



INTERNATIONAL JOURNAL
OF LAW, GOVERNMENT
AND COMMUNICATION
(IJLGC)

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DEPOSIT-REFUND SYSTEMS FOR POLLUTION CONTROL: GLOBAL LESSONS AND POLICY IMPLICATIONS FOR MALAYSIA

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Article Info:

Article history:

Received date: 29.12.2025

Revised date: 15.01.2026

Accepted date: 11.02.2026

Published date: 01.03.2026

To cite this document:

Asmuni, S., Sulaiman, S., Ismail, Z., Sulaiman, N. A., & Khairul Anuar, F. S. (2026). Deposit-Refund Systems for Pollution Control: Global Lessons and Policy Implications for Malaysia. *International Journal*

Abstract:

Deposit-refund systems (DRS) are widely acknowledged as efficient and practical policy measures for pollution reduction alongside with the promotion of circular economy practices since they give the consumers the incentive to return used products and get the refund as a result. The Polluter Pays Principle has been operationalised by DRS and has resulted in countries with strong legislation, efficient infrastructure, and high public participation recording recovery rates of over 90 percent as seen in Germany, Norway, Canada, and South Korea. These examples show that DRS can be applied even in countries with different governance and cultural contexts. The planned introduction of DRS in Singapore in 2025 is another evidence of this growing trend in Asia. Even though Malaysia has implemented various laws and policies pertaining to waste management, it has not yet adopted DRS at the national level and consequently, due to weak governance, limited facilities, and dependence on informal waste collectors, it still records low recycling rates. The paper using international experiences as reference examines the suitability of DRS for Malaysia and suggests a gradual implementation that is backed by the provision of clear

of Law, Government and Communication, 11 (43), 01-13.

legislation, the establishment of collection and digital refund infrastructure, and the active participation of stakeholders. The adoption of DRS in Malaysia is predicted to enhance the country's waste management system, lessen the reliance on landfills, and speed up the achievement of its Sustainable Development Goals.

DOI: 10.35631/IJLGC.1143001 **Keyword:**

Deposit-Refund System (DRS); Economic Instruments for Pollution Control; Waste Management Policy; Circular Economy; Recycling and Resource Recovery; Malaysia Environmental Policy



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Introduction

The problems caused by pollution and the management of solid wastes have become critically serious in the whole world over the last few decades, due to the fast growth of cities, the increase of population and the changes in consumption patterns that have consequently strained the flow of materials and the generation of waste. One of the fastest-growing waste streams all over the world is packaging waste, particularly that of single-use plastics and drink containers, which are a huge burden both environmentally and financially on the very outdated waste management systems (UNEP, 2015; Kaza et al., 2018). Moreover, the latest global evaluations show that the lack of economic advantages for consumers is still one of the most important obstacles in getting better recycling results (Reloop Platform, 2024).

These hurdles are larger in Malaysia, where they are most evident. The amount of municipal solid waste generated has gone beyond 38,000 tons a day, and the disposal of plastic and drink containers is a major contributor to this figure (Department of Statistics Malaysia, 2022). Despite the 2007 Solid Waste and Public Cleansing Management Act and the National Solid Waste Management Policy, recycling rates are still low, and landfill is the most common disposal method (Ministry of Housing and Local Government Malaysia, 2007, 2016). Fragmented governance, limited return infrastructure, and heavy reliance on informal waste recovery are some structural constraints that have made the current approaches less effective.

The remaining drawbacks bring about a strong need for policy tools that are not just limited to conventional command-and-control regulation but rather to ones that directly affect the behavior of consumers and producers. The environmental policy scene has started to perceive market-based instruments as the ones having the potential to internalise externalities and encourage cost-effective behaviour change and thus won the attraction of more and more

people. Among all the different methods used, deposit-refund systems are considered to be the strongest in empirical research for drastically increasing recycling rates and reducing pollution from packaging waste.

Background

Deposit-Refund Systems as an Economic Instrument

A deposit-refund system is an upfront deposit of an economic policy instrument that mixes a monetary deposit paid at the time of purchase with a refund given if the product or its packaging is returned for proper recycling or disposal. This system at the same time prevents improper disposal and encourages material recovery, thus addressing waste-related externalities at the consumption level (Bohm, 1981; OECD, 2020). The DRS unlike taxes which unilaterally penalise and subsidies which only reward, integrates both approaches, thus making it more behaviourally effective.

The rationale behind the DRS is very much in the spirit of the Polluter Pays Principle. Consumers, by paying a refundable deposit, are not only the ones responsible for waste disposal but also have the chance to redeem the deposit through eco-friendly behaviour (Fullerton & Wolverson, 2000). A deposit-refund system has very recently been termed a core operational tool in circular economy strategies as it has the potential to enable material flows in a closed-loop manner and to lessen the draw on virgin resources (UNEP, 2011; Reloop Platform, 2024).

International Evidence

International experience has offered fantastic empirical evidence supporting the reliability of deposit-refund systems. Beverage containers have been subject to comprehensive DRS in Europe with countries like Germany, Norway, and Sweden consistently garnering return rates of over 85–95 per cent (OECD, 2020; Infinitum AS, 2022). Apart from these countries, other contributors like strong legal demands, development of return infrastructure and public interest have broadcast these high returns.

Just like in Europe, similar positive results were seen in the rest of the world. Canadian provinces continue to report 80-90% return rates, thanks to the DRS programmes that have been in place for a long time. South Korea's approach of integrating DRS into its overall waste fee and resource circulation framework has led to a remarkable improvement in container recovery (Waste Management World, 2021; South Korea Ministry of Environment, 2019). The news of Singapore rolling out its nationwide DRS in 2025 is yet another sign of the instrument's increasing acceptance in Asia (Zero Waste SG, 2022).

The Malaysian Context

On the other hand, the deposit-refund system has not been applied nationwide in Malaysia yet. The country's waste management mainly depends on landfilling and informal recycling, while formal recycling efforts are still divided and not uniformly supervised (Department of Statistics Malaysia, 2022). EPR issues have been addressed to some extent, and voluntary returns of products have been created; however, these actions are not powerful enough to change consumer behaviour as the mandatory DRS systems do (OECD, 2016).

The lack of an all-encompassing DRS is a huge gap in the policy area, especially when considering the commitments made by Malaysia to the Sustainable Development Goals and its budding circular economy plan (United Nations, 2015; MGTC, 2024). In this situation, it is important to consider a thorough evaluation of DRS as a possible policy option for Malaysia.

Objectives of the Paper

This paper proposes to examine the effectiveness of deposit-refund systems as an economic tool in managing pollution by positioning the discussion within the context of Malaysia. This paper has three objectives. First, it examines the conceptual framework of deposit-refund systems in different settings. Second, it examines the current state of waste management in Malaysia to look at the gaps that can be filled by deposit-refund systems. Third, it proposes policy guidelines on deposit-refund systems by examining the success of different experiences in different countries. In this manner, it provides its contribution to the larger discourse on how waste management can be made sustainable by exploring the potential of economic tools like deposit-refund systems in complementing present policies on the environment.

This paper endeavors to evaluate the function and significance of deposit-refund systems as an economic tool for the regulation of pollution, and this paper takes Malaysia as the case study. Specifically, the paper intends to (i) review the theoretical basis and fundamentals of DRS, (ii) explore best practices and success secrets worldwide, and (iii) make implications and recommendations concerning the use and implementation of DRS in the Malaysian framework for waste management (OECD, 2020; ReLoop Platform, 2024).

Conceptual and Theoretical Framework

Definition of Deposit-Refund Systems

A Deposit Refund System (DRS) is an economic tool used as an incentive for reducing pollution and increasing the recycling of waste by attaching the purchase of products to an exchange for a refund for the said item or packing after usage and return at an authorised collection point. This tool helps ensure that waste products for return and reuse are not just littered and left to create more garbage in the environment, as the individual is paid back for their money upon the return of the product or packing to an authorised collection point (Martinho et al., 2024).

Deposit Refund System: A Deposit Refund System is an economic tool whereby after the purchase of an item, linked to an exchange for money refund at an authorised collection point after usage and return. This ensures that at no point does the individual litter waste for possible reuse, as they must be paid back for the money they had paid for the item or packing (Bohm, 1981; Fullerton & Wolverton, 2000).

Theoretical Justification

The conceptual basis of DRS is primarily derived from environmental economics and behavioural theory. At the core of DRS is the Polluter Pays Principle, which aims to make private decision-making congruent with societal environmental costs (OECD, 2020). DRS from the standpoint of Behavioural Economics is based on loss aversion, whereby consumers are more likely to participate as they consider recovering a deposit paid to be a loss while

gaining is less motivating, an effect that is evident in their switching from voluntary schemes (Fullerton & Kinnaman, 1995; Ráti & Maró, 2025).

In addition, DRS is also seen to bolster circular economy goals by increasing the quality of materials obtained and the reduction of contamination levels in the recycling streams thus achieving the processing efficiency of the downstream (Aydın, 2025; Reloop Platform, 2024).

Relationship with Other Economic Instruments

Deposit-refund systems run parallel to other economic tools like environmental taxes, tradable permits, and subsidies. The unique feature of DRS is that it combines at the same time both disincentives and rewards, which makes it more effective in changing people's behavior (OECD, 2020). DRS also provides a helping hand to the EPR schemes by making the consumer's role in collection via producer-led recovery systems active (OECD, 2016).

Scope of Application

DRS has been applied all over the world to not only beverage containers but also to lead-acid batteries, motor oil, tyre, e-waste, and pesticide containers. These cases show how easily DRS can be used in different waste streams where the environment suffers the most or where the potential for recovery is the greatest (OECD, 2001; UNEP, 2015).

Relevance to Malaysia

In the context of Malaysia, the DRS is relevant since it has the potential to deal with the waste management challenges that have been around for a long time. Awareness campaigns have been done numerous times, but still the recycling participation rates are very low. The collection of waste is still largely dependent on informal sectors, and these sectors work without a proper incentive or a mechanism for accountability. Most of the waste is still going to landfills and voluntary take-back programs have not gained much popularity. These drawbacks show that Malaysia needs a more powerful policy tool that not only invites the public to participate but also gives measurable environmental results. The conceptual justification for DRS, with its proven success worldwide, therefore, makes it hard to ignore it as an option in the future environmental policy framework of Malaysia. Malaysia has the DRS relevance especially when the challenges of low recycling participation, fragmented governance and constant landfilling are considered. The outcomes of voluntary initiatives have been limited, which points to the need for stronger incentive-based instruments (Ministry of Housing and Local Government Malaysia, 2016; MGTC, 2024).

International Practices of Deposit-Refund Systems

Europe

In the implementation of deposit return schemes (DRS), Europe continues to hold the top position worldwide. Through its rigorous laws and an extensive network of reverse vending machines, the German DRS manages to get nearly all bottles back, with a return rate of nearly 98 per cent (OECD, 2020; Reloop Platform, 2024). Norway and Sweden also note recovery rates close to those of Germany, and this is due to besides centralised system operators and high public trust (Infinitum AS, 2022; Waste Management World, 2021).

North America

In North America, the Deposit Return System (DRS) is primarily in place on a subnational basis. Canadian provinces like Alberta and British Columbia manage to get back 80–90 per cent of used packaging by means of closely located depots and controlled refund systems (Waste Management World, 2021). The outcome in the United States is different from state to state, showing the impact of different deposit amounts and varying enforcement levels (OECD, 2020).

Asia-Pacific

The Asia-Pacific region is characterized by varying levels of experience for DRS schemes.” For example, the incorporation of DRS into the waste fee system in South Korea has allowed the country to reach recycling rates of around 80 percent as of 2019 (South Korea Ministry of Environment, 2019). Singapore is also launching a Singapore-wide DRS in 2025, which is “proof of growing consistency in the region to use tools based on the principles of the circular economy” (Zero Waste SG, 2022; Sensoneo, 2025).

Key Lessons from International Practices

Lessons from global experience with deposit-refund systems point in several directions. In the first place, strict legislation and active enforcement are the best guarantees of high recovery rates (OECD, 2020; Reloop Platform, 2024). In the second place, return infrastructure that is easy to use has the greatest impact on consumer participation (Infinitum AS, 2022). In the third place, public communication and industry involvement via centralised operators improve system legitimacy and efficiency (Waste Management World, 2021). In the end, flexibility is the main thing; the Asian cases show that DRS can be adopted in very different institutional and cultural settings (South Korea Ministry of Environment, 2019; Sensoneo, 2025).

Malaysia’s Current Context

Waste Management Landscape

Malaysia is continuously facing difficulties in solid waste management as the municipal waste generation per day already reached more than 38,000 tonnes. The most significant part of this waste is represented by plastics, beverage containers, and other packaging materials that could be recycled but are, however, quite often disposed of in landfills. The practice of landfilling is still the most common method of waste disposal, whereas recycling is being done at very low rates that are far below the world average. Over the years, the public's knowledge of recycling has risen, but still, people's involvement is not consistent and the separating of waste at the household level is not widely adopted yet.

Policy and Legal Frameworks

The Malaysian authorities have come up with a series of measures and regulations concerning waste management and pollution control. The Solid Waste and Public Cleansing Management Act 2007 gives the ground for the management of solid waste legally, and the National Solid Waste Management Policy promotes sustainability and sets recycling goals. Lately, Malaysia has also progressed the talk on the Circular Economy Roadmap and has applied parts of the Extended Producer Responsibility (EPR) concept to plastic waste among others. Nonetheless,

there has been disparity in the implementation and enforcement problems continue, especially in the areas of the states with different jurisdictions where waste management is done.

Recycling Practices and Pilot Initiatives

In Malaysia, recycling is presently a mixture of both formal and informal sectors. The informal sector, composed of waste pickers and small-scale recyclers, contributes to a great extent in recovering recyclable materials but it works without any systematic incentives or accountability. Several formal programs have been launched in urban areas, such as curbside collection and dedicated recycling bins, but the participation rate is still quite low. There have been pilot projects in small areas, for instance, return schemes for plastic bottles or voluntary take-back programs run by beverage companies, but these are still a patchwork and lack the nationwide coordination that is a hallmark of successful deposit-refund systems in other countries.

Barriers to a Nationwide Deposit-Refund System

The proposal of a countrywide deposit-refund system in Malaysia is facing numerous challenges. The first problem is the disjointed institutional framework for waste management which hinders the cooperation of the federal, state, and local governments in the implementation of the system; these authorities share the responsibility of waste management. Next, the current system for collection and refund processing is extremely inadequate and it would require a lot of money to create and maintain a smooth and effective system. Third, financing is a challenge as there are no clear mechanisms established by either government or industry stakeholders for cost-sharing or system operation. Fourth, consumer behavior presents a major barrier; though the environmental awareness is increasing, the culture of returning items for refunds has not yet developed. Lastly, the industry stakeholders' resistance, who might be anxious about additional compliance costs, also makes it harder to implement a formal DRS.

Opportunities for Policy Innovation

Even with these obstacles, Malaysia has multiple chances to implement a deposit-refund system. The government's dedication to the Sustainable Development Goals, especially Goal 12 on responsible consumption and production, creates a regulatory environment that perfectly fits DRS. There is a growing public demand for action on environmental issues, mainly plastic pollution, which is making the conditions more favorable for public acceptance. Furthermore, digital technology advancements, for instance, the use of e-wallets by most people, could also lead to the development of new ways for refund payments which would lower the impact of transaction costs and thus, more people would be able to take part in it. In addition, Malaysia could take inspiration from the neighboring countries like Singapore and South Korea in terms of their experiences and come up with the model that suits its social-economic conditions.

Comparative Analysis: Global Practices versus Malaysia's Readiness

Global Success Factors

What can be learned internationally is that deposit-refund schemes are effective at reaching high levels of material recovery and can be ensured through effective institutional frameworks. A typical example can be seen in nations like Germany and Norway, where beverage containers

have seen returns of over 90 percent on an average, primarily because of effective legislation and infrastructure in place, mainly reverse-vending machines, and managing organizations. Sweden also sees similar returns on an average because of well-organized infrastructure and an immense amount of public faith and confidence. In Canada, province-wise initiatives have ensured returns ranging from 80 percent to 90 percent on an average, thanks to an extensive network of depots and easy refund schemes. As for Asia, nations like South Korea have already accomplished the task of merging deposit-refund schemes successfully into existing waste fees, and even Singapore is planning a country-wide scheme by 2025. Thus, it is clear that the success factor in deposit-refund schemes is neither geography nor affluence.

Malaysia's Current Readiness

On the other hand, Malaysia has not yet implemented any formal deposit-refund system nationwide. Recycling is still more or less a voluntary activity, and there is not much collection infrastructure. The informal waste collectors are very important in recovering materials, but they are not supported by incentives or integration into the formal system. Laws like the Solid Waste and Public Cleansing Management Act 2007 and the National Solid Waste Management Policy have been established, but their enforcement and coordination are still poor. There are some pilot projects and voluntary take-back programs, but they are not widespread to the extent that the high return rates seen internationally have been achieved.

Comparative Overview and Key Insights

A comparison of international practices with Malaysia's status reveals several key contrasts (Table 1).

Table 1: Comparative Overview and Key Insights

Country/ Region	Items Covered	Refund Mechanism	Return Rate (%)	Key Success Factors	Malaysia (Current)
Germany	PET bottles, glass bottles, aluminium cans	Refund at supermarkets via reverse vending machines	~98	Strong legislation, infrastructure, consumer compliance	No DRS, limited recycling bins; informal collection dominates
Norway	Beverage containers (plastic and aluminium)	Automated machines; centralized operator	~95	Industry-driven operator, high transparency	Pilot EPR schemes; no centralized coordination
Sweden	PET bottles and cans	Refund at retail stores	~85–90	Accessible infrastructure, public awareness	Low recycling rates; fragmented initiatives

Canada (selected provinces)	Beverage containers, some hazardous products	Refund at depots; material- specific rates	~80–90	Decentralized but regulated, dense depot networks	No federal/state- level DRS; reliance on landfill and recycling targets
South Korea	Beverage containers (PET, glass, cans)	Refund through retailers, integration with waste fee system	~80	Strong enforcement, integration with waste policies	Recycling mainly curbside; weak incentives
Singapore (planned 2025)	PET bottles, aluminium cans	Refund at retail outlets and vending machines	Target 80	Government- driven, Smart Nation integration	No announced DRS; focus on recycling policies

The comparison reveals several insights. To start with, legislation and enforcement are crucial for the success of deposit-refund systems; in the absence of statutory rules, the involvement of consumers will probably continue to be voluntary and unevenly distributed. The next thing to mention is the great importance of infrastructure accessibility. The nations that have made the return of products easier for consumers by setting up various locations from which they can pick them up or by installing vending machines have been able to recover more products. The third point concerns the centralized operators. Whether they are industry-managed or government-supervised, they guarantee that funds and logistics will be handled transparently and efficiently. The fourth point is that cultural adaptation is important. In Asia, one of the examples is the scheme in South Korea which reveals that DRS can be harmonized with existing waste collection systems, hence, Malaysia might adopt the route shown. Lastly, the impact of digital innovation as seen in Singapore's forthcoming system signals that Malaysia could take advantage of its burgeoning digital economy and e-wallet usage to develop a refund mechanism that is low-cost and large-scale.

Policy Implications and Recommendations

Strengthening the Legal and Institutional Framework

The main implication coming from international experience is that deposit-refund systems will not be effective without a strong legal foundation. This is the case for Malaysia which must now go through the process of stepping from voluntary or pilot recycling schemes to a nationwide DRS that is mandatory for producers and retailers. A clear assignment of functions among the federal, state, and local authorities will be required to resolve the current division in waste management. A regulatory authority that is centralized or an industry-run consortium like Norway's Infitum model could be created to manage system functioning, guarantee transparency, and handle logistics.

Developing Collection Infrastructure

The success rates of deposit-refund schemes depend largely on the return points' accessibility. The highest rates of return are reached in the countries that offer extensive and easily accessible infrastructure, like reverse vending machines in supermarkets or specific collection points. In Malaysia, the infrastructure development could start in the cities with the highest beverage consumption and gradually move to the suburbs and rural areas. Collaboration with retailers and beverage makers will be of utmost importance in terms of infrastructure funding and upkeep. Involving informal waste collectors in the scheme rather than getting rid of them could not only improve recycling rates but also guarantee social inclusiveness.

Leveraging Digital Technology

The great rate of mobile phone possession in Malaysia together with the acceptance of e-wallets are some of the factors that favor the introduction of inventive refund methods. The consumers would not have to wait for cash refunds anymore, the system for digital transactions could transfer the deposit straight to the e-wallet or bank account of the customer. By using this method, the costs of transactions would go down, the chances of fraud would be smaller, and it would be more attractive for the young and computer-savvy consumers. Also, a digital refunds system would match the government's cashless payment programs, hence supporting the nation's wider objectives.

Phased Implementation Strategy

Considering Malaysia's present preparedness, the gradual method would be the most sensible. Initially, there could be the setting up of experimental projects which would concentrate on the most used waste such as PET bottles and cans. It is expected that the consumer behavior, the cost involved, and the logistical issues would be made clear from the pilot projects. The system could then be extended to cover other materials and advanced to semi-urban surroundings. Ultimately, Malaysia could steer towards a complete DRS-Demand Recycling System that is workable all over the country and takes multiple waste streams including toxic items like batteries and pesticide containers, which is in line with the circular economy plan, for instance, to be used again after processing.

Engaging Stakeholders and the Public

Legislation and infrastructure alone do not determine the acceptance of deposit-refund systems, public trust and stakeholder involvement being significant factors as well. For Malaysia, successful DRS execution would mean a partnership that is tightly woven among government sectors, producers, retailers, NGOs, and consumers. The most important step in winning over consumers would be to inform them about DRS and its advantages for the environment and economy. Conversely, industry is expected to have cost concerns, but these can be alleviated through shared financing models and tax incentives for early adopters.

Anticipated Impacts

A well-implemented deposit-refund system can bring numerous benefits to Malaysia, apart from being eco-friendly and reducing pollution. The economic aspect would include conserving resources, cutting waste management costs, and opening new avenues in recycling

and reverse logistics. It would also create social benefits through community involvement in eco-friendly habits and the opportunity for informal waste collectors to get integrated into the formal systems. These benefits would make Malaysia more committed to the Sustainable Development Goals, particularly to Goal 12 on responsible consumption and Goal 13 on climate change mitigation.

Conclusion

The worldwide research indicates that deposit-refund systems have been among the topmost economic measures to combat pollution and increase recycling rates. Due to potent legislation, broad infrastructure, and active public involvement, Germany, Norway, and Sweden can even reclaim over 90 percent of their waste. Their DRS has been successfully turned into a seamless waste policy in Asia by South Korea, who is in a similar context as Malaysia, and Singapore is gearing up to launch its national system by 2025. These instances demonstrate that the effectiveness of deposit-refund schemes is not just confined to affluent countries but is a matter of clear regulations, efficient systems, and consumer motivation.

On the contrary, the absence of a nationwide DRS in Malaysia denotes a significant policy gap. The existence of regulations like the Solid Waste and Public Cleansing Management Act 2007 and the National Solid Waste Management Policy does not seem to positively impact the level of recycling activity, which is still very low, thus leaving informal waste collectors to carry out most of the work. Pilot projects and voluntary initiatives have been helpful, but they have not led to the required structural change that would solve the problems of low recycling participation, overreliance on landfilling, and weak enforcement mechanisms that persist in the industry.

Through this research, it has been demonstrated that Malaysia could take advantage of the international practices and find out what would work best in terms of deposit-refund system considering its own institutions, economy, and society. Legal robustness, infrastructure that is easy to use, digital refund systems, gradual implementation strategies, and participation of all stakeholders are the important factors for the success of DRS. In the case of proper implementation, DRS can bring about the changes of higher recycling rates of Malaysia, less pollution, and its strong transition to a circular economy.

In conclusion, a deposit-refund system not only brings Malaysia up to par with global best practices but also provides support for its national commitments under the Sustainable Development Goals. Hence, the enactment of DRS can be viewed as a very beneficial move in the overhaul of Malaysia's waste management situation, where the current issues can be turned into opportunities for environment conservation, cost-saving, and local participation. encourage digital transformation among SMEs.

Acknowledgements: The authors wish to express their sincere appreciation to the Department of Business and Management, Universiti Teknologi MARA, Puncak Alam Campus, for providing a supportive academic and research environment that facilitated the development of this study. The authors also extend their gratitude to colleagues and peers who offered valuable insights and constructive feedback during various stages of the research process. Finally, appreciation is conveyed to the anonymous reviewers for their thoughtful comments and recommendations, which substantially contributed to strengthening the clarity, coherence, and overall scholarly quality of the manuscript.

Funding Statement: “No Funding”

Conflict of Interest Statement: The authors declare that there is no conflict of interest regarding the publication of this paper. All authors have contributed to this work and approved the final version of the manuscript for submission to the International Journal of Law, Government and Communication (IJLGC).

Ethics Statement: This study did not involve any human participants, animals, or sensitive data requiring ethical approval. The authors confirm that the research was conducted in accordance with accepted academic integrity and ethical publishing standards.

Author Contribution Statement: All authors contributed significantly to the development of this manuscript. Shahariah Asmuni and Saliza Sulaiman was responsible for the conceptualization, methodology, and overall supervision of the study. Zuraidah Ismail and Noor Adwa Sulaiman handled data collection, analysis, and interpretation of results. Fareha Syuhada Khairul Anuar contributed to the literature review, drafting, and critical revision of the manuscript. All authors read and approved the final version of the manuscript prior to submission.

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