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# Willingness to Accept (WTA) Analysis of Impact Compensation Funds for Transporting Limestone Materials (Case Study: Road Section in Solok Regency, West Sumatra)

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ABSTRACT

Limestone mining activities have a negative impact on the community around the mining location. This impact comes from material transportation activities by transport trucks. The trucks transport materials using public roads. The use of roads results in damage as a result of increased truck traffic and the number of overloaded trucks. The aim of this research is to analyze the cost of compensation funds that will be received by the affected communities. Using the questionnaire method, researchers distributed 66 questionnaires. The number of sample respondents was calculated using the Harry King nomogram formula with an error rate of 10%. To analyze compensation funds using the Willingness To Accept (WTA) approach. Of the 66 respondents, only 62 respondents were willing to accept compensation funds, 4 respondents were not willing to accept it on the grounds that the funds provided were not commensurate with the impact they felt. Using the WTA approach, the estimated average WTA value is IDR 63,000/month/family register and from the estimated average value, the total WTA value that must be paid by the company is IDR 3,900,000 per month. Compensation costs are included in production costs so that they can be a consideration for companies in environmental management

## INTRODUCTION

Some construction materials consist of sand, gravel and limestone which are needed especially for the construction industry (Scott et al, 2003). To meet consumer demand, one of the limestone mining companies in Solok Regency carries out limestone mining using the side hill quarry method. Mining activities have a positive impact on the economy of the surrounding community. Apart from that, it encourages development in society through providing employment opportunities (P. Seloa, V. Ngole-Jeme, 2022). Apart from the positive impacts, negative impacts are also felt by the community from limestone mining activities. There are two main activities in limestone mining, namely mining and transportation. One of the negative externalities comes from the transportation of materials by transport trucks. The trucks transport materials using public roads. The use of roads results in damage as a result of increased truck traffic and the number of overloaded trucks. This is supported by the results of research conducted by The Asia Foundation (2008) which states that the average truck in Indonesia is overloaded by 45% or 4 tons above the maximum load weight permitted in the mining sector. The effect of overloading on society is often not considered by companies. Companies should include loss costs in production costs, including environmental costs.

When considering environmental impacts or transportation risks along with transportation costs, transportation planning becomes a multi-criteria decision-making problem. Previous literature generally offers two approaches to address multi-criteria transportation problems. The first category initially estimates the risks, impacts, or costs of possible routes within a transportation network, then formulates the problem as a multi-objective mathematical

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programming model. Notable examples of this category include the works of Chang et al. (1996) and Veeramani et al. (2020). Although the impacts and risks involved are not as significant as those from hazardous waste (B3) transportation, the transportation of limestone materials still poses potential risks due to its high frequency. One important example is the transportation of limestone generated by large construction projects. This type of transportation causes noise, dust, and congestion in the areas surrounding the transportation routes, which will obviously have negative impacts if the construction is located in densely populated urban areas, such as toll road construction and rapid mass transit system development.

Environmental economic valuation is needed to determine the price of mineral resources and for anyone who takes and uses them to make payments due to the environmental impacts they cause. One of the methods used in environmental economic valuation is the Contingent Valuation Method (CVM) (Spash, 2008). CVM of natural resources and the environment is a method for estimating the economic value of a commodity that is not traded (non-market valuation) and is often used to measure the passive value or value of the existence of natural resources (Fauzi, 2004) of a public good. CVM is a simple, flexible method widely used, among others, in cost benefit analysis and assessment of environmental impact or damage, health risk reduction and public policy (Jianjun et al, 2010; Venkatachalam, 2004). The implementation of CVM involves distributing questionnaires to the community to measure the community's willingness to accept willingness to accept (WTA) compensation for impacts or reductions in environmental quality (Fauzi, 2014). WTA is the minimum amount of compensation that society is willing to accept in exchange for the right to a good living environment

According to Fauzi (2010) value Community WTA can be determined using the CVM method. This CVM approach consists of several steps, namely;

1. Building a Hypothetical Market

   StepThe first step in conducting CVM is to create a hypothetical market and ask questions about the value of environmental goods/services. The hypothetical market aims to explain why society should receive compensation for the use of environmental services by other parties even though there is a monetary value that corresponds to the cost of these environmental goods/services. In a hypothetical market, there must be a detailed, realistic and precise explanation of the price of environmental goods/services.
2. Get an Offer of the Largest Value of the WTA

   The sampling activity was carried out through direct interviews with the community. Interviews were conducted to collect information regarding the community's willingness to receive compensation funds through questionnaires.
3. Estimating the Average WTA Value

   After filling out the questionnaire and collecting data regarding the WTA value, the next stage is calculating the average value (mean) of the WTA.

One method for determining sample size is the Harry King Nomogram in Figure 1. This method can be used with a maximum population size of 2000, with error levels varying from 0.3% to 15% and a multiplier factor adjusted to the specified error level (Sugiyono, 2021). Sampling is carried out by random sampling, the advantage of random sampling is that it ensures that each element in the population has an equal opportunity to be represented in the sample, so that the sample results can be legally considered an accurate representation of the entire population. However, this method also requires complete probability information and good access to the population which is not always practical in some research situations (Hidayati, 2019).

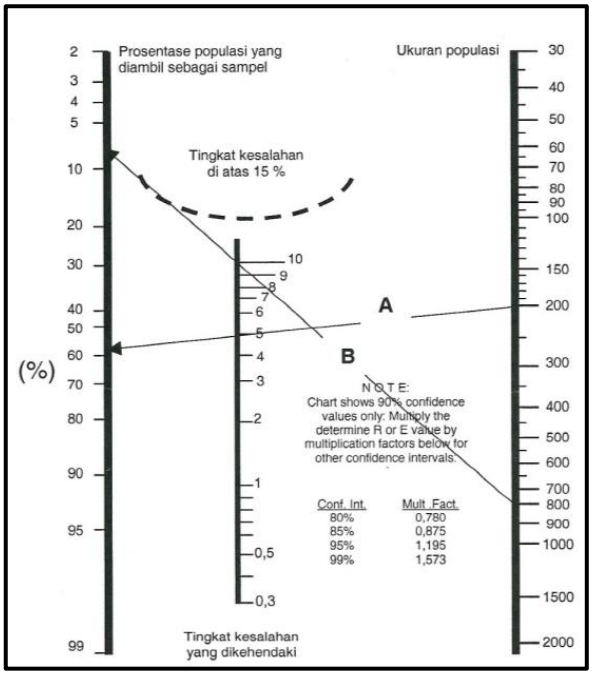


**Figure 1.** *Harry King nomogram*

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## MATERIALS AND METHODS

The data in this study were obtained through the distribution of questionnaires to respondents. The research location was determined using random sampling of residents living along the road traversed by trucks transporting limestone materials. The number of respondents was calculated using the Harry King Nomogram formula with a margin of error of 10%. This margin of error was chosen due to considerations of efficiency, as a smaller sample size is more cost-effective and quicker to collect, which is particularly beneficial for researchers with limited resources. Additionally, a 10% margin of error is still acceptable in the context of rapid surveys or public opinion collection. According to statistical data, there are 240 households (HH) in the study area. Based on the formula, a sample size of 66 respondents was obtained. The questionnaire was distributed to these 66 respondents. The data collected through the questionnaire includes demographic information such as gender, age, education level, occupation, income level, number of dependents, and length of residence.

*Contingent Valuation Method*(CVM) is a method used to estimate the value given by individuals to goods/services. CVM is used in conditions where people do not have a preference for a product's function because it does not exist in the market system. CVM estimates the value using a survey method of certain population units to determine Willingness To Accept (WTA). Thus, "surveys" with questionnaires have become the main research method in economic valuation using the CVM technique.

The WTA value is obtained by calculating the estimated mean WTA value using the weighted mean method. The equation used is:

$$EWTA = \sum_{t=0}^{n} \frac{WTAxi}{n} \quad \text{..... (1)}$$

Information;
EWTA =Estimated WTA Average
xi =Number of Each Data
ni =Respondent Total
i =1st voluntary respondent to receive compensation funds

Data aggregation is a process where the average bid value is modified to be relevant to the population. The total WTA value of the community can be known after estimating the average WTA value. The formula that can be used is;

$$TWTA = \sum_{t=0}^{n} EWTA_i\, n_i \quad \text{..... (2)}$$

Information;
TWTA =Total WTA
EWTA =WTA average value
n =The number of samples I who are willing to accept is WTA
i =1st respondent who is willing to receive compensation funds

## RESULTS DAN DISCUSSIONS

The WTA value is obtained according to the findings from the respondent interviews using a questionnaire, then the amount of compensation fund value that the respondent is willing to accept is obtained. All respondents were given information that if the company would implement a policy of providing compensation funds to communities around the company area that were negatively impacted, respondents chose different amounts of compensation funds. The compensation fund is an illustration of the large willingness to receive funds resulting from a decrease in environmental quality from the transportation of limestone material.

Based on this study, four respondents who expressed unwillingness to accept compensation funds stated that providing compensation to each household does not address the root of the problem. They argued that rather than distributing compensation individually, the company should prioritize the public interest by improving its overall management system.

According to Table 1, the average Willingness to Accept (WTA) value reported by respondents was Rp 62,661 (approximately Rp 63,000) per household per month. This estimated average WTA was calculated based on the distribution of WTA data from the respondents. The average value may serve as a recommendation and a consideration for the company in formulating a compensation policy for the surrounding community.

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**TABLE 1**. Willingness To Accept (WTA) Value Questionnaire Results

| No | WTA/Month | Frequency | EWTA |
|---|---|---|---|
| 1 | 20000 | - | - |
| 2 | 30000 | - | - |
| 3 | 45000 | 8 | IDR 5,806 |
| 4 | 50000 | 21 | Rp. 16,935 |
| 5 | 70000 | 22 | IDR 24,839 |
| 6 | 85000 | 11 | IDR 15,081 |
| **Total** | | **62** | **IDR 62,661** |

The total WTA value was obtained by multiplying the average offer by the total population of respondents. The survey/questionnaire method was used as a tool for critical observation and investigation to gather reliable information regarding specific issues in the study area.

Based on the calculation results, the total WTA value of respondents amounts to Rp 3,884,982 (approximately Rp 3,900,000) per month. This value can be used by the company as a consideration in decision-making processes to address negative externalities. A study conducted by Muhaemin and Chamid (2022) applied the Willingness to Accept (WTA) approach in relation to an andesite mining activity in Lagadar Village. The results showed that 59 respondents consented to compensation. for the impacts experienced due to the mining activities, while 41 respondents were unwilling to accept WTA. The compensation amount offered in that study was Rp 455,200 per household per month. It is essential to recognize that location can influence the value of compensation and number of respondents involved.

The compensation value based on WTA offers can be distributed directly as cash to the community to help them manage the negative impacts. Alternatively, the WTA value may be allocated by the company to fund activities aimed at mitigating the negative effects of mining, such as infrastructure improvements, road repairs, and minimizing dust by enforcing truck weight limits and requiring trucks to be covered with tarpaulins. Compensation costs incurred by the company are included as part of production costs, meaning that compensation payments continue throughout the mining operation. However, compensation amounts may be subject to change over time, depending on production levels or the scale of limestone mining activities.

Compensation funds to minimize the impact of limestone mining material transportation activities include the possibility that there will be a significant increase in the amount of funds, because several mining industries in the research area are retail (via this route when there is marketing) so that compensation funds are also the responsibility of the company who use public roads to transport materials.

## CONCLUSION

Based on the research results, 94% of respondents were willing to receive compensation funds. There were 6% of respondents who were not willing to receive compensation funds. Respondents who were unwilling to accept considered that the compensation funds provided were not commensurate with the impact they felt. From the analysis results, a conclusion can be drawn regarding the level of willingness to accept (WTA) method by estimating the estimated average value of WTA, the compensation value that the community is willing to accept is IDR 63,000/month/family register and from the results of the estimated value we get a total WTA value of IDR 3,900,000/ month. This value can be used as consideration by the company in making decisions in resolving negative externalities.

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## REFERENCES

1. Chang, NB, Yang, YC, Wang, SF.(1996). Solid waste management system analysis with noise control and traffic congestion limitations. J. Envir Eng, ASCE, 122(2), 122–131.
2. Fauzi, A. (2004). Economics and Natural Resources and Environment, Theory and Applications. Jakarta: PT Gramedia Pustaka Utama.

CONTACT Yelli Fitri | yellifitri2016@gmail.com | Mining Engineering Master's Program, Department of Mining Engineering, Faculty of Mineral Technology, Universitas Pembangunan Nasional "Veteran" Yogyakarta

3. Fauzi, A. (2010). Resource Economics *Nature and Environment*. Bogor: IPB Press.
4. Fauzi, A. (2014). Valuation *Economics and Evaluation Damage to Natural Resources and the Environment*. Bogor: IPB Press
5. Hidayati, T. (2019). Basic Statistics Guide for Lecturers and Students Purwokerto: CV. Persada
6. JianJun, Ren Yuan, Du GuoZhen. (2010). The combined application of WTP and WTA in contingent valuation methods. Journal of Environmental Protection, 1. p. 284-292.
7. Muhaemin, M. Y., & Chamid, C. (2022). A study of the willingness to accept (WTA) approach regarding the impacts of andesite stone mining activities in Lagadar Village. In Bandung Conference Series: Urban & Regional Planning (Vol. 2, No. 2, pp. 609–615).
8. P. Seloa, V. Ngole-Jeme. (2022). Community perceptions of the environmental and social impacts of mining in Limpo South Africa and the implications for corporate social responsibility, J. Integr Sains. 19(1).189–207.
9. Scott PW, John M. Eyre, David J. Harrison, Ellie J. Steadman.(2003). River mining: aggregate production and supply in developing countries with particular reference to Jamaica. British Geological Survey, Keyworth, Nottingham. 44 pages.
10. Sugiyono. (2021). Statistics for Research. Bandung: Alphabeta.
11. Spash, C. L. (2008). The contingent valuation method: Retrospect and prospect. Socio-Economics and the Environment in Discussion (SEED). Working Paper Series 2007-01, CSIRO Sustainable Ecosystems, ISSN 1834-5638. 26 pages
12. The Asia Foundation. (2008). Freight Transport Costs, Regulations and Road Charges in Indonesia. Jakarta: The Asia Foundation.
13. Venkatachalam, L. (2004). The contingent valuation method: A review. Environmental Impact Assessment Review, 24. p. 89 – 124
14. Veeramani, C., Sharanya, S. Ebrahimnejad, A. (2020). Optimization for multi-objective sum of linear fractional programming problems: fuzzy nonlinear programming approach. Mathematical Sciences. (14), 219–233.

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