IMPROVING PUBLIC UNDERSTANDING OF WATER RESOURCES IN TUK GEDAT THROUGH DIGITAL MAPS

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Abstract

Mount Merbabu National Park has a water source called Tuk Gedat that is used by the community of Pulihan Hamlet. The objectives of this study are 1) to describe the process of using digital maps and 2) to analyze the increase in community understanding of the Tuk Gedat water source after using digital maps. This research is quantitative, using an experimental method. The type of research is a true experimental design. The research design is a one-group pretest-posttest design. The sampling technique is non-probability sampling with a purposive sampling type, and the sample size is 20. The data collection techniques are observation, questionnaires, interviews, documentation, and pretest-posttest tests. Meanwhile, the data analysis techniques are descriptive and N-Gain tests. Research results 1) The usage process consists of a planning stage, which is to create a Digital Map media and validate the media expert with a score of 91 in the "very good" category, an implementation stage in the form of installing and socializing how to use digital maps, and an evaluation stage related to the advantages and disadvantages of the Digital Map media. 2) The increase in public understanding was measured using the N-Gain test with a score of 0.6593, indicating that public knowledge has increased and is classified as "Fairly Effective" in terms of effectiveness.

Keywords: Digital Map, Water Source, Mount Merbabu.

1. INTRODUCTION

Central Java is a region in Indonesia that has many water sources, due to its many volcanoes. One of the volcanoes that produces springs is Mount Merbabu (Elma *et al.*, 2025).

Mount Merbabu National Park (TNGMb) is a conservation area established based on the Decree of the Minister of Forestry Number: SK. 3623/Menhut-II/KUH/2014 dated May 6, 2014, concerning the Designation of the Gunung Merbabu National Park Forest Area covering 5,820.49 hectares in Semarang Regency, Boyolali Regency, and Magelang Regency, Central Java Province. Its main tasks include protecting life support systems, preserving the diversity of plant and animal species and their ecosystems, and the sustainable use of biological resources and ecosystems. Conservation areas can function as life support systems ((Mahmud *et al.*, 2025) one of which is related to water resource conservation.

Water resource conservation is important to maintain hydrological balance, prevent erosion, protect surrounding areas from flooding and landslides, and ensure sustainability (Bani *et al.*, 2026). The TNGMb area is the main source of water for communities in Magelang, Boyolali, and Semarang regencies, so there needs to be

awareness of the importance of using environmentally friendly products and maintaining the cleanliness of water sources (Nahrowi, 2025). There are 167 water sources in the TNGMb area, most of which are already being used by the community to support household water needs, irrigation, and agricultural activities (RPJP TN. Gunung Merbabu 2025-2034).

Mount Merbabu serves as a water reservoir for the surrounding community, with a number of significant springs that can refresh and revitalize the earth (Al-Fannani *et al.*, 2026). The springs in TNGMb are groundwater discharge points that emerge on the surface as flowing streams, forming water sources in the forest area.

The springs in TNGMb are locally known by the surrounding communities as “Tuk,” which is an interesting typology that gives TNGMb its own unique character. One of the springs in TNGMb is Tuk Gedat, which is used by the Pulihan hamlet in Tajuk village. This spring is preserved due to the presence of large trees that can store water reserves and have a wide canopy, which keeps the soil cool and reduces evaporation from the water source(Sari & Hidayat, 2026).

The sustainability of the ecosystem and the welfare of the communities around TNGMb are very important to consider by maintaining ecological, social, and economic functions, especially for communities that use water resour`ces, who have an obligation to maintain environmental cleanliness in order to preserve water availability for daily needs (Wahyudin *et al.*, 2026). The availability of water sources depends on the condition of forest and vegetation conservation in the Mount Merbabu area. If the mountain ecosystem is disturbed by deforestation, pollution, or forest fires, the function of the forest as a water reservoir will be threatened, which could cause a water crisis for the communities that use it. Therefore, it is important to maintain the sustainability of the ecological functions of TNGMb, especially regarding the preservation of water sources, by providing up-to-date information on water sources using modern technology to foster a sense of responsibility among water users.

The Pulihan hamlet community is highly dependent on the Tuk Gedat spring to meet their daily needs. Efforts to improve the conservation literacy of water users are essential for the sustainability of the water sources they use. However, these efforts still face various obstacles, so that to date there are no modern technology-based educational tools that provide knowledge about water source sustainability to the community, integrated with descriptive narrative data and spatial data that visualizes the location of water sources.

On the other hand, modern technological developments have made today's society more intensive in using smartphones to access various information, which is both an opportunity and a challenge for TNGMb area managers. If used wisely, smartphones can be more than just a communication tool; they can also be a persuasive educational platform. Therefore, it is necessary to transform conventional information media into a more modern form, namely Digital Maps. Informative and responsive Digital Maps on various types of devices will make it easier for the public

to access spatial data and attributes of the Tuk Gedat water source in real-time, efficiently, and increase conservation awareness (Zahara *et al.*, 2026).

This digital map containing information on the Tuk Gedat water source is innovative, as there has been no similar media created or implemented in the TNGMb region before. The innovation of digital map media related to water sources is a first in TNGMb, combining technical mapping and forestry data with user-friendly technology for water users. Through the use of this technology, it is hoped that there will be a stronger awareness among the community to preserve the Tuk Gedat water source, while also serving as an initial step towards the digitization of conservation, particularly for other water sources in the TNGMb area.

2. METHODOLOGY

This study is quantitative research using an experimental method. The type of research is a true experimental design, which involves a measurement group using a pretest before treatment and a posttest after treatment (Selvira & Albina, 2025). The research design is a one-group pretest-posttest design consisting of the Pulihan Hamlet community, the head of the Air Dharma Tirta group, the head of Pulihan Hamlet, and the Masyarakt Peduli Api (MPA).

The sampling technique used was non-probability sampling with purposive sampling, which is sampling based on certain criteria, such as people living in Pulihan Hamlet who frequently use water sources, the head of Dharma Tirta as a stakeholder related to the Tuk Gedat spring, the head of Pulihan Hamlet, and the Fire Awareness Community (MPA). Thus, a total of 20 people were sampled in this study.

The data collection techniques used were observation by visiting the research location, questionnaires to determine the community's response after using the product, interviews with stakeholders to gather information related to the Tuk Gedat water source, documentation by collecting Water Utilization Permit (IPA) decrees, and pretest and posttest to determine the effectiveness of the product. Meanwhile, the data analysis techniques used to explain the research results were descriptive and N-Gain tests to determine the level of media effectiveness.

The N-Gain test is used to provide data related to the results of pre-tests and post-tests that have been conducted on the community, showing a significant increase or decrease in value. A medium can be said to be effective if it shows a tendency for post-test scores to increase (Budiati *et al.*, 2024). The N-Gain test formula is as follows.

$$N - Gain = \frac{posttest\ score\ -\ pretest\ score}{ideal\ score\ -\ pretest\ score}$$

After obtaining the N-Gain value, it is then interpreted based on the following N-Gain criteria table.

Table 1. N-Gain Score Categories

N-Gain Value	Criteria
N-Gain ≥ 0.7	High
0.3 ≥ N-Gain > 0.7	Medium
N-Gain > 0.3	Low

(Source : Hake, 1999)

The N-Gain score categories in percentage form are as follows.

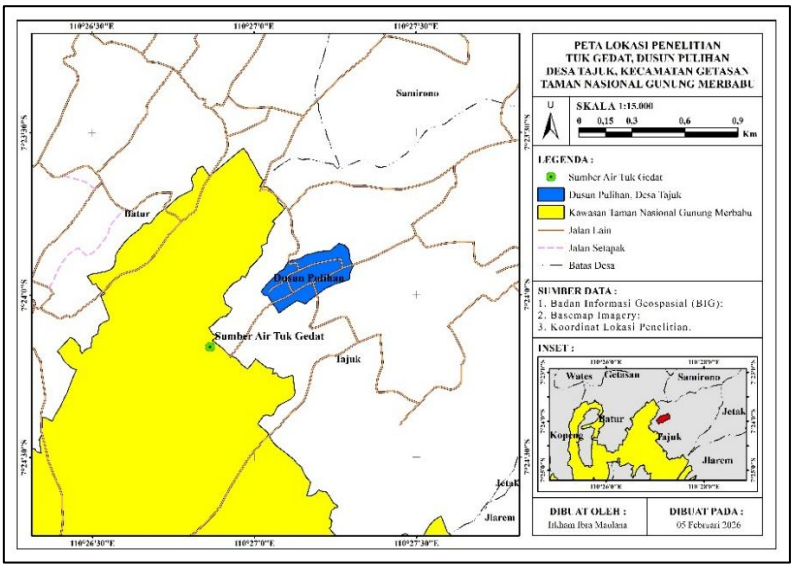
Table 2. Interpretation Category Effectiveness Level

N-Gain Percentage	Criteria
<40	Ineffective
40-50	Less Effective
50-75	Moderately Effective
>76	Effective

(Source : Hake, 1999)

The research location is in Pulihan Hamlet, Tajuk Village, Getasan Subdistrict, Semarang Regency. Astronomically, the Tuk Gedat spring in Pulihan Hamlet is located at coordinates 7º24'09.6'' south latitude and 110º26'51.8'' east longitude. The research location can be seen on the following map.

Figure 1. Location Map of Research



(Source : Research Data Processing, 2026)

3. FINDINGS AND DISCUSSION

3.1 Process of Using Digital Map Media

The process of using digital maps is divided into three stages: planning, implementation, and evaluation.

1. Planning Stage

The planning stage involves compiling digital maps in the form of QR codes, which are then posted on information boards created using the Canva editing platform and digital maps using Google My Maps, incorporating all valid spatial data and attributes obtained from interviews. The information boards will be made of materials that are durable in the natural environment. After the information boards are made, the researchers will create digital map-based media using Google My Maps, starting by determining the coordinates of water sources and the boundaries of the area needed to make the map clearer and more specific. Next, the researchers will enter all attribute data into the coordinates that have been compiled. The researchers also created symbols related to important locations around the water source so that the community could find out the location of the Tuk Gedat water source in detail based on its geographical location. The digital map was then turned into a link that was converted into a QR Code and attached to the Information Board so that it could be accessed by the general public.

After the board creation process was complete, the researchers then conducted expert validation to determine whether the media was suitable for use or needed improvement. The indicators used for expert validation were sourced from (Aprianto & Wahyudin, 2023), and the results were as follows.

Table 3. Media Expert Validation Results

No	Classification	Number
1	Total Questionnaire Score	73
2	Maximum Score	80
3	Descriptive Percentage	91
	Criteria	**Very Good**

(Source : Research Data Processing, 2026)

Based on the table, it is known that the score obtained for media expert validation is 91 and is classified as “very good.” However, the researcher noted that efforts to preserve the Tuk Gedat spring should be added from other sources so that public knowledge can be increased by presenting several sources.

1. Implementation Stage

The implementation phase began with installing digital map media in the field and conducting outreach to the community regarding the function and use of digital maps. The media was installed by digging a sufficient amount of soil so that the information board poles could be firmly embedded, and the installation was also determined in areas around water sources that were clearly visible and not covered by vegetation. The socialization focused on the Dharma Tirta water user group and the Pulihan Hamlet water user community regarding the functions and how to use digital maps by scanning the QR Code on the information board. This implementation stage was carried out directly with the water user group and the Pulihan Hamlet

community with the aim of answering questions or addressing obstacles faced by the community directly so that they could be guided step by step in trying to scan the QR Code.

Figure 2. Installation of Information Media and Socialization of Digital Map Use

(Source : Research Data Processing, 2026)

2. Evaluation Stage

The use of digital maps as a medium to increase public knowledge has the advantage of making it easier for the public to access information related to conservation efforts and the wise use of the Tuk Gedat water source, as it can be accessed anywhere and anytime. This medium is also efficient and free of charge. The use of QR codes on digital maps can attract the public because of their unique form and the fact that there has never been any similar socialization related to the use of QR codes.

In addition to its advantages, digital maps also have disadvantages, such as the need to access them using the internet, which makes them difficult to access for people who do not have internet data. Digital maps are a new medium, so during the implementation process, researchers need to repeatedly explain to the community how to use them.

3.2 Increasing Public Awareness of the Tuk Gedat Water Source

The increase in public understanding can be measured through media effectiveness testing, which refers to the effectiveness indicators according to (Zhafirah *et al.*, 2021), namely the n-gain test, which shows an increase in public knowledge. The researchers distributed a test sheet consisting of 10 questions to 20 samples. The pretest questions were given before the use of the Digital Map media to determine public understanding of the Tuk Gedat water source. Next, the public was given treatment related to the use of the Digital Map, the use of features, and explanations of the information contained in the Digital Map. Next, the researchers gave post-test questions to the respondents to determine the level of community

understanding after being given treatment using the Digital Map media. The results of the pretest score tabulation can be seen as follows.

Table 4. Pre-test Score Data

No	Interval	Criteria	Frequency	Percentage
1	81-100	Very High	0	0%
2	61-80	High	1	5%
3	41-60	Moderate	11	55%
4	21-40	Low	8	40%
5	<= 20	Very Low	0	0%
Number			**20**	**100%**

(Source : Research Data Processing, 2026)

Based on the table, it is known that before being given treatment using Digital Map media, the average score of the community was 41-60, with the highest score being 80 and the lowest score being 30. It can be concluded that at the pretest stage, most of the community had minimal knowledge about the Tuk Gedat water source. This had an impact on efforts to preserve the Tuk Gedat water source, resulting in a lack of public awareness about the cleanliness of the Tuk Gedat water source. Many people still dispose of agricultural waste around the area, which can affect the water source, and there is a lack of understanding about the legality of the Tuk Gedat water source. This is in line with the research conducted by (Ramadhanu *et al.*, 2025) which found that low pretest results indicate low public knowledge.

Next, the researchers collected posttest data after providing treatment to the community using Digital Maps, resulting in the following results.

Table 5. Post-test Score Data

No	Interval	Criteria	Frequency	Percentage
1	81-100	Very High	10	50%
2	61-80	High	8	40%
3	41-60	Moderate	2	10%
4	21-40	Low	0	0%
5	<= 20	Very Low	0	0%
Number			**20**	**100%**

(Source : Research Data Processing, 2026)

Based on the tabulation results, it is known that after the community received training on how to use Digital Maps and the information contained in Digital Maps, the average post-test score was 81-100, with the highest score being 100 and the lowest score being 70. Therefore, it can be concluded that in the post-test stage, the community obtained high scores on average.

It can be said that there was an increase in public knowledge regarding the Tuk Gedat spring after being given treatment using digital maps. In line with research

conducted by (Gaffar *et al.*, 2026), if there is a more significant increase in the post-test stage, then the material has been fully absorbed by the respondents.

Analisis untuk mengetahui ada atau tidaknya peningkatan pengetahuan masyarakat dilakukan dengan uji n-gain efektivitas media peta digital yang digunakan, menggunakan aplikasi SPSS sehingga diperoleh hasil sebagai berikut.

Table 6. N-Gain Score Test Results

	N	Minimum	Maximum	Mean	Std. Deviation
N-Gain Score	20	,33	1,00	,6593	,21443
N-Gain percent	20	33,33	100,00	65,9286	21,44289
Valid N (listwise)	20				

(Source : Research Data Processing, 2026)

Based on the N-Gain Effectiveness test results table, the N-Gain value obtained from 10 pretest and posttest questions distributed to 20 samples is 0.6593 with an N-Gain category of Moderate. Meanwhile, the calculation of n-gain in percentage form shows a value of 65.9286, which is classified as Moderately Effective in terms of effectiveness level. Therefore, it can be concluded that digital maps are effective in increasing public knowledge and understanding, with an effectiveness level of Moderately Effective.

Digital Map Media has a level of effectiveness that is Quite Effective, in line with research (Andari *et al.*, 2026) with the use of extension methods and direct practice and tested using the n-gain test, showing that the effectiveness of the methods used increases with the increase in public knowledge. In line with the research conducted by (Febriani *et al.*, 2026), the n-gain test results show a moderate category, so the media can be said to be effective in increasing student knowledge with moderate effectiveness criteria.

2. CONCLUSION

The conclusion must be concise, coherent, and summarize the main findings and implications Based on the results of the study, this research can be summarized in two points in accordance with the following objectives.

1. The process of using Digital Map media consists of a planning stage where researchers create Digital Map media in the form of QR Codes and then install them on information boards. Researchers create Digital Map-based media using Google My Maps and convert it into QR Code form. Researchers then conduct media expert validation with a score of 91, which is classified as “very good.” There are three stages: the planning stage, which involves designing the Digital Map media and converting the link into a QR Code; the implementation stage, which involves socializing the use of digital maps to the community; and the evaluation stage, which involves analyzing the advantages of the media,

namely that it provides the community with easy access to information about the Tuk Gedat spring in a wise and efficient manner, while the disadvantage of this media is that it must be accessed using an internet network.

2. The increase in public understanding of the Tuk water source can be measured through an n-gain test with a result of 0.6593, which falls within the Moderate criteria. Therefore, it can be said that the Digital Map media is effective in increasing public knowledge with a level of effectiveness that is Quite Effective.

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