



The urgency of environmental law enforcement and public safety responsibility regarding gas pipeline leaks: The Cirebon-Semarang case through ecocracy theory

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ABSTRACT

Background: The Cirebon-Semarang (Cisem) Natural Gas Pipeline Project is a national natural gas infrastructure project aimed at connecting and strengthening the gas network in Java for industrial, household, and national energy security purposes. In June 2025, a pipeline installation site in Arjawinangun District experienced a leak, causing a mud flood that damaged the surrounding environment, including public facilities and private property. This issue is examined by prioritizing corporate responsibility in ensuring public safety and environmental protection. **Methods:** The research method used in this study is normative juridical, referring to Law No. 32 of 2009 on Environmental Protection and Management as the primary legal basis, as well as Law No. 22 of 2001 and Minister of Energy and Mineral Resources Regulation No. 32 of 2021, which form the basis for corporate accountability regarding natural gas pipeline leaks in public areas. The analysis is supported by qualitative secondary data, focusing on literature grounded in the theory of ecocracy and legal enforcement aligned with the principles of *Das Sollen* (legal norms) and *Das Sein* (facts), as expressed by Hans Kelsen. **Findings:** The analysis indicates that the existing legal framework provides a basis for corporate accountability and environmental protection in cases of pipeline leaks. However, effective enforcement requires alignment between legal norms, corporate responsibility, and environmental protection measures. **Conclusion:** Strengthening environmental law enforcement and corporate responsibility is essential to ensure public safety and protect environmental conditions surrounding natural gas pipeline projects. **Novelty/Originality of this article:** This study applies ecocracy theory and the *Das Sollen–Das Sein* framework to analyze corporate accountability and environmental legal protection in the context of the Cirebon-Semarang natural gas pipeline leak.

KEYWORDS: ecocracy; environmental law; gas pipeline leaks; public safety.

1. Introduction

The installation of natural gas pipelines certainly has an important purpose, which is a form of media that can distribute natural gas from its source to consumers and meet all needs, including households, industries, and power plants that are efficient, safe, and economical. In addition to these objectives, the main purpose of installing natural gas pipelines is to reduce fuel oil imports and support a more environmentally friendly energy

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transition in line with the 2060 net zero emissions (NZE) target, which focuses on connecting clean energy programmes for the community and industrial area needs. Natural gas pipelines installed in a project have different levels of difficulty and risk. This is because the longer the pipeline, the higher the risk due to the greater number of workers, tools and systems that must be well integrated to ensure that pipeline operation and maintenance can run safely (Hasnan et al., 2023).

The natural gas pipeline infrastructure in Indonesia is currently progressing rapidly in line with public demand, meaning that the installation of pipelines carries a high risk of occupational accidents, both for pipelines that are already in operation and for pipeline construction sites. One of the natural gas pipeline installation projects with a long route is the Cirebon-Semarang natural gas pipeline project with two stages of construction, where stage I (Cisem I) is 65 kilometres long and located from Semarang to Batang, while the route for phase II (Cisem II) is 245 kilometres long, located from Batang to Kandang Haur (West Java), which began construction in October 2024 and is planned to be completed in April 2026 and funded directly by the State Budget/*Anggaran Pendapatan dan Belanja Negara* (APBN).

The installation of natural gas requires a lengthy process to determine the pipeline route, as the project takes into account various factors, including environmental factors. Good coordination is essential to comply with local regulations, environmental conditions, social conditions, and public acceptance of the risks associated with the installation of natural gas pipelines (Xing et al., 2023). Projects involving large-scale operations are certain to pose high environmental risks and have an impact on the surrounding physical, biological and even social environment (Aung et al., 2020). One high-risk project is the installation of long gas pipelines, which can damage the environment and endanger communities near the installation site. Therefore, this type of project requires careful planning and the implementation of strict safety and environmental standards. Every stage, from site surveys and technical design to construction and operation, must be supervised by experienced experts. In addition, a comprehensive risk analysis is also required to identify potential hazards, such as gas leaks, explosions, or soil and water contamination.

The most serious potential damage that can be caused by natural gas installation projects is the impact on the environment, as occurred during the installation of natural gas pipelines for the Cirebon-Semarang project, particularly in phase II, which involved the installation of 245 km of pipelines from Batang to Kandang Haur (West Java). This environmental damage was caused by a leak in the Arjawinangun sub-district of Cirebon Regency, West Java Province, which caused mud floods that damaged public facilities and even private facilities belonging to residents. The main focus of the adverse impact of this leak incident is not only damage to facilities, but also environmental pollution in the area surrounding the natural gas pipeline installation, which can endanger public health. This is because the mud that comes out can contaminate the soil by covering the surface and pores of the soil, thereby inhibiting air and water circulation within it. In addition, the chemical or hydrocarbon content in the mud can poison soil microorganisms and reduce soil fertility. If the mud flows into water bodies such as rivers or lakes, water quality will decline due to increased turbidity and harmful substance content. This can disrupt aquatic life and even contaminate the community's clean water sources. On the other hand, gases contained in the mud, such as methane (CH₄) and hydrogen sulphide (H₂S), can evaporate into the air and cause air pollution with a pungent odour that is potentially harmful to human health. This pollution can also cause irritation, respiratory problems and, in the long term, damage the surrounding ecosystem. The impact is not only on the environment, but also on the social and economic life of the community, such as damage to agricultural land, declining fishery yields, and increased environmental restoration costs. This means that gas pipeline leaks causing mud to escape are serious incidents that need to be dealt with quickly to prevent more widespread environmental damage.

Failure in installing natural gas pipes is closely related to the gas transmission network and changes in technical conditions, which can pose a danger to humans, life and the environment due to corrosion, mechanical damage, and third-party interference or errors

(Rusin et al., 2021). The worst impact of natural gas leaks in densely populated areas is that they can cause economic losses and damage the ecosystem around the contaminated area, especially in cases where the environmental damage is exacerbated by overflowing mud floods. The environment polluted by natural gas leaks is an important aspect of human life because it provides natural resources such as water, air, soil, plants and animals that support various basic human needs and provide beauty and well-being to natural ecosystems.

Previous studies have also examined the risks of loss and damage from natural gas pipeline leaks, focusing on the environmental pollution caused by such installations, which requires a hierarchical process to prevent and mitigate the resulting disasters (Tian & Lv, 2024). This study mentioned that environments in densely populated areas are at high risk of suffering severe damage if they are close to construction and development activities that are often carried out both above and below ground. This condition will cause damage to the gas transmission network, resulting in leaks and fatal environmental damage. One of the impacts of this is mud flooding, as seen in the case study of the Cirebon-Semarang natural gas pipeline installation in Indonesia. The impact of these leaks causes long-term damage to both the community in the Arjawinangun area and the environment, which is polluted by mud from the natural gas pipeline, affecting health and economic risks.

The legal protection system in Indonesia regarding corporate responsibility for environmental impacts is still unable to address the problems that occurred, especially in cases of corporate negligence that caused environmental pollution (Arifudin & Mulawarman, 2024). The consideration of measures taken by companies is not only a matter of minimizing the risk of workplace accidents that could endanger worker safety, but also requires synergistic action with the government in preventing potential workplace accidents that could harm the environment, given that the impact of existing cases of environmental pollution could be more harmful to the lives of civilians outside the company and even threaten the economy in the project area with negative effects. Therefore, a legal basis has been established to provide environmental legal protection aimed at preventing and overcoming cases of environmental damage and demanding that companies take responsibility for the problems that occur so as not to harm many parties, in line with the principle of a green constitution as a manifestation of the state's firm integrity in building a healthy and sustainable environment. This principle is enshrined in Article 28H paragraph (1) of the 1945 Constitution, which states that 'every person shall have the right to live in physical and spiritual prosperity, to have a place to live, and to enjoy a good and healthy environment.' This statement does not merely serve as a declarative norm, but rather an affirmation of the constitutional rights of citizens to a decent quality of life in an ecological context.

The risk of environmental pollution caused by the gas pipeline leak incident on the Cirebon-Semarang route needs to be further examined based on an analysis of environmental law protection. This is because the impact of the incident will have a long-term effect on the environment. Issues related to pollution from natural gas pipeline leaks need to be followed up based on Law No. 32 of 2009 concerning Environmental Protection and Management, particularly Minister of Energy and Mineral Resources Regulation No. 32 of 2021, as the basis for corporate accountability for natural gas installation leaks that occur in the community. However, the responsibility undertaken by the company must also consider the damage suffered by the affected parties, especially if it involves environmental damage with various potential hazards that may occur after the incident.

The qualitative secondary data used in this study was sourced from doctrines consistent with environmental issues caused by pollution from natural gas pipeline leaks, with the aim of supporting research to identify factors that could cause natural gas pipeline leaks, resulting in mud explosion in residential areas and polluting the surrounding environment. The applicable legal regulations are considered insufficient to address environmental issues and are not in line with the principles of *Das Sollen* (legal norms) and *Das Sein* (facts) (Kelsen, 1995). In particular, the working principles of companies and their

employees have not optimised the interests of the community and the objectives of eco-cratic programmes, as should be prioritised by companies engaged in natural resources with the risk of environmental damage.

2. Methods

The type of research used in this study is sourced from qualitative secondary data with a focus on discussing related social phenomena. Qualitative studies are characterised by a research structure based on the concept of sensitisation to provide strict definitions and explanations of the substance of the issues being studied (Djafar et al., 2021). The qualitative data approach enables researchers to investigate the complexity and factors of environmental pollution caused by natural gas pipeline leaks. This type of research provides rich insights and nuances about the phenomenon and aims to develop theories or gain a deeper understanding. The purpose of qualitative research is to obtain facts and truths related to the phenomenon being studied in order to examine resolutions, solutions, and perspectives that can help solve problems.

The data collection in this study followed qualitative guidelines sourced from two types of data. First, primary data, which consists of the 1945 Constitution of the Republic of Indonesia, Law No. 22 of 2001 concerning Oil and Natural Gas, Law No. 32 of 2009 concerning Environmental Protection and Management, and Regulation of the Minister of Energy and Mineral Resources No. 32 of 2021 concerning Technical Inspection and Safety Inspection of Installations and Equipment in Oil and Gas Business Activities. Second, secondary data used to support this research includes scientific journals on environmental law related to natural gas pipeline leaks based on an analysis of ecocracy theory, which has not been optimally implemented in line with corporate responsibility. In this context, legal journals and books serve as sources of doctrine, namely the opinions of legal experts used to explain, interpret, and critique positive legal norms. Through books and journals, researchers can explore relevant legal theories to construct a theoretical framework and framework of thought in their research. In addition, this secondary data also serves as the main reference in analysing the legal issues under review, providing a conceptual basis and strengthening legal arguments scientifically. Thus, the existence of legal journals and books not only complements the data but also deepens the quality of legal analysis conducted in doctrinal research.

Research on corporate accountability for the impact of natural gas pipeline leaks in the Arjawinangun area is based on epistemological aspects that aim to provide a theoretical study of the importance of restoring the environment polluted by such incidents as a form of control over long-term hazards. The epistemological basis in this study will refer to the procedures that must be carried out by parties involved in legal phenomena, including actions and countermeasures, thereby helping to discuss the factors that caused the natural gas pipeline leak and its resolution from a substantive ecological perspective (Crotty, 1998). The research, based on doctrines that assist in the acquisition of primary and secondary data, is analysed theoretically and provides answers to the various reasons for the phenomenon under discussion (Al-Ababneh, 2020).

The approach used in this study is normative juridical, examining the implementation of environmental legal foundations as stipulated in Law Number 32 of 2009 concerning Environmental Protection and Management related to the adverse environmental impacts following the natural gas pipeline leak incident and Regulation of the Minister of Energy and Mineral Resources Number 32 of 2021 concerning Technical Inspection and Safety Inspection of Installations and Equipment in Oil and Gas Business Activities as the company's accountability for the company's responsibility for the risks of natural gas pipeline installation projects. Terms such as legal doctrine, black-letter law, formalism, doctrinalism, and dogmatic legal research are used in this study to demonstrate the normative function and legal basis related to the principles, rules, and concepts that govern certain fields or institutions, as well as to analyse the relationships between them to resolve legal ambiguities and loopholes (Smits, 2017).

The implementation of environmental protection laws in cases of natural gas pipeline leaks demonstrates how ontology, as the study of reality, is used in this research as a source of knowledge that aids in the analysis of all parties involved, including companies, the government, and the community, and their roles in resolving the issues that arise. The ontological aspect serves as the basis for arguments related to the substance and all attributes involved in legal phenomena to study how reality can be handled in various positive ways that do not harm one another (Hermida, 2023).

Based on studies related to the factors causing leaks in natural gas pipeline installations in the Cirebon-Semarang project, Hans Kelsen's theoretical approach, which refers to the harmony between *Das Sollen* (legal norms) and *Das Sein* (facts), will be a reference for the state to review the provisions contained in the law so that they can be applied to the legal phenomena that occur. Therefore, this research was written with an emphasis on scientific studies that refer to the perspective of ecocracy theory in order to resolve the problems and environmental impacts that occur so that they do not become a long-term risk. The community and companies must understand their obligations and rights to each other in order to overcome the environmental damage that is being experienced, so that the theory and approach used in this study become a new science that can be useful for all parties involved to focus on solving environmental problems and ensuring that the environment returns to a healthy state and does not cause anxiety about the adverse effects that will occur in the future. The formula used to facilitate the steps in this study will be described in detail and effectively in a flow chart and will contain discussion points related to the written study and the form of doctrinal research resolution on environmental issues.

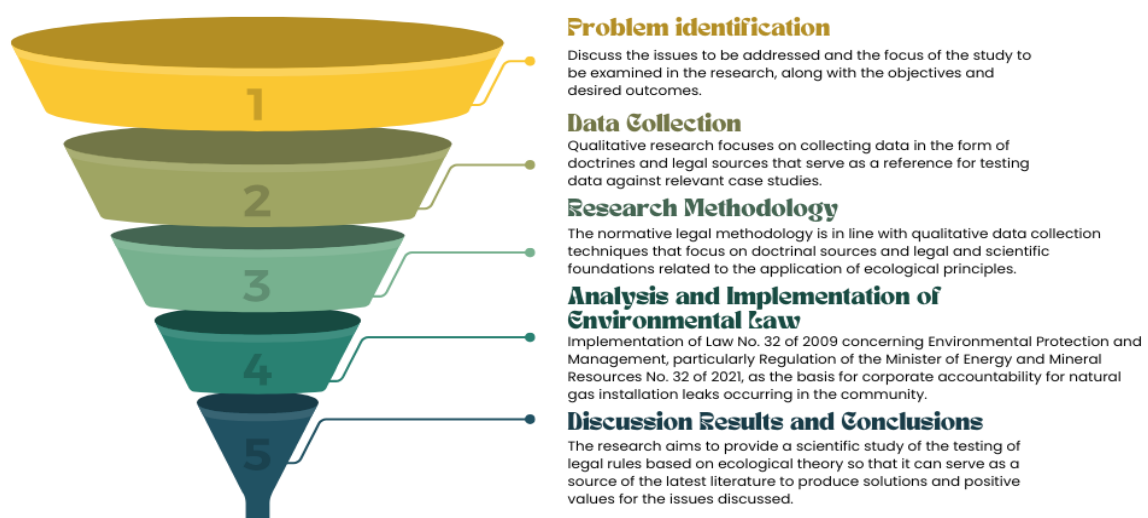


Fig 1. Research steps

In the context of normative research, academic legal researchers play a major role in analysing, distinguishing, classifying, and critically reviewing legal norms, placing them in specific legal categories, and evaluating their position in order to formulate problems that arise in society (Holtermann & Madsen, 2020). In this case, doctrinal studies become a medium for testing the validity of facts in accordance with applicable legal norms so that the function of law can run properly, namely to provide legal certainty, especially the fulfilment of the rights and obligations of every individual, including the environment, which is significant for human life now and in the future.

3. Results and Discussion

3.1 Implementation of environmental law

Studies on environmental awareness should be discussed and treated as a matter of urgency, given that the actions of each individual can have long-term impacts that can be either positive or negative (Murzyn et al., 2025). Climate change and other dangers also need to be based on clear knowledge in order to provide broad information to the public, emphasising that the actions taken now will minimise the risk of an environmental crisis, depending on a culture and society that is active and cares about ecological values. Projections indicate that by 2040, natural gas consumption will surpass that of coal and approach the level of oil when measured in tons of oil equivalent. At that point, natural gas is expected to remain the sole fossil-fuel energy source capable of competing with renewables. Relative to coal and oil, natural gas is considerably cleaner, exhibiting substantially lower greenhouse gas impacts, particularly with respect to carbon dioxide emissions generated during both combustion and utilization processes (Fu et al., 2021).

Pipelines are critical infrastructure for transporting various types of hazardous materials (HAZMAT), including natural gas, crude oil, and other petroleum product (Cheng et al., 2024). The construction of natural gas pipelines has several positive impacts, including increased income and welfare and reduced unemployment due to the trade in new products and labour activities. Most of the impacts of the operational phase are positive, including gas exploitation or natural gas transportation, as well as gas pipeline monitoring. However, the chances of failure for this natural gas pipeline construction project are also quite high and require cooperation from all parties, including contractors, companies, the government, and the community in the pipeline construction area. Without continuity of activities, the risks of installation could become a possibility if prevention and handling measures only come from one side (Karimi et al., 2014).

Preserving the environment is an obligation that must be carried out by all elements of society, including business owners, the government and the state itself. This is because a beautiful environment is a gift from God to all of humanity, and the environment is fundamental to efforts to preserve human life on earth (Salim & Palullungan, 2021). Without a healthy environment, humans will find it difficult to survive for various reasons, one of which is the loss of a healthy quality of life. Various reasons that have the potential to damage even a small part of a healthy environment are not justified, as this aspect does not belong to individuals, but to all citizens and the ecosystem chain.

One of them was a natural gas pipeline leak that occurred in the Cirebon-Semarang phase II project in the Klangeran subdistrict, causing mud to gush to the surface, damaging residents' private property and polluting the environment surrounding the project site. This incident did not cause any fatalities, but the environmental damage is still ongoing and has not been adequately resolved because the mud rising from underground continues to flood residents' homes. The leak was caused by the impact of heavy construction equipment used on the soil in the excavation area and its surroundings, resulting in unavoidable soil cracks and causing mud to overflow and flood the surface of the residential area. The leakage occurred due to the impact of heavy construction equipment used, which affected the soil in the excavation area and its surroundings, causing unavoidable soil cracks and mud to overflow and flood residential areas. Leakage can occur due to different soil conditions. Pipe leakage that shows minimal diffusion in clay soil will result in a very low possibility of an explosion in electrical lines. In sandy soil, gas leaks spread very quickly, penetrating most electrical lines and posing a high risk of explosion. Conditions in sandy clay soil are between these two extremes. Various differences in soil conditions still have the potential to cause natural gas pipe leaks, so project personnel must be prepared to handle such incidents (Ge et al., 2025).

It is little known to many people that the impact of this environmental pollution incident has the potential for long-term hazards because the gases contained in the mud contain methane (CH₄) and hydrogen sulfide (H₂S), which are quite dangerous to human

health. Mud that rises to the surface also risks causing respiratory health problems, irritation, and most fatally, damaging the environmental ecosystem in the area. The impact of this pollution is classified as a long-term hazard because it affects the social and economic life of the community, where mud floods and damage caused by leaks can destroy soil structure, especially agricultural land and clean water sources used by local residents in the affected area. Education about these dangers needs to be known not only by the community, but also needs to be recognized by those responsible for the natural gas pipeline installation project in question so that they can immediately address the increasingly widespread environmental pollution and the dangers mentioned above. Compared to hydrogen, methane has higher density, viscosity, volumetric heat value, and solubility in water. On the other hand, hydrogen has greater heat capacity, diffusivity, mass heat value, flash point, spontaneous combustion temperature, and explosion and fire risk. Due to these differences in physical and chemical properties, mixing hydrogen into natural gas pipelines will alter the combustion and thermal properties of the original natural gas, and may even cause the temperature of the decompression station to drop. This poses a potential hazard if the construction of natural gas pipelines is not accompanied by full responsibility for the potential risks (Tian & Pei, 2023).

Environmental damage is caused by serious reasons and requires comprehensive efforts to overcome it, where these efforts are carried out by all parties, both the community and the government, who are responsible and focused on improvement to minimise the risk of long-term danger and loss of life and damage to the ecosystem. The principle of natural resource use must be in line with and balanced against environmental functions, the purpose of which is to serve the interests of citizens and take into account public safety considerations in the process of use and development. Based on this principle, all forms of policy, plans, and development programmes must be based on ecocracy values and must not use any methods that have the potential to damage a healthy environment. In this regard, the government regulates policies related to environmental aspects through Law No. 32 of 2009 concerning Environmental Protection and Management, which serves as a strong foundation for the central and regional governments to report on environmental conditions in their respective areas and prevent natural damage due to various reasons (Suriyanti et al., 2020). Therefore, environmental studies need to be updated in line with the agenda being carried out. The aim is to ensure that every programme implemented and related to natural resources is carried out strategically and with strong consideration of the risks that may arise in the future.

In the incident of a natural gas pipeline leak, there are also strict rules contained in the Regulation of the Minister of Energy and Mineral Resources No. 32 of 2021 concerning Technical Inspection and Safety Inspection of Installations and Equipment in Oil and Gas Business Activities, where this regulation serves as a clear legal basis for all technical inspection and safety inspection activities, ranging from design review, technical inspection, risk analysis, to the operational approval/*persetujuan layak operasi* (PLO). Workplace safety and environmental protection require a solid analytical foundation in order to minimise potential hazards. Every legal entity and company undertaking a project is required to understand and consider all activities and programmes to be implemented so as to avoid any adverse impact on the environment or the safety of workers involved in the programme itself.

Based on applicable legal principles relating to environmental protection and corporate efforts to address the risks associated with development programmes, legal instruments clearly stipulate that environmental safety must be a primary consideration in public works undertaken by the government. The form of accountability for the programme is based on the principle of ecocracy as the foundation for enforcing the sovereignty of nature (eco-democracy or eco-philosophy), and the main focus of this principle is the responsibility of all parties to maintain a healthy and safe environment. The application of ecocracy principles requires synergy between the government, corporations and the community to ensure that all development activities are carried out sustainably. In this context, companies are not only legally responsible for the environmental impact they cause, but also morally

responsible for ensuring that their operational activities do not damage the ecosystem. The government has an obligation to exercise strict supervision through legal instruments and environmental audit mechanisms, while the community acts as a social watchdog that helps oversee the implementation of environmental policies. This tripartite collaboration is key to realising development governance that is oriented towards ecological balance and long-term sustainability.

The compatibility between the principles of *Das Sollen* (legal norms) and *Das Sein* (facts) of the applicable legal basis is still overlapping and does not function optimally in the discussion of the following research topic. This is because public awareness of the dangers of mud pollution caused by pipeline leaks is still insufficient, and companies carrying out projects are required to provide extensive information on the impact of natural gas pipeline leaks. The main focus of the applicable legal protection is not only preventive measures but also repressive measures after the incident to prevent long-term risks from occurring and endangering the environment and the community at the location of the incident, because the 1945 Constitution states that every citizen has the right to welfare, health and safety, including protection from dangers caused by government-owned public programmes.

An analysis of the implementation of applicable laws and regulations governing environmental protection has been clearly published, so it is necessary to implement them properly for the mutual benefit of all parties and to jointly maintain a healthy environment. All forms of risk caused by development programmes require a high level of risk analysis in order to calculate the dangers that may occur and report them to local, regional and central government so that the study can be examined with reference to the principle of natural resource sovereignty, namely ecocracy. Actions taken throughout the programme must be based on environmental safety as the primary concern above personal or public interests. This is because the potential dangers caused by environmental pollution are long-term risks that will require more extensive solutions in the future if not addressed immediately.

3.2 Responsibility according to ecocracy theory

Companies and institutions that are active in activities related to natural resources are required to implement social and environmental responsibility (Situmorang & Nurdin, 2024). The form of responsibility carried out by the company is preventive and mitigates risks that have a negative impact on the company and the community indirectly involved in the work area. In carrying out business activities or any type of development, the company is not permitted to adopt a passive attitude or fail to explain the impact of the operations being carried out. Information or reports received by the community must be communicated by the company in order to provide education regarding the dangers and future impacts of the activities being carried out, whereby this form of responsibility can prevent fatal losses to the environment, worker safety and the community in the construction area. Basically, the type of long-distance pipeline construction has the potential to significantly disrupt the regional ecosystem, especially in terms of the surrounding environment. Long-term construction projects such as the installation of gas pipelines require appropriate handling, including prevention, good risk management, and environmental responsibility in the event of incidents that directly cause harm and affect the community, especially the environment around the project area (Xiao et al., 2014).

All aspects of business and development activities carried out by companies certainly have the potential to affect the surrounding environment, especially if these activities are directly related to fields that use natural resources (Murjiyanto et al., 2023). Although all development projects contribute to driving regional and national economic growth, it is important to maximise project implementation, especially for the development of economic conditions and to prevent environmental damage related to culture, morals, and natural resources. The responsibilities that companies must fulfil are identified as two types, namely social responsibility and environmental responsibility. The definition of social responsibility is a broad initiative by companies to act ethically and contribute positively to society, where the goal is to create a positive social impact and balance profit with social

responsibility to the communities surrounding their business activities, while the company's obligation is to minimise negative impacts on the environment by operating sustainably. For example, reducing pollution, conserving energy, managing waste, and using natural resources wisely, including avoiding potential short-term and long-term risks. Most companies and project owners rarely consider social costs to society and the environment during the planning, design, and tender evaluation stages of a construction project because these social costs cannot be calculated using standard estimation methods, even though they have a far more crucial impact if not planned immediately (Matthews et al., 2015).

This study examines the environmental impact caused by gas pipeline leaks in the Cirebon-Semarang project, which resulted in mud floods that damaged the environment and private facilities belonging to the community in the Arjawinangun sub-district as well as public facilities in the area. Based on applicable environmental laws, it has been confirmed that the company is obliged to take responsibility for the damage that has occurred and affected several residents who were directly impacted. However, considering the extent of the damage and pollution caused, this responsibility does not end with compensation or restoration of the damaged facilities. This is because the hazardous substances contained in the mud pose a long-term risk if the company does not immediately provide information and education to the community to be cautious in the area where the leak occurred. It is stated that many potential dangers will arise as a result of the mud pollution, and both the company and the community must be sensitive to preventing environmental damage in the future. In line with the function of Law of the Republic of Indonesia Number 32 of 2009 concerning Environmental Protection and Management, which focuses on preserving and conserving ecosystems and environmental quality, hence, social responsibility in this case must be the main focus by providing sufficient information to the public, as well as appeals and environmental conservation programmes in the form of reforestation of the spill area and clean water sanitation, where the mud has contaminated the soil of local residents' settlements, so that the water quality in the area does not become a new source of danger due to the contents of the mud.

Therefore, in every development effort, contractors are required to hold a pre-construction meeting (PCM), which is a meeting with all parties involved in the development project, including contractors, the government, and the community. The PCM is intended as a method for presenting and discussing the project implementation and an overview of the specifications of the equipment, materials, labour, and workflow of the construction project so that all parties can understand the risks and objectives of the construction that will be carried out later (Memić et al., 2023). This meeting was previously known as the pre-construction conference (PCC), where stakeholders were given the opportunity to discuss key issues related to the project. Generally, this meeting must be held after the design or tender process, and the contract has been finalised (Callistus et al., 2013). Support for holding a PCM is essential and must be followed by all elements involved. This meeting will serve as a medium for aligning the objectives of project stakeholders, agreeing on protocols for joint decision-making and conflict resolution, and appointing ambassadors to continuously monitor and evaluate performance against specific agreed targets to support the aligned objectives, one of which is to prevent any possible adverse risks that may occur during the project process (Anvuur, 2008).

Awareness of the long-term risks of environmental pollution must be supported by a strong and active culture of environmental literacy, one example of which is seeking as much information as possible through social media and technological advances to help transform potential environmental hazards into early prevention of other fatal risks. Therefore, protecting the environment is the responsibility and concern of every individual who exploits natural resources, so that their actions are not harmful or even contrary to positive laws that are officially in force (Suryawati, 2021). The existing legal basis provides a form of legal certainty that is fair, definite, and can guarantee actions in the dynamics of economic growth so that there is no deviation between programmes to meet the needs of the community and the state's obligation to provide a healthy life through environmental preservation. The principle of legal protection emphasises that without legal certainty, the

economy cannot develop in an orderly manner; without justice, the economy will not grow healthily; and without fair and meaningful freedom, the economy will not bring prosperity and peace. From this principle, it can be interpreted that economic development cannot be sustainable if it does not take the environment into account, because environmental sustainability is a manifestation of the harmonious relationship between humans and the environment, and humans are always dependent on natural resources.

In addition, the application of the principle of ecocracy requires comprehensive integration between national development policies and efforts to protect and preserve the environment. Every public policy formulated by the government, both at the central and regional levels, should be based on in-depth scientific studies of the possible ecological impacts, so that the development process is not only oriented towards economic growth, but also takes into account the sustainability of ecosystems and the welfare of future generations. In the context of ecologically just governance, the principles of transparency and accountability are crucial to ensuring that every decision-making process related to the use of natural resources can be monitored participatively by the community. Therefore, the successful implementation of ecocracy does not solely depend on existing regulations, but also on the commitment of all parties, including the government, the private sector, and civil society, to realise development practices that are oriented towards a balance between economic, social, and environmental sustainability interests. Thus, the principle of ecocracy can be realised substantively, not merely as a normative concept, but as a new paradigm in the system of government that places environmental sustainability as an integral part of the goal of sustainable national development.

Public concern for environmental issues has led to an understanding of the green constitution programme and has had a positive impact on the implementation of the principles of ecocracy. Democracy in countries that adhere to ecocracy is implemented without damaging nature and for the good of the earth. Therefore, efforts to realise ecocracy must be in line with the goals and ideals of the nation. In its implementation, the government is also required to conduct optimal supervision of all activities related to the utilisation of natural resources and other business activities that have the potential to harm the environment. The basis for this statement is none other than the articles and paragraphs in the applicable environmental laws that prioritise environmental safety (Diamantina & Yulida, 2023).

The ultimate goal of this research is to focus on the legal functions applied in line with the concept of ecocracy, which prioritises the sovereignty of state-owned natural resources so that they are properly utilised, managed and preserved with a sense of responsibility by all parties who use the fruits of these natural resources. This means that environmental pollution caused by human error is unjustifiable and requires immediate and appropriate action to prevent fatal consequences and long-term risks in the future. The principles of this theory are in line with the points discussed in the Constitution of the Republic of Indonesia, whereby every citizen has the right to a decent and prosperous life, including freedom from environmental damage. Ecocracy demands that the protection of the environment is more important than the needs and interests of society itself, as ecocracy always considers a healthy future that can be enjoyed by all living creatures.

In the context of environmental law enforcement, the natural gas pipeline leak incident should serve as a momentum for local and central governments to evaluate and strengthen their oversight mechanisms for energy industry activities that pose high ecological risks. Such oversight should not only be administrative in nature, but should also cover technical and social aspects so that negative impacts on the environment can be identified early on. Furthermore, the principle of ecocracy needs to be concretely implemented in every policy and legal action, where environmental sustainability is the main consideration in every development process and industrial activity. Through the application of this principle, every government decision and corporate action must take into account the ecological rights of the earth and ensure that economic activities are not carried out at the expense of the balance of nature. This is important to foster a collective awareness that environmental

protection is not only a moral obligation but also a constitutional responsibility inherent to every citizen and business entity.

Based on the incident that occurred due to a natural gas pipeline leak in the Arjawinangun sub-district, legal analysis and the principles of ecocracy require companies and the community to be sensitive to the risks posed by the mud that has risen to the surface. The community needs to be educated about the aspects affected by the leak in order to minimise indifference towards a healthy environment. In this case, companies are also required to provide facilities to restore the quality of the environment damaged by the natural gas pipeline leak, which can affect the soil as a source of water for residents, damaged private and public facilities that require special attention, and immediately allocate resources for environmental conservation activities.

Furthermore, synergy between the community, government, and private sector is also key to creating a system for mitigation and rapid response to future environmental incidents. Through improving the community's ecological literacy, developing environmental emergency response protocols, and ensuring transparency of public information from companies, it is hoped that similar risks can be effectively minimised. Thus, the application of the principle of ecocracy does not stop only at the conceptual level, but is truly realised in the practice of development that prioritises human safety and environmental sustainability in order to achieve fair and ecologically-minded sustainable development.

4. Conclusions

The development of Indonesia's natural gas infrastructure, particularly the 310-kilometre Cirebon–Semarang (Cisem) gas pipeline, plays a crucial role in supporting the national energy transition and reducing fuel imports. However, the project's construction and operation also pose significant environmental and safety risks when preventive and legal accountability mechanisms are weak. The leak in Arjawinangun, Cirebon Regency, which caused mud floods, soil contamination, and air pollution from methane and hydrogen sulphide emissions, demonstrates how pipeline failures can inflict long-term ecological, social, and economic damage on local communities.

This study argues that Indonesia's environmental legal framework primarily Law No. 32 of 2009 and Ministerial Regulation No. 32 of 2021 has not been effectively enforced to prevent or address corporate negligence. Despite the constitutional guarantee of a healthy environment under Article 28H (1), gaps persist between legal norms and practical implementation, revealing weak oversight and insufficient preventive action in projects involving natural resources. Through a qualitative, normative juridical approach, the research draws on Hans Kelsen's theory of aligning legal norms with factual realities to assess how environmental protection laws can better reflect industrial conditions.

Ecocracy theory serves as the study's conceptual foundation, emphasising harmony between human activity and ecological balance. It promotes nature's sovereignty and eco-democracy, urging governments and corporations to act as stewards rather than exploiters of natural resources. Under this framework, companies must fulfil both preventive and reparative responsibilities by conducting risk assessments, ensuring transparency with communities, and restoring damaged environments through remediation, compensation, and reforestation. Such actions extend beyond legal compliance to uphold moral and ecological justice.

Finally, the study highlights the need to strengthen law enforcement, public awareness, and environmental education to foster community participation in ecological protection. A sustainable legal framework should institutionalise preventive mechanisms, transparent monitoring, and sanctions for violations, ensuring that environmental protection is not reactive but proactive. By embedding ecocracy principles into Indonesia's energy development agenda, the state, corporations, and citizens can collectively uphold environmental justice and achieve truly sustainable national progress.

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Author Contribution

F.R.S.: Conceptualization (lead), Investigation, Resources, Writing – Original Draft. D.A.S.: Conceptualization (supporting), Methodology, Formal Analysis, Writing – Review & Editing, Visualization. All authors have read and agreed to the published version of the manuscript.

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The study was conducted in accordance with the government Arjawinangun and approved by the government of Cirebon.

Informed Consent Statement

Written informed consent has been obtained from the participants to publish this paper.

Data Availability Statement

The data that used in this research based on Indonesia environment policy and completed argument with doctrinal literature based on journals and books.

Conflicts of Interest

The author declare no conflict of interest and The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results because this research had no funding.

Declaration of Generative AI Use

During the preparation of this work, the authors used Grammarly to assist in improving grammar, clarity, and academic tone of the manuscript. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the content of the publication, also using mendeley for arrange the bibliography towards APA requirements.

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