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Full Length Research Article

Assessing the Economic Value of Water Environmental Services in Mount Merbabu National Park

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ABSTRACT

Mount Merbabu National Park (MMNP) is a conservation area that provides environmental services (water) to surrounding villages spread across its area; however, the community has not realized its essential role. The study aims to calculate the economic benefits of water environmental services in MMNP, which the surrounding community utilizes for household needs. Primary data collection was conducted by interviews using structured questionnaires. Samples were determined using the purposive sampling method on 39 MMNP water sources. Data analysis was carried out by calculating public perceptions of water use and assessing willingness to pay for water use for household needs. The study results showed that the economic value of household water is IDR 10,700,681,768 per year, with the value of the willingness to pay the community for water utilization and conservation IDR 4,360,408,000 per year. The total economic benefit of water in the MMNP area is IDR 15,061,089,768 per year. The views and dynamics of water source management on Mount Merbabu are diverse. The water on Mount Merbabu has been a blessing, a source of conflict, a source of life, and can be a tool of political intimidation. It is necessary to make the public aware of water sources, recharge areas, and better water utilization because water has economic value.

1. Introduction

Water is the fundamental natural resource that supports life, human society, and ecosystems (Liu et al. 2022; Shabbir et al. 2020). Springwater is the primary water source for the community (Ashari and Widodo 2019), and it is widely used in addition to grass and firewood (Aissiyah et al. 2019). Water becomes problematic when it cannot meet human and ecosystem needs (Chiabai et al. 2018; Saraswaty 2013). Dramatic economic growth and population drive an increasing demand for water and water pollution and reduce water resources (Boretti and Rosa 2019). Lack of effectiveness was attributed to many anthropogenic factors, including fishing, erosion, lack of law enforcement, water management, habitat degradation, sedimentation, and invasive non-native species (Acreman et al. 2020).

One of the most crucial discussions within water resource management is the debate between those who defend the concept of economic efficiency and those who privilege notions of

social equity (Prieto 2021). There are two perspectives of water resources management, namely, (1) water as a commodity and (2) water is a fundamental human right. From the first perspective, it is necessary to pay for water use, and water management will be efficient with a price policy. Water scarcity (e.g., during the dry season) can be overcome with a water price policy (Haddout et al. 2021). Bakker (2007) states that one of the problems of humans accessing clean water is that humans refuse to make water a commodity and do not consider it an item of economic value. Therefore, humans should use water by paying for it. In the second perspective, water is a fundamental human right for humans (Cetrulo et al. 2020). In light of the 2010 UN ratification of the human right to water and sanitation, shifts have taken place in policy, legal frameworks, local implementation, and national dialogues (Sultana and Loftus 2019). Privatization is a threat to human rights everywhere. As climate change progresses, resources will become even more scarce, with more of a push from corporations seeking to control and commodify water (Schroering 2019). Water is a public good and public access. The government must guarantee that every citizen gets guaranteed water for their life through law (Burchi 2020). Thus, water should not be commoditized, and water management should be carried out in an integrated manner by the community.

The water demand is increasing with population, income/welfare, necessities of life, and regional economic development (Abu-Bakar et al. 2021). On the other hand, water availability is limited due to changes in land cover and inefficiencies in water utilization (Hassen and Bantider 2020). One of the causes of the inefficient use of water is that people perceive that water has no economic value and is easily obtained (Neto and Camkin 2020; Yuliani et al. 2022). As a result, water resources are not valued, and there is no adequate appreciation for the area to produce/recharge (Grafton et al. 2023). Many users of national park environmental services do not realize and appreciate the contribution of national park environmental services that have been enjoyed and utilized (Hartanto et al. 2019; Rahmadwiati et al. 2022).

The benefits and value of water from Mount Merbabu are not yet known. Information on the benefits and value of water in economic valuation will streamline water utilization and appreciation in these water-producing areas to be more sustainable (Lazaridou and Michailidis 2020). Based on this description, the study of calculating the economic benefits of water environmental services in Mount Merbabu National Park (MMNP) used by the surrounding community for household needs and the willingness to pay (WTP) for water environmental services is not only essential but urgently needed. This study aimed to calculate the economic benefits of MMNP water environmental services used by the community for household needs.

2. Materials and Methods

2.1. Research Location

The research was conducted for one month in February 2022. The research location was in the 39 springs recorded in Mount Merbabu National Park (MMNP) as shown in **Fig. 1**.

2.2.Data Collection

Assessment of the economic benefits of water environmental services of MMNP using primary and secondary data. Primary data were obtained based on the results of interviews with respondents using structured questionnaires. The sampling used a purposive sampling method in

39 water sources of the MMNP area, and the number of respondents was 146 out of 7,607 household populations using water. Each spring, 3–5 respondents can represent water users in springs. Questions on the questionnaire include respondent's identities, number of family members, occupation, amount of water consumption/month, and WTP for water utilization and conservation. Secondary data comes from libraries, statistical data, sub-districts in numbers, village monographs, and relevant literature. There was a COVID-19 pandemic, so health protocols were carried out for respondents and enumerators. The use of masks, hand sanitizers, and social distancing in the interview process is carried out strictly. Due to the pandemic, the interview process cannot be carried out long and intensively. Questions take precedence over key information for research. The team carried out health protocols to measure spring water discharge.

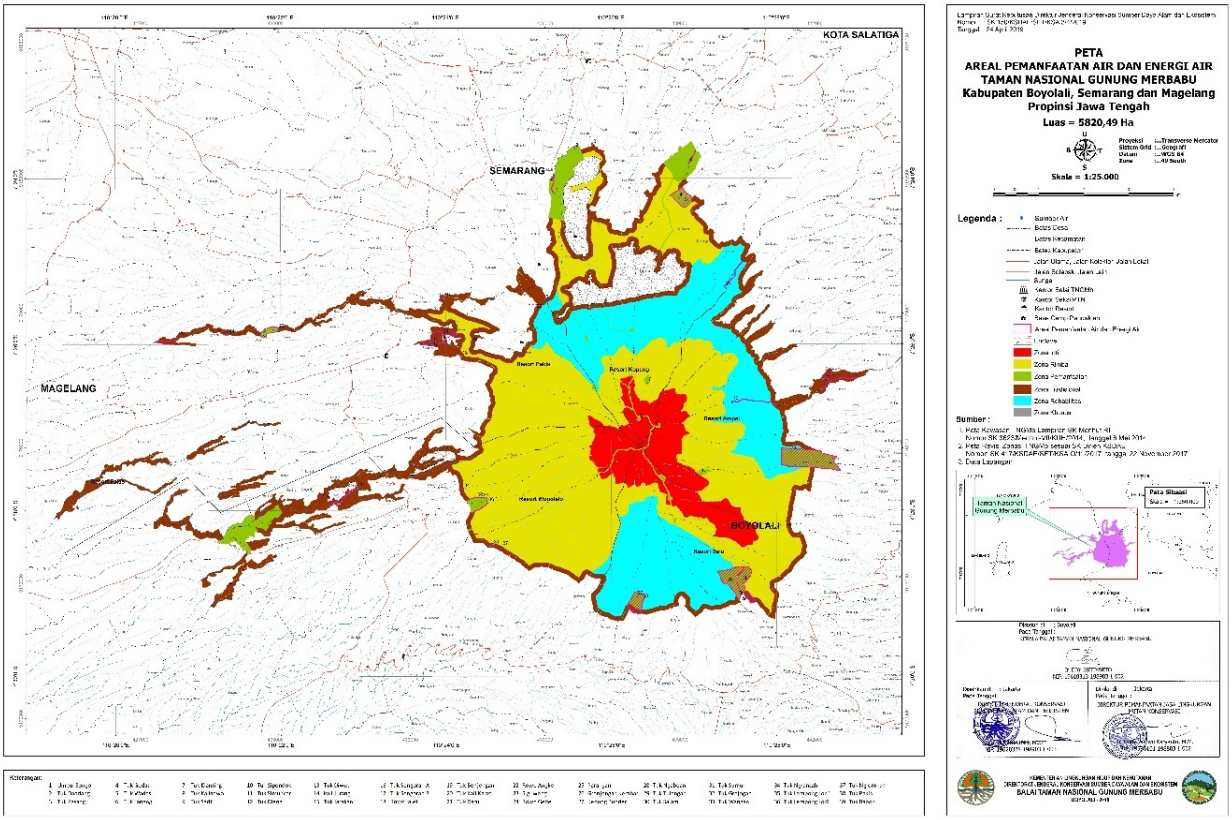

Fig. 1. The research location of Mount Merbabu National Park.

2.3. Data Analysis

WTP is the amount of rupiah to be spent on the utilization and preservation of water from the MMNP area. WTP has been widely applied in research such as COVID-19 (Harapan et al. 2020; Wong et al. 2020), renewable energy (Ntanos et al. 2018), green products (Wei et al. 2018), organic food (Katt and Meixner 2020), consumer goods and (Schmidt and Bijmolt 2020). The economic value of water for household needs is calculated in each water source based on the water needs utilized (Azzahra et al. 2022). The economic value approach is based on the water price of the local water supply enterprise or PDAM (*Perusahaan Daerah Air Minum*) (Benito et al. 2023).

The economic value of water utilization and WTP is calculated using the equation formula applied by previous studies (Jariyah and Purwanto 2020; Lopis et al. 2017; Pratama et al. 2018). The economic value of household utilization was used to calculate household water utilization from the MMNP area using Equation 1.

$$NART = RTPA \times JA \times KP \times HAS \quad (1)$$

where *NART* is the household water utilization value (IDR/household/month), *RTPA* is the number of water utilization households (household), *JA* is the average number of family members (person), *KP* is the average household consumption (m^3/household/month), and *HAS* is the PDAM equivalent price (IDR/m^3).

The amount of WTP in the community for the cost of water utilization and conservation was calculated by the following Equation 2.

$$TWp = R\ Wp \times P \quad (2)$$

where *TWp* is the total value of WTP (IDR/year), *R Wp* is the average WTP of all respondents per year (IDR/year), and *P* is the population (people).

Total economic value (TEP) was calculated using the following Equation 3.

$$TEP = NART + WTP \quad (3)$$

where total economic value is the sum of household water utilization (*NART*) value with total *WTP* (TWp).

3. Results and Discussion

3.1. Water Spring, Location, and WTP

Mount Merbabu National Park (MMNP) is one of the conservation areas that, in addition to conservation functions, also functions socially and economically (Hartanto et al. 2019). The tourism economy is also growing around Mount Merbabu such as Kragilan Top Selfie (Setiawan et al. 2021), Gancik Hill Top (Sari and Rahayu 2018), and Tuk Semuncar (Setiawan and Muhammad 2018). MMNP also produces environmental services. Environmental services are ecosystems that benefit human life, directly or indirectly (Costanza 2020). One of the ecological services that is needed by the community is water. Water sources in the MMNP area have been mapped in the Water Utilization Area Map, according to the Decree of the Director General of KSDAE Number SK.150/KSDAE/SET/KSA.3/4/2019 concerning Water Utilization Area Maps, showing 39 water sources that the community can utilize through the Water Utilization Permit.

Table 1 shows that out of 39 water sources from the MMNP area, the community has utilized 35 springs, and the utilization of four springs is not optimal. The community currently does not use four water sources: Grenjengan Kembar, Kedung Bunder, and Tuk Ngabean, which only flow from the Sat River in the rainy season. As for Tuk Diwut, which had previously been used by 15 families of residents of Tanen Hamlet, it is no longer used at this time because the discharge has decreased. Tuk Sipendok is currently meeting the water needs of Tanen Hamlet households. The most significant water source is Tuk Simuncar, with a water discharge of 68.57 Liters/second (L/s), followed by Tuk Sipendok and Umbul Songo, with a discharge of 42.80 L/s and 33.29 L/s. The largest water user is Tuk Sipendok, with 1,600 households spread across six villages. The results of Prasetyo and Kusumandari (2021) showed that the water discharge available in the Tuk Simuncar and Tuk Sipendok was 23.22 L/s and 31.20 L/s, classified as class IV. The area of Tuk Simuncar is dominated by high-density vegetation (75 ha), while Tuk Sipendok is dominated by moderate-density vegetation (102.28 ha). The Water Use Index (WUA) of the two springs has a value of 0.3, which is included in the low level (Prasetyo and Kusumandari 2021).

Table 1. Name of the spring, characteristics of the spring, use of the water, and willingness to pay

No.	Spring name	Coordinate		Discharge (L/s)	Utilized discharge (L/s)	Benefiters	Number of beneficiaries (household)	Willingness to pay (IDR/month)	Regency
		X	Y						
1	Umbul Songo	436224	9181712	33.29	6.10	Kopeng and Samirono Village	640	10,000	Semarang
2	Tuk Dandang	436695	9182645	5.82	1.01	Batur Village	87	10,000	Semarang
3	Tuk Pasang	437062	9182738	0.63	0.51	Batur Village	87	6,000	Semarang
4	Tuk Gedat	439002	9181513	2.05	1.90	Tajuk Village	136	20,000	Semarang
5	Tuk Wadas	439073	9181430	0.15	0.15	Cingklok Hamlet	26	5,000	Semarang
6	Tuk Lanang	439215	9182312	0.51	0.45	Tajuk Village	54	4,000	Semarang
7	Tuk Klanting	744105	1104407	1.00	0.97	Batur Village	180	6,600	Semarang
8	Tuk Kalisowo	742525	1104318	1.00	0.95	Batur Village	180	5,000	Semarang
9	Tuk Syarif	438084	9176642	1.71	0.66	Cunthel Hamlet	161	15,000	Semarang
10	Tuk Pakis	440377	9173026	4.76	4.42	Tarubatang Village, Senden Village	400	10,000	Boyolali
11	Tuk Babon	440044	9173002	10.10	9.79	Selo, Suroteleng, Samiran, Lencoh, and Genting Village	1,262	9,000	Boyolali
12	Tuk Sipendok	439422	9175434	42.28	14.66	Ngagrong, Kembang, Kembang Kuning, Jeruk, Seboto, and Senden Village	1,600	22,000	Boyolali
13	Tuk Simuncar	441466	9175928	68.57	6.71	Candisari Village	621	10,000	Boyolali
14	Tuk Dieng	440167	9177041	2.954	0.04	Ngganduman Hamlet	7	5,000	Boyolali
15	Tuk Diwut	442150	9177308	0.02	0.09	Tanen Hamlet	15	5,000	Boyolali
16	Kali Jurang	442189	9177537	1.31	0.79	Sampetan Village	125	5,000	Boyolali
17	Tuk Jarakan	439987	9179584	0.10	0.15	Mongkrong Hamlet	40	5,000	Boyolali
18	Tuk Sengoran A	433487	9178308	0.061	0.06	Pogalan Bawah Hamlet	26	5,000	Magelang
19	Tuk Sengoran B	433436	9178359	0.49	0.11	Pogalan Bawah Hamlet	16	5,000	Magelang
20	Tuk Rowo Jalet	434205	9178103	0.13	0.19	Pogalan atas and Pogalan Bawah Hamlet	33	7,500	Magelang
21	Tuk Benjengan	433744	9179333	18.46	2.03	Tejosari Village	175	15,000	Magelang
22	Tuk Kali Karet	431825	9175115	3.43	3.00	Kragilan Hamlet	560	5,000	Magelang
23	Tuk ndaru	436017	9179281	0.84	0.66	Cunthel Hamlet	161	15,000	Magelang
24	Rowo Angker	433976	9178526	0.74	0.01	Pogalan atas Hamlet	1	10,000	Magelang
25	Tuk Siguweng	434349	9178337	0.66	0.05	Pogalan atas Hamlet	4	10,000	Magelang

No.	Spring name	Coordinate		Discharge (L/s)	Utilized discharge (L/s)	Benefiters	Number of beneficiaries (household)	Willingness to pay (IDR/month)	Regency
		X	Y						
26	Rowo Gede	433717	9178516	2.85	0.96	Kaponan Village	95	5,000	Magelang
27	Parangan	433733	178379	2.81	0.94	Kaponan Village	54	10,000	Magelang
28	Grenjengan Kembar	430065	9178637	0.79	0	-		-	Magelang
29	Kedung Bunder	427813	9178446	1.95	0	-		-	Magelang
30	Tuk Ngabean	428940	917852	0.56	0	-		-	Magelang
31	Tuk Tulangan	438056	9172715	0.47	0.46	Kajor, Grintingan, Tritis, Plalangan, Temusa, and Cengkol Hamlet	400	12,000	Magelang
32	Tuk Salam	438158	9172644	0.45	0.35	Kajor, Grintingan, Tritis, and Lendoh Hamlet	80	44,000	Magelang
33	Tuk Sumur	434838	9173842	0.38	0.28	Surodadi Village	45	6,000	Magelang
34	Tuk Grojogan	435795	9179077	0.09	0.08	Burunan Hamlet	14	5,000	Magelang
35	Tuk Wangan	434595	9174909	6.63	0.91	Sobleman Hamlet Banyuroto Village	300	5,000	Magelang
36	Tuk Ngrancah	434339	9175055	0.20	1.17	Banyuroto Village	80	5,000	Magelang
37	Tuk Lempong Lor 1	428020	9167800	0.26	0.14	Banyuroto Village	60	15,000	Magelang
38	Tuk Lempong Lor 2	434771	9174803	0.24	0.16	Banyuroto Village	60	5,000	Magelang
39	Tuk Nglorokan	435107	9173841	0.87	0.82	Wonolelo Village	83	6,600	Magelang

Based on the interview results, all respondents stated that they were willing to pay utilization and preservation costs. The value of WTP still varies for each respondent who uses water resources, with the lowest value of IDR 4,000/month and the highest value of IDR 44,000/month. A reasonably high range of variation is possible due to differences in water source users' perception, knowledge, and household income (Wang et al., 2023; Zabala et al., 2019).

3.2. Economic Value of Household Water

The water source of MMNP is administratively located in 3 regencies, namely Boyolali, Magelang, and Semarang. Each regency has a different basic price of water per m^3, namely IDR 1,800 for Boyolali Regency, IDR 960 for Magelang Regency, and IDR 1,190 for Semarang Regency. Based on **Table 1** and **Table 2**, the highest economic value is the water sources of Tuk Sipendok, Tuk Semuncar, and Tuk Baboon, which are all administratively located in the Boyolali Regency.

The value of the benefits of water sources used respectively is IDR 3,283,200,000/year for Tuk Sipendok, IDR 2,191,639,680/year for Tuk Simuncar, and IDR 1,502,323,200/year for Tuk Babon. The smallest economic value of water is in the water source Tuk Rowo Angker of IDR 684,000/year, Tuk Siguweng of IDR 5,472,000/year, and Tuk Sengoran A of IDR 7,612,000/year.

The highest value of water economic benefits for households is the water source in Boyolali Regency of IDR 7,461,284,160/year. This is because Boyolali Regency has the highest number of beneficiaries, namely 4,285 households, and has the highest PDAM base price compared to Magelang Regency and Semarang Regency of IDR 1,800/m³. The next highest economic benefit value is Semarang Regency, and the lowest is Magelang Regency, each worth IDR 1,848,131,690 and IDR 1,391,265,918/year. Overall, the economic value of household water around MMNP is IDR 10,700,681,768/year. Water use will affect willingness to pay (Etale et al. 2020).

Table 2. The value of household water benefits

Location of water sources (Regency)	Number of beneficiaries (households)	Utilized discharge (litter/second/months)	PDAM Price (IDR/m^3)	Household water utilization value (IDR/year)
Boyolali	4,285	162.00	1,800	7,461,284,160
Magelang	1,592	324.03	950	1,391,265,918
Semarang	1,731	228.86	1,190	1,848,131,690

3.3. WTP Household Supporters

The WTP of household beneficiaries in Boyolali, Magelang, and Semarang Regencies is outstanding. Of the 146 respondents interviewed, all (100%) expressed their WTP money as compensation for water utilization and preservation of water resources in MMNP. WTP is an individual's WTP for an environmental condition or assessment of natural resources and natural environmental services to improve environmental quality (Horowitz and McConnell 2002).

The analysis results show that each household or head of family (KK) is willing to spend money for water conservation; as many as 48% of water users want a contribution of IDR 5,000/month, while 24% express WTP IDR 10,000/month, the rest are willingness to pay below IDR 5,000/month and above IDR 10,000/month. **Table 3** shows that the highest WTP for the utilization and preservation of water environmental services is the community (Ren et al. 2020; Thapa et al. 2022), which utilizes Tuk Sipendok and Tuk Babon water sources in Boyolali Regency and Umbul Songo in Semarang Regency Area. The value of WTP in the three sources is IDR 1,694,400,000/year, IDR 545,184,000/year, and IDR 307,200,000/year, respectively. Water users of Tuk Sipendok and Tuk Babon are willing to provide the highest service returns because they have the most significant number of users, namely 1,600 families and 1,260 families, respectively. The average WTP Tuk Sipendok and Tuk Baboon beneficiaries are IDR 22,000/month and IDR 9,000/month. Umbul Songo in the Regency area has 640 households with an average willingness to pay IDR 10,000/month. Overall, the community's WTP for the utilization and preservation of water in MMNP is IDR 4,360,408,000/year.

The value of economic utilization of water for households is greater than the WTP, but each spring water source is different. This shows that people do not all value water according to their valuations (Costanza 2020). On the other hand, it can be interpreted that people's ability to pay is low because of their economic conditions, such as poverty. Poverty is the main problem the buffer zone community faces in MMNP. The value of household water utilization greater than the WTP for water shows the low value of water, God's grace water so there is no need to pay, and the poor conditions of the community around Mount Merbabu. Field observations show that there are three patterns in water utilization by water users, namely: (1) water utilization using water installation networks independently, (2) utilization together with coordinated through *ulu-ulu*/individuals, and (3) water utilization through water groups formed by the community. For independent use of water,

it is generally free of charge, and if there is damage, it should be handled by themself. Meanwhile, those managed by *ulu-ulu* or groups are charged a fee; if there is damage, the manager will solve it (Cholil 2023; Krisnanda 2020).

Table 3. Economic value of household use, WTP value, and total economic value of water

No	Spring name	Population (people)	The economic value of household utilization (IDR/year)	WTP value of utilization and preservation (IDR/year)	Total economic value (IDR/year)
1	Umbul Songo	2,560	902,952,960	307,200,000	1,210,152,960
2	Tuk Dandang	348	149,911,440	41,760,000	191,671,440
3	Tuk Pasang	348	75,734,266	25,056,000	100,790,266
4	Tuk Gedat	544	280,824,768	130,560,000	411,384,768
5	Tuk Wadas	105	21,781,760	6,240,000	28,021,760
6	Tuk Lanang	216	67,087,440	10,368,000	77,455,440
7	Tuk Klanting	720	143,942,400	57,600,000	201,542,400
8	Tuk Kalisowo	720	140,515,200	43,200,000	183,715,200
9	Tuk Syarif	644	98,094,080	115,920,000	214,014,080
10	Tuk Pakis	1,600	990,720,000	192,000,000	1,182,720,000
11	Tuk Babon	5,048	2,191,639,680	545,184,000	2,736,823,680
12	Tuk Sipendok	6,400	3,283,200,000	1,694,400,000	4,977,600,000
13	Tuk Simuncar	2,484	1,502,323,200	298,080,000	1,800,403,200
14	Tuk Dieng	28	9,676,800	1,680,000	11,356,800
15	Tuk Diwut	0	0	0	0
16	Kali Jurang	500	176,040,000	45,000,000	221,040,000
17	Tuk Jarakan	160	34,560,000	9,600,000	44,160,000
18	Tuk Sengoran A	64	7,612,160	3,840,000	11,452,160
19	Tuk Sengoran B	104	12,962,560	6,240,000	19,202,560
20	Tuk Rowo Jalet	88	22,572,000	7,920,000	30,492,000
21	Tuk Banjengan	700	239,400,000	126,000,000	365,400,000
22	Tuk Kali Karet	2,240	456,583,680	80,640,000	537,223,680
23	Tuk Ndaru	644	98,094,080	115,920,000	214,014,080
24	Rowo Angker	4	684,000	480,000	1,164,000
25	Tuk Siguweng	16	5,472,000	1,920,000	7,392,000
26	Rowo Gede	380	113,715,000	22,800,000	136,515,000
27	Parangan	216	110,808,000	25,920,000	136,728,000
28	Grenjengan Kembar	0	0	0	0
29	Kedung Bunder	0	0	0	0
30	Tuk Ngabean	0	0	0	0
31	Tuk Tulangan	600	54,090,720	86,400,000	140,490,720
32	Tuk Salam	320	41,587,200	168,969,999	210,557,199
33	Tuk Sumur	180	32,703,750	10,800,000	43,503,750
34	Tuk Grojogan	56	10,001,600	3,360,000	13,361,600
35	Tuk Wangan	1,200	107,730,000	72,000,000	179,730,000
36	Tuk Ngrancah	320	138,862,000	19,200,000	158,062,000
37	Tuk Lempor Lor 1	240	16,929,000	43,200,000	60,129,000
38	Tuk Lempor Lor 2	240	18,468,000	14,400,000	32,868,000
39	Tuk Nglorokan	332	96,701,640	26,560,000	123,261,640
	Total	30,369	10,700,681,768	4,360,417,999	15,061,089,768

3.4.Total Economic Value

The total economic value concept operates as a consistent approach for the economic evaluation of natural resources in the context of exacerbating the ecological crisis and overexploitation of natural resources (Yeh et al. 2018). Total economic value is a combination of the economic value of household water in each water source plus the total value of the WTP users

for each water source. The total economic value of water utilization for household utilization of villagers around MMNP is IDR 15,061,089,768/year.

Observations on springs show a tradition of preserving water sources. Tradition is one means of inheriting values from generation to generation, including water management (Remmington 2018). The Saparan tradition is a means for the Selo people to give thanks for the water from the Tuk Babon. For a long time, the people in Selo have had a tradition of maintaining the continuity of spring water sources by preserving the environment based on traditional rituals and traditions (Putri et al. 2017). For the people of Selo Tengah Hamlet in Selo Village, there is a tradition for Tuk Baboon springs, the only spring water source for five villages, in the form of *merti tuk* Baboon. The community will play an active role, from planning implementation to monitoring and evaluating protection development (Agatha et al. 2022). However, the results also show that the social function of water is more prominent than the economic function (Aswoyo and Sularso 2020), so it does not consider the efficiency and value of investment (Pasandaran 2007).

3.5. Local Community Views and Water Management Dynamics

The community around MMNP considers water very important for their lives (Istiyani 2016). Water is used for daily needs (consumption, bathing, washing, and latrines), agriculture, animal husbandry, and fisheries. For this reason, the tradition of a "clean village" is carried out by many people around MMNP. This tradition shows people's appreciation and respect for the springs (Sundawa and Wadu 2021; Wilson et al. 2019). Before the celebration, each hamlet's community deliberates to discuss this tradition's technical implementation. Furthermore, they worked together to clean the environment around the hamlet and places considered sacred, such as cemeteries and springs, and repair damaged waterways. They would then pray together at the village chief's house to be given safety and welfare by God.

Institutions in water source management are relatively diverse in each village with a water source (Hensel et al. 2006). Many villages began to organize and have their management mechanisms-agreement on collecting dues, distribution of water, use of funds, and governance. Initially, much water from water sources flowed through pipes to people's homes without measuring the amount of water used (meter) and faucets. Water is constantly strained and tends to be wasted. The initiative of several parties to manage the water better with *Pamsimas* (*Program Penyediaan Air Minum dan Sanitasi Berbasis Masyarakat*/Community-Based Water Supply and Sanitation Program) (Daniel et al. 2021). Initially, the idea caused pros and cons in decision-making. There are several reasons underlying the residents' approval and disapproval of the plan to implement *Pamsimas*. First, water management with *Pamsimas* is essential so that water distribution is more evenly distributed to all residents. Second, by installing measuring meters for the amount of water used and should be paid, residents will appreciate water more. They will use water more wisely so that no water is wasted. Third, with the difference in water prices, justice will be realized because residents who use more water will pay more, and vice versa. Fourth, disputes among residents due to water problems can be resolved.

In comparison, the reason for residents who initially disagree is that residents should not use water by paying for it. They consider the spring water God's gift and a village asset the community can use without paying. They also worry that *Pamsimas* will make water prices expensive (Istiyani 2016).

Water can also be a tool of politicization and intimidation (Grünwald et al. 2023), for example, in the election of village heads around Mount Merbabu as described (Istiyani 2016). Water became a tool of oppression for residents, who had to choose one of the candidates for village head. Using the power of water to gain votes has erased some communities' rationality in choosing their leaders. The power of water makes it one of the determinants of politics in many countries (Anand 2011; Boelens 2015; Gelles 2000; Somma et al. 2021). In addition, people close to the source of the spring will enjoy it more than those far from it.

Water distribution and use are often the beginning of conflict (Costanza 2020). For example, residents use water to water vegetable crops in the fields in the dry season. One respondent said that in the dry season, residents should not use water to water vegetables in their fields. If this is done, then other residents will lack water. The resource person said a resident drained water using a pipe to water the vegetable plants in his field, leaving the water to flow overnight. The next day, the pipe was found to have been dismembered into pieces without knowing who did it. The interview assumed it was a form of the annoyance of residents towards people who only thought about their benefits without seeing other residents who lacked water.

Water closure cases also occur between villages, as Istiyani (2016) described. At the end of 2013, in Tajuk Village, several residents secretly closed water channels leading to parties outside Tajuk Village, namely two pig farms in Samirono Village and Sumogawe Village, Getasan Sub-District; White Cross Complex in Salatiga and Gedono Hermitage in Tosoro Village, Getasan Sub-District. The community believes that the people of Pulih Hamlet should be prioritized to get water first (Krisnanda 2020). Water should not be distributed to parties outside the hamlet (Almadani and Hermawan 2023). Another reason is the non-transparency in managing money donated by some residents by outside parties. This condition shows that water is one of the sources of conflict around Mount Merbabu if it is not handled correctly (Istriyani 2016).

4. Conclusions

The total economic value of water utilization in MMNP is IDR 15,061,089,768/year, obtained from the economic value of household utilization of IDR 10,700,681,768/year, and the value of the willingness to pay IDR 4,360,408,000/year. The value of household water utilization greater than the WTP for water shows the low value of water, God's grace water so that there is no need to pay, and the poor conditions of the community around Mount Merbabu. It is recommended to socialize the importance of water value and awareness to appreciate water and its utilization so that water utilization is optimal and maintains spring sources. Further research on the economic benefits of water, in addition to household interests, is necessary. In addition, it is essential to study the factors influencing the willingness to pay the community that uses water in the MMNP area.

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