



## Animal Welfare Claims in Indonesia: Comparative Study of EU Standards and Proposed Regulatory Framework

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(Received 01-07-2025; Revised 15-07-2025; Accepted 21-08-2025)

### ABSTRACT

Animal welfare regulations in Indonesia have undergone recent developments, particularly with the proposed umbrella regulation for animal welfare under ministerial regulations. This development is intended to provide legal clarity and serve as a foundation for future welfare-related policies. However, a clear and harmonized animal welfare claims framework is still missing. In contrast, the European Union (EU), as a pioneer and frontrunner in animal welfare governance, has established a comprehensive standards and labelling framework. Taking from the 2009 European Commission's animal welfare claims classification, this study aims to evaluate how Indonesia's existing and proposed certifications related to animal welfare schemes, including Veterinary Control Number, organic, geographical indication, and halal, could be restructured to fit within a welfare claim framework. Through a comparative legal analysis, the study identifies regulatory gaps and opportunities to improve animal welfare policies in Indonesia. Particularly, the adoption of selected practices that have already been implemented in the EU could help Indonesia improve regulatory coherence, support food safety, and enhance its competitiveness in global trade.

**Keywords:** *animal welfare; animal welfare claim; comparative law; food labelling*

### INTRODUCTION

The issue of animal welfare is commonly perceived to be of significant ethical concern. However, it has also deep implications for food safety, environmental sustainability (Sardar *et al.*, 2023), animal productivity and the quality of animal-origin food products (Sinclair *et al.*, 2019), human well-being protection (Raheema & Mohd Omar, 2019), and multiple socio-economic advantages (Mohamud *et al.*, 2023). Moreover, the attention to ethical food production is increasingly gaining momentum across the globe (Fernandes *et al.*, 2021), and consumers are becoming gradually more aware of production practices (Sinclair *et al.*, 2022). As a consequence, the recent tendencies in consumers' behaviours have the potential to influence countries' international reputations (Fernandes *et al.*, 2021). Although animal welfare is not explicitly recognized as a trade barrier under the normative texts of the World Trade Organization, it is a significant and sensitive issue in global markets (Pastorino & de Almeida, 2023). Indeed, countries with strong animal welfare standards are more likely to gain consumer trust (Truong *et al.*, 2022) and improve their reputation in international trade (Fernandes *et al.*, 2021).

Within this context, the European Union (EU) has long been the pioneer and frontrunner in advancing

animal welfare policy (Molitorisová & Burke, 2023). Since the Brambell Report (1965) laid the foundation for modern welfare principles (Majewski *et al.*, 2024), the EU has systematically expanded its regulatory framework by integrating welfare considerations into legislation (Molitorisová & Burke, 2023) and spreading the value to its commercial partners (Pastorino & de Almeida, 2023). The report's conclusions arguably shaped the first EU-wide animal welfare laws introduced a decade later (Giangaspero & Turno, 2024). Consequently, EU animal welfare standards often exceed minimum legal requirements, and they are deeply embedded in societal values, including through animal welfare claims that enhance transparency and inform consumer choice (Alonso *et al.*, 2020; Giangaspero & Turno, 2024).

In contrast, animal welfare has only been gaining relevance in recent times in Indonesia due to pressure from the international community. For instance, in the 2020 Animal Protection Index by World Animal Protection, Indonesia received an "E" rating (World Animal Protection, 2020). The main challenges identified concern outdated regulations, the absence of comprehensive welfare standards, and weak law enforcement (World Animal Protection, 2020). Existing certifications, such as the Veterinary Control Number

(Dharma *et al.*, 2022), organic (Vaarst & Alrøe, 2012), geographical indication/GI (Regolo *et al.*, 2025), and halal (Tamimah *et al.*, 2018), do incorporate certain welfare principles, but they remain quite fragmented. In response, the Ministry of Agriculture is currently drafting a new umbrella regulation, including a dedicated system for animal welfare claims (Holley & Sutar, 2022). However, a further challenge is represented by the decentralization policy, which delegates certification responsibilities to provincial authorities, all with varying capacities and authority levels across regions (Mulyadi *et al.*, 2024). Without careful coordination, this may lead to inconsistencies in implementation. While Indonesia witnesses a global shift towards ethical food production, a comprehensive and enforceable regulatory framework for animal welfare claims is still missing. Through a comparative analysis of EU standards and Indonesia's existing and proposed regulations, this paper aims to assess the potential benefits and challenges of adopting selected EU approaches. The findings of this study are expected to contribute to the development of a coherent and context-sensitive policy that can strengthen animal welfare implementation in Indonesia, improve food safety, and enhance its competitiveness in the global market.

## MATERIALS AND METHODS

This study employs a qualitative legal comparative approach, combining document analysis and semi-structured interviews involving Indonesian animal welfare officials from the Ministry of Agriculture. Prior to the interview, informed consent was obtained from all participants, including permission to use their insights publicly for academic and policy-oriented purposes. The data sources include policy documents, draft ministerial regulations (unpublished), EU regulations (e.g., Regulation (EU) 2017/625, Directive

1999/74/EC), Indonesian regulations (e.g., Law No. 18 of 2009, Government Regulation No. 95 of 2012), and relevant academic literature. The interview data were used primarily for illustrative and contextual purposes, with selected statements cited based on their relevance to the regulatory framework discussed in the paper.

To ensure a structured and comparative analysis, this study adopts the classification framework outlined in the European Commission's 2009 report on animal welfare labelling, which distinguishes between dedicated claim (labels focused exclusively on animal welfare), multi-sector claim (labels that include animal welfare among multiple sustainability or quality criteria), and indirect claims (labels not intended for animal welfare but with positive effects on it). This framework is applied to examine four existing Indonesian certification schemes: Veterinary Control Number, organic, GI, and halal, as well as the proposed dedicated animal welfare claim. The ultimate aim is to support the development of a coherent, integrated, and credible animal welfare claims policy in Indonesia.

## RESULTS

### Animal Welfare Claim: The Main Concept

To provide a structured understanding, animal welfare claims can be categorized based on the following criteria: primary focus and scope, authority and independence, approach used, and obligatory nature, as listed in Table 1.

### Legal Framework and Animal Welfare Claim in Indonesia

Animal welfare in Indonesia is regulated under several key legal frameworks. However, there is no one single comprehensive regulation which specifically addresses animal welfare claims. Moreover, in the

Table 1. Animal welfare claim categorization

Categorization	Criteria	Description
Primary focus and scope <sup>1)</sup>	Dedicated to animal welfare	Claims that exclusively focus on animal welfare practices.
	Multiple aspects including animal welfare	Claims that integrate animal welfare as part of broader certification schemes, such as organic farming
	Indirect effects on animal welfare	Claims that primarily address other factors (e.g., geographical origin, food safety) but have secondary impacts on animal welfare.
Authority and independence	Self-audits certification <sup>2)</sup>	Conducted internally by producers or companies without external oversight.
	Government certification <sup>3)</sup>	Issued and regulated by national or local authorities.
	Third-party certification <sup>4)</sup>	Managed by independent organizations or private certification bodies.
Approach used <sup>5)</sup>	Resource-based	Focuses on providing essential inputs such as food, shelter, and space.
	Outcome-based	Assesses actual welfare outcomes, such as animal health indicators.
	Continuous improvement-based	Encourages progressive advancements in animal welfare practices over time.
Obligatory nature	Mandatory scheme <sup>6)</sup>	Legally required, such as EU table egg labeling regulations.
	Voluntary scheme <sup>7)</sup>	Optional certifications chosen by producers to differentiate their products in the market.

Note: 1) Kara *et al.* (2009), 2) Manning *et al.* (2021), 3) Vogeler (2019), 4) Desai (2018), 5) Main *et al.* (2014), 6) Di Concetto (2024), 7) USDA (2025).

food production context, there is no official animal welfare claim scheme currently exists. However, several existing certification systems (either directly or indirectly) address elements of animal welfare. While these certifications are not explicitly categorized as animal welfare claims, they incorporate certain aspects in line with animal welfare principles. Based on the classification of animal welfare claims outlined in the European Commission's 2009 report on animal welfare labelling, four existing certification schemes in Indonesia can be mapped into this. Table 2 provides an easy-to-read overview.

Furthermore, Indonesia's Ministry of Agriculture is currently developing a dedicated animal welfare regulation through a new ministerial regulation. According to an official from the Directorate of Veterinary Public Health-Ministry of Agriculture (personal interview, July 12, 2024), this proposed framework aims to create a more structured and transparent system for animal welfare implementation, including its claim. The scheme is designed to be fully dedicated to animal welfare. The government will serve as the primary regulatory authority, responsible for creating regulatory guidelines, while certification and enforcement will be delegated to provincial authorities.

The same official stated that the proposed animal welfare claim system will operate as a voluntary scheme, allowing producers to opt in based on market demand and ethical considerations. The key components and operational structure of the proposed scheme are summarized in Table 3.

## Animal Welfare Standards and Claims in the European Union

The EU's animal welfare claim system can be generally divided into two main categories: mandatory and voluntary claims. The mandatory claim scheme applies exclusively to table eggs, covering both domestic and imported products, requiring all egg producers to register with a competent authority and receive a specific number for traceability.

In addition, the voluntary animal welfare claim schemes allow producers to include welfare-related labels on products at their discretion. These schemes are broadly classified as either retailer-led and non-retailer-led initiatives. A breakdown of these scheme types and their characteristic is presented in Table 4.

## DISCUSSION

A major milestone in the development of modern animal welfare principles was the introduction of the Five Freedoms in the 1965 Brambell Report (Pastorino & de Almeida, 2023). This report, issued by a British government committee on farm animal welfare chaired by Roger Brambell, laid the groundwork for recognizing animals' physical and behavioral needs (Webster, 2016). These freedoms (freedom from hunger and thirst; discomfort; pain, injury or disease; fear and distress; and the ability to express natural behavior) have since become the foundation of global animal welfare policies (Majewski *et al.*, 2024).

Table 2. Existing animal welfare claims in Indonesia<sup>1)</sup>

Aspects	Veterinary control number	Organic	Geographical indication	Halal
Legal basis	Minister of Agriculture Reg. No. 11 of 2020	Minister of Agriculture Reg. No. 64 of 2013	Minister of Law and Human Rights Reg. No. 10 of 2022	Law No. 33 of 2014 Government Reg. No. 39 of 2021
	Minister of Agriculture Reg. No. 17 of 2023			
Primary focus and scope	multiple aspects including animal welfare	multiple aspects including animal welfare	Indirect effects on animal welfare	Indirect effects on animal welfare
Authority and independence	Government certification	Mix: Government and third-party certification	Government certification	Mix: Government and third-party certification
Approach used	Resource-based	Outcome-based	Outcome-based	Resource-based and Outcome-based
Obligatory nature	Mandatory scheme	Voluntary scheme	Voluntary scheme	Mandatory scheme (by 2026)

Note: <sup>1)</sup>Indonesia JDIH (Legal Documentation and Information Network)

Table 3. The proposed animal welfare claim in Indonesia<sup>1)</sup>

Legal basis	Will be regulated through: A Minister of Agriculture regulation
Current stages	Legal review by the ministry's legal bureau
Primary focus and scope	Dedicated to animal welfare
Authority and independence	Government certification: The central government (Ministry of Agriculture) will create the regulatory framework.
	The certification process will be delegated to provincial authorities
Approach used	Continuous improvement
Obligatory nature	Voluntary scheme

Note: <sup>1)</sup> Directorate of Veterinary Public Health, personal interview, July 12, 2024

Table 4. The European Union's retailer-led animal welfare claim schemes<sup>1)</sup>

The schemes	Description	Examples
Welfare-centered	Prioritize high welfare standards and ensure strict compliance with animal well-being requirements	Italy: Esselunga, Coop, Conad Sweden: Hemkop, ICA Malmshorgs The Netherlands: Albert Heijn
Organic with less explicit welfare	Focus on integrating animal welfare within broader organic farming standards, but welfare is not their primary focus.	Italy: Natura Si France: Rayon Vert The Netherlands: Natuurwinkel Norway: Helios
Quality-combined with welfare	Link product quality with animal welfare practices, offering an added value approach	Italy: Despar, Proda, GS-Carrefour France: Carrefour, Auchan Sweden: Citygros/Hypermarket, Maxi ICA/Hypermarket The Netherlands: C1000, Edah Norway: Ultra, Centra, Meny
Minimal or no welfare focus	Labels that do not emphasize animal welfare but may use welfare-related claims as a marketing tool	Italy: Lidl France: Lidl Sweden: Willys The Netherlands: Lidl, Aldi Norway: Rimi, Kiwi, Joker

Note: <sup>1)</sup> Kjaernes *et al.* (2007)

'Animal welfare' is a term that encompasses both physical well-being and mental health of animals, providing a comprehensive framework for assessing and improving standards (Reimert *et al.*, 2023). While animal welfare claims refer to statements or labels used to market animal-origin food by emphasizing how well animals were treated during production (Bech-Larsen *et al.*, 2024), these claims aim to enhance consumer awareness and transparency (Alonso *et al.*, 2020), ensuring that food production aligns with ethical and regulatory standards (Sardar *et al.*, 2023). Traditionally, animal welfare claims were perceived as solely focused on animal treatment. However, modern frameworks have expanded the definition to incorporate multiple aspects, including food safety, environmental sustainability, and market differentiation (Manning *et al.*, 2021).

Depending on how a country defines and regulates welfare claims, these schemes may cover a wide range of approaches since there is no consensus on an internationally recognized mechanism for animal welfare (Di Concetto, 2024; Reimert *et al.*, 2023; Tsygantsova, 2021). The EU has been integrating animal welfare considerations into its legal and policy frameworks (Molitorisová & Burke, 2023). The foundation of the EU's commitment to animal welfare is laid out in the Treaty on the Functioning of the European Union (TFEU), specifically in Article 13, which recognizes animals as sentient beings (Giangaspero & Turno, 2024). This recognition ensures that animal welfare is taken into account in the development and implementation of EU policies (Martinez & von Nolting, 2023).

A pivotal milestone in the EU's animal welfare advocacy was the 2018 European Citizens' Initiative (ECI) "End the Cage Age", advocating for a ban on cages used in farming systems (Majewski *et al.*, 2024). The initiative's aim was to raise ethical and welfare

awareness of intensive farming. Moreover, this ECI led to its inclusion in the Farm to Fork Strategy (F2FS), a major EU policy aimed at transforming the food system (Majewski *et al.*, 2024; Stevenson, 2020). However, the recent political situation has raised uncertainties about the EU's long-term commitment to animal welfare (Di Concetto, 2024).

The EU system demonstrates a clear differentiation between mandatory and voluntary schemes. The mandatory claim scheme applies exclusively to table eggs (Di Concetto, 2024). This scheme falls under Commission Regulation (EC) No 589/2008 on Eggs Marketing Standards Regulation and Council Directive 1999/74/EC on the Protection of Laying Hens. While compliance with this scheme is compulsory, producers wishing to display specific animal welfare labels or logos must obtain additional voluntary certification (Kara *et al.*, 2009).

In addition, the voluntary animal welfare claim scheme falls under the Regulation (EU) No 1169/2011 on Food Information to Consumers, which is broadly classified as either retailer-led and non-retailer-led schemes (Kjaernes *et al.*, 2007). The former is driven by supermarket chains and the latter is initiated by NGOs, producers, or government agencies (Derstappen & Christoph-Schulz, 2023). This diversity of schemes, on one side, provides flexibility for producers to align with various consumer values and marketing strategies (Kara *et al.*, 2009). However, on the other side, it also creates challenges, especially as the overabundance of welfare labels can lead to consumer confusion and make it difficult for them to distinguish between claims (Cornish *et al.*, 2020; Giangaspero & Turno, 2024). This issue has been recognized at the EU level and also incorporated into the F2FS, which calls for the development of a harmonized animal welfare labelling framework. The strategy aims to streamline existing voluntary schemes, reduce consumer confusion, and enhance transparency



by setting minimum criteria for welfare claims across the EU (Di Concetto, 2024).

In contrast, Indonesia's primary legal framework for animal welfare is based on two fundamental laws (Safitri & Firman, 2021). Law No. 18 of 2009 and its amendments serve as the foundational legislation for livestock and animal health services. In addition, Government Regulation No. 95 of 2012 provides more specific provisions related to veterinary public health and the implementation of animal welfare measures. These regulations establish basic standards for animal treatment, transport, and slaughter.

Beyond livestock and veterinary laws, aspects of animal welfare are also addressed in Indonesia's criminal code. Law No. 302 of 1946, as amended by Law No. 1 of 2023, prevents acts of animal cruelty and ensures humane treatment. While this law provides some level of protection, it is not specifically designed to regulate animal welfare in food production. Furthermore, in terms of internationally recognized mechanisms, the Institutional Animal Care and Use Committee (IACUC), which oversees the ethical use of animals in research, has been adopted by several universities and research institutions in Indonesia. These institutions have implemented ethical clearance procedures that are aligned with international expectations (Retnam *et al.*, 2016). However, there is currently no nationwide legal mandate requiring IACUC implementation across all institutions, nor a harmonized standard regulating their operations (Wallis, 2023).

In the food production context, Indonesia currently lacks a formal scheme (World Animal Protection, 2020), although several established certification systems, including the Veterinary Control Number, organic certification, geographical indication and halal certification, implicitly incorporate animal welfare principles (Dharma *et al.*, 2022; Regolo *et al.*, 2025; Tamimah *et al.*, 2018; Vaarst & Alrøe, 2012). Furthermore, the recent development of a new ministerial regulation on animal welfare presents an opportunity to consolidate existing frameworks and establish a coherent system (DGLAHS, 2024). By establishing a dedicated framework for animal welfare claims, Indonesia aims to strengthen compliance and improve enforcement mechanisms. The scheme will result in the issuance of a certificate that verifies a business unit's consistent application of animal welfare principles, adherence to specific requirements, and implementation of continuous monitoring procedures (Herlin *et al.*, 2021; Main *et al.*, 2014). The upsides of this approach concern its flexibility and the possibility of avoiding regulatory burdens. However, it also presents several downsides. Producer participation may remain limited due to the potential increase in production costs and the need for significant investment in consumer education and awareness campaigns (Abdulahleem, 2022; Kara *et al.*, 2009). Furthermore, products with welfare claims are often priced at a premium, potentially discouraging purchases in price-sensitive markets (Fernandes *et al.*, 2021).

Other challenges concerning the newly proposed animal welfare certification system in Indonesia concern

the country's decentralized governance (Mulyadi *et al.*, 2024). Keeping certification responsibilities under provincial governments could lead to inconsistencies in how animal welfare claims are verified and implemented because authority and capacity vary significantly across provinces (Mulyadi *et al.*, 2024). This concern is particularly relevant given that the proposed animal welfare claim system is expected to replicate the certification process of the Veterinary Control Number, which also falls under veterinary public health and relies on provincial personnel (Directorate of Veterinary Public Health, personal interview, July 12, 2024). Consequently, there is a risk that provincial authorities may become overwhelmed in meeting certification demands (Setiawan *et al.*, 2022). By contrast, the EU employs a centralized monitoring mechanism, which helps ensure relatively consistent enforcement of standards across member states (Blanc & Faure, 2020).

Although the EU and Indonesia differ in their governance models, certain approaches, particularly the use of third-party certification (Di Concetto, 2024), may be worth adapting to the Indonesian context. Entrusting voluntary animal welfare claims entirely to accredited third-party bodies, as done in the EU, could help mitigate inconsistencies in provincial implementation. To achieve this, the Indonesian government should establish an official accreditation system for third-party certification bodies, ensuring they meet specific technical and ethical standards before being authorized to issue certifications (Vince, 2018).

Nevertheless, when viewed through the lens of the European Commission's 2009 classification of animal welfare claims (Kara *et al.*, 2009), Indonesia's existing and proposed certification systems already exhibit relevant characteristics, as further detailed in Table 5. While the EU's mandatory welfare scheme is limited to table eggs (Di Concetto, 2024), Indonesia's mandatory systems, such as the Veterinary Control Number and halal certification, apply more broadly across the animal-based food sector. Although Veterinary Control Number primarily targets food safety, it incorporates minimum requirements of animal welfare principles as one of its components (Dharma *et al.*, 2022). Likewise, halal standards, while grounded in religious practices, indirectly support welfare objectives through provisions on humane slaughter (Raheema & Mohd Omar, 2019; Tamimah *et al.*, 2018). Thus, recognizing and integrating these existing schemes into the upcoming animal welfare claims regulation could strengthen the Indonesian legal framework. According to Law No. 18 of 2009 in conjunction with Government Regulation No. 95 of 2012, this integration is highly feasible considering that the Ministry of Agriculture plays a central role in policy-making and consistently supports various initiatives related to animal protection and welfare.

In summary, this comparative analysis demonstrated that the EU model cannot be transplanted in its entirety. Rather, it supports a strategic adaptation, focusing on mechanisms that enhance label credibility, standard verification, and certification harmonization. Such an approach could strengthen Indonesia's regulatory coherence while maintaining its flexibility

Table 5. The comparison among animal welfare claims in the European Union and Indonesia

Schemes	Method	EU	Indonesia
Animal welfare claim <sup>1) 2)</sup>	Primary focus and scope	Dedicated only to animal welfare	Dedicated only to animal welfare
	Authority and Independence	Government and Third-party verification	Government: standards are made by central animal welfare authority, and verification processes are done by the provincial authority
	Obligatory	- Mandatory: only for table eggs, government do the verification - Voluntary: for all animal-based products. Third-party verification	Voluntary
Organic <sup>1) 3)</sup>	Primary focus and scope	Multiple aspects including animal welfare	Multiple aspects including animal welfare
	Authority and independence	Third-party verification	Government and third-party verification
	Obligatory	Voluntary	Voluntary
Geographical indication schemes <sup>1) 3)</sup>	Primary focus and scope	Under PDO/PGI Schemes Primarily focused on other aspects but have indirect effects on animal welfare	Under geographical indication schemes, primarily focused on other aspects but have indirect effects on animal welfare. However, this scheme is not very popular in Indonesia.
	Authority and independence	Government (European Commission)	Government
	Obligatory	Voluntary	Voluntary
Halal <sup>5) 6)</sup>	Primary focus and scope	Non-compliant with EU classification due to the practice of non-stun slaughter, which contravenes EU Animal Welfare regulations	Primarily focused on other aspects but have indirect effects on animal welfare (the process of animal slaughter can be performed using stunning, and the government recommends the use of a specific non-penetrative stunning method that complies with the fatwa issued by the Indonesian Ulema Council, and as well as complies with animal welfare principle)
	Authority and independence	Third party	The process is a combination of steps. Registration is conducted through a Halal Agency specifically under the Ministry of Religious Affairs; the verification process may be carried out by a third party
	Obligatory	Voluntary	Mandatory for all products by 2026
Veterinary control number (VCN) <sup>7)</sup>	Primary focus and scope	-	Multiple aspects focus on, including animal welfare.
	Authority and independence	-	Government: standards are made by the central authority, and verification processes are done by the provincial authority
	Obligatory	-	Mandatory for all animal-based producers. Serves as a minimum requirement for producers

Note: <sup>1)</sup> Kara *et al.* (2009), <sup>2)</sup> Directorate of Veterinary Public Health, personal interview, July 12, 2024, <sup>3)</sup> Minister of Agriculture Reg. No. 64 of 2013, <sup>4)</sup> Minister of Law and Human Rights Reg. No. 10 of 2022, <sup>5)</sup> Kumar *et al.* (2023), <sup>6)</sup> Law No. 33 of 2014 and Government Reg. No. 39 of 2021, <sup>7)</sup> Minister of Agriculture Reg. No. 11 of 2020

in practice. Instead of replicating the EU's complex labelling architecture, Indonesia could selectively adopt features that balance enforceability, administrative efficiency, and consumer trust, and, in this way, boost both domestic confidence and international competitiveness.

## CONCLUSION

This study identified five critical aspects in the comparison of animal welfare claims in Indonesia and the EU: legal authority, scheme structure, governance, third-party certifiers, and integration with established systems. The findings highlight that several existing certifications, such as the Veterinary Control Number,

organic, geographical indication, and halal, already incorporate various degrees of animal welfare principles. However, a unified legal framework for animal welfare claims is still missing. To improve legal clarity and coherence, Indonesia should establish a central regulatory framework that consolidates these certifications under a clear animal welfare claims structure. Given the country's decentralized governance, relying solely on provincial authorities may risk inconsistent enforcement. Also, integrating a nationally coordinated third-party verification system would be essential to support reliable certification. Furthermore, a two-tiered model is recommended: mandatory schemes like Veterinary Control Number and halal can serve as the minimum animal welfare

requirements, while voluntary schemes under organic, geographical indication, and the forthcoming dedicated claim can offer businesses the flexibility to adopt higher welfare standards. This would enhance legal clarity and consumer trust, while positioning Indonesia more competitively in global markets.

### CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organization related to the material discussed in the manuscript.

### ACKNOWLEDGEMENT

Gratitude is extended to the Indonesian Endowment Fund for Education (*Lembaga Pengelola Dana Pendidikan* – LPDP) for providing the financial support that made this research possible. The institution's commitment to advancing education and research has played a crucial role in supporting academic pursuits and contributing to the development of knowledge in this field.

### DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the author(s) used ChatGPT for language polishing. After using this tool/service, the author(s) reviewed and edited the content as needed and take full responsibility for the content of the publication.

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