Validity and Reliability of Instruments Assessing Household Satisfaction With 3R-Based Waste Management (Tempat Pengolahan Sampah) and Waste Bank Services in Depok, Indonesia

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Abstract: Solid wastes in Indonesia are managed by two types of units regulated by two different ministries. Households are the end clients for both units; thus it is important to assess their satisfaction with the quality of the waste management services. To assess each unit, we developed survey instruments that incorporate the 3R concept and tested each instrument's construct validity and reliability. The survey was conducted in Depok City, Indonesia, interviewing household members responsible for domestic waste management. The sample size for each unit was 30 households. Construct validity was tested using confirmatory factor analysis; reliability was measured using the Cronbach-α coefficient. Results show that both instruments have fairly valid constructions (communality >50%) while performing with good reliability. The final number of items in each instrument is similar for the TPS3R and waste bank instruments.

Keywords: waste management, community, satisfaction, TPS3R, waste bank

1. INTRODUCTION

As of 2008, 53% of Indonesian cities had no landfill due to limited land availability (Ministry of Environment, Republic of Indonesia, 2008). Under these conditions, solid waste management at the municipal/district level is problematic [1]. Therefore, Indonesia issued Law No. 18 in 2008, defining solid waste management as the handling and reduction of landfill-bound solid waste. The law also assigned responsibility for waste management to the government, including provincial, district and local governments. However, community involvement is also required due to limited resources and funds.

In 2013, the Ministry of Public Works and Public Housing issued Decree No. 03/PRT/M mandating community empowerment in waste management in the form of a reduce, reuse and recycle (3R)-based waste management unit hereafter named Tempat Pengolahan Sampah 3R berbasis masyarakat (TPS3R). Meanwhile, the Ministry of Environment and Forestry issued Decree No.13 in 2012, designating waste banks as the community-level waste management unit.

The TPS3R and waste bank units have standard operating procedures that differ primarily in the sorting and selecting of biodegradable and non-biodegradable waste. In TPS3R systems, settlement-derived waste, which may or may not be separated, is transported using carts and collected at a single TPS3R unit site. Site workers then sort the waste into biodegradable and non-biodegradable categories. Generally, the biodegradable waste is processed into compost, non-biodegradable waste with economic value is sent to private waste collectors, and residual non-biodegradable waste is sent to the landfill. Every household, shop, office and market that sends their waste to the TPS3R unit site has to pay a fee that is determined by rules that are area-specific. In contrast, the waste bank system recommends that the waste producers (households, shops, offices, etc.) voluntarily sort their own waste, especially non-biodegradable waste with economic value, before selling the waste to the waste bank. The waste bank member is then compensated financially based on the amount of deposited waste [2, 3].

Both the TPS3R and waste bank systems need to perform their services reliably to increase community satisfaction with waste management [4]. Satisfaction can be assessed from public perception of the waste management services [5] and can be measured using ServQual, an instrument that captures public perception of service quality at multiple scales using five dimensions [6, 7, 8, 9]. The dimensions are defined as follows: 1) tangible, which are the parts of the service and its providers (i.e., physical facilities, appearance of personnel, tools or equipment used to provide the service) that can be directly observed [6]; 2) reliability, which is the ability to provide services at the designated time [6]; 3) responsiveness, which is the ability of a service provider to provide quick, precise service and to deliver clear information to others [6]; 4) assurance, which relates to the ability of the staff to carry out their duties with knowledge and skill while inspiring trust and confidence in their problem-solving abilities [6, 7, 8, 9]; and 5) empathy, which is the ability of service providers to care about customer needs [9].

To measure client satisfaction with waste management, previous studies have developed assessment tools that evaluate the variables of frequency, time of waste collection and waste transportation, waste transportation vehicles, collection staff, the behaviours and attitudes of the collection staff, the working clothes of and protective instruments for the collection staff [10], cost of the management service [11], the amount paid by the waste bank, the diversity of waste types accepted by the waste banks and the financial system within the waste bank [12]. The satisfaction-level assessment may also use the ten-scale system [10]. However, none of the tools that have been developed have taken the 3R concept into account. Yet Indonesia has already incorporated the 3R concept of reducing, reusing and recycling solid waste in the implementation of TPS3R and waste banks.

Depok is a city located in West Java in Indonesia that has recently implemented the 3R concept at the household level through both the waste bank and the TPS3R systems. To be

able to measure household satisfaction with the performances of the TPS3R and waste bank units, it is important to develop an instrument that incorporates the 3R concept in assessing customer satisfaction with both units. Ultimately, the aim is to improve waste management at the community level. This study aims to develop such an instrument for each type of waste management unit; here, we focus on evaluating the validity and reliability of the instruments.

2. MATERIALS AND METHODS

A. Study Design

A cross-sectional study was conducted in Depok City, West Java, Indonesia. In 2017, Depok's population size was 2,254,513, out of a total population of 261,890,900 in Indonesia [13]. This city consists of 11 sub-districts, with densities ranging from 6,094 to 17,448 heads per square km and a sex ratio of approximately one [13]. The study was conducted from February until April 2018.

B. Study Population and Sampling

This survey examined two populations: households that received services from the TPS3R unit and households listed as waste bank members. The respondents from both populations are household members who are responsible for household waste management.

Data from the Depok Environment and Sanitation Office show 28 active TPS3R units in Depok that are responsible for managing household solid waste. In addition, the city has 405 waste bank units. Out of the 28 listed active TPS3R units, 6 units were randomly chosen and in the second stage of sampling, households within a given TPS3R unit were chosen via stratified random sampling. The stratification defined a 1-km radius zoned living area based on the existing TPS3R cart service. For the purposes of this study, the TPS3R service area was web mapped geographically into the following 3 zones: <0.5 km, 0.5 km–1 km and >1 km from the selected TPS3R unit site. In each zone, one community unit, or rukun warga (RW), was selected randomly. Within each selected RW, one subordinate neighbourhood unit, or rukun tetangga (RT) was chosen randomly; and from each selected RT, a total of five households were randomly selected: two households from Zone 1, one household from Zone 2 and two households from Zone 3. The final sample size was 30 households.

At the same time, waste bank member households were sampled as follows: in each chosen TPS3R service area, a waste bank nearest the TPS3R unit was chosen and the waste bank manager was asked to provide a list of member households. From this list, five households were selected by systematic random sampling. The final sample size was 30 households.

A sample size of 30 is the minimum size needed to detect differences between the proportion of households that are satisfied with either TPS3R or waste bank units. This sample size was determined by power analysis because the significance of the values provided is unclear, which found a minimum of 0.4, with a 95% confidence level and 80% power of the study [14].

C. Data Collection

The first draft of each instrument was designed based on the five dimensions of the ServQual concept: tangible, reliability, responsiveness, assurance and empathy [6, 7, 8, 9]. New questions regarding the 3R concept were then inserted, for a total of 25 question, each with

responses in the form of a scale ranging from 1 to 10. The questions referring to satisfaction levels with TPS3R and waste bank services are worded differently, but operate within the same dimensions.

The instruments for assessing satisfaction levels with TPS3R and waste banks were developed from various previous studies [10, 15, 16, 17]. The research team were briefed prior to the survey and then conducted face-to-face interviews with the respondents. At the beginning of every interview, each respondent was asked to complete a written informed consent letter. Ethical clearance for this study was issued by the Ethics Committee of the Faculty of Public Health, Universitas Indonesia (No. 513/UN2.F10/PPM.00.02/2017).

D.   Statistical Analysis

The results of descriptive statistics are presented in tables. In addition, a confirmatory factor analysis was performed to determine the validity of the assessment of construct representation. The indicators used in factor analysis, including the Kaiser–Meyer–Olkin (KMO) test and Bartlett's test, measured the following: sampling adequacy (>0.5); communalities for describing the proportion of variance of each variable that explains the formed factor (>0.5); and factor loadings indicating the percentage of the variance in the original variable that is explained by a factor (>0.55) [18]. The second analysis is the reliability test, which evaluates the consistency of the results, and is estimated using the Cronbach-α coefficient. The larger the value of this coefficient (>0.7), the more reliable the instrument [18].

A scale of 1 to 10 was used to measure the level of household satisfaction with waste management services of TPS3R or waste banks because respondents are more familiar with the 10-scale assessment system [19]. The Likert rating system usually applies a 5-scale system but can be modified to use scales of ten or more [20]. Thus, in this study, numerical data are grouped into a 1–5 scale, and the mean score fits into five categories, e.g., 0–2.0 = very dissatisfied, 2.1–4.0 = not satisfied, 4.1–6.0 = moderately satisfied, 6.1–8.0 = satisfied, 8.1–10 = very satisfied.

3. RESULTS AND DISCUSSION

A.   Socioeconomic and Demographic Characteristics of Respondents

The study respondents were primarily female, the majority of whom has a high education level (Table 1). The median age is 44 years (standard deviation 9 years), with a range of 26 to 64 years. Although the sex ratio of the Depok population is approximately 1, the respondent profile indicates a degree of specialisation in domestic waste management, i.e., the individuals who manage household waste tend to be older-than-average and female (the Depok population's mean age is 25 years) [13]. The average respondent profile describes either a housewife or housemaid; this information can be considered for the next intervention that may seek to investigate means to improve the quality of community solid waste management.

Table 1. Survey Respondent Characteristics

Respondent Characteristics	TPS3R	Waste Bank	p Value
Number of Respondents (n)	30	30	
Age Mean/Median (years)	44.33/44.0	43.1/44.0	0.622
Age Range (min–max years)	26–63	26–64	
Age Group:			0.529
< 30 years	1	2	
30 to 45 years	15	18	
> 45 years	14	10	
Gender - Female (%)	73.33	100	0.011
Education			0.060
Low (none, primary, secondary)	10	3	
High (high school or above)	20	27	
HH Monthly Income (Rupiah)			0.078
Median (thousand)	4,740	3,250	
Min to Max (thousand)	1,000 to 50,000	1,000 to 10,000	
HH Monthly Income Based On Regional Minimum Wage in Depok Above Minimum Wage (%) Below Minimum Wage (%)	44 54	56 46	0,600

Note: *Depok minimum wage: Rp3,584,700 (Source: West Java Governor Decree No. 561, Year 2018)

Table 1 also shows household economic conditions. Monthly median income for TPS3R clients is Rp4,740,000, with a range of Rp1,000,000 to Rp50,000,000. This amount is slightly higher than the monthly median income for waste bank clients, which is Rp3,250,000, with a range of Rp1,000,000 to Rp10,000,000. This difference may be related to what differentiates the two waste management systems, that is, the TPS3R unit requires a fee from participating households, while waste bank members are paid for the waste they collect. Likewise, the target clients of the two systems are different.

B.   Instrument validity

The first draft of each instrument was developed after performing a literature review. The draft contained the five dimensions of quality (tangible, reliability, responsiveness, assurance and empathy), with each dimension represented by five questions or items. Since TPS3R units and waste banks operate different processes for solid waste management, the questions in each instrument were worded differently. These first drafts were then revised in a meeting attended by academics, representatives from the Ministry of Public Works and Housing and

the Ministry of Environment and Forestry and personnel from TPS3R and waste bank units. The revised draft was tested on selected households in areas that were not part of the study sites to evaluate the acceptability of the questions' wording and the flow of questions. After minor revisions, this process was repeated, resulting in the final survey instruments. The TPS3R and waste bank instruments each contain 18 and 19 items, respectively. The above steps were undertaken to confirm the face validity of our instruments prior to assessing their construct validity.

The results of data analysis after survey completion are presented in Tables 2 and 3, which summarise the responses to each item, and shows response variations; the analysis indicates the instruments are able to distinguish between low and high levels of satisfaction. Furthermore, the communalities of both instruments exceed 50% (Tables 4 and 5). Anti-image correlation analysis found moderate to high correlations between variables, with values of 0.5 or higher. The adequacy of our sampling strategy is demonstrated by KMO values of 0.5 or higher in all dimensions in both instruments. The factor loading values of all items in both instruments are 0.55 or higher. These results are similar to those of a previous study that used similar components [16].

Table 2. Household Satisfaction With TPS3R, Score per Dimension Item

Satisfaction Dimension		Mean	Median	SD	Min–Max
Tangible					
1	Different vehicles or separate equipment are used to transport biodegradable and non-biodegradable waste.	6.9	7.0	1.97	3–10
2	The collection staff wear personal protective equipment (i.e., boots, gloves, etc.).	7.7	8.0	1.56	3–10
3	The collection staff carries equipment (i.e., broom, dustpan, etc.) to clean the waste.	7.7	8.0	1.64	3–10
4	The collection staff are easily recognised by special signs (i.e., uniform, sound, etc.).	7.63	8.0	1.79	3–10
Reliability					
1	There are different collection schedules for biodegradable and non-biodegradable waste.	4.47	4.0	2.59	1–9
2	The collection staff does not mix the biodegradable waste, the non-biodegradable waste and the residue waste during transport.	4.37	4.0	2.49	1–9
Assurance					
1	The collection staff is trustworthy and will not commit crimes when carrying the waste.	8.6	9.0	1.1	6–10
2	The collection staff refuse tips.	8.27	9.0	1.5	3–10
3	The collection staff only take solid waste from the household.	8.0	8.0	1.36	4–10
Responsiveness					

	Satisfaction Dimension	Mean	Median	SD	Min–Max
1	The collection staff, neighbourhood or local government or others provide guidance on solid waste collection methods.	6.7	7.0	1.8	3–10
2	The collection staff provides fast service when there is a complaint from the household.	7.7	8.0	1.14	4–10
3	There is an available contact number for the collection staff.	6.37	7.0	2.1	1–10
4	After being contacted by the household, residual solid waste is transported by the collection staff.	7.1	7.0	1.6	3–10
Empathy					
1	The collection staff is polite to the household.	8.23	8.0	1.22	4–10
2	The collection staff does not protest when carrying excess solid waste.	7.77	8.0	1.38	4–10
3	The collection staff helps the household to clean up the solid waste.	7.93	8.0	1.48	3–10
4	The collection staff provides equal service.	7.73	8.0	1.36	3–10
5	The collection staff waits patiently.	8.1	8.0	1.42	3–10

Table 3. Household Satisfaction of the Waste Bank, Score per Dimension Item

	Satisfaction Dimension	Mean	Median	SD	Min–Max
Tangible					
1	The savings book/savings card is available for the customer.	8.77	9.0	1.3	5–10
2	The list of litter types and prices is available.	8.83	9.0	1.1	6–10
Reliability					
1	The waste bank opens regularly according to the operational hours.	8.27	8.0	1.62	4–10
2	The waste is weighed in line with its type.	8.93	9.0	1.01	7–10
3	The waste bank administrators give clear mechanism directions.	8.57	9.0	1.45	5–10
4	The solid waste prices in waste banks compete with private waste collectors.	7.93	8.0	1.72	4–10
5	The waste bank accepts a greater variety of solid waste.	8.67	9.0	1.32	5–10
Assurance					
1	The waste bank administrators are trustworthy.	9.03	9.0	1.03	7–10

	Satisfaction Dimension	Mean	Median	SD	Min–Max
2	The waste bank administrators do not ask for rewards/tips.	9.37	10.0	0.76	8–10
3	The waste bank administrators record the amount of household solid waste and report it to the customers.	9.0	9.0	1.05	6–10
4	The waste bank administrators calculate and record the amount of money from selling household solid waste, then report it to the customer.	8.93	9.0	0.98	7–10
Responsiveness					
1	There is notification about the waste bank service.	9.0	9.0	0.95	7–10
2	The waste bank administrators give directional guidance on solid waste separation.	8.73	9.0	1.08	7–10
3	The waste bank administrators accept complaints from customers.	8.0	8.0	1.29	5–10
4	The waste bank administrators are helpful to the customers.	8.83	9.0	1.39	5–10
Empathy					
1	The waste bank administrators are friendly to customers.	9.33	10.0	0.92	8–10
2	The waste bank administrators give equal service.	9.0	9.0	0.91	8–10
3	The waste bank administrators do not grunt when serving the customers.	8.57	9.0	1.16	6–10
4	The waste bank administrators remain patient while serving the customers.	8.83	9.0	1.02	7–10

Table 4. Satisfaction of the TPS3R Instrument in Terms of Construct Validity and Reliability

Satisfaction Dimension	Construct Validity					Reliability		
	Anti-image Correlation	KMO & Bartlett test	Communalities	Loading Factor		Mean Score	Standard Deviation Score	Cronbach Alpha
Tangible		0.821*						0.902
1	0.908		0.660	0.813		6.900	1.971	
2	0.764		0.854	0.924		7.700	1.557	

Satisfaction Dimension	Construct Validity					Reliability		
	Anti-image Correlation	KMO & Bartlett test	Communalities	Loading Factor		Mean Score	Standard Deviation Score	Cronbach Alpha
3	0.795		0.840	0.917		7.700	1.643	
4	0.857		0.791	0.890		7.630	1.790	
Reliability		0.500*						0.931
1	0.500		0.936	0.967		4.470	2.596	
2	0.500		0.936	0.967		4.370	2.498	
Assurance		0.722*						0.869
1	0.772		0.770	0.877		8.660	1.078	
2	0.741		0.791	0.889		8.310	1.561	
3	0.670		0.857	0.926		8.000	1.363	
Responsiveness		0.801*						0.823
1	0.808		0.714	0.845		6.700	1.803	
2	0.796		0.730	0.854		7.700	1.149	
3	0.875		0.550	0.742		6.370	2.092	
4	0.757		0.759	0.871		7.100	1.605	
Empathy		0.854*						0.938
1	0.852		0.736	0.858		8.230	1.223	
2	0.937		0.763	0.874		7.770	1.382	
3	0.842		0.823	0.907		7.930	1.484	
4	0.844		0.849	0.921		7.730	1.363	
5	0.813		0.848	0.921		8.100	1.423	

Note: Item per dimension code refers to Table 2. (*) Significance of Bartlett test for $p < 0.05$; Construct Validity test: Anti-image Correlation, Kaiser–Meyer–Olkin (KMO) test, Communalities and Loading Factor; Reliability test: Mean Score of each item, Standard Deviation score and Cronbach Alpha per dimension.

Table 5. Satisfaction of the Waste Bank Instrument in Terms of Construct Validity and Reliability

Satisfaction Dimension	Construct Validity					Reliability		
	Anti-image Correlation	KMO & Bartlett's Test	Communalities	Loading Factor		Mean Score	Standard Deviation Score	Cronbach Alpha
Tangible		0.500*						0.849
1	0.500		0.936	0.875		8.77	1.305	
2	0.500		0.936	0.875		8.83	1.085	
Reliability		0.854*						0.885
1	0.876		0.724	0.851		8.27	1.617	
2	0.822		0.793	0.890		8.93	1.015	
3	0.856		0.701	0.837		8.57	1.455	
4	0.883		0.571	0.756		7.93	1.721	
5	0.850		0.792	0.890		8.67	1.322	
Assurance		0.793*						0.852
1	0.841		0.833	0.694		9.030	1.033	
2	0.730		0.900	0.809		9.370	0.765	
3	0.765		0.873	0.763		9.000	1.050	
4	0.897		0.753	0.567		8.930	0.980	
Responsiveness		0.587						0.788
1	0.637		0.775	0.600		9.000	0.947	
2	0.562		0.808	0.653		8.730	1.081	
3	0.560		0.722	0.522		8.000	1.287	
4	0.593		0.842	0.709		8.830	1.392	
Empathy		0.810						0.867
1	0.828		0.851	0.724		9.330	0.922	

Satisfaction Dimension	Construct Validity					Reliability		
	Anti-image Correlation	KMO & Bartlett's Test	Communalities	Loading Factor		Mean Score	Standard Deviation Score	Cronbach Alpha
2	0.850		0.807	0.652		9.000	0.910	
3	0.791		0.866	0.750		8.570	1.165	
4	0.783		0.866	0.750		8.830	1.020	

Note: Item per dimension code refers to Table 3. (*) Significance of Bartlett test for $p < 0.05$; Construct Validity test: Anti-image Correlation, Kaiser–Meyer–Olkin (KMO) test, Communalities and Loading Factor; Reliability test: Mean Score of each item, Standard Deviation score and Cronbach Alpha per dimension.

The reliability values of our instruments were measured by the corrected item-total correlation method, and the results are remarkable because all values for both instruments reached 0.7. The overall Cronbach-α for the TPS3R instrument is 0.918, with a per dimension range of 0.823 to 0.938; and for the waste bank instrument, this value is 0.851 with a per dimension range of 0.788 to 0.885. Compared to the results of Putra [16] in Jakarta, the instruments that we developed provide more reliable measurements of household satisfaction with TPS3R and waste bank services. Therefore, when used by trained interviewers, our instruments provide reliable measurements of the satisfaction level of solid waste management service clients at TPS3R and waste banks in Indonesia.

C.   Household satisfaction

Table 6 shows that on a 0-to-10 scale, the average household satisfaction score of the waste banks (8.77) is significantly higher than that of the TPS3R services (7.31). Clients of the waste bank system may be more satisfied because they are paid for their collected waste, while the clients of the TPS3R system have to pay for their service. It is likely that the financial returns of the waste bank system is what initially motivates the households to separate waste. The data shows that the listed waste bank clients are primarily female (Table 1). In this context, it is thus noteworthy that in Surabaya, Indonesia, most wives assume the role of managing household finances [21].

Table 6. Households' Satisfaction of the TPS3R and the Waste Bank

Satisfaction Statistics	TPS3R	Waste Bank	p Value
Respondent Numbers (n)	30	30	
Mean Score	7.31	8.77	0.000
Median Score	7.33	8.79	
Standard Deviation	1.12	0.62	

Satisfaction Statistics	TPS3R	Waste Bank	p Value
Score			
Minimum–Maximum Score	3.61–8.67	7.58–9.74	
Satisfaction Category (%):			
Very Satisfied	23.3	86.7	0.000
Satisfied	63.3	13.3	
Moderately Satisfied	10	0	
Not Satisfied Very dissatisfied	3.3	0	

Based on different client characteristics, these two systems have the potential to be developed and improved continuously in the future. That is, past customer satisfaction with service quality can positively influence the behaviour of future clients, resulting in the overall improvement of waste management services [22].

Then identifies five items in which clients' satisfaction scores with the TPS3R service were lower than eight. These items are related to the separation of biodegradable and non-biodegradable waste, notably the first of the questions in the tangible, reliability and responsiveness categories. This is understandable, considering that the TPS3R system does not require clients to separate waste. Future research may consider asking the question of whether the clients expect the collecting staff to do waste separation. Additionally, the third and fourth items in the responsiveness category, which are related to communication between clients and collecting staff, have been identified as an area that needs to be improved. Therefore, we recommend that TPS3R collecting staff address the needs to educate clients on waste separation and improve communication with clients.

4. CONCLUSIONS

We have developed instruments to assess client satisfaction levels with TPS3R units and waste bank services using five dimensions of satisfaction. In general, the instruments perform moderately well in terms of construct validity, while performing strongly in terms of reliability. To obtain consistent results, these instruments should be used to reassess more respondents in a wider area, with the instruments having 18 and 19 items. These instruments indicate that households are slightly more satisfied with waste banks than the TPS3R system.

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