

## ECOTOURISM MANAGEMENT BASED ON LOCAL WISDOM FOR OPTIMIZING THE FUNCTION OF CAVE WATER RESOURCES AS A PREVENTION OF FLOODS AND DROUGHTS IN WAKATOBI REGENCY, INDONESIA

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**Abstract:** The basis of local wisdom is an effort to preserve the environment in line with the main goal of developing ecotourism. Successful ecotourism management can optimize the function of the existence of natural resources. The purpose of this study was to examine the local wisdom of the community in ecotourism management to optimize the function of cave water as a prevention of flooding and drought in urban strategic areas. The research method uses descriptive qualitative by digging information through in-depth interviews with traditional leaders, relevant government, community and visitors to water caves. SWOT analysis in this study is used to determine the management of water resources and to plan the development of sustainable ecotourism as an alternative to managing the potential and conservation of cave water. Checking the validity of the data using a triangulation model. The results of the study show that there are three forms of community local wisdom regarding cave water conservation, namely: (1) *Ufe Karia*, (2) *Imaeka*, and (3) *Sala piara* (mistake of care). Should either intentionally or unintentionally have disturbed the existence of cave water. The cave water functions as a natural infiltration well that is able to accommodate large amounts of rain water with a concentrated flow pattern at the cave water point. Meanwhile, other cave water points are the main raw water sources to meet the domestic needs of the community with stable water discharge and never dry. The results of the SWOT analysis show that cave water has the potential to be developed into ecotourism so conserve water resources as a prevention of floods and droughts on Wangi-Wangi Island.

**Key words:** Ecotourism management, Local wisdom, Cave water resources, Prevention of floods and droughts

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### INTRODUCTION

The potential of natural resources and the use of nature by the community are the main assets for sustainable tourism development. Applying the ecotourism concept is a tourism strategy that focuses on environmental sustainability by maximizing nature's potential as the main product. Therefore, analyzing the potential of available natural resources is the first step that can be taken to achieve the desired goals. The fact that Wakatobi Regency's marine source is undeniable is reflected in the wealth that has been recorded. Wakatobi Regency has a great potential in marine resources, offered as the leading tourism product of the island. Marine tourism is the main sector developed through community-based management integrated with the ecotourism concept (Al Dilwan and Astina, 2019). Besides having great marine potential, the land area on Wakatobi Island also plays a significant role. Based on geographic location, the natural resources in Wakatobi Regency is very diverse, not limited under the sea. Geodiversity on the mainland also needs to be developed as ecotourism to achieve equal welfare for the community with caving ecotourism activities, but the development needed to be explored (Haryono et al., 2014).

The tourism in Wakatobi Regency still has weaknesses, namely the low level of community participation in ecotourism management due to the disclosure of information related to ecotourism development, weak coordination and communication between stakeholders, the lack of public knowledge about ecotourism, and political dynamics among locals. The lack of land potential studies needed to examine the natural resources of Wakatobi, especially the land potential.

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The resources can benefit mainland tourism development based on community empowerment (Hamid, 2010). The district government of Wakatobi seems to be more focused on maritime potential, not on land potential. It is shown on the 2012-2032 Wakatobi Regency spatial plan, only aimed to realize the district spatial layout by optimizing marine-based natural resources. The spatial management of Wakatobi Regency that tended only on the potential maritime causes the need to re-examine the land potential to become a tourism area on Wangi-Wangi Island to be developed for sustainable ecotourism. The tourism development of Wakatobi Regency has been focused on marine resources, raises challenges in exposing that area. This research was conducted because the studies on the ecotourism potential were still limited, especially in Wangi-Wangi Island. One of the land potentials in Wakatobi Regency is the caves with rich water resources used by the surrounding community for daily water needs. Also, the utilization for a long time has fostered a tradition that was born in society. This study contributed to knowledge about cave water resources on Wangi-Wangi Island to be developed for sustainable ecotourism. Wakatobi community interaction with the surrounding environment creates local wisdom and culture. Adaptation ability to the environment forms a cultural setting that is not easy to change. The community's cultural identity, resource availability, and the threat of natural disasters are the primary reasons for humans to maintain the environment. Environmental conservation is essentially a system of mutual relationships. The available natural potential is used by humans to sustain life, on the other hand conservation awareness is an effort to keep the environment sustainable. Humans contribute to sustainability by establishing a local community knowledge system. Mentions that local wisdom is highly influenced by local values such as the conservation principles, management and exploitation of natural resources carried out by social groups (Masita, 2012). Local wisdom contains good values about the preservation of natural resources needed to maintain sustainability. Local wisdom supports a lot of nature conservation programs. According to Zamroni (2013) the local wisdom foundation can use as a basis for innovation in disaster management by community.

Creating a sustainable environment can help to prevent natural disasters. Maryani and Yani (2016) suggest that nature conservation to prevent natural disasters are disaster mitigation efforts. Natural disasters continue to occur frequently and are difficult to control. Disasters come in various of forms and result in property loss and even fatalities. Floods and droughts are unresolved problems in areas with climate deviation. Floods and droughts continue to be a problem in several areas of Indonesia. According to Kastolani and Mainaki (2018), Indonesia is a tropical country with high rainfall and irradiation, making it extremely prone to disasters such as drought, tropical storms, and floods. In general, flooding occurs when the water volume in a river exceeds the channel capacity (Adi Seno, 2013). However, an extended drought season can result in a drought disaster. Due to the vulnerability of hydrometeorological disasters that threaten areas of Indonesia, disaster mitigation actions are necessary. Various types of activities aimed at disaster mitigation can be conducted structurally or non-structurally. Flood disaster mitigation strategies that included in the structural category may also include regenerating the drainage system, normalizing rivers, constructing reservoirs, and absorption wells (Prasetyo, 2019).

Natural disasters caused by hydrometeorology are essentially uncontrollable by human understanding and technology. Meanwhile, the nature has been designed in such a way to try to recover itself. In other locations, disaster mitigation is performed through structural methods, but in Wakatobi Regency, disaster mitigation occurs naturally because of cave water supplies. Water caves located around Wangi-Wangi Island are unique potentials. This island is not only used as a natural bathing location, but also serves a critical mitigation function that should be fully investigated.

In Wakatobi Regency, there are several cave waters located in urban areas, namely *Ufe Kontamale* cave water, *Ufe Te'ekosapi* cave water, *Ufe Topa Wanci* cave water, *Ufe Lesa'a* cave water, *Ufe Endapo* cave water, *Lia Bete* cave water, *Te'e Ea'a* cave, *Te'eponu* cave water, and *Topa Mandati* cave water. According to initial observations, the community used cave water resources as a public bath, washing clothes, and raw water resource for household water needs controlled by regional water companies. Furthermore, the cave water serves as an indirect flood control mechanism in the capital urban districts. While cave water in urban areas serves the community as water source, it has a negative impact on cave water conservation due to the area's increasing population growth. Besides served as a flood and drought disaster mitigation method, conservation of cave water resources is necessary to encourage researchers to conduct disaster mitigation studies based on local cultures. This study aimed to explain the local wisdom of the Wanci and Mandati indigenous peoples regarding the preservation of cave water resources to prevent floods and droughts and sustainable ecotourism in the Wangi-Wangi Island area, Wakatobi Regency.

## LITERATURE REVIEW

The studies in modern tourism focus a lot on the sociological factors of tourism activities and the environmental effects of tourism development. Thus, tourism is considered a social phenomenon with real ecological impacts. However, those view is very common because tourism can not be work without a valuable resource base, and natural resources are often important for tourism development in a particular region. Natural resources play a key role in tourism and tourism activities as the main instrument in community economic development (Fredman et al., 2012; Ijeomah et al., 2011; Firdaus et al., 2019; Sumarmi et al., 2020). One of the tourism concepts that can reduce environmental impact is ecotourism.

Ecotourism is a tourism practice that prioritizes sustainability aspects and environmental economic value. Stated that the tourism industry provides a huge contribution to the local economy (Nutsugbodo et al., 2020). Ecotourism is best applied in natural and rural areas, including the local community culture (Yilmaz, 2011). Ecotourism is the solution to humanity's problems with the environment, poverty, climate change, and human efforts to promote a more sustainable tourism industry (Zeppel, 2012). Understanding the importance of natural resource conservation, environmental education, and local communities' welfare, ecotourism is increasingly being raised as a recommended solution. Many countries make massive ecotourism promotions and attractions to get the benefits and opportunities in the ecotourism market. Ecotourism has been recognized as a core component of the sustainable development agenda due to its ability to promote the three

primary principles of environmental protection, economic development, and community development (Cobbinah et al., 2015). Kunjuraman and Aziz (2019) also stated that diversifying income sources for community livelihoods, maintaining the community's cultural authenticity, restoring degraded forest environments, and developing communities are the surest ways to optimize the benefits of ecotourism projects. Ecotourism studies in Indonesia can be approached from the perspective of the overall performance of the national park (TN). One of the fast-growing ecotourism destination areas in Indonesia is placed in Wakatobi National Park, Southeast Sulawesi. Wakatobi Regency holds two positions: a conservation area and a tourism area for contribute to the local economy (Marlina et al., 2021). The results were obtained from diving and research services, foreign operators, adventure tourism, and the local economy. Based on the tourist visits in 2015-2020, tourism in Wakatobi Regency tended to be stable, which remained flat. The following table 1 showed the number of tourism visits in Wakatobi Regency for 2015-2020. For more details, the increase in tourist visits to Wakatobi can be seen in Figure 1 on the graph of the number of local and international tourist visits in 2020.

Table 1. The tourist visits in Wakatobi Regency for 2015-2020  
(Source: Wakatobi Regency Government, Tourism Office)

Year	Visits		Total
	Local Tourists	International Tourists	
2015	11.401	6.626	18.027
2016	14.560	7.820	22.380
2017	20.419	7.020	27.439
2018	22.411	6.997	29.408
2019	23.093	5.764	28.857
2020	3.096	415	3511

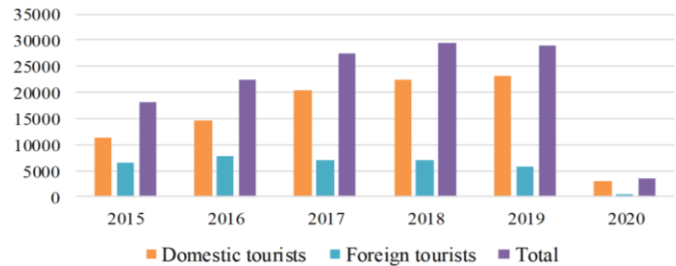


Figure 1. The graph of tourist visits in Wakatobi Regency for 2015-2020

Based on Figure 1, the tourist visits in Wakatobi Regency have increased continuously from 2015-2019, but then drastically decreased in 2020 due to the Covid-19 pandemic. The data of tourist visits were obtained from the number of visits to hotels and inns in Wakatobi Regency. In accordance with the main objective of ecotourism as an effort to preserve natural resources, it is directly an effort to optimize the function of the existence of natural resources. The physical existence of cave water resources is an area that is naturally able to prevent natural disasters such as floods and droughts. Plus the support of local wisdom in management is a strategic step that can be taken to optimize environmental management. Environmental studies based on local wisdom become more important. Culture is defined as the ability to use human intelligence to act wisely on the environment. Local wisdom is frequently conceptualized in foreign languages as local wisdom, local knowledge, or local genius. Local wisdom is defined by the local community as a wise way of using natural resources that is based on good principles and agreed by the all community members. Local wisdom is defined as the wisdom or understanding that results through community adaptation processes to the environment.

Local wisdom is formed from the traditions and practices of the community for generations. The truth of a local wisdom is a cultural legacy that has been believed and lived by every community (Gadeng et al., 2018). Umin (2019) stated local wisdom as a personality, cultural identity of the community in the form of values, norms, ethics, beliefs, customs, and special rules accepted by the community. Understanding the values of local wisdom is very important as a reference in responding to the challenges of natural resource conservation in an area (As'ari and Hendriawan, 2016; Marlina et al., 2020). Herawati and Kartini (2019) emphasized that local wisdoms and the values including in it can be used to help in disaster management. Wikantiyoso (2010) emphasized that local communities generally have local knowledge and ecological wisdom in predicting and mitigating natural disasters in surrounding area.

## METHODOLOGY

Wakatobi Regency is located in Southeast Sulawesi Province, Indonesia. Wakatobi Regency is an archipelago district. Wakatobi is an acronym for the four major islands, Wangi-wangi, Kaledupan, Tomia, and Binongko. Astronomically, Wakatobi Regency is located in the southern hemisphere, extending north to south between 5,000 and 6,250 south latitude (160 kilometers) and west to east between 123,340 and 124,640 east longitude (120 kilometers). Wakatobi capital city is located on Wangi-Wangi Island, the main island with a larger population than the other three islands.

Wakatobi Regency has a lot of cave water, and in Wangi-Wangi Island's urban area, cave waters are spread across community settlements. Communities in the surrounding of the cave water area have easy access to clean drinking water. In general, the Wangi-Wangi Island area is a reef rock with a high density. Morphologically, the mainland area of Wangi-Wangi Island has an altitude below 500 meters above sea level (masl) and is located around the equator, so this area has a tropical climate. This research is a qualitative descriptive study that use an inductive approach to explain research problems regarding the effectiveness of mitigation planning. An inductive method draws conclusions from a particular situation (the location of the topic under review) to make ideas more general and applicable to other fields.

The methodology used is a review of the literature and field research. Qualitative research approaches include field observation and in-depth interviews. Secondary data used in this study is population data and rainfall data from Meteorological, Climatological, and Geophysical Agency (BMKG). Qualitative analysis was used in this study to determine: (1) by conducting in-depth interviews with traditional leaders, communities in the area, and visitors to water caves to evaluate the local wisdom for preventing cave water resources; (2) by analyzing the community's role in cave water resource management. The data analysis used a triangulation methodology to determine the local wisdom of the Wanci and Mandati peoples on Wangi-Wangi Island. For more details, the research location can be seen in Figure 2.

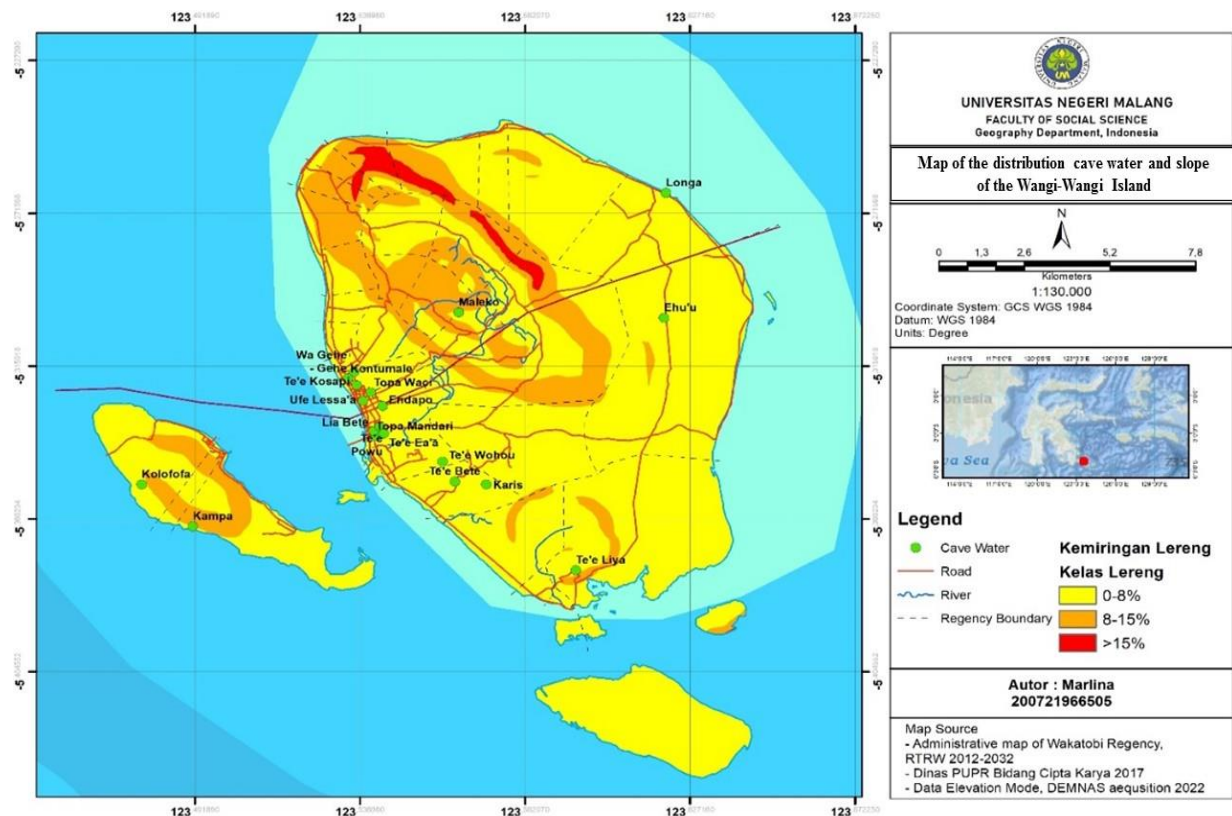


Figure 2. Wangi-Wangi Island distribution cave water and slope classification map (Source of research, 2021)

### Data Collection Method

The research used descriptive methods with quantitative and qualitative analysis techniques. The data used in this study are primary data and secondary data. Primary data collection was carried out by interview, observation, and focus group discussions (FGD) with village and sub-district administrators and managers. Interviews were conducted with visitors, local communities. Secondary data were obtained from government agencies, institutions, and the community. Researchers are used as an instrument of data collection at the research location. In this study, the researcher described the study results as an impartial third person and reported the result and observed from the participants. The researchers conducted valid and accountable data collection in three stages:

1. In-depth interviews. The interview was used by asking the questions directly to the informants. The interviews conducted are unstructured interviews aimed at the questions being flexible, more open but still following the signs that have been made to obtain information in-depth.
2. Participant observation is data collection by observing and recording carefully and systematically. Direct observation made by researchers aimed to observe and record information on cave water resources.
3. Observation of cave water resources was carried out to observe the potential resources and then analyzed with SWOT analysis.
4. Documenting and enhancing information found by examining data sources from current field records.

### Data analysis

Researchers used a SWOT analysis followed by the Analysis Hierarchy Process (AHP) to identify cave water resources. A ready-to-eat market around the cave water area, with traditional special snacks on offer, is an alternative policy for sustainable ecotourism development and improving the local economy that the government has planned. The research area is located in two sub-districts, namely Wangi-Wangi District and South Wangi-Wangi District, with ten caves water resources in the strategic urban area of Wangi-Wangi Island, Wakatobi Regency. The topography of Wangi-Wangi Island is at an altitude of 0-200 meters above sea level, with a relatively flat land surface. Overall, Wangi-Wangi Island is a low-lying coastal area with an altitude of 0-200 masl. The land use of Wangi-Wangi Island is varied, consisting of scrublands, forests, airport areas, gardens, mangroves, grasslands, residential houses, and farming. The research location map is shown in the following Figure 3. The analysis method used by researchers is by using the SWOT method. According to Oka A. Yoeti (1996), the SWOT analysis method consisting of Strengths, Weaknesses, Opportunities, and Threats.

- a. Strength, namely the strength that tourism has.
- b. Weakness, namely all factors that not beneficial to the tourism sector.
- c. Opportunities, namely all opportunities that exist as government policies, applicable regulations, or national or global economic conditions that considered to provide opportunities for tourism to grow and develop in the future.
- d. Threats, namely all factors that could threaten the development of tourism in Wakatobi regency.

The SWOT formula used in this research showed in the following Table 2.



Table 2. SWOT Matrix (Source: Damanik et al., 2006)

Internal Audit External Environment	Strengths	Weaknesses
Opportunities	SO	WO
Threats	ST	WT

Explanation:

SO: maximize strength to increase opportunities

ST: maximize strength to anticipate threats and to create opportunities

WO: minimize weakness to increase opportunities

WT: minimizing weakness to anticipate threats

## RESULTS AND DISCUSSIONS

### 1. Characteristics and utilization of cave water in Wangi-Wangi Island

The cave water resources in Wangi-Wangi Island are gravitational water sources, which the water level of the cave is higher at high tide and falls at low tide. The source of cave water comes from groundwater, with a stable amount of water discharged during the dry and rainy seasons. As the climate changes, the clarity of the cave water changes slightly during the rainy season because it is influenced by rainwater flowing into the cave water, which is in a lower condition than the surrounding land conditions. The cave water area of Wangi-Wangi Island is an area of alluvium rock, and sediment, and limestone, which originated from frozen breakthroughs of Holocene, meosin and pleosine coral formations. In general, the Wangi-Wangi Island area is a high-density coral rock. The mainland area of Wangi-Wangi Island is below 500 meters above sea level (masl) and is around the equator, so this area has a tropical climate. The physical distribution of cave water appears to be very clear. The depth of the lowest cave water is 1.5 meters, to the deepest is about 2.5 meters. Based on the observation that the cave water area has a different appearance, some are very closed so that some of the cave water does not get sunlight, while at some other place, the condition of the cave water is fully open. The largest cave water area is *Ufe Kontamale* cave water, the most favorite natural bathing area. The cave water is almost always crowded with people for tours or washing clothes. The water caves studied were covered by ten water caves, namely *Ufe Kontamale* cave water, *Ufe Te'ekosapi* cave water, *Ufe Topa Wanci* cave water, *Ufe Lesa'a* cave water, *Ufe Endapo* cave water, *Lia Bete* cave water, *Te'e Ea'a* cave water, *Te'eponu* cave water, and *Topa Mandati* cave water. The water caves are located in the strategic urban area in the capital. Because it is placed in the center of residential areas, so it is very easy for the community to use it. The community can easily access cave water for daily water needs. To clarify the potential beauty of cave water resources can be seen in Figure 3.



Figure 3. Potential of cave water in Wangi-Wangi Island in the picture (a) the physical condition of the *Kontamale* cave water (b) The atmosphere of the cave water is visited by many people (c) The outside view of the *Topa Wanci* cave water (Source of research, 2021)

### 2. Types of community local wisdom

An unwritten rule that cave water is essential to the community's well-being develops a conservative attitude that is still widely accepted. Cave water is a source of living water provided by God to supply the island's water demands. The use of cave water supports a unique conservative culture that reflects good values for sustainable cave water management. Sumarmi et al. (2020) stated that behavior in response to the environment is influenced by the community local wisdom. Wanci and Mandati indigenous people, particularly those who lived alongside the cave water, still maintain to the traditions and values of their predecessors, as seen by the community's loyalty to existing local wisdom. The local wisdom that are still preserved by the community are as follows:

#### a. *Ufe Karia* (Traditional water)

*Ufe Karia* interprets as traditional water; *ufe* means water, and *karia* refers to a tradition of converting every child to Islam on a large scale in Wakatobi Island. *Ufe Karia* is a method of water management that has been used for centuries to support traditional need. The use of cave water in *Ufe Karia* is a stage in the ancient procession of the Karian tradition, which began with the discovery of cave water. This tradition is carried out in the months of Shawwal, Zulhijah, Safar and Sa'ban in the Hijri year (Islamic Year). *Ufe Karia*, which means "convert to Islam" in the local dialect, is the first of a series of traditional processions that should be preserved. The results showed that at least four required traditions depend on cave water supply traditional requirements, namely: (1) *Ufe Karia Mbo'u Mbo'u*, (2) *Ufe Karia Ntooge/Hoporuku*, (3) *Ufe*

*Heraha Kuni* and (4) *Ufe Kafi* (Wedding traditional water) (Marlina et al., 2022). The whole tradition has different meaning. The community believes that cave water is highly beneficial for healing, bringing blessings and health, wealth, and soul calmness. The use of cave water for "Ufe Karia" in particular reflects the local community's conservative behavior in preserving the cave's culture, rituals, and water resources. Traditional practices of the Wakatobi community are intended to purify, protect, and Islamize Wakatobi children so that they are prepared to serve their religion, country, and state. The community believes in the benefits of cave water as a result of historical traditions about the arrival of a princess or an angel who bathed in Lesa'a cave water. Interview with traditional leader stated that:

"*Jari dimolengo no gaa'a kae te mansuana mai ane ke putri te bijajari no hesofui di ufe Lesa'a iso. Jari no hesofui iso aneke mia umita a mina di atu ai te ufe iso gara no piri sae emo kua ake te jari hekombi, te pa lalesa numaho, gara to dahani emo na guna nu ufe iso jari apa menae ufe iso no pakili torusu e.*" it means "Les'a cave water has long been thought to have therapeutic characteristics and to magnify the human spirit, according to the stories of a princess or angel who bathed in the water and was seen by the public. As a result, the water is always kept clean" (Interview with Traditional Leaders, 2021).

The Wanci and Mandati indigenous peoples use a specifically selected child to harvest water from the *Les'a* and *Lia Bete* caves following traditional rules, namely *Kanalako/Impi Ufe*. Water intake is started by placing the dish in a betel leaf stuffed with gambier, tobacco, lime, and areca nut on a banana leaf plate. The dish is then placed on a rock around the cave water. The child then pulls water on the right using a water storage container (kettle), and after the water is completely filled, the child brings it to the location of the Karia Ritual. The taboo in the process of taking water is not making a sound and not being allowed to respond even if a question is asked on the route to the destination. Mandatory use of *Les'a* and *Lia Bete* cave water because they believe in the efficacy of cave water as a healer and repellant to evil. *Les'a* refers as soul freedom or heart spaciousness. Drinking and bathing in cave water can help heal and maintain good health. People are aware that maintaining sustainable cave water is critical. If the water is constantly pure, it can also be beneficial to the community.

### **b. Imaeka (Feared)**

Human interaction with the environment has the potential to have an effect on the knowledge system and behavioral patterns in life. Local wisdom is a type of intelligence/knowledge or way of life expressed through the activities of local communities (custom, religion, science, economy, communication, and art) to maintain, improve, and develop aspects of their needs while responding to the ecosystem and human resources (Marfa'i, 2012). The responsibility to preserve the environment cannot be separated from the local community's trust. *Imaeka*, which interprets as being terrified in the water, is one form of popular belief in cave water. *Imaeka* (Feared) is a creature that is visible to the bare sight but is widely believed to exist by the community. *Imaeka* manifests as *Sa'a* (Snake), *Fulelu* (Big Snake), *Imbu* (Octopus), and *Onitu* in each waterbody (Guardian Jin). Interview with the community member stated that: "*Sabaene'e na ufe ane ketunggu no, te tunggu ato te jumagae iso an eke sa'a, e imbu, te onitu fane ahu atu, koru o giu, te kita ana topirisae ae mou yako to ita kua toka temanusana mai no elo kua bara di mingku sapoilu miu karena maka nu daolaro na mia jumagae.*" it means

"Even though we can not see them, we believe that the water in every cave is protected by creatures like snakes, octopuses, and even people who seem like light. Our parent said to do not do anything reckless in the cave water, and don't get the guardian upset" (Interview with Traditional Leaders, 2021).

The public's belief about feared guards in cave water makes people afraid to let the cave water in a dirty and unmaintained condition. Although the Wakatobi Regency Hygiene Service had previously avoided working in the cave water region, the community worked cooperatively to clean the cave water area every Sunday. The fear of disasters and tragedies that threaten the area motivates complete cleanup activities. The threat starts with the stories of previous generations, which are then passed down to the new generation. Interview with traditional leader stated that:

"*Jari paraba'a nu tula-tula mansuana mai kua di ufe iso ane ke sa'a mina di Loba La Honiki, te loba iso no posambu kua ufe topa ana apa te'e kapaa iso, Te loba iso no ido api e te kau pepungo ane eke sa'a no repe'e tee aaka nu kaau. Jari te Sa'a iso no elo kua ara kaluara di junia ana ku tomolo te togo saba'e*". It means "A giant tree (Pepungo) provided support for the cave water, according to the parents' legend, and the tree roots constricted the snake underneath. The cave was connected to the water from the Topa Wanci cave to *Te'ekapa*. Snake then claimed that if he left the world, he would swallow an island." (Interview with Traditional Leaders, May 2021). Because of the dangers that could arise if the cave water is not managed, the area is kept clean. The community considers *Imaeka* a real thing and the threat will also become a reality. The proof showed that the cave water is always in a sustainable state, and that the trees surrounding the region have never been damaged by the evil hands of humans. Furthermore, there is a genuine conservation awareness in the concept that water cannot be disturbed or damaged at specific times. *Kontamale* cave will be closed down on Fridays since locals believe that an *imbu* (octopus) called *Imaeka* will play drums in the water, and the sound will be heard by the people. People will choose not to use cave water at that time. Interview with the community member stated that: "*Saga'a ara olo juma'a maka ane te rodongo te rambi nu ganda imbu, Teiso mo na di maeka nu mia kene topiri sae'a antaada ufe iso ane ke loba to'oge jari tantomo ane ke kadadi umidho kene no jaga mot e ifo iso*". it means "On Fridays, sometimes we hear the sound of drums being played by Imbu (Octopus). That's what people are afraid of, hence why they think there's a guard in the cave. People believe that this cave must be habitat to several species of animals" (Interview with Traditional Leaders, 2021).

*Imaeka*, the community's local wisdom, teaches about conservation and wise use of cave resources. Fear of *Imaeka* becomes a particular taboo against society's values and norms. In addition, the existence of *imaeka* forms social regulations that apply to the use of water to separate its use according to gender. It has been a long time since these special rules apply and are obeyed by the community. The community has quite unique rules, namely regulating special areas for women and special water for men, these rules apply to water points with physical conditions of scattered cave water. This arrangement grew on the basis of the community's belief that mixing between men and women is considered



to violate norms and customs. Based on the community belief, it is done that placing men and women in one place is against local customs and norms. The community put the faith to keep the rules. The separation for bathing place is for safety, peace, and comfort. This regulation follows religious values and has become the way of life for the Wanci and Mandati society. The rules did not work for caves with open water resources and had only one pool of water. It can be different in each cave, according to the conditions of the area, such as *Kontamale*, *Tekosapi*, *Te'ea*, *Ufe Lesa'a*, and *Topa Mandati* cave water which have a public bathing place. Apart from being used as a public bathing place, people also use cave water for washing clothes. The activity of washing together has become a habit for the community. This activity is popular because people can chat, exchange information, or discuss so that washing activities become more enjoyable. Besides, washing in the cave is considered energy saving. The community feels more significant benefits from this activity than washing at home because they have to draw water first or use electricity for pumps and washing machines. More clearly about community activities in the use of cave water can be seen in Figure 4.

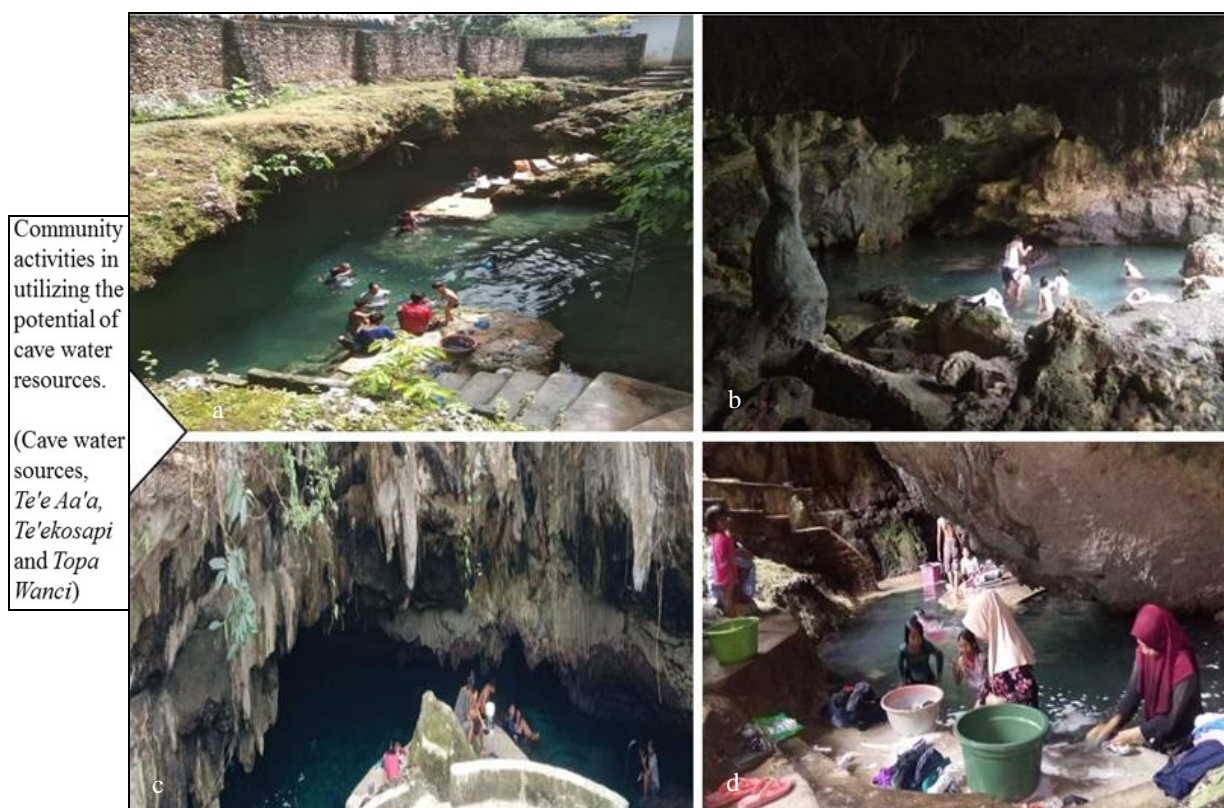


Figure 4. Community activities on the potential of cave water resources in the picture consist of: (a) Community activities in *Te'e Aa'a* cave water (b) Community activities in *Te'e Kosapi* cave water (c) Community activities in *Topa Wanci* cave water for men –male (d) Community activities in *Topa Wanci* cave water for women (Source of research, 2021)

### c. *Sala Piara* (Miscarried)

Another local wisdom about cave water is *Sala Piara* (miscarried). *Sala Piara* comes from two words *Sala* means wrong and *Piara* means to carry. *Sala piara* is interpreted as a form of action that is not carried out because it is not in accordance with what should be either intentionally or unintentionally disturbing the existence of *Imaeka*. *Sala Piara* can develop because visitors to the cave water area disrespect nature and the cave water, conduct immoral behavior in the cave water area, and throw waste. The community believes that when *Sala Piara* activities are carried out, the consequences given can be extremely dangerous, causing visitors to become ill or even lose their lives. Interview with traditional leader stated that:

“*Koru'o natu namia fila manga-manga di Ufe Kontamale iso toka nu molinga e na dafu nu imaeka iso jari no sala piara mo, saga'a natu no moho, tei meri ako iso hempia mo na mia molomo di ufe iso karna te salapiara mo iso bai. Jari leama no iso to sarati'e misalno iso to pingi koe mot e imanga di mbafan to iso kene to mbta tata koe mo kua ako mot e dafu nu ufe. Kene uka bara tomolingae ako mara to sai jao di ufe*” Interview with Traditional Leaders, 2021. It means “There are numerous incidents of people going on picnics at Air Goa Kontamale but ignoring the restricted area, then will be *Sala Piara*. Some were sick, some of them even drowned at worst. Thus, it is beneficial to demonstrate appreciation for nature by adding a small amount of food to the water. Also, avoid immoral behavior in the cave water area” (Interview with Traditional Leaders, 2021). *Sala Piara* indicates serious punishments for anyone who violates the applicable rules. Following to the regulations is the most effective approach to avoid punishment. *Sala Piara* is highly trusted by the community. The need of prohibitions and recommendations for cave water conservation is important. Furthermore, the ecological benefit of the prohibition is to ensure that the cave water is constantly clean and sustainable. Furthermore, wise use of water resources helps ensure the long-term sustainability.

### 3. SWOT analysis ecotourism management for prevention of floods and droughts

The first step in planning the development of cave water ecotourism on Wangi-Wangi Island is to recognize its physical

and social potential. The steps include (1) physical potential, namely the morphological and hydrological characteristics of cave water resources and the development of regional spatial planning based on cave water distribution, (2) development of facilities and infrastructure to support ecotourism, and (3) management of areas for water conservation. The social potential referred to is social, economic, cultural, local wisdom, and the potential for community involvement around the cave water area. SWOT analysis is used to measure strengths, weaknesses, opportunities, and threats to determine cave water potential for ecotourism development. The results of the SWOT analysis are shown in the following Table 3.

Based on the results of the Focus Group Discussion and analysis of internal and external factors regarding the development of cave water ecotourism, it is known that there are 6 strengths with a score of 8.8, there are 4 weaknesses with a score of 7.3, there are 6 opportunities with a score of 8.6 and there are 5 threats with a score of 7.4. More clearly can be seen in Figure 5 about the results of the SWOT analysis for the development of cave water ecotourism. From the results of the SWOT analysis, it is described through quadrants and it is concluded that it is in quadrant 1 with a value (1.50, 1.20). More clearly can be seen in Figure 6 about the position of the quadrant of the SWOT analysis.

Table 3. IFAS and EFAS Matrix of Kontamale Cave Water (Source: Research data analysis, 2021)

Internal factors				External factors			
Strengths	Quality	Rating	Score	Opportunities	Quality	Rating	Score
Many cave water spots	0.30	4	1.20	The water discharge is quite a lot	0.40	4	1.60
Cleanliness is well maintained	0.20	3	0.90	The water is safe to use for bathing	0.40	5	2.00
Safe and conducive area	0.40	3	1.20	Have regulations managed the ecotourism development	0.30	3	0.90
Suitable to be developed into an ecotourism area	0.30	4	1.20	Get community support	0.40	5	2.00
Easy access to the area	0.40	4	1.80	Large number of visitors	0.30	3	0.90
Strategically located in an urban area	0.50	5	2.50	Allows local economic activity	0.30	4	1.20
<b>Total</b>			<b>8.80</b>	<b>Total</b>			<b>8.60</b>
Weaknesses	Quality	Rating	Score	Threats	Quality	Rating	Score
The surrounding area is a little creepy	0.30	4	1.20	Lack of investors to manage	0.40	4	1.60
Lack of promotion from the tourism office	0.40	4	1.60	Garbage that has not been managed properly	0.30	4	1.20
Lack of comprehensive management	0.40	5	2.00	Many people still wash clothes in the cave water	0.40	5	1.80
Lack of facilities and infrastructure	0.50	5	2.50	Less attraction as many other tourist attractions are better	0.30	4	1.20
<b>Total</b>			<b>7.30</b>	Growth of community settlements in cave water areas	0.40	4	1.60
<b>X = Strengths – Weaknesses = 1.50</b>				<b>Total</b>			<b>7.40</b>
<b>Y = Opportunities – Threats = 1.20</b>							

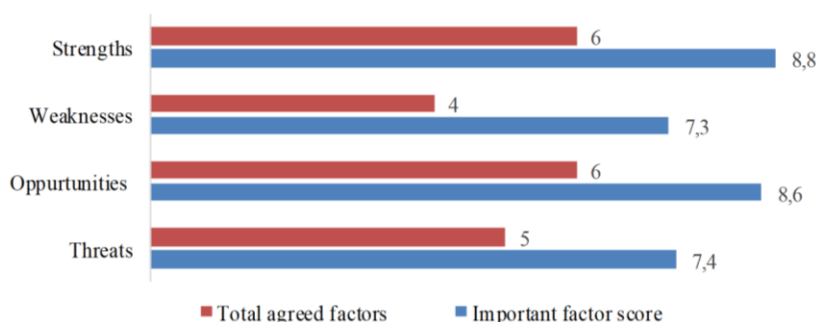


Figure 5. The graph of the results of the SWOT analysis of the development of ecotourism (Source: Research data analysis, 2021)

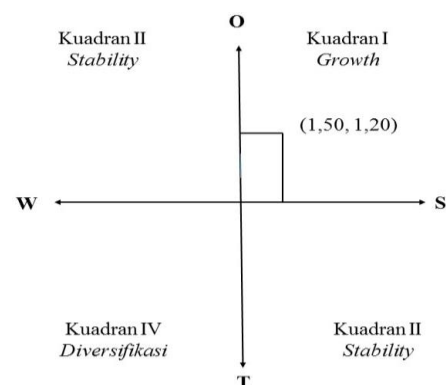


Figure 6. The quadrant of the SWOT analysis (Source: Research data analysis, 2021)

The results of the IFAS and EFAS analysis of cave water are shown in the following Figure 6. The formulation of the X and Y axes is used to determine strategic quadrants' location, which is considered to have high and urgent priority. The X-axis is EFAS (Opportunity - Threat), and the Y-axis is IFAS (Strengths - Weaknesses) which are stated according to the scoring results. Based on the SWOT matrix analysis, IFAS and EFAS are weighted as in Table 3. The X and Y values for the development of cave water ecotourism, it is known that the X value is 1.50 and the Y value is 1.20. The X value is obtained from internal factors (strength - weakness), while the Y value is obtained from external factors (opportunity - threat). The result was placed on quadrant I with x, y values of 1.20, 1.40. It means that cave water ecotourism can be developed. The SWOT results in the quadrant are shown in the following Figure 8. The development of cave water for tourism is in quadrant I, meaning that it has a prospective opportunity to develop the existing potential. A strategy that can be done is to support policies for natural bathing activities to improve the community's local economy around the area. The S-O policies are building tourism facilities and infrastructure, maintaining the area's cleanliness, and making regulations to regulate ecotourism management. The W-O policy is area management by applying conservation rules so that washing clothes in the area does not interfere with tourism activities and increases tourism promotion based on cave water's potential. The policy based on the S-T is to strictly regulate the planning for the construction of people's houses, while the W-T policy is to manage the area and carry out more promotions to invite investors. Strategies that can be taken to develop cave water ecotourism based on the SWOT results include:

1. Manage cave water resources by building facilities and infrastructure to improve the local economy of the people around the cave water area.



2. Strengthening the concept of cave water ecotourism by reducing activities that do not support tourism.
3. Create strict rules regarding the prohibition of development around the cave water area.
4. Encourage business units to support cave water ecotourism and increase regional promotion of cave water tourism.

The results of the analysis show the importance of proper cave water management. The main key to cave water ecotourism on Wangi-Wangi Island is to build infrastructure and enforce strict rules. The advantage that will be obtained is the increase in the community's local economy around the area so that the existence of cave water can become an icon of new tourist attractions that are of interest in Wakatobi. The final result is that cave water ecotourism can develop as water conservation areas for the surrounding area. Konservasi sumber daya air goa melalui pengelolaan ekowisata yang berhasil merupakan usaha yang dapat dilakukan untuk berusaha menjaga kelestarian sumber daya air gua sehingga fungsi air goa dapat optimal sebagai pencegah banjir dan keekringan. Mengingat besarnya potensi air gua sebagai pemasok air utama untuk domestik di Pulau Wangi-Wangi. Maka kelestarian kawasan sangat penting untuk terus dipertahankan. Berdasarkan data potensi sumber daya air gua dari kantor daerah diketahui bahwa air gua telah melayani 1856 Rumah tangga di Pulau Wangi-Wangi. Lebih jelas dapat dilihat berdasarkan tabel 4 Potential of cave water in the Wangi-Wangi Island service area

Table 4. Potential of cave water in the Wangi-Wangi Island service area (Source: RISPAM Wakatobi Regency 2015-2035)

Regency	Water Capacity		SR Number	Service Area
	Water Source	Usage Lit/det		
Wangi-Wangi Island	Wa Gehe-Gehe	40	1824	Wanci and Mandate
South Wangi-Wangi	Te'e liya	10	750	Liya and surrounding area
	Te'e bete	55	1856	Numana and Mola, Wandoka, Sombu, Waha, Koroconowa and surrounding area

The potential of cave water is needed to be developed. Preservation of cave water resources through ecotourism management is an action to optimize the function of the existence of cave water. The community used of the potential of cave water resources for a variety of purposes. Floods and droughts can be mitigated using cave water related to disaster mitigation. During the rainy season, the cave water serves as a natural infiltration well, collecting large amounts of rain water in a concentrated flow pattern at the cave water point. During the rainy season, the cave water will appear cloudy. The morphological condition of the cave water at *Ufe Lesa'a*, *Ufe Topa Wanci*, *Ufe Te'e A* and *Ufe Te'ea* is lower than other locations, automatically bringing water to the cave water. Interview with the community member stated that:

*"Aram beaka te ane nu ufe Topa ke Lesa'a na amura ta banjiri mo antaeda sabaneeke na ufe mina di gunu iso no mai kuaana, maka uka te kita di kota ana rata-rata tesumee mo laa jari mbeamo na salah nu ufe."* (Interview with Traditional Leaders and community's, 2021).

"If it were not for the water from the *Les'a'a* caves, *Ufe Endapo* and *Topa cave* waters, our area might be prone to flooding because all the water, even from the mountains, ends up in cave water, and the average community already uses cement to build houses and level the yard" Interview with Traditional Leaders and community's, 2021.

The community's gratitude for cave water's existence as a flood prevention strategy in urban areas is expressed through conservation programs. In the recent decade, urban housing development has increased in line with the people's water needs. The potential of cave water resources combined with local wisdom is the environmental carrying capacity that benefits the community surrounding the cave water location. The following is a map showing the distribution of cave water and slope classifications. In Figure 2 it is known that map of slope classification and cave water distribution on Wangi-Wangi Island showed that the cave water point area is in the 0-8% slope class, which is the lowest area compared to the surrounding area. The cave water is in lower condition, with the surface area functioning as the final destination for surface water flow. Therefore, the strategic urban area is very safe from flooding. The strategic position of cave water around community settlements has naturally prevented urban flooding. Moreover, the primary use of cave water resources is to mitigate drought disasters, since the cave water acts as a natural water storage capable of handling the community's household water needs. Certain cave waters remain very pure throughout the wet and dry seasons, with a reasonably constant water discharge, such as *Kontamale* cave water, *Wagehe-gehe* cave water, *Tee Ponu* cave water, *Topa Madanti*, and *Te'e Bete* cave water. Water from *Wagehe-gehe* cave is used to supply the Regional Water Company (PDAM). The direct use of cave water as a supply of raw water for residential purposes demonstrates how critical cave water is to the welfare of the Wangi-Wangi Island. Maintaining and protecting cave water is a vital activity to take, despite the scale of its benefits and functions. The need of appropriate cave water management is a great strategy to challenge conservation in the case of potential flood and drought disasters. Having access to water is critical to life because it is used in many things. Only 1824 houses are provided by PDAM from this water, with service regions including Wanci and Mandati (urban strategic areas).

In addition to having a PDAM to fulfill the demands of the local community, the community around the location manages cave water by building a water pump machine that pumps water through pipes to people's homes. A number of water machines have been constructed around *Te'e Ponu* cave water, while activities for bathing, washing, and latrines (MCK) continue in the same location. According to the findings of community interviews, the quality of the cave water will not decrease. The water quality in this location has remained consistent for a long period of time. Since ancient times, the community has relied on cave water resources to support the household water needs. The cave water is referred to as *Ufe/Topa* by the locals. The water source comes from ground water from the hill area. The PDAM's cave water usage system is designed to deliver water to people's houses through iron pipes, although some of the cave water is unsuitable for human consumption and should be used just for bathing, washing, and cleaning, and water rain is collected in earthen jars and profile tanks. The increase and decrease of sea levels has an effect on the groundwater levels throughout the Wangi-Wangi islands. Along with the groundwater from the hills and the rainwater that is absorbed, there is also some well water, but not a lot.



Figure 7. Utilization of cave water managed by local companies (PDAM) and the community  
 (a) Topa Wanci cave water pipe, (b) community water machine in Te'ea cave water (c) PDAM water management house,  
 (d) PDAM water machine and (e) PDAM regional water company piping system (Source of research, 2021)

The number served by PDAM in Wakatobi Regency is 30,750 people or 26.84% of the total population of 114,550 people. PDAMs have attempted to expand service coverage by submitting funding proposals to local and central governments to finance the addition of the main (tertiary) pipeline network, particularly the sub-district capital, by utilizing stalled installed capacity, increasing service hours, reducing leakage rates, planning the procurement of master meters and zone meters, and adding water storage installations (reservoirs). The level of SPAM water consumption in Wakatobi Regency is generally 7.32 m<sup>3</sup>/year and the average consumption per person per day is 56.99 liters/person/day. As one of the cave waters managed by the PDAM of Wakatobi Regency, the *Wa Gehe-Gehe* cave has a high-water potential.

Ensuring that the cave water is always sustainable is critical for sustainability and achieving water fulfillment in the archipelago. *Wa Gehe-Gehe* cave water refers to cave water that the government previously used to fulfill regional clean water needs. However, many residents in the area continue to dig wells around their homes rather than constructing PDAM water systems. The direct use of cave water as a source of raw water to meet domestic needs is clear evidence that the existence of cave water is very important for the welfare of the people of Wangi-Wangi Island. Knowing the magnitude of the benefits and functions of the existence of cave water, maintaining and preserving cave water is an urgent action to take. The importance of good cave water management through ecotourism management is a strategic step for cave water conservation so that it can continue to be optimal naturally as a flood and drought prevention.

## CONCLUSION

The field data findings expanded our understanding of the critical role of cave water in meeting community requirements, sustaining and preventing floods and droughts on Wakatobi Island. Therefore, the sustainability of water resources is very necessary. Also, the preservation of local wisdoms serves as a regulatory system for sustainable water management. Ecological values, prohibitions, balance, and sustainability achieved by applying local wisdom that contribute significantly to prevent natural disasters. Although the government has not implemented an official management system for cave water, the community has strictly regulated and committed to the local wisdom values. There are 3 different types of community local wisdom involving cave water conservation, namely: 1) *Ufe Karia*, using *Lesa'a* cave water and *Lia Bete* cave to support *Karia* tradition that belief the cave water as a healer and a repellent against evil/bad luck. 2) *Imaeka* is the public belief about a guard that feared people to keep the cave water clear. 3) *Sala piara* is interpreted an action that should not be taken because it could disturb the cave water. Conservation is created when the community recognizes the value of cave water, allowing the environment to continue functioning optimally and preventing floods and droughts.

The results showed that cave water was used by the community for various purposes, such as for public bathing, washing clothes, and besides that, it was used as a water source to meet domestic water needs on Wangi-Wangi Island. The cave water resources on Wangi-Wangi Island have the potential for developing cave water ecotourism. Also, cave water is essential because it functions as a flood disaster control system in strategic urban areas. However, the use of cave water has not been appropriately managed. It is necessary to carry out management based on cave water zoning so that its use can be grouped. The SWOT analysis results show that cave water has the potential to be developed as sustainable ecotourism to improve the local economy of the people around the area and as water conservation on Wangi-Wangi Island.

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