

Supporting information

Determinants of willingness to pay for faecal sludge management services and knowledge gaps - a scoping review

*Hiroaki Tomoi**^{1,2}, *Clara MacLeod*¹, *Taeko Moriyasu*³, *Sheillah Simiyu*⁴, *Ian Ross*¹, *Oliver Cumming*¹, *Laura Braun*¹

1 London School of Hygiene & Tropical Medicine, Keppel Street, London, WC1E 7HT, United Kingdom

2 Nagasaki University School of Tropical Medicine and Global Health, 1-12-4 Sakamoto Nagasaki 852-8523, Japan

3 Nagasaki University Office for Global Relations, Bunkyo-machi, 1-14, Nagasaki, Japan

4 African Population & Health Research Centre, APHRC Campus, Manga CI, Nairobi, Kenya

*Corresponding author: Hiroaki Tomoi hiroaki.tomoi@lshtm.ac.uk

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Supporting Information 1: Willingness to pay and the elicitation methods

WTP can be divided into “stated WTP” and “revealed WTP”.

- Stated WTP: Elicited by asking respondents about their valuation. In the water and sanitation sector, generally, stated WTP has been estimated through the contingent valuation (CV) method and discrete choice experiments (DCEs) (1, 2).
- Revealed WTP: Estimated by observing actual behaviour in a market (3). It has been examined through real-money coupon trials (2, 4).

CV method: This is a method to elicit WTP by directly asking respondents about their WTP for a hypothetical good or service with several variations: open-ended question; bidding game; payment card; and, single/double-bounded dichotomous choice (5).

DCE: This method does not directly ask respondents about their WTP but starts with presenting two or more hypothetical options (profiles) of a good or a service. These goods or services have slightly different prices and characteristics (attributes), and the respondents choose a preferable one or rank them (6).

Supporting Information 2: Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	Title Page
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Abstract
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Introduction
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Materials and Methods, para 1
METHODS			
Protocol registration and	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Materials and Methods, Research question
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Materials and Methods, Eligibility criteria
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Materials and Methods, Search strategy
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Materials and Methods, Search strategy & Supplementary Information
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Materials and Methods, Study screening and selection
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Materials and Methods, Extracting and charting the data para 1
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	Supplementary Information Table S2
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Materials and Methods, Extracting and charting the data para 2

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Materials and Methods
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Results, Search Results Figure 1
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Results, Study Methods Table 2, Supplementary Information Table S4
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	Supplementary Information Table S3
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Results, Gap between WTP and market price Table 3
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Results, Determinants of WTP Table 4
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Results, Search Results
Limitations	20	Discuss the limitations of the scoping review process.	Discussion, Limitations
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Discussion, Recommendations for future research
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Acknowledgement

JB1 = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: 10.7326/M18-0850. (19)

Supporting Information 3: Search strategy

- Scopus

(TITLE-ABS-KEY ("f?ecal sludge" OR "f?ecal waste" OR "sanitation" OR "toilet*" OR "latrine*" OR "septic tank*" OR "sanit* facilit*" OR "non-networked" OR "onsite treatment" OR wash OR desludg* OR "pit empty*" OR "sludge remov*") AND TITLE-ABS-KEY ("willing* to pay" OR wtp OR "willing*-to-pay" OR "economic analysis" OR "economic evaluation" OR "cost analysis" OR "cost evaluation" OR "contingent valuation" OR "conjoint analysis" OR "discrete choice" OR "auction" OR "bidding" OR "Becker-DeGroot-Marschak" OR "take-it-or-leave-it"))

- Web of Science

(TS=("f?ecal sludge" OR "f?ecal waste" OR sanitation OR toilet OR latrine OR "septic tank*" OR "sanit* facilit*" OR non-networked OR "onsite treatment" OR WASH OR desludg* OR pit empty* OR sludge remov*)) AND TS=("willing* to pay" OR "willing*-to-pay" OR wtp OR "economic analysis" OR "economic evaluation" OR "cost analysis" OR "cost evaluation" OR "contingent valuation" OR "conjoint analysis" OR "discrete choice" OR "auction" OR "bidding" OR "Becker-DeGroot-Marschak" OR "take-it-or-leave")

Search Terms

Component 1: FSM	Component 2: WTP
f?ecal sludge OR f?ecal waste OR sanitation OR toilet* OR latrine* OR septic tank* OR sanit* facilit* OR non-networked OR onsite treatment OR WASH OR desludg* OR pit empt* OR sludge remov* OR FSM	willing* to pay OR willing*-to-pay OR WTP OR economic analysis OR economic evaluation OR cost analysis OR cost evaluation OR contingent valuation OR conjoint analysis OR discrete choice OR auction OR bidding OR Becker-DeGroot-Marschak OR take-it-or-leave-it

Supporting Information 4: List of codes used in the screening process

Table S1. List of codes used in the screening process

Title screening		Code
Is this paper a duplicate of another?	→ YES	1
↓NO		
Is this paper about water & sanitation issues?	→ NO	2
↓YES/Uncertain		
Is this paper about faecal sludge management at sanitation facilities?	→ NO	3
↓YES/Uncertain		
Abstract screening		
Is this paper about faecal sludge management at onsite sanitation facilities (pit latrine, septic tank etc)?	→ NO	4
↓YES/Uncertain		
Does this paper include economic analysis?	→ NO	5
↓YES/Uncertain		
Is this paper about WTP for onsite fecal sludge emptying?	→ NO	6
↓YES/Uncertain		
Full paper available?	→ NO	7
↓YES		
Full text screening		
Is this paper about WTP for onsite fecal sludge emptying?	→ NO	8
↓YES		
Can WTP for fecal sludge emptying be assessed separately?	→ NO	9
↓YES		
Does the paper include original findings? (not just citing other papers?)	→ NO	10
↓YES		
Included		

Supporting Information 5: Components of the data extraction sheet

Table S2. Data extraction sheet includes the following items.

Title	Authors	Publication year
Study setting	Study aim and design	Household characteristics
Latrine maintenance practice	Type of emptying service investigated	Method used to elicit WTP
Type of WTP (stated/revealed/both)	Study population and sample size	Who is responsible for emptying cost
Frequency of emptying	Average emptying fee by service	WTP amount
Market price/WTP (%)	Investigated determinants of WTP	Statistically significant determinants of WTP
Potential bias	Quality of the literature	

Supporting Information 6: Results of quality assessment

Table S3. Results of quality assessment against five criteria: (i) survey design including sample size calculation and bid distribution, (ii) instrument validation via pre-test, focus group discussion or similar, (iii) survey implementation including quality control and data management, (iv) mean WTP elicitation, and (v) ex-post validity assessment on WTP. These criteria were based on the technical note developed by Asian Development Bank (ADB). (7)

Author & Year	Assessment results
Harder et al., 2013 (8)	i. Fair (<i>“there is a potentially larger hypothetical bias for non-connected households because they essentially face two hypothetical scenarios”</i>) ii. Good iii. NA iv. Good v. Good
Russel et al., 2015 (9)	i. Fair (No rationale for sample size) ii. NA iii. Good iv. NA v. NA
Jenkins et al., 2015 (1)	i. Good ii. Good iii. Fair (No enumerator training/quality control mentioned) iv. NA v. Good
Parikh et al., 2016 (10)	i. Good ii. Good iii. Fair: (a large proportion of households (30 per cent) did not respond to this question) iv. NA v. Good
Balasubramanya et al., 2017 (11)	i. Good ii. Good iii. NA iv. Good v. Good
Ross & Pinfeld, 2017 (12)	i. Fair: No rationale for the sample size; Although WTP <70K seemed to be the majority, the cheaper range was not covered ii. Good iii. Good iv. NA v. Good
Vásquez & Alicea-Planas, 2018 (13)	i. Good ii. Good iii. Fair (No enumerator training/quality control mentioned) iv. Good v. Good

World Bank, 2019 (14)	<ul style="list-style-type: none"> i. Fair: No rationale for the sample size ii. NA iii. NA iv. Good v. Fair: Table 8 just shows positive income elasticity
Burt et al., 2019 (2)	<ul style="list-style-type: none"> i. Poor: No rationale for sample size; Redemption period was not long enough; Redeeming rules were so complicated that some HHs were excluded due to their misuse; No validity check for price distribution. ii. NA iii. NA iv. Good v. Good but (<i>"Our stated preference results do not correspond with our estimates for current market prices for sealing and emptying...our model indicates the total WTP for sealing is at least double the average rate"</i>)
Peletz et al., 2020 (4)	<ul style="list-style-type: none"> i. Poor: Was the sample size for real-money trial enough? (<i>"This sample size allowed us to detect a minimum 22 percentage-point difference in the proportion of the population WTP for the two different services at each price point."</i>); no rationale for the sample size on the stated WTP though it seems sufficient; Redemption period was not long enough (<i>"revealed WTP may have increased if we had given households more time to redeem vouchers"</i>) ii. Good iii. Good iv. Good v. Good but (<i>"not able to examine revealed WTP at price points for Gasia Poa"</i>)
Naing et al, 2020 (15)	<ul style="list-style-type: none"> i. Good ii. NA iii. Fair: (<i>"a large proportion of households (30 per cent) did not respond to this question"</i>) iv. Good v. Good
Harper et al., 2021 (16)	<ul style="list-style-type: none"> i. Good ii. Good iii. Good iv. Good v. Good but (<i>"Because it is unlikely that households would be willing to pay such a high premium for a service with a given attribute, the reported WTP estimates can be interpreted as too large. Thus, reported WTP estimates describe the relative preferences for FSM-service attributes and should not be considered as true representations of the cost households would actually pay."</i>)
Delaire et al., 2021 (17)	<ul style="list-style-type: none"> i. Fair: No rationale for the sample size ii. Good iii. NA iv. Good v. NA
Singh et al., 2021 (18)	<ul style="list-style-type: none"> i. Poor (WTP scenario was not explained in detail.) ii. NA iii. NA iv. NA v. NA

Good... fully addressed; Fair...partially addressed but there is room for improvement (one serious drawback); Poor...hardly addressed (two or more serious drawbacks); NA...not reported

Extract of the ADB’s quality checklist for WTP studies (left column) and its correspondence with the five criteria for quality assessment in this study (right column)

ADB’s Quality checklist item	Corresponding Criterion for the quality assessment in this study
1. Design Issues 1.1 Precharacterization of Water Supply and Sanitation (WSS) 1.2 Contingent Valuation (CV) scenario 1.3 Commodity definition 1.4 Elicitation method 1.5 Bid distribution 1.6 Sample (e.g., sample size, sampling frame and method)	Design Phase (i) survey design including sample size calculation and bid distribution *Since the included studies in this scoping review used not only CV methods but also others, 1.2 was interpreted as “study scenarios”
2. Survey Instrument 2.1 Focus Group Discussions 2.2 Pretesting 2.3 Quality of Survey Instrument	Pre-survey Phase (ii) instrument validation via pre-test, focus group discussion or similar
3. Potential Biases	
4. Survey Implementation 4.1 Enumerator Training 4.2 Field Supervision	Implementation Phase (iii) survey implementation including quality control and data management
5. Data Management 5.1 Quality Checks 5.2 Preliminary Analysis	
6. Validity Tests	
7. Estimation of Mean WTP	Analysis Phase (iv) mean WTP elicitation
8. Demand Analysis	(v) ex-post validity assessment on WTP
9. Reporting	N/A

(Cited from “Table 6 Quality checklist for mission leaders (pp.32)” in the ADB’s technical note (7))

Supporting Information 7: Characteristics of sanitation management behaviour

Table S4. Characteristics of sanitation management behaviour

Author & Year	Study country	Onsite facilities used	Average emptying volume per event	Number of people sharing one facility	Emptying frequency (average; current practice)	Emptying frequency (average; proposed service)	Person responsible for emptying cost
Harder et al., 2013	Philippines	Single vault septic tank (43%), latrine	NA	NA	NA *only 13% of households have desludged their septic tanks in the past 10 yrs.	Every 3 years	Household
Russel et al., 2015	Haiti	NA	NA	NA	NA	Twice-weekly collection (CBS)	NA
Jenkins et al., 2015	Tanzania	Traditional pit latrines (88%), ventilated improved pit latrines (8%), pour-flush latrines (2%), and drum/tyre pit latrines (1.5%)	0.3 m ³	10 (average)	Every 7.5 years for latrines that had been emptied 8.2 years (unlined), 6.5 years (partially lined), 8.5 years (fully lined), 4.7 years (drum/tire), 5.5 years (other, mainly septic and sewer)	2.5 m ³ pit storage capacity would be full within 10 years, on average, and in as little as 2.5 years	81% said owner household 16% said shared responsibility by users
Parikh et al., 2016	Sierra Leone	Onsite systems (>90%, pit latrines with or without septic tanks)	NA (*average pit volume: 14,3 m ³)	NA	NA *Once a year (44%) or more frequently (44%)	NA	NA
Balasubramanya et al., 2017	Bangladesh	Latrine (93%), while 67% use a sanitary latrine (which is most often a pit toilet)	0.73 m ³	5	NA *Most pit latrines were installed around 4 years ago. 20% had emptied at least once, while the rest would empty soon.	Every 3.7 years	NA
Ross & Pinfeld, 2017	Rwanda	Pit latrine (69.4%), VIP latrine (8.8%), automatic cistern flush (6.4%), pour/manual	NA	11	Every 9 years.	NA	Owner-occupier and landlord

		flush (5.3%),						
Vásquez & Alicea-Planas, 2018	Nicaragua	Unimproved latrine (60%), toilet (35%), although few of them (if any) are connected to a septic tank that can be periodically emptied	NA	NA	NA	NA		NA
World Bank, 2019	Cambodia	Pour-flush latrine connected to a soak-pit (87.8%), pour-flush latrine connected to a tank (12.0%), traditional pit latrine (0.2%)	NA (*average pit volume: 2.6 m ³)	5.4	NA	NA		NA
Burt et al., 2019	Rwanda	Pit latrine	1.2 m ³	NA	8.7 years (95%CI: ±0.85)	NA		NA
Peletz et al., 2020	Kenya	Dry improved pit latrine (74%), pour-flush to septic tank (12%), dry unimproved pit latrine (7%), pour-flush to pit latrine (7%)	NA	NA (6 households)	NA *Within 3 months ago (16%); 3-12 months ago (24%); 1-2 years ago (11%); Over 2 years ago (6%); Never (40%); Unknown (3%)	NA		Landlord and homeowner
Naing et al., 2020	Myanmar	Septic systems (84.7%), unlined pit latrine (5.2%), lined pit latrine (4.8%), cesspool (3.8%).	NA	NA	0.079 time/unit/year (= Every 12.7 years)	NA		Household
Harper et al., 2021	Cambodia	Pour-flush latrine	NA	NA	2-5 years	NA		NA
Delaire et al., 2021	Kenya	NA	NA (*average pit volume: Kisumu 2.4 m ³ , Nakuru 5.1 m ³ ,	Kisumu: 8, Nakuru: 1, Malindi: 5,	NA	Lined pit: 30 months (Kisumu), First empty after 65 months, then every 43 months (Nakuru), First empty after 102 months, then every 68 months (Malindi), Vault: 1		Landlord, homeowner, or tenant

			Malindi 12 m ³)			month (Malindi), Septic tank: 30 months (Malindi), Communal septic tank for mini-sewer: 25 months (Malindi)	
Delaire et al., 2021	Ghana	NA	NA (*average septic tank volume: 10.9 m ³)	4	NA	Septic tank: 82 months	Landlord, homeowner, or tenant
Delaire et al., 2021	Bangladesh	NA	NA (*average septic tank 5.7 m ³)	1	NA	Vault: 7 month, Septic tank: 34 months, Communal septic tank for mini-sewer: 30 months	Landlord, homeowner, or tenant
Singh et al., 2021	Bangladesh	Septic tanks with/without soakwell (76%), pit latrines as containments (24%).	NA (*average pit volume 1.96 m ³)	NA	Once in less than one year ~ not emptied in 15 years (half of the households surveyed emptied their containment at least once in less than 3 years)	Every 3 years	Household

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