RASCH ANALYSIS OF HOUSEHOLD WASTE REDUCTION BEHAVIOR: CASE STUDY IN SUNTEN JAYA, BANDUNG BARAT REGENCY

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Abstract

The reduction of domestic waste in developing countries is a critical issue that requires attention. Behavioural intentions of households can lead to reduce, reuse and recycle behaviour in waste management. Many factors influence the reduction of waste. Psychological and behavioural characteristics often hinder the effectiveness of technical solutions in managing household waste, so it is important to understand human behaviour to design effective policies. Rural areas also face waste problems, but they do not receive as much attention as urban areas. This research aims to identify the behavioural intentions of households to reduce waste in a small village in Bandung Barat Regency. This study uses Rasch model to measure a person's perspective in an objective way. Data for this study was collected using a questionnaire. The questions were rated on a five-point Likert scale. The number of respondents who participated in this study was 27. The small number of respondents was due to difficulties in finding respondents, as most people were farming at the time of the study. The result shows that the person's reliability is statistically misfit, whereas the item reliability is fit. The respondent/person misfit may be because the respondents are farmers with a low level of education. The Cronbach's alpha value, which measures the interdependence between the person and the item, is 0.70. Since the item reliability is 0.95 and the person reliability is 0.62, it can be concluded that the quality of the items of the instrument is good, and the consistency of the respondents' answers is also good. Questionnaire item I8 is the most difficult question for respondents to agree with a value of +2.09 logit. On the other hand, the easiest questionnaire item to agree on is I18 with -1.74 logit. From the results it can be concluded that the respondents know about waste separation. However, they never carried out waste separation. It can be inferred that the behaviour of the respondents does not reflect their knowledge.

Keywords: *household waste management, Rasch Analysis, waste reduction intention*

Introduction

Reducing domestic waste in developing countries is a critical issue that requires attention. Residential waste reduction intention

behavior is an important area of research that has been explored in several studies. Household behavioral intentions can lead to reducing, reusing, and recycling behavior of waste management (Chengqin, 2022), (Yustiani et al., 2019). Several studies have examined the antecedents of household garbage reduction behavior, recycling, and composting intentions in the context of an integrated waste management behavior model (Taylor, 1995). Incentive measures can strengthen the effect of

intention on behavior (Shanyong, 2020). Waste collection and treatment infrastructures must be in place so that citizens can see that sorting waste is a social norm (Bardus, 2022) (Rachman et.al, 2016).

Many factors influence waste reduction. Attitude towards waste reduction behavior has a strong effect on both recycling and reducing waste behavior (Nishio, 2005) (Yustiani, 2019). Situational factors such as collection frequency and recycling bin provision can influence waste reduction behavior (Whitmarsh, 2018). Recycling benefits, perceived control, and situational variables are factors that influence household recycling behavior (Schoeman, 2022). Beliefs and values of individuals can affect the engagement of households in waste separation activities (Zaikova, 2022). Waste collection and treatment infrastructures must be in place so that citizens can see that sorting waste is a social norm (Kannan, 2022).

Psychological and behavioral traits often hinder the effectiveness of technical solutions in managing household waste. Masdek (2023) highlights the importance of understanding human behavior to create effective policies. Masdek (2023) suggests that addressing the lack of participation requires a holistic approach, including educational materials, social media coverage, awareness campaigns, and incentivizing composting. Mouloudj (2023) provides a more comprehensive understanding of the factors influencing intentions to reduce waste. Practical implications for organizations, suggesting that investing in green policies and practices can foster sustainable norms and contribute to environmental sustainability (Costa, 2022).

Rural areas also face waste problems but are not given as much attention as urban areas. Factors influencing domestic waste in rural areas of developing countries include social factors such as population, education, and culture (Zhiyong,

2018). Economic factors such as household income and expenditure, energy and fuel structure also play a role (Zhe, 2018). Natural factors like geography and climate also affect waste characteristics (Sih, 2023). Therefore, this research aims to identify the behavioral intentions of households to reduce waste in a small village in Bandung Barat regency.

Research Methodology

There are several methods for measuring waste reduction behavior, including the use of psychometric models such as the Rasch model (Whitmarsh, 2018). This study utilizes Rasch model because it provides a mathematical framework for analyzing categorical data, such as answers to questions on a reading assessment or questionnaire responses, as a function of the trade-off between the respondent's abilities and thus serve as a tool for quantifying unobservable human conditions (Whitmarsh, 2018). Rasch is a model for measuring a person's perspective in an objective way.

Data for this study was collected through a questionnaire. The questions were rated on a five-point Likert-type scale. The questionnaire contains questions about waste reduction behavior by asking questions about individuals' waste reduction practices, attitudes, and beliefs. The questionnaire asked about the frequency of waste reduction behaviors, such as recycling or composting, and the factors that influence these behaviors, such as convenience or knowledge about waste reduction practices (Whitmarsh, 2018, Neff, 2015, Taylor, 1995). The questionnaire was used to collect data on waste generating habits, which can help identify opportunities for behavior change and inform waste reduction strategies (Van Herpen, 2019). It can also provide valuable insights into waste reduction behavior and help guide efforts to reduce waste.

The number of respondents participating in this study is 27. The small number of respondents

was due to difficulties in finding respondents because most people were farming at the time of the study.

Result and Discussion
Instruments Reliability

Table 1 provides an overview of the instrument data, which includes the person and item's reliability. The summary indicates that the measurement generates reliable and accurate findings.

The outcomes from the analysis are divided into two categories: person output and item output. The person statistics in table 1 show the statistical misfit of the person, whereas the item statistics in table 2 show the statistical fit of the instrument's items. The person's mean score of -0.51 was below the item mean score of 0. The misfit of the respondents may be because respondents are farmers who have a low level of education.

The Cronbach's alpha value, which measures the interdependence between the person and the item is 0.70. Given that item reliability is 0.95 and person reliability is 0.62, it can be inferred that the quality of the instrument's items is good, and the consistency of the respondents' responses is also good.

The separation value can then be used to determine how individuals and items are grouped. The higher the degree of separation, or stratum separation (H), the better the instrument is in terms of overall respondents and items since it may identify groups of respondents and other groups of related items that are used to examine the grouping more closely. There are 2 groups of respondents, as indicated by H = 1.44 in Table 1, which is rounded up to 2.

Validity

Rasch modeling applies the ideal model to the accuracy of the data. The degree to which a response pattern is sensitive to the target item on the person, or the opposite, is known as infit. According to Sumintono and Widhiarso (2014), the outfit evaluates the sensitivity of the answer pattern to items with a specific level of difficulty on the respondent (response) or vice versa.

MNSQ INFIT and MNSQ OUTFIT data are based in table 1. The ideal value is 1.00 (the closer to 1.00 the better), while the average value is 0,98 and 0,96. This value suggests that the measurement environment is less favorable. The average values in the table person for INFIT ZSTD and OUTFIT ZSTD are -0,16 and -0,24, respectively, although the optimum value is 0,0 (the closer the value is to 0.0, the higher the quality). This value suggests that there is a logical estimate in the data. In other words, the model and the data agreed.

The person (left side) and items (right side) scalogram map is shown in Figure 1. From the figure I8 is worth +2.09 logit. This reflects that the instrument on the questionnaire item I8 is the most difficult question for respondents to agree on. I8 question is "I always separate household waste before disposing of it". Whereas the easiest questionnaire item to agree upon is item I18, which is -1.74 logit. I18 question is "I feel knowledgeable about how to properly separate household waste". The results inferred that respondents were knowledgeable about waste separation. However, they never conducted waste separation.

```
    SUMMARY OF 27 MEASURED Person
------------------------------------------------------------------
|         TOTAL                     MODEL      INFIT      OUTFIT    |
|         SCORE    COUNT   MEASURE    S.E.    MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------|
| MEAN      62.2    18.9     -.51      .25     .98   -.16    .96  -.24 |
|  SEM       1.5      .1      .09      .00     .11    .28    .12   .28 |
| P.SD       7.4      .5      .44      .01     .54   1.43    .62  1.41 |
| S.SD       7.6      .5      .45      .01     .55   1.45    .64  1.44 |
| MAX.      76.0    19.0      .38      .27    3.23   4.68   3.67  4.90 |
| MIN.      45.0    17.0    -1.59      .25     .29  -2.87    .33 -2.45 |
|-----------------------------------------------------------------|
| REAL RMSE    .27 TRUE SD    .35  SEPARATION  1.28  Person RELIABILITY  .62 |
|MODEL RMSE    .25 TRUE SD    .36  SEPARATION  1.44  Person RELIABILITY  .67 |
| S.E. OF Person MEAN = .09                                         |
------------------------------------------------------------------
Person RAW SCORE-TO-MEASURE CORRELATION = .99 (approximate due to missing data)
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .70  SEM = 4.06 (approximate due to missing data)
STANDARDIZED (50 ITEM) RELIABILITY = .84
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Figure 1. Result of Statistics summary of person reliability instruments

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    SUMMARY OF 19 MEASURED Item
----------------------------------------------------------------------------
|          TOTAL                        MODEL        INFIT        OUTFIT      |
|          SCORE     COUNT    MEASURE     S.E.     MNSQ    ZSTD    MNSQ   ZSTD |
|--------------------------------------------------------------------------|
| MEAN      88.4     26.8        .00      .22      .92    -.37     .96   -.32 |
|  SEM       6.4       .1        .26      .01      .12     .43     .15    .48 |
| P.SD      27.1       .6       1.08      .04      .51    1.82     .63   2.05 |
| S.SD      27.8       .6       1.11      .04      .52    1.87     .65   2.10 |
| MAX.     127.0     27.0       2.09      .31     2.32    4.35    2.52   4.53 |
| MIN.      41.0     25.0      -1.74      .18      .35   -3.14     .35  -2.89 |
|--------------------------------------------------------------------------|
| REAL RMSE    .24 TRUE SD   1.06  SEPARATION  4.44  Item   RELIABILITY  .95 |
|MODEL RMSE    .22 TRUE SD   1.06  SEPARATION  4.74  Item   RELIABILITY  .96 |
| S.E. OF Item MEAN = .26                                                    |
----------------------------------------------------------------------------
Item RAW SCORE-TO-MEASURE CORRELATION = -.99 (approximate due to missing data)
Global statistics: please see Table 44.
UMEAN=.0000 USCALE=1.0000
MISSING RESPONSES:    .8%  (APPROXIMATE)
```

Figure 2. Result of Statistics summary of item reliability instruments
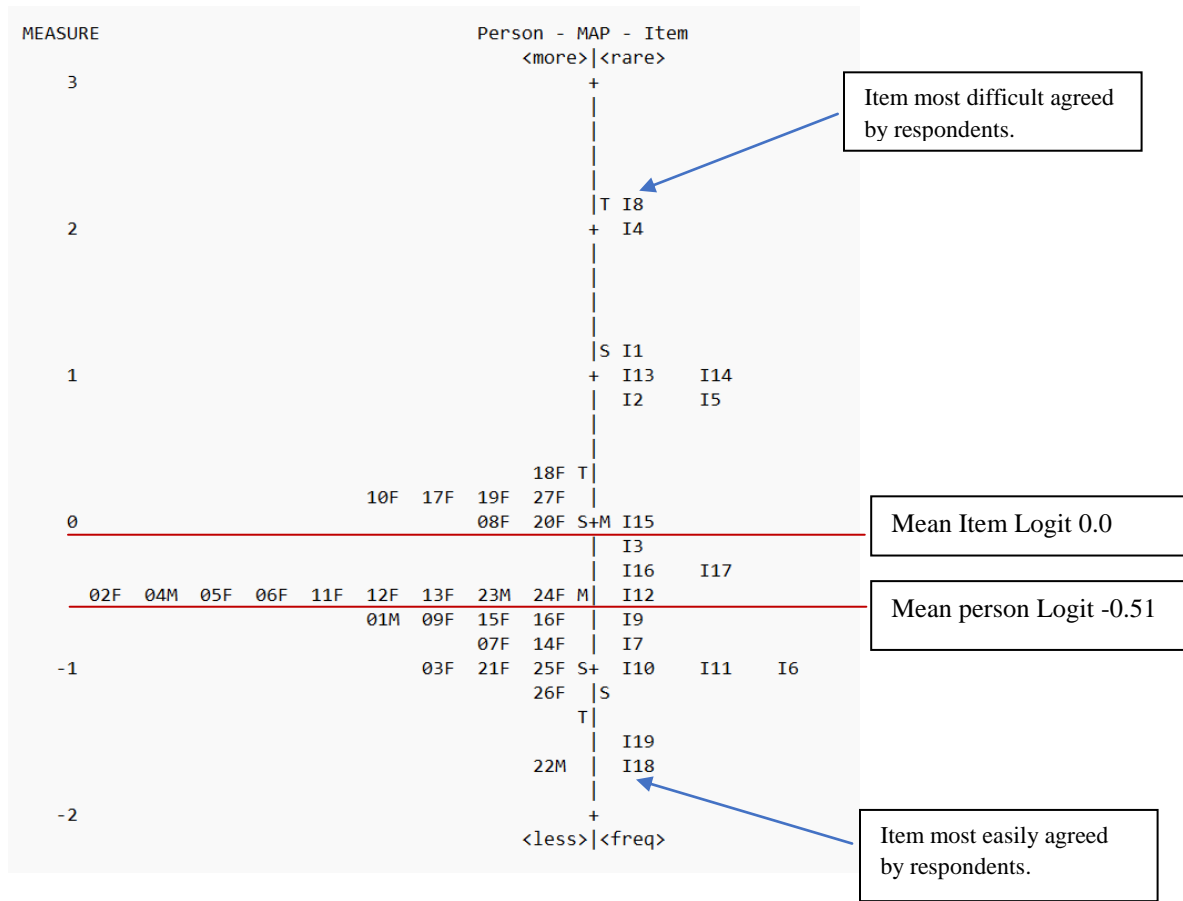
Figure 3. Scalogram map

Validity of Person and Items
The designed instrument's capacity to measure what it is intended to measure is assessed using the measure of unidimensionality. The findings of the raw data variance measurement are shown in Table 3 as 58,3%. This demonstrates that the minimum criteria of 20% unidimensionality has been reached.

```
      Table of STANDARDIZED RESIDUAL variance in Eigenvalue units = Item information units
                                       Eigenvalue   Observed    Expected
Total raw variance in observations      =    45.9833 100.0%           100.0%
  Raw variance explained by measures    =    26.9833  58.7%            57.7%
    Raw variance explained by persons   =     5.3419  11.6%            11.4%
    Raw Variance explained by items     =    21.6414  47.1%            46.3%
  Raw unexplained variance (total)      =    19.0000  41.3% 100.0%     42.3%
    Unexplned variance in 1st contrast  =     5.2252  11.4%  27.5%
    Unexplned variance in 2nd contrast  =     3.1038   6.7%  16.3%
    Unexplned variance in 3rd contrast  =     2.7815   6.0%  14.6%
    Unexplned variance in 4th contrast  =     1.8525   4.0%   9.7%
    Unexplned variance in 5th contrast  =     1.4786   3.2%   7.8%
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Tabel 3. Unidimentionality

Conclusions

The result shows the person's reliability is statistically misfit, whereas the item reliability is fit. The misfit of the respondents/person may be because respondents are farmers who have a low level of education.

The Cronbach's alpha value, which measures the interdependence between the person and the item is 0.70. Given that item reliability is 0.95 and person reliability is 0.62, it can be inferred that the quality of the instrument's items is good, and the consistency of the respondents' responses is also good.

Questionnaire item I8 is the most difficult question for respondents to agree on worth +2.09 logit. Whereas the easiest questionnaire item to agree upon is item I18 wotth -1,74 logit. The results inferred that respondents were knowledgeable about waste separation. However, they never conducted waste separation. It can be concluded that respondents' behaviour does not reflect the knowledge they have.

Acknowledgment

References

Bardus M, Massoud MA. Predicting the Intention to Sort Waste at Home in Rural Communities in Lebanon: An Application of the Theory of Planned Behaviour. (2022). *Int J Environ Res Public Health*. Jul 31;19(15):9383. doi: 10.3390/ijerph19159383. PMID: 35954744; PMCID: PMC9368497.

Chengqin, E.K., Zailani, S., Rahman, M.K., Aziz, A.A., Bhuiyan, M.A. and Gazi, M.A.I. (2022), "Determinants of household behavioural intention towards reducing, reusing and recycling food waste management", *Nankai Business Review International*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/NBRI-01-2022-0011

Hizuru Nishio and Toshie Takeuchi, (2005), "Factors of Household Recycling and Waste Reduction Behavior", in AP - Asia Pacific Advances in Consumer Research Volume 6, eds. Yong-Uon Ha and Youjae Yi, Duluth, MN, *Association for Consumer Research*, Pages: 46-51.

Costa A, Mouro C and Duarte AP, (2022), Waste separation—Who cares? Organizational climate and supervisor support's role in promoting pro-environmental behaviors in the workplace. *Front. Psychol*. 13:1082155. doi: 10.3389/fpsyg.2022.1082155

Kannan Govindan, Yue Zhuang, Gang Chen, (2022), Analysis of factors influencing residents' waste sorting behavior: A case study of Shanghai, *Journal of Cleaner Production*, Volume 349, 131126, ISSN 0959-6526,

https://doi.org/10.1016/j.jclepro.2022.131126.

Mouloudj, K.; Njoku, A.; Asanza, D.M.; Bouarar, A.C.; Evans, M.A.; Mouloudj, S.; Bouarar, A. Modeling Predictors of Medication, (2023), Waste Reduction Intention in Algeria: Extending the Theory of Planned Behavior. *Int. J. Environ. Res. Public Health*, 20, 6584. https://doi.org/10.3390/ijerph20166584

Nik Masdek, N.R., Wong, K.S.K., Mohd Nawi, N., Sharifuddin, J. and Wong, W.L. (2023). Antecedents of Sustainable Food Waste Management: Empirical evidence

from urban households in Malaysia. *Management & Marketing*, Vol. 18, No. 1, pp. 53-77, DOI: 10.2478/mmcks-2023-0004.

Rachman, I., Yustiani, Y.M., Raharjo, S., Matsumoto, T., (2016). Analysis on the Appropriate model of community-based management (Case of rural area in Karang Joang Village, Balikpapan, Indonesia). *International Journal of Waste Resources*, 6(4): 34-38. DOI: 10.4172/2252-5211.1000258

Rasch Modelimg, https://www.publichealth.columbia.edu/research/population-health-methods/rasch-modeling

Schoeman DC, Rampedi IT. Drivers of Household Recycling Behavior in the City of Johannesburg, South Africa. (2022). *Int J Environ Res Public Health*. May 20;19(10):6229. doi: 10.3390/ijerph19106229. PMID: 35627763; PMCID: PMC9141565.

Shanyong Wang, Jinpeng Wang, Shu Yang, Jun Li, Kaile Zhou, (2020), From intention to behavior: Comprehending residents' waste sorting intention and behavior formation process, *Waste Management*, Volume 113, Pages 41-50, ISSN 0956-053X, https://doi.org/10.1016/j.wasman.2020.05.031.

Sih, Damayanti., Tri, Rakhmawati. (2023). Household food waste reduction intention: A conceptual framework. Nucleation and Atmospheric *Aerosols*, doi: 10.1063/5.0106003

Sumintono, B., & Widhiarso, W. (2014). *Aplikasi Model Rasch untuk Penelitian ilmu-ilmu Sosial* (Revisi Nov). TRIM Komunikata Publishing House.

Taylor, S., & Todd, P. (1995). Understanding Household Garbage Reduction Behavior: A Test of an Integrated Model. *Journal of Public Policy & Marketing*, *14*(2), 192–204. http://www.jstor.org/stable/30000128

Whitmarsh LE, Haggar P and Thomas M (2018) Waste Reduction Behaviors at Home, at Work, and on Holiday: What Influences Behavioral Consistency Across Contexts? *Front. Psychol.* 9:2447. doi: 10.3389/fpsyg.2018.02447

Yustiani, Y.M., Rochaeni, A., Aulia, E. (2019). Konsep Pengelolaan Sampah di Desa Babakan Kabupaten Bandung. *EnviroScienteae*, 15(1): 121-126. DOI: 10.20527/es.v15i1.6332

Yustiani, Y.M., Abror, D. (2019). Operasional Bank Sampah Unit dalam Pengelolaan Sampah Perkotaan. Jurnal Lingkungan dan Sumberdaya Alam (JURNALIS), 2(2): 82-89

Zaikova, Anna, Ivan Deviatkin, Jouni Havukainen, Mika Horttanainen, Thomas Fruergaard Astrup, Minna Saunila, and Ari Happonen. (2022). "Factors Influencing Household Waste Separation Behavior: Cases of Russia and Finland" *Recycling* 7, no. 4: 52. https://doi.org/10.3390/recycling7040052

Zhe, Liu., Zhe, Liu., Michelle, Adams., Tony, R., Walker. (2018). Are exports of recyclables from developed to developing countries waste pollution transfer or part of the global circular economy. *Resources Conservation and Recycling*. doi: 10.1016/J.RESCONREC.2018.04.005

Zhiyong, Han., Yong, Liu., Min, Zhong., Guozhong, Shi., Qibin, Li., Dan, Zeng., Yu, Zhang., Fei, Yongqiang., Yanhua, Xie. (2018). Influencing factors of domestic waste characteristics in rural

areas of developing countries. *Waste Management*. doi: 10.1016/J.WASMAN.2017.11.039