Preliminary Study on Identification of Sociological Perspective to Landfill Management Facilities over Bakung landfill, Bandar Lampung, Sumatera

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Solid waste disposal management is a great challenge to be socially accepted in many aspects. Unmanaged landfill is still commonly faced in Indonesia with characteristic of open dumping. Bakung Landfill located in Bandar Lampung It is one of them. The operation of landfill related to manage a facility can be negatively affected to who living near the landfill. Thus, in this study aimed to analyze sociological perspective of Bakung landfill by some influential factors. Here, forty samples had been collected by interviewing respondents with random sampling around 1 to 5 km in distance from landfill where Eight components consist of 35 questions in total were given to respondents. The components are covered a general information such as the existence of landfill, owner management, technology facilities availability, financial, social impact, nuisance, disturbance, and damaging environment. The Principal Component Analysis (PCA) and Cluster Analysis (CA) as comparison were conducted to identify data. Some statistical tools were done to filter data as quality assurance i.e. validity, reliability, normality and KMO test. Four new components were extracted and named by "facility management", "pollution", "financial and convenience", and "technology to handling". Facility management and pollution explained the top highest of total variance. CA had similar result with better visualization of the proximity of components. Many literatures supported the fact that unmanaged system in landfill related to the facility management was occurred and the pollution coming from landfill was exist. However, future research regarding institutional perspective and broader area of research need to be conducted to support the issues.

Keywords: Perspective, Landfill, PCA, Bakung Landfill, Bandar Lampung.

1. INTRODUCTION

Solid waste production is an inevitable consequence from human activities and all material use [1]. The issue becomes big problems in many cities around the world including Indonesia [2, 3]. Municipal solid waste in Indonesia arose continually because of the increase number of populations [4]. Final solid waste disposal still largely depends on landfill operation. Landfill in Indonesia was operated as open dumping as much as 47% during 2016-2017 in 355 observed districts/cites [4]. Beside open dumping system, the 12-municipal solid-waste landfills in major cities showed that controlled dumps were more common and operated rather than sanitary landfill [5]. In order to manage final solid waste disposal as well as municipal solid waste management, the local government has responsibility to be engaged in

waste management. The local government faced many problems, usually related to the lack of sufficient budget, inappropriate equipment, uncollected and improper solid waste management and planning [5]. Other problems perhaps showing up in municipal management are low recycling rate and low awareness of health risks. The situations become serious problems in middle-income countries such as Indonesia [1]. Some of landfills in Indonesia were built as controlled landfills at first but practicing as open dumping predominantly [6]. Those are poorly designed and commonly operated under inappropriate procedure. The practice also occurred in Bakung landfill, Bandar Lampung city. According to Develop Sanitation Master Plan from Regional Development Planning of Lampung Province in 2015 reported that Bakung landfill was operated since 1994. At the beginning, Bakung Landfill was designed as sanitary

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landfill with total area 14 Ha. However, based on some regional development planning of Lampung Province in 2015, the operation and maintenance of Bakung Landfill had several problems so that the landfill system was afterwards operated as open dumping without any good improvement [7].

A present of landfill is not always accepted by residents around the landfill site. Closure of existing landfill facilities sometimes can be caused by social movements and conflicts between residents and authority. Besides, residents living close to solid waste disposal facilities dialog with public involving the planning stage for better communication. The most influential of people' concern and attitudes can be found by investigating resident's perspective about landfill facilities and management. Many factors associated to resident's perspective to the acceptance of landfill management facilities [8]. Personality characteristics and perception are fundamentally linked to each action of waste management behavior. Those are influenced by psychological factors that come from a various number of variables to perceive, which by this case related to waste and landfill management [9]. To reduce that multidimensional view of environmental attitude, concern and perspective, some techniques i.e. PCA (Principal Component Analysis), CFA (Confirmatory Factor Analysis), CA (Cluster Analysis) and other dimensionality reduction methods were used in some researches [8,10,11]. Some of them exposed waste management and landfill issues to set a manageable size while retaining as much of original information as possible. The objective of this study aims to analyze sociological perspective (concerns and attitudes) over Bakung landfill in Lampung Province as preliminary study. In order to know which factors affecting the landfill management, the most influential attitudes and impacts against facilities would be identified by using PCA and CA as comparison.

2. METHODOLOGY

A. Sampling Background

The study has been conducted in February 2019. Bakung Landfill was the only one landfill in Bandar Lampung city. Determination of sampling area was undertaken in purpose. The sampling site was restricted by 1 to 5 km in distance from landfill site in order to find particular issues around specific object i.e. Bakung landfill. The landfill itself is specifically located around 5°27'32.1"S 105°14'24.8"E. The location of landfill can be seen at Figure 1. The landfill was designed at first as sanitary landfill meanwhile it is currently operating to be open

dumping system because of some issues such as facilities management, budgeting and landfill's expertise. The sampling site was around Bakung Ward with residents of 7039 persons in 2018 [12].
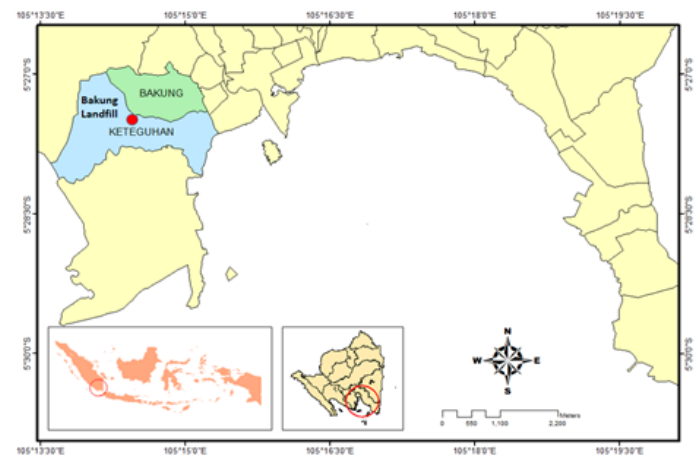

Figure 1. Bakung landfill and sampling site

B. Data Collection

Sampling technique was conducted by random sampling. Forty samples had been collected from residents around Bakung landfill site by interviewing and fulfilling a questioner. The components of questioner were adopted from literature review of Rahardyan et. al. with some improvements adjusted by landfill's situation [8]. The component and attribute of questioner can be seen at Table I. The component would be as a boundary of question and related to the impacts. The accounted impact affecting to environment and residents are regarding the existence of landfill, owner management, technology and facilities availability, technology and facilities availability, financial related, social impact, nuisance and disturbance, nuisance and disturbance, and damaging environment (See Table 1). Those components then will be elaborated into some attributes. Component 1/ C1 contained 9 independent questions that were provided by various choices depending on typical of the question the example of the answers for a question of education level (part of C1) is (a) no education, (b) elementary school, (c) junior high school, (d) senior high school, (e) bachelor degree, and (f) higher education. That question results a descriptive data. The question of Q2, Q3, Q4, Q5 would be answered by "strongly disagree", "disagree", "agree", and strongly agree. The answer for Q6, Q7, and Q8 are "strongly distrusted", "distrusted", "trusted", and "strongly trusted". Those answers were changed into scales from 1 to 4 for analysis purposes.

Table I. Component and attributes in questioner

No	Component	Attribute
C1	General Information	Educational level, gender, age, experience of visitation to landfill, length of stay, current job, knowledge of landfilling, knowledge of landfill, background, knowledge of landfill resources
C2	The existence of landfill	Landfill planning, landfill absence
C3	Owner management	Owner's landfill management, ability to managing landfill, owner independency, openness of facility owner, owner and government, ability to planning, following procedures
C4	Technology and facilities availability	Availability of facilities, convenience facility, application of technology, operational and plan suitability, reliability of technology
C5	Financial related	Financial stability of facility owner, government's financial ability
C6	Social impact	deterioration of living environment, providing compensation
C7	Nuisance and disturbance	Handling disturbance, handling odor, handling noise
C8	Damaging environment	Handling air pollution, handling soil contamination, handling water contamination, handling vector disease

C. Data Processing

Data processing of questioner would be firstly filtered by validity and reliability test. The unqualified data can be removed by criteria based on those test as quality assurance and evaluation to the measurement tool for a good research [11, 12]. The interpretation of validity test would be valid if $r_{calculation}$ is greater than r_{table}. Validity is a calculation to know how well instrument works [14]. The reliability test would be considered acceptable and satisfactory by Cronbach's Alpha above 0.7, respectively. All analysis method was performed by Microsoft Excel and R program. Descriptive analysis was done at first. Factor analysis method then was conducted in order to identify what and which factor affect to people trust and concern. Normality test has a requirement to meet where p-value more than 0.05 indicating the data was normally distributed [15]. KMO (Kaiser Meyer Olkin) is a test to check the Measurement Adequacy (MSA) greater than 0.5. Each data should be checked of its MSA to know the adequacy of data. Data with low MSA value (<0.4) will be excluded from the analysis [14, 15]. The proper and adequate data would be analyzed of PCA and CA) if those tests are fit and met from those particular requirements. The analyzed data then was tested by Principal Function in R program. PCA was used to redefine component based on correlation among variables. The criterion to retain the factor is according to eigen value of greater than 1 as Kaiser Criterion. Varimax rotation was also used to PCA. The loading value with greater than 0.5 will be considered as new principal component. Each factor would be renamed as new PC defining the whole considered components and attributes. Furthermore, CA provides categories based on measured

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similarity and gives better graphical representation of a cluster model by dendrogram graph [17].

D. Waste Disposal Management of Bakung Landfill in General

Estimated waste entering the landfill was around 150,000 tons in 2017 and predicted being more than 20,000 tons per year in 2032. The highest percentage of waste composition was leftover foods (80.66 tons) and followed by textiles (8.82 tons) and papers (6.06 tons). Eighty percent of total solid waste entered in to Baku landfill mostly coming from domestic activities meanwhile 20% of non-domestic waste was discarded to the landfill. Independent treatments, for instance waste and waste bank activities, were also done by 1% and 5%, respectively in 2016 [18]. The landfill was designed at first as sanitary landfill system meanwhile it is currently operated to be open dumping because of some issues such as facilities management, budgeting and landfill's expertise. Bakung landfill summary including establishment year, depth, large area, number of employers, domestic waste transport, and leachate plant had been provided. Bakung landfill was started the operation in 1994. It was categorized as shallow landfi with less than 5 meter in depth. The landfill was operated by 23 employees and had 93 units of waste transport. There is no leachate treatment plant [7,12].

3. RESULT AND DISCUSSION

A. Data Background

Questionnaires have been spread to 40 respondents to identify public trust in waste management facilities. The respondent profiles were listed on several personal attributes (see Table I). Forty percent of man and 60% of woman were given a questioner and had interview to identify resident's persepective related Bakung landfill waste management facilities.
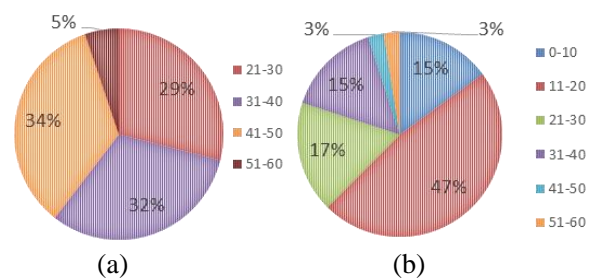

Figure 2. Respondent's profile of (a) age (b) length of stay

The respondents of 78% had visited to the landfill. The respondent's age background mostly came from age of 41 to 50 years old (33%) followed by age of 31-40 years old (30%). Around age of 21 to 60 of respondents has stayed for years with the furthest distance of 5 km from landfill. About 48% of respondent has stayed about 11 to 20 years near to landfill. The proportion of respondent's profile related age and length of stay are visualized in Figure 2. Other

backgrounds are also shown by Figure 3 regarding their knowledge of landfilling system, landfill background and landfill resources. Most of them (>60%) were not concerned to landfill resources and its background meanwhile half of them was concerned about landfilling system. The job backgorund of respondents were mostly students (25%), housewife (28%), laborer (18%). Other jobs (29%) were fisherman, online driver, scavanger, farmer, and private sector.
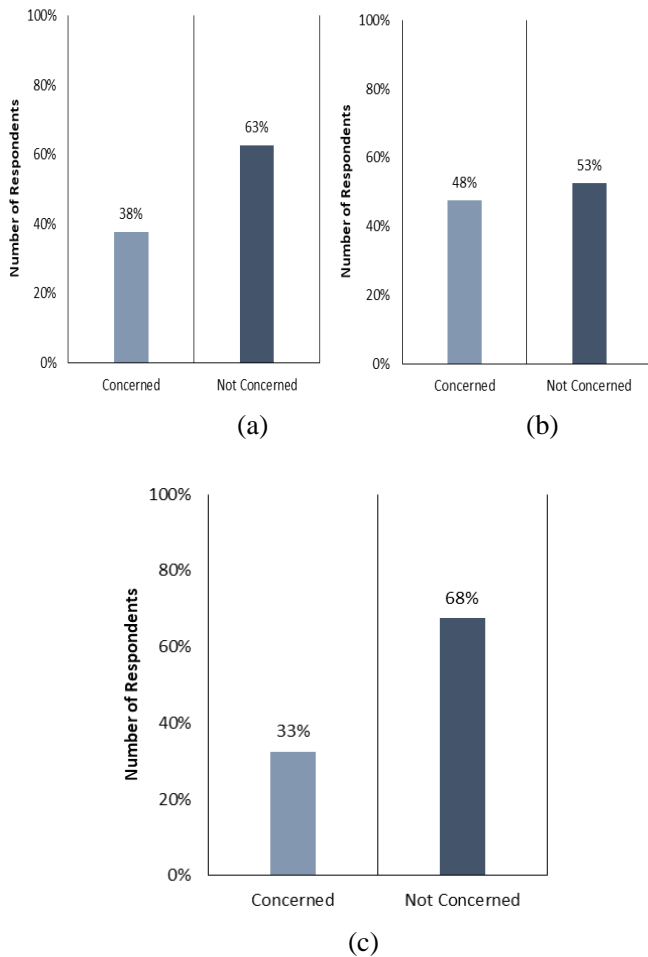

(a)

(b)

(c)

Figure 3. Respondent's knowlegde of (a) Landfilling (b) landfill background (c) landfill resources

As seen in Figure. 4, all attributes are mostly answered in range 1 to 2. It means that most of them answered either strongly disagree or disagree for Q2-Q5 and either strongly distrusted or distrusted for Q6-Q8. Based of those results, we can intepret the problems might be exist. The problems afterwards will be further categorized by PCA and CA in order to simpifly the visualisation and the explanation.
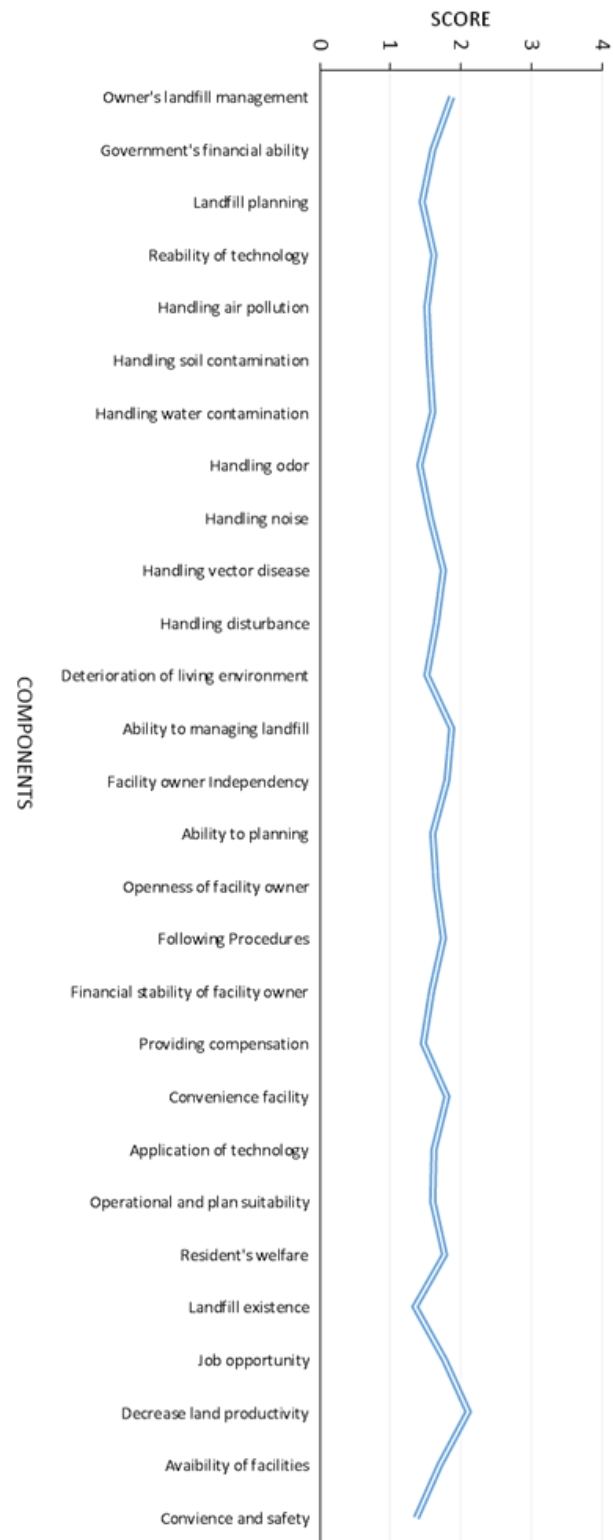

Figure 4. Rating answers for each attribute

B. Data Filter and Analysis

The questionnere items have been filtered by validity and reabilty tests as pre-requisite the use of those data. The removed data was done by deleting some questions because of invalid data i.e financial stability, landfill planning, and owner's ability handling vector disease components.

Table 2. The loading value of PCA

Component	PC1	PC2	PC3	PC4
Reliability of technology	-	-	-	0.81
Handling air pollution	-	0.67	-	-
Handling soil contamination	-	0.69	-	-
Handling water contamination	-	0.62	-	-
Handling odor	-	0.79	-	-
Handling noise	-	0.72	-	-
Handling disturbance	-	0.51	-	0.63
Deterioration of living environment	-	0.75	-	-
Ability of human resources to managing landfill	0.87	-	-	-
Facility owner Independency	0.87	-	-	-
Ability to planning	0.84	-	-	-
Openness of facility owner	0.69	-	-	-
Following Procedures	0.61	-	-	-
Financial stability of facility owner	-	-	0.78	-
Providing compensation	0.72	-	-	-
Convenience facility	-	-	0.78	-
Application of technology	0.58	-	0.62	-
Operational and plan suitability	0.59	-	0.68	-

Note: the provided data is only loading value greater than 0.5

All valid data was represented by $r_{calculation}$ (varied between 0.35-0.7) > r_{table} (0.312). The reability data was 0.83 based on Cronbach Alpha index with greater than 0.6. After validity and reability test, all data should be normally distributed and adequate before performing PCA. Those data was calculated by Shapiro-wilk normality test with all results of *p*-value below 0.05 indicating that the data were normal distrubuted. MSA was tested by KMO and determining the data whether can be retained or removed. Component of *"an owner's need to landfill management"* was removed because the MSA value was below 0.5. The data would be kept to retain with minimum MSA value of 0.5 as quality assurance of data analysis. Loading value of PCA test is shown in Table 2. Undetected value was considered as loading value below 0.5. The result of PCA shows that there will be four new components to be redefined all items. For determininng the new components, standard eigen value was used > 1. Four new components have been created to describing of PC1, PC2, PC3, and PC4. PC1 (facility management) involves components of ability to managing landfill, facility owner independency, and ability to planning, openness of facility owner, following procedures, and providing compensation. This new component explained 26% of total variance. PC2 (pollution) is handling air pollution, handling soil contamination, handling water contamination, handling odor, handling noise, deterioration of living environment. The components of PC3 (financial and convenience) provided in Table 2 are financial stability, openness of facility owner, convenience facility, application of technology, and operational and plan suitability PC4 (technology to handling) includes reliability of technology and handling disturbance.
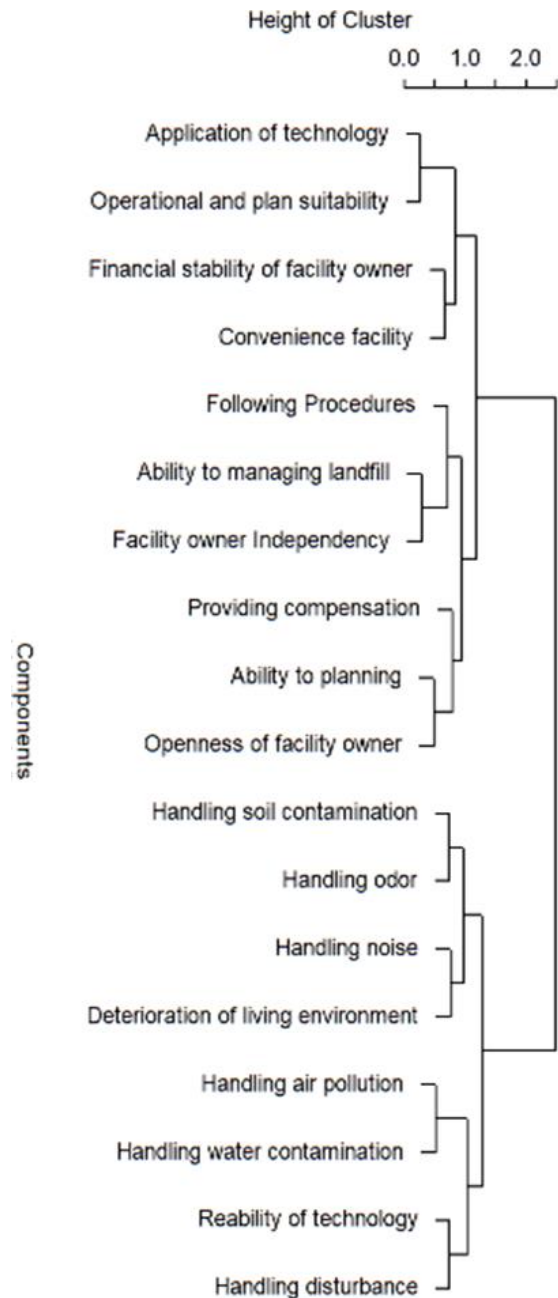

Figure 5. Dendrogram of Cluster Analysis

The naming was technology to handling coming from the highest loading in reliability of technology component. The total variance of PC was 73%. PC 2, 3, and 4 was explaining 19%, 16%, and 11%, respectively. The test of PCA that 4 components were sufficient and valid with fit based upon off diagonal values of 97% and p-values < 0.05. The PCA result is afterwards compared to CA (See Figure 5). The figure 5 displays, which represented by dendrogram graph, that many similarities from identification result from PCA. Four big categories are still found. A small difference between CA and PCA is that components of reliability of technology and handling disturbance are merged being one cluster with components of handling air pollution and handling water contamination. Conversely, in PCA result shows that those components were different factors. The results still have huge similarities since the components of reliability of technology and handling disturbance are much closer each other rather than other components. According to that reason, between PCA and CA is still comparable method to identify the resident's perspective against landfill facilities and its management.

C.   Discussion and Future Research

Facilities management and pollution explained top two highest components of total variance. Resident's perspective on these two mostly was supported by some news and previous researches. Based on some news, the local government admitted that landfill disposal management in Bakung Landfill was unmanaged well [19, 20]. Unmanaged landfill was also depicted by how contamination from landfill spread out to the neighborhood. In July 2019, Bakung landfill had been eroded owing to heavy rain according to local news [19]. A large waste landslide dragged 4 workers after four days raining in 2019 [21]. Leachate contamination flowed dominantly into aquifer system (river) near the site. The groundwater generally flows to the South-Southeast that is directed near from landfill. The study determined that a possibility of leachate contaminated to the groundwater. The river's water had bad odor because of the presence of waste materials causing interaction between leachate and river (close to the landfill) [22]. The soil water in the nearest well from landfill (around 100 meter) had been contaminated by high organic content and low pH [18]. Methane gas came from landfill was predicted to generate an average of 2665 m^3 million methane during 2018 to 2032 [7]. Methane gas is usually used to determine the dispersion of low reactivity-odorous species around landfill site [23]. Odor annoyance near waste treatment centers could be associated to physical symptoms [24]. Odor is a common issue affects to residents living near landfill facilities. However, the studies of people's negative perspective to pollution damaging environment and affecting residents also were found in other places [8, 25–27]. One of those researches shows that citizen's perspective to pollution and facility management had been identified to be one of influential factors for landfill

acceptance by using PCA method. The finding of the research provides information that a significant respond to authorities and landfill management facilities was low and needs to be fixed and improved. Good management, information disclosure, transparency in management and mutual communication are needed to avoid conflicts and build social trust [26]. Other component affects to residents living near landfill facilities are financial and convenience issue as well as technology to handling. The low of variance explaining the components perhaps is due the background of respondents coming from low-income and not very educated residents. By seeing people's perspective provided data that people's convenience in to the existence of landfill was not met yet. The government and/or authorities afterwards should give more attention to improve landfill's system management in order to make people's acceptance and increasing trust issues. To support this research, related the institutional of landfill management as well as authorities and or local government perspective can be carried out in order to make the problem clearer and balanced. Besides, larger samples should be conducted with broader area to know the effect of distance between residence and landfill in various backgrounds.

4. CONCLUSION

Resident's perspectives against Bakung Landfill in area 1 to 5 km were influenced by four factors. By 35 questions spread out into residents, facility management and pollution became a critical issue influencing trust and concern of residents in to landfill management facilities. The factor explained the top highest of total variance. Other influential components were *"financial and convenience"*, and *"technology to handling"*. The fact related to its unmanaged landfill and pollution. It needs to be improved from government and authorities to increase the acceptance and trust of residents living near landfill facilities.

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