



The Economic Benefit of Gunung Merapi National Park for the Welfare of the Buffer Village Community

Manfaat Ekonomi dari Taman Nasional Gunung Merapi untuk Kesejahteraan Masyarakat Desa Penyangga

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ABSTRACT

Gunung Merapi National Park (GMNP) is an inseparable conservation area from the surrounding community, as the buffer village community has used its existing forest resources. Therefore, this research aimed to identify the forest resources used by the buffer village community and assess the economic benefit value generated by GMNP. The economic benefits evaluation adopted the direct use value approach and market prices. The results showed that the community used water, firewood, grass, land, and sand. Utilization was conducted in utilization, traditional, and rehabilitation zones. These resource utilizations generated a value of IDR426,230,560,828/year, significantly contributing to the welfare of the buffer village community.

INTISARI

Taman Nasional Gunung Merapi (TNGM) merupakan kawasan konservasi yang tidak dapat terpisahkan dengan masyarakat sekitar. Masyarakat desa penyangga telah memanfaatkan sumber daya hutan yang ada pada kawasan TNGM sejak sebelum terbentuknya sebagai kawasan taman nasional. Oleh karena itu, penelitian ini bertujuan untuk mengidentifikasi sumber daya hutan yang dimanfaatkan oleh masyarakat desa penyangga dan nilai manfaat ekonomi yang dihasilkan TNGM dari pemanfaatan tersebut. Penilaian manfaat ekonomi tersebut menggunakan pendekatan nilai guna langsung dan harga pasar pada saat penelitian dilakukan. Hasil penelitian menunjukkan bahwa masyarakat memanfaatkan sumber daya hutan di TNGM berupa air, kayu bakar, rumput, lahan, dan pasir. Pemanfaatan tersebut dilakukan pada zona pemanfaatan, tradisional, dan rehabilitasi. Beberapa kegiatan pemanfaatan sumber daya hutan oleh masyarakat tersebut dapat dinilai secara ekonomi dan menghasilkan nilai manfaat TNGM untuk kesejahteraan masyarakat sebesar Rp426.230.560.828,00/tahun.

Introduction

A robust cultural connection between the community and the forest is widely presumed to play an essential role in maintaining a constant supply and quality of water. However, in terms of flood or drought, forest loss is often implicated (Ayenew 2015). The importance of natural forest ecosystems in human welfare remains undeniable, as its services contribute to economic development and social welfare. The Gunung Merapi National Park (GMNP) buffer village community has coexisted with Mount Merapi, relying on forest resources to support livelihood (Atmojo et al. 2018). The economic benefits of forest resources can contribute to the community's welfare. The community depends substantially on the existence of the Merapi forest to meet daily needs. Since ancient times, communities have used the forest for agriculture with a shifting cultivation system. These utilization strategies have adjusted as the purposes and management of the Merapi forest have undergone substantial changes. The dependence on natural resources manifests in efforts to meet needs (Suharti 2015).

GMNP consists of seven management zones, each serving specific management objectives, including protecting the primary function of the National Park as a conservation forest in the core zone. It is important to note that forests have intricate links to human intervention. There are zones on the outermost part of the National Park to accommodate the community's interests in the forest area, thereby ensuring the preservation of the core zone.

Natural forests are invaluable economic resources essential for understanding and managing the environment, making it imperative to study economic valuation (Tolera 2022). According to (Atmojo et al. 2018), people rely on many natural resources, including water, grass, firewood, sand, culture, and tourism. For instance, water utilization within GMNP reaches 1,106,717 m³/year, with grass and firewood yielding 77,618,630 kg/year and 367,106.35 bundles/year, respectively. Economic valuation aims to quantitatively assess the worth of goods and services produced by natural resources and the environment, irrespective of market availability (Desriani et al. 2017). This anthropocentric approach

to economic value underscores that forest goods and services derive value solely from their contribution to human welfare (Ayenew 2015). Therefore, the total economic value (TEV) framework gauges the worth of forest resources, consisting of both use and non-use values based on human utilization. Use value relates to actual, planned, or potential exploitation of goods, such as tourism activities (Pearce et al. 2006). Based on the above explanation, forest resources significantly influence the daily lives of the community, thereby possessing an anthropocentric economic value. Umayana et al. (2020) researched the direct use of GMNP, amounting to IDR87,947,589,505/year. However, the specific allocation of this value within the buffer village community remains uncalculated. This research aims to identify forest resources used by the buffer village community and determine the economic benefit value generated by GMNP.

Materials and Methods

Time and Location

This research was conducted over two months in buffer villages of GMNP, from November to December 2022. Buffer village communities have been depending on the natural resources of GMNP, such as water sources, grass for animal feed, firewood and carpentry wood, animal hunting, land encroachment, sand mining, as well as religious and cultural ritual needs (Wijayati & Rijanta 2019). The resource utilization occurred in Special, Utilization, Rehabilitation, and Traditional Zones. The utilization of the religious zone had no associated charges, while the Jungle Zone had no direct economic value because of no utilization in this zone. GMNP comprised two management sections and seven resorts in four regencies (Figure 1).

Tools and Materials

This research used a questionnaire as an interview guide (Sugiyono 2019). The questions included the respondents' profiles, such as age, employment, income, and distance from residence to GMNP. Additionally, the study delved into the type and extent of forest resources used in each period. Pens, notebooks, and cameras became documentation tools for the interviews.

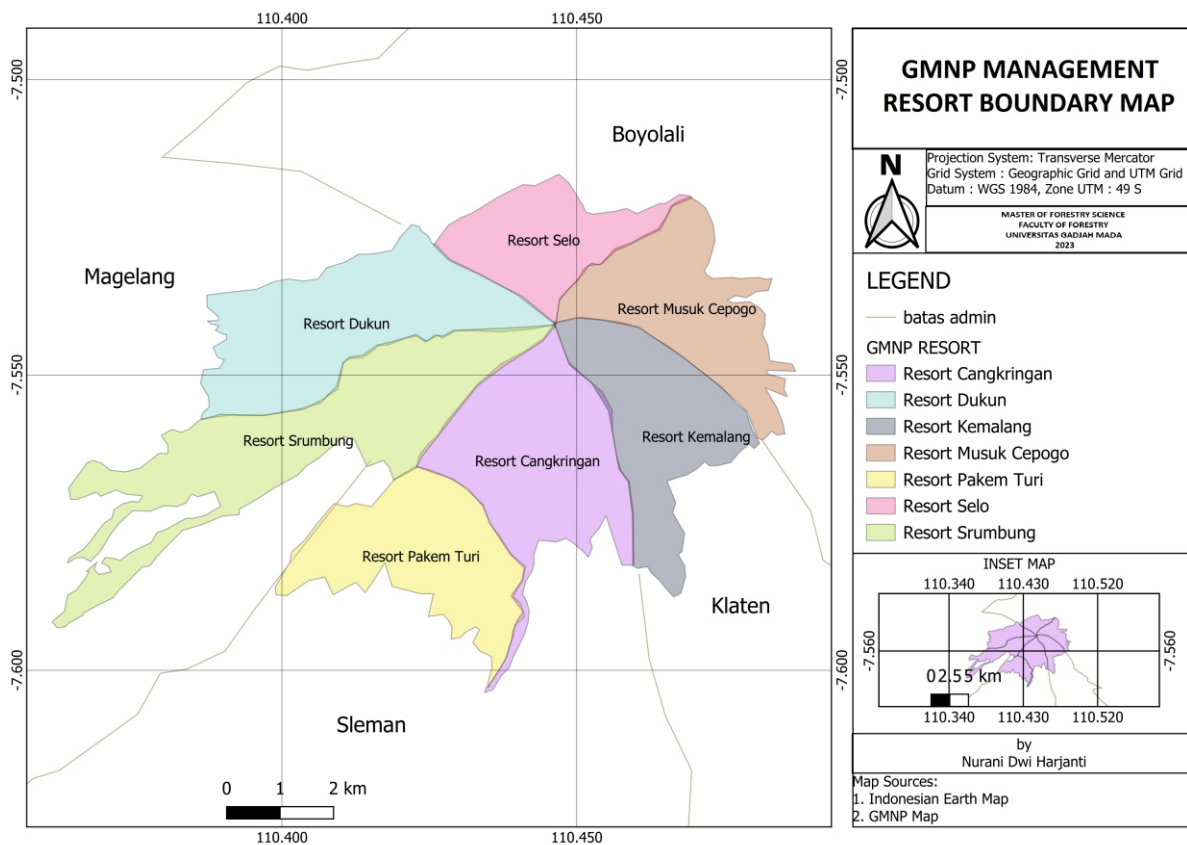


Figure 1. GMNP management resort boundary map

Table 1. Buffer villages of GMNP

No	SPTN	RPTN	Regency	District	Village
1.	I	Pakem Turi	Sleman	Pakem	Purwobinangun
2.		Cangkringan	Sleman	Cangkringan	Umbulharjo
3.		Srumbung	Magelang	Srumbung	Ngablak
4.	II	Dukun	Magelang	Dukun	Ngargomulyo
5.		Kemalang	Klaten	Kemalang	Tegalmulyo
6.		Musuk-Cepogo	Boyolali	Tamansari	Mriyan
7.		Selo	Boyolali	Selo	Lencoh

Remarks: SPTN = National Park Management Section; RPTN = National Park Management Resort

Sampling Technique

This research applied a quota purposive sampling to select and determine the number of respondents. The selected respondents were direct users of one or more of the natural resources in GMNP. Due to the large population, the difference in the number of users of each forest resource, and limited time and energy, a quota was applied to determine the sample size. According to (Roscoe 1982), a suitable sample size ranged from 30 to 500. This research sampled 154 of 37,404 households from the Buffer Village community (Table 1). This sample size was almost saturated for the forest resource users in the buffer village of GMNP, as increasing the number of respondents in the field proved challenging.

Data Analysis

In this research, the valuation of forest resources used by the community employed market prices (Table 2). These market prices reflected the costs/benefits associated with changes in the quality and quantity of environmental goods traded in perfectly functioning markets (Birol et al. 2006). The market value of living resources was the most apparent reason for conserving habitats and biodiversity threatened by certain exploitations. The market availability was obtained from the costs of harvesting, transportation, and resource access (Pearce & Moran 1994). Therefore, biodiversity had a low market value regarding its direct usage. The more difficult access to biodiversity, the fewer chances of being threatened and the lower

Table 2. Forest resource market price

Resources	Market Price (IDR)	Unit	Source
Water	3,450	m ³	PDAM Sleman
Grass	50,000	bunch	Trader in GMNP
Firewood	50,000	bunch	Trader in GMNP
Sand	135,000	m ³	Trader in GMNP
Land (Salak)	2,000	kg	Trader in GMNP
Land (Kelapa)	2,000	piece	Trader in GMNP

the value attributed to the use of biological resources (OECD 2002). Based on direct observations in the field, the buffer village community used water, grass, firewood, sand, and land for snake fruit and coconut cultivation. Hence, these variables were incorporated into this research.

The value of these resources was calculated using the productivity method analysis from the Minister of Forestry and Environment Regulation Number concerning Guidelines for Economic Valuation of Forest Ecosystems as follows.

$$NS = \frac{JP_i}{t} \times P_i$$

Description: NS = Total value of forest resources (IDR); JP = Quantity of commodities assessed (bunches, stems, trucks); P_i = Market prices of commodities assessed (IDR); i = Type of commodity; t = Period (day, week, month, year).

Results and Discussion

Identification of Forest Resources Utilization

GMNP became a conservation area in 2004. Despite the status, the local community depended on the GMNP area to sustain livelihood. This dependence predated the establishment of the national park (Faida et al. 2021). Historically, the Merapi forest area served as a site for shifting cultivation. In 1912, the Dutch government initiated the designation of this area as a protected forest, changing the agricultural system from shifting cultivation to a sedentary farming pattern (Atmojo et al. 2018).

In 1960, Perhutani, a State-Owned Enterprise with the duty and authority to manage state forest resources on Java and Madura Islands, managed Merapi's western, northern, and eastern parts. Meanwhile, the southern part was designated as a Nature Tourism Park (TWA) and Nature Reserve (CA) in 1975, managed by the Forestry and Plantation

Service in Yogyakarta. The part of the forest managed by Perhutani was pine stands (*Pinus mercusii*) (BTNGM 2022a). The choice of these species was due to its ability to support livelihood through cooperation between the community and Perhutani, particularly in tapping pine resin. This arrangement ensures that the community continues to derive benefits from the forest. In addition to tapping pine, there was permission to gather grass under the pine stands for animal feed. During the rejuvenation period, the community could also engage in agriculture using an agroforestry system by caring for young pine trees on the cultivated land (*sanggeman*) (Sulfiantono et al. 2012). This program is referred to as PHBM. In this context, Community Forest Management is a forest management scheme that provides space for the village community around the forest as the main actors.

Community utilization of forest resources in GMNP was classified as direct use value, whereas the assessment of natural resources was anthropocentric (Pearce & Moran 1994). Use values reflected the actual exploitation of specific resources, such as forests for timber, grass fodder, water resources, and recreation. The use values were further divided into direct-use values, such as fishing and timber extraction (Rogers et al. 1995). GMNP used only a few forest resources out of various benefits to support the buffer village community.

Forest ecosystems could fulfill almost all human needs by contributing tangible and intangible values (Roslinda & Yuliantini 2014). Based on the history of GMNP management, the community depended heavily on the existence of the Merapi forest to fulfill daily needs. After being designated as a national park area, the community could exploit forest areas within utilization, rehabilitation, and traditional zones (Table 3). Based on field observations, the non-timber exploitable forest products were water resources, grass, firewood, sand, and land use. Despite the

proximity and shared conservation area status, the buffer village community in GMNP had different uses for natural resources than Gunung Merbabu National Park. In Gunung Merbabu National Park, the buffer village community also exploited timber, medicinal plants, honey, and hunted animals in addition to forest resources such as water, firewood, and grass (Gunawan et al. 2013). Meanwhile, the buffer village community in the Danau Sentarum National Park utilized forest resources such as fish, honey, rubber, rice, and firewood (Roslinda 2019). Mangrove forests in South Sulawesi served as a source of fish, crabs, shrimp, firewood, handicrafts from nipa leaves, and charcoal production for the community (Malik et al. 2015). These results showed that each forest type had different forest resources.

All buffer villages except those located in Selo Resort utilized water from GMNP. This discrepancy arose from the absence of spring water from Mount Merapi flowing in the Selo Resort. At the Kemalang Resort, several springs flowed but were inaccessible. Therefore, residents of Tegalmuyo Village in Kemalang Resort preferred to buy water from PDAM (Local Water Company) Klaten. At the same time, the community in Balerante and Sidorejo Villages utilized water from Bebeng Springs in the Cangkringan Resort. PDAM was a regionally owned business unit specializing in distributing clean water to the general public, functioning administratively across regencies and provinces. Water was a direct resource for

household necessities such as bathing, washing, and drinking, as well as agricultural irrigation and commercial ventures. The water source in Cangkringan was used commercially by PDAM Tirta Marta Yogyakarta, PDAM Tirta Sembada Sleman, and PT AMI (Anindya Mitra Internasional). However, this research calculated only the benefits values of water used by the buffer village community.

Unlike others, land utilization was only identified in Srumbung Resort. This practice was an exception in a conservation area, where agroforestry activities are typically prohibited. However, land utilization permits could resolve land conflict between the previous manager and the community. For example, in Srumbung District, residents of four villages engaged in agroforestry activities. Sand extraction occurred in Srumbung Resort, constituting an illegal activity in a conservation forest area. Mining operations occurred in the upper reaches of the Krasak River and Kaliputih River, comprising residents from five villages in Srumbung. Before GMNP was established, the community already practiced sand extraction in Kaliputih (Faida et al. 2021).

Economic Value of Forest Resources

This research used the productivity method to calculate the benefit of direct-use values derived from community utilization in the buffer villages of the GMNP area. The direct-use value aligned with the ecosystem economic value approach, prioritizing the

Table 3. Resources used by the buffer village community

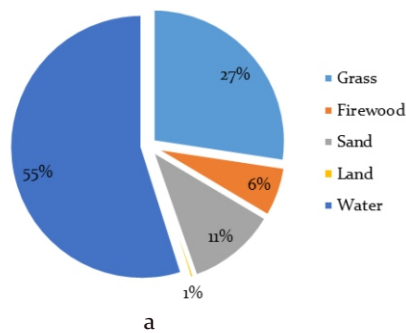
SPTN	RPTN	Water	Grass	Firewood	Sand	Land
I	Pakem Turi	4	3	4		
	Cangkringan	3	3	3		
	Dukun	4	4	4		
	Srumbung	6	6	6	5	4
	Sub total	17	16	17	5	4
II	Musuk Cepogo	4	4	4		
	Kemalang	2	3	3		
	Selo		6	6		
	Sub total	6	13	13	0	0
Total		26	29	30	5	4

Table 4. The economic values of forest resources used by buffer village community

Regency	Economic Value of Forest Resources (IDR)					Total
	Water	Grass	Firewood	Sand	Land	
Sleman	17,792,510,449	2,287,350,000	-	-	113,509,134,897	133,588,995,346
Magelang	28,413,729,167	3,901,575,758	47,325,600,000	2,006,330,909	119,767,802,228	201,415,038,061
Boyolali	29,096,115,385	3,599,151,111	-	-	705,073,216	33,400,339,711
Klaten	41,400,125,000	16,413,718,000	-	-	12,348,709	57,826,191,709
Sum	116,702,480,001	26,201,794,869	47,325,600,000	2,006,330,909	233,994,359,049	426,230,564.828

Notes: SPTN = National Park Management Section; RPTN = National Park Management Resort

Percentage of Forest Benefit Value for each Forest Resource



Percentage of Forest Benefit Value for each Regency

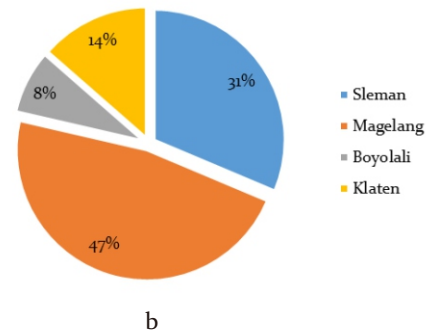


Figure 2. Percentage of forest benefit value by type of resource and by regency

community's forest resource use. Direct-use value refers to ecosystem goods and services used directly by humans, including consumptive uses such as harvesting food products, using wood for fuel or construction, harvesting medicinal products, and hunting animals for consumption. People who visited or lived in the ecosystem enjoyed the most direct-use value (Steiner et al. 2004). The benefit value of GMNP was part of the area's use value. Calculating direct-use values involved determining the commodities used by the community, the quantity exploited, and the market price.

GMNP had more than 40 springs with high water discharge flowing through the utilization zone (BTNGM 2022b). Most springs were scattered in the Cangkringan Resort, Sleman Regency, with a total water discharge of around 31,163,565 m³/year. Meanwhile, the total discharge from springs used by the community was 67,824,452 m³/year. The buffer village community of 3,369 households used the water from the GMNP area for household needs. Water was the most economically valuable resource (55%) compared to other direct uses in the buffer villages of GMNP (Table 4) and significantly higher than the water utilization values from the Mendalam sub-watershed, Kapuas Hulu (Roslinda & Yuliantini 2014). This result differed from the buffer village community in Gunung Merbabu National Park, where the highest value was from timber (Gunawan et al. 2013). The value of water in Mount Merbabu National Park was IDR53,002,947,456 (BPPTKG 2023), or 23% of water utilization.

Following water, grass was the next significant contributor to economic value, constituting 27% of the total benefits (Figure 2). This high value was

attributed to the substantial potential for grass in the GMNP area, obtainable from both the utilization and traditional zones. Approximately 3,286 households relied on this resource, with each resident maintaining an average of two cows and one goat. Therefore, the daily demand for grass ranged from 1-3 large bunches. The collection of this resource occurs in the morning and evening, with increased activity during the dry season to meet livestock needs. In Srumbung Resort, the buffer village community utilized grass for generations along the Kaliputih River before GMNP was formed.

Conversely, sand mining in the area was considered illegal. Five supporting villages, which were members of the Green Merapi Association consisting of 1,121 households, practiced sand mining. They formed the association to bridge the gap between the people who used sand and the GMNP Office to facilitate a suitable solution for both parties. Consequently, manual mining without heavy equipment was permitted, with resident-owned trucks limited to only one daily load. The Mount Merapi sand was of good quality and categorized in class A. Mount Merapi is an active volcano and has been on alert 3 (BPPTKG 2023) because the dome often emitted hot clouds and even spewed cold and incandescent lava at certain times. These volcano activities continuously supply abundant sand. Weekly mining operations occurred from Monday to Saturday, with 130 resident-owned trucks carrying approximately 7 m³/truck. The economic value of sand contributed 11% to the direct use value (Figure 2), amounting to IDR47,325,600,000/year.

The buffer village community of GMNP continued to rely on firewood for water boiling, livestock

drinking, charcoal production, and household fuel. A total of 3,286 households used firewood, with each household consuming an average of two large bundles obtained from both traditional and utilization zones. While regulations stipulated the use of grass and firewood exclusively from the traditional zone, the available resources often proved insufficient, necessitating utilization from the broader area. The value of the firewood used by the community was IDR26,201,794,869/year, or 6% of the direct-use value generated by GMNP. This firewood direct-use value was higher than Gunung Merbabu National Park (IDR of 17,833,200.00), assuming 50% of the community exploited firewood (BTNGMb 2018).

Agroforestry land of snake fruit and coconut trees in Ngablak Village, Srumbung District, contributed IDR2,006,330,909/year or less than 1% to the direct use value of GMNP (Figure 2). A total of 190 households in Srumbung used the land by producing 1-2 baskets of snake fruit/day every month during the main harvest and 25 coconuts/3 months. The land value was relatively small compared to other resources due to the limited availability of arable land, which had previously been a conflict between the community and park managers. The land use fell in the traditional zone of Srumbung Resort. In contrast, the Gunung Merbabu National Park had a wider variety of

agroforestry plants, including 17 types of vegetables, four types of fruit, two types of flowers, and four types of food crops. These plants collectively generated an economic value of IDR7,162,080,000/year (BTNGMb 2018).

The most significant benefit value was in Dukun Resort, followed by Cangkringan Resort. Conversely, Selo Resort had the most minor economic benefits due to the absence of springs. The SPTN I had a more significant value than SPTN II, primarily due to the presence of the springs (Table 5). Community access in the GMNP area was limited to certain management zones to protect the core zone from human intervention. The utilization zone held significant direct value for GMNP. The core zone held no direct use value because human activities were prohibited, while the utilization of the religious zone had no associated charges. The Jungle Zone has no direct economic value because people are not allowed to use the area to protect the core zone from disturbance (Table 6). The total economic benefits from GMNP were significantly greater than Danau Sentarum National Park (Roslinda 2019).

The livelihood of most of the buffer village community was closely related to the utilization of forest resources in GMNP (Umaya et al. 2020b). Most buffer village community members (54.6%) worked as

Table 5. Economic benefits at each RPTN

SPTN	RPTN	Economic Value (IDR)	Percentage (%)
I	Pakem Turi	12.126.310.162	2,85
	Cangkringan	121.462.685.184	28,50
	Dukun	122.039.796.664	28,63
	Srumbung	79.375.241.398	18,62
Sub Total		335.004.033.407	78,60
II	Musuk Cepogo	30.354.985.609	7,12
	Kemalang	57.826.191.709	13,57
	Selo	3.045.354.103	0,71
Sub Total		91.226.531.421	21,40
	Total	426.230.564.828	100

Remarks: SPTN = National Park Management Section; RPTN = National Park Management Resort

Table 6. Utilization value in GMNP management zone

Zone	Area (ha)	Economic Value (IDR)	Percentage (%)
Core	1,052.72	0	0
Special	237.57	38,452,050,000	9.02
Utilization	481.98	264,577,881,251	62.07
Rehabilitation	317.56	8,873,550,000	2.08
Religion	9.64	0	0
Jungle	3,210.79	0	0
Traditional	1,297.25	114,327,083,577	26.82
Sum	6,607.51	426,230,564,828	100

cow and goat breeders who used grass from the GMNP area to feed livestock for free (Atmojo et al. 2018). Without grass from the GMNP, their welfare was disrupted because they needed to spend more on animal feed.

Conclusion

In conclusion, GMNP played an essential role in providing livelihoods and supporting the welfare of the buffer village community. Forest resources, such as water, grass, firewood, sand, and land use, were also provided. Buffer village community had been using these resources for generations before the formation of the national park. These occurred in the utilization, traditional, and part of the rehabilitation zones. GMNP contributed significantly to supporting the welfare of the buffer village community with an economic benefits value of IDR426,230,560,828/year. Good management practices, conducted in partnership with the community, were crucial for enhancing the value of economic benefits from GMNP. In addition, the buffer village community should use resources wisely to improve their welfare. Synergies of cooperation and community awareness of the importance of forests determine the forest resources and utilization sustainability.

References

- Atmojo T, Umayra R, Santosa IB, Tyastuti DP, Primandaru K. 2018. Desa Mawa Cara Negara Mawa Tata. BTNGM, Yogyakarta.
- Aynew B. 2015. Economic Valuation of Forest Ecosystems Services Role in Maintaining and Improving Water Quality. *Economics* 4:71.
- Birol E, Karousakis K, Koundouri P. 2006. Using Economic Valuation Techniques to Inform Water Resources Management: A Survey and Critical Appraisal of Available Techniques and an Application. *Science of the Total Environment* 365:105122.
- BPPTKG. 2023. Aktivitas Gunung Merapi Terkini 11 Maret 2023. Available from <https://bpptkg.esdm.go.id/pub/page.php?idx=659>.
- BTNGM. 2022a. Laporan Kinerja Balai Taman Nasional Gunung Merapi Tahun 2021. BTNGM, Yogyakarta.
- BTNGM. 2022b. Laporan Statistik Balai Taman Nasional Gunung Merapi Tahun 2021.
- BTNGMb. 2018. Valuasi Ekonomi Ekosistem Hutan Taman Nasional Gunung Merbabu, Jawa Tengah:191.
- Desriani J, Putro T, Iyan R. 2017. Nilai Ekonomi Ekowisata Taman Nasional Tesso Nilo dengan Pendekatan Metode Contingent Valuation Dikecamatan Uku Kabupaten Pelalawan. *JOM Fekon* 4:11751189.
- Faida LRW, Susanto D, Wianti KF, Anggoro MD, Putri M. 2021. Community Interactions in Sand Utilization within Mount Merapi National Park. *Jurnal Ilmu Lingkungan* 19:525530.
- Gunawan H, Bismark M, Haruni Krisnawati Pusat Litbang Konservasi dan Rehabilitasi Jl Gunung A. 2013. Kajian Sosial Ekonomi Masyarakat Sekitar Sebagai Dasar Penetapan Tipe Penyangga Taman Nasional Gunung Merbabu, Jawa Tengah. *Jurnal Penelitian Hutan dan Konservasi Alam* 10:103119.
- Malik A, Fensholt R, Mertz O. 2015. Economic valuation of Mangroves for comparison with commercial aquaculture in South Sulawesi, Indonesia. *Forests* 6:30283044.
- OECD. 2002. Handbook of Biodiversity Valuation A Guide for Policy Makers (Complete Edition - ISBN 9264197311). Source OECD Environment & Sustainable Development 2002:1153.
- Pearce D, Atkinson G, Mourato S. 2006. Cost-Benefit Analysis and the Environment. OECD, Paris.
- Pearce D, Moran D. 1994. The Economic Value of Biodiversity. Earthscan, London.
- Peraturan Menteri Negara Lingkungan Hidup Republik Indonesia Nomor 15 tahun 2012 tentang Panduan Valuasi Ekonomi Ekosistem Hutan. 2012. Peraturan Menteri Negara Lingkungan Hidup Republik Indonesia Nomor 15 tahun 2012 tentang Panduan Valuasi Ekonomi Ekosistem Hutan.
- Rogers CD, Pearce D, Moran D. 1995. The Economic Value of Biodiversity. *The Journal of Applied Ecology* 32:672.
- Roscoe. 1982. Research Methods For Business. Mc Graw Hill, New York.
- Roslinda E. 2019. Economic Valuation of the Danau Sentarum National Park, West Kalimantan, Indonesia. *Biodiversitas* 20:19831989.
- Roslinda E, Yuliantini. 2014. The Economic Value of Hydrological Services in Mendalam Sub Watershed, Kapuas Hulu Regency, West Kalimantan, Indonesia. *Indonesian Journal of Forestry Research* 1:18.
- Steiner A, McCormick SJ, Johnson I. 2004. How Much Ecosystem is an Worth? How Much Assessing the Economic Value of Conservation. 4 The International Bank for Reconstruction and Development/THE WORLD BANK, Washington, DC.
- Sugiyono. 2019. Statistik untuk Penelitian. Alfabeta, Bandung.
- Suharti S. 2015. Pemanfaatan Tumbuhan Bawah di Zona Pemanfaatan Taman Nasional Gunung Merapi oleh Masyarakat Sekitar Hutan. Pages 14111415.
- Sulfiantono A, Gunawan, Budhami PD, Nastiti P, Anifah N. 2012. Buku Informasi Kearifan Lokal Masyarakat Sekitar Kawasan TNGM. BTNGM, Yogyakarta.
- Tolera T. 2022. The economic valuation of Gedo Natural Forest conservation benefits, Ethiopia. *Journal of Innovation and Entrepreneurship* 11. Springer Berlin Heidelberg.
- Umayra R, Hardjanto, Soekmadi R, Sunito S. 2020. Direct Economic Benefits and Human Dependence Toward Gunung Merapi National Park, Indonesia. *Biodiversitas* 21:982993.
- Wijayati D, Rijanta R. 2019. Evaluasi Zonasi Taman Nasional Gunung Merapi. *Jurnal Litbang Sukowati: Media Penelitian dan Pengembangan* 3:15.