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The Local Wisdom of Tuk Serco in Protecting Water Sources to Mitigate the Impacts of Climate Change in Kendal Regency

Endah Septiani, Dewi Liesnoor Setyowati*, Juhadi Juhadi, Fadly Husain, Apik Budi Santoso

Faculty of Social Science and Politic, Universitas Negeri Semarang, 50229 Semarang, Indonesia

* Correspondence: Dewi Liesnoor Setyowati (liesnoor2015@mail.unnes.ac.id)

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Abstract: The community of Ngijo Hamlet, Purwogondo Village, Boja District, Kendal Regency, possesses the local wisdom of Tuk Serco to clean water channels and sustain springs. This study aims to (1) describe the local wisdom of Tuk Serco in maintaining springs, (2) identify community behaviours associated with Tuk Serco's local wisdom in addressing climate change impacts, and (3) analyse the role of Tuk Serco's local wisdom in mitigating climate change effects. A qualitative method was employed, utilizing in-depth interviews, observations, and documentation. Data were analysed using NVIVO 12 Plus software. The findings indicate that the Tuk Serco spring is a vital resource for the community. Rituals and norms, including prohibitions and recommendations, are strictly followed to ensure the sustainability of the spring. The most prevalent community behaviour related to Tuk Serco's local wisdom is adherence to norms, particularly the Nyadran Serco tradition. Elements of local wisdom (knowledge, values, ethics, morals, and norms) play a significant role in climate change mitigation, with norms having the greatest impact. The local wisdom of Ngijo Hamlet serves as a concrete example of how traditional values can synergize with modern conservation efforts to mitigate climate change effects.

Keywords: Local wisdom; Tuk Serco; Water sources; Mitigate; Climate change

1 Introduction

Climate change has long-term consequences for society. According to the IPCC [1, 2] there is a correlation between social dynamics and climate patterns on Earth. Since 1850, the world has experienced 12 of the hottest years on record, with increasingly severe consequences, such as a rise in natural disasters in coastal areas [3–5]. Flooding, droughts, landslides, and coastal erosion threaten communities due to climate change.

Defined as significant changes in climate or climatic variability persisting for at least a decade, climate change arises from both internal and external factors [6]. The attribution of responsibility remains a key aspect, as some view climate change as a natural phenomenon, while others emphasize the role of human-induced environmental degradation. This perception influences the extent to which individuals believe climate change can be controlled [7].

Natural disasters are exacerbated by climate change, as shown by the International Disaster Database, which records 345 global disasters, 60% of which result from extreme climate events such as floods, droughts, forest fires, storms, and landslides. While public understanding of climate change remains limited, communities reliant on natural conditions, such as farmers, are the most vulnerable to its effects [8].

The phenomenon of climate change is having an increasingly worse impact on Indonesia's coastal areas [9–11]. The nickname of a maritime country with more than 17,000 islands. This title brings up the negative side, namely the threat and danger to coastal disasters. Floods and tidal floods or the entry of sea water into the land due to the influence of the ebb and flow of sea water, have recently become serious problems in coastal areas of Indonesia. Floods and tidal floods make the affected areas into slums because the infrastructure and public facilities are not functioning.

Kendal Regency, which is located right on the coast of the North Coast of Java, is one of the regencies that has often been hit by coastal disasters over the past 5 years. The disaster that hit the coastal area of the North Coast of Java was tidal flooding which was influenced by two factors, namely sea level rise and land subsidence. In addition, Kendal Regency is one of 112 coastal areas that are threatened with sinking. The impacts of flooding and tidal

flooding in the Kendal Regency River Basin Area include inundation in settlements, hundreds of hectares of ponds experiencing crop failure, and disruption to access to the Pantura road [12].

Previous research shows that the area on the North Coast of Kendal Regency experienced the highest subsidence compared to other areas, namely above 2.4 cm/year, which includes Kaliwungu, Kendal, Brangsong, Patebon, Kangkung, and Cepiring Districts [13]. In terms of sea level rise, Kendal Regency also showed the highest increase in 2020 of 191.56 cm [14]. Seeing this phenomenon, Kendal Regency has vulnerabilities, dangers, and risks from tidal floods, one of which is in the social aspect. In 2023, based on the report of the Kendal Regency BPBD, 70 heads of families were affected by tidal floods with a water height of 10-50 cm [12]. Another impact felt directly by the community is the disruption of school activities and events, services, and the economy.

The Kendal community on the North Coast of Java depends on the sea for its livelihood, so the sustainability of its marine nature must be maintained through local wisdom. Through mitigation, it can help increase public awareness and knowledge in dealing with the risks and impacts of disasters [15]. The community believes that disaster mitigation can provide benefits to reduce disaster risks [16]. Structural mitigation is a method used to minimize disasters by building buildings with engineering techniques that are resistant to disasters, water resistant, and so on [17]. Non-structural mitigation is very much based on technological developments by looking at technology that will predict, reduce, and anticipate the risk of a disaster [18]. Adaptation to climate change must be carried out immediately, otherwise the world will experience a decline in food production of up to 7% [19]. However, sustainable adaptation certainly requires high costs, for example by building irrigation, using additional production inputs, conservation measures and so on [20]. The importance of increasing understanding and resilience to disasters must be instilled in the surrounding community, especially children at an early age who still do not understand what they should do when an unexpected disaster occurs [21, 22]. The tidal flood and abrasion that come at any time make the coastal community of Kendal adapt to existing conditions.

Education is an important agent in addressing climate change issues. The United Nations Framework Convention on Climate Change (UNFCCC) gives responsibility to Parties to the Convention to conduct education and public awareness campaigns on climate change, and to ensure community participation in programs and access to information on this issue [23]. Through the perspective of Sustainable Development Goals (SDGs), local wisdom has been proven to be effective in preventing damage to environmental functions, so it needs to be explored, studied, and developed. Such as local wisdom in cultivating ratun rice which can be used to anticipate the impacts of climate change such as increasingly limited water availability [24]. There is also traditional knowledge owned by the community that has taught the Acehnese people to adapt to nature, without damaging the forest ecosystem [25].

Local wisdom is one of the things that must be considered in environmental protection and management activities. This is stated in Law No. 32 of 2009 that environmental protection and management includes planning, utilization, control, maintenance, supervision, and law enforcement where all activities related to environmental protection and management must pay attention to several things including: (1) diversity of ecological characters and functions; (2) population distribution; (3) distribution of natural resource potential; (4) local wisdom; (5) community aspirations; and (6) climate change [26].

Research on the damar repong system is not only about economics and ecology, but is also closely related to the cultural values of the Lampung community [27]. The management of damar forests is passed down from generation to generation and is part of the identity and social life of the local community. Research on the knowledge system of the Lungkak fishing community as one of the local wisdoms and social capital in managing and utilizing marine resources. The Lungkak fishing community has local wisdom in the form of a knowledge system on the management and utilization of marine resources. This knowledge system is in the form of knowledge about marine biota with economic value, knowledge about fishing spots and the position of fish houses, knowledge about the seasons (seasonal patterns and times of fish emergence), knowledge of signs in the sea and in the sky, knowledge about the socio-cultural environment, belief/belief systems [28]. Research on local wisdom in anticipating climate change in Lerep Village, West Ungaran District, Semarang Regency shows 3 (three) local wisdoms that aim to maintain food security, maintain water sources and as a form of gratitude for the community's harvest [29].

Local wisdom in the coastal area of Kendal affected by rob needs to be studied more deeply as a source of learning in order to mitigate climate change. The coastal area of Kendal has local wisdom that is in line with climate change mitigation such as sea alms, Tuk Serco clean rivers, Sea festivals, Kliwonan, and Barikan. Knowledge about the causes and impacts of climate change is still weak, Climate change education integrated in schools must include social norms and personal efficacy [30]. Recommendations that can be given by integrating local wisdom for resilience to climate change [31].

In relation to the above, it is important to explore one of the local wisdoms in Kendal Regency, namely Tuk Serco in its efforts to maintain springs as a mitigation of the impact of climate change. The objectives of this study are to 1) Describe the local wisdom of Tuk Serco in maintaining springs, 2) Identify community behavior in the local wisdom of Tuk Serco to overcome the impacts of climate change, and 3) Analyze the role of local wisdom of Tuk Serco in overcoming the impacts of climate change. Water is a priceless source of life. However, the biggest challenge we face

today is maintaining the sustainability of clean water sources so that they remain available for future generations. In various regions in Indonesia, communities have developed local wisdom that is effective in maintaining and preserving water sources. Local wisdom continues to be maintained in order to maintain the sustainability of a spring called Tuk Serco. In order for the water to continue flowing throughout time, the people of Ngijo Hamlet, Purwogondo Village, Boja District, Kendal Regency made a joint agreement that resulted in conservation wrapped in noble values that apply and are held from generation to generation and produce local wisdom. All activities are carried out to keep the Tuk Serco water flowing as a form of mitigation of the impact of climate change. Water is very much needed by humans for consumption, household needs to large-scale industrial needs. Increasing water use that is not balanced with the management of the quality and quantity of water resources will have a serious impact on environmental damage. One of them is the decline in groundwater discharge and the decline in land surface [32].

The research framework is based on the theory of local wisdom [33] which states that traditional knowledge can be used for sustainable environmental management. In addition, this study is also based on the theory of climate change adaptation and mitigation [34], which emphasizes the importance of community-based strategies to deal with climate change.

The Integrated Adaptation and Mitigation Theory [1] states that mitigation (reducing emissions) and adaptation (adjusting to the impacts of climate change) must be carried out simultaneously to effectively reduce climate risks.

In this context, community behavior structured in the Nyadran ritual and norms related to Tuk Serco is one form of mitigation based on local wisdom. This study provides a unique contribution by exploring how the local wisdom of Tuk Serco in Kendal Regency is not only a cultural tradition but also a model for community-based climate change mitigation. There are not many studies that specifically examine the role of rituals and norms in maintaining water sources and their relationship to climate change mitigation. This study also introduces a methodology that combines qualitative analysis with NVIVO 12 to map the relationship between local wisdom and climate change mitigation.

2 Methodology

This study uses a qualitative approach with a descriptive type. Qualitative research is an approach used to explore and understand the meaning associated by individuals or groups to a social or humanitarian problem [35]. The informants in this study were community leaders, local communities (traditional practitioners of Tuk Serco), and residents around Tuk Serco, Ngijo Hamlet, Purwogondo Village, Boja District, Kendal Regency. The determination of informants was carried out by purposive sampling which used several specific considerations according to the desired criteria to be able to determine the number of samples to be studied [36]. Informants in Tuk Serco are selected to ensure depth, accuracy, and diversity of perspectives, which support the analysis and interpretation of the phenomenon as a whole. To understand the phenomenon holistically, informants come from various backgrounds that represent variations in experience and understanding related to the research subject. Informants must have direct experience or deep involvement with the phenomenon being studied. The data collection technique in this study was through in-depth interviews, direct observation and documentation studies. The distribution of informants and main topics in interviews and field observations was based on. The data collection technique can be described in Table 1.

Table 1. The informant distributions

Informant	Role	Data Collection Techniques	Main Topics
Community Figure	Local wisdom keeper	In-depth interview	Knowledge, Values, Ethics and Morals, Norms
Tuk Seco User	Using Tuk Serco	In-depth interview; Observation	
Community Member	Implementing local wisdom	In-depth interview	
Residents Around Tuk Seco	Guarding Tuk Serco	In-depth interview; Observation	

2.1 Location and Subjects of the Research

This research was conducted at Tuk Serco (Serco spring) located in Ngijo Village, Boja District, Kendal Regency. The subjects in the research were ritual leaders, community members and community leaders in Ngijo Village.

The research location is in Kendal Regency which is the 20th largest regency in Central Java Province with an area of 1,002.23 km^2. Kendal Regency consists of 20 sub-districts, 266 villages, and 20 urban villages. Boja District has an area of 64.09km^2 consisting of 18 villages [37]. Purwogondo Village is one of the villages located in Boja District, which is located in the southern part of Kendal Regency. The distance of Purwogondo Village from the capital of Kendal Regency is 35 km. This village has an area of 140,863 km^2, with the potential for productive land

including plantations and forests. Ngijo Hamlet oversees 1 RW (Citizens' Association) and 2 RT (Neighborhood Association) [38].

2.2 Data Collection Techniques

Data collection techniques in this study were conducted through in-depth interviews with the surrounding community, direct observation at Tuk Serco and documentation studies at the Tuk Sero location. The relationship between data types, data collection methods, instruments used and data analysis in this study are presented in Table 2.

Table 2. Data collection techniques

Types of Data	Data Collection Techniques	Instruments	Data Analysis
Local Wisdom Tuk Serco	In-depth interview; Observation; Documentations	Interview guide; Observation guide; Documentation guide	Descriptive
Community Behavior in Local Wisdom			Descriptive NVIVO 12 plus
The Role of Local Wisdom in Mitigating Climate Change			Descriptive NVIVO 12 plus

2.3 Data Analysis

The analysis process involved thematic coding, querying to identify key patterns, and data visualization to clarify the relationship between local traditions and climate change mitigation. Data were also validated through triangulation by comparing interviews, observations, and secondary sources. Data from interviews, observations and documentation were then analyzed using NVIVO 12 Plus to find relevant patterns related to the Tuk Serco tradition with climate change. The analysis includes coding, querying and visualization and thematic analysis. The analysis flow is as follows:

• Preparing data: collecting data from interviews, observations and documentation during research in Ngijo Hamlet. Data related to Tuk Serco local wisdom, rituals and efforts made by the community.
• Preparing a new project: Tuk Serco and Climate Change.
• Importing data: separating data by type and entering transcripts.
• Coding: Main themes and sub themes.
• Main themes: Knowledge, Values, Ethics and Morals, Norms.
• Sub themes: Water, Springs, Values, Norms.
• Coding data through segments of community views on local wisdom values, climate change mitigation and the Tuk Serco ritual.
• Thematic analysis: looking for connections between the Tuk Serco ritual and climate change mitigation. Local wisdom values with ecological values.
• Creating visualizations to map relationships.
• Drawing conclusions based on the data that has been collected.

The data in this study were analyzed using thematic analysis method with the help of NVivo 12 software. The process includes: Initial coding, namely identifying the main themes from interview transcripts and observations. Code grouping, namely organizing similar codes into certain categories. Theme extraction, namely an in-depth analysis of the categories that emerge to find patterns of relationships between local wisdom and climate change mitigation. The results of this analysis clarify how local wisdom carried out by the community can contribute to climate change mitigation.

3 Result and Discussion

3.1 Description of Local Wisdom of Tuk Serco in Protecting Water Springs

Water is the most abundant substance on the earth's surface, covering almost 71% of the earth's surface. The surface area of the earth [39]. Tuk Serco is a spring located in Ngijo Hamlet, Purwogondo Village, Boja District, Kendal Regency. Based on Figure 1, the location of the Boja District land which is in the highlands uses land for plantations, rice fields and agriculture. 45% of the land is used for rice fields, 33% for agriculture and 22% for plantations [40]. Land use distribution is a crucial aspect in environmental planning and management because it affects various aspects of life, from ecosystem sustainability, climate change mitigation, to social and economic welfare of the community. The division of land can be described as follows:

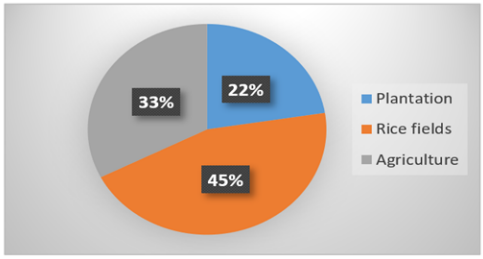

Figure 1. Land division

For the local community, Tuk Serco is not an ordinary spring. This is why Tuk Serco is maintained in a way that is 'quite different' from other springs. One of the reasons is because of the belief that has been passed down from generation to generation about Tuk Serco being able to cure various diseases such as flu, headaches, or coughs. The community believes that the benefits of bathing in Tuk Serco can make you healthy. Not only that, Tuk Serco is even believed to be able to make people who bathe there stay young. The village government has divided bathing times for children, men and women, so that residents who want to bathe in Tuk Serco do not mix.

The belief in Tuk Serco is one of the things that drives the community to continue to maintain it. The community believes that Tuk Serco has a guardian from the supernatural, so it needs to be given 'food' in the form of offerings. The community carries out movements that ensure that Tuk Serco remains sustainable. The community's movement is reflected in local wisdom that has been carried out for generations. The Tuk Serco spring, which never recedes, is always maintained by the surrounding community because of its special qualities. Special springs certainly need to be maintained according to their characteristics. Here is a picture of the Tuk Serco spring:

Figure 2. The Tuk Serco spring

Based on Figure 2 the water flow is channeled through 2 pipes to make it easy to distribute. Tuk Serco is a spring that never runs out, has a discharge of 12.03 lt/sec, or 1,039,392 lt/day. Tuk Serco is used for household needs of 106 families/351 people and irrigation of 5.75 hectares of rice fields in Ngijo Hamlet 527,126.4 liters (50.71%). The remaining 512,265.6 liters (49.29%) water flow [41]. The following is a diagram of the use of Tuk Serco by the community:

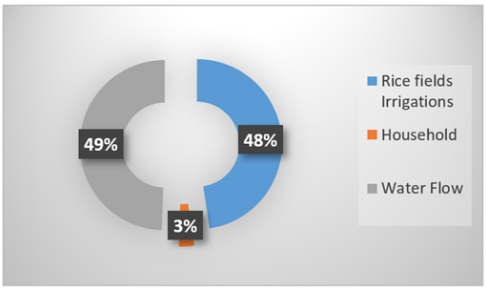

Figure 3. Distribution of Tuk Serco

Nowadays, Tuk Serco is used more dominantly for household needs, especially for drinking water as shown in Figure 3. This is related to the spring that has been channeled to the residential area. According to local residents

(informant 1), the spring has appeared since ancient times until now it has never receded. Even when entering the dry season when the water flow in this area begins to shrink, the Tuk Serco discharge continues to flow rapidly. The Tuk Serco water flow remains strong, making it a mainstay for the clean water needs of residents, public facilities, and irrigation of local agricultural land. In the past, residents took water by lifting it using buckets. In order to ensure fair water distribution, the community made rules for dividing the water flow involving community leaders and joint supervision by land owners. The village government created a water distribution system from Tuk Serco with flow from pipes. Pipes from Tuk Serco are collected in several containers to facilitate flow to residents. This distribution system makes it easier for residents, as well as an effort to implement the value of justice in utilizing water. The Figure 4 shows the distribution of water.

Figure 4. Water flow distribution of Tuk Serco

Meanwhile, springs in Semarang City concentrated in Gunungpati District are threatened by massive urbanization and development. They need to be preserved through a comprehensive strategy based on existing conditions [42]. As in Kampung Naga, there is a water utilization pattern that follows the spatial planning pattern of the Kampung Naga village area with the concept of water conservation with forest conservation [39].

Therefore, efforts to preserve the Tuk Serco spring continue to be carried out by planting several types of hard plants such as petai, durian, melinjo, and sengon trees in the land around the spring. Hard plants are chosen because their roots are able to bind and store water. Not only planting, the community also makes an agreement regarding the criteria or requirements for trees that can be cut down. For example, the height of the tree trunk is more than 30 meters, the diameter of the trunk is more than 80 centimeters, and the age of the tree is over four years. Every tree trunk that has been cut down must be replaced, namely seedlings from similar plants to be replanted [43]. The community makes a strict agreement regarding the criteria for trees that can be cut down and their replacements must be replanted, maintaining the balance of the spring ecosystem.

The local wisdom of the Purwogondo Village community consists of: 1) Community knowledge, in the form of titen science. 2) Values: values of togetherness, obedience, consensus, justice, and concern. 3) Ethics and morals: manifested in environmentally wise attitudes and behavior, polite, morally responsible for the existence and sustainability of Tuk Serco, not damaging, not threatening the existence of Tuk Serco. The community realizes that Tuk Serco and all its contents are fellow creatures of God who must be appreciated and respected. 4) Norms, in the form of: recommendations, prohibitions, sanctions, and expression [44]. Local wisdom plays an important role in maintaining ecosystem balance and supporting environmental sustainability. Traditional knowledge passed down from generation to generation often reflects adaptive practices to local environmental conditions.

The norms that must be adhered to at the Tuk Serco spring can be seen in Table 3.

Table 3. Norms at Tuk Serco

Recommendations	Prohibitions
Holding a ritual at Tuk Serco	Buildings are not permitted around springs
Caring for the environment around the spring	It is not permissible to channel water over springs
Making offerings at the spring	Do not wash kitchen utensils that contain soot
Leaving the spring in its natural condition	Do not change points around springs
Making offerings sincerely	Do not take objects from the spring

Residents are also prohibited from cleaning eating utensils and kitchen utensils in the spring pool because it can pollute the environment. They are also prohibited from building either permanent or semi-permanent buildings

around the water flow. Recommendations and prohibitions have been passed down from generation to generation so that they are obeyed by the surrounding community.

3.2 Behavior of the Ngijo Hamlet Community in Local Wisdom Tuk Serco for Climate Change Mitigation

The Ngijo Hamlet community has a hereditary tradition in maintaining the Tuk Serco spring. The local wisdom they have can be described in the following Table 4.

Table 4. Local wisdom of Tuk Serco

Elements of Local Wisdom	Descriptions
Knowledge	Titen Science
Value	Togetherness, obedience, consensus, justice, and concern
Ethics and Morals	Environmentally wise, polite, responsible
Norm	Suggestions, prohibitions, sanctions, and expressions

• Knowledge

The Titen science is owned by the community around Tuk Serco. Titen in Indonesian is a reminder of things that can be a guideline for life. The community believes that in the dry season the water discharge of Tuk Serco is getting faster, while in the rainy season the discharge is smaller. This provides balance for the earth so that drought and flooding do not occur. The Titen science related to Tuk Serco is by giving offerings when holding a celebration, such as circumcision and marriage. Offerings in the form of ingkung, bananas and parts of a cow that are cooked for the celebration. This is believed to be able to provide smoothness during the celebration.

Since the beginning, local traditions in Indonesia, especially Java, can be considered as religious traditions, but in a simple form. The community in Indonesia is very strong in practicing religion and magical institutions because they think that they will receive the curse and disaster of their ancestors if they violate it [45].

• Value

The values that are always upheld by the people of Ngijo Hamlet, Purwogondo Village, Boja District are very much implemented. The location in the countryside makes the community highly uphold the value of togetherness with the surrounding residents. Comply with the rules that have been set. Utilize deliberation in reaching consensus or agreement. Be fair to the surrounding residents, including being fair in the distribution of Tuk Serco. The value of caring is seen during mutual cooperation activities, sambatan, and helping local residents.

• Ethic and Morals

The community's actions are in line with existing norms. It can be seen that the community members are very polite and courteous in receiving guests from outside. The residents are also responsible for maintaining Tuk Sero by routinely cleaning the area. An environmentally friendly attitude can also be seen from the willingness of the residents to voluntarily maintain the area around Tuk Serco, as in the Figure 5.

Figure 5. Mr. Suhadi maintaining the Tuk Serco area

According to him, the act of caring for Tuk Serco was based on his gratitude for the spring that never dries up and flows through the village.

• Norms

One form of community norms is expressions such as, if we protect nature, then nature will give us good things. Indigenous peoples identify themselves as an integrated part of the universe in an interrelated, dependent, and mutually influencing relationship, therefore it is very important to create harmony, a harmonious and balanced relationship to achieve a harmonious atmosphere between humans and their environment.

There are also prohibitions, such as not building permanent buildings. According to informants, there was once a resident who wanted to build a fence around Tuk Serco resulting in the death of the resident. This shows that if human behavior becomes greedy, disrupts the balance of nature and is not in harmony with the rhythm of nature, there will be disturbances of disharmony and turmoil in the universe in the form of natural disasters, pandemic diseases, floods, droughts and landslides as a form of anger of the guardian spirit of nature. This mindset gives rise to a careful, responsible attitude and sustainable management of natural resources [46].

The recommendation is for the community to perform the Nyadran ritual, which is to hold a prayer while bringing offerings. Through their prayers, they ask the Creator that Tuk Serco will always flow water for the surrounding community. The ritual carried out at the Tuk Serco spring consists of residents of RT 1, 2 and 3 with RW 3. The last ritual was carried out in September 2024. At 05.30 the community flocked to Tuk Serco bringing cleaning tools. The residents cleaned the area around Tuk Serco such as the footpath, land and trees. At 08.30 the community brought offerings to the spring, such as ingkung chicken, agricultural products, tumpeng rice, fruits, usually bananas. The ingkung chicken that was brought was a lot because according to the residents' beliefs, the children of the Tuk Serco residents were many so they needed to be given offerings evenly. The ingkung chicken was brought by the Village Head, Carik, and village elders. The ritual began with a prayer for all the gifts of the spring that never stopped. The prayer was led by a village elder named Mbah Soleh, then continued with cleaning the water channels, the environment around the spring and the pipes. The ritual ended with a meal together, as shown in the Figure 6.

Figure 6. Eating together after Nyadran Tuk Serco

Routinely, the community maintains the channels and PVC pipes that carry Tuk Serco water and monitors the condition of the hill forest behind the village, which is the water supply barn for Tuk Serco. All of this is done voluntarily with full awareness of the importance of maintaining water resources for their survival. The community does this voluntarily because they do not want to lose the great benefits of this special spring. This traditional ceremony is the result of acculturation between religion and local culture, that religion is a cultural system [47]. Community behavior in maintaining local wisdom of Tuk Serco after being analyzed using NVIVO 12, produced the following pattern (see Figure 7).

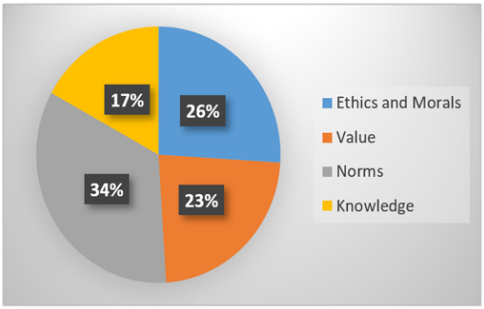

Figure 7. Community behavior in elements of local wisdom

Norms that contain traditions are the most common behaviors carried out by the community in large numbers. The Nyadran Tuk Serco tradition is carried out by the majority of the community because it has been passed down from generation to generation. Knowledge such as titen science is also carried out by the community, but when they are going to hold a celebration. Ethics and morals such as environmental wisdom are also carried out but not all do it simultaneously, such as Mr. Suhadi who routinely maintains the environment around Tuk Serco. The values of togetherness, obedience and consensus are also carried out by residents, but are not too related to the preservation of the Tuk Serco spring.

3.3 The Role of local Wisdom for Tuk Serco in Mitigating Climate Change

Tuk Serco's local wisdom has an impact on climate change mitigation in the Purwogondo area. Although most of the community does not know what is meant by climate change, the behavior they have carried out so far is in line with climate change mitigation. Existing local wisdom can be used as an effort to protect the environment [48, 49]. The community has not been aware of the impact of climate change, because the people of Purwogondo Village have never been affected by floods, abrasion or drought. Although in fact the community must be prepared for the impact of climate change, because they live on earth full of uncertainty [50].

Elements of local wisdom that have an impact on climate change mitigation can be described as follows:

• Knowledge

The knowledge possessed by the Purwogondo Village community lies in the science of titen about the arrival of the rainy and dry seasons. During the dry season, the Tuk Serco discharge increases to maintain the community's water needs so that it does not experience drought. During the rainy season, the water discharge actually decreases, preventing flooding and landslides. The traditional knowledge of indigenous and local communities provides local adaptation strategies in responding to global climate change. However, in the context of the impact of climate change on indigenous and local communities around the world, local adaptation strategies in different regions also contain a global perspective [51].

• Values

The value upheld by the community is that the Tuk Serco spring is a special spring that protects the village. This value gives rise to the values of togetherness, justice, mutual cooperation and consensus. In relation to climate change mitigation, strong values move the community to continue to care for the Tuk Serco spring so that it does not run out.

• Ethics and Morals

Actions related to climate change mitigation can be seen from local residents cleaning the Tuk Serco area regularly, even voluntarily.

• Norms

Among the elements of local wisdom believed by the Purwogondo community, it consists of knowledge, values, ethics and morals and norms. The belief that protecting nature is part of a moral and spiritual responsibility drives sustainable conservation practices. The existence of customary prohibitions against environmental destruction, such as cutting down trees indiscriminately or fishing in destructive ways, provides strong social control in maintaining the ecosystem. Customary rules governing the use of springs help prevent over-exploitation and maintain the balance of the ecosystem.

After being analyzed using NVIVO 12 Plus, the elements that have the most impact on climate change mitigation are as shown in Figure 8.

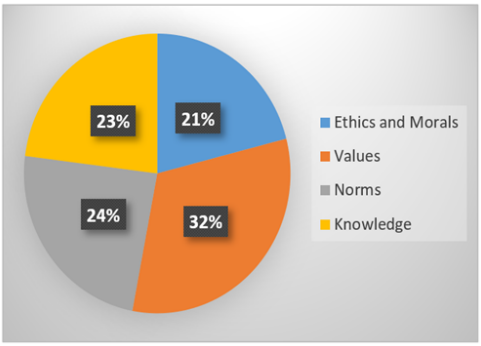

Figure 8. The impact of local wisdom elements on climate change mitigation

The most influential element of local wisdom in mitigating climate change is the values believed by the community. The community's values and beliefs in the existence of Tuk Serco as a gift from God that moves residents to continue to preserve Tuk Serco.

The results of the study indicate that the social norms applied in the Purwogondo Village community are in line with the community-based mitigation theory. For example, the prohibition of polluting water sources and the obligation to participate in cleansing rituals have a direct effect on water conservation and adaptation to climate change. In addition, the behavior and norms observed in the Tuk Serco tradition are compared with the climate change mitigation theory to show their alignment and differences.

Relevance to the Climate Change Mitigation Theory includes the Tuk Serco local wisdom which emphasizes the importance of maintaining the cleanliness of springs and carrying out cleansing rituals in line with the concept of

climate change mitigation which emphasizes the conservation of natural resources. In addition, the collective role of the community in maintaining Tuk Serco reflects a community-based mitigation approach that emphasizes the active involvement of the community in environmental management. Practices such as planting trees around springs to maintain water discharge are in line with ecosystem-based mitigation strategies that emphasize the importance of vegetation in water conservation.

However, there are also differences in principle with the Climate Change Mitigation Theory, namely the Tuk Serco Tradition is more based on spiritual and customary values, while climate change mitigation in scientific studies emphasizes a data-based and technology-based approach. Although communities implement conservation measures, their awareness of climate change as a global phenomenon is still limited. Unlike scientific mitigation strategies that are often supported by quantitative data, the effectiveness of Tuk Serco-based mitigation has not been systematically measured.

4 Conclusions

The people of Ngijo Hamlet, Purwogondo Village, Boja District, Kendal Regency, see Tuk Serco as more than just a spring that flows to the residents. Furthermore, Tuk Serco has local wisdom that has been passed down from generation to generation. Through real actions and shared commitment, the Ngijo community has succeeded in preserving one of the most vital resources for life: water. Through local wisdom, we can learn a lot about how to preserve water resources in a way that is in harmony with nature and local culture. Let's work together to protect and preserve our clean water sources for a better future. Protecting clean water sources with local wisdom is a sustainable solution that has been proven effective in various regions in Indonesia. By adopting and supporting these practices, we not only preserve the environment but also ensure the availability of clean water for future generations. Let's move together towards a greener and more sustainable future. This research makes significant contributions in the fields of education, environment, and socio-culture.

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Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] T. Oakes, "Asia," in *International Encyclopedia of Human Geography*, 2009, pp. 214–219. https://doi.org/10.1016/B978-008044910-4.00250-9

[2] J. Vieira, S. L. Castro, and A. S. Souza, "Psychological barriers moderate the attitude-behavior gap for climate change," *PLoS One*, vol. 18, no. 7, p. e0287404, 2023. https://doi.org/10.1371/journal.pone.0287404

[3] Dinas Lingkungan Hidup dan Kehutanan Kabupaten Buleleng, "Perubahan iklim. (climate change)," 2019. https://dlh.bulelengkab.go.id/informasi/detail/artikel/perubahan-iklim-climate-change-32

[4] B. Neumann, A. T. Vafeidis, J. Zimmermann, and R. J. Nicholls, "Future coastal population growth and exposure to sea-level rise and coastal flooding—A global assessment," *PLoS One*, vol. 10, no. 3, p. e0118571, 2015. https://doi.org/10.1371/journal.pone.0118571

[5] G. Griggs and B. G. Reguero, "Coastal adaptation to climate change and sea-level rise," *Water*, vol. 13, no. 16, p. 2151, 2021. https://doi.org/10.3390/w13162151

[6] D. S. A. P. M. Baede, E. Ahlonsou, and Y. Ding, "The climate system: An overview," in *Climate Change 2001: Impacts, Adaptation and Vulnerability*, 2001, pp. 87–98.

[7] H. C. Haryanto and S. A. Prahara, "Perubahan iklim, siapa yang bertanggung jawab?" *Insight: J. Ilm. Psikol.*, vol. 21, no. 2, pp. 50–61, 2019. https://doi.org/10.26486/psikologi.v21i2.811

[8] D. Nurhayati, Y. Dhokhikah, and M. Mandala, "Persepsi dan strategi adaptasi masyarakat terhadap perubahan iklim di kawasan Asia Tenggara," *J. Proteksi*, vol. 1, no. 1, pp. 39–44, 2020.

[9] M. A. Marfai, "Impact of sea level rise to coastal ecology: A case study on the northern part of Java Island, Indonesia," *Quest. Geogr.*, vol. 33, no. 1, pp. 107–114, 2014. https://doi.org/10.2478/quageo-2014-0008

[10] A. W. Hastuti, M. Nagai, and K. I. Suniada, "Coastal vulnerability assessment of Bali Province, Indonesia using remote sensing and GIS approaches," *Remote Sens.*, vol. 14, no. 17, p. 4409, 2022. https://doi.org/10.3390/rs14174409

[11] M. J. Case and E. Spector, "Climate change in indonesia implications for humans and nature," 2007. https://www.researchgate.net/publication/237325800

[12] BPBD Kendal, "Jumlah kejadian bencana 2023," 2023. https://data.kendalkab.go.id/gl/dataset/jumlah-kejadian-bencana-2023

[13] G. D. Kresteva, B. Rochaddi, and A. Satriadi, "Studi kenaikan muka air laut di perairan Kendal," *J. Oceanogr.*, vol. 3, no. 4, pp. 535–539, 2014.

[14] I. S. Kurniawan and U. Toharudin, "Pengembangan model pembelajaran biologi berorientasi etnopedagogi pada mahasiswa calon guru," *Sci. Educatia: J. Pendidik. Sains*, vol. 6, no. 1, pp. 27–35, 2017. http://doi.org/10.24235/sc.educatia.v6i1.1287

[15] Juhadi, A. Muis, and Sriyanto, "Kearifan lokal dalam mitigasi bencana," 2018. http://lib.unnes.ac.id/id/eprint/37042

[16] N. Hamid, D. L. Setyowati, J. Juhadi, A. S. Priyanto, S. Suswanti, M. A. Royyani, and E. N. Aroyandini, "Sustainable development of the coastal environment through participatory mapping of abrasion prone areas," *J. Environ. Manag. Tour.*, vol. 12, no. 5, pp. 1997–2009, 2021.

[17] M. Herlina, D. Setyowati, and J. Juhadi, "Local wisdom of repong damar for landslide mitigation in Way Krui sub-district Pesisir Barat Regency Lampung," in *Proceedings of the 5th International Conference on Science, Education and Technology*, Semarang, Central Java, Indonesia, 2020. http://doi.org/10.4108/eai.29-6-2019.2290240

[18] A. Urbanus, R. L. Sela, and A. E. Tungka, "Mitigasi bencana banjir struktural dan non-struktural di kabupaten Bolaang Mongondow Selatan," *Spasial*, vol. 8, no. 3, pp. 447–458, 2021. https://doi.org/10.35793/sp.v8i3.36350

[19] A. B. Sekaranom, E. Nurjani, and F. Nucifera, "Agricultural climate change adaptation in Kebumen, Central Java, Indonesia," *Sustainability*, vol. 13, no. 13, p. 7069, 2021. https://doi.org/10.3390/su13137069

[20] K. Abbass, M. Z. Qasim, H. Song, M. Murshed, H. Mahmood, and I. Younis, "A review of the global climate change impacts, adaptation, and sustainable mitigation measures," *Environ. Sci. Pollut. Res.*, vol. 29, pp. 42 539–42 559, 2022. https://doi.org/10.1007/s11356-022-19718-6

[21] B. Hayudityas, "Pentingnya penerapan pendidikan mitigasi bencana di sekolah untuk mengetahui kesiapsiagaan peserta didik," *J. Edukasi Nonformal*, vol. 1, no. 2, pp. 94–102, 2020.

[22] A. I. Wiluyana, J. Juhadi, T. B. Sanjoto, and W. A. B. N. Sidiq, "Pembelajaran mitigasi bencana tanah longsor dengan simulasi 3D pada siswa sekolah dasar," *Geogr. J. Kajian, Penelit. dan Pengemb. Pendidik.*, vol. 12, no. 2, pp. 817–831, 2024. https://doi.org/10.31764/geography.v12i2.24812

[23] United Nations, "Education is key to addressing climate change," 2020. https://www.un.org/en/climatechange/climate-solutions/education-key-addressing-climate-change

[24] K. Komariah, D. P. Ariyanto, S. Sumani, Y. Yanti, A. Setyawati, and R. P. W. Priswita, "Kearifan lokal padi ratun sebagai upaya mitigasi dan adaptasi perubahan iklim di desa wonosari kecamatan Gondangrejo," *SEMAR: J. IPTEKS untuk Masy.*, vol. 10, no. 1, pp. 7–12, 2021. https://doi.org/10.20961/semar.v10i1.45428

[25] H. Hairumini, D. L. Setyowati, and T. B. Sanjoto, "Kearifan lokal rumah tradisional Aceh sebagai warisan budaya untuk mitigasi bencana gempa dan tsunami," *J. Educ. Soc. Stud.*, vol. 6, no. 1, pp. 37–44, 2017.

[26] "Uu nomor 32 tahun 2009," 2009. https://peraturan.bpk.go.id/details/38771/uu-no-32-tahun-2009

[27] Juhadi, M. Herlina, B. Saifuddin, A. F., and A. Achadiyat, *Repong damar: Sistem pengelolaan sumberdaya hutan berkelanjutan di desa Way Sindi, Krui, Pesisir Barat*. Semarang: Fastindo, 2019.

[28] F. Husain, "Sistem budaya bahari komunitas nelayan Lungkak desa Tanjung Luar, Lombok Timur, Nusa Tenggara Barat," *Komunitas: Int. J. Indones. Soc. Cult.*, vol. 3, no. 1, pp. 40–50, 2011. https://doi.org/10.15294/komunitas.v3i1.4173

[29] F. Himmah, D. L. Setyowati, Juhadi, and T. Arsal, "The strategy of Lerep Village community in anticipating climate change in the context of food security," *Int. J. Res. Rev.*, vol. 7, no. 9, pp. 35–41, 2020.

[30] K. C. Busch, N. Ardoin, D. Gruehn, and K. Stevenson, "Exploring a theoretical model of climate change action for youth," *Int. J. Sci. Educ.*, vol. 41, no. 17, pp. 2389–2409, 2019. https://doi.org/10.1080/09500693.2019.1680903

[31] E. M. Douglas, K. M. Reardon, and M. C. Täger, "Participatory action research as a means of achieving ecological wisdom within climate change resiliency planning," *J. Urban Manag.*, vol. 7, no. 3, pp. 152–160, 2018. https://doi.org/10.1016/j.jum.2018.05.003

[32] D. Mulyanti, "Kearifan lokal masyarakat terhadap sumber mata air sebagai upaya konservasi dan pengelolaan sumber daya lingkungan," *Bina Huk. Lingkung.*, vol. 6, no. 3, pp. 410–424, 2022. https://doi.org/10.24970/bhl.v6i3.286

[33] K. Moore, "Hermeneutics in anthropology," *Rev. Politics*, vol. 48, no. 4, pp. 647–648, 1986. https://doi.org/10

.1017/s0034670500039802

[34] A. Mukherji, "Climate change 2023 synthesis report," 2023. https://doi.org/10.59327/ipcc/ar6-9789291691647.001

[35] J. W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications, 2009.

[36] J. W. Creswell, *Qualitative Inquiry: Choosing Among Five Traditions*, Thousand Oaks, CA, 1998.

[37] Badan Pusat Statistik Provinsi Dki Jakarta, "Berita resmi statistik," 2022. https://stream-asset.stockbit.com/stream_77741_d526390d-33a4-490d-aad3-4aa9604ab4d1_doc1.pdf

[38] Kabupaten Kendal, "Purwogondo, kec. boja kab. kendal." https://purwogondo.kendalkab.go.id/profile

[39] R. As'ari, D. Rohmat, E. Maryani, and E. Ningrum, "Management of water resource based on local wisdom: A develompment study of Kampung Naga as field laboratory of Geography Education in Tasikmalaya, West Java," *IOP Conf. Ser.: Earth Environ. Sci.*, vol. 243, no. 1, p. 012002, 2019. https://doi.org/10.1088/1755-1315/243/1/012002

[40] Kendal Regency Statistics Agency, "Kendal regency in figures 2024," 2024. https://kendalkab.bps.go.id/id/publication/2024/02/28/be45c1bdb0585a4c84e33698/kabupaten-kendal-dalam-angka-2024.html

[41] T. T. Siswadi and H. Purnaweni, "Kearifan lokal dalam melestarikan mata air. (Studi Kasus di Desa Purwogondo, Kecamatan Boja, Kabupaten Kendal)," *J. Ilmu Lingkung.*, vol. 9, no. 2, pp. 63–68, 2011. https://doi.org/10.14710/jil.9.2.63-68

[42] N. K. T. Martuti, D. L. Setyowati, M. Rahayuningsih, N. K. Dewi, W. A. B. N. Sidiq, and D. P. Mutiatari, "Springs distribution and biophysical mapping as a strategy to preserve water sources in Semarang City, Indonesia," *J. Environ. Manag. Tour.*, vol. 14, no. 1, pp. 113–125, 2023. https://doi.org/10.14505/jemt.v14.1(65).11

[43] Portal Informasi Indonesia, "Menjaga kelestarian air ala kearifan lokal kendal," 2024. https://indonesia.go.id/kategori/budaya/8283/menjaga-kelestarian-air-ala-kearifan-lokal-kendal?lang=1

[44] E. Mailani, A. Khairiyah, N. S. Pakpahan, K. Saumina, and S. E. Tarigan, "Mengeksplorasi kearifan lokal dalam pembelajaran matematika kecepatan dan debit," *J. Pendidik. Inklusif*, vol. 8, no. 3, pp. 73–80, 2024.

[45] D. N. Dewi, I. N. Kusumawardani, and A. P. Lintangsari, "Local wisdom-based stories in conserving water resources," *Local Wisdom: J. Ilm. Kaj. Kearifan Lokal*, vol. 12, no. 1, pp. 71–78, 2020. https://doi.org/10.26905/lw.v12i1.3646

[46] F. N. Hapsari, D. L. Setyowati, and P. Lestari, "Local wisdom nyadran as the social capital in "Warung Air Tirto Mulyo" community-based water management," *Int. J. Res. Rev.*, vol. 10, no. 2, pp. 216–225, 2023. https://doi.org/10.52403/ijrr.20230228

[47] C. Geertz, *Agama Jawa: Abangan, Santri, Priyayi Dalam Kebudayaan Jawa*. Komunitas Bambu, 2013.

[48] Juhadi, Pargito, and H. Tjahjono, *Repong damar sistem pengelolaan sumber daya hutan berkelanjutan pada kawasan taman nasional bukit barisan kabupaten pesisir barat lampung*. Tasikmalaya: RCI, 2024.

[49] D. L. Setyowati, P. Hardati, M. Amin, and E. Trihatmoko, "Trees spatial distribution and energy awareness to reduce net CO2 emission at Universitas Negeri Semarang campus, Indonesia," *J. Environ. Sci. Manag.*, vol. 27, no. 2, pp. 1–10, 2024. https://doi.org/10.47125/jesam/2024_2/01

[50] K. M. Norgaard, *Living in Denial: Climate Change, Emotions, and Everyday Life*. MIT Press, 2011.

[51] L. Yin and X. Zhang, "Traditional knowledge is the light of wisdom for conserving biodiversity and adapting to climate change," *Das Questoes*, vol. 10, no. 1, pp. 104–108, 2020. https://doi.org/10.26512/dasquestoes.v10i1.32550