SWOT Analysis in Determining Environmental Risk Management Strategy in Medium Scale Nickel Laterite Mining (Case Study in PT Rohul Energi Indonesia)

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Abstract. Nickel is an essential metal in modern infrastructure, with significant uses in the stainless-steel industry for less than 65%. Nearly 70% of the world's nickel laterite production comes from Indonesia and the Philippines. The high demand for nickel-based materials globally and the availability of nickel laterite ore in Indonesia make laterite nickel mining in Indonesia inevitable. Medium and small mining companies are more likely to have a more significant impact on the environment than large companies. Therefore, it is necessary to evaluate the implementation of environmental risk and impact management, and develop a company strategy. The research was conducted by qualitative method, namely by descriptive analysis and SWOT analysis. The data was collected in interview text, questionnaire results, field notes, documentation, photos, and videos. SWOT is one of the methods to analyze the strategy of an organization by identifying and measuring strengths and weaknesses, and opportunities and threats of the organization. Result is obtained score 3.77 (the X-axis), and 0.34 (the Y-axis) and will be plotted into a quadrant graph of the SWOT analysis method. The research resulted in PT. REI is in quadrant I. Therefore, the strategy would be utilizing the strengths and opportunities of the organization.

1. Introduction
Indonesia has a wealth of mineral and coal resources. In 2016 there were 1,453 potential locations for metal minerals, then increased to 1,658 potential locations in 2017 [1]. The contribution of state revenues is about 20% per hour, coming from the oil and gas, minerals and coal, and geothermal sector [2]. Nickel is one of the essential metals in modern infrastructure, with significant uses in the stainless steel industry, 65%; alloys, 20%; electrical and battery base industries, 20%; and metal plating industries, 9% [3]. The needs of metal-based industries will continue to increase with an increasing human population that will reach 8.3 billion by 2030 [4]. Indonesia produces nickel laterite about 30% in the world [5]. With great potential and increased demand, laterite nickel mining is inevitable.

Mining is activity that impacts the environment, economy and society [6][7]. These conditions will provide access to damage to ecological conditions, such as soil susceptibility to erosion, compaction of soil due to the mobilization of heavy equipment, and poor water system, and which is invaluable with the loss of vegetation, animals, and biodiversity, which is an invaluable natural wealth [8]. Nickel mining in Indonesia is carried out by large, medium, and small scale companies [9], where specifically
for laterite nickel mines are entirely carried out with most open pit mining systems [10]. Environmental impact and social responsibility must be well managed, and maintain relationships with governments, non-governmental organizations, industry and other stakeholders [11].

The impacts caused by mining have an essential category of impact, so the company must conduct environmental management properly [12]. One of the conditions for changing the landscape that occurs is the formation of an ex-mining pit. In 2015 approximately 45 active mining pits covered an area of 4,402 ha, 183 inactive mine pits covered an area of 3,227 ha, and 24 mining pits were backfilled covering an area of 273 ha [10]. The existence of abandoned mining pits means that the mining process has not been carried out correctly and adequately, and the monitoring system is weak, meanwhile, small and medium-sized mining companies have barriers in providing funding and commitment from their management [9]. Previous research discussed all mining company scales without any classification. Therefore, it is necessary to evaluate the implementation of environmental risk and impact management in the medium-scale laterite nickel mining company, then developed a company strategy.

Research is in PT Rohul Energi Indonesia as a medium-scale laterite nickel mining company with 100,000 metric tons per month. The company locates in Bombana Regency, Southeast Sulawesi Province.

2. Method

The criteria of institutional aspects of environmental risk management are evaluated consisting of corporate policies in environmental risk management, provision of human resources, infrastructure readiness, and funding support. Qualitative approach information was applied from three informants and nine informant – The fundamental questions regarding the existence and importance of environmental policies, actual conditions for the number of workers, competencies and training programs, conditions and maintenance programs for supporting equipment, and top management's commitment to funding aspects. Since the research to explore the company strengthens. Therefore, Strength Weaknesses Opportunity Threat (SWOT) method is utilized.

The quantitative analysis method used is SWOT method to determine the company's strategy in managing environmental risk. SWOT analysis is done by collecting information within the company and outside the company that influences the company in achieving its goals [13]. The next stage of arranging and distinguishing factors into 2, namely IFASs table (Internal Factors Analysis Summary) and EFAS table (External Factors Analysis). Weighting is done by sharing questionnaires with respondents by sorting the priorities contained in the company [14].

3. Results and discussion

3.1. Environmental risks in nickel laterite mining

PT Rohul Energy Indonesia (REI) is a laterite nickel mining has been producing since 2016 with an annual production plan of 1,200,000 metric tons per year. PT Rohul Energi Indonesia is located in Lengora Village, Kabaena Tengah District, Bombana Regency, and Southeast Sulawesi Province, with 3,450 ha. Geographically located at latitudes 121°56'36.78" - 121°59'6" East Longitude and 5°6'0.63" - 5°11’ 16.42" South Latitude (Figure. 1), precisely in Kabaena Island. Kabaena island is one of the well-known places that have nickel laterite resources in South East Sulawesi. This place could be reached from Kendari City by boat for about 2 - 3 hours.
PT REI conducts a critical impact evaluation at the stage of mining operations from the land clearing stage to the loading of laterite nickel ore on the barge using the evaluation matrix approach as in Table 1.

**Table 1.** Important impact of nickel laterite mining in PT REI.

| Environmental Components                  | Nickel Laterite Ore Mining Operational Phase | Information                                      |
|-------------------------------------------|---------------------------------------------|--------------------------------------------------|
| Economics                                 |                                             |                                                  |
| Job opportunities                         | V V V V V                                  | 1. Land clearing,                                |
| Community income                          | V V V V V                                  | 2. Stripping of shoots and ground cover,         |
| Facilities and infrastructure             | V                                            | 3. Excavation of nickel laterite ore,            |
| Domestic income (PAD)                     |                                             | 4. Transport of nickel laterite ore to storage,  |
| Social                                   |                                             | 5. Loading of nickel laterite ore onto barges    |
| Attitudes and perceptions of society      | V V V V V                                  |                                                  |
| Community unrest                          | V V V V V                                  |                                                  |
| Human resource development                | V V V V V                                  |                                                  |
| Environmental                             |                                             |                                                  |
| Soil, air and water quality               | V V V V V                                  |                                                  |
| Noise and vibration                       | V V V V V                                  |                                                  |
| Soil erosion                              | V V                                         |                                                  |
| River water quality                       | V V V V V                                  |                                                  |
| Domestic waste toxic (LB3) waste increase | V V V V V                                  |                                                  |
| Land and water biota                      | V V V V V                                  |                                                  |
| Landscapes                                | V V                                         |                                                  |
3.2. Analysis of the company's internal and external factor

Determination of internal and external factors of the company is done by giving questionnaires to 9 respondents from the top management level and middle management of PT REI. The selection of these respondents is based on authority and work related to environmental risk management.

The results of rating calculation and weighting of questionnaires that have been disseminated for the IFAS table scored 6.34 for strength factor (S) and 2.57 for weakness factor (W) (Table 2). From the calculation, the result obtained strength (S) minus weakness (W) of 3.77. This number 3.77 will be plotted on the quadrant graph of the SWOT analysis method on the X-axis.

| No. | Strength (S)                                      | Rating | Weight | Score |
|-----|--------------------------------------------------|--------|--------|-------|
| 1   | Fulfillment of the number of employees who handle environmental aspects | 10.44  | 0.09   | 1.06  |
| 2   | Corporate environmental policy                   | 10.11  | 0.09   | 0.98  |
| 3   | Top management commitment in environmental management | 8.22   | 0.08   | 0.92  |
| 4   | Identify important aspects and impacts           | 6.11   | 0.17   | 0.67  |
| 5   | Environmental management program according to RKL-RPL | 3.78   | 0.08   | 0.44  |
| 6   | Funding for environmental management as planned  | 3.33   | 0.07   | 0.40  |
| 7   | Number of supporting facilities for environmental management | 4.78   | 0.08   | 0.38  |
| 8   | Supporting facilities for environmental management in good condition and maintenance is carried out periodically | 4.11   | 0.08   | 0.38  |
| 9   | Supporting facilities in accordance with its designation (according to its function) | 4.67   | 0.08   | 0.34  |
| 10  | Motivation of all employees in environmental management | 5.22   | 0.08   | 0.32  |
|     | **Total Strength (S)**                          | **62.6** | **1.00** | **6.34** |

| No. | Weakness (W)                                    | Rating | Weight | Score |
|-----|------------------------------------------------|--------|--------|-------|
| 1   | Competence of employees who handle environmental aspects | 3.78   | 0.26   | 0.99  |
| 2   | The company's mining operations (Lifetime) are short | 2.67   | 0.24   | 0.64  |
| 3   | Employee training program that handles environmental aspects | 1.44   | 0.21   | 0.63  |
| 4   | Company's appreciation for employees             | 2.22   | 0.29   | 0.31  |
|     | **Total Weakness (Q)**                          | **62.6** | **1.00** | **6.34** |

The rating and weighting calculation results for the EFAS table scored 3.51 for the opportunity factor (O) and 3.17 for the hazard factor (T) (Table 3). From the calculation of the opportunity (O) minus the threat (T) of 0.34. This number 0.34 will be plotted into a quadrant graph of SWOT analysis methods on the Y-axis.
Table 3. Matrix analysis EFAS PT REI.

| No. | Opportunity (O)                                      | Rating | Weight | Score |
|-----|------------------------------------------------------|--------|--------|-------|
| 1   | PROPER assessment of the company                     | 3.67   | 0.16   | 0.71  |
| 2   | Domestic nickel ore sales obligations                 | 3.78   | 0.18   | 0.67  |
| 3   | Nickel smelter industry development program in Indonesia | 3.22   | 0.17   | 0.60  |
| 4   | Supervision of the relevant agencies                  | 4.11   | 0.17   | 0.57  |
| 5   | Pricing of domestic minerals by the government        | 3.78   | 0.15   | 0.56  |
| 6   | Standards of adherence to environmental aspects        | 2.44   | 0.6    | 0.39  |

**Total Opportunity (O)** 21.00 1.00 3.51

| No. | Threat (T)                                               | Rating | Weight | Score |
|-----|----------------------------------------------------------|--------|--------|-------|
| 1   | Inconsistent government regulation                        | 3.70   | 0.38   | 1.45  |
| 2   | Community disorders                                       | 3.44   | 0.16   | 0.52  |
| 3   | Nickel resource depleted                                  | 3.11   | 0.14   | 0.46  |
| 4   | Presence of NGOs                                          | 1.89   | 0.16   | 0.43  |

**Total Threats (T)** 15.00 1.00 0.30

| Opportunity (O) – Threat (T) | 0.34 |

3.3. Environmental risk management strategies

Based on the plotting results between the differences in SWOT conditions, the company's strong position is in quadrant 1, which means to improve environmental management and monitoring programs at PT REI could be achieved by utilizing the available strengths and opportunities (Figure 2).

![Figure 2. Strategy quadrant of PT REI.](image-url)
The company’s condition in quadrant I also show the company in a state of growth (Growth Strategy). Strategies that can be achieved related to environmental risk management include:

- Maintaining the commitment of top management can improve the standard of compliance with environmental aspects.
- Implementing the company's environmental policy can provide a clear direction in the management of environmental risks.
- Increased support for human resources, markets and funding will maintain the sustainability of environmental risk management.
- Maintaining the motivation of all employees will increase the level of concern for aspects of environmental risk management.
- Proper activities of the Ministry of Environment and Forestry provide motivation for companies in managing environmental risks.
- The presence of supervision from relevant agencies increases the level of compliance of the company.
- The development of the nickel smelter industry provides positive value for mining activities.

In general, the commitment of top management supported by the company’s resources and employee motivation will improve the fulfillment of standards of obedience to environmental aspects.

Previous research on the management of environmental risks and impacts by companies emphasizes on supervision from government agencies and aspects of internal and external communication of the company. Several studies emphasize the supervision carried out by government oversight bodies and communications. This research still believes that internal company strengthens would be the most crucial aspect of environmental risk management.

4. Conclusion
Mining will have a significant impact on the environment. The responsibility of all stakeholders is indispensable and plays an active role in the management of environmental risks.

The results obtained for the IFAS table by reducing the strength score (S) minus the score for weakness (W) by 3.77 will be plotted on the X-axis. The results obtained for the EFAS table by reducing the opportunity score (O) minus the threat score (T) of 0.34 will be plotted on the Y-axis to get the results of the condition of the company being in quadrant I. Thus, improving environmental management and monitoring programs at PT REI could be achieved by utilizing the available strengths and opportunities as a Growth Strategy.

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