50%	50%	0%	100%	0%[NO]	0%[NW]
14	12	42%	58%	0%	75%	0%[NO]	25%
15	12	42%	58%	0%	83%	0%[NO]	17%
16	11	36%	64%	0%	82%	0%[NO]	18%
17	10	50%	50%	0%	100%	0%[NO]	0%[NW]
18	10	40%	60%	0%	100%	0%	0%[NW]
19	8	63%	38%	0%[NL]	100%	0%[NO]	0%[NW]
20	10	40%	60%	0%[NL]	80%	0%[NO]	20%
Average	**10**	**49%**	**51%**	**0%**	**93%**	**2%**	**5%**

2.0 Most Effective Method

Table S4. Summary of the total number of unique community and unique sanitation priorities identified in each community. Numbers reflect the total from all three priority identification methods combined in each community.

Community #	Total Number of Unique Priorities Identified	
	Community	Sanitation
1	15	12
2	12	11
3	15	12
4	12	10
5	12	14
6	13	12
7	10	9
8	15	10
9	14	15
10	14	11
11	15	10
12	14	12
13	14	10
14	14	12
15	14	11
16	15	11
17	13	12
18	14	10
19	15	11
20	15	15
Average	**14**	**12**

Table S5. Comparison of method performance in all 20 communities for identifying the total number of unique community priorities and sanitation priorities for (a) interviews compared to focus groups, (b) focus groups compared to interviews, (c) focus groups compared to photovoice. Compared using one-way ANOVA (p-values are listed in parentheses): bold denotes p-values less than the confidence-level used in the analysis ($p<0.05$) and * denotes p-values greater than the confidence-level used in the analysis ($p>0.05$).

		(a) Interviews vs. Photovoice	(b) Focus Groups vs. Interviews	(c) Focus Groups vs. Photovoice
Community Priorities	**Total**	Interviews (0.095)*	**Interviews** (0.000)	**Photovoice** (0.000)
Sanitation Priorities	**Total**	**Interviews** (0.000)	**Interviews** (0.015)	**Photovoice** (0.003)

Table S6. Comparison of method performance in all 20 communities for identifying the total number of unique physical priorities and unique abstract priorities. Compared using one-way ANOVA (p-values are listed in parentheses): bold denotes p-values less than the confidence-level used in the analysis ($p<0.05$) and * denotes p-values greater than the confidence-level used in the analysis ($p>0.05$). Note: p-values for the comparison between interviews and focus groups and between photovoice and focus groups were all less than 0.033.

	Physical Priorities	**Abstract Priorities**
Community Priorities	Interviews (0.094)*	Interviews (0.895)*
Sanitation Priorities	Interviews (0.652)*	**Interviews** (0.000)

Table S7. Comparison of method performance in all 20 communities for identifying the total number of unique community priorities and sanitation priorities for (a) interviews compared to focus groups, (b) focus groups compared to interviews, (c) focus groups compared to photovoice. Compared using one-way ANOVA (p-values are listed in parentheses): bold denotes p-values less than the confidence-level used in the analysis ($p<0.05$) and * denotes p-values greater than the confidence-level used in the analysis ($p>0.05$).

		(a) Interviews vs. Photovoice	**(b) Focus Groups vs. Interviews**	**(c) Focus Groups vs. Photovoice**
Community Priorities	**Most Important**	**Interviews** (0.037)	**Interviews** (0.000)	**Photovoice** (0.009)
Sanitation Priorities	**Most Important**	**Interviews** (0.000)	**Interviews** (0.018)	Photovoice (0.057)*

2.1 Most Important Priorities

2.1.1 Analytical Hierarchy Process Methodology

The Analytical Hierarchy Process (AHP) was conducted with a different focus group (called the AHP group) in each community to develop rankings for each of unranked lists of community and sanitation priorities. The unranked lists of community and sanitation priorities were generated from the combined results of each community's interviews, photovoice, and focus group results. Each community's AHP group had 8 to 10 community members, who were selected to ensure a balance of age, sex, and socio-economic status within the community. The AHP group was provided with visual aids and verbal explanations (in their native language) of the AHP objectives and procedures. For each AHP pairwise comparison, the participants had to determine which of the two priorities was most important and then rank its relative importance by choosing an integer value between 1 and 9, where 9 indicates a priority is extremely more important than the other and 1 indicates the priorities are equally important. Researchers documented the process with observation notes, and intervened in discussions only as needed to ensure that all group members had the chance to voice their opinions and that consensus on the final choices was achieved.

An example pairwise comparison for sanitation priorities: An AHP group was asked to compare *low cost* and *energy generation*. An example response was, "Low cost is more important than energy generation." Then they would be asked, "How much more important is low cost than energy generation?" An example follow-up response was, "Low cost has strong importance over energy

generation" (or low cost is 5 times more important than energy generation). The scores chosen for each pairwise comparison populated an AHP comparison matrix, which was used to calculate the relative importance. Thus, the AHP facilitators would assign "low cost" a value of 5 and assign "energy generation" a reciprocal value of 1/5 in the AHP comparison matrix.

Example AHP Pairwise Comparison Matrix. *Shaded boxes correspond to the example given in the text.*

	Low Cost	Energy Generation	Cleanliness
Low Cost	1	5	1/3
Energy Generation	1/5	1	1/7
Cleanliness	3	7	1

The pairwise comparisons continued until all priorities in the list had been compared to each of the others. Then, the normalized eigenvector of the AHP comparison matrix was calculated to determine the overall relative rank of each priority (i.e., the ratio scale of priorities).[1,2] To assure judgements were not random, a consistency ratio was calculated; the data's consistency index was first calculated from the normalized eigenvector and then divided by a standardized evaluation index (i.e., the random consistency index, generated from numerous simulations of randomized ratings) to determine the consistency ratio.[2] If the ratio was less than 0.10, then the judgements were considered consistent.[2] If the ratio exceeded 0.10, then the judgements were considered inconsistent (i.e., they could potentially have been generated in a random manner), and researchers facilitated discussions with the AHP groups to resolve contradictory judgements and obtain a consistent result. After a consistent ranked list was generated, researchers performed member checking, where the AHP group was asked to confirm that the rankings and relative importance.

2.1.2 Determining the Top Priorities Threshold

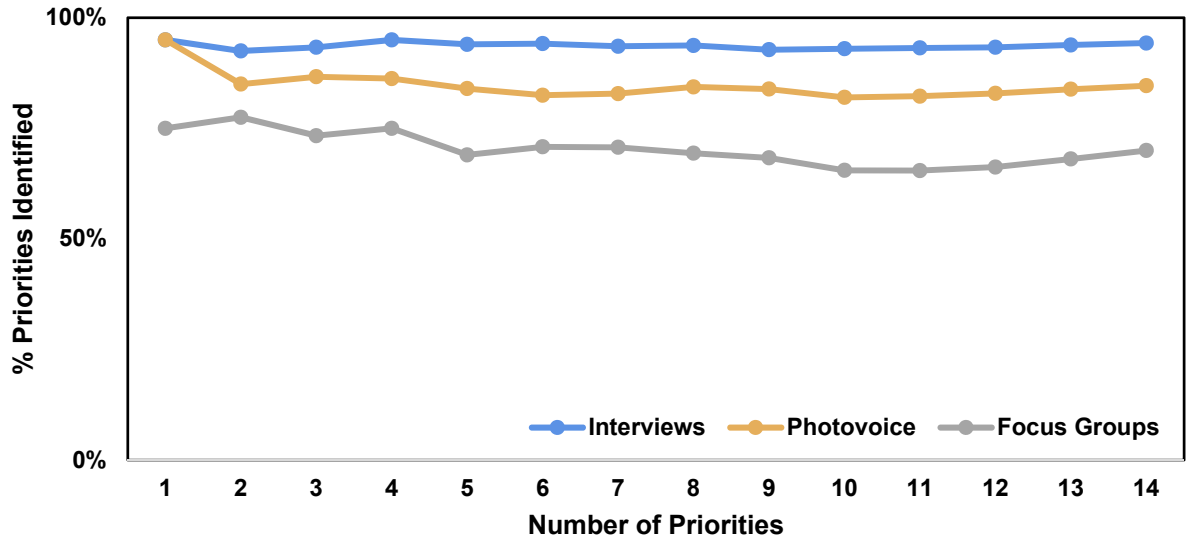

Figure S1. Results of average method performance across all 20 communities for identifying the top priorities. Based on the steadier performance of methods for n>5, it was determined that the top five highest ranked priorities are where methods differ greatest and thus in-depth comparisons are most important.

2.2 Method Effectiveness and Time Required

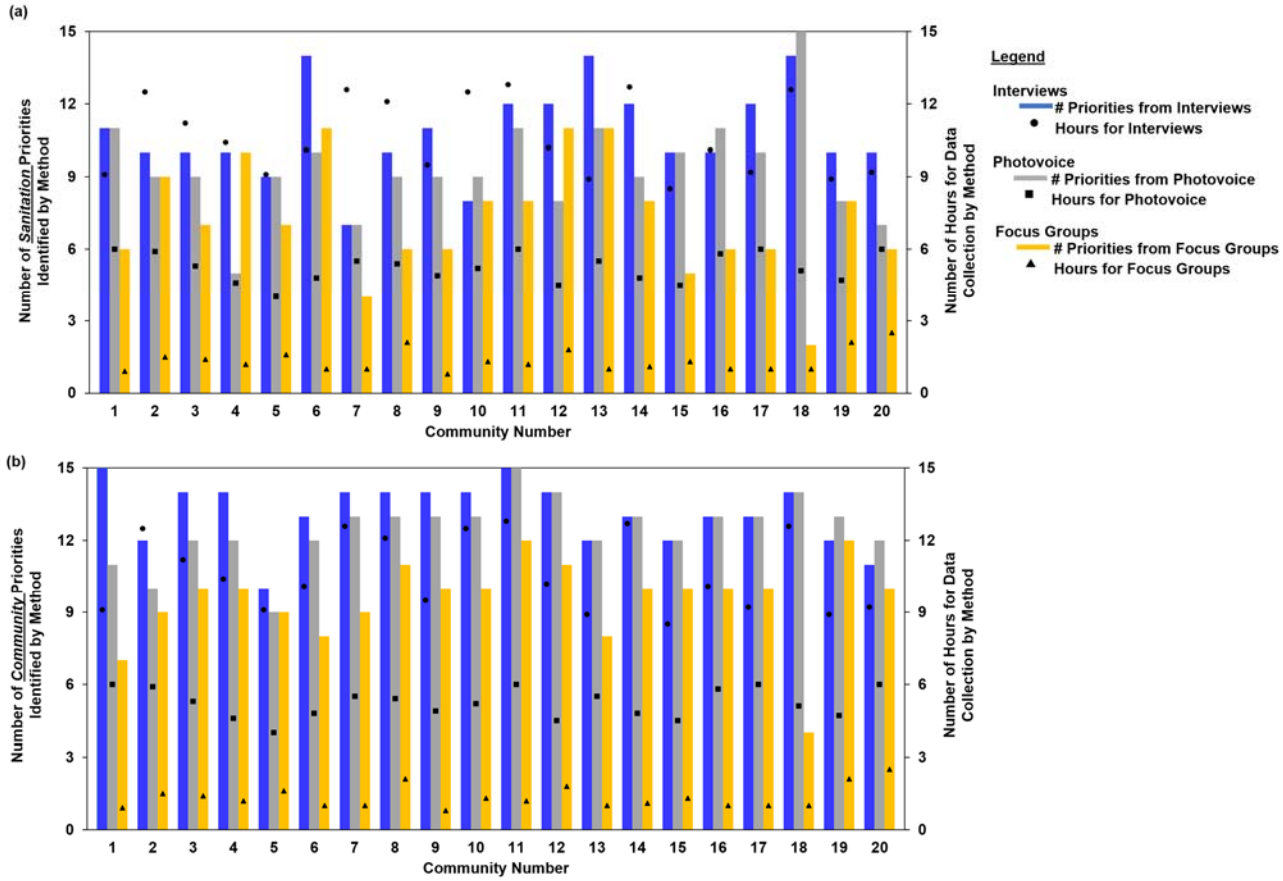

Figure S2. Comparison of the number of unique priorities identified and the time required for data collection for interviews, photovoice, and focus groups. Results show (a) community priorities and (b) sanitation priorities for all 20 communities.

3.0 Impact of Community Role and Respondent Sex on Method Effectiveness

3.1 Respondent's Community Role

Table S8. Results of a comparison of the most effective role from all 20 communities based on identification of the greatest number of the most important priorities. Results are for comparisons between (a) leader and operator, (b) leader and WSHG member, (c) community member and leader, (d) community member and operator, (e) community member and WSHG member, (f) WSHG member and operator. For Community Member (Member) and WSHG Member (WSHG), the results are for the average response for one individual. The p-values from one-way ANOVA are in parentheses. Bold denotes p-values less than the confidence-level used in the analysis ($p<0.05$) and * denotes p-values greater than the confidence-level used in the analysis ($p>0.05$).

Method	Priority Category	Role					
		(a) Leader vs. Operator	**(b) Leader vs. WSHG**	**(c) Member vs. Leader**	**(d) Member vs. Operator**	**(e) Member vs. WSHG**	**(f) WSHG vs. Operator**
Interviews	**Community Priorities**	Leader (0.574)*	WSHG (0.635)*	**Member** (0.000)	**Member** (0.000)	**Member** (0.000)	WSHG (0.054)*
	Sanitation Priorities	Leader (0.454)*	WSHG (0.255)*	**Member** (0.000)	**Member** (0.000)	**Member** (0.000)	WSHG (0.053)*
Photovoice	**Community Priorities**	Leader (0.149)*	WSHG (0.188)*	**Member** (0.000)	**Member** (0.000)	**Member** (0.000)	**WSHG** (0.020)
	Sanitation Priorities	Leader (0.496)*	WSHG (0.056)*	**Member** (0.000)	**Member** (0.005)	**WSHG** (0.000)	**WSHG** (0.024)

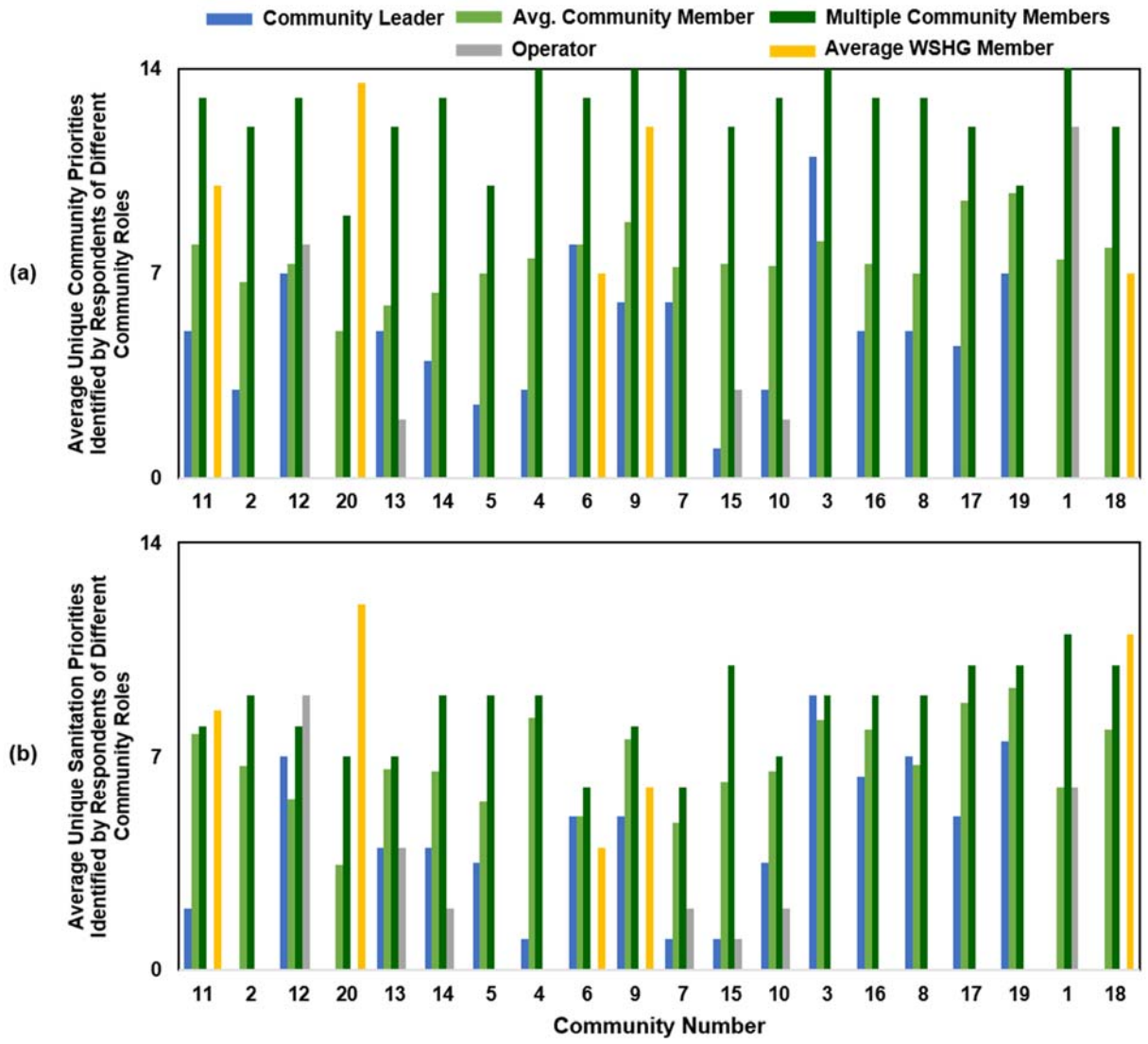

Figure S3. Results of community roles for identifying unique sanitation priorities through interviews for (a) community priorities and (b) sanitation priorities. Bars represent the average number of unique sanitation priorities identified by one participant from each role, except for Multiple Community Members, which presents the total number of sanitation priorities identified by multiple community members.

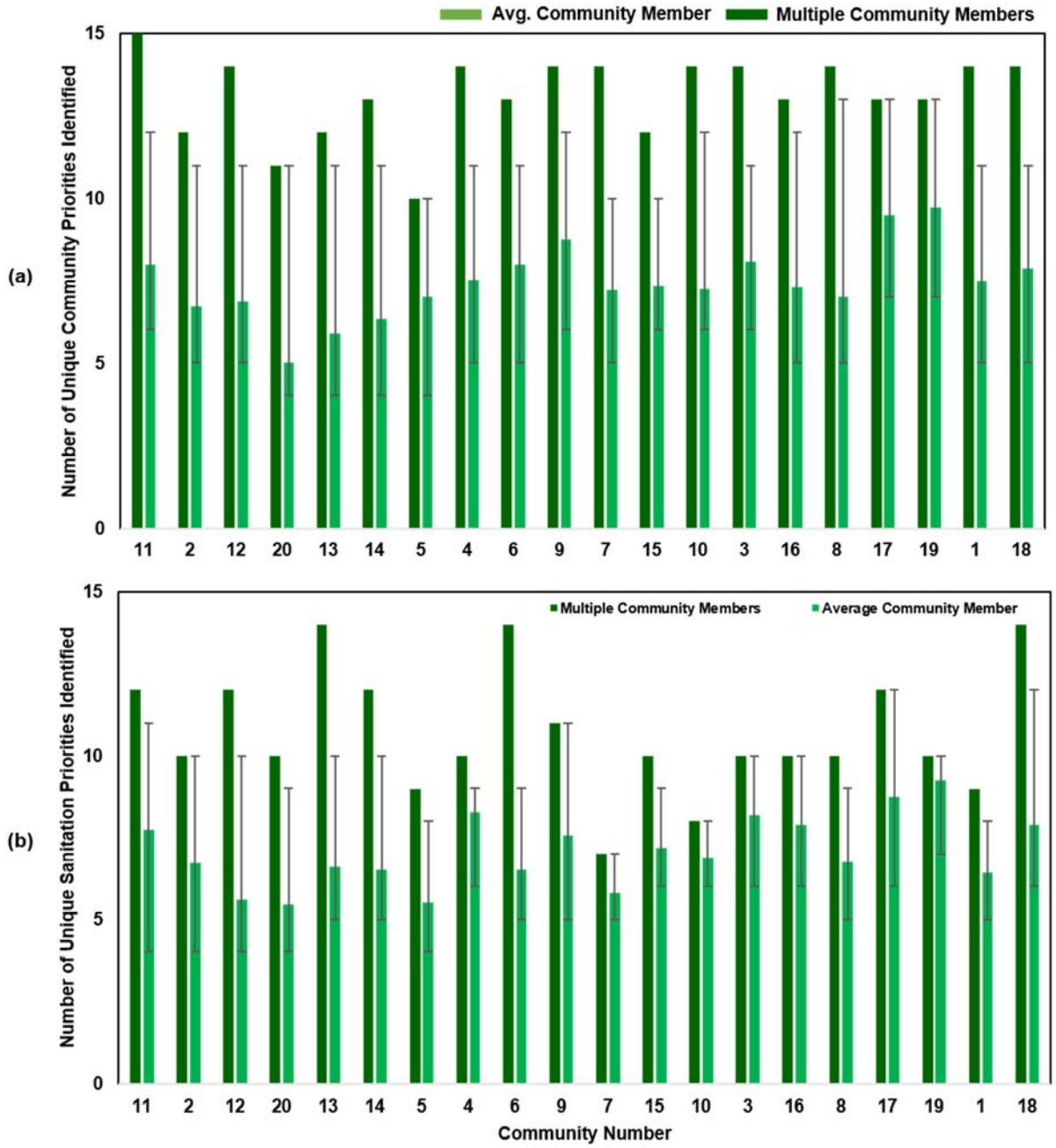

Figure S4. Results of the number of unique sanitation priorities identified by all community members in interviews (n = 7 to 12) and the average community member in an interview for (a) community priorities and (b) sanitation priorities. Error bars represent the maximum and minimum number of unique sanitation priorities identified by individual community members are also presented.

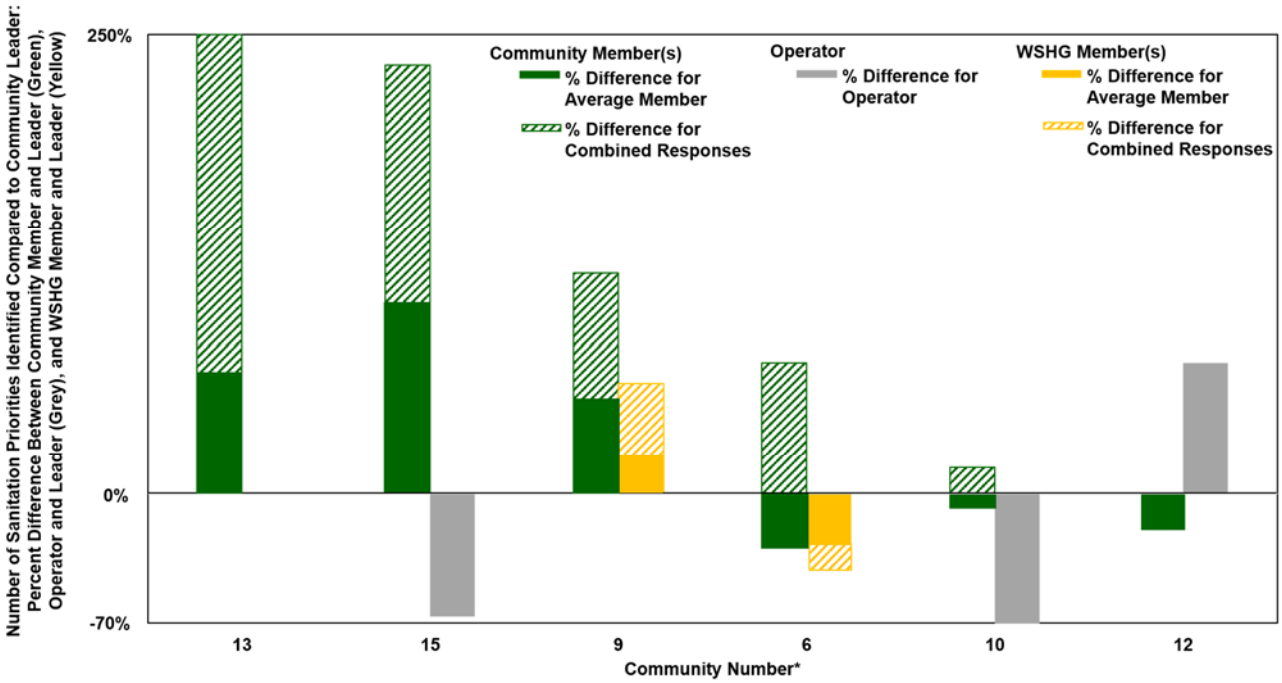

Figure S5. Results of the number of unique sanitation priorities identified in interviews by each community role (community leader, community members, system manager). Communities presented are the six communities (out of 20) that had three roles (leader, members, and manager; where a community had either an operator or WSHG). Results are normalized to community leaders and reflect the percent difference between the number of unique sanitation priorities identified by the community leader and members of each comparative role. Total Responses for Community Members and WSHG Members reflect results from all respondents in the role until theoretical saturation was reached (n=7 to 12 and n=3 to 5, respectively). Complete results of the comparison between roles for all communities are presented in Figure S3(a)†. Results for sanitation priorities are presented in Figures S3(b) and S5†. CL = Community leader; CM = Community member; OP = Operator; WSHG = Women's Self-Help Group. *Community number not in numerical order.

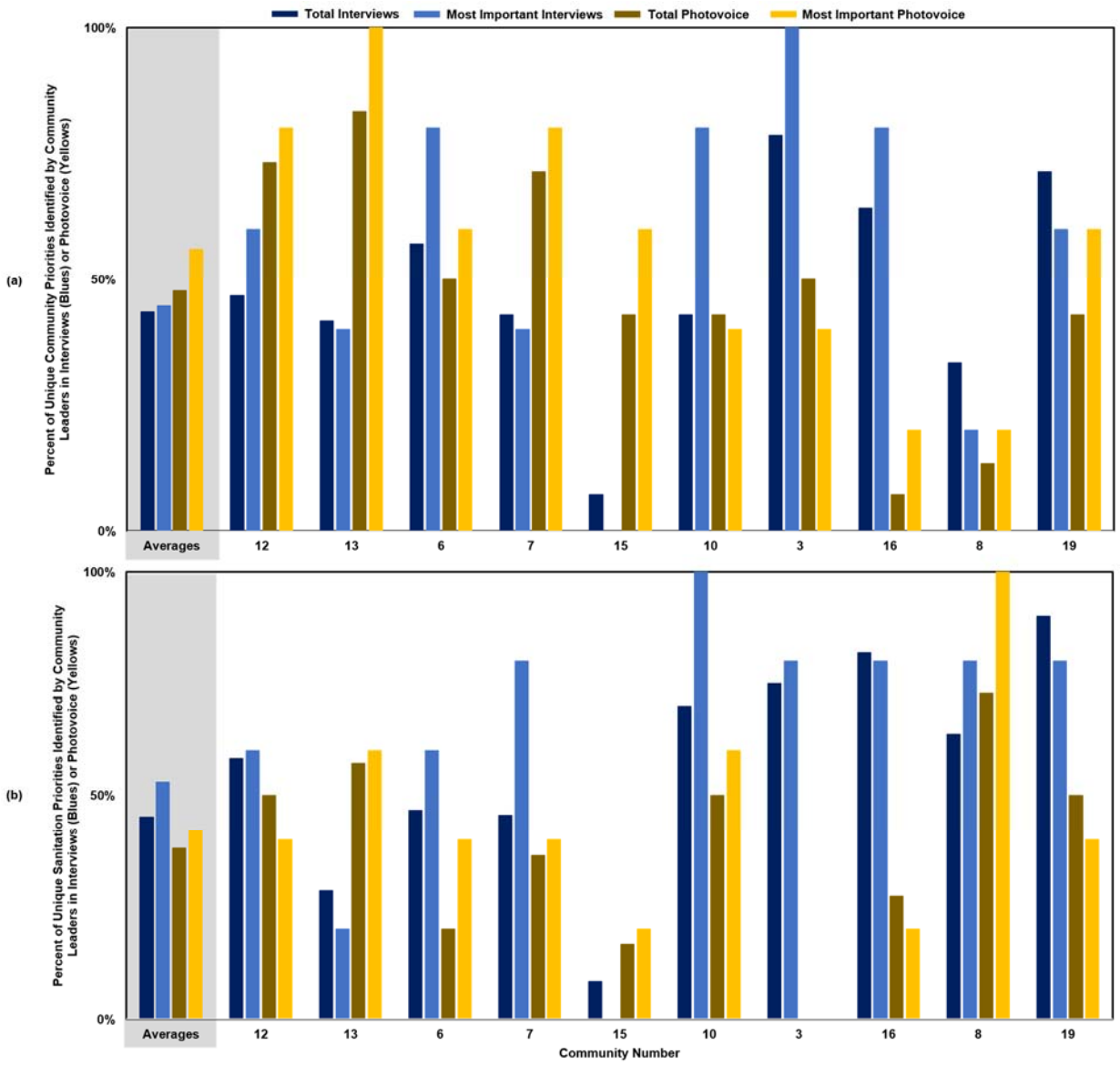

Figure S6. Results for identifying sanitation priorities when speaking with community leaders for (a) community priorities and (b) sanitation priorities. Bars represent the percent of unique sanitation priorities identified by one community leader from interviews and photovoice.

3.2 Community Member Sex

Table S9. Results of the effectiveness of respondent sexes for identifying the most unique priorities. Results are presented for a comparison of the total number of unique priorities identified by multiple members of each sex and the average number of unique priorities identified by one member of each sex. P-values from one-way ANOVA are in parentheses. Bold denotes p-values less than the confidence-level used in the analysis ($p<0.05$) and * denotes p-values greater than the confidence-level used in the analysis ($p>0.05$).

Method	Priority Category	Priority Importance	Respondent Sex	
			Average Male vs. Average Female	Multiple Males vs. Multiple Females
Interviews	Community Priorities	Total	**Female** (0.000)	**Females** (0.000)
		Most Important	**Female** (0.000)	**Females** (0.001)
	Sanitation Priorities	Total	**Female** (0.005)	Females (0.110)*
		Most Important	**Female** (0.000)	**Females** (0.039)
Photovoice	Community Priorities	Total	**Female** (0.049)	Females (0.610)*
		Most Important	Female (0.106)*	Females (0.387)*
	Sanitation Priorities	Total	Female (0.317)*	**Females** (0.015)
		Most Important	Female (0.137)*	Females (0.213)*

3.3 Most Effective Method for Each Community Role and Respondent Sex

Table S10. Results of the most effective methods to use with each community role. P-values from one-way ANOVA are in parentheses. Bold denotes p-values less than the confidence-level used in the analysis ($p<0.05$) and * denotes p-values greater than the confidence-level used in the analysis ($p>0.05$).

		Community Priorities		Sanitation Priorities	
		Total	Most Important	Total	Most Important
Community Roles	Community Leader	Photovoice (0.799)*	Photovoice (0.236)*	Interviews (0.818)*	Interviews (0.754)*
	Multiple Community Members	Interviews (0.062)*	**Interviews** (0.010)	**Interviews** (0.006)	**Interviews** (0.026)
	Average Community Member	Interviews (0.234)*	Photovoice (0.150)*	**Interviews** (0.002)	Interviews (0.618)*
	Operator	Interviews (0.775)*	Photovoice (0.897)*	Interviews (0.739)*	Interviews (0.678)*
	Average WSHG Member	Interviews (0.608)*	Photovoice (0.907)*	Interviews (0.868)*	Interviews (0.846)*

Table S11. Results of the most effective methods to use with each sex. Results are presented for a comparison of the total number of unique priorities identified by multiple members of each sex and the average number of unique priorities identified by one member of each sex. P-values from one-way ANOVA are in parentheses. Bold denotes p-values less than the confidence-level used in the analysis ($p<0.05$) and * denotes p-values greater than the confidence-level used in the analysis ($p>0.05$).

		Community Priorities		**Sanitation Priorities**	
		Total	**Most Important**	**Total**	**Most Important**
Respondent Sex	**Average Male**	**Photovoice** (0.017)	Interviews (0.929)*	Interviews (0.317)*	Interviews (0.056)*
	Average Female	Interviews (0.324)*	**Interviews** (0.000)	**Interviews** (0.007)	**Interviews** (0.000)
	Multiple Males	**Photovoice** (0.002)	Photovoice (0.103)*	Interviews (0.091)*	Interviews (0.119)*
	Multiple Females	Interviews (0.399)*	Interviews (0.247)*	Interviews (0.723)*	Interviews (0.082)*

4.0 Electronic Supporting Information References

1 T. L. Saaty, A scaling method for priorities in hierarchical structures *J. Math. Psychol.*, 1977, **15**, 234–281.

2 T. L. Saaty, Decision making with the analytic hierarchy process, *Int. J. Serv. Sci.*, 2008, **1**, 83–98.