

## **Impact of Aluminum Industry Development on Public Welfare and State Defense**

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### **Abstract**

*This research focuses on the impact of the development of the aluminum industry on the welfare of society and national security in Indonesia. As a strategic sector, the aluminum industry plays a central role in economic growth and national defense. The research aims to identify complex social impacts and provide detailed policy recommendations. The research method used is Systematic Literature Review (SLR), which collects and analyzes relevant literature between 2014 and 2024. The results show positive growth in the production and employment of the aluminum industry, with the adoption of current technology improving worker qualifications. However, the research also reveals several challenges, including job displacement, uncontrolled urban growth, and environmental impact. The role of aluminum in national defense indicates dependence on key resources, requiring diversification strategies and supply security. Policy implications emphasize the need for equitable distribution of benefits, sustainable defense strategies, and a balance between defense needs and societal welfare. The conclusion of this research is that the aluminum industry in Indonesia, despite its positive impact on the economy and defense, also poses complex challenges. Collaboration between the government, industry, and society is key to managing these impacts, with wise policies to create a balanced, sustainable environment that supports national development. This research contributes to the social sciences literature and serves as a basis for wiser policies in managing the social and security impacts of the development of the aluminum industry in Indonesia.*

**Keywords : Aluminum, Kesejahteraan Masyarakat, Pertahanan Negara.**

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## **INTRODUCTION**

The aluminum industry, as one of the main sectors in the modern economy, serves not only as an economic growth supporter but also as a pioneer in technological innovation with complex social impacts (Nugraha et al., 2024). The development of this industry has brought about significant transformations in various aspects of social life and national security. Therefore, this research aims to conduct an in-depth exploration of the impact of aluminum industry development on community welfare and national security, primarily focusing on the social dimension and a social science approach. The aluminum industry, widely recognized as a strategic sector, plays a crucial role in the global economy and national defense (Susdarwono, 2021). The extensive use of aluminum in the defense industry, such as aircraft manufacturing and military equipment, not only reflects the sustainability of this metal but also signifies the urgency and sustainability in maintaining a nation's security. Furthermore, the development of the aluminum industry also makes a significant contribution to increased productivity and creates employment opportunities, ultimately positively affecting community welfare.

However, like the development of other industries, the growth of the aluminum industry also brings about a number of complex issues, both socially and ethically (Wahyunindyawati & Sari, 2016). The emergence of critical questions regarding the impact of this industrial development on the well-being of the local community, as well as its implications for national security, demands in-depth study. This research aims to approach the complexity of these relationships through the lens of social science, detailing the positive and negative aspects that may arise and formulating detailed policy recommendations. Through careful analysis, it is

hoped that this study can provide a deeper understanding of the concrete contribution of the aluminum industry to the well-being of society and national defense. Furthermore, it is expected to identify challenges that may arise with the development of this industry and open up space for consideration of opportunities that can be optimized. Overall, with a meticulous academic approach, this research is expected to make a valuable contribution to the social science literature and serve as a foundation for wiser policies in managing the social and security impacts of aluminum industry development.

## **RESEARCH METHODS**

The research method applied in this study is a Systematic Literature Review (SLR), a systematic and structured approach to collect and analyze literature relevant to the research topic, which is the impact of the development of the aluminum industry on community welfare and national defense. The SLR approach is designed to provide a comprehensive and objective overview of existing literature, adhering to rigorous research standards (Boell & Cecez, 2015). In conducting literature searches, keywords related to the research topic, such as aluminum industry, community welfare, and national defense, were used. The search was conducted in both English and Indonesian, using data sources from journals and research articles published between 2014 and 2024. The search process was carried out through various databases, including Google Scholar and Scimedirect, to ensure the completeness and credibility of the acquired data. The applied SLR method forms a solid foundation for examining and exploring related literature that serves as the basis for understanding the impacts of the development of the aluminum industry on community welfare and national defense.

## **RESULT AND DISCUSSION**

### **Research Results Scheme or Diagram (PRISMA)**

Chart 1: Describing the steps of the article selection process, referring to the Preferred Reporting Systematic Reviews and Meta-analysis (PRISMA) guidelines. A total of 80 articles were successfully identified in the initial search phase covering the period from 2014 to 2024. After undergoing the screening process, 7 articles were selected for further evaluation and synthesis to be included in the final literature review report. This selection process was conducted carefully to ensure that the chosen articles were relevant and aligned with the desired scope of the research. These steps adhere to the PRISMA guidelines, ensuring the quality and precision of the article selection and ultimately establishing a robust literature foundation for this study.

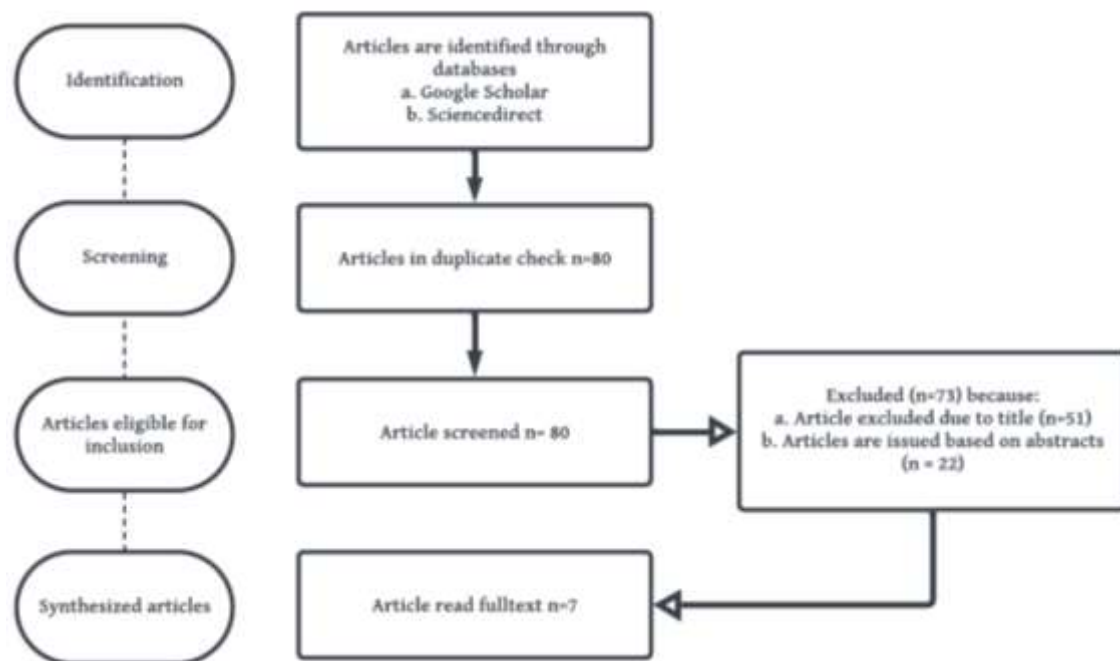


Chart 1. PRISMA Diagram

The researcher conducted the selection of obtained articles and extracted data from each article acquired from various databases. The results of these articles were reviewed regarding dampak pengembangan industri aluminium terutama terhadap kesejahteraan masyarakat dan pertahanan negara.

Table 1. Previous Studies

Title and Researcher	Objective	Results
Environmental and Social Impacts of Hydroelectric Dams in Brazilian Amazonia: Implications for the Aluminum Industry. (Fearnside, 2016)	To highlight the impact of aluminum processing on electricity consumption and the effects of dam construction worldwide, with a focus on the development plans for numerous hydroelectric dams in the Amazon region of Brazil and its neighboring countries.	The research findings indicate that the dam impacts encompass not only economic aspects but also perverse political and social consequences. Aluminum exports serve as an example of why reconsidering energy usage is crucial as a starting point for revising energy policies.
Research and Development (R & D) Sebagai Pilar Utama dalam Membangun Ekonomi Industri Pertahanan Indonesia. (Susdarwono, 2020)	To explain how research and development (R&D) in defense are utilized to accelerate the economic self-sufficiency of Indonesia's defense industry.	The research results reveal that the development of competitive defense technology through R&D supports not only addressing security threats but also making Indonesia relevant in global competition.
Circular Economy: Questions for Responsible Minerals, Additive	To discuss the potential of two parallel trends yet to be connected, namely responsible mineral	The research outcome emphasizes the need for an integrated research agenda that combines two parallel

Manufacturing and Recycling of Metals. (Giurco, Littleboy, Boyle, Fyfe & White 2014)	supply chains and additional manufacturing, known as 3D production systems, in the context of the global circular economy.	trends, responsible mineral supply chains, and additional manufacturing (3D production systems), to support Australia's opportunities in the circular economy.
Motivasi Indonesia Menghentikan Ekspor Mineral Mentah Jenis Bauksit ke Tiongkok Pasca Pemberlakuan Undang-Undang Minerba No. 4 Tahun 2009 (Fauzi & Harto, 2017)	To explore the impact of Indonesia's bauxite export policy to China following the enactment of Mining and Coal Regulation No. 4/2009.	The research findings indicate that Indonesia's bauxite export policy has a significant impact on the dynamics of trade relations between Indonesia and China. Furthermore, it is revealed that China responded to this policy by reducing bauxite supply from Indonesia and increasing investments in smelter construction in Indonesia.
How aluminum changed the world: A metallurgical revolution through technological and cultural perspectives (Ashkenazi, 2019)	To review the history of aluminum from technological, cultural, and social perspectives, spanning from its discovery to the 19th and 20th centuries until today.	The research results show that aluminum has a high strength-to-weight ratio, good thermal conductivity, and corrosion resistance, making it an attractive material for various applications in transportation, electricity, packaging, architecture, and food industries.
The Aluminium Industry: A Review on State-of-the-Art Technologies, Environmental Impacts and Possibilities for Waste Heat Recovery (Brough & Jouhara, 2020)	To provide a comprehensive overview of the aluminum production process, from ore to finished alloy products.	The research results include a thorough understanding of the aluminum production process, the latest technologies used, and the environmental impacts generated. Additionally, the research presents the application of waste heat recovery technology as a potential method to reduce energy consumption and environmental impact in the aluminum industry.
Kepentingan Nasional Amerika Serikat Dalam Penerapan Pajak Produk Baja Dan Aluminium China Tahun 2018 (Fragrans & Hartati, 2023)	To determine the reasons behind Donald Trump's imposition of tariffs on Chinese steel and aluminum products in	The research findings indicate two main reasons for the imposition of tariffs by the United States on Chinese steel and aluminum products in 2018: political interests and

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2018 and to explore the economic interests. This outcomes of that policy. This policy became part of the trade war between the United States and China, causing both support and opposition globally.

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Source : Data Processed by Researchers, 2024

### **Development of Aluminum Industry in Indonesia**

In recent years, the aluminum industry in Indonesia has experienced significant growth, reflecting the positive economic development of the country (Pratama, 2020). Aluminum production continues to increase, indicating investments and a focus on sector development. This industry plays a crucial role not only in boosting the national Gross Domestic Product (GDP) but also in positively impacting the welfare of the society. Investments in modern technology serve as a primary driver for growth, improving production efficiency, product quality, and enhancing the competitiveness of Indonesia's aluminum industry in the global market (Hanafi et al., 2019). Product diversification and market expansion are also trends in this industry, aiding in creating a broader market share and improving competitiveness at the international level. However, environmental impact challenges need careful management. Increasing awareness of sustainability and sustainable production practices is crucial for maintaining societal support. Dependency on the import of raw materials, especially bauxite, is a concern. Therefore, diversification of raw material supplies and investment in bauxite processing into alumina are crucial steps to enhance the sustainability of the aluminum industry (Jaya, 2021). The Indonesian government continues to support the growth of this industry through incentive policies and supportive regulations. According to data from the Central Statistics Agency (CEIC, 2023), Indonesia reported raw aluminum imports totaling 19,311 USD in April 2023, a decrease compared to the previous month's 27,356 USD in March 2023. This data reached its highest point at 56,047 USD in July 2021 and its lowest record at 8,621 USD in May 2020, with an average from January 2019 to April 2023 of 20,742 USD, as illustrated in Figure 1.



Figure 1. Import Volume: Unwrought Aluminium

Source : Central Statistics Agency (CEIC, 2023)

### **Improving Community Welfare through the Aluminum Industry**

The increase in production and utilization of aluminum has become one of the main pillars in improving the welfare of the Indonesian society (Styawati et al., 2023). A significant contribution to the national economy is the result of the rapid growth of the aluminum industry. With the rising production, there are significant opportunities to create new job opportunities,

assist in reducing unemployment rates, and positively contribute to the overall income levels of the society. The importance of the aluminum industry in job creation not only impacts the level of economic well-being but also contributes to the increase in people's income (Husnaeni, 2022). With more job opportunities, the community can secure stable income sources, which, in turn, affect the improvement of purchasing power and overall quality of life. The increasing income levels of the society serve as a positive indicator of the aluminum industry's contribution to the overall economic welfare.

The adoption of cutting-edge technology in the aluminum industry has a positive impact on the qualifications of workers. The improvement in qualifications encompasses not only technical aspects but also involves enhancing the skills and expertise of workers (Purusottama et al., 2022). The advanced technology adopted in the production process not only increases productivity but also provides opportunities for workers to develop new skills. Thus, the adoption of the latest technology stimulates the growth of societal well-being through the enhancement of workers' qualifications, creating a more dynamic work environment, and supporting the development of individuals and collectives. Through the combination of increased production, job opportunities, income growth, and the adoption of modern technology, the aluminum industry plays a significant role in achieving improved societal welfare in Indonesia.

### **Social Challenges in the Growth of the Aluminum Industry**

The growth of the aluminum industry, despite providing a positive contribution to the economy, poses several social challenges that need to be seriously considered. One major challenge is the displacement of traditional jobs due to industrial modernization. Changes in production technology and the need for new skills can lead to the loss of traditional jobs, requiring adaptation and skill enhancement from workers (Berger & Frey, 2016). Furthermore, industrial growth can also lead to uncontrolled urban expansion around industrial facilities. This can put pressure on city infrastructure, such as high population density, a lack of affordable housing, and traffic congestion. Therefore, wise urban planning is necessary to manage population growth, taking into account its impact on the quality of life and the well-being of the local community.

In addition, waste management and environmental impact are critical challenges that must be addressed in the development of the aluminum industry. The aluminum production process can generate significant waste and potentially harm the surrounding environment (Mahinroosta & Allahverdi, 2018). Hence, strict and effective policies are required to address potential environmental impacts, including sustainable waste management and the adoption of environmentally friendly technologies. Facing these challenges, collaboration between the government, industry, and the community is crucial. Involving the community in the planning process, overseeing the implementation of environmental policies, and developing skills training programs for affected workers can help reduce negative impacts and enhance the social benefits of aluminum industry growth. With a holistic approach, this industry can continue to grow sustainably without compromising social justice and environmental sustainability.

### **Dynamics of Aluminum in National Defense**

Aluminium plays an unquestionable strategic role in maintaining national security, particularly in military equipment and defense technology (Safrilana & Khairuman, 2023). As a primary material in the production of military equipment such as fighter aircraft, armored vehicles, and advanced weapon systems, the sustainability of aluminium supply is essential for the reliability and effectiveness of a nation's defense tools. The increase in aluminium production and utilization directly contributes to enhancing a country's defense capabilities. With an adequate supply of aluminium resources, a nation can consistently develop and update its inventory of military equipment (Sverdrup et al., 2015). This provides an advantage in maintaining national security, ensuring military readiness, and facing potential external threats.

However, a notable challenge is the excessive dependence on aluminium as a key resource for national defense. This risk can manifest in the form of global price fluctuations, resource conflicts, or supply disruptions. Therefore, to enhance resource resilience and reduce the risk of sole dependence on aluminium, nations need to adopt strategies such as resource diversification and the development of alternative raw materials. Consequently, it is crucial for governments to design national security strategies that include resource diversification and the pursuit of alternatives to mitigate dependence on aluminium. Empowering local resources and international collaboration can be key steps in addressing these challenges. Thus, nations can achieve better resource resilience, mitigate potential risks, and maintain the sustainability of their national defense capabilities.

### **Policy Implications of Aluminum Industry Development**

The importance of policies in responding to the development of the aluminum industry in Indonesia brings significant implications, especially concerning the welfare of society and national defense.

#### **1. Welfare Enhancement Policy**

This policy underscores the need to ensure that the benefits of the aluminum industry's growth permeate evenly across society. Regulations and incentives supporting fair distribution of outcomes, including increased wages, safe working conditions, and the participation of local communities in industry-related decision-making processes, are essential. This policy recognizes the crucial role of the community in the sustainability of national economic growth.

#### **2. Sustainable Defense Strategy**

The implications of this policy highlight the necessity of considering sustainability and the security of resource supplies in national defense policies. In the context of the aluminum industry, the government must ensure that dependence on specific resources, such as aluminum, does not create risks to national security. Diversification of resources and investments in research and development of alternative resources are strategic steps to achieve sustainability in the context of national defense.

#### **3. Balance Between Defense and Welfare**

This policy reflects the importance of maintaining a balance between the needs of national defense and the welfare of society. While national defense is crucial for ensuring a country's security, it should not compromise the welfare of the population. This policy emphasizes the need for harmonization between investments in defense and social development, ensuring that economic growth and national security are inseparable from the sustainability of social welfare.

In implementing these policies, the roles of the government, industry players, and the community are crucial. Well-thought-out and wise policies can create an environment that supports a balance between economic sustainability, national security, and social welfare. Thus, the formulation of sustainable policies oriented toward common interests can have long-term positive impacts on overall national development.

## **CONCLUSION**

The aluminum industry in Indonesia has experienced significant growth, reflecting positive economic development. This growth has had a positive impact on the welfare of society through increased production, job opportunities, and the adoption of the latest technologies. Despite contributing positively, the growth of the aluminum industry also poses challenges such as job displacement, uncontrolled urban growth, and environmental impacts. The dynamics of aluminum in the context of national defense underscore the importance of resource

diversification and security supply strategies. The emerging policy implications include the need for policies that support equitable distribution of the benefits of industrial growth, sustainable defense strategies, and maintaining a balance between defense needs and societal well-being. Collaboration among the government, industry, and the public is key to implementing these policies, with the hope of creating a balanced, sustainable environment that supports national development.

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