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Predicting Community Participation of Waste Separation for Informal Waste Recycling Facility using Binary Logistic Regression Model

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ABSTRACT

Waste bank is informal waste recycling facility using the principle of community participation in reducing waste generation. Berkah Bersatu Waste bank was established in 2021 but the number of registered customers remains constant. Therefore, this study investigates participation decisions made by the villager. This cross-sectional study used data collected from 148 households randomly. Through a series of analysis, the impact of 24 influential factors on participation decision-making was explored using logistic regression analyses. The results showed seven variables are positively related to community participation in waste bank i.e. age, residence status, trash bin availability, knowledge of environmental issues, individual's interest, intrinsic motivation, and norm existence. Probability calculation using the model shows the maximum probability is 99% if all determinants play role in the area indicating that most villagers are willing to participate in waste separation and reduction as they become WB member.

1. Introduction

Waste management is considered as a multidimensional problem that includes political, institutional, social, environmental, and economic aspects [1]. The rapid growth of the human population, urbanization, and economic development has significantly accelerated global waste production [2]. Developing countries confront waste management problems for significantly increasing waste generation caused by exponential population growth and economic development [3]. One of the relevant strategies for such conditions are implementation of efficient waste management practices, such as material recovery through recycling, reusing, reducing (3R) and energy recovery through waste-to-energy (WtE) concept according to [4]. It is confirmed that proper waste management can generate not only environmental benefits but also economic benefits, i.e. employment creation and income generation. However, inefficient waste management systems are the main problem in many developing countries nowadays along with other problems such as insufficient infrastructure, weak funding scheme, and political obstacle. Problem solving through approaches implemented in high-income countries are not necessarily appropriate for different geographic and demographic as well as economic factors. According to [5] community-based-waste management are more appropriate to be implemented in developing countries like Indonesia. The role of the community has positive contribution to waste reduction and waste management efficiency improvement. Community-driven waste management activities, such waste banks in Indonesia [6] and community initiatives for food waste separation [7] are the examples. Local communities can foster recycling habits through regulatory support and social influences. Regulatory support, including the inclusion of waste pickers in waste management systems and providing basic salaries, can encourage households to engage in recycling activities [8]. Social variables, such as norms and networks, also have a substantial impact on recycling behaviour. Social norms can support or discourage recycling based on what other community customers are doing, while social networks give opportunity for information sharing and collaboration to achieve waste management goals [9]. By taking these aspects into account and establishing policies that promote both regulatory assistance and social effects, local populations can be encouraged to create and maintain recycling habits, contributing to sustainable waste management practices [10], [11].

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Waste bank (WB) is an informal waste sector driven by community engagement (WBs) which effectively manage and minimize waste as well as generates economic value [12]. In WB, waste is separated, weighing, recorded and sold and the revenue is shared between customers and staffs [13]. In Indonesia, there are substantial increase of both the number of WB and the customers contributing to inorganic waste reduction [14]. WB is not only help reduce waste but also provide economic benefits for the community [15], [16]. They can be established and managed by the community, fostering collective consciousness, and promoting waste sorting, recycling, and utilization [17]. Waste banks contribute to environmental conservation and the economic value of waste, improving both welfare and the cleanliness of the environment [18]. Increasing the community participation through WB is the common challenge facing by many WBs in Indonesia. Success of WB program depends on community participation namely through customership and source separating recyclable waste from other household waste. The factors influencing residents' willingness to participate in waste separation vary between cities due to differences in the level of urbanization, economic development and institutions. Economic incentives can motivate residents to separate waste, but their effectiveness may be limited as they may only motivate a portion of the population [19]. Other factors, such as attitude, subjective norms, perceived behavioural control, and perceived policy effectiveness, have been found to significantly influence residents' intention to separate waste [20]. Additionally, factors like ecological performance expectation, social performance expectation, knowledge reserve, institutional norms, technical convenience, and governance foundation have a positive influence on residents' willingness to participate in waste separation [21]. It is important for the government to provide adequate physical waste separation facilities and effective regulation enforcement to increase residents' participation in waste separation [22]. The determinants of waste separation behaviour include perceived behavioural control, moral commitments, and perceived policy effectiveness [23]. The configuration impact of external factors on residents' participation in waste sorting varies, and there are different methods that can lead to high or low participation rates. Individual characteristics including age, gender and family size are commonly considered in empirical studies, but the mechanisms of these factors are subject to the socio-economic context and the results for which individual factors tended to be conducive to recycling were equivocal or even conflicting [24], [25]. In recent cases, [26] and [27] found that neighbourhood behaviours and community rules play a key role in promoting waste separation. The Theory of Planned Behaviour (TPB) supports the importance of social attitudes and values on participation willingness, whilst the subjective judgments of waste separation in the community have an impact [25], [28].

To enhance involvement in waste separation through WB, a remarkable understanding is required for tackling the underlying structural and personal constraints that communities confront, as well as the enablers that might encourage behavioral change.

Researchers have utilized various statistical models such as logistic regression which was used by [25] or hierarchical multiple regression by [29], and structural equation model by [30]. To analyse influencing factors in waste separation behaviour. [31] conducted comparison study of several statistical regression models, such as Generalized Linear Models (GLM) with Binomial, Poisson, and Gamma errors, as well as Beta regression to manage continuous proportion data in waste separation studies. Those studies explored several factors may affect a person's participation in manging waste through waste bank. According to [32], the level of community participation in waste management through waste bank can be influenced by socio demographic factor i.e. age, gender, education level. Income, social status, employment status, family size, property ownership, and knowledge related to the environment as well as community perceptions of waste management issues. Meanwhile, [33] found out that social and psychological factors are effective strategies used to motivate people to recycle waste by raising environmental awareness and providing infrastructure to recycle solid waste. Lower-middle income groups are particularly aware that selling valuable waste as raw material is a significant contributor to the financial sustainability of waste banks [34], while better educated group have more awareness and positive response influencing their attitudes towards waste management that they tend to encourage good and correct intentions and behaviours in waste management [35]. Distance is the other factor may affect the participation decision making in waste reduction through recycling facility like WB [36].

Nonetheless, waste separation requires to be adjusted to local conditions and there are limited number of studies focusing on local heterogeneity between factors due to constraints of survey data and statistical models. This study therefore aims to track and quantify the factors influencing community' waste participation willingness using logistic regression. Probability of the community to participate in waste separation through WB is calculated afterwards. The results are expected to be a reference for the local government to develop a framework for participation willingness of the community. The following research questions were addressed: (1) what factors play role in community's decision making for participation; and (2) what is the probability that the community will participate in waste separation through WB. The result of probability calculation indicates the acceptance of the community to WB and may further contribute to a higher level of public participation and promote other environmentally-friendly behaviours.

2. Material and Methods

2.1. Study Area and Data Sources

Currently, waste generation in Bojonegoro Regency is about 536 tons/day in 2020 and has continued to rise by 4.6% every year along with the population growth. With the level of waste collection service is only about 47%, the local government will face major problems if there are no appropriate measures to overcome waste problem in the next decades. The primarily landfill as an approach to end-of-pipe solution has not been reversed and regulation on waste

separation through WB since 2021 have not effectively improved community participation both in urban and rural areas of Bojonegoro Regency. Waste separation management (WSM) therefore faces a key challenge in achieving a long-term transformation of community's willingness to separate and behavioral patterns. Concerning about the possible future waste problem, local government of Sembung Village encourage the community to involve in waste separation and reduction by empowering the existing WB namely Berkah Bersatu waste bank (BBWB). There are 536 HHs as BBWB's customers with the furthest distance from WB is about 800 m. With a service radius of 800 km, the scale of waste bank services is focused on one village.

Using the demographic data provided by the local government, sample was determined using simple random sampling method with a margin of error of 7%. This study investigated 148 households (HHs) to track their participation and satisfaction with WB service in November 2023. Referring to the literature review results and discussion with the local government, 24 factors were selected to analyze key influences on decision-making to participate in waste separation: Age (*X1*), Job (*X*2), Education (*X*3), Income (*X4*), Social Status (*X*5), Organization Participation (*X6)*, Status of Family Member (*X7*), Regency Status (*X8*), availability of waste containers/bins (*X9*), Distance (*X10)*, knowledge of environmental issues (*X11*), knowledge of waste production (*X12*), knowledge of waste problems (*X13*), knowledge of waste programs (*X14*), Attention to waste (*X15*), Motivation (*X16*), Opinion (*X17*), Subjective Norm (*X18*), Willingness to Act (*X19*), Feeling of Belonging (*X20*), Source of Knowledge (*X21*), 3R Information (*X22*), 3R Socialization (*X23*), Environmental Cadres (*X24*). SPSS was used for data analysis and logistic regression model was fitted to the data collected from primary and secondary survey. Questionnaires are distributed among the samples living within a radius of 1 km from WB location. [37] and [38] stated that the farthest distance people are willing to walk to the waste processing site is 1 km. Some questions in the questionnaire was in the form of a 5-level Likert scale, with questions assigned a score. The reliability of the questionnaire was tested using Cronbach's alpha coefficient, where if the value was less than 0.5 the reliability of the questionnaire was considered unacceptable.

2.2. *Logistic Regression Analysis*

Descriptive statistics were employed to summarize data related to demographic and socioeconomic attributes of respondents and their willingness to participate in WB. Binary logistic regression was used to analysed 24 variables consisting of sociodemographic variables, economic variables, and psychological conditions and to explain the links between household level of participation in WB and their related variables. All the variables are processed through validity test including reliability test, significance test, and the goodness of fit test beforehand. For each participation indicator i.e., waste separation and collection, decision-making and WB utilization (Eq. (1)).

Based on Eq. (1), participationi for i = 1,2,3; represents HH participation decision in waste separation; $\beta 0$ is a constant, βi, i from 1 to 12, are parameters of the regression model; and $\in j$ represents the random error term. The description and summary statistics of the independent variables of the ordered logistic regression model (equation 1) is presented in Table 1.

The related variable (Y) in this research is community participation in waste bank activities. Independent variables (X) in research are obtained from several research variables, which include socio-demographic conditions, academic knowledge, situational variables, psychological conditions, and other influencing factors.

In logistic regression analysis, there are several test stages carried out, namely validity test to determine the suitability of the instrument for defining variables, reliability test to measure the stability and consistency of respondents' answers, significance test to determine whether the independent variable has a significant influence on the dependent variable, goodness of fit test to find out whether the model formed is suitable to explain the data. At the logistic regression test stage, the results can be interpreted, among other things, through the model summary table regarding the ability of the independent variables to explain the dependent variable, the classification table to determine the accuracy of the model, and the variables in the evaluation table.

The model from the analysis is used to calculate the probability of the Sembung Villager to participate in waste reduction through BBWB using the following equation (Eq. (2))

3. Result and Discussion

3.1. *Characteristics of Respondent*

The average age of respondents was 24% were adults (18–40 years old), 43% were between 41 and 55 years old, 21% were over 55 years old, and only 12% respondents were over the age of 65. However, the survey results showed that 57% of families included elderly people age of 65, and more than 22% of families included two elderly people. In addition, the proportion of responding families that contained both elderly people and children was 21%, where in many cases the elderly will play an important role in raising grandchildren and housework, including waste disposal. Therefore, because the survey gathered information about the collective behavior of households rather than individuals, the behaviors of people of all ages will be reflected in the results. In the survey, 21% respondents received primary education, 68% experienced secondary while only 11% tertiary education.

The mean household size was 3.7, and 65% of families had 3 or 4 customers. 33% of respondents has formal job working for companies or other affiliations as administrator, office staff, civil servants, private employees. About 69% of responding households has an average monthly income below regional minimum wage (RMU) (Rp. 2,279,568,-) and 31% earns above RMU. According to the National Statistic Agency (BPS) the average monthly disposable income of a family in Bojonegoro was Rp Rp 1.848.900,- in 2023. In this survey, 52% of respondents' monthly income was less than the average income, while about 7% of respondents' earned more than twice the average disposable income. The Cronbach's alpha coefficients for the 2022 and 2023 samples were 0.672 and 0.734 respectively, indicating good overall reliability of the questionnaire.

$$\text{Participationi} = \beta 0 + \beta 1\text{AGE} + \beta 2\text{JOB STATUS} + \beta 3\text{EDUCATION} + \ldots\ldots + \beta 24\text{ENVIROMENTAL} \quad (1)$$

$$P = \frac{e^{-C+aX1+bX8+cX9+dX11+\cdots+i\,Xn}}{1+e^{e^{-C+aX1+bX8+cX9+dX11+\cdots+i\,Xn}}} \quad (2)$$

Table 1. Variables used in the logistic regression equation.

Variables	Type	Description	References
Age	Binary	Productive age (15-65 years old) = 1, less/more than productive age = 0	Meidiana *et al*, 2018
Job Status	Binary	1 if formal employment with certain affiliation , 0 otherwise if informal sector	Yadnya, 2005
Education	Binary	education above secondary level = 1, primary & secondary education = 0	Meidiana *et al*, 2021 Dhokhikah, 2015
Income	Binary	above the regional minimum wage (RMU) =1 below RMU = 0	Erfina, 2013
Social Status	Binary	Having certain role in the community leaders = 1, otherwise = 0	Hamid, 2013 Maryani *et al*, 2018
Organization Participation	Binary	1 = involved in local organizations or social activities, 0 = otherwise	Nugraha, 2020 Widiarti, 2012 Bertelings & Sterner, 1999
Family size	Binary	Extended family = 0, nuclear family = 1.	Adiana, 2012
House ownership	Binary	Private ownership = 1, otherwise (rental house/family ownership) = 0	Nugraha, 2020
Waste bin availability at home	Binary	1 if available, 0 if not available	Widiarti, 2012
Distance between house and WB	Binary	1 if ≤ 700 m and (0) if > 700 m	Bertelings & Sterner, 1999
Knowledge about environmental issues	Binary	having knowledge = 1 and having no knowledge (0)	Singhirunnusson, *et al*, 2012
Knowledge of Waste Production	Binary	having knowledge = 1 and having no knowledge (0)	Singhirunnusson, *et al*, 2012
Knowledge of Waste Problems	Binary	having knowledge = 1 and having no knowledge (0)	Singhirunnusson, *et al*, 2012
Knowledge of Waste Programs	Binary	having knowledge = 1 and having no knowledge (0)	Singhirunnusson, *et al*, 2012
Attention to Waste	Binary	Agree = 1 and disagreed = 0	Barr, 2007
Motivation (economic, psychological reason)	Binary	Agree = 1 and disagreed = 0	Barr, 2007
Opinion (risk waste on public health and welfare)	Binary	Agree = 1 and disagreed = 0	Barr, 2007
Subjective Norm	Binary	Agree = 1 and disagreed = 0 (one individual's act on waste problem solution will have domino effect to the others to do the same thing).	Barr, 2007
Willingness to Act (Reason to act)	Binary	Agree = 1 and disagreed = 0 Waste treatment is solution for waste problem.	Barr, 2007
Sense of Belonging	Binary	Agree = 1 and disagreed = 0 (A need for active involvement in sustainability).	Barr, 2007
Source of Knowledge	Binary	1 if > 1 source (internet, television, newspapers, magazines, etc.) and 0 if = 1 source	Dhokhikah *et al*, 2015
Recipient of 3R Information	Binary	1 if received information through mass media and 0 if never received information	Dhokhikah *et al*, 2015
Recipient of 3R dissemination	Binary	1 if have received and 0 if never received dissemination	Dhokhikah *et al*, 2015
Role of Environmental Cadres in motivation creation	Binary	Agree = 1 and disagreed = 0	Dhokhikah *et al*, 2015

3.2. *Characteristics of Waste Bank in Sembung Village*

Berkah Bersatu Waste Bank (BBWB), which is an implementation of local waste management programs namely "One Village One Waste Bank", was established in 2021. Currently, the registered member is 47 HHs but only 33 HHs (70%) actively involved in WB activities i.e. waste sorting, weighing and selling. To be precise, only 25 customers regularly deposit waste at each opening. BBWB does not have its own building and all related activities are carried out in one of the WB workers. Since its establishment in 2021, the number of BBWB customers remain constant. BBWB has scheduled opening time, which is two times a month, but it has recently reduced to once in 2 months because not all active customers are able to achieve the minimum selling weight of waste required by BBWB. The amount of collected waste is too low within 1 month. Based on the data collected from November 2022 until November 2023, the total waste amount flows to BBWB are 1,228.10 kg/opening or approximately 136.45 kg/opening time comprising of 24% food waste, 30% paper, 5% cloth, 12% rubber, 2% plastic, 1% metal and 26% glass. There were only 9 opening times during that period and the total waste amount in BBWB. The most common type of waste is paper waste, about 366.80 kg and the least is rubber waste with a weight of 13.30 kg. RF value range between 0.21% - 9.31% with metal has the highest RF and food waste has the lowest RF. The recovery factor for each type in BBWB is 0.21%, 7.94%, 3.00%, 9.31%, 4.34%, 0.86%, and 1.89 % for food waste, paper, plastic, metal, cloth, glass, rubber, and textile respectively. The waste amount and its recovery factor (RF) is shown in Figure 1. Totally, waste reduction rate through

BBWB was only 0.83% per year which is very low compared to total waste generation in Sembung village of 153.96 ton/year. Food waste has the highest percentage in waste composition in Sembung Village but has the lowest recovery factor (RF) because BBWB accept only dried leftover rice (Karak) and used cooking oil (Jelantah). Both food waste type can be processed further i.e. Karak for poultry feed industries and Jelantah for biodiesel fuel companies. Metal has the highest RF, about 9.31%. since it has the highest price compared to other waste type that customers tend to separate and collect it properly.

3.3. *Factors Affecting Participation Decision Making*

The Factors that influence interest in community participation in this study were analysed using binary logistic regression, where 24 predictor variables were used consisting of sociodemographic variables, situational variables, environmental knowledge, psychological conditions and supporting factors. Before entering the logistic regression test stage, the available data meets the criteria for the validity test, reliability test, significance test, and also the goodness of fit test.

Validity testing is carried out before entering the logistic regression analysis step. The validity test aims to determine the suitability of the instruments in the list of questions to define a variable [35]. In this research, the validity of the instrument is seen through Corrected Item-Total Correlation, where if r count > r table then the questionnaire items can be said to be valid. Based on the r table, the r table used in this study for the number of respondents 148 is 0.135. The following are the results of the questionnaire validity test, which can be seen in Table 2.

In this study, the number of respondents in the research sample was 148 people and an α of 0.05 was used. So the r table used is 0.135. The research instrument can be said to be valid if r count > r table, then in this study all instrument items must have r count > 0.135. Based on Table 2, it can be seen that the corrected item total correlation value is in the range 0.193-0.784, which means that all items have a calculated r > r table, so that all items can be said to be valid or suitable for use.

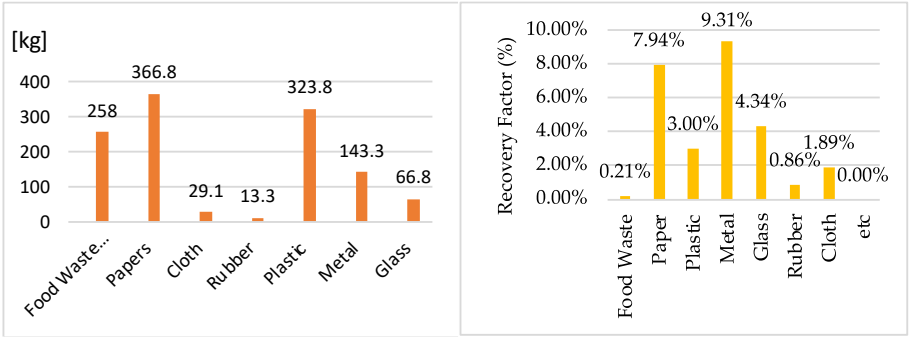

Figure 1. Waste type and its recovery factor in BBWB (November 2022-2023)

Table 2. Result of validity test

Variable	Corrected Item-Total Correlation	r tabel (α 0,05 sampel 148)	Result of Validity Test
Age	.636	.135	Valid
Job Status	.659	.135	Valid
Education	.760	.135	Valid
Income	.581	.135	Valid
Social Status	.587	.135	Valid
Organization Participation	.610	.135	Valid
Status of Family Members	.441	.135	Valid
Residence Status	.193	.135	Valid
Availability of Bins	.597	.135	Valid
Distance	.389	.135	Valid
Knowledge of Environment Issue	.657	.135	Valid
Knowledge of Waste Production	.665	.135	Valid
Knowledge of Waste Problems	.784	.135	Valid
Knowledge of Waste Programs	.724	.135	Valid
Attention to Waste	.598	.135	Valid
Motivation	.735	.135	Valid
Opinion of Waste Problem	.648	.135	Valid
Subjective Norm	.323	.135	Valid
Willingness to Act	.568	.135	Valid
Feeling of Belonging	.394	.135	Valid
Source of Knowledge	.772	.135	Valid
3R Information	.679	.135	Valid
3R Dissemination	.608	.135	Valid
Environmental Cadres	.645	.135	Valid
Constant	.514	.135	Valid

The reliability test is used to measure the stability and consistency of respondents in answering questions in the questionnaire [39]. The research instrument can be said to be reliable if Cronbach's alpha shows a number greater than 60% or 06. The results of the reliability test is presented in Table 3.

Based on Table 3, the reliability test results show Cronbach alpha with a value of 0.937 indicating all data in the questionnaires are reliable. The significance test is a test carried out to determine whether the independent variable has a simultaneous influence on the dependent variable. In this research, the α used is 0.05 meaning if the significance value is less than 0.05, the hypothesis is accepted indicating the independent variable has a significant influence on the dependent variable. Table 4 shows the results of the significance test.

Based on Table 4, it can be seen in the sig column. shows the number 0.000. Because the value of the significance test results shows a number smaller than the α used, it can be said that the 24 independent variables have a significant influence on the dependent variable.

The Goodness of Fit test stage or overall model test is a general stage of testing whether the resulting model is suitable for explaining the data. The interpretation of the goodness of fit test results can be seen from the Hosmer and Lemeshow Test table, where if the significance value is > α, it can be said that the model formed is in accordance with the Hast date of the Goodness of Fit test which can be seen in Table 5. The significance value is 0.586 or greater than the research α value (0.05) indicating that the model that is formed fits the data and is able to explain the relationship between the dependent variable and the independent variable.

The Cox & Snell R Square and Nagelkerke R Square values are used to describe the summary model functions and to find out the ability of the independent variables to explain the dependent variable using (Table 6). It shows the results of the summary model with a large Nagelkerke R Square value of 0.783, which means that the independent variables in the research have an influence of 78.3% on the dependent variable, while the other 22.7% of the dependent variable is influenced by factors outside the research variables. Table 7 presents how good the results of the model predictions are and is used as a measure of model accuracy, where a good model will have a high accuracy. It shows percentage of 83.8. This shows that the accuracy of the logistic regression model for this research is 83.8%. Furthermore, variables in the equation function describe the relationship between independent variables (X) and dependent variable (Y) which is if the value less than 0.05, variable X a significant influence on variable Y.

Based on Table 8 there are 7 variables that have a significant influence on the dependent variable and Model Summary using 7 significant variables is provided in Table 9, while Table 10 presents the classification table for the second regression test.

The summary model produces a Nagelkerke R Square value of .769, which means that the predictor variables in this research have an influence of 76.9% on the dependent variable. The percentage correct value in the classification table is 81.5, which means the accuracy of the regression model formed is 81.5%. Variable Table In The Equation for the 2nd logistic regression is shown in Table 11 and the percentage is 81.5 meaning 81.5% accuracy of the regression model.

The results of the logistic regression test on 24 predictor variables on interest in community participation are interpreted through the variables in the equation table for variables that have a significance value of <0.05, which means these variables have a significant influence on the dependent variable. There are 7 factors that have a significance of <0.05, namely age, residence status, availability of waste containers/bins, knowledge of environmental issues, attention to waste, motivation and subjective norms. The following is the logistic regression model that was formed (Eq. (3)).

Table 3. Result of Reliability Test

Reliability Statistics	
Cronbach's Alpha	N of Items
.937	25

Table 4. Result of Significance Test

Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	88.031	24	.000
	Block	88.031	24	.000
	Model	88.031	24	.000

Table 5. Result of Goodness of Fit Test

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	8.528	8	.586

Table 6. Model Summary Table

Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	167.388[a]	.514	.783

Table 7. Classification Table

Observed			Predicted		
			Community Participation		Percentage Correct
			Not Interest	Interest	
Step 1	Community Participation	Not Interest	75	8	90.4
		Interest	16	49	75.4
	Overall Percentage				83.8

Table 8. Variable In the Equation

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1[a]	Age	.511	.555	.849	1	.004	.600
	Job Status	.058	.103	.314	1	.575	1.059
	Education	-.681	1.165	.341	1	.559	.506
	Income	-.323	.589	.301	1	.583	.724
	Social Status	.369	1.115	.109	1	.741	1.446
	Organization Participaion	1.055	1.083	.949	1	.330	2.872
	Status of Family Members	-.854	.663	1.657	1	.198	.426
	Residence Status	3.150	.893	12.450	1	.000	23.327
	Availability of Bins	17.016	40.063	.000	1	.021	24.661
	Distance	.393	.555	.502	1	.479	1.482
	Knowledge of Environment Issue	23.681	19.928	.235	1	.003	19.028
	Knowledge of Waste Production	-18.653	40.063	.000	1	1.000	.000
	Knowledge of Waste Problems	-.488	1.089	.201	1	.654	.614
	Knowledge of Waste Programs	.386	.950	.165	1	.685	1.471
	Attention to Waste	21.533	19.928	.000	1	.000	.000
	Motivation	14.711	.925	.590	1	.022	2.036
	Opinion of Waste Problem	.474	1.031	.212	1	.645	1.607
	Subjective Norm	1.370	.716	3.662	1	.006	3.935
	Willingness to Act	-.108	.860	.016	1	.900	.898
	Feeling of Belonging	.372	.853	.190	1	.663	1.451
	Source of Knowledge	.094	1.132	.007	1	.934	1.099
	3R Information	.657	.710	.855	1	.355	1.928
	3R Dissemination	1.940	1.042	3.470	1	.216	6.962
	Environmental Cadres	.245	.825	.088	1	.766	1.278
	Constant	-2.493	3.261	.584	1	.445	.083

Table 9. Model Summary, Second Regression Test

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	167.388[a]	.586	.769

Table 10. Classification Table, Second Regression Test

Observed			Predicted		
			Community Participation		Percentage Correct
			Not Interest	Interest	
Step 1	Community Participation	Not Interest	74	9	89.6
		Interest	15	50	73.4
	Overall Percentage				81.5

Table 11. Variable In The Equation, Second Regession Test

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Age	2.754	.305	3.398	1	.001	2.570
	Residence Status	2.029	.403	1.461	1	.023	1.627
	Availability of Waste Bins	2.230	.717	.256	1	.031	2.438
	Knowledge of Enviromental Issues	2.550	.801	1.905	1	.000	1.331
	Attention to Waste	2.506	.718	.406	1	.004	1.580
	Motivation	2.564	.806	3.652	1	.026	2.214
	Subjective Norm	2.783	.468	1.707	1	.019	2.843
	Constant	-11.431	1.501	1.980	1	.000	8.259

$$Y = -11.431 + 2.754\,X1 + 2.029\,X8 + 2.230\,X9 + 2.550\,X11 + 2.506\,X15 + 2.564\,X16 + 2.783\,X18 \quad (3)$$

$$P = \frac{e^{-11.431+2.754X1+2.029X8+2.230X9+2.550X11+2.506\,X15+2.564X16+2.783X18}}{1+e^{-11.431+2.754X1+2.029X8+2.230X9+2.550X11+2.506\,X15+2.564X16+2.783X18}} = \frac{398.928}{399.928} = 0.997 \text{ or } 99{,}7\% \quad (4)$$

where e is the natural logarithm number (≈2.72).

All influencing factors have B with a positive value, which means that all factors have a positive influence on the dependent variable. This means that respondents with a value (1) on the variables age (X^1), residence status (X^8), availability of accommodation (X^9), knowledge of environmental issues (X^{11}), attention to waste (X^{15}), motivation (X^{16}), and subjective norms (X^{18}) make it more likely for people to have an interest in participating in the Berkah Bersatu Waste Bank.

Those of productive age are 2.5 times more likely to have an interest in participating in a waste bank, this is in accordance with research [40] which states that residents aged between 35 – 65 years tend to have a higher probability of

sorting household waste. In the Residential Status Variable, respondents are divided into 2 categories, namely respondents with own residential status (1) and respondents with contract/rented residential status (0). The residential status variable in this study is said to have a significant influence because it has a significance value of 0.023, which means it is smaller than the α value of 0.050. The B value for this variable is positive, which indicates that there is a positive relationship between the residential status variable and the community's interest in participating in the Berkah Bersatu Waste Bank. An Elxp (B) value of 1.627 means that respondents who have their own residence (1) are 1.627 times more likely to be interested in participating in a waste bank compared to respondents who have a contract/rented residence. This is in accordance with research [40] which states that the resident's residence status influences community participation in carrying out 3R activities, where residents whose residence is their own will have higher participation. Availability of containers, this variable has an ElXP (B) value of 2.43, which means that the availability of containers/trash bins allows respondents to participate in the waste bank 2.34 times greater than respondents without container/trash bin facilities. This is in accordance with research [41] which states that waste containers need to be provided on a household scale to support the community in carrying out waste management behavior. According to [40], the availability of waste containers can encourage people to sort waste so that they are more likely to participate in waste banks.

Someone with knowledge of waste issues is 1.3 times more likely to be interested in participating, this is in accordance with research [42] on general knowledge about environmental and waste issues. The knowledge possessed by the community regarding the environment in general and waste maznagement in particular has become one of the most crucial factors influencing waste processing from household waste sources. Attention to waste problems and intrinsic motivation can increase a person's possibility of having an interest in participating in a waste bank. This is in line with the statement in research [43] that there is awareness that processing waste can help overcome environmental problems and self-motivation/awareness to process waste can significantly improve waste processing behavior. Subjective Norms, in this variable there are two parameters, namely respondents who agree and disagree that the actions of other people around them such as neighbors, family, relatives, friends in managing waste will give encouragement to themselves to do the same. The subjective norm variable has an EXP (B) value of 2.84, which means that respondents who agree that behavior around them in waste management can encourage the same behavior in themselves will have a 2.84 times probability of participating in the waste bank, this is in accordance with research [43] which states that the higher a person's desire to fulfill expectations according to the perspective of other people who have personal relationships (such as family, friends, neighbors, etc.) will increase the person's intensity in carrying out certain behavior. This can increase a person's ability to carry out waste management.

3.4. Probability of Public Partisipation

The model is used to predict the participation decision making of villagers to be the customer of BBWB. The probability implies the community's acceptance rate toward WB. The probability is calculated using Equation 2 coming to the result of 99.7% probability if all influencing factors in the model are available in Sembung Village having value of 1 as following Eq. (4).

The results of probability calculations show that the possibility of a person having an interest in participating varies from the lowest figure of 0% if a person does not have a single influencing factor, up to the highest value, namely 99.75% if he has all the influencing factors.

4. Conclusion

The total amount of waste deposited by all Berkah Bersatu Waste Bank customers during that period was 1,228.10 kg. Overall, the percentage of waste that can be reduced by the Berkah Bersatu Waste Bank is very low which is 0.83% indicating that BBWB with 47 customers and an average of 30-35 active customers has not been able to provide a significant change in reducing the amount of waste going to landfill. Factors influencing community participation in BBWB is analysed to find out the model able to predict the HHs participation decision making in waste reduction through WB. Binary logistic regression using 24 independent variables come to the result of 7 significant factors i.e., age, house ownership, availability of containers/trash bins, knowledge of issues, environment, attention to waste, motivation and subjective norms. Probability calculation using the model assuming all significant factors play role in Sembung Village generates 99.7% probability indicating that most HHs is willing to participate in waste management program by reducing waste through WB.

Author Declaration

Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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References

[1] S. E. Derdera and G. S. Ogato, "Towards integrated, and sustainable municipal solid waste management system in Shashemane city administration, Ethiopia," *Heliyon*, vol. 9, no. 11, p. e21865, 2023, doi: 10.1016/j.heliyon.2023.e21865.

[2] T. Kumari and A. S. Raghubanshi, "Waste management practices in the developing nations: challenges and opportunities," *Waste Manag. Resour. Recycl. Dev. World*, no. October 2022, pp. 773–797, 2023, doi: 10.1016/B978-0-323-90463-6.00017-8.

[3] O. Timofei, "EFFICIENT WASTE MANAGEMENT : ECONOMIC ASPECTS," *Mest J.*, no. July, pp. 207–216, 2022, doi: 10.12709/mest.10.10.02.20.

[4] A. Ranjbar, S. Nasri, M. Fatemi, and S. Ghazinoory, "A systematic approach toward waste management: Problem-oriented Innovation System (PIS)," *Technol. Anal. Strateg. Manag.*, pp. 1–17, 2023, doi: 10.1080/09537325.2023.2225654.

[5] C. Meidiana, T. A. Kurniawan, A. Yudono, and S. Surjono, "Community-Based Waste Management Model in Optimizing Waste Reduction," *IGI Glob.*, pp. 98–113, 2022, doi: 10.4018/978-1-7998-9190-1.ch006.

[6] T. Sekito, T. B. Prayogo, Y. Dote, T. Yoshitake, and I. Bagus, "Resources , Conservation and Recycling Influence of a community-based waste management system on people ' s behavior and waste reduction," *"Resources, Conserv. Recycl.*, vol. 72, pp. 84–90, 2013, doi: 10.1016/j.resconrec.2013.01.001.

[7] A. P. Salinger *et al.*, "' People are now working together for a common good ' : The effect on social capital of participatory design for community-level sanitation infrastructure in urban informal settlements," *World Dev.*, vol. 174, no. November 2023, 2024, doi: 10.1016/j.worlddev.2023.106449.

[8] S. Nickel and O. Von, "Effectiveness of Community - Based Health Promotion Interventions in Urban Areas : A Systematic Review," *J. Community Health*, vol. 45, no. 2, pp. 419–434, 2020, doi: 10.1007/s10900-019-00733-7.

[9] M. M. Bishnoi, A. Verma, A. Kushwaha, and S. Goswami, *Social factors influencing household waste management*. Elsevier Inc., 2021. doi: 10.1016/B978-0-323-85403-0.00008-6.

[10] M. Hänninen, "Recycling on the local level in Thailand: influence of trust, norms and social networks," 2018.

[11] M. D. Lucas and Moja, "Survey Carried Out in Cosmo City , South Africa , about Recycling Practices and Local Community Perceptions on Waste Management Practices Abstract," *iMedPub J.*, vol. 5, pp. 3–6, 2018, doi: 10.21767/2394-9988.100068.

[12] C. Meidiana, T. Sekito, and W. Sasongko, "Determining Factors of Community Participation in Waste Bank," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 940, no. 1, 2021, doi: 10.1088/1755-1315/940/1/012085.

[13] R. Thakur and S. C. Onwubu, "Household waste management behaviour amongst residents in an informal settlement in Durban , South Africa," *J. Environ. Manage.*, vol. 349, no. May 2023, p. 119521, 2024, doi: 10.1016/j.jenvman.2023.119521.

[14] T. A. Kurniawan, C. Meidiana, M. H. Dzarfan Othman, H. H. Goh, and K. W. Chew, "Strengthening waste recycling industry in Malang (Indonesia): Lessons from waste management in the era of Industry 4.0," *J. Clean. Prod.*, vol. 382, no. November 2022, p. 135296, 2023, doi: 10.1016/j.jclepro.2022.135296.

[15] D. Wulandari, S. H. Utomo, and B. S. Narmaditya, "Waste Bank : Waste Management Model in Improving Local Economy," *Int. J. Energy Econ. Policy*, vol. 7, no. 3, pp. 36–41, 2017.

[16] M. R. Ismiraj, A. Wulansari, Y. Setiadi, A. Pratama, and N. Mayasari, "Perceptions of Community-Based Waste Bank Operators and Customers on Its Establishment and Operationalization: Cases in Pangandaran, Indonesia," *Sustain.*, vol. 15, no. 14, 2023, doi: 10.3390/su151411052.

[17] P. Awasthi, G. Chataut, and R. Khatri, "Solid waste composition and its management: A case study of Kirtipur Municipality-10," *Heliyon*, vol. 9, no. 11, p. e21360, 2023, doi: 10.1016/j.heliyon.2023.e21360.

[18] I. Sabela, W. Adhaeni, A. I. Azzah, and N. Ngazizah, "Increasing Environmental Conservation and Economic Value of Waste Through Waste Bank Management," *Islam. J. Integr. Sci. Educ.*, vol. 1, no. 1, pp. 73–82, 2022, [Online]. Available: https://doi.org/10.30762/ijise.v1i1.285

[19] S. Jie, "Economic incentive in enhancing community waste separation and collection: A panel data analysis in China," *J. a Sustain. Circ. Econ.*, no. 2001, pp. 3–29, 2023.

[20] S.-C. Chuah, L. Putit2, and J. K. Singh, "Assessing Residents Intention Towards Municipal Solid Waste Source Separation: A Case Study Of Malaysia," *J. Malaysian Inst. Planners*, vol. 21, no. 1, pp. 382–399, 2023, [Online]. Available: https://doi.org/10.21837/pm.v21i25.1245

[21] Z. Cao, M. Wang, and W. Zhao, "A study of farmers' willingness to separate domestic waste based on UTAUT model," *Adv. Econ. Manag. Res.*, vol. 5, no. 1, p. 60, 2023, doi: 10.56028/aemr.5.1.60.2023.

[22] T. Babazadeh, S. Ranjbaran, K. Kouzekanani, S. Abedi Nerbin, H. Heizomi, and M. E. Ramazani, "Determinants of waste separation behavior Tabriz, Iran: An application of the theory of planned behavior at health center," *Front. Environ. Sci.*, vol. 11, no. March, pp. 1–7, 2023, doi: 10.3389/fenvs.2023.985095.

[23] B. Jin and W. Li, "External Factors Impacting Residents' Participation in Waste Sorting Using NCA and fsQCA Methods on Pilot Cities in China," *Int. J. Environ. Res. Public Health*, vol. 20, no. 5, 2023, doi: 10.3390/ijerph20054080.

[24] M. Martin, I. D. Williams, and M. Clark, "Social, cultural and structural influences on household waste recycling: A case study," *Resour. Conserv. Recycl.*, vol. 48, no. 4, pp. 357–395, 2006, doi: 10.1016/j.resconrec.2005.09.005.

[25] T. M. W. Mak, I. K. M. Yu, D. C. W. Tsang, S. C. Hsu, and C. S. Poon, "Promoting food waste recycling in the commercial and industrial sector by extending the Theory of Planned Behaviour: A Hong Kong case study," *J. Clean. Prod.*, vol. 204, no. 2018, pp. 1034–1043, 2018, doi: 10.1016/j.jclepro.2018.09.049.

[26] R. Xiao, Y. Zhang, X. Jiang, P. Polaczyk, Y. Ma, and B. Huang, "Alkali-activated slag supplemented with waste

glass powder: Laboratory characterization, thermodynamic modelling and sustainability analysis," *J. Clean. Prod.*, vol. 286, p. 125554, 2021, doi: 10.1016/j.jclepro.2020.125554.

[27] K. Govindan, Y. Zhuang, and G. Chen, "Analysis of factors influencing residents' waste sorting behavior: A case study of Shanghai," *J. Clean. Prod.*, vol. 349, no. July 2021, p. 131126, 2022, doi: 10.1016/j.jclepro.2022.131126.

[28] I. Ajzen, "The theory of planned behavior," *Organ. Behav. Hum. Decis. Process.*, vol. 50, no. 2, pp. 179–211, 1991, doi: 10.1016/0749-5978(91)90020-T.

[29] A. H. Pakpour, I. Mohammadi, M. Mahdi, S. Asefzadeh, and H. Pearson, "Household waste behaviours among a community sample in Iran : An application of the theory of planned behaviour," *Waste Manag.*, vol. 34, no. 6, pp. 980–986, 2014, doi: 10.1016/j.wasman.2013.10.028.

[30] J. Hu, K. Tang, X. Qian, F. Sun, and W. Zhou, "Behavioral change in waste separation at source in an international community: An application of the theory of planned behavior," *Waste Manag.*, vol. 135, no. June, pp. 397–408, 2021, doi: 10.1016/j.wasman.2021.09.028.

[31] M. A. Mansournia, A. Geroldinger, S. Greenland, and G. Heinze, "Separation in Logistic Regression: Causes, Consequences, and Control," *Am. J. Epidemiol.*, vol. 187, no. 4, pp. 864–870, 2018, doi: 10.1093/aje/kwx299.

[32] A. B. P. Saputra, C. Meidiana, and K. E. Sari, "Faktor yang mempengaruhi minat partisipasi masyarakat pada bank sampah pas 27 kecamatan kepanjen," *Plan. Urban Reg. Environ.*, vol. 12, no. 0341, pp. 261–268, 2023.

[33] O. A. Labib, L. B. Abd Manaf, A. H. Bin Sharaai, S. S. B. M. Zaid, and M. S. Khalil, "The influence of Socio-Psychological Factors on Residents' Willingness to Practice Sustainable Waste Handling in Dammam City, Saudi Arabia," *Sustain.*, vol. 15, no. 18, 2023, doi: 10.3390/su151813654.

[34] R. A. Pratama *et al.*, "The challenges in sustaining waste banks in Serang City : How far the circular economy can go ? The challenges in sustaining waste banks in Serang City : How far the circular economy can go ?," *IOP Conf. Ser. Earth Environ. Sci.*, 2023, doi: 10.1088/1755-1315/1201/1/012007.

[35] C. Liao and H. Li, "Environmental education, knowledge, and high school students' intention toward separation of solid waste on campus," *Int. J. Environ. Res. Public Health*, vol. 16, no. 9, 2019, doi: 10.3390/ijerph16091659.

[36] S. Barr, *Factors influencing environmental attitudes and behaviors: A U.K. case study of household waste management*, vol. 39, no. 4. 2007. doi: 10.1177/0013916505283421.

[37] S. Mulat, W. Worku, and A. Minyihun, "Willingness to pay for improved solid waste management and associated factors among households in Injibara town , Northwest," *BMC Res. Notes*, pp. 1–6, 2019, doi: 10.1186/s13104-019-4433-7.

[38] W. Singhirunnusorn, K. Donlakorn, and W. Kaewhanin, "Contextual Factors Influencing Household Recycling Behaviours: A Case of Waste Bank Project in Mahasarakham Municipality," *Procedia - Soc. Behav. Sci.*, vol. 36, no. June 2011, pp. 688–697, 2012, doi: 10.1016/j.sbspro.2012.03.075.

[39] P. Sujarweni, V. W., & Endrayanto, "Statistika Untuk Penelitian," *Yogyakarta: Graha Ilmu.*, 2012.

[40] I. Syaiful, F. L., & Hayati, "Inovasi Pengolahan Sampah Plastik Menjadi Produk Dan Jasa Kreatif Di Kenagarian Kinali Kabupaten Pasaman Barat. Jurnal Hilirisasi Ipteks," no. 4(4), pp. 233–240, 2021.

[41] I. W. Widiarti, "Pengelolaan Sampah Berbasis 'Zero Waste' Skala Rumah Tangga Secara Mandiri.," *Yogyakarta Univ. Pembang. "Veteran".*, 2012.

[42] J. D. M. Nixon, H., & Saphores, "Information and the decision to recycle: results from a survey of US households," *J. Environ. Plan. Manag.*, pp. 257–277, 2009.

[43] S. Barr, "Factors influencing environmental attitudes and behaviors: A UK case study of household waste management. Environment and behavior," no. 39(4), pp. 435–473, 2007..