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# Triple Helix Collaboration in PT. INALUM's Corporate Social Responsibility Program for Empowering Coastal Women in Kuala Indah Village

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**ABSTRACT**

This study examines the implementation of Triple Helix collaboration within PT. INALUM's Corporate Social Responsibility (CSR) program in empowering coastal women engaged in clam shell peeling activities in Kuala Indah Village through the utilization of clam shell waste. The research explores how collaboration among government, industry, and academia can create an innovative and sustainable empowerment ecosystem for coastal communities. The study employs a mixed-methods approach using a case study design integrated with Participatory Action Research (PAR). Quantitative data were collected through surveys involving 100 purposively selected respondents, while qualitative data were obtained from in-depth interviews, field observations, and document analysis. The research process included needs assessment, training on processing clam shell waste into calcium oxide-based products, participatory evaluation, and community mentoring. The findings indicate that the socio-economic conditions of coastal women remain relatively low, characterized by limited educational attainment, unstable daily income averaging IDR 50,000 from middlemen (tauke), and restricted access to empowerment programs. The study further reveals that Triple Helix collaboration contributes to emerging socio-economic transformation through product innovation based on coastal waste processing and strengthened community capacity. The collaboration also facilitated the emergence of five women as local innovation drivers within the community. To ensure long-term sustainability, stronger institutional support from Triple Helix actors, particularly local government, is required so that empowerment initiatives do not remain dependent on external intervention.

**Keywords:** Corporate Social Responsibility (CSR); Coastal Women Empowerment; Social Innovation; Triple Helix Collaboration; Waste Management

## 1. Introduction

The abundant potential of marine natural resources in coastal regions necessitates the establishment of sustainable governance mechanisms for coastal resources, as these areas remain highly vulnerable to economic, social, and environmental pressures (Winata, 2023). Within coastal communities, women play a particularly significant role in various household economic activities, including the processing of marine products such as clam shucking, as observed in Kuala Indah Village, Batu Bara Regency, North Sumatra.

Kuala Indah Village is one of the coastal villages endowed with considerable marine resources, including clams, octopus, and blue swimming crabs. In this village, women assume productive roles as clam shuckers, a

post-harvest occupation that constitutes an essential component of the local economic value chain. These women are predominantly fishermen's wives who actively contribute to sustaining household livelihoods. Such productive engagement in marine product processing demonstrates that coastal women possess substantial potential to strengthen family economies while simultaneously serving as integral actors in local development processes (Wulandari et al., 2022).

Nevertheless, coastal women frequently experience social, economic, and even environmental marginalization due to limited access to education, information, and other supporting resources (Firdausi et al., 2021; Sudarso et al., 2019). In addition to low daily incomes and labor dependency on local middlemen (tauke), the intensive labor activities undertaken by coastal women's groups have also raised environmental concerns, particularly pollution from discarded shell waste and other by-products of marine processing that are indiscriminately disposed of in coastal areas. Structural challenges, such as restricted access to education, training, information, and economic capital, further hinder efforts to empower them (Firdausi et al., 2021).

Evaluation studies of the implementation of CSR programs by PT Indonesia Asahan Aluminum (INALUM) in Kuala Indah Village reveal that although the company has implemented CSR initiatives through various social interventions, most of these programs have yet to generate sustainable empowerment impacts. Isdaputra and Aisyah (2025) assert that the low sustainability of INALUM's CSR programs is primarily attributable to insufficient post-program assistance, weak local beneficiary institutions, and the absence of an optimal viable exit strategy to ensure community transition toward self-reliance. These findings are consistent with the study of Dima Jamali and Charlotte Karam (2018), which demonstrates that CSR implementation in many developing countries continues to be dominated by a compliance-based philanthropy approach, whereby CSR is conducted merely to fulfill regulatory obligations and corporate legitimacy rather than functioning as a participatory development instrument oriented toward long-term social transformation. Consequently, many CSR programs remain normative, top-down, short-term in orientation, and ineffective in building sustainable community institutional capacity.

The convergence of these developmental actor limitations indicates the existence of both conceptual and empirical gaps in the governance of coastal community empowerment. First, there is a discrepancy between the design of CSR programs and the structural needs of local communities. Second, there is a gap between academic knowledge production and its social implementation at the community level. Third, weak coordination among development actors has undermined program sustainability. Within the framework of collaborative governance, Chris Ansell and Alison Gash (2008) argue that the success of interventions is fundamentally determined by the quality of dialogue, trust, and a balanced distribution of roles among stakeholders (Bryson et al., 2015). The interconnection between knowledge, policy, and implementation thus becomes a crucial determinant.

Henry Etzkowitz and Loet Leydesdorff (2000) further emphasize that innovation is no longer linear but emerges through dynamic interactions among universities, industry, and government within a Triple Helix system. The Triple Helix framework is particularly relevant because it offers a collaborative model that integrates the role of government as regulator, industry as resource provider, and academia as knowledge producer within an interconnected innovation system (Etzkowitz & Leydesdorff, 2000; Leydesdorff, 2012). This approach enables the formation of a social innovation ecosystem grounded not merely in assistance-based interventions, but also in collective learning processes and community self-reliance.

Accordingly, this study aims to analyze the implementation of Triple Helix collaboration among government, industry, and academic actors within the CSR program of PT Indonesia Asahan Aluminum (INALUM) to empower coastal women clam shuckers through coastal waste management initiatives in Kuala Indah Village. More specifically, this research seeks to explain how collaborative interactions among governmental, industrial, and academic actors within CSR programs can foster a more adaptive and innovative empowerment ecosystem for coastal women in response to the complex realities and challenges they face.

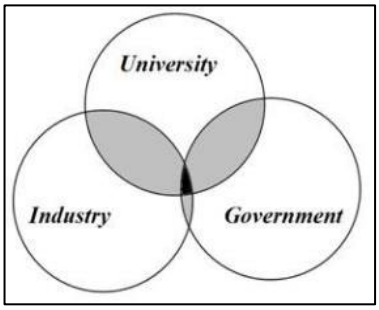


Figure 1. Triple Helix Model
Source: Leydesdorff, 2012

## 2. Method

This study employs a mixed-methods approach with a case study design integrated with Participatory Action Research (PAR). This approach was selected because the research not only aims to understand the phenomenon of Triple Helix collaboration in the empowerment program for female clamshell processors in Kuala Indah Village, but also to conduct social intervention in a participatory manner through cycles of diagnosis, action, and evaluation. According to Creswell & Clark (2018), mixed methods enable the integration of quantitative and qualitative data to produce a more comprehensive understanding, while Yin (2018) emphasizes that case studies are used to examine contemporary phenomena in depth within real-life contexts. The quantitative approach was applied through surveys to identify the community's socio-economic conditions, perceptions of the program, training needs, and potential for developing innovation based on coastal waste. Meanwhile, the qualitative approach was used to gain an in-depth understanding of the dynamics of collaboration among government, industry, academia, and the community in implementing the empowerment program.

The research was conducted over 10 months (January–October 2024) in Kuala Indah Village, Sei Suka Sub-district, Batubara Regency, North Sumatra. The location was purposively selected as it is a ring-1 coastal area of PT. INALUM is characterized by dominant clam harvesting and shell-peeling activities that generate large amounts of shell waste.

The study population consisted of all clam collectors and shell processors in Kuala Indah Village. The study's focal area was Dusun IV, the main center of activity. The study involved 100 survey respondents selected through purposive sampling based on the following criteria: permanent residency in the village, occupation as clam collectors or shell processors, and active involvement in coastal economic activities.

The initial stage of the research was conducted through a survey and needs assessment to map socio-economic conditions, levels of need, and community readiness for participation. Needs assessment is the process of identifying gaps between actual and desired conditions to determine intervention priorities (Kaufman, 1999). The results of this stage were used as the foundation for participant selection.

Based on the survey results, 20 core participants were selected purposively using indicators of motivation, willingness to learn, openness to innovation, collective working ability, and commitment to participate throughout the program. This selection aligns with a community-based empowerment approach that emphasizes change through local change agents (Chambers, 1997) and with the diffusion of innovation theory, which highlights the role of early adopters in the adoption of social innovation (Rogers, 2003).

Subsequently, the 20 participants attended a two-day innovation-based training using a learning-by-doing method focused on processing clam shell waste into calcium oxide (CaO)-based products. The training covered technical stages including cleaning, drying, burning, crushing, sieving, and calcium derivative production.

After the training, a participatory evaluation was conducted to assess leadership capacity, technical skills, consistency of participation, and social mobilization capacity. Based on this evaluation, five individuals were selected as local heroes, local actors who function as drivers of program sustainability (Ife, 2016). These local heroes then received intensive mentoring, including entrepreneurship guidance, strengthening production capacity, product innovation development, and communication facilitation through direct assistance and a

WhatsApp-based digital group. This approach aimed to build community leadership and ensure program sustainability beyond the research intervention.

Data collection techniques included surveys, in-depth interviews, observation, and document analysis. Surveys were used to collect quantitative data, while semi-structured interviews were conducted with village government officials and PT. INALUM representatives, academics from Universitas Sumatera Utara, and female clamshell processors. Observations were conducted to examine field conditions and program implementation, while documentation was used to analyze CSR reports, village archives, and activity records.

Quantitative data were analyzed descriptively using percentage tabulation. In contrast, qualitative data were analyzed using the interactive model of Miles, Huberman, and Saldaña (2014), which consists of data reduction, data display, and conclusion drawing/verification. Data validity was strengthened through source and method triangulation to ensure consistency and credibility of the research findings.

## 3. Result and Discussion

### *3.1 Socio-Economic Profile of Female Clamshell Processors in Kuala Indah Village*

Clam harvesting activities are concentrated in Dusun IV of Kuala Indah Village. Every morning during low tide, clam collectors walk approximately 2 km to the coast to harvest clams by hand. The daily catch can reach 15–60 kg per person. After that, the clams are shucked to extract the meat, an activity predominantly carried out by women. Based on field data, survey participation was dominated by women, as shown in Table 1. Most respondents are housewives in the productive age group, with the majority aged 31-40.

Table 1. Respondents' Gender

| Gender | Percentage | Frequency |
|---|---|---|
| Male | 7% | 7 |
| Female | 93% | 93 |
| Total | 100% | 100 |

The findings on respondents' socio-economic conditions indicate that the majority of female clamshell processors are in an unfavorable socio-economic situation. In general, they have low educational attainment, limited to elementary school (SD), and a considerable number have never received formal education. According to one respondent, this condition is influenced by the coastal community's mindset, which prioritizes practical skills in marine-based work over formal education. This factor is a structural determinant of low-income levels and overall welfare.

Economically, these women work under the coordination of a tauke, with a wage of IDR 2,500 per kilogram of processed clams. Based on interviews and field observations, their daily income is generally below IDR 50,000, and they face relatively high household dependency burdens and daily expenditures disproportionate to their earnings.

Compared to the Regional Minimum Wage in Batubara Regency in 2024, which is approximately IDR 3,000,000 per month (or around IDR 100,000 per day), there is a significant income disparity. With an average daily income of less than IDR 50,000, female clamshell processors earn only about 40–50% of the formal minimum income standard. This indicates a substantial income gap between the actual conditions of informal coastal workers and regional wage adequacy standards.

This disparity is not only nominal but also structural, as they are excluded from formal employment systems that guarantee minimum wage standards, social security, and labor protection. The situation is further exacerbated by high household dependency ratios, daily income fluctuations, and reliance on tauke-based patronage systems, which significantly weaken their bargaining position within the local economic value chain. Consequently, this condition leads to chronic economic vulnerability, including dependence on debt to meet basic household needs. The statement of one respondent reinforces this:

*"Because the income is not sufficient, while household needs are many, sometimes we have to borrow money from shops to cover daily necessities."* (Interview, Mrs. F, 2024)

*3.2 Needs Analysis Result*

The daily activities of clam harvesting and shelling carried out by female clamshell processors in Kuala Indah Village have generated new environmental issues. Based on field observations, a significant accumulation of clam shell waste, amounting to hundreds of kilograms, was found scattered along the coastal area. This condition has the potential to cause environmental impacts, as such organic waste may increase Biological Oxygen Demand (BOD) during decomposition when exposed to sunlight and seawater, thereby posing risks to coastal ecosystems and public health. This is further supported by an interview with one respondent, who stated:

*"Once the shells pile up, the fishy smell starts to become noticeable. We usually just focus on shucking because that is what directly generates income."* (Interview, Mrs. S, 2024)

The survey results in Dusun IV, Kuala Indah Village, Sei Suka Sub-district, Batubara Regency, indicate that coastal waste issues have become a problem directly experienced by the community. The majority of respondents (94%) stated that clam shells are always scattered in the surrounding environment; however, 63% admitted they have never collected or managed the waste. However, 78% of respondents acknowledged that clamshell waste is the most common type in their area. This condition indicates that coastal waste is perceived as an environmental issue that has not been optimally addressed.

On the other hand, there is a relatively high level of awareness of the potential for waste utilization. As many as 99% of respondents agreed that coastal waste should be processed into products with economic value for the community. In addition, 17% of respondents stated that they had previously collected or requested waste from others for reuse. Community expectations regarding waste management are also diverse, with 29% of respondents expressing the desire for more optimal waste utilization through training and processing activities that could increase household income. This is further emphasized in the following interview:

*"If someone could teach us how to process these shells, we would definitely be willing. If it has benefits, it would be a pity to throw it away."* (Interview, Mrs. R, 2024)

Other important findings indicate a very high need for waste management training. As many as 97% of respondents stated that they had never received any training on clam shell waste management, and 86% had never received training from local government regarding the utilization of such waste. Furthermore, 92% of respondents had never been trained in producing derivative products such as calcium from clam shells.

Nevertheless, there is a very strong level of enthusiasm: 95% of respondents are willing to participate in training, 98% are interested in learning waste management techniques, and 99% are willing to provide waste materials for training practice. Even more notably, all respondents (100%) expressed readiness to participate in training on producing calcium-enriched water based on clam shell waste. The statement of one respondent reinforces this:

*"We have never received such training before, especially training on how to process clam shells into products. So far, they have been just discarded. The government has also never come to us to ask about our problems and needs."* (Interview, Mrs. S, 2024)

Furthermore, almost all respondents (99%) expressed their readiness to collaborate in transforming coastal waste management programs into innovative products with economic value. However, 67% of respondents reported never receiving any Corporate Social Responsibility (CSR) assistance from PT. Inalum. The assistance they had previously received was generally limited to basic food packages (19%), limited training activities (4%), and housing renovation programs (2%).

Overall, the majority of the community demonstrated limited knowledge of calcium and its derivatives, yet showed strong motivation to learn. This indicates strong potential for the development of empowerment programs based on innovations in coastal waste processing, which are not only oriented toward environmental improvement but also toward enhancing household economic conditions.

The needs analysis reveals that the community of Kuala Indah Village has a relatively high level of environmental awareness, accompanied by strong enthusiasm to participate in training and waste management programs. This condition provides an important foundation for developing more innovative, sustainable, and empowerment-based CSR programs, particularly by utilizing clamshell waste as an alternative economic resource for coastal communities.


Figure 2. Field Conditions of Clam Shell Activities in Dusun IV, Kuala Indah Village
(a) Female workers collecting clams along the coastal area ; (b) Accumulated clam shell waste along the coastal environment

*3.3. Triple Helix-Driven Social Innovation in Coastal Waste Management*

One of the innovations generated by this program is the development of a simple technology to process clam shell waste into organic calcium flour, which can be used as a liquid additive in food and beverage products. The processing stages include cleaning the clam shells, drying, heating, crushing, sieving, and boiling to produce calcium-enriched water ready for application in various food products. Although the technology used is relatively simple, this innovation holds strategic value as it transforms previously valueless coastal waste into a new economic resource for the community. This practice can be categorized as community-based social innovation.

According to Mulgan (2019), social innovation refers to efforts to create new solutions to social problems through the utilization of local resources and community participation. Such innovation not only generates economic value but also strengthens communities' collective capacity to address development challenges.

The use of clamshell waste as a raw material for innovative products also aligns with the circular economy concept, which emphasizes the reuse of resources within production systems. Ghisellini, Cialani, and Ulgiati (2016) explain that the circular economy aims to reduce waste by converting it into new resources that can be reintegrated into production processes. In the context of coastal communities, applying circular economy principles provides two main benefits: increasing community income while simultaneously reducing environmental pollution from coastal waste.

The subsequent stage of the program involves entrepreneurship mentoring activities for coastal women's groups. Based on previous training results, five women were selected as "local heroes" for their high capabilities and commitment to developing calcium-based enterprises. The mentoring process was conducted through several methods, including direct mentoring by academics and the establishment of a digital communication community via a WhatsApp group. This approach was designed to ensure that the empowerment process does not stop at the training stage but continues toward business strengthening.

The results of the mentoring program show that participants developed various innovative calcium-based products, including calcium-enriched salted fish, calcium-coated kembang goyang (traditional snack), calcium-coated roasted peanuts, calcium-enriched rengginang (rice crackers), calcium-enriched anchovies, and calcium-based body powder. Several examples of these innovations are presented in Figure 3 below.


Figure 3. Various Calcium-Enriched Innovative Products from Local Heroes

Products such as those presented in Figure 3 demonstrate that the community is not only capable of processing local raw materials but also of diversifying products that generate added economic value. This practice reflects the community economic development approach, namely an economic development strategy based on local potential and community participation. Smith (2019) states that the success of community economic empowerment programs is strongly influenced by the community's ability to enhance product value through innovation and appropriate marketing strategies.

Furthermore, this concept is consistent with the sustainable livelihood framework proposed by Chambers & Conway (1992), which emphasizes that the sustainability of community livelihoods depends on strengthening human, social, and economic assets through continuous mentoring processes. In this context, calcium-based product innovation is not merely the outcome of a short-term training program, but rather part of a long-term capacity-building process that requires institutional support and access to resources. Scoones (2015) emphasizes that the sustainability of community empowerment programs is largely determined by local institutions' ability to sustain innovation through social learning and strengthened collaborative networks.

Without post-intervention mentoring mechanisms, community innovations tend to remain at the initial adoption stage and fail to develop into independent enterprises. This is further reinforced by the capacity-building theory proposed by Morgan (2006), which holds that strengthening community capacity cannot rely solely on technical training but must also include continuous mentoring, strengthening local organizations, and improved access to markets and capital. In the context of this study, the presence of local heroes and academic mentoring represents an initial effort to build such capacity; however, it still requires long-term support from institutional actors, such as local government and industry. The sustainability of coastal waste-based product innovation, therefore, depends heavily on continuous mentoring, local-level institutional strengthening, and integration into a broader economic system. Without these elements, innovation risks stagnating at the project stage and failing to evolve into sustainable community economic transformation.

*3.4 Analysis of Actor Roles*

To better understand the dynamics of collaboration within the coastal women's empowerment program based on clamshell waste processing in Kuala Indah Village, this analysis employs the Collaborative Governance framework (Ansell & Gash, 2008; Bryson et al., 2015). This framework emphasizes three main dimensions, namely institutional facilitation capacity, the quality of inter-actor interaction, and the distribution of roles and resources. The framework is further enriched by the Triple Helix perspective (Etzkowitz & Leydesdorff, 2000), which positions government, academia, and industry as the three primary actors in the production of social innovation.

In the empirical context of this study, collaboration is not merely a formal division of roles, but rather a relational configuration that reflects a degree of asymmetry in access to resources, decision-making processes, and control over program sustainability. Therefore, the following analysis positions the three actors not merely as administrative entities, but as strategic actors with varying degrees of influence across the policy cycle and program implementation stages.

Table 2. Analysis of Triple Helix Actor Roles from the Perspective of Collaborative Governance

| Actor | Dimension of Collaborative Governance | Normative Role | Empirical Findings in the Field | Implications for Sustainability |
|---|---|---|---|---|
| Government (Village and Regency) | Institutional embeddedness and policy integration | Regulator, policy facilitator, and integrator of CSR programs into development planning | The government primarily plays an administrative facilitation and initial coordination role, but does not integrate the program into key development planning documents such as the Regional Medium-Term Development Plan (RPJMD) and the Work Plan (RKPD) | Indicates weak institutionalization of CSR, meaning program sustainability is not embedded within the government system but instead depends on external actors |
| Academia | Knowledge linkage and capacity building | Knowledge producer, innovation enabler, and bridge between science and society | Academia plays a dominant role across the entire innovation cycle, from problem identification and waste-processing technology design to training and mentoring local heroes. | Produces a strong academia-led innovation pattern, but creates a risk of structural dependency of the community on academic actors |
| Industry | Resource governance and strategic CSR | Resource provider, social investor, and strategic CSR agenda setter | Industry acts as the dominant actor in providing funding, program legitimacy, and social incentives, including awarding Antam gold to local heroes as a form of motivational reinforcement | Indicates a shift toward strategic CSR, while simultaneously strengthening the industry's position as an agenda setter that shapes program direction and incentives |
| Community (Local Hero) | Participation and co-production | Co-creator of social innovation and program implementer | Five local women heroes emerged, developing calcium-based products and acting as community drivers, although they still require continuous mentoring | Reflects an early stage of co-production but has not yet reached a self-sustaining institutional phase |

Based on Table 2 above, it can be affirmed that the Triple Helix configuration in this case does not operate in a symmetrical pattern as assumed in the ideal model proposed by Etzkowitz and Leydesdorff (2000), but instead reflects an asymmetrical collaborative governance pattern. This imbalance is particularly evident in the distribution of institutional capacity, where industry and academia exercise greater control over resources and knowledge. At the same time, the government remains primarily in a facilitative-administrative position, which has not fully translated into policy integration. Within the Collaborative Governance framework of Ansell & Gash (2008), this condition reflects a weak dimension of policy embeddedness, namely the absence of CSR program integration into the regional development planning system. Consequently, although the program demonstrates success at the implementation level, particularly in fostering product innovation and local heroes, it has not yet been institutionally embedded as part of a sustainable public development system. This reinforces the argument that the collaboration remains project-based rather than system-based.

The role of academia in this case exhibits strong characteristics as both a knowledge broker and innovation designer. However, the dominance of academia across the entire innovation cycle creates a dependency pattern that, in development literature, is referred to as an institutional dependency trap (Morgan, 2006). While the community has increased its technical capacity, it has not yet reached the stage of an autonomous innovation system. In other words, knowledge transfer has not fully evolved into the internalization of institutional capacity at the community level.

Meanwhile, the industry, in this case, PT. INALUM demonstrates a shift from a traditional CSR model toward a more outcome-based strategic CSR approach. The provision of appreciation in the form of Antam gold to local heroes can be understood not only as an economic incentive but also as a mechanism for institutional reinforcement aimed at strengthening the program's social legitimacy. However, from a governance

perspective, the dominance of industry in determining incentives also indicates a resource asymmetry, in which corporate preferences significantly influence the program's sustainability.

On the other hand, the emergence of local heroes as new actors within the innovation ecosystem represents an initial indication of co-production governance, as conceptualized in Ostromian governance literature. Nevertheless, their level of independence remains at an early stage, as they continue to rely on academic assistance and industry support, meaning they have not yet achieved institutional autonomy.

The implementation of the Triple Helix in this program has successfully generated community-based social innovation, but structurally, it remains at a transitional stage of governance. The collaboration has not fully shifted from a sectoral intervention model toward an institutionalized collaborative governance system. The unequal distribution of roles among actors indicates that program success is largely determined by resource holders (industry) and knowledge holders (academia). In contrast, the government actor has not yet functioned as a binding policy integrator within the regional development system.

This situation strengthens the argument that the sustainability of social innovation in coastal areas is not determined solely by the technical success of programs, but by the extent to which it is embedded within a broader public governance system. Without such transformation, innovation risks remaining at the level of CSR projects rather than becoming part of a sustainable, multi-actor collaborative development system.

## 4. Conclusion

The Triple Helix collaborative approach in the CSR program of PT. INALUM in Kuala Indah Village demonstrates that synergy among government, academia, and industry contributes to the emergence of community-based social innovation, particularly through the transformation of clam shell waste into calcium-based value-added products. Substantively, the program generates public value through three main achievements: (1) the initial utilization of clam shell waste as an economic resource within a circular economy framework, (2) the enhancement of technical capacity and the early development of entrepreneurial potential among coastal women, and (3) increased community knowledge and awareness regarding the utilization of local resources and potential.

However, this collaboration does not operate symmetrically as assumed in the ideal Triple Helix model. Instead, it reflects an asymmetrical collaborative governance pattern, where academia and industry play dominant roles in providing knowledge, resources, and innovation design, while the government remains primarily in an administrative facilitation role that has not yet been fully integrated into the regional development planning system. This condition indicates that program success is more evident at the level of innovation implementation, but has not yet been fully institutionalized within a sustainable public governance system.

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## 6. Conflict of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article

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