Villagers perceptions on the existence of hazardous waste treatment facility at Bogor, Indonesia

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Abstract. Indonesian government built a hazardous waste treatment facility near two villages in Bogor, Indonesia. The facility has been operating since 1994, and its activities affect the neighboring villages. There had been two significant conflicts between the village's community and the company, in 2006 and 2008. The acceptance of the surrounding neighborhood is one of the major risks affecting a company's lifetime. This study aims to provide the latest perception of the two villages' community on the facility's existence. The survey, observation, and in-depth interviews were employed to gather enough information for perception analysis. The perception analysis represents variables: socio-demography, knowledge and information, health issues, social-economy values, and trust. The survey was conducted to 100 respondents, and the data were analyzed as a Likert scale for each variable. The univariate analysis was performed to map the perception, which resulted in "good perception". The bivariate analysis was performed to explore the socio-demographic variable's influence on perception. The result showed that there is no significant correlation between age, education level, and occupations with perception. These results can be used as the base information to determine the company's sustainability strategy.

1. Introduction
The acceptance of the people or community is one of the major risks that need to be addressed for the continuity of an organization [1]. The behavior of local people has an important and lasting impact on the environment and should be considered as a factor for the organization's policy and strategy [2]. The acceptance of the community is built from the community perception. This study aims to explore the latest perception of a village community to a hazardous waste treatment facility existence. The study was motivated by the history of conflicts between the company and the villagers in 2006 and 2008. The conflicts were driven by the inequity in the local employment, and the exposure of odor from the facility to the village area. The odor came from the hazardous waste treatment activity inside the facility.

There was never any scientific assessment performed on the village community's perception of the facility. The complaints about odor and dissatisfaction about the local worker's recruitments were frequently delivered to the company's representative. Unfortunately, the immensity of the complaints was never investigated. The company has no records of villager's complaints, so it cannot be mapped and analyzed. The complaints mapping can be used as a method to identify gaps between the company and the villagers. The local people's acceptance is included in environmental risk management as an external risk [3]. The risk needs to be managed as a part of the decision-making process. As a scientific
assessment, the study's result can be used as a base to identify the gaps in the relation between the organization and the village community and determine the priorities to fix the identified problems.

The community perception of risks usually focused on "feelings" so it weighed on the characteristics of the consequences than the probability of experiencing those consequences [4]. Meanwhile, [5] interpreted perception as something that the individual interprets and feels to be something meaningful based on his experience and can differ from the actual reality. [6] indicated that its socioeconomic characteristics influence the perception of a community. The community perception of an issue is linked to its demographic factor. The demography factor can be used in profiling the segment of active people sensitive to the problems that create the perception. The perception of the people who live near hazardous waste landfill is fear of exposure to toxic materials that will damage their health [16]. Four factors build the fear: view of health problems, trust to the organization, government, and science to address the risks, inequity will create resistance, social-demography factors. In [6] research, they analyzed community perception by measuring social-economic factors, hardships, health, work-life and social behavior. Another study of protested projects by a community [17] used variables such as knowledge of the project, including its benefits and defects, social-economic factors, trust in the company management and government, awareness of former issues, and pollution awareness concerns of risks, and complaint experience.

The researched hazardous waste treatment facility has an integrated treatment system and can treat almost all hazardous waste listed in Indonesian regulation. The facility receives about 20,000 tons/month of hazardous waste from all regions of Indonesia. US-EPA defined hazardous waste as waste with hazard characteristics that can threaten human health or the environment. [18] categorized hazardous waste based on its origin, composition, and characteristics. The facility generates the risk of hazardous substance exposure to the neighboring villages. The concern of exposure from a hazardous treatment facility is mainly related to odor [15]. A large amount of treated waste through all kinds of biological and physicochemical processes could expose toxic compounds and odor to its surrounding area [19]. Some organic compounds that generate odor, such as sulfur compounds, alkylbenzenes, limonenes, and certain esters, could cause nose, eye, throat irritation, headaches, nausea, and shortness of breath, and loss of appetite [22]. Long-term exposure to volatile compounds in odor compounds could lead to a problem in the respiratory system, nervous system, and even cancer [20]. The odor nuisance could also cause emotional stress such as anxiety and could form physical reactions such as headache, vomit, short of breaths, and eye irritation [19], [23], [24].

Conflicts between the industry and its surrounding communities had happened in the past all over the world. The driver for the conflicts came from disagreements on environmental, governance, social
responsibility, and local rights [25]. These disagreements were formed by unfulfilled expectations, lack of compensations, inadequate communication/consultation, land dispossession, and environmental degradation that could trigger opposition [26]. [27] implied that large projects that were transforming the landscape could curtail and expand mobilities and opportunities. The changes could bring benefits such as road construction and job opportunities, but the local stakeholder whose livelihoods entirely depend on the lands could get disadvantages from the projects [28]. Local community engagement is one of the key factors for projects' success [29], [30]. Progressive changes without well-planned stakeholder participation will significantly adverse environmental, social, economic, and policy impacts [29].

Corporate social responsibility (CSR) is a form of effort from companies to address conflicts, support local development linking to social and economic goals to achieve "win-win" outcomes [30], [31]. Referred to [32] that stated sustainable development asserts the need for corporate accountability and the private sector's duty to contribute to the evolution of equitable and sustainable communities and society, conveyed that companies/private sectors are responsible for the development of its surrounding communities. CSR should not be only distributing charity to the local community, but to develop the community as the main purpose. The community's development can be achieved by performing training, giving of agricultural inputs, and activities closely aligned with the company's activity, such as local content policies that support purchasing services and goods from local businesses [31]. The CSR program's failure showed by the unsolved issues in the community and useless programs that the community does not get the benefits from them. A poor plan by the company causes these failures. The company is only manifesting the problems without trying to assess the root causes [33]. This strategy only solves short terms problems, but the base and big issues remain.

2. Method
In this study, the perception of the community village is analyzed by exploring five factors:

1) Social-demography
2) Knowledge and information
3) The outlook of health problems
4) The outlook of social-economy benefit
5) Trust

A survey was conducted to the village community to gather data and information to describe the five factors (variables). The survey contains 6 questions for social-demography, 3 questions for knowledge and information, 4 questions for the outlook of health problems, 3 questions for the outlook of social-economy benefit, and 3 questions for trust. The survey's result was analyzed into a Likert scale for each variable. The Likert data would be examined by univariate analysis and bivariate analysis. The research process is expressed in figure-1.

There are 600 households inside the research area. The number of samples calculated with Slovin formula in Eq-1:

\[
n = \frac{N}{1+N \cdot e^2}
\]

In which n is the number of samples, N is the population (600 households), and e is the tolerable error margin (10%). The calculation result is 85.17, it rounds up to 90, but the samples taken are 100 to anticipate sample failure. The samples were taken randomly inside the study area. The questionnaires will be distributed to 100 respondents as samples. The survey will be assisted by the enumerator from Nambo village.
Before the data is analyzed into a Likert scale, the data and the questionnaire will be tested for its validity and reliability. The validity test uses the Pearson Product Moment method. The test will be conducted for 20 respondents. \cite{34} stated that the validity of the questionnaire can be tested to 20 respondents who have similar characteristics with research samples.

The reliability test uses Alpha Cronbach’s formula, represented by coefficient $r$. The reliability test is to make sure that the answers from the respondents are reliable. The answers are stated sufficiently reliable when the $r$-value is greater than 0.6; the more it gets close to value 1.0, the more reliable the answers are.

The questionnaires are presented as Likert items and processed using the SPSS version 24 software program. The software also performed univariate and bivariate analysis. Univariate analysis was used to describe the perception of the villagers. The perception describes as "good" and "bad". Category for "good" is when the sum of a Likert scale for each variable is greater than or equal to 60% of the total sum. If it is less than 60%, then it categorizes as a "bad" perception.

Bivariate analysis was used to discover the dependency between variables (age, education, and occupation) in the perception's social-demography factor. The bivariate analysis uses the chi-square method to find the dependency between the independent variables and the perception as a dependent variable. The chi-square method uses two hypotheses. Hypothesis null ($H_0$) is there is no correlation/dependency between the independent variables and the perception variable. The second hypothesis ($H_a$) is there is a correlation/dependency between the independent variables and the perception variable. $H_0$ is aborted when the chi-square calculated number is greater than the number in the chi-square table. The chi-square method requires that there are no cells that have the expected count less than 5. If cells with the expected count are less than 5, then the Fisher exact test is used \cite{35}.

Besides the survey, observation and in-depth interviews are also performed to get more detailed information to describe and understand the village community’s characteristics and profile. The interviews proceeded to key actors in the village community, such as the village leaders and witnesses of the confrontation in 2006 and 2008.
The hazardous waste treatment facility is located at Bogor Regency rural area, West Java Province in Indonesia. The total area is about 60ha, and 30 ha is dedicated to hazardous waste landfills. There are two villages and one cement factory near the facility. The layout of the facility and its neighbors is presented in figure 2.

The villages near the facility are Nambo and Bantarjati. The land is fertile and mostly used for farming, and the rest is for housing, schools, mosques, market, and government’s official offices. The area for Nambo villages is 1,043 Ha area with 10,085 population, and Bantarjati village is 367 Ha with 7,220 population. Most of the villagers are working in agriculture. The lands for agriculture are not fully productive; many lands are not open for farming yet.

The research area is the hazardous treatment area and 500-meter radius from the facility's area, shown with a red line in figure 2. A hazardous waste treatment with landfills is considered giving significant impacts on people who live in a 500-meter radius from the facility. Inside 500 meter radius, there are about 600 houses, which about 15% is Bantarjati village, and 85% is Nambo village. The Bantarjati's area is the north-eastern part, and the Nambo's area is the north-western part.

![Figure 2. The research area, edited from [36] [37].](image-url)

3. Results and discussion

3.1. Validity Test and Reliability Test

The validity test is addressed to 20 respondents and analyzed using SPSS 24 program. The results show that the calculated Cronbach’s coefficient for all variables is above 0.4444; all questions are valid. A Valid test result means that the questions made can describe the purpose of the survey.

The reliability test is also addressed to 20 respondents and analyzed using SPSS 24 program. The results show that the calculated r-value is greater than 0.6, so all the answers from the respondents are reliable. The result of the validity and reliability test for each variable is shown in Table 1.
Table 1. Validity and reliability test result

| Variable                  | Validity       | Reliability |
|---------------------------|----------------|-------------|
| Knowledge and information | $Q_1 = 0.670$  | 0.640       |
|                           | $Q_2 = 0.840$  |             |
|                           | $Q_3 = 0.823$  |             |
| View of health problems   | $Q_4 = 0.477$  | 0.685       |
|                           | $Q_5 = 0.805$  |             |
|                           | $Q_6 = 0.891$  |             |
|                           | $Q_7 = 0.753$  |             |
| View of social-economy benefit | $Q_8 = 0.874$ | 0.812       |
|                           | $Q_9 = 0.817$  |             |
|                           | $Q_{10} = 0.671$ |            |
| Trust                     | $Q_{11} = 0.781$ | 0.699       |
|                           | $Q_{12} = 0.747$ |             |
|                           | $Q_{13} = 0.847$ |             |

3.2. Characteristics of Respondents

The social-demographic data collected is to describe the profile or characteristics of the villagers. The social-demographic data are age, education, gender, occupation, location (Nambo/Bantarjati), and numbers of household members. There were 100 respondents who willing to participate in the survey, 84 come from Nambo village, and 16 come from Bantarjati village. The characteristics of the respondents are expressed in Table 2.

Table 2. Characteristics of Respondents

| Characteristics     | Group            | %   |
|---------------------|------------------|-----|
| gender              | Male             | 48  |
|                     | Female           | 52  |
| age                 | 17-23 yo.        | 28  |
|                     | 24-29 yo.        | 31  |
|                     | 30-35 yo.        | 19  |
|                     | 36-41 yo.        | 10  |
|                     | 40-47 yo.        | 7   |
|                     | >47 yo.          | 5   |
| education           | Junior high school | 45 |
|                     | High school      | 45  |
|                     | Associate degree | 2   |
|                     | Bachelor degree  | 8   |
| occupation          | laborer          | 16  |
|                     | teacher          | 6   |
|                     | housewife        | 33  |
|                     | employee         | 19  |
|                     | student          | 11  |
|                     | self-employment  | 6   |
|                     | unemployment     | 9   |

The number of male and female respondents is quite a balance (48%:52%). More than half of the respondents are young people between 17-29 years olds (59%). The majority of the respondents are junior high school and high school graduates (90%) for the educational level. The occupation of the respondents is varied considerably.
3.3. Knowledge and Information

The knowledge and information variable is consists of knowledge about the activity in the hazardous waste treatment facility, the knowledge about hazardous waste, and the knowledge about the risk/hazard of hazardous waste. According to the survey results, 62% of respondents are knowledgeable about the facility's activity, 61% of respondents are knowledgeable about the hazardous waste, and 71% of respondents are knowledgeable about the hazard of the hazardous waste.

The respondents' minimum education level is a junior high school, and the facility had been operated for more than 25 years. It means that the respondents have been living near a hazardous waste treatment facility for a long time. The survey result showed that 60%-70% of the respondents understand hazardous waste, its harmful effects, and the purpose of the facility. The respondents' knowledge and information could be shared via the company, their schools, their parents, their neighbors, or other media. A question raised from the 30%-40% gap is why people who live near a hazardous waste treatment facility for a long time are still not well informed about hazardous waste.

There are possible reasons why there are some people who do not well informed about hazardous waste. One reason is that maybe the company does not conduct enough socialization for the villagers. The socialization events need cooperation with the village government, so the village government can share knowledge and information with the villagers. Since the year 2008, there are few socialization events held by the company. The socialization usually happened when the company revising its environmental permit to add or changes the treatment activity. The socialization happened in the year 2013, 2016, and 2018.

The other reason comes from the individuals themselves; it could be that because they are ignorant and have no willingness to get knowledge or information. The villagers who live near a hazardous waste treatment facility need to know about hazardous waste. If incidents caused by hazardous waste happened, at least the villagers have a standard preparation and countermeasures for the incidents.

3.4. The outlook of health problems

The most important variable of perception about hazardous waste treatment facility is the outlook of health problems. For this research, the outlook of health problems variable is consists of awareness of the risk for living near the facility, odor nuisance from the facility, health problems (nausea/headache/short of breaths), and the health problems of household members. According to the survey results, 91% of respondents are aware of the risk of living near the facility, 29% of respondents never smell the facility's odor, 54% of the respondents smell the odor occasionally, but 17% of the respondents smell the odor every day. The symptoms of health problems such as nausea, headache, and shortness of breaths experienced occasionally by 63% of respondents, every day by 10% of the respondents, and 27% of the respondents never had any symptoms. Members of the respondent's household also experience the symptoms of health problems. According to the survey result, 32% of the respondents stated that few of their household members are experiencing the symptoms and 9% of the respondents stated that all their household members are experiencing the symptoms.

Interviews with the key actors in both villages showed that Nambo village and Bantarjati village have sanitary and dust problems. Both villages do not have a proper system for solid waste and wastewater disposal. The solid waste is burnt or buried in lands. The wastewater from households is disposed into the creeks, rivers, or ponds. Clean water is also a problem because of the limestone as the land formations, so the water is rich in hardness. Both villages are located near two giant cement factories and other industries, and the truck's traffic is high. Traffic generates a huge amount of dust daily. The films of dust can be seen in every household and plantation in the villages. These conditions have an impact on the village's health. The villagers' common health symptoms are spotted lungs, glandular pain, upper respiratory tract infection, and strokes.

Most of the respondents are aware that there are risks to living near a hazardous waste treatment facility. The survey shows that almost half of the respondents are having health issues related to the facility. About 10% of the respondents are bothered by the facility's odor and have health problems daily symptoms like nausea/headache/short of breaths. These nuisances also happened to all the household
members. These are the group of people that are the most vulnerable to the facility's impact. They live in an area that parallels with the wind direction.

The odor comes from the stabilization process and the landfill process. The company had made some efforts to prevent odor exposure to the villagers. They installed a series of foggers around the landfill area and at the stabilization area, but unfortunately, they are not enough. The company needs more strategies executed to address this problem. The company could give the affected people some compensation for their inconvenience. The local people's health should always be the main priority of any company operated in the local area.

3.5. The outlook of social-economy benefits

The establishment of the hazardous waste treatment facility near the two villages had made a social and economic impact on the villagers, even from the beginning. It opened new job opportunities, local business development, and social changes for the villagers. The outlook of social-economy benefits is one of the variables measured for perception. In this research, the outlook of the social-economy benefits variable is consists of job opportunities, local business opportunities, and the benefits of CSR programs.

According to the survey results, 47% of respondents think it was easy to get a job in the company, and 22% think it was very hard. Respondents who thought that local businesses were growing and profited significantly since the facility was operated is only 8%. 30% of respondents never had any business/work opportunities from the company. On the benefits from CSR programs factor, 29% of the respondents did not get any benefit from the CSR programs, 21% of the respondents were not included in the CSR programs, and 38% of the respondents get the benefits from CSR programs.

The survey shows that villagers opinion is divided in half about the job opportunity at the company. Indonesian government encourages companies to hire local workers. The company hired local workers that are 25% of the company's total workers, about 160 persons. The company operates in a very specific field, so it needs certain qualified workers. Because of the local workers' educational level, they are mostly junior high school, so they work on low skilled jobs. A few of them managed to level their skills through frequent training and experiences, so they become supervisors. The villagers need to get a higher educational level and appropriate skills if they want to work.

Since the company starts operating, there were new job/business opportunities for the villagers. The examples are housing for the company's workers, transportation, food stores, grocery stores, worker provider business, etc. One particular local business was groomed by the company to become hazardous waste transporter. The survey result showed that most respondents do not think that there is not enough local work/business created by the company's existence.

The company has CSR programs for the villagers. The programs are implemented in many fields, such as health, education, economy, infrastructure, youth development, sports, culture, and religion. The company built baby-toddler healthcare, clinic, and public health co-center for health programs. One elementary school was built in Nambo village; the company hired eight teachers and gave 5 kids scholarships until they graduated from high school. The company supports road repairs in both villages with a working contract with local companies. There is an interesting view of the village's youngsters, and they think it is cool to become a goon because a goon has lots of money. Thuggery practice is a common thing in the villages. They usually ask for money from trucks that pass through the village's area. The transportation traffics high because there are two giant cement factories and other industries located around the village's area. So the company intends to make an effort for the village's youngsters by sending 30 kids to a soccer school. For the religion and culture program, the company regularly gives donations for religious and cultural events.

The survey result showed that more than half of the respondents do not benefit from the CSR programs. This result raised questions such as why people who live near the facility feel that they do not benefit from its CSR programs. It could be caused by a lack of communication between the company and the villagers. The company could not map what the villagers needed most because the villagers did not have channels to voice their concerns. The company needs to evaluate its CSR programs, especially for the people who live near the facility.
3.6. Trust
The trust variable consists of trust in the company to provide enough budget for the risk management program, trust in the company's human resources in risk management, and trust in the company's risk management system. According to the survey results, 78% of respondents think that the company has enough funds to cover the hazardous waste treatment facility's risks. On the company's trust in human resources, 77% of the respondents are trusting the company. The company employed a risk management system, and 46% of the respondents trusted the system, but 33% of the respondents are skeptical about it.

A high-risk facility such as a hazardous waste treatment facility must have a solid, dependable risk management system. Risks generated from activities in the facility must be measured and managed to prevent catastrophe. Hazardous waste has harmful effects on the environment and all living things. That is why it has specific treatments and regulations separated from other types of wastes. The survey result showed that the respondents' opinions regarding the company's risk management system are fairly varied. This condition can be due to a lack of information about the company's risk management and a lack of risk management knowledge of the respondents. The company has an ISO 14001:2015 certificate; it means that it has implemented an environmental management system (EMS) and verified by an accountable institution. The risk management system is part of the EMS, so the company had applied a risk management system. The company should share this information with the villagers to be well informed and have some confidence that they are protected. Several indicators showed a lack of communication between the company and the villagers. One is that the company does not have records of complaints from the villagers. The villagers do not have a proper medium to channel their concerns related to the company.

The survey results show that even in some areas need to be improved, most of the respondents trust the company that the company has all reliable resources such as funds and human resources for a risk management system.

3.7. The Univariate and Bivariate Analysis
The univariate analysis is to express the perception mapping of the respondents from the survey result. The univariate analysis is conducted using SPSS version 24; the result is expressed in Table 3.

| No | Variable                     | Perception |
|----|------------------------------|------------|
|    |                              | Good | Bad   |
| 1  | Knowledge and information    | 78%  | 22%   |
| 2  | The outlook of health problems| 83%  | 17%   |
| 3  | The outlook of social-economy benefit | 50%  | 50%   |
| 4  | Trust                        | 81%  | 19%   |
|    | OVERALL                      | 83%  | 17%   |

Table 3. The Perception mapping of the respondents

The analysis result showed that the villagers' overall perception on the existence of the hazardous waste treatment facility operated near their residence is good. This result is akin to the research from [38],[10], which showed a good community perception on high-risk projects.

The bivariate analysis is performed to find the correlation between the socio-demographic variables such as age, education, and occupation with perception. The result shows whether the perception depends on the socio-demographic factors or not. The bivariate analysis using chi-square analyzed with SPSS version 24 is shown in Table 4.

| No | Variable | Chi-square | Fisher Exact |
|----|----------|------------|--------------|
| 1  | Age      | 5.341 a    | 0.193        |

Table 4. The Bivariate analysis result
The chi-square analysis showed that there are cells that have expected count less than 5, so it needs a fisher exact test for the accuracy of the correlation. The p-value from the Fisher exact test for the age variable is 0.193, and it is greater than p-value 0.05 (significant 95%), so it means that there is no significant correlation between age and perception of the hazardous waste treatment facility. The Fisher exact test result for two other variables is the same, the p-value is greater than 0.05, so there is also no significant correlation between education and occupation with the perception of the hazardous waste treatment facility.

Contrast with most perception research that indicated perception usually is influenced by the socio-demographic factors such as age, education, and occupation do not correlate to a community perception. This condition could be contributed by the behavior of the villages in general. People who live for quite a long time near the hazardous treatment facility had found some kind of normality in its existence. The facility had become a part of their lives, their routines, so there are no negative feelings unless something extraordinary happens. Villagers of all ages, educational levels, and occupations view the facility as a part of their routines, whatever the routine was. The facility is not a threat to the villagers' lifestyle. It showed by the survey's results, 83% of respondents have a good perception of the facility.

4. Conclusions

The villagers of Nambo and Bantarjati appeared to have a good perception of the hazardous waste treatment facility’s existence. But the survey shows that some issues need to be assessed and solved between the company and the villagers. The first one is health problems; some people experience daily health problem symptoms such as nausea, headache, and short of breaths because of the facility’s odor.

The second one is the social-economic issue. Some people who live near the facility do not feel the social-economic benefits from the facility’s existence. The company needs to engage more in local businesses and re-evaluate its CSR programs. The survey and the interview also show a lack of communication between the company and the villagers that could be a source of other issues such as complaints assessment and information on risk management.

The analysis showed that the social-demographic factors do not have a significant influence on the villager’s perception. The villagers’ perception of the hazardous waste treatment facility’s existence does not depend on their age, education level, and occupation.

The company needs to address the gaps before they get wider and unmanageable. The company needs more engagement and builds good communication with the villagers to preserve its sustainability with the villagers’ acceptance. Further research could analyze the villagers’ acceptance as a base of the company’s strategy in risk management.

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