

## ANALYSING THE REGULATORY MECHANISMS OF RIVER POLLUTION IN MALAYSIA

Zulaikha Mokhtar  
Siti Hafsyah Idris  
Steven Kenway  
Ilje Pikaar

### ABSTRACT

Malaysia has comprehensive regulatory mechanisms for controlling water pollution. This study examines in detail the mechanisms for water pollution control in Malaysia, with a particular emphasis on industries' compliance with the regulations. Despite legal frameworks and regulatory agencies regulating water pollution, Malaysia still has a persistent water pollution problem. This study identified several gaps in the regulatory mechanism for controlling water pollution. This study highlights the need for a more proactive and participatory approach that involves industries, regulatory agencies, and society to address Malaysia's water pollution. Sources of information used in this study include academic literature, government reports, and industry publications to provide insights into the regulatory framework and compliance practises. This paper provides recommendations for enhancing regulatory mechanisms and improving industry compliance practises. Overall, this study contributes to the existing literature on water pollution control in Malaysia. This study provides insights into the regulatory framework, industry compliance practises, and recommendations for enhancing regulatory mechanisms to achieve sustainable and effective water pollution control in Malaysia. This study provides a valuable resource for policymakers, regulators, and industries interested in addressing Malaysia's persistent water pollution problem.

**Keywords:** River pollution, environmental legislation, federal and state legislation, Malaysian industries, agencies' jurisdiction.

### INTRODUCTION

The environmental impact and public health concerns associated with industrial effluent discharges have made compliance a critical global concern. According to the United Nations, three planetary crises are preventing sustainable development: climate change, biodiversity loss, and pollution. Water pollution from industrial effluents poses a significant threat to ecosystems and environmental stability. They often contain hazardous substances that can have harmful effects on the surrounding environment (Saravanakumar et al., 2022). Industrial waste discharged into water bodies without being properly treated or insufficiently treated can contaminate drinking water supplies, influencing both human and animal populations (Ali et al., n.d.). In addition, industrial effluents can directly endanger human health (Prasad et al., 2021).

Malaysia's water issues include river pollution, drinking water safety, and water disruption. Poor river water quality is likely to significantly affect Malaysia's water supply because 97% of its water comes from rivers (Chan, 2012a). Based on their respective water quality indexes, out of 672 rivers monitored by the Malaysian Department of Environment in 2022, 22% (148) were slightly polluted, and 4% (29) were polluted. A total of 74% (495) showed good water quality (Mokhtar, 2023). From the number of polluted rivers, several rivers are in Johor (14), Penang (7), and Selangor (3) where most industries that discharge industrial effluent are located. This implies that industrialization in Malaysia has resulted in environmental problems (Ridzuan et al., 2022) and significant implications for river pollution.

Given that a substantial proportion of rivers in Malaysia are still polluted to some degree, water supply is projected to fall short of demand (Abdul Rahman, 2021). The deterioration of river water quality in Malaysia is attributed to urbanization, industrialization and high pollutant loading. Through increased awareness and enforcement of environmental regulations, improved waste management practises, and better land use planning, Malaysia should address the causes of river pollution (Fitri et al., 2020a). Pollution of rivers has detrimental effects on the environment, public health, and water supply, making it a major problem for countries around the world (Loi et al., 2022). Human health is adversely affected by polluted water in Malaysia, as it can cause poor blood circulation, skin lesions, vomiting, and neurological damage (Afroz et al., 2014). Significant increase in the level of river pollution in Malaysia are due to human activities such as population growth, urbanization, and industrialization (Fitri et al., 2020b). To date, there are 82,431 industries in Malaysia with 55,589 in operation, and 3611 of these industries are being regulated under the *Industrial Effluent Regulation 2009* for their industrial effluent discharges into inland water.

In recent years, there have been many reoccurrences of pollution incidents caused by industrial sectors. The Kim Kim River pollution tragedy in Pasir Gudang, Johor, Malaysia, occurred due to illegal disposal of chemicals (benzene, acrolein, acrylonitrile, hydrogen chloride, methane, toluene, xylene, ethylbenzene, d-limonene) in the Kim Kim River in 2019. A total of 2,775 people, including schoolchildren, have been hospitalised (*30 Hospitalised in Johor after Being Exposed to Toxic Waste Dumped into River*, 2019) because of respiratory difficulties (Chia, 2019) and vomiting ("35 Treated for Chemical Poisoning after Illegal Waste Dumping in Johor's Pasir Gudang," 2019), and 111 schools have been closed.

In 2020, the pollution tragedy of Sungai Selangor (*Police Investigating Odour Pollution in Sungai Selangor | The Star*, n.d.), Malaysia, caused closure of SSP1, SSP2, and Rantau Panjang Water Treatment Plant (WTP) due to 'solvent like odor' pollution at Velox Industrial Park (*Police Investigating Odour Pollution in Sungai Selangor | The Star*, n.d.). This was a historical case in Malaysian environmental criminal charges as it was also charged under Section 124 K and Section 34 of the same code. If

convicted, the defendant will face life imprisonment (*4 Arrested over Latest Water Pollution Incident in Selangor That Caused Disruption to More than 1m Households | The Straits Times*, n.d.). Owing to odour pollution at the Jenderam Hilir raw water pump station, unexpected water disruptions were also experienced at the Sungai Semenyih WTP (*Sungai Semenyih Water Treatment Plant Temporarily Stopped for Odour Pollution | Malay Mail*, n.d.). A total of 463 areas in five Selangor districts were affected by this event in 2021, some municipalities, such as Petaling, Hulu Langat, Sepang, Putrajaya, and Kuala Langat, are also included (*Gangguan Bekalan Air Tidak Berjadual Di Sebahagian Kawasan Lembah Klang Ekoran Pencemaran Bau Sungai Semenyih - Semasa | MStar*, n.d.).

To address these concerns and to prevent an increase in industrial pollution incidents, this study aims to contribute to understanding- How are Malaysian industries regulated to prevent the pollution of rivers with respect to enforcement agencies' jurisdiction? Even though Ta et al. (Ta et al., 2018) discussed legislation on the prevention of pollution and contamination in waterways and on the regulatory framework related to watershed management in Malaysia, but they did not specifically address the jurisdiction of agencies and departments related to the discharge of industrial effluent. Saimy et al. (Saimy & Yusof, 2013) argued that jurisdictions overlap between federal and state governments on water management in Malaysia, while Khalid et al. (Khalid et al., 2018a) argued that river-basin decision making should be determined at the local or federal level based on subsidiary principles. Water pollution governance has been muddled by too many authorities (Mamun & Zainudin, 2013) with conflicting and competing objectives, each with its own water-based legislation (Abdul Rahman, 2021). Nonetheless, the advancement of regulatory frameworks for water pollution is dependent on strong legal principles, high regulatory standards, and policy coordination based on an appropriate legal and institutional framework (Gani & Scrimgeour, 2014).

Consequently, this study investigates and offers comprehensive assessments of the components of environmental legislation designed to prevent river pollution from industries. Following these assessments, this study outlines how jurisdiction is distributed among government agencies responsible for controlling water pollution in a multilevel government. The multilevel government structure is also analyzed to determine who is responsible for controlling water pollution. This review examines evidence (if any) of overlapping jurisdictions between agencies and investigates the federalism framework for managing river pollution. The multilevel government structure provides a framework for analyzing the roles and responsibilities of different agencies in managing water pollution.

Several new contributions are made in this study that help to facilitate a more comprehensive understanding of the multilevel components of water governance in Malaysia. First, one of the key contributions to this study is its focus on water pollution research. This is crucial for understanding the various factors contributing to water contamination and developing effective strategies for water governance in Malaysia. Second, it investigates the regulatory framework currently in place to control river pollution. Third, it determines the regulatory agencies' jurisdiction in managing river pollution from industry. Additionally, this study offers recommendations for enhancing regulatory mechanisms to achieve sustainable and effective water pollution control. The outcome of this research will be valuable to policymakers, regulators, and industries concerned with the persistent problem of water pollution in Malaysia. Thus, this study serves as a platform to better understand the various levels of the Malaysian government's role in water pollution control.

## METHODS

### Data Collection

The methodology approach for this study was based on the framework used by Machete and Marques (Machete & Marques, 2021), which consisted of 3 phases. Topics and selection of appropriate search engine keywords were used to identify and review the literature related to regulatory mechanisms of river pollution control. Sources of documents reviewed, including journals, government reports, industry publications, proceedings, and newspapers. Using this approach, the research framework outlined in figure 1 was developed and applied to find the environmental component themes on regulatory mechanisms of controlling water pollution from industries, which have been discussed in the literature.

A Scopus review was conducted using four keywords (water governance, river pollution legislation, industrial effluent in Malaysia and Malaysia agencies jurisdictions) during data collection. After a first phase of finding 279 articles, 197 articles remained after a visual elimination process by eliminating irrelevant and duplicate entries. As a next step, some of the articles dealing with air pollution and scheduled waste management were eliminated. In total, this study had 82 peer-reviewed articles for semantic network analysis and narrative analysis.

The practise of discovering and categorising themes represented in text, known as sentiment analysis (Jiang et al., 2018). Narrative analysis was used, and the documents were examined in terms of their structure, content, context, themes, and patterns.

### Analysis

To develop a comprehensive multilevel water governance framework for Malaysia's industrial effluent regulatory and governance landscape, a desktop analysis was conducted on study reports, policy documents, and relevant legislation. Legislation and regulations on each regulatory body were identified and tabulated to understand of the federalism framework in Malaysia. Sources for documents, including legislation databases, such as the federal legislation portal (<https://lom.agc.gov.my/>), Malaysian law journal (<https://www.lexisnexis.com.my/>), and government agency websites.

A method developed by Fidelman et al. is used to understand the multilevel components of water governance by using NodeXL to facilitate exploration, analysis, and visualization of relationships among federal, state, and local agencies (Fidelman et al., 2019). This method enables easy and rapid access to information regarding regulations and governance related to industrial effluent

legislation by analysing and interpreting the data (Ahmed & Lugovic, 2019). Court cases on environmental matters that discussed the conflict of jurisdiction between federal and state were identified and discussed. Finally, the institutional mapping of organisations, agencies, jurisdictions and relevant legal provisions for monitoring river pollution originating from industries were plotted with each jurisdiction or agency mentioned to facilitate visualisation.

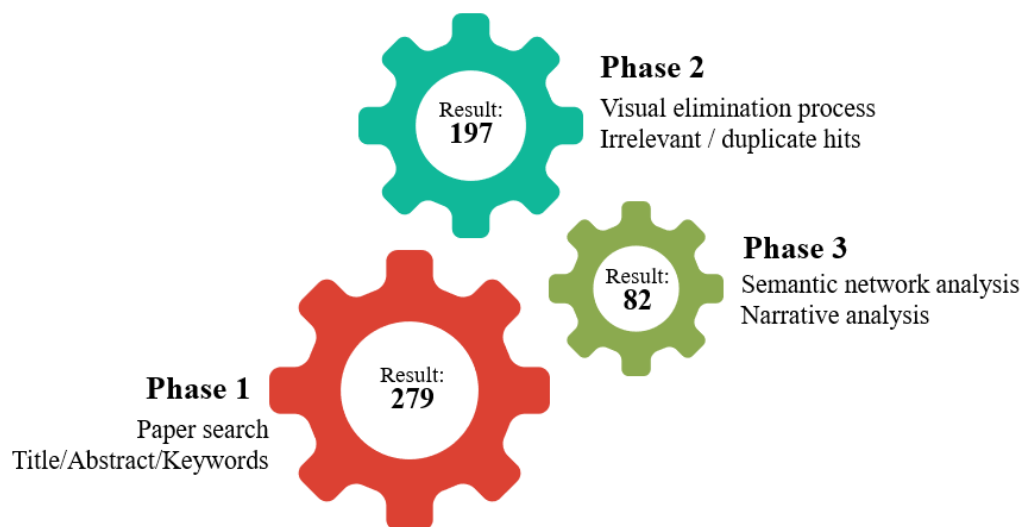


Figure 1 Research framework

## RESULTS AND DISCUSSIONS

Based on an analysis of 82 peer-reviewed publications, six environmental component themes regarding the regulatory mechanisms used to control industrial water pollution were identified to provide a comprehensive assessment of the components of environmental legislation designed to prevent river pollution from industries. It is divided into six themes: federal and state governance, government policies and legislation, industrial effluent discharge management, water quality, regulatory standards, and enforcement jurisdictions.

### Federal and State Governance

The *Constitution of Malaysia 1957* specifies that both the state and federal governments play significant roles in the management of water pollution control which indicates a co-governance management. At the federal and state levels, Malaysia has numerous department-based water legislation (Mamun & Zainudin, 2013) that also takes part in the management of the environment. Several laws in Malaysia mandate water pollution control, and the Department of Environment (DOE) is responsible for overseeing point sources of discharged water (Khalid et al., 2018a), water-quality programmes, and regulations.

To effectively manage water pollution, federal and local governments must engage in fair and transparent collaboration. Both federal and state governments play complementary roles in regulating and preventing river pollution. While the federal government focuses on regulating waste generated during manufacturing processes, states are responsible for regulating aquaculture and farming. The development and implementation of comprehensive policies and strategies for water management at both the federal and state levels, involving local communities and relevant stakeholders, is crucial to ensure sustainable water resources and supply for the future (Saimy & Yusof, 2013).

The Federal Government established several agencies to oversee environmental protection and management. State law provides a more comprehensive framework for regulating water pollution through specific laws and regulations. While federal and state legislations have been enacted, water pollution, especially from industries, has continued to be prevalent. As a result, the environment and the health of the public are adversely affected (*Right to Clean Water – SUHAKAM*, n.d.).

A co-governance water management policies and effort is also being practiced in Europe, Australia, and North America to reduce pollution. These efforts are supported financially and technically by the federal government, the states, and citizens. In addition to the pressure for change, it also involves a coordinated governance structure, adequate funding, management skills, organizational development, resource utilization, and a dedication of time (Graversgaard et al., 2018). Co-governance policies can be effective in water pollution management by integrating various perspectives and fostering collaboration, although its success may be influenced by factors such as governance structures, leadership, and potential conflicts with existing political systems (Borowski-Maaser et al., 2021; Gani & Scrimgeour, 2014; Scott, 2016)

However, the implementation of these policies and regulations may vary considerably from state to state, making it difficult to ensure consistency and inclusiveness. A better environmental waterway future can only be achieved with consensus and harmonisation among federal, state and local governments in the co-governance management. It is essential that continuous research and monitoring of the effectiveness of these collaborations be conducted to ensure the protection of Malaysia's rivers and the health of its citizens.

### Government Policies and Legislation

In Malaysia, policies on effluent standards, contravention licences, and enforcement actions have been developed by the government (Machete & Marques, 2021). The effectiveness of government policy and legislation in controlling water pollution from industries can be measured by monitoring the decline in water pollution from point sources and by implementing multiple strategies to control pollution. Policy instruments such as environmental taxes, pollution permits, water pricing, and industrial parks can help regulate water pollution from industries and promote sustainable development (Ghazouani et al., 2021). Hence, strict and targeted environmental laws and regulations are important to achieve effective pollution control and protect water resources (Norouzi & Ataei, 2021). It is vital to develop industry-specific institutional policies to address water pollution, particularly in developing economies with weaker institutional structures (Gani & Scrimgeour, 2014).

However, based on the institutional framework in Malaysia, spill-over effects are associated with the governance of water pollution. Furthermore, as the core document for Malaysia's national environmental policy, the *Environmental Quality Act 1974* has been criticised for being outdated and insufficient in addressing current environmental issues. The Act establishes a basic structure for regulating pollution discharges into Malaysian waters. As a federal statute, the Act is based on the principle of preventing, abating, controlling, and improving the environment (Abdul Kader, 2007). The Act requires industries to obtain licences before discharging any effluent and sets strict limits on the concentration of pollutants they can release. Effluent from industries must be treated before being released into the environment according to the *Industrial Effluent Regulation 2009*. As part of this law, regular monitoring and reporting of effluent quality is also mandated. Despite several attempts to revise this Act, it has not been updated since 2012 because of changes in the Malaysian political landscape over time. A primary requirement that needs to be updated is the discharge standard limit and associated penalties.

For the management of water pollution, the improvement of water quality, the protection of human health, and the support of sustainable development, government policies and legislation are essential (Graversgaard et al., 2018). The Malaysian water management policy emphasizes the adoption of measures to ensure the sustainability of water resources to achieve water security (Saimy & Yusof, 2013). Likewise, in neighbouring country, Singapore has established a water agency to manage its water resources and implemented strict regulations to reduce water pollution. They have also developed various programs to conserve water and promote water conservation (Cui et al., 2021). As for Indonesia, they have implemented water resource management policies such as the use of water-efficient technologies, water pricing, and water conservation programs. They have also implemented initiatives to reduce water pollution and promote sustainable water use (Muryati & Triasih, 2021).

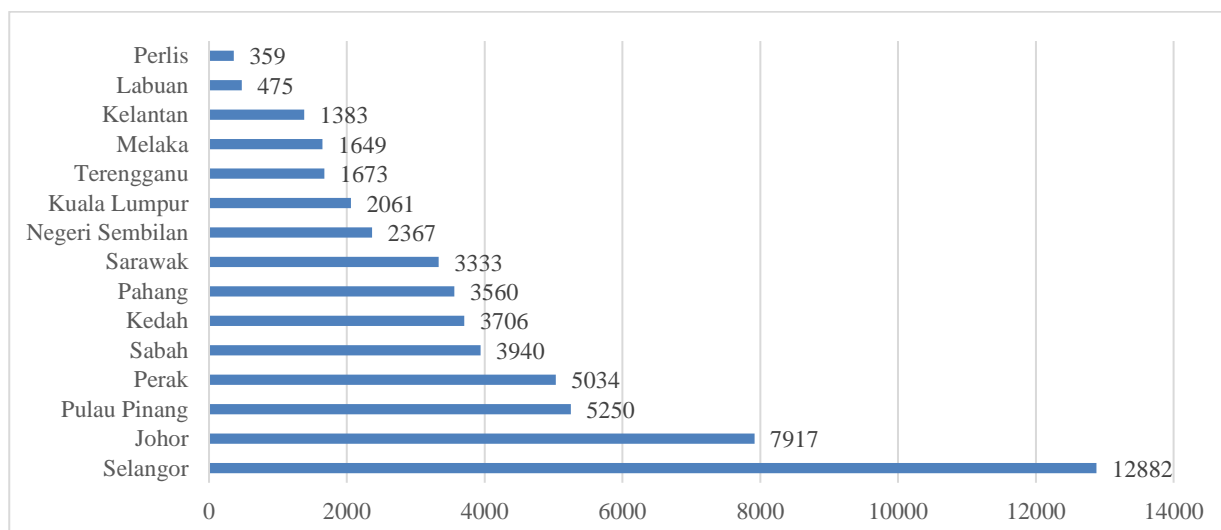
Malaysian environmental legislation were typically based on command-and-control (CAC) strategies before 2009, which limited pollutants discharged by individuals, regulated pollution control technology, regulated pollutant release rates under specific technologies, monitored emissions, and enforced compliance fines. Consequently, the DOE began incorporating desktop enforcement (DE) into its investigation strategy in 2020 rather than the usual CAC approach to ensure that compliance across the industry was continually assessed. This includes online monitoring for continuous emissions monitoring systems (CEMS), online effluent reporting (OER), environmental mainstreaming tools (eMains), and electronic scheduled waste information system (eSWIS).

Considering the enforcement mechanisms of environmental legislation, as well as the socio-economic environment and organisational culture, is crucial to gain a better understanding of the factors that influence law compliance in industries. The effectiveness of law enforcement significantly influenced compliance. For example, in environmental regulations, it is important to show a clear commitment by the government to ensure compliance with the law (*ASSURING ENVIRONMENTAL COMPLIANCE A Toolkit for Building Better Environmental Inspectorates in Eastern Europe, Caucasus, and Central Asia*, 2004). Compliance behaviour can be determined by conducting a cost-benefit analysis. Non-compliance occurs when small penalties are imposed or incentives are not provided (Creamer, 2021). Organizational culture can significantly influence compliance. For example, ignorance of environmental laws, unwillingness to respect environmental laws, and insufficient knowledge of environmental concerns can lead to non-compliance.

Hence, governments should create a strong deterrent against non-compliance. The penalties imposed in the *Industrial Effluent Regulation 2009* should be increased. A compliance incentive programme should be implemented. It is beneficial to provide financial assistance or other incentives to industries to encourage compliance. The societal attitude towards environmental degradation should be changed, and a more sustainable culture should be promoted. Environmental awareness and education programmes can assist in improving compliance with environmental laws and regulations. Identifying areas of non-compliance and implementing corrections can be accomplished through regular monitoring and compliance.

### Industrial Effluent Discharges Laws in Malaysia

There are three types of industries in Malaysia that are classified as point sources and discharge effluent into waterways, and thus are regulated under EQA: prescribed premises, non-prescribed premises (other types of industries), and sewerage (Mokhtar, 2023). Palm oil mills, raw natural rubber, and facilities licenced under Section 18, of the EQA, are considered prescribed premises. The *Industrial Effluent Regulation 2009* should be considered when computing the compliance of these industries. The compliance of these industries with the *Industrial Effluent Regulation 2009* relies on the discharge limit standards set under Standards A and B of Regulations 11 and 12 of this Regulation. It is imperative to note that, as shown in figure 2, the number of point sources varies among Malaysian states. Selangor has the most point-source industries, followed by Johor and Pulau Pinang. Less than two thousand DOE technical officers are working in Malaysia, making it practically impossible to inspect each premises annually. As a result, enforcement strength is not aligned with the growing number of industries, and uninspected sites are assumed to be compliant, which leads to an overestimation of compliance rates.



**Figure 2** Number of industries and population by state in Malaysia with Selangor, Johor, and Pulau Pinang are priority areas due to having many industries 12882, 7917, 5250, and 69% of the total industries that discharge industrial effluent into inland waters.

Generally, compliance with laws and legislation is measured to determine the ability of industries to conduct business professionally. An environmental compliance assessment can be beneficial to business owners concerned about the potential exposure to substantial liabilities associated with non-compliance with environmental laws (Moorman & Kirsch, 1991). From the compliance statistics for 2016–2022 based on the Department of Environment enforcement of the EQA, eight industries with low percentages are tabulated in Table 2.

**Table 1** Types of Malaysian industries with the highest non-compliance percentage with industrial effluent discharges

The type of Industry	2016	2017	2018	2019	2020	2021
Food product manufacture	87%	77%	75%	68%	76%	73%
Manufacture of the base metal	70%	75%	72%	63%	62%	69%
Manufacture of chemicals and chemical products	80%	82%	79%	76%	84%	76%
Production of coke and refinement of petroleum products	74%	91%	87%	79%	92%	81%
Producing papers and paper-related products	80%	72%	74%	65%	61%	67%
Manufacturing of rubber and plastics	75%	63%	69%	64%	74%	70%
Manufacturing of mineral products other than metals	67%	76%	80%	68%	68%	72%
Production of metals other than machinery	59%	52%	70%	55%	64%	60%

With remarkable economic growth, industries have flourished, but so has the challenge of pollution. Industrial production scale expansion increases industrial pollutant emissions, with a stronger effect on industrial wastewater than on waste gas and waste (Yang et al., 2019). Industrial effluents are major contributors to water pollution, and untreated discharge has significant negative impacts on the environment and human health (Saravanakumar et al., 2022). The discharge of untreated effluents into water bodies leads to pollution of rivers, destruction of aquatic life, pollution of vegetation, and negative impacts on human health (Ado et al., 2015).

To manage pollution in rivers in Malaysia, the current institutional and legal framework plays an important role. It is also important to understand the challenges faced by these eight types of industries in complying with environmental laws and regulations. Analysis of the challenges they encountered in complying with the laws is necessary to determine whether current laws are useful or need to be amended.

### Water Quality

To maintain a high level of water quality, strict enforcement of current regulations should cater towards preventing water pollution from industries (Schliemann et al., 2021) because pollution resulting from industrial wastewater is the primary cause of water quality variables, along with urban runoff and agricultural activities (Huang et al., 2010a). Water quality issues are mostly caused by stormwater runoff, untreated industrial effluent discharged into river reservoirs, anthropogenic activities, and uncontrolled urbanisation (Huang et al., 2010b). Water quality must be assessed in relation to land use for waste disposal, industrial activities, and urbanisation (van der Hoven et al., 2017).



An assessment of 97 countries' rivers, lakes, and aquifers in 2020 showed sixty percent had good water quality (*Water and Sanitation - United Nations Sustainable Development*, n.d.). According to the United Nations Sustainable Development, because of a lack of monitoring, at least 3 billion people do not know the quality of the water they consume. Nevertheless, one of the most significant sources of water pollution in the world is the discharge of industrial effluent (Duque et al., 2021). Industrial effluents are regulated and monitored internationally under an international legal framework to address this issue. Such regulations prevent further environmental damage and ensure industry compliance with certain discharge limits.

In Malaysia, to assess the health status of river water quality, the Water Quality Index (WQI) is used (Masturah et al., 2021). A Water Quality Index (WQI) measures water quality on a scale from 1 to 100, with higher numbers indicating better water quality (Mokhtar, 2023), using data collected from 1353 manual monitoring stations and another 30 automatic stations that monitor the desired 672 rivers. Similarly, Singapore monitors the water quality of more than 34 streams and 14 ponds within its water catchment areas quarterly. Water quality in the reservoirs within the water catchment areas is jointly monitored by the Pollution Control Department (Tortajada & Joshi, 2014).

Increasing awareness of the negative impacts of industrial effluent discharge on water quality and human health led to the development of an international legal framework for industrial effluent discharge. The United Nations Watercourse Convention is one of the most notable international legal instruments governing industrial effluent discharge and controlling water quality. Transboundary water resources are managed, conserved, and used under this convention (Ilias et al., 2021). Furthermore, there are international legal instruments other than the UN Watercourse Convention, including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and the Disposal of Hazardous Wastes, the Stockholm Convention on Persistent Organic Pollutants, and the Rotterdam Convention on Prior Informed Consent. Effluent discharge into water bodies is regulated by all three of these legal instruments in the interest of human health and the environment (Duque et al., 2021).

### **Regulatory**

Regulatory quality in the form of government effectiveness, control of corruption, and accountability for water pollution across all industries can contribute to legal and ethical standards (He et al., 2022). Industrial pollution avoidance remains largely dependent on direct regulation; hence, environmental effectiveness and impact on operations must be considered when evaluating regulatory instruments (Testa et al., 2012). In locations with low levels of environmental control, environmental regulations have a significant impact on industrial water pollution intensity (Zhou et al., 2021).

Industrialisation has benefited Malaysia's economy greatly, but it has also created severe environmental problems. In addition, water services in Malaysia have several issues, such as low pressure, poor quality, and large amounts of nonrevenue water. Public outcry over water interruptions demonstrated the immediate need for water resources management reform (Hezri & Hasan, 2006). To reduce the impact of global water pollution, industrial effluent discharges into water bodies must be regulated. By mandating strict regulations for industrial effluent discharge, industries will take appropriate measures to protect water quality and human health.

Hence, Malaysia has established laws that govern the discharge of industrial effluents into the environment to address these issues. These laws protect the environment and public health by setting standards for the treatment and disposal of industrial effluents. By mandating strict regulations for industrial effluent discharge, industries must take measures to protect water quality and human health. A list of laws and regulations designed to protect the environment from industrial waste will be discussed in more detail in Multilevel Governance in Malaysia.

### **Enforcement Jurisdictions**

Water pollution, particularly that caused by industries, remains widespread despite both federal and state legislation (Suki et al., 2020) and has adverse effects on the environment and public health (Alzira & Dinis, 2016; Saravanakumar et al., 2022). The need for comprehensive and coordinated actions, financial support for appropriate technology, cooperation between stakeholders, and effective policy enforcement to address water pollution are essential to address conflicts of jurisdictions (Abdul Rahman, 2021) and overlapping between agencies (Muyibi et al., 2008). There is a need for improved cooperation and integration across different levels of government (Saimy & Yusof, 2013) as well as the creation of a comprehensive water legislation or river law to handle jurisdiction issues in river management (Chan, 2012b).

As some rivers flow between two or more nations, a cross-border issue such as industrial effluent discharge requires the cooperation of nations to be effectively addressed (Mostafaie et al., 2021). As a result, national legislation on industrial effluent discharge also been developed in some regions. *The Water (Prevention and Control of Pollution) Act* in India, the *Clean Water Act* in the United States, the *Environmental Protection Act 1994* in Queensland, the *Water Services Industry Act (2006)*, and the *Environmental Quality Act (1974)* in Malaysia are some examples.

An increase in industrial production has led to irresponsible discharge of untreated wastewater, which poses challenges for enforcement agencies. This results in the need for stricter and more rigorous regulation (Zhang et al., 2012). It is essential to gain a thorough understanding of law and its implementation and the jurisdictions of agencies relating to the power in their locus standi. Conflicts among the federal, state, and local governments regarding rivers, associated water, and land must be resolved to restore rivers to pristine conditions.

## FEDERALISM FRAMEWORK IN MALAYSIA

The *Federal Constitution 1957* of Malaysia specifies the division of power. Malaysia is a three-tiered system of governance comprising federal, state, and local governments (2008\_ *Legal\_and\_institutional\_framework\_for\_pollution\_prevention\_in\_Malaysian\_rivers*, n.d.). Generally, if a matter is on the State List (See table 1), Parliament cannot legislate on it. However, there are situations in which Parliament can legislate with respect to matters in the State List. These situations include a declaration of emergency or if coordination is required across state boundaries. In the schedule, there are jurisdictions that fall under the jurisdiction of the federal government and jurisdictions that fall under the jurisdiction of the states. However, there is also a joint list (concurrent list) that states the cooperation between the two, for example, in town planning, public health, prevention of disease, drainage, irrigation, water supply, and service. The jurisdiction of river pollution matters in the Federal Constitution is further elaborated in table 1.

Conflict may arise from the concurrent list in which both state and federal legislatures can exercise authority, such as in list 11, matters concerning rivers. *Article 75* of the *Federal Constitution* provides a solution in such cases, providing, "if any state law conflicts with a federal law, the federal law shall prevail and the state law shall be null and void". Due to federal regulatory mechanisms, there are many agencies that regulate water pollution in which studies have argued will cause overlap in jurisdictions between federal, state, and local governments (Saimy & Yusof, 2013) and public uncertainty regarding who is responsible for managing river pollution (Khalid et al., 2018b).

The Federal Government has executive power over all matters that Parliament can legislate. State governments have executive power over all matters that the State Assembly (DUN) can legislate. This can be further explained in figure 2. On the recommendation of the Ministry, the Cabinet will decide on a policy on water pollution control. Regulatory agencies are created within a federal government agency responsible for 'water matters'. However, some of these matters are also interrelated with other agencies, including Water and River. The state government formed several enforcement agencies to combat river pollution.

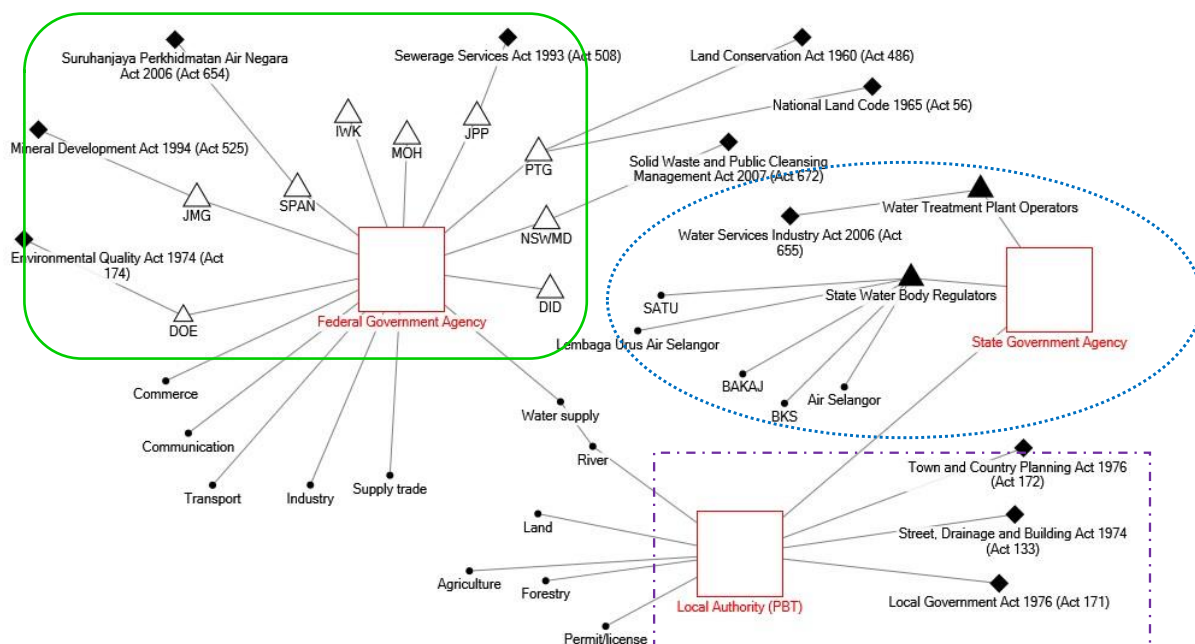


Figure 3 Interorganizational network for monitoring water pollution in Malaysia. The green square represents the federal government, the blue sphere represents the state government, and the purple square represents the local government. The white triangle represents federal government agencies such as the Department of Environment (DOE), Department of Mineral and Geoscience (JMG), National Water Services Commission (SPAN), Indah Water Consortium (IWK), Ministry of Health (MOH), Sewerage Services Department (JPP), Department of Lands and Mines (PTG), National Solid Waste and Public Cleansing Management (NSWMD), and Department of Irrigation and Drainage (DID). Legislation under the agency is represented by black solid diamonds. State government agencies are represented by black triangles. In controlling water supply, the federal government's jurisdiction over water may intersect with local authorities' responsibility for rivers.

**Table 2 Jurisdiction of river pollution matters as stipulated in the Malaysian Federal Constitution 1957**

Lists	Jurisdiction
Federal list	<ol style="list-style-type: none"> <li>1. External affairs of the nation, including (a) treaties, agreements, and conventions with other countries; (b) the implementation of such treaties, agreements, and conventions.</li> <li>8. Trade, commerce, and industry, including (a) mineral resource development, mining, mining of minerals and minerals ores, oils, and oil fields, as well as; and (b) manufacturing facilities, boilers, and machinery.</li> <li>9. Maritime and estuarine fishing, excluding turtles, including shipping, navigation, and fisheries.</li> <li>10. In addition to communication and transportation, (a) bridges, roads, ferries, and other means of communication that are declared federally significant by or under federal law; (b) regulations governing traffic by land, water, or air; (c) the transportation of passengers and goods via land, sea, or air.</li> <li>11. Activities and powers of the federal government include (a) the provision of supplies of water, canals, and rivers, excluding those within one state or governed by an agreement between all states concerned, the production, distribution, and supply of electrical energy from water sources; (b) electricity, gas, and gas work.</li> <li>16. Indigenous people's welfare</li> <li>20. Agricultural pest control</li> <li>25. Tourist attractions</li> </ol>
State list	<ol style="list-style-type: none"> <li>2. Exceptions are made for Kuala Lumpur, Putrajaya, and Labuan land, including (a) tenure for land, relations between landlords and tenants, and registration of titles and deeds; (b) exploration and mining permits, leases, and certificates; (c) compulsory land acquisitions.</li> <li>3. Activities related to agriculture and forestry, except those within the federal territories of Kuala Lumpur, Putrajaya, and Labuan</li> <li>4. Local governments outside the federal territories of Kuala Lumpur, Putrajaya, and Labuan, including the following: (a) municipal corporations, local town and rural boards, municipal services, municipal rates, and municipal elections; (b) public nuisances and obnoxious trades within local authority areas.</li> <li>6. Water and state works include: (a) works performed for the benefit of the state; (b) except for those on the federal list, roads, bridges, and ferries; (c) except for those on the federal list, water (including water supplies, rivers, canals), sediment control, and property rights related to riparian areas.</li> <li>12. Fishing for turtles and other riverine species</li> </ol>
Concurrent list	<ol style="list-style-type: none"> <li>3. National parks and protection of wildlife and birds</li> <li>4. Veterinary services, animal quarantine, animal husbandry, and animal cruelty prevention</li> <li>5. Except for the federal capital, town and country planning</li> <li>7. Prevention of diseases, sanitation, and public health (except for the sanitation provided in the federal capital).</li> <li>8. Irrigation and drainage</li> <li>21. Rehabilitating soil that has eroded because of mining</li> </ol>

The issue of federal and state jurisdiction has been addressed in several court cases. First, in the case entitled *Kajing Tubik v. Ekran Bhd* and others (*Kajing Tubek and Others v. Ekran Bhd and Others | UNEP Law and Environment Assistance Platform*, n.d.) concerning the construction of the Bakun Hydroelectric Dam in Sarawak, there was a dispute regarding whether the issue should be addressed under the EQA, federal legislation, or the *Natural Resources Ordinance 1949*, state legislation. Plaintiffs argued that their right to obtain copies of the Environmental Impact Assessments (EIA) on the construction of a hydroelectric project in Bakun, and their right to representation and hearing before the approval of such an EIA, had been violated. The High Court ruled that the public has the right to receive a copy of the EIA and to participate in the process. However, in *Ketua Pengarah Jabatan Alam Sekitar & Anor v. Kajing Tubek & Ors and Other Appeals (KETUA PENGARAH JABATAN ALAM SEKITAR & ANOR V KAJING TUBEK & ORS AND OTHER APPEALS. | UNEP Law and Environment Assistance Platform*, n.d.), the appellants argued that although the EQA applied throughout Malaysia, the project was exempt because the land was owned by Sarawak, which was not subject to Parliament's jurisdiction. According to the Court of Appeal, Parliament cannot interfere with the constitutional authority of the State under a federation based on Federal and State relations (Muhamad Ideres et al., 2023). No copy of the EIA report had to be provided to the respondents under the applicable Ordinance.

Second, in *Malaysian Vermicelli Manufacturers (Melaka) Sdn. Bhd. v. Pendakwa Raya* (Muhamad Ideres et al., 2023), effluent was discharged into an inland water body (the Malacca River), subjected to Regulation 8(1)(b) of the Environmental Quality (Sewage and Industrial Effluents) Regulation. The counsel argued that section 51 of the EQA empowered the Minister to enact regulations. The matter in question was specifically mentioned on the Federal List (See Table 2). In this case, it was determined that Malacca had jurisdiction over the "environment", which included inland waters and land. As a result, even an unintentional violation of item 6(c) and item 2 of the State List would not impair the Federal Government's ability to enact the Regulations, as the Regulations were a law regarding item 7 of List III (the Concurrent List), which is also under the Federal Government's legislative authority. Therefore, the *Environmental Quality (Sewage and Industrial Effluents) Regulation* applies to this matter.



## MULTILEVEL WATER GOVERNANCE IN MALAYSIA

Several organisations in Malaysia regulate the discharge of industrial effluent into water bodies under various legal frameworks. Multiple agencies are responsible for regulating industrial effluent discharge in Malaysia because different legal frameworks govern it. In the absence of a clear delineation of pollution types, overlapping responsibilities may have occurred, leaving the public in the dark regarding the responsibility for the management of pollution in rivers (Khalid et al., 2018a). Despite this, Malaysia has also been developing policy discourses parallel to the worldwide discussion about environmental issues and sustainable development (Hezri & Hasan, 2006). This study examines the legal framework for dealing with spill-over effects associated with water pollution governance. According to table 3, the main organisations responsible for preventing river pollution from industries in Malaysia are listed, along with their main responsibilities under the applicable legislation of the federal, state and local governments.

A mapping of institutional relationships among agencies is presented in figure 4 in relation to the management of river pollution resulting from industry. Following repeated water outages caused by illegal chemical dumping (Lee Goi, 2020), several citizens have advocated stronger enforcement of industrial polluters; however, there is public uncertainty regarding who is responsible for managing river pollution (Khalid et al., 2018b). Therefore, this institutional mapping helps to visualise the respective agencies' jurisdictions and the related laws and regulations.

Table 3 Organisation, Acts, and Jurisdiction of agencies in Federal, State, and Local Governments responsible for controlling river pollution from industries.

Level	Organisation	Act	Description
Federal	Department of Environment (Malay: <i>Jabatan Alam Sekitar</i> ) abbreviated as <b>DOE/JAS</b>	Act 174: <i>Environmental Quality Act 1974</i>	In addition to preventing, abating, and controlling pollution, this legislation enriches the environment. It provides environmental regulations that cover point sources, discharges from industrial facilities, scheduled and hazardous waste, sewerage, and environmental impact assessment projects.
	Solid Waste and Public Cleansing Management Corporation, abbreviated as <b>SWCorp</b>	Act 673: <i>Solid Waste Management and Public Cleansing Corporation Act 2007</i>	An act that establishes a corporation responsible for managing solid waste and enforcing and administering solid waste laws.
	National Solid Waste Management Department (Malay: <i>Jabatan Pengurusan Sisa Pepejal Negara</i> ) abbreviated as <b>JPSPN</b>	Act 672: <i>The Solid Waste and Public Cleansing Management Act 2007</i>	A key objective of the Act is to improve services (such as collection, transportation, treatment, and disposal), protect the environment, and standardise solid waste management
	Ministry of Health abbreviated as <b>MOH</b>	National Water Quality Standard	Establish drinking water quality guidelines to ensure that public drinking water is safe, thereby reducing the incidence of water-borne diseases or illnesses caused by poor quality water supplies.
	Department of Mineral & Geoscience (Malay: <i>Jabatan Mineral dan Geosains</i> ) abbreviated as <b>JMG</b>	Act 525: <i>Mineral Development Act 1994</i> , F.M.S. Cap 147: <i>Mining Enactment 1936</i>	The purpose of this Act is to ensure that mineral exploration and mining are inspected and regulated, and that mineral ore and matters connected thereto.
	Department of Land and Mines (Malay: <i>Pejabat Tanah Galian</i> ) abbreviated as <b>PTG</b>	Act 56: <i>National Land Code 1965</i> Act 486: <i>Land Conservation Act 1960</i>	These laws ensure that land management throughout the Federal Territory is conducted in accordance with the policies and laws set by the government. They also determine the yield of soil collected systematically and effectively.
	Sewerage Service Department (Malay: <i>Jabatan Perkhidmatan Pembentukan</i> ) abbreviated as <b>JPP</b>	Act 508: <i>Sewerage Service Act 1993</i>	Control over the development, management, and regulation of sewerage systems throughout the country.

Level	Organisation	Act	Description
	National Water Services Commission (Malay: <i>Suruhanjaya Perkhidmatan Air Negara</i> ) abbreviated as <b>SPAN</b>	Act 654: <i>Suruhanjaya Perkhidmatan Air Negara Act 2006</i>	Responsible for supervising and regulating water supply and sewerage services, enforcing the laws of water supply and wastewater treatment, and other related issues.
	Department of Drainage and Irrigation (Malay: <i>Jabatan Pengairan dan Saliran</i> ) abbreviated as <b>JPS</b>	-	This agency is responsible for mechanical and electrical services, dam design, and the regional centre for Damp Tropical Hydrology and Water Resources for Southeast Asia and the Pacific Building and Infrastructure.
State	State Water Treatment Plant Operators and State Water Body Regulators (Air Selangor, BAKAJ, LUAS, SATU, BKS etc.)	Act 655: <i>Water Services Industry Act 2006</i>	This Act promotes national policy by regulating and licencing activities related to water supply and sewage disposal.
Local	Local Authority (Malay: <i>Pihak Berkuasa Tempatan</i> ) abbreviated as <b>PBT</b>	Act 133: <i>Street, Drainage and Building Act 1974</i> Act 171: <i>Local Government Act 1976</i> Act 172: <i>Town and Country Planning Act 1976</i>	Responsible for planning, development, implementation, and operation, forest management and conservation, slaughtering, pollution control, effluent wastewater/discharge Also on streets, drainage, buildings, earthworks, and sedimentation controls.



Figure 4 Institutional mapping of organisations, agencies, jurisdictions, and related legal provisions for monitoring river pollution sourced from industries. The red line indicates the river

As a means of improving the effectiveness of the water quality governance, it is beneficial to understand the interdependencies among the various governmental agencies involved in water management. As shown in figure 4, every agency has its own responsibilities regarding the management of river pollution caused by industries, and none of the responsibilities overlap. This outcome contests the claims made by Saimy et al. (Saimy & Yusof, 2013) and Mamun et al. (Mamun & Zainudin, 2013) that jurisdictions overlap of in managing water pollution. Governance of water pollution is being decentralised through this approach. To encourage collaborative coordination among the federal, state, and local levels of government and promote decentralisation, it is essential to encourage collaborative coordination structures. Enhanced responsiveness to local socio-ecological conditions can be achieved through the decentralisation of river pollution control measures. To create synergy and avoid complexity in water pollution management, it is imperative that a proactive and inclusive approach be taken to address Malaysia's water pollution. To achieve this, a collaborative effort between the government, business community, and society is necessary.

#### LIMITATION AND FUTURE RESEARCH DIRECTIONS

An important aspect of this case study is the strong local context. As legal frameworks differ from country to country, the results of this study should be adjusted as necessary by other countries if they wish to apply them to their own jurisdictions. It is possible to gain insight into Malaysia's laws by comparing them. Furthermore, it should provide insights into the problem along with suggestions on how to resolve it. Despite its limitations, this study offers scholars and stakeholders a comprehensive overview of the legislation utilised in Malaysia to mitigate river pollution caused by industrial activities and has provided a valuable resource for policymakers, regulators, and industries interested in addressing Malaysia's persistent water pollution problem.

The vast geographical extent of river pollution also makes it a complex issue. Part of this complexity is its involvement across multiple jurisdictions. Hence, future research should consider the development and implementation of river pollution management strategies that are effective in addressing this issue, with full consideration of its complexity and vast geographic scope.

Furthermore, industry-based research on environmental legislation and river pollution control is limited in Malaysia. Compliance with environmental strategies should go beyond just adhering to regulations; hence, further research should be conducted to explore ways to justify and calculate compliance from industries in terms of pollution elimination and the integration of corporate practises into products to provide competitive advantage.

#### CONCLUSIONS AND RECOMMENDATIONS

A significant part of sustainable development in Malaysia has been achieved through environmental regulations implemented by the Malaysian government. Environmental regulations are imperative for ensuring sustainability, economic development, and socioeconomic development. Despite this, Malaysian environmental legislation has too many layers of control and too many laws and regulations that are enforced at the same time. In spite of this, all laws and agencies operate within their respective jurisdictions without overlapping. However, to streamline and enhance the effectiveness of environmental regulations in Malaysia, it is crucial to establish a co-governance structure. By promoting collaboration and coordination among different agencies and stakeholders, a co-governance structure can eliminate redundancies, enhance efficiency, and ensure a more holistic approach to sustainable development.

There are several laws and regulations that have been enacted in Malaysia under the jurisdiction of the federal, state, and local governments. To achieve the regulatory objectives, it is necessary to investigate the reasons why the regulations fail and why the compliance rate is low. The *Industrial Effluent Regulation 2009* should be updated to keep pace with technological advancements to prevent pollution from effluent discharge. Furthermore, industries should be subjected to higher penalties to ensure that they learn their lesson. It is imperative that state, local, and federal governments work together to prevent the inevitable distorting of information during cross-communication between agencies. Developing collaborative coordination among agencies and decentralizing the governance of water is imperative.

Environmental legislation operational mechanisms need to be improved. Consequently, it is important to conduct ongoing research and monitor the effectiveness of these policies and regulations. This is to ensure the protection of Malaysia's rivers and the health of its citizens. To ensure effective river pollution monitoring, policymakers must develop policies that facilitate citizen participation and appropriately decentralise decision-making authority. It is essential to regularly monitor the political and socioeconomic dynamics that influence water quality governance. There should be more research conducted on the effectiveness of collaborative governance in reducing river pollution as well as the factors that contribute to its success or failure. Ultimately, better-informed policies and effective collaborative governance strategies are essential for sustainable river health.

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Zulaikha Mokhtar  
School of Chemical Engineering  
Australian Centre for Water and Environmental Biotechnology  
The University of Queensland, St Lucia, Queensland, 4072 Australia  
Department of Environment  
Levels 1 – 4, Podium 2 & 3  
Wisma Sumber Asli, No.25, Persiaran Perdana  
Precinct 4, Federal Government Administrative Centre  
62574 Putrajaya, Malaysia  
Email: z.mokhtar@uqconnect.edu.au  
\* Corresponding author

Siti Hafsyah Idris  
Faculty of Law, Universiti Teknologi Mara, Malaysia (UiTM)  
Email: sitihafsyah@uitm.edu.my

Steven KenwaY  
Australian Centre for Water and Environmental Biotechnology  
Email: s.kenway@uq.edu.au

Ilje Pikaar  
School of Civil Engineering, University of Queensland, Australia  
Email: i.pikaar@uq.edu.au