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Philosophy of Watershed Management as an Effort to Control Flood and Drought Reviewed from Axiological Philosophy: A Review

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Abstract
The management of watersheds plays a crucial role in maintaining ecological stability and mitigating the impacts of natural disasters, such as floods and droughts. As human activities, such as deforestation and unsustainable land-use practices, continue to put pressure on watershed ecosystems, the risks of environmental degradation increase. This study aims to examine the philosophy of watershed management through an axiological philosophy lens, with a focus on its potential to control flood and drought occurrences. A systematic literature review was conducted, analyzing articles published between 2015 and 2025, sourced from reputable online databases like Scopus. The findings indicate that effective watershed management requires an integrated approach, balancing human needs with environmental sustainability. Key strategies for managing watersheds include controlling erosion, restoring vegetation, and ensuring water quality. Additionally, the axiological perspective emphasizes the importance of ethical and moral considerations in addressing the socio-environmental consequences of watershed degradation. This research concludes that comprehensive watershed management, which includes social, economic, and institutional considerations, is essential for ensuring long-term environmental sustainability. It is recommended that policymakers adopt a holistic approach to watershed management to mitigate the adverse effects of land-use changes and improve flood and drought resilience.

Keywords: Watershed Management Philosophy, Axiological Philosophy, Floods and Droughts, Hydrology Introduction
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1. Introduction

The Watershed Area (DAS) is a water catchment area that regulates the water system. Naturally, the quality of a watershed is influenced by bio-physical factors such as soil, water, and vegetation. However, land use closely related to human activities can affect the balance of the watershed ecosystem. Exploitation within the watershed can increase flow discharge and the risk of erosion.

The rapid population growth leads to an increased demand for both the quality and quantity of resources, while the availability of land resources decreases and becomes increasingly limited. This contradictory situation increases the pressure on land resources, which are forced to produce at maximum capacity without considering the consequences, resulting in land use changes. These land use changes are often not accompanied by preventative measures, leading to further land degradation, characterized by high levels of erosion and sedimentation, as well as low infiltration capacity, which impacts surface flow rates. This may lead to an increase in flood discharge during the rainy season and droughts during the dry season.

Land-use change due to human activities generally alters vegetation and land management. These two factors contribute the most to erosion and increased flow discharge within a watershed. Land clearing in various regions, including the Province of West Nusa Tenggara (NTB), has caused many problems, including the potential for erosion, increased flood discharge, and droughts. According to Wahana Lingkungan Hidup (Walhi), 60 percent of the forest land in NTB is damaged. "The rate of damage is caused by mining activities, deforestation, and land conversion for tourism development," said Walhi NTB Director Amry Nuryadin in Mataram, Monday (28/8/2023).

Land-use changes are often not accompanied by actions to prevent land damage, leading to further degradation. This is visibly marked by high levels of erosion and sedimentation, as well as low rainwater infiltration, which results in increased surface flow and a higher potential for flooding.

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The damage caused by erosion includes the decrease in soil fertility and productivity, flood hazards during the rainy season, droughts during the dry season, sedimentation of rivers or lakes, and the expansion of critical land. Erosion prevention and surface flow increase are crucial, as continuous erosion and flow increase will lead to environmental imbalances.

From an axiological philosophy perspective, erosion, floods, and droughts are phenomena that have significant negative impacts on human survival. They not only decrease soil quality, reducing land productivity but also cause direct disasters that harm local communities. Awareness and understanding of this condition urge immediate efforts to address the issue. Disaster management activities related to erosion, flooding, and drought should be conducted comprehensively from the upstream to downstream areas of the watershed, ensuring significant and tangible results.

Given the importance and function of watersheds for human life, watershed management needs to be carried out continuously and in an integrated manner. One effort that can be made is to analyze surface flow rates during the rainy season and the impact of droughts during the dry season, which can serve as a basis for taking proper and targeted rehabilitation and watershed management actions.

Watershed management is essentially the management of natural resources (SDA) that regulates water systems, including: 1) Erosion, 2) Infiltration, and 3) Critical Land. Kometa and Ebot (2012) highlight that the main problems faced in watershed ecosystems are related to the increasing human population and changes in land use, which can affect watershed management. This review and study are expected to provide insights and directions that can create a positive impact on watershed management through green revolution efforts, both vegetatively and civilly, in each watershed.

Based on this, this article aims to describe and explain a subtopic within the theme of Hydrology, as part of sustainable agriculture studies, namely the subtheme of the importance of watershed management. The goal is to explore the philosophy of watershed management, how erosion, flooding, and droughts occur, and what their benefits and drawbacks are. To provide a detailed and adequate explanation of watershed management, the study in this article will be developed based on the foundational principles of science, including axiological aspects.

The objective of this research is to philosophically reveal the importance of watershed management as an effort to control floods and droughts from an axiological philosophy perspective.

2. Materials and Methods

The research is characterized as a systematic review. An online article search (computer-assisted literature search) was conducted in important online databases like Scopus. The selection of Scopus as databases was due to three main reasons. Firstly, the prestige and international reputation of these tools, as they are currently the main sources for finding publications with the greatest impact. Secondly, with respect to the sample, its representativeness is guaranteed by its international prestige and its requirements in the indexing protocol. Thirdly, there is the possibility of complementarity, despite some overlap in coverage, and the persistent bias pointed out in certain disciplines. The aim was to provide a fairly comprehensive overview of research in this area and provide philosophical view of Watershed Management itself. The search was conducted against reference lists of articles found electronically. However, it is also guaranteed by the specific limitations of a defined set of search criteria and procedures. Thirdly, there is the possibility of complementarity, despite some overlap in coverage, and the persistent bias pointed out in certain disciplines. The aim was to provide a comprehensive overview of research in this area. The search was conducted against reference lists of articles found electronically. The search was based on articles published as recently as March 2024. The cited descriptors were associated with the Boolean operators ‘and’ and ‘or’, directing the search to the terms sought. In addition, manual searches were conducted based on the reference lists of electronically found articles. Therefore, the search was conducted until March 2024.

2.1 Criteria of Exclusions

The articles selected for this study were chosen according to the following criteria: (1) Published between January 2015 and January 2025; (2) Published in academic or peer-reviewed journals; (3) Specified search descriptors in the title, keywords and/or abstract; (4) English The selected articles were required to be written in English, to be related to the fields both either in the title, abstract, or keywords.

2.2 Study Selection and Data Extraction

The literature search systematically retrieved and reviewed a total of 142 documents from Scopus involving keywords (watershed AND management AND flood AND drought), taking into account the inclusion criteria for research published in the period 2015-2025, both inclusive, in the field of Social Sciences, with a filter that only includes English language journal articles and only articles discussing Floods/Droughts/Water Management were taken, only 30 articles were obtained. Then the same search was carried out on the keywords (environmental AND science AND Philosophy) Table 1 shows the number of papers refined published in the period 2015-2025 discussing about Floods, Droughts, Water Management in the analyzed databases. Meanwhile, the interpretation and discussion are based on philosophy sourced from the articles listed in table 2.

Table 1 Results of data extractions for floods/droughts/water management

Title	Authors
Integrated assessment of flood and drought hazards for current and future climate in a tributary of the Mekong river basin	(Penny et al., 2023)
Evaluating the impact of ponds on flood and drought mitigation in the Bagmati River Basin, Nepal	(Gautam & Corzo, 2023)
Water Supply in the Lower Colorado River Basin: Effectiveness of the 2019 Drought Contingency Plan	(Huizar et al., 2023)
Managing flood flow connectivity to landscapes to build buffering capacity to disturbances: An ecohydrologic modeling framework for drylands	(Maxwell et al., 2021).
Drought and wetness events encounter and cascade effect in the Yangtze River and Yellow River Basin	(Lu et al., 2024)
Drought-flood abrupt alternation dynamics and their potential driving forces in a changing environment	(Shi et al., 2021)
Does Wetland Location Matter When Managing Wetlands for Watershed-Scale Flood and Drought Resilience?	(Ameli & Creed, 2019)
Drought Governance in Transition: a Case Study of the Meuse River Basin in the Netherlands	(Brockhoff et al., 2022)
Paleohydrological context for recent floods and droughts in the Fraser River Basin, British Columbia, Canada	(Brice et al., 2021)
Rain belt and flood peak: A study of the extreme precipitation event in the Yangtze river basin in 1849	(Yang et al., 2021)
Reservoirs regulate the relationship between hydrological drought recovery water and drought characteristics	(J. Wu et al., 2021)
Can the combining of wetlands with reservoir operation reduce the risk of future floods and droughts?	(Y. Wu et al., 2023)
Average domination: A new multi-objective value metric applied to assess the benefits of forecasts in reservoir operations under different flood design levels	(Quinn et al., 2024)
Recent hydrological evolutions of the Senegal River flood (West Africa)	(Bruckmann et al., 2022)
The role of large reservoirs in drought and flood disaster risk mitigation: A case of the Yellow River Basin	(Feng et al., 2024)
Enhancing community resilience in arid regions: A smart framework for flash flood risk assessment	(Nakhaei et al., 2023)
Human deforestation outweighed climate as factors affecting Yellow River floods and erosion on the Chinese Loess Plateau since the 10th century	(Yan et al., 2022)
Assessing the impact of human interventions on floods and low flows in the Wei River Basin in China using the LISFLOOD model	(Gai et al., 2019)
Drought evolution due to climate change and links to precipitation intensity in the Haihe River Basin	(Liu et al., 2017)
Identifying priority watersheds to mitigate flood and drought impacts by novel conjunctive water use management	(Brindha & Pavelic, 2016)
A review of scientific and linked media allegations that “Melbourne's water catchments are under threat” from logging in the Thomson Catchment, Victoria, Australia	(Bren, 2024)
The human factor in seasonal streamflows across natural and managed watersheds of North America	(Singh & Basu, 2022)

Table 2 Results of data extractions for floods/droughts/water management

Title	Authors
A philosophical view of the ocean and humanity	Omstedt A.
Philosophy of field methods in the GPSS-GLI program: Dealing with complexity to achieve resilience and sustainable societies	(Mino et al., 2016).

Moving towards public policy-ready science: philosophical insights on the social-ecological systems perspective for conservation science	(Sala & Torchio, 2019)
Philosophical issues in ecology: Recent trends and future directions	(Colyvan et al., 2009)
Rethinking the Ethical Challenge in the Climate Deadlock: Anthropocentrism, Ideological Denial and Animal Liberation	(Almiron & Tafalla, 2019)
Sustainability science is ethics: Bridging the philosophical gap between science and policy	(Joaquin & Biana, 2020)
Between economics and ecology: Some historical and philosophical considerations for modelers of natural capital	(Foster, 2003)

2.3 Finding Synthesis

The data obtained from the article are from two different fields, namely environmental science and philosophy. The data obtained needs to be synthesized so that a comprehensive explanation of environmental science in the form of Watershed Management using a philosophical scalpel is obtained.

3. Results

3.1 Axiology Philosophy

Axiology is a philosophical study that discusses the benefits and disadvantages of a particular science or field (Colyvan et al., 2009; Edelheim et al., 2022; Roy et al., 2025). In this context, we will examine the benefits and disadvantages caused by the management of Watersheds. Rapid population growth has given rise to pros and cons regarding land management (Mino et al., 2016), including in management of Watersheds areas. Controversy has arisen between policy makers and business people who have interests(Foster, 2003). The pro group argues that the potential of available natural resources must be utilized as much as possible for equitable development, regional development, and increasing people's prosperity, as well as to overcome food shortages and reduce unemployment in the agricultural sector. On the other hand, the contra group argues that excessive land use without considering environmental sustainability can have a negative impact on the sustainability of the agricultural environment and global climate change. Another impact is the decline in the function of land as a natural resource, which ultimately harms farmers, especially conventional farmers who cannot increase productivity more profitably.

Watersheds are areas that are topographically limited by mountain ridges, which function to accommodate and store rainwater before finally being channeled to the sea through the main river (Maxwell et al., 2021). As an ecosystem, watersheds play an important role as reservoirs, storage, and distributors of water, and their existence is known as water catchment areas (Bren, 2024; Brindha & Pavelic, 2016; J. Wu et al., 2021; Y. Wu et al., 2023), which involve natural resources such as land, water, and vegetation, as well as human resources as users of natural resources (Colyvan et al., 2009). The main problems in watersheds are related to the amount (quantity) and quality (quality) of water (Jiang et al., 2024). The phenomenon of drought or flooding illustrates the problem of water quantity (Bruckmann et al., 2022), while water quality is disturbed due to erosion or pollution of toxic substances from industrial or agricultural areas. A watershed is said to be good if it meets several criteria, such as constant river discharge, maintained water quality, small discharge fluctuations, and stable groundwater levels. One of the main indicators that disrupts the hydrological function of a watershed is the formation of critical land, which causes ecosystem damage and has the potential to cause disasters such as floods (Y. Wu et al., 2023). Therefore, watershed management must pay attention to the balance between human needs and the sustainability of natural resources, as well as consider social, economic, cultural, and institutional aspects. Management that is not in line with regional spatial planning can cause watershed damage, which in turn increases the risk of natural disasters.

3.2 Watershed Management Approach Philosophy

Watershed Management is an activity carried out by communities, farmers, and the government to improve land conditions and water availability in an integrated manner in a watershed(Nakhaei et al., 2023). This process involves the formulation and implementation of activities or programs aimed at manipulating natural and human resources in the watershed in order to obtain production and service benefits without damaging water and soil resources (Singh & Basu, 2022). Watershed management includes flood (Brindha & Pavelic, 2016) and erosion prevention (Yan et al., 2022), as well as protection of the aesthetic value of natural resources, which involves identifying the relationship between land use, soil, and water, and the relationship between upstream and downstream areas in the watershed. The objectives of watershed management include conserving soil on agricultural land, storing excess water during the rainy season to be used during the dry season, encouraging sustainable farming, and improving ecological balance, including water quality, land capability, and biodiversity(Jiang et al., 2024). The philosophy of watershed management recognizes that human life is influenced by the interaction between water resources and other natural resources, which can have positive or negative impacts (Colyvan et al., 2009). The impact of this interaction does not recognize political boundaries, such as the example of flooding that occurs due to human activities in upstream areas that are not environmentally friendly. In addition, land management activities that are considered good by one political entity are not always good for other political entities because they can have negative impacts on downstream areas. Therefore, good watershed management is one that is able to consider all costs and benefits that arise and can be borne proportionally by all actors involved, be it the government, the community, or individuals.

Before carrying out watershed management, several things that need to be understood are the potential and problems in the watershed, and what is to be achieved from the management. This will help form a clear vision in watershed management. For example, if the main problem in the watershed is increasing water turbidity and frequent flooding, the management objectives can be directed at restoring water quality and controlling flooding (Brindha & Pavelic, 2016). Improvements that can be made include changing the planting pattern to annual crops or a mixture of annual and seasonal crops, and building reservoirs to store water(Teixeira et al., 2022). These changes are expected to reduce water turbidity and control flooding, as well as ensure longer water availability for community needs.

The components of watershed management include management and conservation of agricultural land, creation and maintenance of water channels, increasing land cover through agroforestry techniques, and maintenance of river banks. Forests play an important role in conserving watersheds, because they can reduce high river discharge during the rainy season, maintain stable water flow during the dry season, and reduce erosion (Yan et al., 2022). Therefore, forests need to be maintained and if they have already been cleared, land use must approach the form of a forest by implementing an agroforestry system. Watershed management must also pay attention to the main problems that exist, such as water quantity and quality(Jiang et al., 2024), as well as appropriate steps to overcome these problems, for example by improving watershed filters or avoiding excessive deforestation.

Table 3 Water problems and alternative techniques to overcome them

Water Problems	Alternative Techniques to Overcome It
Water Quantity	
Flood	Increased use and absorption of water in the upstream and middle sections Watershed Management through: • Planting trees • Making reservoirs • Overcoming narrowing (due to waste) and shallowing of rivers.
Drought	• Planting water-efficient crops such as pigeon peas, cowpeas, green beans, sorghum, cassava. • Reducing evaporation, for example by using mulch. • Storing excess water during the rainy season for use in the dry season, for example by making reservoirs and ponds.
Decrease in groundwater level	Reducing groundwater depletion (saving water usage) Increasing soil infiltration and percolation capacity by making pits, infiltration wells, and so on.
High fluctuation of peak discharge with base discharge	Planting trees Increasing the filling of pores and groundwater with infiltration wells, rorak, gulud and so on
Water quality	
High sedimentation and mud deposition at the bottom of the river	• Improving the "filter" function of the watershed, especially along riverbanks, by planting grass and other plants that can tightly cover the soil surface. • Securing riverbanks that are prone to landslides, for example by planting relatively light and deep-rooted plants such as bamboo (if the sediment comes from riverbank erosion).
Pollution of river water and ground water	It is necessary to investigate the source of the pollutant and carry out purification (water treatment/purification) before the water is discharged into the river.
Eutrophication (increased nutrient concentration in water bodies)	Adjust the use of fertilizer according to plant needs (not excessive)

3.3 Axiological Aspects of Watershed Management

The axiological aspect is related to the benefits or uses of science, which can be seen from two perspectives: positive and normative (Aranson, 2018; Edelheim et al., 2022; Hayati et al., 2022). Positively, the value of science is used to describe, explain, and predict phenomena in accordance with the object of study. Meanwhile, normatively, science is used to control these phenomena in order to achieve the desired goals (Haryanto & Sarjan, 2025). This normative aspect is also related to considerations of values, ethics, and morals. In research, the axiological aspect is usually manifested in suggestions or recommendations resulting from the study. For example, in watershed management, an understanding of the dangers of erosion, flooding, and drought that are detrimental to the environment and humans has encouraged efforts to control these impacts, such as decreased soil fertility and shallowing of reservoirs.

Human awareness of the impacts of damage caused by erosion, flooding, and drought has driven various watershed management efforts. One of the main focuses in watershed management planning is land use changes, such as converting agricultural land into forests, as well as regulating slope and length by creating terraces. Rational watershed management includes several principles, such as recognizing the demands to save the environment (Colyvan et al., 2009), considering the values of environmental services in policies(Sala & Torchio, 2019), aligning conflicts of interest between natural boundaries and political boundaries(Joaquin & Biana, 2020), and creating investments and regulations that link activities in upstream and downstream areas(Foster, 2003). Watershed management must pay attention to biophysical dimensions, such as erosion control and reforestation of critical land, as well as social dimensions related to local socio-cultural conditions.

Good watershed management will reduce the risk of flooding and drought by restoring and preserving natural vegetation(Singh & Basu, 2022; Teixeira et al., 2022), preventing erosion(Yan et al., 2022), and protecting forests along the watershed(Yan et al., 2022). The objectives of watershed management include effective coordination in planning, implementation, control, monitoring, and evaluation, as well as the sustainability of environmental functions and community welfare(Nakhaei et al., 2023). The objectives of watershed management include the creation of optimal hydrological conditions, increasing land productivity, and improving community welfare. The success of watershed management also depends on a paradigm shift, an understanding of biogeophysical and socio-cultural characteristics, and applicable regulations. Therefore, watershed management must consider social, economic, and institutional aspects inside and outside the watershed to ensure its sustainability..

4. Conclusions

Watershed management is seen as a planning system of resource management activities including land use, local resource management and utilization practices and resource management practices outside the program/project activity area, Implementation tools to place watershed management efforts as effectively as possible through community elements and individuals. Organizational and institutional arrangements in the project area are implemented. Effective watershed management requires confirmation of important issues or problems that require immediate handling as well as the division of management authority. Clear formulation of biogeophysical problems (deterioration of forest, land and water resources) and socio-economic (complexity of resource utilization and increasing farmer income). The targets to be achieved generally in watershed management are to improve/repair the condition of the watershed so that the level of productivity in that place remains high, at the same time, the negative impacts caused by land use management activities in downstream areas can be minimized.

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