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Original Article

Safety, Compliance, and Productivity in Indonesian Coal Mines: A Regulatory Assessment

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Abstract *- This study explores the safety measures that have been put in place in Indonesia's coal mining industry and how well they work to make workers safer and more productive. Since Indonesia relies heavily on coal exports and mining is dangerous, the research aims to find out how strict government rules are, how well they are followed by both public and private operators, and how well they are enforced. The study shows how training, using new technology, and government audits can help lower the number of accidents at work. Even though Indonesia has a lot of rules and regulations, they are not always followed in the same way in every part of the country. This paper stresses the need for specific changes to make sure that all workers are equally protected, especially in informal mining, where safety compliance is low. This paper aims to investigate how far and how well safety measures have been put in place in Indonesia's coal mining industry, focusing on how these measures have affected the health and safety of workers and the productivity of the mines. It explores whether following safety rules has made working conditions better, lowered the risks of getting hurt on the job, and helped the company make more money and produce more. It also traces the rules and regulations the Indonesian government sets, checking how thorough these safety laws are and how well they are followed in public and private mining operations. The study also compares Indonesia's safety standards to those of highly developed coal-mining countries to see how well Indonesia is doing and where it can improve. The paper's goal with this analysis is to answer important questions about worker safety, following the rules, and the bigger effects of safety on the mining industry's operational efficiency and economic outcomes. The primary data was collected through structured interviews with government officials and mine managers, and a survey of 47 mine workers was conducted. The results show that big mines follow strict safety rules that are in line with national and international standards. However, smaller and illegal operations still have problems because there is not enough oversight.*

Keywords *- Coal mining safety, Informal mining, International standards, Mining regulations, Safety training, Worker protection.*

1. Introduction

Indonesia holds 39.9 billion tons of coal, or 3.7 percent of global coal reserves. During the colonial era, coal exploration in the country began close to 160 years ago. The modern coal industry started in the 1980s due to the introduction of two new investment and mining laws in 1967, which provided the framework for the entry of experienced mining companies [1]. As indicated in the map above, the coal industry developed in Sumatra and Kalimantan due to the Cenozoic sedimentary basins, which have coal deposits with thick seams that are amenable to low-cost mining. Subsequently, systematic coal exportation was successful with the discovery of world-class coal. 2015, nearly 28 percent of Indonesian coal output came from these areas. Commercial coal production under the First-Generation Coal Contracts of Work (CCoW) began in 1989. By 2005, Indonesia became the world's largest coal exporter. Coal production from these first-generation CCoWs still accounts for 50 percent of coal mined. The initial stages led to private companies targeting coal, which had high calorific value (Steam coal). Mining this type of coal had low transport costs; most of this coal was found in Kalimantan, on the east and southeast coast. The rivers were easily navigable by barges.

Subsequently, the focus moved to include lower-ranked sub-bituminous coal and lignite, which are suitable for Indonesia's domestic market and used as blended coal in India, China, and Southeast Asian countries. Recently, exploration has been successful in removing areas of Kalimantan for coking coal. The main thrust to Indonesia's coal mining industry took place with the opening of new mines in the late 1980s. This was close to 20 years after the liberalization of Indonesia's investment and mining laws, which was a precursor to this group. The rapid growth resulted in Indonesia becoming the world's largest steam coal exporter by 2005. In 2013, it supplied 38 percent of global steam coal exports and half of Asia's demand for steam coal imports. Prior to 2005, its primary markets were Japan, Korea, and Taiwan, but by 2016, exports were primarily to India and China. As the Indonesian economy

was growing, the demand for coal was also generated by the growing domestic market, primarily for electricity generation.

Indonesia is the world's fourth most populous country as of 2025, and electricity is provided from coal-fired power plants. Coal has outstripped natural gas as the dominant technology in the power sector since 2000. Coal-fired plants in Indonesia are ranked fifth amongst global leaders in terms of future coal-fired capacity development. Despite large coal deposits, 8% of the inhabitants of the country do not have access to electricity. Indonesia's energy requirements, production, and policies arise from a complex interaction of politicians with different objectives, such as the president of the country, political parties, political functionaries with different vested interests, voters, and civil societies.

Exploration techniques have evolved over the years, but the most important one is understanding the importance of "safety" and respecting the natural environment. Given the extent of greenhouse emissions that are generated by burning coal, and the fact that 'climate change' is a reality that cannot be wished away, it is important to mine coal and use it with ultra-critical care so that it does not add to greenhouse gas emissions. Indonesia has introduced various safety regulations in coal mining to protect workers' health, including training, audits, and equipment mandates. However, implementation faces challenges such as poor worker awareness, weak management support, high workforce turnover, inadequate audits, and limited government communication. These factors reduce the overall effectiveness of safety measures and highlight the need for stronger enforcement and better information dissemination.

2. Literature Review

Indonesia has to manage a complex situation that involves competing demands of energy security, climate change mitigation, and energy poverty. This climate change mitigation involves appropriate forms of governance. This trilemma is a quandary with three alternative courses of action. The country needs to ensure some headway in all three objectives, which may result in limited achievement of either; there is a possibility that only two of these goals would be able to be achieved at any one time. Though Indonesia, over the years, has transformed from a centrally planned economy to a market-based one, it is still facing huge numbers of people who live below the poverty line. 50% of its 225 million inhabitants live on less than $2 a day, and more than 80 million people lack access to electricity (Asian Trends Monitoring 2010). This level of poverty leads to the coal industry, at times short-changing itself in terms of security for its workers.

In spite of the high poverty levels and the shift towards sustainable production and alternative uses of fossil fuels, the coal market in the country is resilient and strategic. In 2023, it reached an unprecedented 775 million tons and exported 518 million tons in the same year, which was an 11% growth from 2022. Indonesia, being a developing nation, has fuelled its growth. In regions like Java, Indonesia faces the challenge of having access to coal power, but there are other parts of the country where people live without electricity. It is a delicate balance between the two that needs to be achieved. Historically, Indonesia's energy sector has been determined by the prevalence of State-Owned Enterprises (SOEs) with Pertamina (oil and gas) and PLN under state control. SOEs have an extensive task of receiving government support whenever they face any crisis. The increasing reason for focus on coal is the need for the country to hasten infrastructure development, including power plants, rural electrification, transmission, and distribution networks.

Fiscal sustainability is an important area that needs to be addressed to manage the balance of payments and maintain fiscal discipline. Law Number 3 of 2020 took away the power of district and city governments to issue mining business permits and gave it to the central government. This makes it harder for regions to govern themselves. The provincial governments now have the power to issue mining permits. The study further explored what the change in law could mean and the problems of corruption and permits that overlap at the regional level. The new rule, Law Number 3 of 2020, centralized mining business permits, which means that regional governments, especially district and city governments, have much less power to run mining operations. Because of this change, district and city governments can no longer give out mining business permits. The study showed that centralizing power is meant to solve problems like corruption and overlapping business permits that happened when local governments were in charge of mining permits. As a result, the central government has given the provincial government the power to issue mining-related permits. The main drivers of coal production. Decentralization of the allocation of mining permits, revenue sharing in the administrative and fiscally decentralized Indonesia, and andolitical links to coal mining have shaped the country's domestic energy policy [1].

Indonesia's mining governance has changed from centralized in 1967 to decentralized in 2009 and then to centralized in 2020. The Mining Law of 2020 wants to be open and responsible, which is different from how many African countries run their governments [2]. A study explores how mining is governed in Indonesia, focussing on the central government's control over strategic minerals and the roles of regional governments in local laws and permits. It does not talk about safety rules, ISO standards, international agreements, or how it compares to other countries that make coal. The Minerba Law 2009 gave the Central Government power [3]. Another study talks about the rules for Mining Business Permits (IUP) in Indonesia. It talks about how the central government has more power than provincial governments when it comes to giving out permits. It does not talk about mining safety frameworks,

ISO standards, or how Indonesia compares to other coal-producing countries. A policy model for giving out IUPs had been suggested in order to make the law clear and investments easy [4].

A study explores Indonesia's mining governance, which is complicated because it involves both central and local authorities and has rules that overlap. The central government gives out permits, and the local governments make sure that the rules are followed. It stresses the importance of having consistent rules to protect the environment and make mining last. Indonesia needs a full set of mining laws. Local governments need to do a better job of managing mining and making it last [5]. A study explores governance and accountability in state-owned enterprises (SOEs) like Pertamina and PLN. It also talks about how public-private partnerships can help make energy and mining safer by adding safety committees, audits, and third-party inspections.

Corporate governance and SOE accountability are very important areas of study. There are big problems and gaps in empirical research in the field [6]. Safety training and getting workers involved both help with safety compliance, but only if they know about safety. Safety training has a positive effect on following safety rules. Getting workers involved is linked to better safety compliance. Safety knowledge is what connects safety training to workers' involvement and safety compliance [7].

Berau Coal made a learning management system to make employees more skilled, improve the safety culture, and give managers more control over operations. Combining SINTESIS+ with the SID system raised the level of compliance for employee skills to 98% and made processes run more smoothly. SINTESIS+ made employees more aware of health, safety, and the environment (K3L), which may have lowered the number of incidents. More than 7,867 employees used SINTESIS+, and many took part in tests and webinars, showing that operational processes have improved[8]. The paper looks at the main things that make it easy or hard to use mining safety management systems in Indonesia. The study finds that good governance, a strong safety culture, resource availability, SMART planning, management commitment, effective OH-IH management, and compliance leadership are seven key factors that will help SMKP MINERBA succeed. Low management commitment, lack of safety leadership, and a bad OHS strategy are some of the things that make it hard to put these plans into action. Suggestions for corrective actions are given to make SMKP MINERBA more effective based on the CSFs and barriers that were found [9].

New technologies have made mining operations safer, better at communicating, and better at protecting the environment. New technologies have made mining operations safer, more productive, and better for the environment. Technological progress has been very important in making mining safer and more efficient. The change from mechanization to automation in technology has made both surface and underground mines safer [10]. A study suggests an IoT-based system that uses sensors in miners' helmets to monitor mine safety and send out alerts in an emergency. The paper suggests using a safety helmet with environmental sensors to make mines safer and easier to watch over. Zigbee technology lets the helmet send data wirelessly to a central hub. IoT technology sends the data to a web server so that it can be monitored from afar [11].

Wireless sensor networks could make it easier to keep an eye on the health and safety of workers in underground mines. The review divides WSN applications into three groups: tracking and monitoring locations, tracking and monitoring body and physiological movements, and tracking and monitoring the environment. The authors suggest seven areas for future research, including more uses, practical implementation, big data analytics, multiple monitoring systems, integration with other systems, adaptation to IoT, and autonomous WSNs [12].

3. Methodology

This study uses a mixed methods approach to examine how safety measures are implemented and how well they work in Indonesia's coal mining industry. Structured interviews and questionnaires were used to collect the main data from two important groups of stakeholders, i.e. government officials and private mine owners. Two separate semi-structured questionnaires were administered to get a full range of opinions. The first questionnaire was sent to two big mine owners in Indonesia who are important players in the coal export business. Their annual revenue is a big part of the country's output.

The survey asked about safety rules at work, how employees are trained, how they use equipment, how they respond to emergencies, and how well they follow company policies. People were interviewed in Bahasa Indonesia, and then the interviews were translated into English for analysis. The second questionnaire was made for high-ranking government officials in charge of ensuring people are safe and healthy at work. It talked about making and enforcing safety rules, keeping an eye on things, doing inspections on a regular basis, setting new safety standards, and working with mine operators.

These interviews were also conducted in Bahasa Indonesia and then translated into English. The main idea behind this study is that Indonesia, a developing economy that depends on coal exports, has some of the strictest safety rules in the world, which are enforced by both public and private groups. The research gap that this study fills is the lack of real-world information about how these safety rules are actually followed in Indonesia, especially when compared to global mining standards.

Coding was done for all the interviews using QDA MinerLite software to look at the qualitative data. We developed codes using an inductive method, and then we

used thematic analysis to find patterns that repeatedly appeared in the responses. This framework for analysis helped the study look at how deep and wide safety compliance is and how regulatory frameworks and real-world practices work together.

4. Analysis

Indonesia's coal exports are broken down by destination countries. This shows how much the world depends on Indonesian coal. Figure 4 reveals that most of Indonesia's coal exports go to Asian economies, especially China, India, and other Southeast Asian countries. This shows how important Indonesia is in the regional energy supply chain. This shows how big and concentrated Indonesia's coal trade is in terms of geography. Figure 5 shows how Indonesia's GDP has grown over the years. It shows economic trends that are linked to important national events, like the growth of industry and the export of resources, including coal. The diagram shows how the Indonesian economy has changed over time and how coal production and export growth have affected the economy. These numbers show coal is important to the country's economy and export strategy.

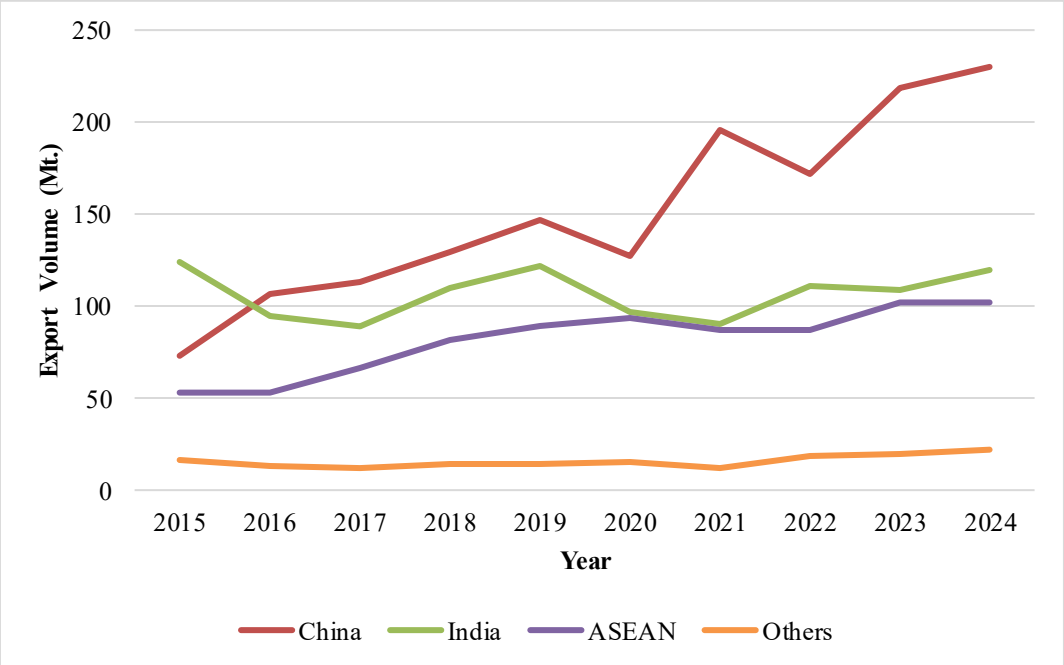

Fig. 1 Indonesia's coal exports to different countries

Source: https://coalmetal.asia/article/navigating-the-futures-of-indonesia-coal-exports

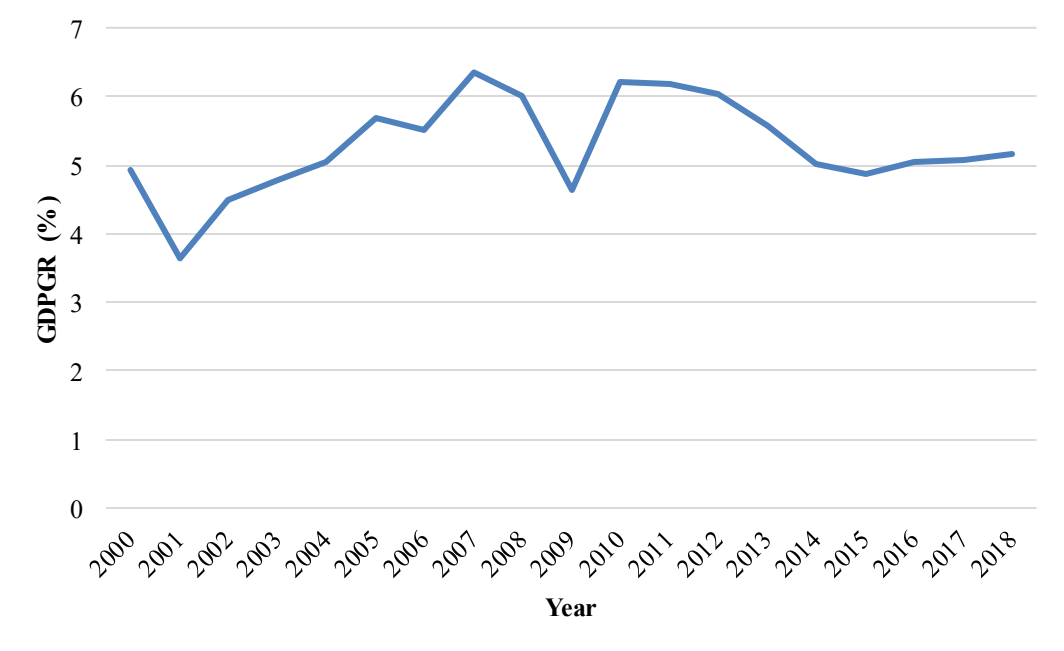

Fig. 2 Indonesia's GDP growth (annual)

Source: https://www.researchgate.net/figure/GDP-Annual-Growth-Rate-in-Indonesia

Table 1. Workforce employment in agriculture, industry, and services (2012 – 2023)

Year	Agriculture (%)	Industry (%)	Services (%)
2012	19.39	9.1	12.2
2013	14.89	14.3	45.3
2014	15.22	5.8	12.5
2015	15.32	5.8	12.8
2016	14.51	8.7	13.1
2017	11.9	9.4	15.4
2018	13.4	9.3	7.6
2019	10.4	9.3	24.5
2020	13.5	12.3	23.9
2021	10.5	11.5	23.7
2022	10.5	11.9	23.8
2023	14.54	11.6	23.8

The table above indicates the importance of the industrial sector in the Indonesian economy. Within the industrial sector, the workforce is primarily employed in mining. The primary mining commodities that are mined are nickel, cobalt, tin, copper, coal, and gold.

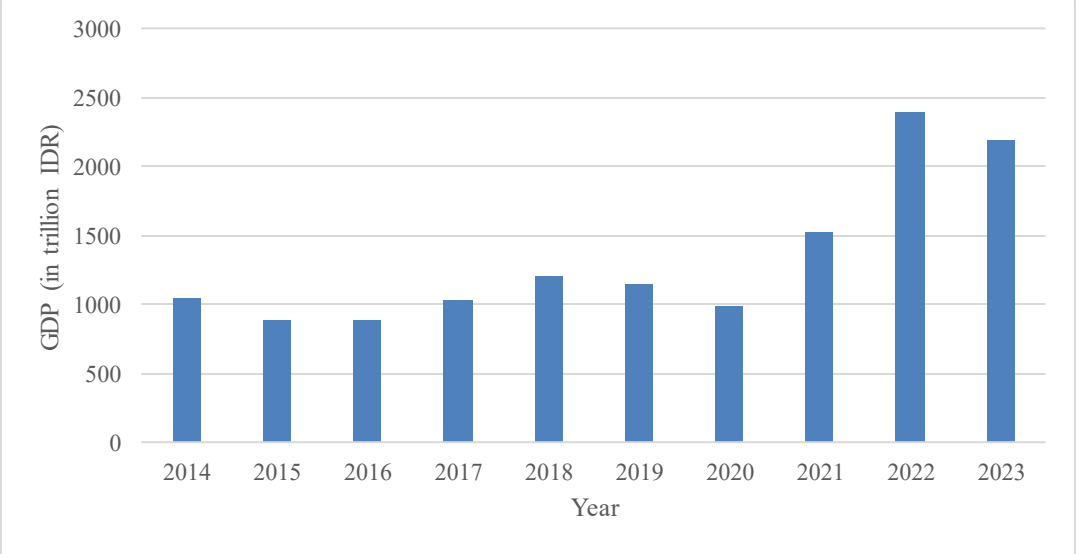

Fig. 3 GDP Earned from Mining and Quarrying in Indonesia (2014-23)

The industrial sector includes the mining sector, and the largest contributor to Indonesia's GDP is the manufacturing sector. Mining contributes 5% of the total Indonesia GDP.

4.1. Safety Metrics for the Mining Industry

The ILO's 1984 guidelines on safety and health in coal mines were developed with input from both developed and developing countries, including Nigeria, Brazil, Germany, and Australia. These guidelines aim to support national laws by providing safety standards applicable to public and private mines. Governments must ensure safe mining conditions with minimal health risks and include worker representation in safety-related discussions. Mine operators are responsible for providing adequate financial and safety provisions, employing qualified staff, and ensuring full compliance with national regulations. They must not interfere with technical operations but ensure inspectors have full access to safety audits. Managers and engineers must be appropriately certified, and all mine entries, equipment, and abandoned areas must be documented, maintained, and secured. Workers are also expected to take personal responsibility for their safety and comply with statutory duties.

4.1.1. Surveyors

No mine should be worked till there is a qualified surveyor. He or she is appointed by a mine operator (private or public). The surveyor's duty is to prepare and/or supervise all drawings and sections of the mine that must be operated. Their plans should be accurately followed. All mines should have with them: accurate plans and drawings indicating where each and every worker is to work, which scene should be mined, a surface plan should be available, and all this should come under the ambit of the national law. The surface plan is as important as the underground one, as it helps to know where the workers are in case of an emergency. These should be made available and exhibited in every office of the mine, as it is extremely necessary and imperative in any emergency.

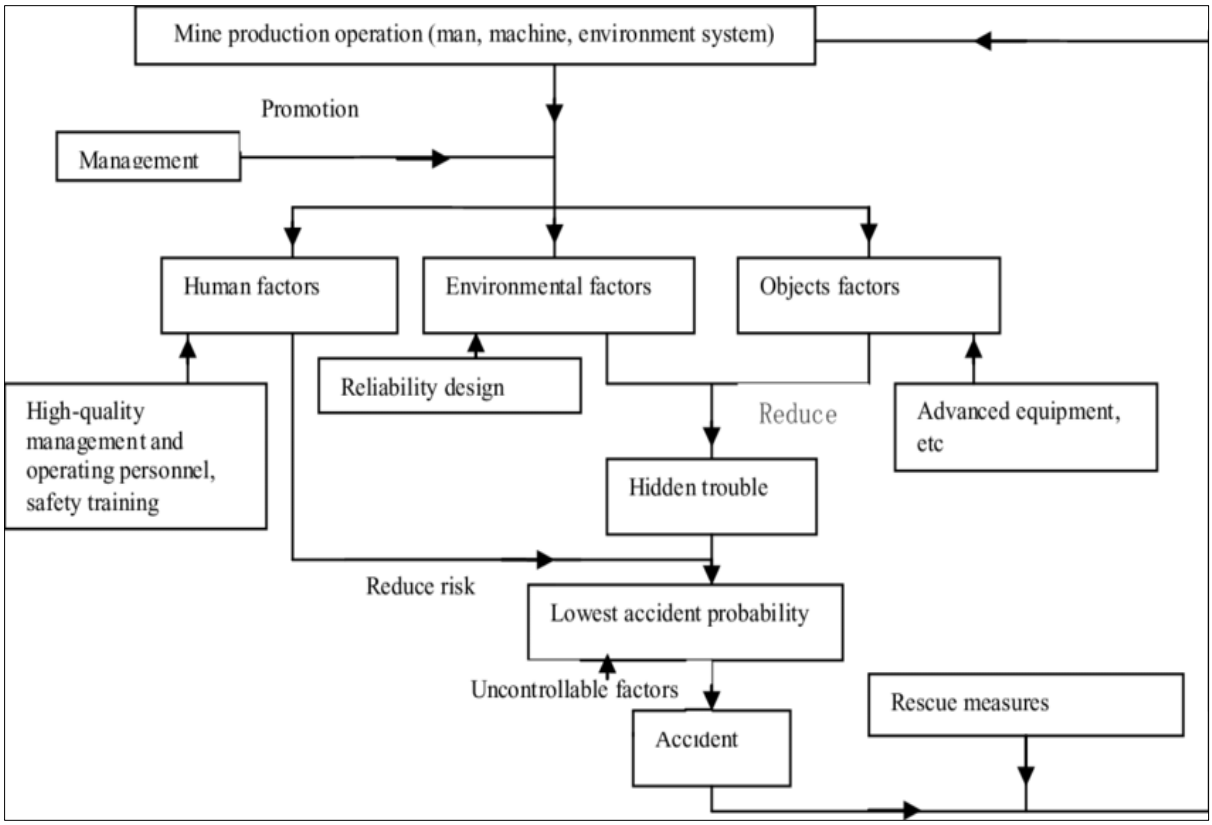

Fig. 4 Essential safety coal mine construction structure diagram

Source: researchgate.net/figure/Essential-safety-coal-mine-construction-structure

It is extremely important that when a mine has been abandoned, all mine plans have to be updated until it is abandoned. These abandonment plans should be examined by competent authorities in the government administration. All operations should be registered with the competent authority by the mine operator. Notification that the mine is going to be operated should be intimated; all laws and regulations, whether concerning the working of the mine or its abandonment, need to be adequately and predominantly notified. Indonesian coal mines must follow certain rules about their physical conditions. For example, each site must have at least one dedicated surface entrance and plenty of light, and all of the work areas must be freshly whitewashed to make them easier to see. Mines must put in secure gates, mine cars, and safety-rated equipment, and they must also make sure that there are safe ways to get across the shafts when the weather is bad, like when ice forms, conditions must be quickly and safely improved. Operators must closely monitor surface and seepage water, ensure shafts are free of loose coal or debris, and keep insulated speech-communication systems working with clear signalling protocols. All tools, fixtures, and personal protective equipment must be of certified quality. Maintenance crews must wear safety harnesses that are properly anchored. Ladders must be checked regularly to ensure they are safe, and a qualified person chosen by the manager must check all safety gear and important equipment at least once a week to ensure they are still in compliance.

In order to analyze qualitative data, thematic analysis of Interviews had been conducted, and a total of 44 codes were generated, which helped us generate 9 themes.

Table 2. Thematic Analysis of Interviews

Theme	Number of Codes
Policy and Regulation Gaps	6
Awareness and Education	5
Infrastructure and Resources	7
Training and Capacity Building	4
Insurance and Social Security	6
Employment and Informality	5
Digital Integration and Access	4
Trust and Governance	3
Financial Constraints	4

Source: QDAminerlite

The thematic analysis of the interviews found ten main themes that together shed light on the problems and possibilities that come with digital integration and labour market policies. Policy and Regulation Gaps became a major theme, pointing out inconsistencies, outdated frameworks, and the lack of enforceable digital labour laws that leave workers in informal sectors without enough protection. The theme of Awareness and Education is closely related to this one. It points out that stakeholders, especially workers and small business owners, do not know enough about digital rights, entitlements, and government programs, which makes them less effective.

Another big concern was infrastructure and resources, which means that the lack of good technology infrastructure, especially in rural or semi-urban areas, makes it hard to access social security services and job boards. A lot of people said that training and capacity building were very important, especially for frontline workers and administrative staff who have trouble adjusting to new digital systems. This makes it harder to deliver services at the last mile. Insurance and Social Security became a major topic of discussion because people were worried about not having enough coverage, having trouble signing up, and having to wait a long time for benefits, especially for gig and informal workers. The topic of Employment and Informality came up a lot. Participants talked about how unstable informal work is and how gig work is not officially recognized, leaving many workers without social protections.

Digital Integration and Access was also brought up, with a focus on the digital divide and how having limited access to smartphones or the internet makes it harder for people to use government websites. This is related to the theme of Trust and Governance, which talked about how a lack of trust in government systems, fear of data misuse, and corruption kept people from fully participating in state-sponsored programs. Also, financial constraints were discussed in terms of both individual and systemic affordability. Beneficiaries often do not have the money to wait for late payments, and governments have budgetary pressures that make it hard to expand welfare programs.

Finally, Implementation Challenges cover the problems that come up in the real world when trying to carry out policies. These problems can be anything from technical issues to failures in coordinating between departments, and they all make digital welfare programs less effective. Safety conditions, especially in a mining economy like Indonesia, are extremely imperative. Primary interviews with government officials and mine owners have indicated a strict following of guidelines laid down by the government. As a developing country and dependent on this natural resource, Indonesia has one of the most stringent safety rules, which is at a higher level than any other economy in the world. The problem arises with respect to small mines and illegal mining, which requires serious and concerted effort in the implementation of the law.

Interviewing with Dean Simorangkir, Sub-Coordinator of Mineral Mining Safety, ESDM (Government official). He stated that:

"The main regulations in Indonesia consist of several levels, starting from laws (peraturan undang-undang), which cascade to government regulations (peraturan pemerintah), ministerial regulations (peraturan menteri), and up to ministerial decrees (keputusan menteri). Some key regulations to note include Law No. 3 of 2020, ESDM Ministerial Regulation No. 26 of 2018, then ESDM Ministerial Decree No. 1827 of 2018, and other derivative regulations at the director-general level."

There are various types of mines in Indonesia, ranging from large to small, and every time the registration of the mine takes place, all stakeholders, including the government, are involved in explaining and understanding all regulations involved with respect to safety. Only then are documents signed and passed, as stated by Mr Dean Simorangkir. Failure of implementation attracts various clauses starting with a warning, and ultimately leading to the closure of the mine if not corrected. To ensure that safety measures are adequately addressed, trial runs are conducted by government officials before the actual functioning of the mine. Subsequently, monitoring is periodically done. "As per Government Regulation No. 55 of 2010, every mining company must be inspected at least once a year. The duty of mine inspectors is to oversee and provide guidance, and they are stationed both at the central and provincial levels (regional mine inspectors)." (Dean Simorangkir). There are regular visits and the collection of data to monitor safety rules. No private agencies are involved in safety; it is wholly and solely with the government. The government also checks whether the workers are technically trained in safety measures while working in the mines. This is stipulated under ESDM Ministerial Regulation No. 42 of 2016. Besides being involved in the initial stages of safety, independent agencies undertake random checks on the mines and their workers to check their ability and capability on safety rules. These safety rules start with the heavy equipment used and go right up to soil testing and various fluids used (all according to international safety standards). These are checked at the point of inception and periodically through random checks. The mining accidents are measured more according to the frequency rather than the Frequency Rate (FR) and the Severity Rate (SR).

Another interview was conducted with Mr. Soeparli – PT Berau Coal (transcript attached in the appendix). Mr Soeparli is an expert in managing mine operations, as it involves managing people. According to him, machines function independently, and productivity remains fairly stable, but human behaviour is unpredictable and ensuring safety amongst them is a challenge. The safety procedures are primarily those that have been laid down by the government (Ministry of Energy and Resources). The company has established Standard Operating Procedures (SOPs) based on the government's guidelines. These are further divided into specific procedures and work

instructions. Mandatory regulations by the government require safety management audits once a year, for the non-mandatory ones, the time is 2 - 3 years. At Berau Coal, safety compliance is rigorously enforced through both internal protocols and external audits. Government inspectors conduct ISO audits when companies are flagged as unsafe or following fatal accidents, while certified external auditors, licensed by the government, regularly assess policy, implementation, and documentation standards. A minimum compliance score of 80% is mandatory. Annual medical checkups, basic safety training, and special operating licenses (SIMPER) for heavy machinery operators are required to maintain safety. Safety training—delivered in Indonesian and English by academicians, industry experts, and government officials—is conducted annually or as needed. Free safety gear, including shoes, helmets, vests, glasses, earplugs, masks, and PPE, is updated regularly to meet international SOP standards. Technological tools such as the Driver Monitoring System (DMS), Mining Eyes surveillance, and Georadar for slope detection enhance preventive safety. All related costs are fully borne by the mine; if an accident occurs, the site shuts down for at least two months, with no government financial support provided.

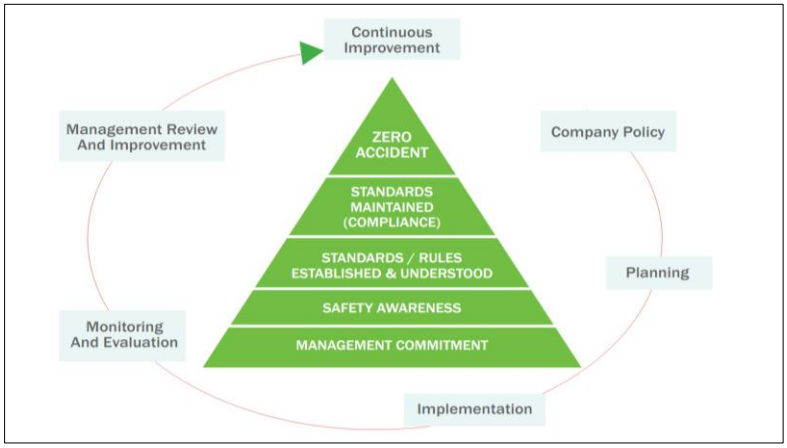

Fig. 5 Strong safety programme of PT Berau Coal.
Source: https://beraucoalenergy.co.id/health-and-safety/

Fig. 6 Imagine the safety gear of workers in PT Berau Coal.
Source: https://beraucoalenergy.co.id/health-and-safety/

Fig. 7 Actual image of mining operations of PT Berau Coal.
Source: https://beraucoalenergy.co.id/our-profile/operation/

Table 3. Year-wise losses due to illegal mining activities in IDR.

Year	Loss Due to Illegal Mining Activities (in Indonesian Rupiah)
2018	No data available
2019	1.6 trillion IDR
2020	No data available
2021	No data available
2022	3.5 trillion IDR (Approx. 96 illegal mines)
2023	No data available
2024	271 trillion IDR

Illegal mining is the main reason why a number of security lapses take place, leading to accidents and loss of lives. The government has been trying to plug this loophole through various ordinances, but given the poverty levels and unemployment levels in the economy, the temptation in both workers and so-called "mine owners" of illegal mines is tremendous. The workers work in hazardous conditions without any semblance of protection, whether it is with respect to the gear that they wear, or through other measures in terms of equipment used, training of both workers and security officials, as well as following the strict guidelines laid down by the government. There is a flouting of norms at every stage, as these illegal mine owners do not have the capital or the capability to follow the strict measures laid down by the Indonesian government. The main reasons for this are the abundant resources that are available for mining, poverty levels of the economy, lack of jobs, and poor standard of living. All the above make jeopardizing one's life in illegal mines attractive. The only way out is to increase standards of living, decrease poverty, and increase employment opportunities, besides this, a clamp down of corruption amongst government officials would go a long way in preventing the mushrooming of these mines, maybe help by the government in the form of subsidies would also streamline the processes from illegal to legal helping the residents as well as revenues of government. In recent years, health and safety as an aspect of coal mining practices have been managed by the government of the Republic of Indonesia.

Fig. 8 Image of coal mine in Sumatra (PT. Ansaf)
Source: Pictures taken when I visited the mines.

Fig. 9 Image of coal mine in Sumatra (PT. Banjasari Pribumi)
Source: Pictures taken when I visited the mines.

4.2. Safety Procedures in the Mines that were Visited

All the mines that were visited during the collection of primary data showed excellent safety measures that were extremely well implemented. One of the mines, PT Long Daliq Primacoal (site PT Banjasari Pribumi) located in Lahat, Sumatra, is prone to landslides as it is made of sandy materials; however, even though it is artificially made, landslides still tend to occur. The contract workers are happy to work in these mines because of their high salaries.

The adopted safety protocols are "We implement LMSNKB, a mining safety management system, that starts from initial handling to evaluation and follow-up, beginning with management commitment, company policies, and standardization (SOPs, risk assessments, and risk identification). The above includes mechanical work, plant work, production, and even office roles.

In addition to the above, periodic inspections and field monitoring are undertaken" (mine safety manager of site PT. BP). There are three steps of training that is imparted to new workers, the first being a basic introduction with all coworkers, the second senior management, and the third job-training which is the K3 induction that includes "introduction to the work area, critical areas, incident evaluations, and safety rules—starting from golden rules to mandatory regulations" (mine safety manager of site PT. BP). They also have a system of training every six months, which includes "emergency drills, evacuation methods, transportation methods, and emergency responses to dangerous conditions" (mine safety manager of site PT. BP).

4.3. Analysis of Primary Research Conducted on 47 Mine Workers

The methodology used to collect this data was a questionnaire. The mines that were considered were PT Batubara Lahat, PT BME, PT Banjarmasin Pribumi, and PT Ansaf. The results are tabulated below.

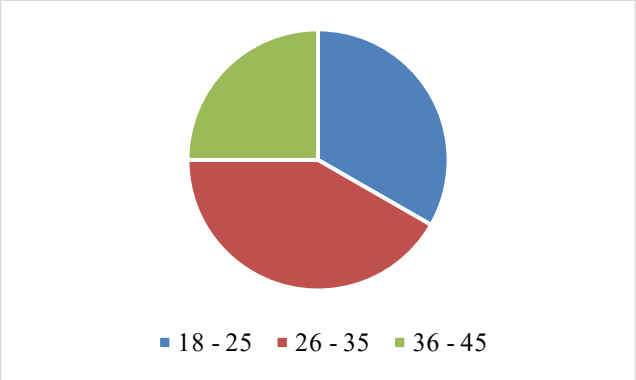

Fig. 10 Age of miners

Most of the workers interviewed were in the age group 26 - 35 (41.7%), and there were a few in the age group of 18 - 25 (33.3%), meaning they may have just finished their basic education and joined the workforce due to the need for income.

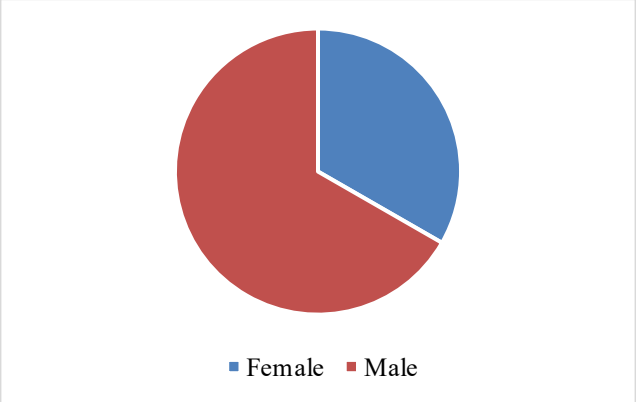

Fig. 11 Gender wise employment of workers in the mines

Most of the mine workers were male (66.7%), but it was a pleasant observation that these mines employed female workers to the extent of 33.3%; these workers were primarily absorbed in the administration departments of the mine.

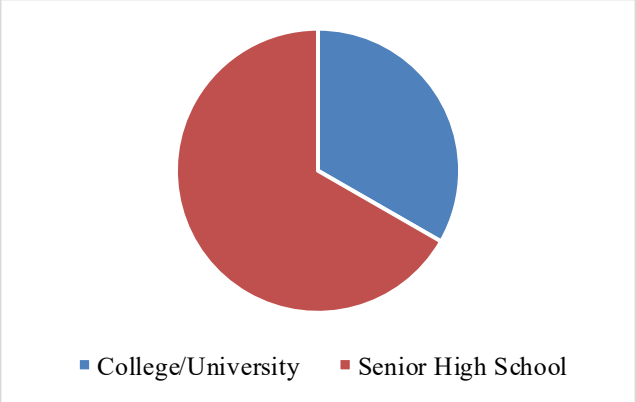

Fig. 12 Educational Qualifications of mine workers

The majority of the mine workers had just passed senior high school, which clearly indicates the extent of need for regular wages, resulting in them obtaining jobs straight after school.

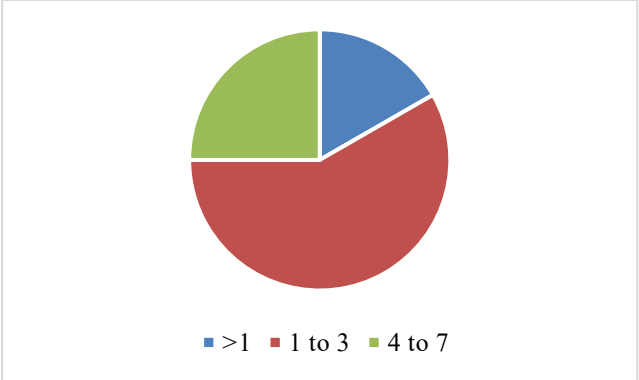

Fig. 13 Number of years of employment in the mine

Most of the workers interviewed had been working between 1 and 3 years in the mines (58.3%).

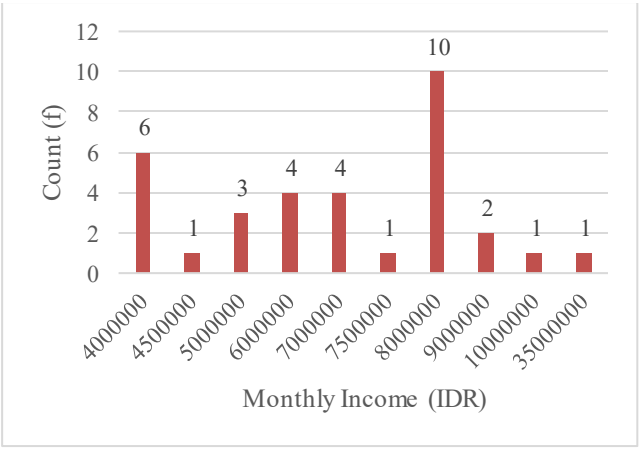

Fig. 14 Monthly income of the workers (IDR) ranged from 4,000,000 to 8,000,000 IDR

The per capita income of the economy of Indonesia for 2025 is approximately 6,813,056 IDR monthly. Thus, according to the graph above, the majority of the workers were well above the country's per capita income, except for a few who earned 4,000,000 IDR per month (21.3% of the sample surveyed).

Fig. 15 Accidents that occurred during their employment.

The above figures indicate that approximately 92% of them have witnessed an accident in their workplace. The survey indicated that all the mine workers were apprised of safety procedures and were given training accordingly periodically.

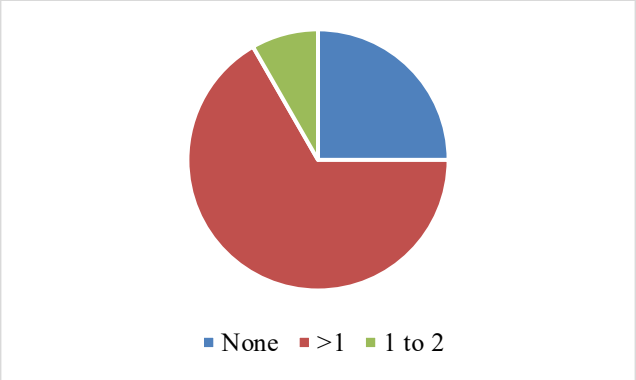

Fig. 16 Hours of training provided

Fig. 17 Frequency of training provided

Combining figures 16 and 17, less than one hour of training was provided every week. A large number fell in the monthly category, and so also in the bracket of 'no training at all'.

Fig. 18 Mine workers who want their family members to continue this profession.

The survey brought out an interesting analysis where only 33.3% of the current workers would like their children to enter this profession. Some of them (16.7%) were very clear that they would not like their children to follow in their footsteps, and half of them were not too sure, indicating that, given the opportunity, they would like to see their children in another profession.

5. Conclusion

Indonesia's approach to mine safety demonstrates a proactive and evolving regulatory framework that prioritizes both prevention and responsive mechanisms. The government's insistence on mandatory safety teams, periodic drills, and detailed incident tracking reveals a strong institutional commitment to accident mitigation. By identifying key causes of accidents—such as geotechnical failures, human error, and mechanical collisions—the authorities emphasize the need for robust engineering practices and adherence to operational protocols.

The integration of safety management systems and inclusive safety committees reflects a participatory governance model that includes leadership and worker representation. Importantly, the shift towards decentralizing safety planning—allowing mine owners to formulate context-specific measures—marks a significant step in recognizing the heterogeneity of mining operations.

While the absence of subsidies places full financial responsibility on mine operators, this reinforces accountability and the embedding of safety as a non-negotiable operational cost. Overall, Indonesia's mine safety regulations, characterized by their adaptability and comprehensive design, set a benchmark that in many aspects surpasses international standards, offering valuable insights for other resource-intensive economies. Time constraints allowed me only to interview one mine safety engineer of a big mine.

My study would have been more representative if interviews had been possible with medium and small mine owners who, given monetary constraints, may or may not have followed all government regulations. A large number of accidents occur in very small mines, or those that have been illegally mushroomed in the country. This eventually boils down to the implementation of government rules as well as controlling bribes and corruption at all levels.

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