ISSN: 18158129 E-ISSN: 18151027
Volume 19, Issue 11, November, 2023

Sustainable Watershed Management Model Concept

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ABSTRACT— Watersheds are vital for human life. Management has been carried out for a long time, but many are still in the critical category. The watershed is a complex nature-human system involving various interacting biogeophysical and socio-economic cultural components. Degradation of forest, soil, and water resources, as well as population pressure, has led to a decrease in watershed sustainability, and this is one of the biggest obstacle to sustainable watershed management in most developing countries in the humid tropics. This research aims to create a concept for a sustainable watershed management model. The research method consists of two stages. The first concept development stage is based on theoretical studies and research results on watershed management and sustainability. The second stage is concept improvement based on input from stakeholders such as BPDASHL Brantas Sampean, Perum Jasa Tirta I, and the Brantas Water Resources Office. The research results produced a concept for a sustainable watershed management model. Management is based on a sustainability index with a continuity planning, implementation, and evaluation cycle.

KEYWORDS: watershed, management, sustainability, model, concept.

1. INTRODUCTION

A watershed is a geographical area where all surface water and groundwater flows into a river, lake, or sea channel. The watershed is significant for our life [3], [8], [11], [12]. Watersheds are the source of most of the world's freshwater, providing clean water, irrigation for agriculture, and water for industrial use [32]. Numerous plant and animal species are sustained by watersheds; healthy watersheds provide food and shelter for aquatic creatures as well as animals and aid in the preservation of genetic diversity [26]. According to Fatholoumi et al. (2023) [19], healthy watersheds aid in controlling water flow, lowering the risk of erosion and flooding, because they absorb and store carbon and other greenhouse gases, watersheds play a key role in regulating the climate. Watersheds provide opportunities for outdoor recreation, such as fishing, boating, and hiking, which contribute to the economy and improve physical and mental health [32]. Watersheds are important to many indigenous communities with cultural and spiritual connections to the land and water. Watersheds provide economic benefits such as hydropower, irrigation, and commercial fishing [33].

The sustainability of the land, agriculture, and forest must all be taken into account when using a watershed. Thus, "the management of a watershed system with sustainable technological options, which may ensure the sustainability of land, agriculture, and forestry or its combinations to conserve natural resources, with adequate institutional and economic options" could be the definition of sustainable watershed management.

A watershed is a complex natural-human system involving various biogeophysical, socio-economic, and cultural components that interact [24], [30]. Degradation of forest, land and water resources and population pressure have led to a decline in watershed sustainability which is the biggest obstacle to sustainable watershed management in most developing countries in the humid tropics [31].

The definition of sustainable watershed management is "the management of a watershed system with adequate institutional and economic options, and sustainable technological options, which may ensure the sustainability of land, agriculture, and forestry, or their combinations to conserve natural resources."

Watershed management has been carried out for a long time, but many are still in the critical category [24], [30]. This is caused by the lack of integrated management and not implementing the principles of sustainability [30], [27], [28], [24].

2. METHODS

This research was conducted from August to September 2023 at BPDASHL Brantas Sampean, Perum Jasa Tirta I, and the Brantas Water Resources Office, East Java, Indonesia. The concept of a sustainable watershed management model was developed based on theory and research results on watershed management and sustainability. The concept was improved by discussing with stakeholders such as BPDASHL Brantas Sampean, Perum Jasa Tirta I, and the Brantas Water Resources Office.

3. Watershed system

A watershed is a complex natural-human system because it involves various biogeophysical and socio-economic and cultural components that interact [24], [30]. Hydrological and ecological processes integrated with aspect social economy the people [3]. Activity man impact on the watershed system [8] which will influence service ecosystem [32].

A watershed can be seen as something the system inside has various subsystems like biophysical, economic, social, cultural, policy, and sector. The watershed system is presented in Figure 1.

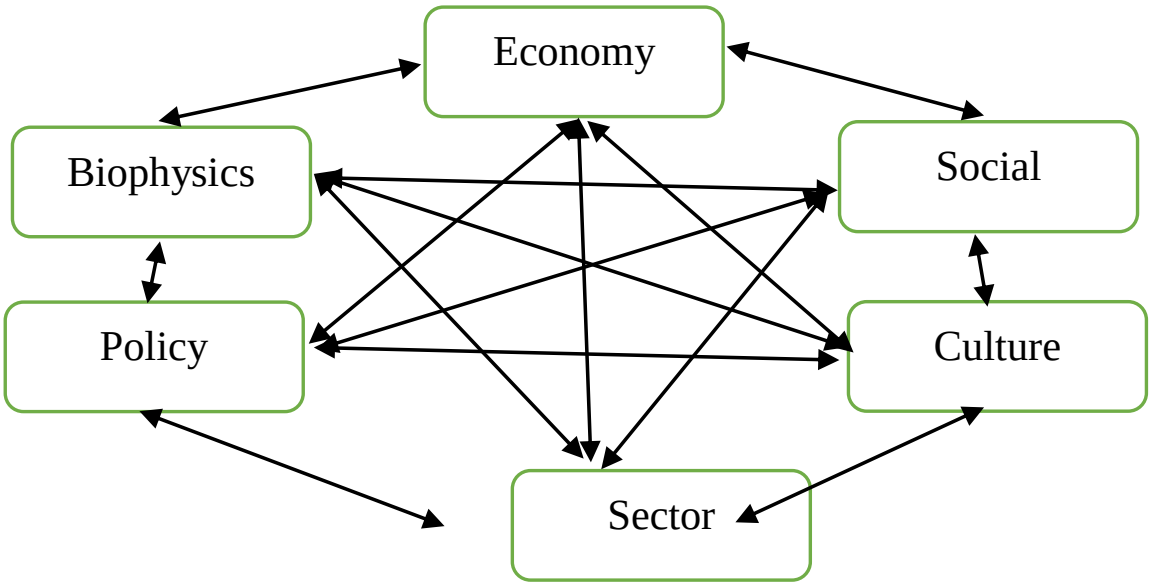

Figure 1. Watershed System

4. Integrated Watershed Management

Studies on watershed management have been carried out starting in 1990 by [13]. A study of watershed management by integrated has conducted by Basuki studied enhancement cohesiveness watershed management in Indonesia [2]. Katusiime reviewed the importance cohesiveness legislation [17]. In contrast,

ISSN: 18158129 E-ISSN: 18151027
Volume 19, Issue 11, November, 2023

Zoltay implemented an integrated management model [36]. Waskitho has studied the importance cohesiveness between sectors [30] while Cho studied the importance of collaboration integrated between stakeholder [6].

Management based participation public has been studied by [14], while Pahl-Wostl studied the importance of learning social and cultural [23]. Evrendilek has a study about data integration [10].

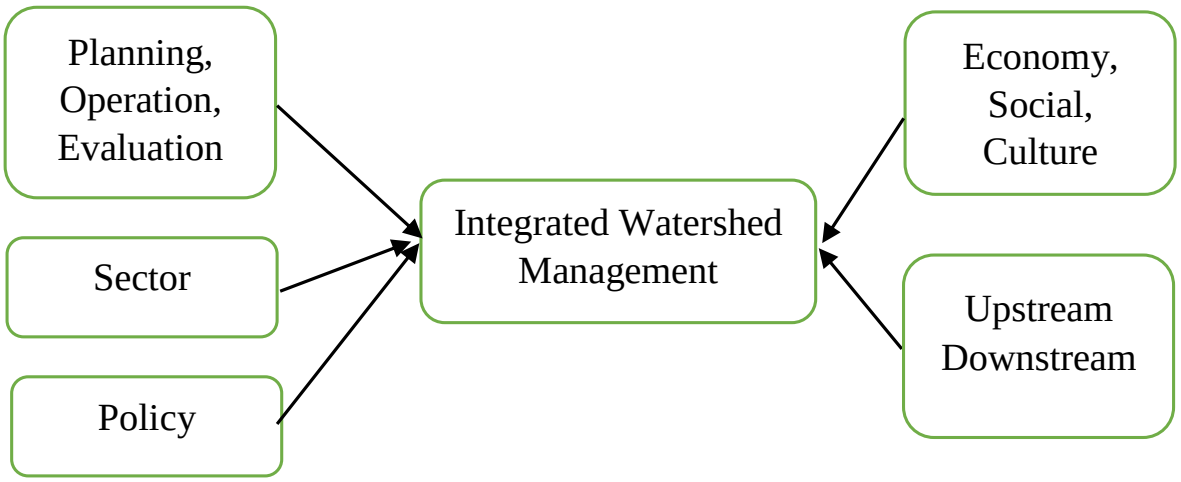

Figure 2. Integrated Watershed Management

5. Sustainability

The study of sustainability has carried out in various field for supporter sustainable development. The importance social learning and cultural has been studied by [23], whereas the evaluation of global learning has been studied by [35]. Kineber has studied building sustainability [18] whereas Jiang has studied marketing sustainability [15]. Index water quality has been studied by [1], whereas ruonff has analyzed by [19].

In 2016, Chang conducted a study on sustainability [4] in 2017 Eckart studied low-impact development [9] in 2020 Kagaya studied sustainability management [16]. Protection to sustainability has been studied by [5].

Chaves et al (2006) have submitted watershed sustainability index based on hydrology, environment, life and policy [22] as presented in figure 3.

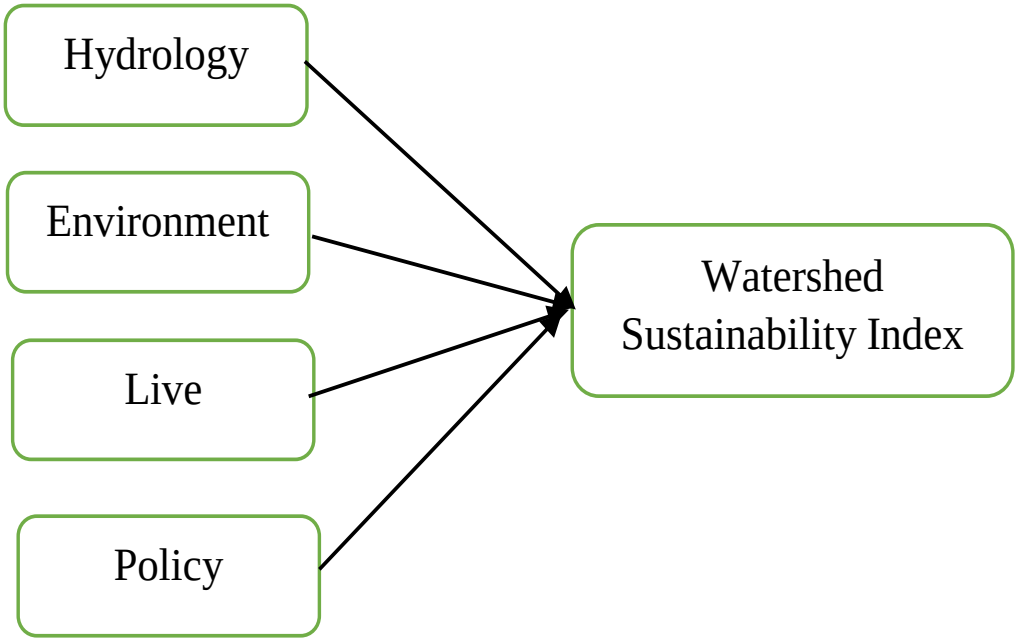

Figure 3. Watershed Sustainability Index

6. Sustainable Watershed Management Model Concept

The sustainability of watershed management in Indonesia has been studied by [20], its relation to energy and food security has been studied [21], ecosystem services [34], public policy [28], [27] study in South Asia [25], sectoral integration [30], integrated management [2], formulation of sustainability [27], application of a sustainability index [7].

A watershed is composed of various interconnected influential subsystems so that appropriate management is integrated. Its sustainability is a prerequisite for interest in the present and future. Thus, Figure 4 presents the suggested sustainable watershed management approach. By taking into account hydrology, environment, life, and policy, index sustainability can be used to gauge the watershed's current state. Since indexing has already achieved good sustainability, it is complete. Should the sustainability of the index still require improvement, it must be combined with a concentration element that is less sustainable. Planning and execution focus on the areas that require improvement. Furthermore, data collection and data analysis to measure index its sustainability again. This is a sustainable watershed management model, which is cycle gone stop based index sustainability.

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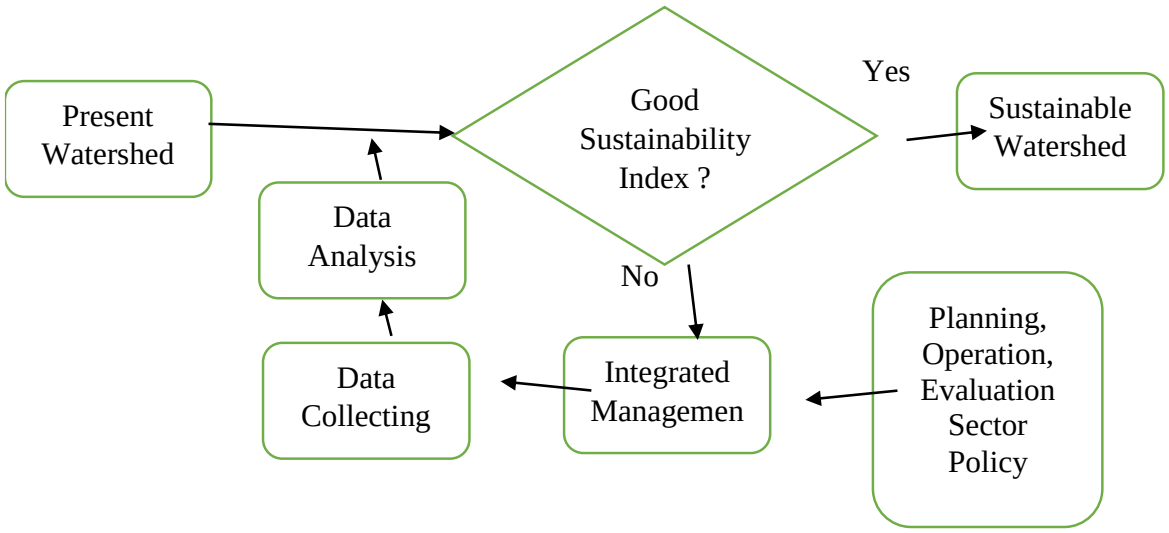

Figure 4. Sustainable Watershed Management Model

7. Conclusions and Recommendations

Watershed is necessary to be managed based on a sustainable management model. The index consists of sustainability from hydrology, environment, life, and policy. Management starts from integrated planning, implementation, monitoring, and evaluation in cycle management.

All watershed managers are advised to use a sustainable watershed management model. With the application of this model, the public will gradually become prosperous. Well-functioning institutions and economic viability are prerequisites for sustainable watershed management. Watershed initiatives can be evaluated using the framework this chapter develops, which also helps identify potential barriers to their sustainability.

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