

Review on community-based strategies for improving the quality of lake waters (Case study: Urban Lake Rawa Besar, Depok, West Java, Indonesia)

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Abstract. Lakes provide important habitat for fish, birds, reptiles and aquatic plants, and produce fishing, tourism and recreation industries. However, the condition of the lake's water quality continues to decline. Until now, lake management has not reflected sustainable lake management. This paper aims to provide a review of community-based water quality improvement strategies. The case study is in urban lake Rawa Besar, Depok, West Java, Indonesia. This paper not only provides a strategy but before that there is a comprehensive analysis of the factors causing a decline in the quality of lake waters, so that the strategy is expected to be appropriate. The community is also expected to be the main and first protector of the condition of the quality of the lake waters.

1. Introduction

Human life is very dependent on natural resources. Water is one of the renewable natural resources. According to research conducted [1], aquatic systems have values and roles in society, namely economic value, social value, and the value of the ecological environment. However, an increase in population and the nature of human activities that tend to exploit nature ultimately disrupts the water cycle, causes environmental degradation, and also decreases water values [2]. This environmental degradation occurs in almost all types of waters without exception of lake water directly adjacent to settlements and business locations. Lake itself has ecosystem services as regulatory services such as flood control and climate, aquatic habitat; support services such as nutrition or pollination cycles; cultural services such as recreational and aesthetic means; service provider resources such as fisheries, agriculture, food sources and water [3].

The value of ecosystem services from the lake is so great for meeting the needs of human life. However in fact, almost all lakes in the world face pollution problems that cause damage. The decline in lake water quality occurs in Pontchartrain Lake, the United States due to fecal pollution originating from rainwater runoff in urban areas, overflow of wastewater, damaged sewers, and wastewater treatment plants [4]. Parramatta recreational lake, Sydney, Australia also experienced pollution originating from urban waste that was carried by rainwater and resulted in visitors being banned from swimming in the lake for three days after heavy rain [5]. Research [6] found that human activities originating from urban areas, especially domestic waste and agricultural activities that were disposed of into the lake resulted in water pollution on Lake Burullus, the second largest lake in Egypt. Indonesia as well as other Asian countries also experience lake pollution problems,

one of which is lake Rawa Besar. Lake Rawa Besar has experienced pollution, sedimentation and eutrophication[7].

A large amount of literature has studied the strategies for improving the quality of lake waters, but there is still very little to learn about community-based strategies that prioritize the advantages and disadvantages that local communities themselves will face. This paper first introduced the cause of the decline in the quality of lake waters, specifically what happened in urban lake Rawa Besar, Depok, West Java, Indonesia. Then present the concept of improvement strategies for the decline in the quality of the community-based environment.

2. Review of the causes of decreasing lake water quality and its strategy

Natural activities and human activities such as industrialization, agriculture, and urbanization followed by an increase in human populations around lakes can affect lake water quality through increased contaminants [8]. Increased human activities that provide input to plastic waste and domestic waste disposal to water bodies and increased utilization of aquatic resources such as fisheries result in changes in decreasing water quality [9]. Before choosing an improvement strategy for lake quality, the factors that cause a decline in lake water quality must be explored first because pollutant sources often originate from non-point sources, such as agricultural runoff or urban runoff water [10].

Different causative factors require different water quality management approaches [11]. Each lake has different characteristics and conditions so that the causes of decreasing lake quality and management plans must be prepared based on the evaluation of specific problems or locations [12]. In developed countries such as China and developing countries such as Indonesia, lake pollution occurs a lot due to industrial sector waste which can lead to drinking water crisis [13]. Industrial and urban sector waste is a major cause of other lake pollution [14]–[17]. This also happened in urban lake Rawa Besar, Depok, West Java, Indonesia.

Pollution in lake Rawa Besar was caused by the presence of household waste and human activities that produce organic waste such as tofu factories, poultry dung, fish cages and landfills that go directly to lake Rawa Besar or through small sewers[7]. The source of pollution caused the value of Biochemical Oxygen Demand (BOD) in the lake Rawa Besar to be 29 mg/liter, with a Chemical Oxygen Demand (COD) value of 63.7 mg/liter, and a Dissolved Oxygen (DO) value of 2.4 mg /liter[18]. Environmental quality standards according to PP RI No.82 of 2001 Class III, namely the value of BOD should not exceed 6 mg/liter, COD values do not exceed 50 mg/liter, and DO values of at least 3 mg/liter. Therefore, it is necessary to improve community-based water quality because the community is an actor directly affected by the damage and repairs that occur. The community is also the main guardian and supervisor of each strategy in the lake water quality improvement program.

2.1. Improvement Strategy

According to [19] pollution is a significant driver behind lake repairs, but the research also reveals that often improvement strategies actually create new problems. In addition, many current restoration and management practices inadvertently simplify the complexity of the issue of deterioration by changing the scale of these complex issues into fully ecological subsystems, and solutions focus solely on the problem at hand rather than finding out the underlying causes of the problem situ [20]. Situ management strategies that do not

see the problem as a holistic problem are what cause the strategy to fail and be unsustainable. Therefore it is necessary to identify the right approach to improve water quality. The improvement strategies proposed in this research are:

2.1.1. Community empowerment.

Community empowerment encourages each individual to be independent, confident, and energetic [21]. Empowerment is the main theory in community psychology and is the main concept for achieving a better quality of life for the community and environment [22]. Research [23] shows that community empowerment is related to participation, social capital, shared vision, ownership, resources, knowledge, skills, and communication. Sustainable situ management needs to empower local communities to manage the sustainability of fisheries there [24]. The community must be given knowledge about the number of cages and the number of pellets given based on the carrying capacity of the waters for fish farming in lakes, types of fish that are kept [25]. Local wisdom in managing fish resources is also a form of community-based fisheries management.

Community-based conservation discourse needs community participation and community initiatives to realize their potential in improving water quality [26]. Local community empowerment can also be done in the aspect of tourism. Tourism has the potential to increase income, increase employment, develop skills, and empower local communities [27]. Community-based tourism in communal areas is seen as an important tool for building local support for conservation and sustainable use of natural resources [28].

2.1.2. Waste Water Treatment Plant (WWTP).

Waste treatment with biological processes is widely used in domestic wastewater treatment to prevent ecological problems such as eutrophication of water sources [29]. The existence of WWTP will change the quality of the waters because organic waste from domestic waste does not directly enter there, which in turn will improve cleanliness, health levels, and change the quality of life of the community. However, this improvement strategy has several obstacles, both from the expensive development costs and considerable maintenance costs. In addition, the community response is very important in this strategy because the community will not necessarily accept it if the house is demolished for the purpose of building a pipeline or WWTP channel.

Construction of the WWTP will also require land for the construction of the WWTP unit. According to [30] WWTP with a biological aeration filter system and granular activated sludge is considered capable of overcoming the problem of increasing construction costs and lack of space availability. The addition of biofilter units is considered capable of reducing the BOD value to 90% of the biofilter process. This is because the food chain is longer than conventional activated sludge processes.

2.1.3. Settlement Relocation.

Land use change has a direct effect on lake health [19]. This is caused by the loss of open green space and some of the waters bodies are permitted by changes in spatial structure into settlements so that when it rains comes the dirt carried by rainwater is not filtered and directly into the waters of the lake [31]. The advantage of the settlement relocation improvement strategy is that the community will get a more feasible place so that there will be an increase in quality of life [32]. After the transfer is carried out, the government does not need to incur large costs, only the cost of situ monitoring, the lake is

not polluted anymore because the source of pollutants is no longer [33]. Besides that, the residential area can be replaced by the construction of green open space. Green space is an effort to improve ecological functions along riparian zones (land areas that surround waterways) [34]. However by moving settlements, the social models and social structures that have been interwoven will be lost [32]. In addition to social models, people's livelihoods are also lost or changed [35]. From the government side, this transfer would certainly require a lot of costs, namely compensation costs, the cost of finding a new settlement location.

3. Conclusion

The main causes of the decline in the quality of the lake waters especially in the lake Rawa Besar are human activities that are in the vicinity of the lake waters, domestic waste, and land conversion. In fact, humans should be able to coexist with nature in harmony for the sake of human welfare. The various programs and strategies that are available are not yet sustainable. Therefore, community-based strategies, namely community empowerment, Waste Water Treatment Plant (WWTP), and relocation of settlements are expected to be able to answer the needs of sustainable lake management. Furthermore, the researchers will conduct biological water quality testing, namely the diversity and dominance of phytoplankton tests, to see how far the quality of the waters in the large swamp lake has decreased.

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