



Dodokan River Watershed Development Strategy as a Sustainable Tourism Attraction

Sirajuddin Haji Abdullah¹✉ | Markum¹ | Joko Sumarsono²

¹✉ Doctoral Program in Sustainable Agriculture, Postgraduate Program, University of Mataram, West Nusa Tenggara 83115, INDONESIA.

²Agricultural Engineering, University of Mataram, West Nusa Tenggara 83115, INDONESIA

Abstract

Using watersheds in NTB indirectly provides benefits and impacts both positive and negative impacts on watershed environmental sustainability. To minimize the effect, efforts to develop sustainable tourism are carried out to maintain and improve socio-cultural, socio-economic, and ecological aspects. This research was carried out to optimize the use of watersheds as sustainable tourist attractions. Therefore, sustainable development and tourism are used to develop river watershed management as a sustainable tourist attraction. The Dodokan watershed was used as the object of research because it is the largest and has many tourism activities and residential areas compared to other watersheds. This research is a philosophical study of phenomena or situations related to hydrological problems. These actual phenomena or conditions are not studied directly with the methods and objects of the problem location but are highlighted philosophically by reviewing them based on reality or connected to the nature of the environment and humanity. This research uses data from literature studies and is analyzed using descriptive-qualitative analysis techniques. Supporting material for this research is obtained from previous papers that relate to hydrological problems for the objects under review. Based on the results of research that has been carried out, it is stated that "there are 5 (five) strategies for improving river watersheds: 1). Sustainable Forest Management Strategy; 2). Law Enforcement Strategy; 3). Community Empowerment Strategy; 4). Integrated Management Strategy; and 5). Economic Improvement Strategy".

Keywords: Watershed, Watershed Development Strategy, Sustainable Tourism, Dodokan Watershed

How to cite: Abdullah, S. H., Markum., Sumarsono, J. (2025). Dodokan River Watershed Development Strategy as a Sustainable Tourism Attraction. *Internatioanl Journal of AgroEduTech-Tourism (IJAETT)*, 1(1), 32-43.

1. Introduction

NTB Province has many rivers that function and play an important role in ecological, socio-cultural, economic, religious, and raw water sources, and they are even used as electricity generators. The strategic role of rivers as part of natural resources that support human life. The role of the river in the urban context is quite an important issue for the ecosystem in terms of efforts to maintain water resources.

One aspect of Water Resources Management (PSDA) in the Water Resources Development Area (WPSA) is the management of River Watersheds (DAS), which exploits water sources in an integrated manner through efforts to control and preserve them (Suganda et al., 2009). "A watershed is defined as a land area which is a unit with rivers and their tributaries whose function is to accommodate, store and channel air originating from rainfall to lakes or the sea naturally, where the boundaries on land are topographic boundaries, and the boundaries at sea are up to water areas which still influence land activities."

Following government regulation Number 37 of 2012 concerning Watershed Management, "watershed management is a human effort to regulate the reciprocal relationship between natural resources (SDA) and humans and all their activities within the watershed to create a balanced ecosystem so that humans can feel the benefits of the watershed sustainably." Regarding development, watershed management needs to pay attention to the fact that watershed development is a complex, multi-dimensional system that, if carried out on one component, will impact other elements, and conflicts will arise. This condition follows (Shalizi, 2003) statement that development in the economic and social fields often means environmental damage is a problem.

Furthermore, according to (Kartodihardjo, 2004), understanding watershed management is the rational management of all resources owned to obtain maximum benefits without time limits with the smallest possible risk of environmental damage. In other words, it is carried out with the principle of resource sustainability. In a broad context, watershed management can be

viewed as a resource system (ecology), a social-economic development, and a regional spatial management that shows the integration and balance of the principles of productivity with the conservation of natural resources.

One of the stakeholders in watershed management is the NTB Provincial Government, which has created a policy to regulate the management and overcome misuse of watersheds in NTB. This policy was implemented later with the issuance of NTB Provincial Regulation No. 5 of 2017 concerning integrated watershed management. Based on the principles: a. cohesiveness; b. participative; c. justice; d. expediency; e. sustainability; f. harmony; g. community empowerment; h. coaching and supervision; i. accountable; j. openness; and k. recognition of local wisdom. However, in the development and practice in the field, watersheds in NTB have found several problems in their management and maintenance, both from nature and negative community behaviour, as can be seen from the development of watersheds in NTB Province. There are many changes in land use, excessive exploitation of a part of the watershed, pollution of the environmental ecosystem, illegal logging to meet economic needs on one side only, namely in the upstream watershed, and many other problems.

Based on the problems seen today and by realizing the importance of watershed management, this research aims to review the extent of watershed management in the NTB region, especially Lombok Island, to produce solutions for the watershed so that it can be sustainable for the masses to come. This research studied the Dodokan watershed as the object under review. The Dodokan watershed was used as the object of research because it is the largest and has many tourism activities and residential areas compared to other watersheds.

2. Materials and Methods

This research is a philosophical reflection on hydrological phenomena or conditions. The actual phenomenon is not studied directly according to the method and object of the problem location but is highlighted philosophically by reviewing it based on reality or being connected to the nature of the environment and humanity. The data in this research was obtained from a literature study and analyzed using descriptive-qualitative analysis. The supporting material for this research was obtained from previous written work related to the hydrological field of the object under review. The written work in question is in the form of a book that discusses this research problem comprehensively and from articles in periodic scientific journals related to the research topic.

The latest research in the period 2020 to 2024 has provided fresh insight into the development of watersheds (DAS) as a sustainable tourism attraction. Here are some relevant studies: 1). Innovation Strategy in Improving Tourism Marketing in West Nusa Tenggara Province through Sustainable Smart Tourism. This research emphasizes the importance of digitalization in tourism promotion. Through the use of digital tourism and digital integration, there has been an increase in tourist visits. The proposed strategy includes developing tourism services, utilizing human resources, and connecting services through access to transportation, the internet, and digital cultural introduction (Strategy et al., 2024); 2). Implementation of Local Culture in River Watershed Management to Support the Development of Ecotourism Areas. This study highlights the role of local culture, especially the Tri Hita Karana concept, in watershed management. Active community participation in maintaining a balanced relationship between humans, the environment and God is the key to developing sustainable ecotourism (Suparsa et al., 2022); 3). Strategy for developing the natural tourist attraction of Sing-Sing Waterfall in Temukus Village, Banjar District, Buleleng Regency. This research uses SWOT analysis to formulate a natural tourism development strategy. The resulting strategies include conserving natural resources, creating educational tourism packages, improving the quality of human resources, and intensive promotion through social media (Sukerti et al., 2022); 4). The role of the Rinjani Lombok Geopark as a Pillar of Sustainable Tourism in West Nusa Tenggara. This study discusses how the Rinjani Lombok Geopark contributes to sustainable tourism development through programs that are in line with the four pillars of sustainable tourism: destination management, economic use for local communities, cultural preservation, and environmental conservation (Di & Tenggara, 2022); 5). Ecotourism-Based Watershed Conservation and Waterfall Tourism Strategy in the Manikyang Village Area, Selemadeg District, Tabanan. This research identifies development potential and problems in Manikyang Village, especially related to watersheds. The proposed conservation strategy involves community participation in watershed management to support ecotourism development (Desa et al., 2025); 6). Strategy for Sustainable Management of the Ayung River Watershed in Gianyar, Bali. This study emphasizes the importance of technological aspects in the sustainable management of the Ayung River Basin. The government plays a dominant role in realizing clean rivers and improving water quality through outreach and guidance to the community (Sudipa et al., 2024); 7). Sustainable Tourism Development Strategy to Increase the Competitiveness of Local Destinations. This research analyzes the importance of collaboration between stakeholders, tourism product innovation, and education for tourists in increasing the attractiveness of local destinations while preserving the environment (Meningkatkan et al., 2025); 8). Tourism Industry Recovery Strategy in West Nusa Tenggara Province Based on Resilience. This study examines the impact of the COVID-19 pandemic on the tourism industry in NTB and formulates a resilience-based recovery strategy. Market analysis, digital innovation and collaboration between parties are the keys to restoring a resilient tourism industry (Saputra, 2023); 9). Regional Government Strategy in Tourism Development in West Nusa Tenggara Province. This research identifies regional government strategies in developing tourism through determining superior destinations, sustainable development planning, infrastructure development, promotion, partnerships and improving the quality of human resources in the tourism sector (Provinsi & Tenggara, 2020). The studies above were accessed through various scientific journal databases, including Google Scholar and cover publications up to 2024.

3. Results

3.1 Theoretical Review

3.1.1 development

Puturusi (2001) (in Susi Iswanti & Zulkarnaini, 2022) states that development is a strategy used to promote, improve, and improve the tourism conditions of an object and tourist attraction so that tourists can visit it and can provide benefits to the community around the object and tourist attraction as well as to the Government.

In developing tourism, Page, 1995 (in Bawole, 2022) explains that there are five approaches to developing tourism, including:

1. Boostertern approach. It is a simple approach that sees tourism positively impacting a place and its inhabitants. However, it does not involve local communities in the planning process and does not carefully consider the area's carrying capacity.
2. The economic industrial approach. It is an approach to tourism development in which economic objectives are prioritized over social and environmental goals, and the main targets are based on supporting experiences and level of satisfaction.
3. The physical spatial approach. This approach is based on geographical land use traditions. Development is based on planning strategies using spatial principles. For example, visitors are grouped and separated in one area to avoid conflicts.
4. The community approach. This approach emphasizes the full involvement of local communities in the development process.
5. Sustainable approach. It is a sustainable approach and an interest in the long future and in the resource and environmental impacts of economic development that may cause social and cultural disruptions that reinforce individual lifestyle patterns and lifestyles.

3.1.2 Sustainable Development

The World Commission on Environment and Development (WECD), in 1987 known as the Brundland Commission, published a book entitled *Our Common Future*, which describes Sustainable Development as: "Sustainable development is the development that meets the needs of present generations without compromising the ability of future generations to meet their own needs."

Sutamihardja (2004) (in Pasaribu, 2013) states that the target of sustainable development is to realize the following:

1. Benefits from equitable development results across generations (intergeneration equity), which shows that the use of natural resources for the importance of growth should pay attention to reasonable limits in controlling ecosystems or environmental systems and be directed towards replaceable natural resources and emphasize exploitation of unreplaceable natural resources as low as possible
2. Safeguarding or safeguarding the preservation of natural resources and the existing environment and preventing ecosystem disturbances to ensure a good quality of life for future generations
3. Management and utilization of natural resources only to pursue the interests of economic growth in the interests of equitable benefits for sustainable natural resources between generations.
4. Maintaining the sustainability of people's welfare for the present and the future (intertemporal).
5. Management of natural and environmental resources or development benefits so that they are maintained for long-term or sustainable beneficial impacts between generations.
6. The quality of human life must be maintained between generations according to their habitat

According to Heal (in Pasaribu, 2013). There are at least two dimensions to the concept of sustainability. The first is the time dimension because sustainability shows what will happen in the future. The second is the dimension of interaction between natural resource systems, the environment, and the economic system. Sutamihardja (2004)(in Pasaribu, 2013), in the concept of sustainable development, there may be a policy collision between the need to explore natural resources to deal with poverty and efforts to prevent or avoid environmental degradation, and it is hoped that this can run in a balanced manner. Surna T. Djajadiningrat (2005:123)(in Komarudin et al., 1999) states that sustainable development requires a long-term perspective. Furthermore, ideally, achieving sustainable development requires achievements in (1) ecological, (2) economic, (3) socio-cultural, (4) political, and (5) defence and security issues.

3.2 General Description of the Dodokan River Flow Area

On the island of Lombok, four main large watersheds spread from upstream to downstream of Lombok Island, namely the Dodokan Watershed, White Watershed, Menanga Watershed, and Jelateng Watershed. Of the four existing watersheds, the Dodokan watershed is the largest, with an area of 578.62 km². The Dodokan watershed covers three districts and one city: East Lombok, Central Lombok, West Lombok, and Mataram City. This situation indicates that the Dodokan watershed greatly contributes to the sustainability of water resources on Lombok Island.

The Dodokan watershed is located on Lombok Island, NTB Province. Based on PP No. 12 of 2012 concerning River areas, the Dodokan Watershed is located in the Lombok River Area, which is a National Strategic River area with code 03.02.A3-173 (WS Code: 03.02.A3 and DAS Code: 173). Geographically, the Dodokan Watershed is located between -8033'57.26" South Latitude to -8052'51.22" South Latitude and 11603'38.47" East Latitude to 116022'11.33" East Latitude, and administratively,

the Dodokan Watershed is in West Lombok Regency (18.90% of the Watershed Area) and Central Lombok (81.10%) covering 4 Sub-districts (14 villages) in West Lombok Regency, 10 sub-districts (64 villages/sub-districts) in Central Lombok Regency. The area of the Dodokan watershed is 578.62 km², with the circumference and main river length being 179.10 km and 64 km, respectively, with 8 river orders. The Dodokan Watershed is a watershed with a high level of utility, and there are two dams in it, namely the Batujai Dam and the Pengga Dam. The Dodokan watershed map can be seen in Figure 1. (BWS Nusa Tenggara I, 2014)(in Ilmi et al., 2021).

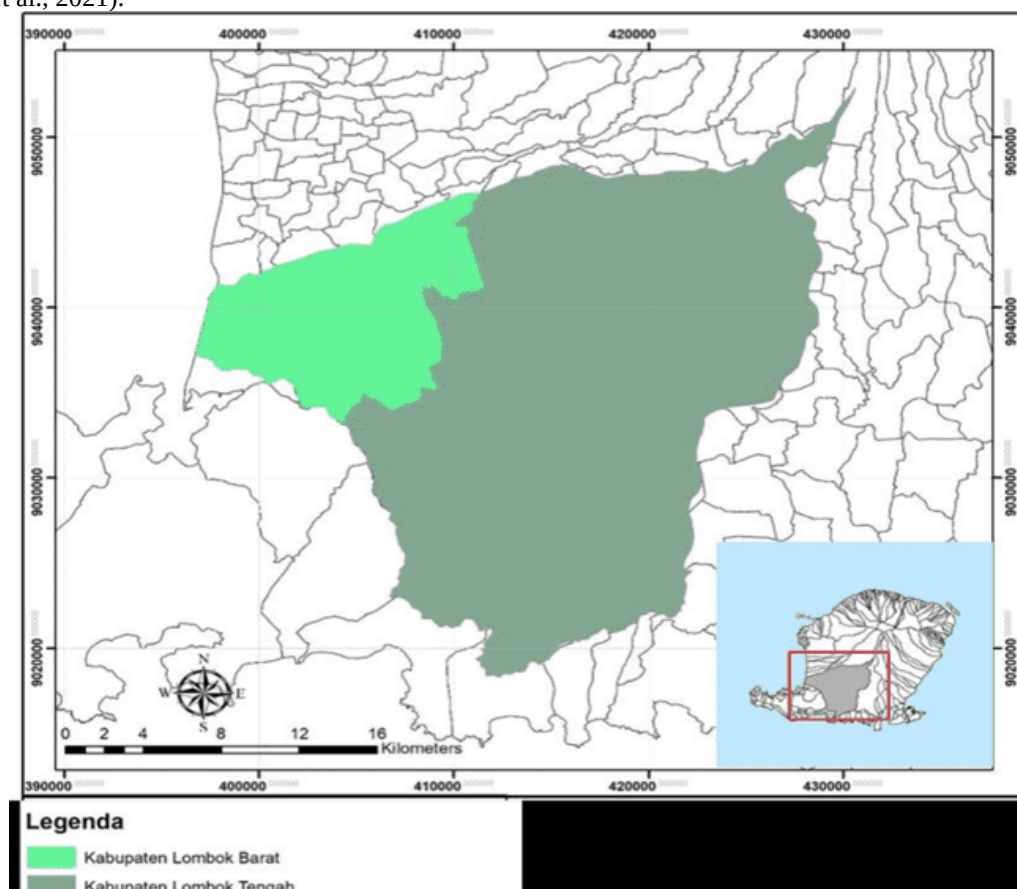


Figure 1 Map of the Dodokan River Watershed Area (Ilmi et al., 2021).

Based on the image interpretation results, land cover in the Dodokan watershed shows that rice fields dominate it. In the 6 years (2001-2007) there were many changes in land cover. In 2001, the area of rice fields was 33,527 ha (= 59.07% of the total watershed area); in 2007, it was 33,719 ha (= 60.34%). It shows that over 6 years, the area of rice fields has increased by 262 ha. On the other hand, a decrease occurred in forest area of 2 ha, namely from 1,646 Ha (in 2001) to 1,644 ha (in 2007). The ratio of river branching calculations to river order parameters was found to be <3 , which indicates that the rise in water level in the river channel can occur quickly but decrease slowly. Apart from that, the Dodokan watershed has a flow density of 2.07 km/km², which means it falls within the criteria for medium flow density with a rectangular dendritic flow pattern. The results of calculating the land cover index (IPL) for the Dodokan watershed obtained a value of 0.029. IPL is the ratio of land area with permanent vegetation to watershed area. The low IPL value (0.029) indicates that the Dodokan watershed is included in the critical watershed criteria (Muhammad Khalis Ilmi, 2021)(in Marta et al., 2023).

Based on biophysical conditions, the Dodokan watershed is divided into 3 parts: the Upstream, Middle, and Downstream areas. The area is used for forest conservation (upstream area), plantations, tourism, agriculture (middle part), and housing (downstream part). In the upstream part, the Dodokan watershed slopes to a very steep topography. The central region has flat to undulating topography. And the downstream area almost entirely has flat topography.

In some areas, the Dodokan watershed is used as an agricultural irrigation dam, namely Batujai Dam and Pengga Dam, which are located and irrigated two districts, including Central Lombok and West Lombok districts, which are also used as tourist locations. Meanwhile, tourism activities in the Mandalika MotoGP Circuit location in the Central Lombok district receive additional water from the Pengga Dam Central Lombok.

3.3 Utilization and Impact of Development of the Dodokan River Flow Area

The watershed areas in NTB in the upper, middle, and lower parts of the watershed are generally used as forest conservation areas, plantations and agriculture, water resources, residential areas, and tourism.

3.3.1 Forest Conservation.

The upstream area of a watershed is a significant location that determines its sustainability. This upstream area is usually a forest conservation area that can accommodate rainwater infiltration and maintain the quantity of water discharge in the watershed. Permitted land use in protected areas is zero tillage, and cutting down forest vegetation is prohibited. This protected area can be used as a service area for environmental services and the collection of non-timber forest products. However, with the increase in population and development of society, there has been a change in the use of conservation areas to areas that produce wood due to the economic needs of the community and even government officials' illegal logging.

Mistakes in using conservation areas as production areas will result in erosion, landslides, floods, sedimentation in river flows in the rainy season, and drought in the dry season. To avoid natural disasters that may occur due to the reduction or loss of conservation areas in the watershed, it is necessary to take regular and sustainable forest reforestation measures to sustain the watershed in the future.

3.3.2 Plantation and Agriculture

Lombok Island is known as an agricultural island because the Sasak people make their living mainly from farming. Part of the community's agriculture utilizes an irrigation system inherited from generation to generation among farming communities, known as subak, and this irrigation system has been recognized worldwide and has become a world heritage. Subak is an irrigation and agricultural institution with a socio-religious character that operates primarily in water management for crop production, especially rice, according to the Tri Hita Kara principles. In the Sasak indigenous community, the irrigation water management system adopts the Subak system in Bali as a result of the influence of the Karang Asem Kingdom over Lombok. As a result, the existence of subak is very dependent on the water quality originating from the watershed that supplies it.

Understanding the cause-and-effect relationship, water quality in a river basin is influenced by using pesticides and chemical (non-organic) fertilizers that farmers commonly and widely use. The more pesticides and chemicals farmers use, the more they harm river water quality. The low quality of river water will cause death to organisms and vegetation in the watershed area. Therefore, it is necessary to implement organic farming without using chemicals. Organic agriculture in the farming community is very dependent on the involvement of the Government as a supporter. Apart from that, the participation of the Subak farming community significantly influences organic farming.

3.3.3 Water Resources

Water has a function for consumption, health, and industry, as well as a source of agricultural drive, which has a strategic position for agriculture in rice fields (Pasandaran, 2006; Sumaryanto, 2007)(in Tarigan, 2014). The rate of decline in water availability for agriculture will occur more rapidly compared to the rate of reduction in land availability. Water use disparities sometimes exist between sectors, downstream and upstream areas, and even between community groups in food pockets with good water quality. The main reason is the increasing demand for water for consumption and industrial needs faster than the agricultural sector. Changing demand for agricultural commodities and changes in agricultural land use are other factors that influence the use of agricultural water resources. This condition also influences the economic value and competition for increased water use (Tarigan and Simatupang, 2014)(in Putra, 2017). The potential of Lombok Island, which has many springs compared to other islands, is a blessing that should be appreciated. In contrast, for example, small islands in Oceania are trying to distil water from the sea at quite high costs. However, even though Lombok Island has many water sources, the high demand for water from the community and industry has not been able to be met by the Government or PDAM, which has given rise to the practice of illegal use of underground water by several industries and the privatization of water sources by private companies, as has happened in several locations.

3.3.4 Settlement.

Land for settlement in Lombok is starting to become limited, and the high price of land in urban areas has made Lombok residents and immigrants choose to build and live on the city's outskirts, including around river basins where land prices are relatively lower. Meanwhile, settlements constructed by developers or private individuals sometimes do not think about the condition of the surrounding environment with inadequate waste disposal systems and ignore existing building regulations. The river basin area seems to be only a backyard, and its condition is not overlooked. This problem is different from the development of settlements in several developed countries, where river flows are used as front yards that must be looked after and kept clean, for example, rivers in France or England, in Singapore, this is where the perception of the local people of Lombok needs to be changed to make the river basin a beautiful place to look at.

3.3.5 Tourism as a concept for sustainable watershed management.

NTB Province is a province that is famous as a destination for foreign tourists. However, the development of tourism in NTB is developing towards mass tourism, with a considerable number of visitors without paying attention to the negative impacts arising from tourism, both economic, social, and cultural effects (degradation of community culture), as well as the impact on the environment which in turn has an impact on environmental damage around the tourism area such as landslides.

Because of the negative influences that arise, a tourism concept has been developed that takes into account socio-cultural, economic, and environmental aspects in the future, following the World Commission on Environment and Development (WCED, 1987) report, which states that: "sustainable development is the development that meets the needs of the present without compromising the ability of the future generation to meet their own needs." The WTO (1993) also states that sustainable development must adhere to three principles, namely ecological sustainability, social and cultural sustainability, and economic sustainability, both for the current generation and future generations. Besides financial and natural resources, cultural sustainability is essential in tourism development (Baiquni et al., 2009)(in Tarigan, 2014). One well-known example of watershed management is the Seine River tourism in Paris, as shown in Figure 2 below.



Source: downloaded from

<http://life.viva.co.id/news/read/523918-foto--menyambangi-pantai-buatan-di-tepi-sungai-seine>
on June 22, 2024

Figure 2 View of tourism activities on the banks of the Seine, Paris

Based on these problems, tourism can be used as a concept for watershed conservation media if it is carried out according to environmentally and community-based tourism. Through watershed management designated for environmentally based tourism areas and based on community-based tourism, the watershed area will be conserved and provide benefits for the surrounding community. Erosion events and decreased land productivity around the watershed have many social impacts on communities in the watershed's upper, middle and lower areas. The results of identifying the influence of the social effects can be divided into two, namely socio-cultural and socio-economic impacts.

Sub-optimal management and use of watersheds in several areas in NTB have had socio-cultural impacts that need to be taken into account by all parties involved. Based on the results of a qualitative analysis of the Dodokan watershed, it is one of the watersheds that has clear socio-cultural, economic, and environmental impacts. So, below are some of the effects.

First, there is a decline in the performance of farmers along the watershed. Where the hard work they do is hampered when cultivating their land by drought or floods, resulting in crop failure

Second, the culture of "ulah alih aluh" that we have heard about recently is increasingly developing among the people of Bali-Lombok, where if they can improve their lives more efficiently, they will use it to improve the quality of their lives. This slogan then leads to converting agricultural land or plantations to be rented out or sold to other people. This kind of practice causes a shift in the culture of the people of NTB, who are famous for their agriculture and are slowly moving towards a culture of land entrepreneurs. As happened in Mataram City and West Lombok Regency, it can be seen in Table 1 of the area of rice fields according to Regency/City in NTB Province, 2014-2015 below:

Table 1 Area of Rice Fields by Regency/City in NTB Province, 2014-2015

Regency/City	Area of Paddy Fields by Regency/City and Type of Irrigation in West Nusa Tenggara Province (Hectares)					
	Irrigation		Non-Irrigation		Total	
	2014	2015	2014	2015	2014	2015
Nusa Tenggara Barat	205 126,00	210 933,00	51 103,00	55 545,00	256 229,00	266 478,00
Mataram City	2 058,00	1 988,00	5,00	5,00	2 063,00	1 993,00
Bima City	2 030,00	2 026,00	241,00	241,00	2 271,00	2 267,00

West Sumbawa regency	9 100,00	9 100,00	2 525,00	2 637,00	11 625,00	11 737,00
Sumbawa regency	43 673,00	44 337,00	12 518,00	12 057,00	56 191,00	56 394,00
North Lombok regency	8 195,00	8 172,00	743,00	746,00	8 938,00	8 918,00
East Lombok regency	45 578,00	46 029,00	1 734,00	1 734,00	47 312,00	47 763,00
Central Lombok regency	40 676,00	40 705,00	13 620,00	13 631,00	54 296,00	54 336,00
West Lombok regency	13 580,00	13 133,00	3 321,00	4 192,00	16 901,00	17 325,00
Dompu regency	16 005,00	16 013,00	5 243,00	6 769,00	21 248,00	22 782,00
Bima regency	24 231,00	29 430,00	11 153,00	13 533,00	35 384,00	42 963,00

Third, the existence of Subak as a world heritage is starting to fade in the era of globalization. There is a perception from the farming community that the profession of being a farmer is less profitable. Also, due to the large percentage of crop failures, the lack of role and support from the Government in farming culture has led to the development of a paradigm to look for new professions that are more promising in improving their quality of life, for example: selling or renting out land for business or tourism that looks more promising. The consequence is that future generations of Subak farmers will be lost because the profession of a farmer is not promising enough to be inherited continuously.

Management of river basins in a sustainable direction will have a beneficial impact on the surrounding community in increasing its economic level. Based on the results of a qualitative descriptive analysis of the communities around the Dodokan watershed, several socio-economic impacts can be identified as follows:

First, the decline in the level of welfare of farmers and land owners due to crop failure or crop yields cannot cover the capital spent in the production process. As we know, farmers do not get a fixed income every month, but they earn revenue from their harvest after 4-6 months or even up to a year to meet their daily needs for the following year. Furthermore, farmers also have to pay land tax in a very dire financial situation. The multiplier effect occurs when farmers cannot meet their primary and secondary needs.

Second, the high poverty level among farmers further impacts farmers' inability to provide for their families. Apart from that, the existence of intermediaries and loan sharks further worsens the economic situation of farmers. In this case, the Government's role is fundamental in improving the farmers' economy in the future.

In watershed management, several stakeholders have an interest, including:

1). Government.

The Government is one of the stakeholders that play a significant role in the continuity of watershed management. By Government Regulation (PP) no. 38 of 2007 concerning the Division of Government Affairs between the Government, Provincial Regional Governments, and Regency/City Regional Governments, watershed management is a sub-sector of the Forestry Sector. The division of affairs for the sub-sector of watershed management (number 41) is:

- The Government's business is the determination of general patterns, norms, standards, procedures, and criteria for watershed management, determining criteria and sequence of priority watershed/sub-watersheds, and preparing integrated watershed management plans.
- The provincial Government's business is to provide technical considerations for management plans and implement provincial-scale watershed management.
- The business of district/city regional governments is to provide technical considerations for preparing management plans and implementing district/city scale watershed management.

However, with the enactment of PP No. 37 of 2012, the preparation and determination of watershed management plans is carried out by:

- Minister for cross-country watersheds and cross-provincial watersheds;
- Governor according to his authority for watersheds within the province and/or across districts/cities;
- Regent/mayor according to their authority for watersheds in the district/city.

Through West Nusa Tenggara Provincial Regulation Number 5 of 2017 concerning Integrated River Watershed Management, the Government as an executive institution has placed restrictions on watershed management in NTB. However, in its implementation, it can be seen that there is a lack of implementation of the regional regulation in existing watersheds, resulting in land conversion occurring; which should be used as a water catchment area is then converted only to fulfil temporary economic needs by several capital owners and land owners, illegal logging and so on.

In general, the Government has carried out watershed management by issuing government regulations, and a Watershed Management Agency (BPDAS) has been formed. However, the structure within the Government can be said to have not been able to coordinate completely to be able to manage watersheds in an integrated direction and tends only to be fragmented based on its use, for example, watershed management for drinking water under PDAM, forest conservation in watershed areas under the Forestry Service, management of irrigation areas under the Agriculture Service, tourism management in watersheds under

the Tourism Service. The watershed management system, divided based on its use, will be more integrated if it is carried out by holding discussion forums between departments.

2). Public.

Experts have many definitions of participation. If we look at the word's origin, the word participation comes from the English word "participation," which means taking part, taking part (John M. Echols & Hasan Shadily, 2000: 419)(in Tarigan, 2014). According to Isbandi (2007: 27)(in Tarigan, 2014), community participation is the participation of the community in the process of identifying problems and potential that exist in the community, selecting and making decisions about alternative solutions for handling issues, implementing efforts to overcome difficulties, and involving the community in the process of evaluating changes that occur.

Participation as an element of development is a process of community adaptation to ongoing changes. This means that participation has an important role in development. Sumodiningrat added that the prerequisite that must exist in the sustainable development process is that all members of the community/people must be included in every stage of development (Sumodiningrat, 1988) (in Masyarakat et al., 2014). In rural development projects, the success of project implementation is greatly influenced by community participation in planning and implementing the project. When applied in the field of development, participation includes three main things, namely:

1. There is the mental and emotional involvement of someone participating;
2. There is a willingness from the community to contribute material, energy, and thoughts to participate in a joint activity to achieve goals and;
3. There is a sense of responsibility for the activities carried out by a person (Ndraha, 1982 (in Masyarakat et al., 2014).

Sometimes, there are obstacles to the implementation of a project. This possibility can happen if the community is not involved in the planning so that it is not following the community's needs so that, in the end, it is not used and maintained by the community (Raharjo, 1985) (in Masyarakat et al., 2014). According to research conducted by Masyarakat et al., (2003), many project activities fail because the approach starts from the top (top-down approach). The community is not included in the planning, so community participation is lacking in safeguarding, maintaining and supporting the implementation of these activities. For the implementation of environmental conservation activities to run smoothly, the community must be involved in the planning process, namely by carrying out PRA (Participative Rural Appraisal). In environmental management, people's income, poverty, and a person's level of education also influence community participation. This was revealed in research conducted by Erwiantoro (2006)(in Tarigan, 2014). It was further revealed that a person's ambition to achieve specific goals is also related to the economic level of their family. So, a better or higher income level also influences the incentive for someone to participate better (Rahadiani, 2014)(in Tarigan, 2014).

Watershed management in NTB is greatly influenced by community participation in environmental protection. It is a fundamental factor, both in the form of statements and activities in the form of input of thought, expertise, time, energy, capital, and/or materials, as well as taking part in utilizing and enjoying the results of development. If the community has active awareness of participating in maintaining river flows in their area, the watershed will move towards sustainability.

To maintain the existence and dynamic balance of natural resources, watershed management and development are directed through various efforts to protect, rehabilitate, and support them. One small role that has a considerable impact is managing household waste disposal. This is because a large amount of watershed pollution comes from household waste, so the denser the population in a watershed, the more significant the impact on the ecosystem in a watershed. Therefore, regular and periodic education needs to be provided to the community about the importance of protecting and preserving the watershed environmental ecosystem.

3). Academics.

Academics are one of the stakeholders in watershed management because, as intellectuals, academics are in a neutral position to contribute knowledge and monitor the sustainability of watersheds in the future through monitoring and evaluation through research or actively participating in community service.

4). Non-Governmental Organization (NGO)

NGOs are known as international-scale private associations that do not act on behalf of their respective governments and cross national boundaries. These organizations do not involve the Government directly; in Indonesia, they are better known as NGOs (non-governmental organizations), which get funds from donations from the public or world institutions such as the UN. NGOs aim to develop underdeveloped areas by providing education to local communities so they can manage their areas. Apart from that, it also carries out monitoring, for example, the participation of Greenpeace as an NGO in Citarum in waste monitoring.

Monitoring carried out by Greenpeace on waste entering the Citarum River is carried out to see the increasing amount and impact of waste entering the Citarum River, which continues to increase. This increase is caused by the rise in the number of factories appearing and operating along the Citarum River, and this is also exacerbated by the dumping of rubbish by the community, who throw household waste into the tributaries of the Citarum River, which flows into the main Citarum river (Yuda, 2013)(in Iskandar, 2018). In NTB, several NGOs have already paid attention to the environment.

3.4 Problems Faced in Dodokan Watershed Management

3.4.1 Physical Problems

1). Erosion and Landslides

Soil erosion is defined as an event of loss or erosion of land or parts of land from one place to another caused by the movement of water, wind, and ice. In tropical areas such as Indonesia, erosion is mainly caused by rainwater (Rahim, 2003). High rainfall not accompanied by dense ground cover vegetation causes erosion and landslides on several sides of the watershed in NTB, especially on land with a high slope in the upper reaches. Erosion may not be avoided with high rainfall conditions in tropical areas, but this problem can be reduced by increasing the number of ground cover plants in the upstream regions of the watershed. Thus, in addition to reducing the impact of erosion, this can also increase underground water discharge in the NTB area.

2). Watershed sedimentation.

The increasing rate of river silting and the subsequent growth of water hyacinths disrupt the population of aquatic biota in the river caused by sedimentation due to high levels of erosion and landslides in the upstream part of the river in the watershed area. Suppose the sedimentation process occurs continuously without being followed by sustainable countermeasures in the watershed. In that case, it will cause flooding in the downstream parts of the river because the flowing water cannot be accommodated by the river, which has experienced shallowing. Thus, the dredging process in rivers must be carried out periodically, both by the Government and the communities around the river basin.

3.4.2 Social Problems.

The main problems in developing watershed management are the lack of solid institutions and the weakness of a comprehensive planning system. Although watershed management efforts in Indonesia have been implemented for quite a long time, due to the complexity of the problems faced, the results have not yet achieved the desired results, especially those related to the development of human resources and community institutions. Poverty is often considered one of the causes of environmental degradation and the negative impacts of development. On the other hand, the decline in ecological carrying capacity can cause poverty to emerge and develop. To effectively address the problem of poverty, the approach should be systematically embedded in various development programs and targeted initiatives.

1). Management system that is not yet integrated.

The urgency for integrated watershed management in NTB requires integration between interested departments. Typically, each party manages the watershed according to its respective portion without fostering synergy with other parties. This partial management has resulted in the watershed experiencing a decline both in terms of ecology and also in terms of utilization of the area around the watershed.

2). Illegal Logging.

As natural and environmental resources, Indonesia's forest resources have a very strategic role in supporting the implementation of national development. Forest resources also protect dozens of river basins from the dangers of flooding, drought, erosion, and sedimentation. However, in recent developments, forests in Indonesia in general and the NTB area in particular have experienced deforestation, land area has decreased, and vegetation has shrunk along with the development of residential areas and economic factors. One of the factors that further reduces the quality and quantity of forests as water conservation areas is illegal logging. High economic needs and a lack of awareness among some people of the importance of forests are driving factors for illegal logging in NTB. The further impact of this problem is the occurrence of landslides and flooding in residential areas around the watershed. There are many environmental exploitation or degradation activities on a local and national scale, and they are carried out in many places throughout the world, so they can be considered global problems, for example, soil erosion and degradation, deforestation, water pollution, and so on.

Therefore, it is necessary to prepare a plan and implementation of forest management that is directed, detailed, and integrated. Forest management must include aspects of utilization, conservation, and research carried out through activities including (1) increasing reforestation activities; (2) increasing HPH development; (3) development of ecotourism forests; (4) development of River Watershed management; (5) increasing biodiversity research; (6) outreach to the community.

3). Land Function Transfer

Population development makes watershed management seem endless in line with changes over time. Watershed management is an ongoing activity because natural and man-made factors always exist and change (Sheng in Paimin et al., 2012). Land conversion is shifting land use and management from one side to another, considering various things to increase its benefits, generally in terms of economic benefits. However, sometimes, changes in land use only prioritize one party without considering ecological aspects and future needs. For example, cliff land in the river basin is used to improve the economic level of landowners on the Dodokan River, and many tourist attractions developed on the banks of the Dodokan River, both private and company-owned. As a result, water catchment areas are reduced, and landslides occur. If viewed from the long-term impact, it is fluctuating water discharge, resulting in floods in the rainy season and drought in the dry season.

4). Environmental pollution.

Suppose we look at the phenomena regarding the availability of clean water and water quality in Indonesia. Environmental pollution is one factor that can be said to be one of the major contributors to the deterioration of water quality in watersheds in NTB, whether it comes from household waste or industry along the river flow. The waste and rubbish are directly thrown into the river without being processed.

This is different from what happens in other countries where before it flows into rivers, the waste is processed first. For example, developed countries process their waste in large underground reservoirs so that when it is thrown into the environment, it does not cause environmental pollution. Looking at this problem and then comparing it with other developing countries, including Indonesia, several things trigger environmental pollution in Indonesia in general and NTB in particular, namely: 1). There is still low public awareness of how to self-manage waste in a good and safe way; 2). Weak government consistency in implementing existing regulations; 3). Lack of holistic planning in developing residential areas; 4). Limited existence and ownership of waste transport fleets; 5). Insufficient rewards and punishment, both legally and socially.

3.5 *Dodokan Watershed Management Optimization Strategy*

Based on the previous discussion of watershed management, several causes of less than optimal watershed management in NTB can be identified, including lack of law enforcement by the Government in supervising watershed management, lack of public awareness to actively participate in managing watersheds in an integrated direction, economic factors, and holistic planning in developing residential areas. Because of these problems, a strategy for optimizing River Watershed (DAS) management was developed as follows:

1. Ecological Sustainability, carried out by implementing the Forest Management Strategy by maintaining the quality and quantity of vegetation in the upstream part of the watershed through sustainable reforestation;
2. Sustainability of Defense and Security, carried out by implementing a consistent Law Enforcement Strategy for violations of the RTRWP (Provincial Spatial Planning Plan);
3. Socio-Cultural Sustainability Water Management Strategy. Bottom-up planning involves stakeholders in planning system development and management of water resources, developing organic farming systems (promoting subak), and planning planned waste disposal; community development strategy through education about the importance of watersheds.
4. Political Sustainability is carried out by implementing an Integrated Management Strategy. By establishing a discussion forum to monitor and evaluate watershed management involving stakeholders (government, community, academics, and NGOs);
5. Economic Sustainability is carried out by implementing strategies to improve the economy of urban communities to reduce land conversion. Building environmentally based tourism to improve community welfare, for example, agrotourism as a tourism concept to maintain food self-sufficiency and the existence of Subak, a world heritage; ecotourism as a forest conservation concept.

4. Conclusions

Based on the analysis and discussion that has been described regarding watershed management in NTB, several conclusions are drawn as follows: 1). The Government has provided limitations and procedures for integrated watershed management in NTB through government regulations regarding integrated watershed management and RTRWP, but implementation and evaluation in the field are less than optimal; 2). There has not been a comprehensive and integrated watershed management system in NTB; 3). As a fundamental factor in development, the community lacks awareness of watershed management in NTB; 4). The lack of careful planning in building settlements in NTB has harmed the watershed; 5). Economic factors significantly contribute to watersheds' sustainability in NTB, so an environmentally friendly industrial concept is needed that can also improve the welfare of communities around the watershed; 6). Sustainable tourism can be used to optimize the benefits of watersheds for local communities: ecotourism, agrotourism, and community-based tourism. Based on existing problems, several strategies for optimizing Dodokan watershed management include: 1). Sustainable Forest Management Strategy; 2). Law Enforcement Strategy; 3). Community Empowerment Strategy; 4). Integrated Management Strategy; and 5). Economic improvement strategy. The implications of this research are; a). This research provides a comprehensive strategy for developing the Dodokan Watershed (DAS) as a sustainable tourism attraction. By implementing the five proposed strategies, it is hoped that social, economic and ecological sustainability in the region can be improved. This includes attention to forest management, law enforcement, community empowerment, integrated management, and economic improvement; b). It is also hoped that the results of this research can become a reference for local policies and the implementation of environmentally based management practices, which have the potential to strengthen collaboration between government, society, academics and non-governmental organizations for more effective watershed management. Weaknesses of this research; a). This research is philosophical in nature and uses data sourced from literature studies, thereby limiting a comprehensive understanding of the phenomena observed. A greater focus on descriptive analysis and a lack of quantitative data may reduce the validity of the results; b). This research did not carry out direct field studies that could provide more detailed information about the actual conditions of the Dodokan watershed. This could potentially lead to more generalist conclusions and not fully reflect local dynamics; c). The problems faced in the Dodokan watershed include complex factors that are not fully the focus of this research, so the

proposed strategy does not cover all existing problems. The results of this study have the potential to be generalized, but with several important notes: 1). Specific Local Context; This research focuses on the Dodokan watershed in NTB which has unique ecological and socio-cultural characteristics. Therefore, the developed strategy may not be completely suitable for watersheds in other areas with different natural and social conditions; 2). Scale and Scope; Although the proposed strategy can be implemented in other locations, it is important to consider variations in local stakeholder interests, environmental conditions, and community dynamics. In a broader context, adaptation to local conditions is necessary for effective implementation; 3). Data Limitations; limitations in data collection and focus on literature studies can cause the results produced to not fully reflect the field situation. Therefore, for broader generalizations, further research is needed that includes empirical analysis and quantitative data in various locations. Thus, research results can provide a useful frame of reference, but need to be adapted to local contexts and circumstances in other areas to achieve the desired effects in watershed management.

5. Suggestion

Further research is recommended to examine and evaluate the development of the Dodokan River Watershed (DAS), bearing in mind the importance of conducting more in-depth evaluations and studies of the watershed to determine developments in the use of the River Watershed.

Acknowledgment

The authors would like to thank the University of Mataram for the support provided.

Ethical considerations

Not applicable.

Conflict of Interest

The authors declare no conflicts of interest.

Funding

This research did not receive any financial support.

References

- Bawole, M. T. (2022). Persepsi Masyarakat Lokal terhadap Keberadaan Situs-Situs Bersejarah dan Ketersediaan Amenitas dalam Pengembangan Wisata Pusat Kota Manado. *Jurnal Hospitaliti Dan Pariwisata*, 5(1), 243–254. <https://doi.org/10.35729/jhp.v5i1.96>
- Desa, K., Selemadeg, K., Nurwarsih, N. W., Pradnyaningrum, P. S., & Erick, I. W. G. (2025). *Strategi Konservasi Daerah Aliran Sungai dan Wisata Air Terjun Berbasis*. 5(1), 269–276.
- Di, B., & Tenggara, N. (2022). <http://stp-mataram.e-journal.id/JIH>. 11(2).
- Ilmi, M. K., Sipil, P. T., Teknik, F., & Mataram, U. M. (2021). *Penentuan Indeks Penggunaan Air (Ipa) Sebagai Salah Satu Indikator Hidrologi Penilaian Kesehatan Daerah Aliran Sungai (Das) Di Das Dodokan, Pulau Lombok, Indonesia*. 1(2), 63–69.
- Iskandar, Y. (2018). Peranan Greenpeace Melalui Program Detox Campaign Dalam Mengurangi Limbah Beracun Di Daerah Aliran Sungai (Das) Citarum. *JIPSi: Jurnal Ilmu Politik Dan Komunikasi UNIKOM*, III(1), 42–62.
- Kartodihardjo, H. (2004). *Institusi pengelolaan daerah aliran sungai: konsep dan pengantar analisis kebijakan*. Fakultas Kehutanan, Institut Pertanian Bogor.
- Komarudin, Alfisa, W., & Setyaningrum, E. (1999). Pembangunan perkotaan berwawasan lingkungan. *Direktorat Jenderal Cipta Karya*, 53(9), 1–458. https://simantu.pu.go.id/personal/img-post/superman/post/20181129101319_F_KMS_BOOK_20180723025129.pdf
- Marta, S., Suhartanto, E., & Sidqi, J. (2023). Validasi Data Curah Hujan Satelit dengan Data Stasiun Hujan di DAS Ngasinan Hulu, Kabupaten Trenggalek, Jawa Timur. *Jurnal Teknologi Dan Rekayasa Sumber Daya Air*, 3, 35–45. <https://doi.org/10.21776/ub.jtresda.2023.003.01.04>
- Masyarakat, P., Danau, S., Konservasi, D., Daya, S., Participation, T. H. E., Community, O. F., The, S., Beratan, L., Conservation, T. H. E., & Water, O. F. (2014). *Jurnal Spektran*. 2(2), 41–49.
- Masyarakat, P., Proses, D., Pembangunan, P., Sarjana, P. P., & Area, U. M. (2003). *Partisipasi Masyarakat Dalam Proses Perencanaan Pembangunan Di Kota Binjai Tesis*.
- Meningkatkan, U., Saing, D., & Lokal, D. (2025). *Jurnal dinamika sosial dan sains*. 25–31.
- Paimin, Pramono, I. B., Purwanto, & Indrawati, D. R. (2012). *Sistem perencanaan pengelolaan daerah aliran sungai*. Kementerian Kehutanan, Badan Penelitian dan Pengembangan Kehutanan, Pusat
- Pasaribu, R. B. F. (2013). *Pertumbuhan Ekonomi Dalam Konsep Pembangunan Berkelanjutan*. 420–467.
- Provinsi, D. I., & Tenggara, N. (2020). *Strategi Pemerintah Daerah Dalam Pembangunan Pariwisata Di*. December. <https://doi.org/10.34010/agregasi.v8i2.3817>
- Putra, W. A. E. (2017). *Manajemen Pengembangan Daerah Aliran Sungai (Das) Sebagai Daya Tarik Pariwisata Berkelanjutan*.

- Studi Kasus Daerah Aliran Sungai Ayung. *Jurnal Ilmiah Manajemen Dan Bisnis*, 2(1)(9), 80–94.
- Rahim, S. E. (2003). *Pengendalian Erosi Tanah: dalam rangka pelestarian lingkungan hidup*.
- Saputra, J. C. (2023). *Strategi Pemulihan Industri Pariwisata di Provinsi Nusa Tenggara Barat Berbasis Resiliensi*. IPB University.
- Shalizi, Z. (2003). *Sustainable development in a dynamic world: transforming institutions, growth, and quality of life* (Vol. 25). World Bank Publications.
- Strategy, I., Improving, I. N., Of, M., Nusa, W., Province, T., Sustainable, T., & Tourism, S. (2024). *Strategi Melalui Sustainable Smart Tourism Innovation Strategy In Improving Tourism*. 17–26.
- Sudipa, N., Vipriyanti, N. U., Yastika, P. E., & Denpasar, U. M. (2024). *Strategi Pengelolaan Daerah Aliran Sungai Ayung Berkelanjutan di Gianyar , Bali Sustainable Ayung River Basin Management Strategy in Gianyar , Bali*. 9, 99–107.
- Suganda, E., Yatmo, Y. A., & Atmodiwirjo, P. A. (2009). Pengelolaan Lingkungan dan Kondisi Masyarakat Pada Wilayah Hilir Sungai. *Makara Human Behavior Studies in Asia*, 13(2), 143. <https://doi.org/10.7454/mssh.v13i2.255>
- Sukerti, N. W., Komang, N., Aprilia, T., & Masdarini, L. (2022). Strategi Pengembangan Daya Tarik Wisata Alam Air Terjun Sing-Sing Di Desa Temukus Kecamatan Banjar Kabupaten Buleleng. *Jurnal Pendidikan Teknologi Dan Kejuruan*, 19(2), 140–149. <https://repo.undiksha.ac.id/12923/%0Ahttps://repo.undiksha.ac.id/12923/9/1815011036%28LAMPIRAN%29.pdf>
- Suparsa, I. M., Muliani, N. K., Dea Manik Puspawati, A. A., Aprilia Wiryastuti, N. N., & Bintang Maharani Putri, I. D. A. A. (2022). Implementasi Budaya Lokal Dalam Penataan Daerah Aliran Sungai Untuk Menunjang Pengembangan Kawasan Ekowisata. *Jurnal Ilmiah Vastuwidya*, 5(1), 57–64. <https://doi.org/10.47532/jiv.v5i1.410>
- Susi Iswanti, S. I., & Zulkarnaini, Z. (2022). Peran Pemerintah Desa dalam Pengembangan Objek Wisata Pulau Tilan di Kepenghuluan Rantau Bais Kecamatan Tanah Putih Kabupaten Rokan Hilir. *PUBLIKA : Jurnal Ilmu Administrasi Publik*, 8(1), 92–103. [https://doi.org/10.25299/jiap.2022.vol8\(1\).9307](https://doi.org/10.25299/jiap.2022.vol8(1).9307)
- Tarigan, H. (2014). *Dampak Undang-Undang Sumber Daya Air Terhadap Eksistensi Kelembagaan Subak Di Bali Impacts of the Water Resource Act on Existence of Subak Institution in Bali*. 103–117.