

# Lake and the laws: An exploratory network analysis of legal provisions for lake management

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**Abstract.** Integrated lake management requires coherence of various regulations related to environmental preservation and natural resource use. There are, as of yet, no specific laws governing lake management. Legal provisions related to lake management are widely scattered in various environmental legislations. Legal provisions provide a framework for stakeholders, especially government agencies, to take the various actions required in lake management and have a major impact on the efficiency and effectiveness of implementing these measures. This study aims to analyse the relationship between various legal provisions of lake management as mandated in laws and regulations. The method used in this research is exploratory quantitative method by applying social network analysis tools. The data used are 32 laws and government regulations identified have relevance to lake management. The analysis shows that the legal provisions of lake management in Indonesia are complex and tend to be sectoral. The complexity on the one hand gives an indication that the management of the lake has been arranged in detail and on the other hand shows the neglect of complexity and ambiguity in implementation. Weak law enforcement also adds to the problem of implementation. The implication of these findings is the need for government efforts to synchronize various regulations in lake management.

## 1. Introduction

Lake degradation that continues to happen in many parts of the world, with no exception for Indonesia, has prompted to a shift in the paradigm of lake management from being sectoral ones to some sort of integrated management approaches [1–3]. This new paradigm constitutes a sort of lake management that takes into account the interdependencies of various elements of a lake ecosystem and its basin. This change also has consequences on the need for adjustments in the legal system architecture, one of which are laws and regulations related to lake management. Moreover, the existing laws and regulations are mostly not intentionally designed from the perspectives of integrated lake management or ecosystem-based management, but rather in most cases they were designed purposively to address the individual components of environmental problems. In addition, state agencies, which are the main actors of lake management in Indonesia, must subject to the rules, in particular formal rules, such as laws or government regulations, in undertaking any measures. This tacitly implies that the success of lake management to some extent can be attributed to the legal system upon which actors regulate activities related to lake management. Laws and regulations designed coherently in such a way as to facilitate, incentivize, or steer actors engaged in lake



management to coordinate their actions are likely to pay off. Institutional changes, however, are not trivial endeavors [4]. Without a firm understanding of the configuration of formal and informal rules relating to lake management, institutional changes may reinforce the deteriorating process of the lake's ecosystem [4]. Research projects on institutional aspects of lake management in Indonesia are, however, still limited [5] and therefore there remain many questions that need to be answered about how integrated lake basin management approaches are believed able to transform the deteriorated lakes to sustainable states should be implemented. Furthermore, experiences from various countries around the world, however, have revealed the fact that effective lake management for sustainable use is a complex undertaking, it needs to take into account many issues, including scientific, socio-economic, and governance issues[6].

Indonesia is a tropical archipelago country endowed with many natural lakes which provide a multitude ecosystem services for human as well as other living organisms. Some research projects intended to reveal the uniqueness [e.g., 7,8] and potential benefits of some major natural lakes in Indonesia have been undertaken [9–13] and similar research projects on lakes are likely to be carried out in the near future since there are a large number of lakes are still *limna incognita* for limnologists [12]. Most of the research projects on lakes deal with biophysical issues and this have provided a lot of useful information for science as well as in policy making although there are still many scientific findings that have not been transformed into practical guidance for government agencies responsible for daily lake management activities. Giesen's findings for more than two decades regarding the main problems plaguing Indonesia's main lakes are still of relevance [12,14]. According to The Indonesian Ministry of Environment and Forestry, there are currently 15 major lakes prioritized for restoration to address environmental problems such as siltation, eutrophication, shrinkage, deterioration of water quality as well as loss of biodiversity [15].

Although it is often mentioned in state speeches on many occasions that lakes are multipurpose natural resources beneficial for economic development, Indonesia at present does not have yet laws and regulations that specifically regulate lake management. Instead, many legal provisions pertaining to lake management are scattered in various laws and regulations, both general laws and those that are designed to address other particular matters. This indeed makes it difficult for actors engaged in lake management to find legal provisions that can serve as guidelines for undertaking their actions. It is not uncommon to encounter in daily lives that in many cases the actions of one or more state agencies conflict with other agencies simply because they are lack of knowledge regarding the legal environmental provisions governing the activities. For instance, a municipal governmental agency responsible for agricultural and fisheries affairs enacts policies intended for fish cage culture or intensive seasonal agriculture in the riparian zone of a lake for the benefits of food security, while on the same lake there are some other state agencies that are trying hard to overcome the problems of the lake, such as eutrophication, silting, and shrinkage of the lake area. Based on this matter, this research is aimed to explore the configuration of formal rules pertaining to lake management in Indonesia.

## 2. Lake management challenges

A lake is often depicted, such in paintings or panoramic photographs as a peaceful, pleasant, and beautiful place with clear water inhabited by a variety of marvelous aquatic biotas. This depiction is to some extent close to reality especially for pristine lakes situated in remote locations where the human interferences are absent or at least minimal. For most lakes in Indonesia, their real conditions, however, are far from what have been depicted in some imaginative idealistic paintings of 'healthy' lakes. Some major lakes are all virtually facing a multitude of environmental problems, such as excessive aquatic weeds proliferation, biodiversity degradation, accelerated silting as well as water pollution, which in turn lead to deterioration of their ecosystem services [9,12,14,16,17]. These problems are somehow attributed to human activities on the water body and catchment area of a lake [12,18–20]. Some lakes are even predicted to vanish in the foreseeable future if no any extraordinary measures are undertaken to remedy the current downward trend.

Lakes, whether natural or human-made, are broadly defined as areas filled with water of various sizes [19,21,22]. They are typically located in basins and surrounded by lands, apart from any feeder rivers or other drainage outlets [1,19,21,22]. They are considered natural resources that provide various benefits for human beings and other living organisms [1,14]. Lakes have an important role as storage of surface freshwater. Combined with reservoirs, they store 90% of the world's surface freshwater [1,6,19]. Furthermore, they are habitats for numerous aquatic plant and animal species, many of which are endemics. While, for some people, lakes are places of recreation for temporarily escaping from busy times, for others, especially farmers or fishermen, they are central for livelihood. The advancement in science and technology, especially in the field of lake management, has brought forth a comprehension that lakes, which are natural resources, with their unique properties, cannot be managed partially or often called sectoral management [1]. Lakes tend to be more vulnerable than rivers because they integrate and hold water intake for relatively long periods, and do not respond to any disturbance or intervention immediately due to the complexity of their ecosystem [1,22,23]. The linkages between water quantity and quality of a lake and land use in its catchment area are widely recognized. Slight changes in land use in the catchment area of a lake are more likely to affect its water body ecosystem, which in turn often lead to unpredictable environmental outcomes that can emerge in unpredicted time. In addition, as natural resources that provide many benefits, lakes are melting pots of various interests. The implication is that lake management objectives usually cover more than one and some of them may incompatible with one another and therefore need to be compromised [3]. These interdependencies have prompted integrated lake management to emerge as an alternative strategy for lake management [1].

### 3. Prior research

Most of the research projects on legal system networks were conducted in a number of qualitative studies using the concept of a policy network in terms of legislation or policy making. The policy network is formed when internal and external stakeholders within the policy community share information with each other and coordinate and agree on the process of policy decisions. There have been many case studies that have identified the policy and legislative process of each field that is developing in this form, and in particular, a dynamic analysis of the process of policy formation using qualitative data such as literature search, newspaper article reference, and interviews [24,25]. In these studies, the actors playing a major role were identified, and the conflict and cooperative relationship between them were identified.

Existing studies have analysed policy processes in various fields such as medicine, science and technology, information and communication, and public and social welfare [26,27]. In the case of medical and bioethics related fields, the continuity and changes of medical division of labour policy were identified from the perspective of the policy network, and the roles and relationships of stakeholders who participated in the medical division of labour policy decision process were identified.

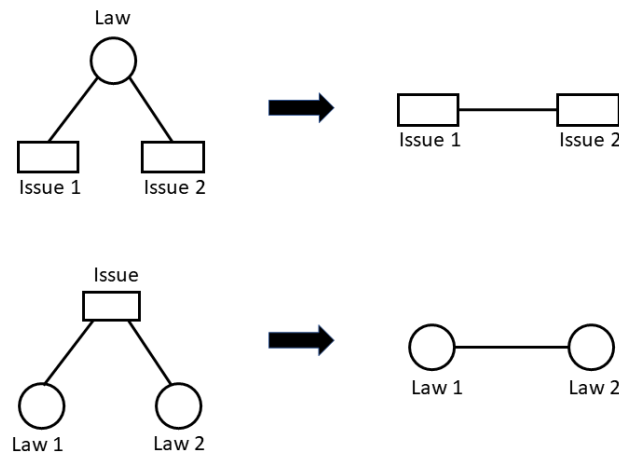
### 4. Methods

This research examines the laws and regulations that constitute the legal framework for lake management in Indonesia. Since Indonesia does not have yet any laws designed specifically to address lake management issues, we first listed laws and regulations that have relevance to lake management issues in Indonesia, which include laws and regulations in the realm of water resources management, environmental and natural resources management, spatial planning and local government (Table 1). It is not exhaustive list, but it includes most of the laws and regulations that are normally referred to by government officials in charge for lake management related activities, i.e. watershed management, river and irrigation management, soil and conservation, etc. Secondly, we listed a number of lake management issues (Table 2). Part of information regarding laws and regulations and lake management issues was obtained from interviews with a number of government officials in the fields of watershed management, river basin management, agriculture, forestry, fisheries, and environmental

management. Apart from that, we also interviewed two functionaries from two multi-stakeholders forums, one is a functionary of Watershed Management Forum of Central Java Province and the other is of River Basin Water Resources Management Coordination Team of Pemali-Juana River Basin. The total number of interviewees was 15 people. In addition, lake management issues were also obtained from newspapers and research reports on lakes. Before being included in the list, these issues were confirmed to several interviewees to ensure their validity.

**Table 1.** Laws and regulations relevant for lake management

Laws	Type
<i>Basic Law</i>	
Basic Agrarian Law (No.5/1960)	Statute
<i>Public Administration and Planning Law</i>	
Local Government Law (No.32/2014)	Statute
National Planning System Law (No.25/2004)	Statute
Spatial Planning Law (No.26/2007)	Statute
Presidential Decree of River Basin Area (No.12/2012)	Presidential Regulation
<i>Environmental Law</i>	
Protection and Management of Living Environment Law (No. 32/2009)	Statute
Soil and Water Conservation Law (No. 37/2014)	Statute
Biological Resources and their Ecosystems Conservation Law (No. 5/1990)	Statute
Waste Management Law ( No. 18/2008)	Statute
Government Regulation of Watershed Management (No. 37/2012)	Regulation
Government Regulation of Environmental Economic Instrument (No. 46/2017)	Regulation
Government Regulation of Environmental Health (No. 66/2014)	Regulation
Government Regulation of Environmental Permit (No. 27/2012)	Regulation
Government Regulation of Fish Conservation (No. 60/2007)	Regulation
Government Regulation of Water Quality Management and Water Pollution Control (No. 82/2001)	Regulation
Presidential Decree of Management of Protection Area (No. 32/1990)	Presidential Regulation
Public Work and Public Housing Ministerial Regulation of Setback line of River and Lake (No. 28/2015)	Ministerial Regulation
<i>Sectoral Law</i>	
Water Resources Law (No. 17/2019)	Statute
Sustainable Agricultural Cultivation Law (No. 22/2019)	Statute
Plantation Law (No.39/2014)	Statute
Forestry Law (No. 41/1999) in conjunction with Law No. 19/2004	Statute
Fisheries Law (No.31/2004) in conjunction with Law No. 45/2009	Statute
Coal and Mineral Mining Law ( No. 4/2009)	Statute
Industrial Law (No. 3/2014)	Statute
Electricity Law (No. 30/2009)	Statute
Oil and Gas Law ( No. 22/2001)	Statute
Government Regulation of Water Exploitation (No. 121/2015)	Government Regulation
Government Regulation of Jasa Tirta State (No. 46/2010)	Government Regulation
Transportation Ministerial Regulation of Dredging and Reclamation (No. 125/2018)	Government Regulation
<i>Infrastructure Law</i>	
Building Law (No. 28/2002)	Statute
Housing and Settlement Law (No. 1/2011)	Statute
Road Law (No. 38/2004)	Statute



**Figure 1.** Transformation procedure

**Table 2.** List of Lake Management Issues

Issue	Description and relation to lake management
Silting	Silting is a problem of excessive sedimentation comes from various sources, such as eroded soil particles, organic matter from dead aquatic plants, or remains of feed of fish cage culture. This in turn reduces lake capacity to hold water used for hydroelectric power and agricultural irrigation in lowland areas.
Water quality	Deterioration of water quality due to pollutants from various sources, such as soil particles due to soil erosion, nutrient and pesticide loadings from intensive agricultural activities in catchment and riparian areas, feed remains from fish cage culture, and household and industrial waste.
Aquatic plant	Excessive proliferation of aquatic plants, especially exotic aquatic plants such as water hyacinth. The presence of excessive aquatic plants reduces the oxygen content in the water which in turn causes the death of fish and other aquatic species.
Inland water artisanal fishing	Artisanal fishing is various small-scale, low-technology, low-capital, fishing practices undertaken by individual fishing households. They are currently in competition with fish cage culture and facing a decline in fish population.
Fish cage culture	Fish cage culture is growing fish in cages located in the water body of the lake. It is an intensive form of aquaculture and has a direct impact on water quality. The more fish cages in the lake, the worse the water quality.
Riparian zone conservation	Riparian area is transition area of terrestrial and lake water body. This area helps control nonpoint source pollution by holding and using nutrients and reducing sediment. The contemporary problem of riparian areas is the conversion to other uses such as settlements, tourist attractions or rice fields.
Biodiversity	Lakes are habitats for many species. Some of them are even endemic species. Reduced biodiversity, for example, can have an impact on the disruption of ecosystem services.
Land use and land cover	The quality and quantity of water in lakes and other changes that occur in lake ecosystem are closely related to land use in the catchment area.
Coordination	Lake management requires coordination and participation of stakeholders
Law enforcement	Law enforcement is intended to overcome violations of various provisions
Environmental fund	Limited funding is one of the main obstacles in implementing lake management plans

We identified a list of 11 issues and used them to examine the linkage between the laws and regulations listed in Table 1. This was done to figure out their configuration structure and identified which laws and regulations are central for lake management. To this end, two-mode matrix was

constructed to link between laws and regulations and lake issues. The linkage is the occurrence of the issue in the articles of the laws and regulations. Manual coding was applied in identifying which issues are addressed by the articles of the laws and regulations. This is done to avoid the possibility of missing one or more of the issues that are subtly addressed in the articles of laws and regulations being examined. For further analysis, we projected two-mode matrix to two one-mode matrices as suggested Borgatti and Everett [28]. Following [29] procedure of matrix projection is depicted in Figure 1.

The methods utilized to analyse projected one-mode matrices will be those developed by Borgatti and Everett [28]. In exploring the connections of laws and lake management issues and identifying those most centrally located within the legal framework structure, this research will focus on degree centrality. It is simply the number immediate connection of a node has in a network. All social network measures and figures were derived using the open-source software Gephi and R.

## 5. Results and discussions

### 5.1. Several provisions of lake management related environmental legislations

Environmental legislations related to lake management in Indonesia by virtue of their subject matters can be categorized into basic laws, public administration and planning laws, environmental management laws, infrastructure laws, and sectoral laws. The first three categories of laws, in principle, regulate the overarching aspects of property right systems of natural resources, government administration, including planning, coordination, or environmental management in a broader sense, and serve as references for other formal regulations. Sectoral laws are specifically designed for regulating a specific natural resource or an aspect of environmental management. Lake management, however, is still a peripheral issue in Indonesian legal systems, which is indicated from the number of words “lake” mentioned explicitly in those laws and regulations. Overall, there are at most only 7 laws and regulations containing word “lake” (Table 3).

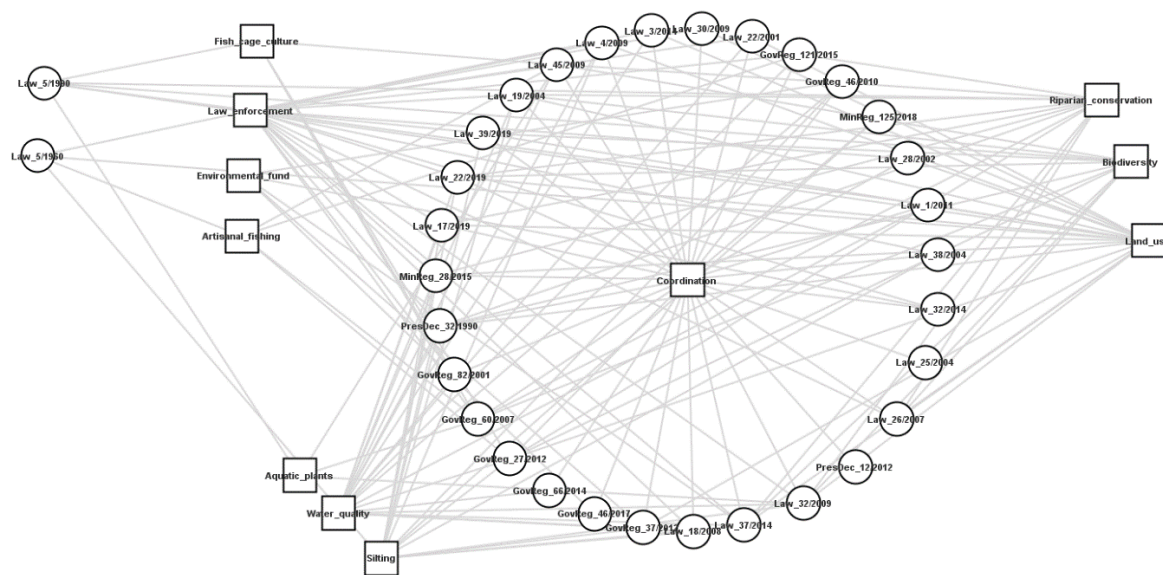
**Table 3.** Legal provisions of lake management in several environmental legislations

Law and Regulation	Subject	Legal Provisions
Law 17/2019	Water Resource	- Protection of lakes as natural freshwater sources - Lakes are controlled by government - Division of lake management authorities
Law 31/2004	Fisheries	- Lake is a fishing and fish farming area - Lake can be included as wetland conservation areas of fish and aquatic freshwater species
Law 41/1999	Forestry	Prohibition of logging activities of forest and trees situated in areas close to lakes
P.D. 32/1990	Management of Protection Areas	Designation of protected areas for lake preservation
M.R. 28/2015 (Public Work)	Setback Line of River and Lake	Minimum distance of setback line of the lake
M.R. 125/2018 (Transportation)	Dredging and Reclamation	Lake dredging and reclamation for navigation and wharf construction

Further examination of laws and regulations articles, legal provisions for lake management cover several key issues, such as spatial planning, division of authority, protection of riparian areas, and fish biodiversity. The provisions on planning and licensing in environmental management, which implicitly include lake management, compared to other matters seem dominant. It seems likely prevention measures are more prioritized than those of mitigation or resolving environmental problems. This can be seen clearly from the inclusion of a number of preventive instruments, such as strategic environmental studies, regional spatial plans, integrated plans, environmental impact analysis (AMDAL), environmental permits, environmental quality standards, post-mining guarantee funds, reclamation funds, and so on. The use of these instruments also indicates an emphasis on point-source

abatement strategies, although it is apparent that most of water pollution sources, in particular the pollution of a lake water body, are mainly from side-effects of various activities that occur both in a lake water body and in its catchment area and are therefore quite costly, if it is possible, to attribute pollution sources to the parties responsible for.

Another thing that deserves attention is the mechanism for enforcing stipulated legal provisions. The articles containing rules of law enforcement do not completely regulate law enforcement mechanisms, especially those related to water pollution, violations of land use, or in compliances of land conservation principles involving small businesses or upland rural poor communities, which in the aggregate are major contributors to lake degradation. Administrative sanctions or even fines or imprisonment for violations as stipulated in the articles of laws and regulations will be very difficult to apply because of the difficulty in proving it and in certain cases contrary to social norms held by the general public, many of which value providing assistance to the poor rather than punishing them for violation of environmental management law provisions. The limited number of human resources with certain capabilities, technological support, and a budget in accordance with the needs of environmental law enforcement also adds to the problem. The stipulated law enforcement provisions seem to be designed by assuming ideal conditions and therefore encounter many obstacles when they are implemented.



**Figure 2.** Laws and Regulations Configuration

In addition, it is interesting to note that various laws and regulations are ordering for community participation in lake and environmental management activities in a broad sense, from planning, implementing to monitoring, and evaluating. This implicitly shows that the regulations pertaining to lake management in Indonesia call for participatory governance, although in many cases the roles of government are still dominant. The regulations on integrated watershed management or integrated water resources management that are closely related to lake management, for instance, can provide an illustration of this. The legal provisions for community involvement are limited to providing inputs on plans made by the government, while the final decision on matters to be included in the management plan remains with the government. In terms of implementing the activity plan, the public is still positioned as the implementer who is expected to comply with the established plan. Any deviation

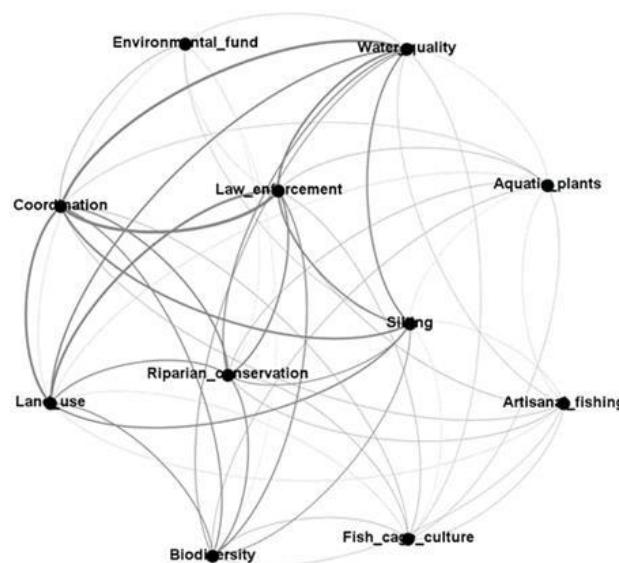
from the plan is considered a violation of legal consequences. Participatory governance that is envisioned in statutory regulations appears to be still some sort of pseudo-participatory governance.

Examining further the provisions of laws and regulations, it turns out that the planning stages of natural resource management and the environment receive more attention than other stages of management. There are at least seven types of management plans mandated by statutory regulations, such as development plans, water resources management plans, forest management plans, environmental management plans, spatial and territorial plans, and soil conservation plans. This on the one hand shows comprehensiveness, but on the other hand adds to the complexity of environmental management, especially for managers who take care of day-to-day various management activities. At the very least, they will be faced with complicated choices about which plan to refer to. Moreover, each plan has different objectives, implementation time schedules, monitoring systems, and evaluation criteria. Therefore, it is not surprising that some plans are merely administrative documents without being implemented further.

Turning to the local government whether provincial or municipality governments, to date only a few have enacted laws and regulations aimed at lake management (e.g., Agam reGENCY, Semarang reGENCY). These local regulations can be said to resemble statutory regulations at the national level and have not addressed yet specific issues relevant to local lakes which in many cases have their specificities. In this case, the existing local regulations do not contain legal provisions specifically aimed at regulating the management of lakes within the jurisdiction of the local government. These regulations are more symbolic than regulations designed to resolve environmental problems that occur in those lakes.

### 5.2. Network analysis of lake management related environmental legislations

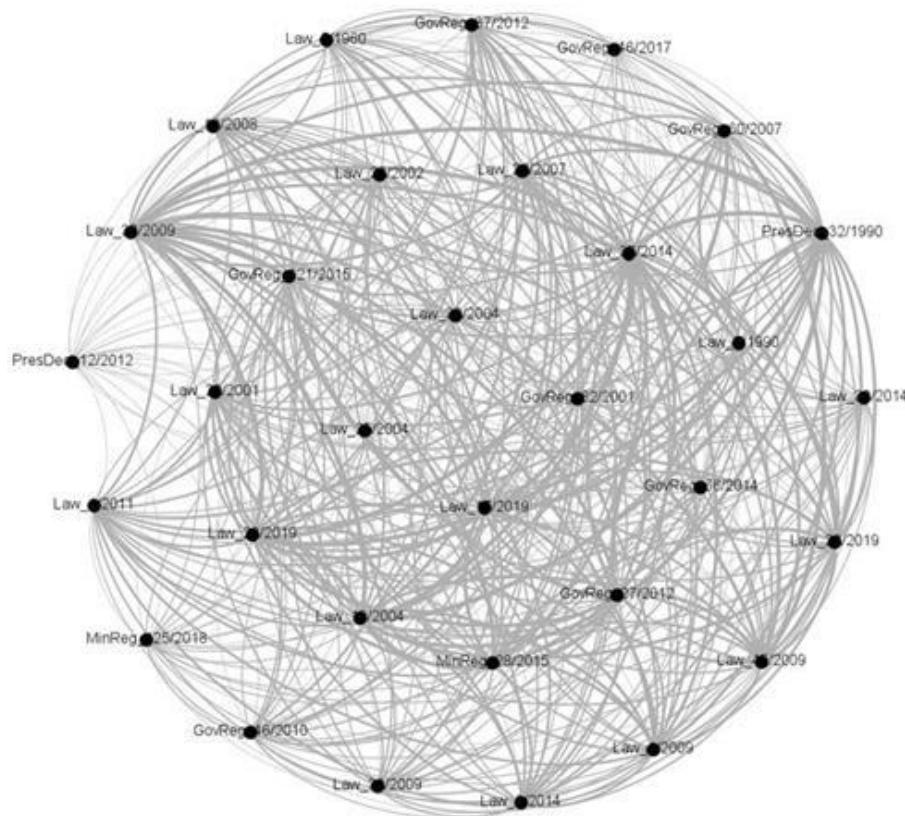
To explore more deeply the relationship between one statutory regulation and another, it is necessary to conduct an examination of lake management issues that are covered by environmental legislations. In this regard, we examine the extent to which the co-occurrence of lake management issues is covered by the legislation. This co-occurrence can at least be an indication of policy integration. Figure illustrates co-occurrence of lake management issues in Indonesia. The circles in Figure 3 depict various lake-management-related issues and a tie denotes that one or more articles in a law regulate both issues. The thickness of ties represents the number of laws integrating two issues. The thicker the ties, the stronger the law-based integration across issues.



**Figure 3.** Law-based co-occurrence of lake management issues



The picture portrays the association of 11 key issues, but only 5 association issues stand out, namely coordination, land use, law enforcement, water quality, and silting. There are two things that can be taken as lessons. First, the association between key issues, for example land use - water quality or land use - silting, indicates that articles of environmental legislations often integrate those issues that are presumed as a causal relationship. In the example of the association between land use and water quality, here the quality of lake water is attributed to developed land use practices at both the plots and landscape levels. In similar vein, the association between land use and siltation also represents a causality relationship where siltation problems are attributed to land use problems. Second, issue pairs that exhibit strong integration ties include coordination and law enforcement. It points out that the legislation implicitly acknowledges the nature of interdependence between the social and ecological components that make up the ecosystem. In this case, the interdependent issues are regulated in the same law to promote coherence.



**Figure 4.** Network configuration of environmental legislations related to lake management

This study, furthermore, also identifies prominent laws and regulations in management of lake. Figure 4 depicts network configuration of 32 statutory regulations. Similar to Figure, the circles are the laws or government regulations, while a tie denotes that the laws or regulations regulate the same lake management issue. Overall, the network density is comparatively tight, almost none of the laws and regulations are not connected. This is an indication that the environmental legislations concerning to lake management seems likely integrated, although it may only appear on the document.

Of a number of regulations that are the subject of this study, some of them, such as Law 32/2009, Law 37/2014, Law 5/1960, Law 23/2014, or Law 26/2007, are laws that are comparatively comprehensive and become a reference (basic regulation) for other laws and regulations. Meanwhile, some other laws, such as Law 17/2019, Law 45/2009, Law 41/1999 or Law 22/2019, are sectoral laws. The central position in the regulatory network is occupied by Law 32/2019, which is Environmental Protection and Management Law. This indicates that this law is an umbrella law that becomes the reference or basic regulation of other laws. Meanwhile, Government regulation 37/2012, which is the only written regulation that regulates watershed management, its connectivity to other laws and regulations is relatively low, namely only eight laws and regulations especially in terms of soil and water conservation, post-mining reclamation and land, and spatial rehabilitation. Regarding water pollution and also biodiversity conservation, it is still not connected. Even though these two things are closely related to water quality, which is one of the main objectives of lake management. Table 4 provides a list of prominent laws in lake management based on the degree of centrality.

**Table 4.** Prominent laws and regulations in lake management

Law and Regulation	Subject
Law 32/2009	Protection and Management of Living Environment Law
Law 37/2014	Soil and Water Conservation Law
GovReg_27/2012	Government Regulation of Environmental Permit
Law 45/2009	Fisheries Law (No.31/2004) in conjunction with Law No. 45/2009
Law 5/1960	Basic Agrarian Law
GovReg 60/2007	Government Regulation of Fish Conservation
PresDec 32/1990	Presidential Decree of Management of Protection Area
Law 22/2019	Sustainable Agricultural Cultivation Law
Law 19/2004	Forestry Law (No. 41/1999) in conjunction with Law No. 19/2004
Law 5/1990	Biological Resources and their Ecosystems Conservation Law
MinReg 28/2015	Public Work and Public Housing Ministerial Regulation of Setback line of River and Lake
Law 17/2019	Water Resources Law

### 5.3. Lake management plan: a case of ambiguity and complexity

Lake management, which is a form of ecosystem-based natural resource management, requires regulatory coherence. I will discuss the coherence between these regulations. In this case, the discussion is limited to the planning aspect.

Almost all regulations related to lake management order the formulation of a plan that is crafted as a guideline in carrying out activities as mandated by the regulation. These plans can generally be grouped into general plans and cover all aspects of development and thematic plans that are specific and only cover certain aspects. Each plan uses a different reference basis. Environmental Protection and Management Plans (RPPLH), for example, the references used include eco-regions and Strategic Environmental Studies (KLHS), while the Watershed Management Plans (RPDAS) are prepared based on an inventory of natural resource degradation, particularly land and water, at the watershed scale. The same thing will also be clearly seen when each plan is compared with one another.

The basic differences in the formulation of these plans have implications for complexity at the level of implementation. Ecosystem-based natural resource management, such as a lake, requires integrated management. Current resource management regulations mandate a wide variety of plans. This on the one hand indicates that natural resources in Indonesia have been regulated in detail and cover various things from typologies to their ecosystems, but on the other hand raises fundamental questions about integration, synchronization and synergy among the plans mandated by the regulation. Most of the existing regulations require the integration of the plans mandated by them or at least become a

reference in the preparation of development plans starting from the central level to the city or district level. Even though it seems simple, the integration of one plan into another has its complexities, especially in terms of time, prioritization and adaptation. In terms of timeframe, for example, some regulations explicitly require sequential or gradual planning with the end in the development plan. Thus, the development plan is drawn up after other plans, such as RPPLH, RTRW, RPDAS, RKTA, have been completed. However, such ideal conditions are very difficult to achieve because development plans are drawn up in accordance with the cycle of the government period or following a budgeting timeline which in many cases differs in time rhythm from other plans. In addition, several related plans, such as RPPLH, RPDAS, and RKTA as well as parts of RTRW, have some similarities. Integrating the four plans is also not a trivial task because the regulations that underlie the four plans do not clearly explain the integration process and each wants the plan mandated to be prioritized in development. So far there has been no mechanism for integrating these various plans.

Although the results of the analysis show that there is a lot of disconnect between the tested regulations, watershed management must prioritize flexibility, according to the physical, chemical, and biological characteristics related to water. From a political perspective, watershed management must also have a big responsibility for opportunities and challenges related to prevention, improvement, and the goal of increasing watershed processing towards the freedom of individuals and communities who own their natural resources and are managed by the community themselves.

## 6. Conclusions

Integrated lake management requires coherence of various regulations related to environmental conservation and utilization of natural resources. Regulation is a framework for stakeholders, particularly government agencies, to act and therefore greatly affects the efficiency and effectiveness of the implemented lake management strategy. There are only at most seven environmental legislations that explicitly mention the word “lake”, while other legislations tend to use the word environment which has a broader meaning. Examining further, it appears that lake management in Indonesia still prioritizes water quality and silting problems, whereas environmental pollution problems in general and biodiversity that provides many environmental services are not yet the domain of lake management. Rather, the realm appears to be managed within an environmental conservation and pollution control regulatory framework. This has a consequence in the form of disconnected regulation which has resulted in the emergence of various management plans. Moreover, almost all regulations mandate a number of plans without providing an explanation for their integration. Thus, the current regulations do not fully frame lake management as a form of ecosystem-based management. For this reason, it is highly recommended to make regulations governing the integration of plans and implementation strategies.

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