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Economic value of forest ecosystems in the Nipa-Nipa Grand Forest Park, Southeast Sulawesi, Indonesia

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Abstract. *Kasim S, Astuti T, Agarwal A, Hasddin, Fariki L, Sulistiyono N, Rustam LO, Asizah N, Saranani F, Ahmad. 2024. Economic value of forest ecosystems in the Nipa-Nipa Grand Forest Park, Southeast Sulawesi, Indonesia. Biodiversitas 25: 4292-4303.* The economic value of ecosystem services is crucial for development planning that prioritizes the sustainability of natural resources. Research aimed at determining the economic value of forest ecosystems is very important. The total economic value of this ecosystem is based on the number of tourist visits, utilization of water resources, and carbon absorption. The research was conducted in the Nipa-Nipa Grand Forest Park, Southeast Sulawesi Province, Indonesia. The research sample was 150 visitors selected using incidental techniques. The main data of the research used surveys and field measurements supported by secondary data. The TEV equation calculates the total economic value of forest ecosystem services. The monetary value of water resource environmental services is based on Household Water Value (NART), EWTP, and TWTP. The value of water resources for agricultural irrigation is calculated using the Water Value for Rice Agricultural Irrigation (NAUT) equation. The carbon absorption value is determined using the Carbon Uptake Value (CAV) equation. The total economic value of environmental services based on the number of visits, utilization of water resources, and carbon absorption capacity is IDR 186,742,287,967 per year or USD 11,694,269.91 per year. This value is equivalent to 40% of the GRDP of the forestry business sector in Southeast Sulawesi Province. Theoretically, this further emphasizes the importance of environmental services in the economy and human survival. Further research should focus on calculating the value of carbon absorption according to vegetation type and carbon stock to see the balance curve.

Keywords: *Castanopsis buruana,* CAV, NART, TEV, WTP

INTRODUCTION

Developing countries, particularly those with tropical forests, are poised for a bright future, given their vast potential for ecotourism development (Yoeti 2016; Rafif and Musthofa 2019; World Travel and Tourism Council 2022). The increasing number of visits, including those from international tourists, and the sustained economic value generation are clear indicators of the momentum and growth in ecotourism. This trend is evident in the national parks of Costa Rica, Zimbabwe (Nash 2021), and Vietnam (Huy et al. 2023).

Indonesia's visits to natural tourism (ecotourism in conservation forests) have also increased. The Ministry of Environment and Forestry of the Republic of Indonesia (2023, 2024) noted that in 2023, there will be 6.06 million people in conservation areas. The number of ecotourism-based tourists in 2022 will be 5.29 million, an increase of around 770 thousand people. Meanwhile, tourist visits in 2021 were only 2.9 million people. The economic value of ecotourism will be IDR96.7 billion in 2022 and IDR34.2 billion in 2021; likewise, tourist visits to the Nipa-Nipa Grand Forest Park will increase. The number of visits in 2016 was 1,019 people to 1,451 people in 2018. However, there was a decrease between 2019-2021 due to the Covid-19 pandemic. The trend in the number of visits began to improve in 2021-2023, from 117 people to 789 people. This indicates the possibility of an increase in the number of visits in the future.

Several researchers also reported evidence of the role of natural tourism (ecotourism) and the resulting economic value (valuation) (Iasha et al. 2015; Ekayani et al. 2019; Heagney et al. 2019; Wihastuti and Utama 2021; Junialdi and Merina 2023; Rahmasari et al. 2023; Wang et al. 2023). Furthermore, ecotourism activities encourage forest conservation because they produce economic value from environmental services (economic valuation), as reported by the Town of Aurora (2013) and supported by previous

researchers (Patterson and Cole 2013; Kauffman 2016; Mehvar et al. 2018; Amirnejad and Solout 2021; Brouwer et al. 2022; Al-Saedi and Syakir 2023; Yang et al. 2023; Suhardono et al. 2024).

Moreover, several researchers (Nash 2021; Armus et al. 2021; Firmansyah et al. 2023) have highlighted that the development of nature tourism faces challenges that endanger local ecosystems and forests. The influx of tourists can lead to environmental degradation, and the demand for tourist accommodation further exacerbates these pressures (Suharti et al. 2016).

The economic value of ecosystem services in the Nipa-Nipa Grand Forest Park has been limited to hydrological services (Indriasary and Baco 2017). This study expands on that by assessing the broader economic value, including nature tourism, water use, and carbon sequestration. To address these gaps, further research is recommended to update both theoretical and conceptual frameworks for analyzing the economic value and environmental services of nature tourism ecosystems (Canu et al. 2015; Halleux 2017; Zhao et al. 2019; Pérez et al. 2020; Pache et al. 2020; Alikhani et al. 2021; Cruz et al. 2021; Zhao et al. 2022; Saputra et al. 2022; Brouwer et al. 2022; Schiavon et al. 2022; Eger et al. 2023; Mo et al. 2023; Rosaprana et al. 2023; Zhang et al. 2024; Pásková et al. 2024). Integrating the assessment of tourism activities, water resources, and carbon not for sustainable forest management and mitigating climate change is also suggested by other researchers (Lasco 2002; Nurfatriani 2005; Sanim 2011; Aoyama et al. 2011; Baral et al. 2016; Mariana et al. 2016; Batchelor 2018; Pérez et al. 2020; Ahmad et al. 2021; Armus et al. 2021; Brill et al. 2021; Alikhani et al. 2021; Li et al. 2021; Saputra et al. 2022a and 2022b; Boni et al. 2023; Gössling et al. 2023; Wheeler et al. 2023; Haydir et al. 2023; Sugiana et al. 2024; Zhang et al. 2024).

This research is of utmost importance because it has the potential to determine and analyze the economic value of forest ecosystems. The economic value is calculated based on three aspects: the value of ecosystem services from natural tourism activities, the use of water resources, and carbon uptake from forest vegetation. The object of analysis is a forest with a natural conservation area function in the Nipa-Nipa Grand Forest Park, Southeast Sulawesi Province, Indonesia.

MATERIALS AND METHODS

Research design

The research was carried out in the Nipa-Nipa Grand Forest Park, which is administratively located in Southeast Sulawesi Province, Indonesia. The research period lasts approximately six months in 2022. This research is a combination of two types of quantitative and qualitative research. A quantitative approach is taken to statistically analyze each indicator for each variable or research object to analyze each indicator for each variable or research object statistically. The qualitative approach descriptively analyzes a phenomenon based on data and information obtained in the field (Hasddin et al. 2019). A qualitative approach in this research is used to describe the characteristics of tourists, while a quantitative approach analyzes the economic value of forest ecosystem services.

Data and variables

Economic characteristics according to the number of visits

Data on public and private economic characteristics were collected through primary and secondary data obtained from literature searches and field surveys supported by interviews with the community. The components of the community's economic characteristics observed are livelihood, income level, average expenditure (per month).

Economic benefits (valuation)

Economic valuation data for Nipa-Nipa Grand Forest Park natural tourism comes from primary and secondary data supported by interviews with the community, visitors, and managers (government). The economic value (valuation) analyzed includes tourism value, water resource value (direct and indirect use value or existence), and carbon absorption value. Tourism value in research is the direct/indirect use value of tourism goods/services received or enjoyed by visitors (Baral et al. 2016; Mehvar et al. 2018; Ekayani et al. 2019; Pache et al. 2020; Brouwer et al. 2022; Mo et al. 2023; Huy et al. 2023; Suhardono et al. 2024).

Aspects of the economic value of natural tourism that will be analyzed include a) The description of economic characteristics (by IDR), b) Economic benefit contribution (IDR), and c) Economic valuation: direct use value, indirect use value, optional use value, inheritance use value and existence use value (IDR). The data components and research variables are presented in Table 1.

Sample

Sample of tourist visitors

Sampling of visitors for this research used incidental techniques, namely visitors who happened to be found at tourist locations. From this technique, a sample size of 150 tourist visitors was obtained. Visitors came from several areas in Kendari City, Konawe District, and South Konawe District. The distribution according to origin is presented in Figure 1.

The number of visits from Kendari City dominates tourists in the Nipa-Nipa Grand Forest Park, namely 85.33%, while other areas such as Konawe only have around 11.33% and South Konawe as much as 3.33%. Tourist visits from Kendari City are spread throughout the region, while other areas are only a few sub-districts that directly border Kendari City.

Figure 2 presents the characteristics of the number of tourist visits to the Nipa-Nipa Grand Forest Park by gender. Where male visitors are more numerous, namely 82 people (55%), and females as many as 68 people (45%), based on age, tourist visits range from 21-40 years; from these age characteristics, it can be seen that tourist visits are still relatively productive. This is closely related to a person's stamina to carry out natural tourism activities where the topography is quite steep (hilly).

Table 1. Data and research variables on the economic value of nature tourism

Data components	Substance
Direct economic value of tourism goods/services	Total of visits Travel costs Visitor characteristics (gender and age) Origin of visitors Length of visit
Water use value (Direct and indirect use/existence)	Identification of water user households (domestic) Identify commercial water businesses Volume of water use Agricultural land
Carbon conversion	Forest cover area (primary and secondary)

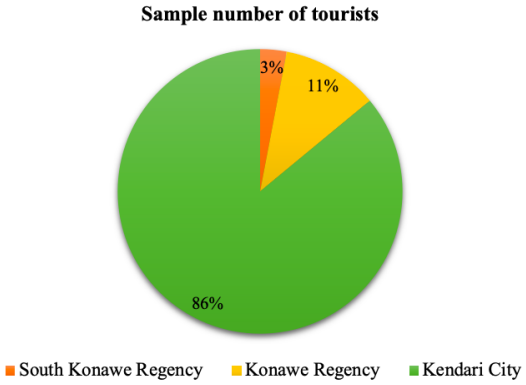

Figure 1. Percentage of the sample number of tourists according to regional origin

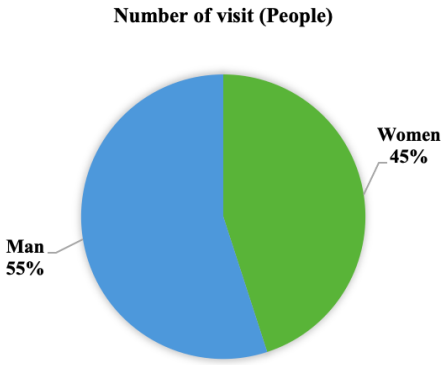

Figure 2. Percentage of sample number of tourists by gender

Sample of water user

The sample of water users is taken from the total number of people. There are 1,451 households (people) who use water sourced from the Nipa-Nipa Grand Forest Park. The number consists of 695 people in Kendari City and 756 people in Konawe District.

Sample of irrigation water users

Farmers identified for the calculation of the economic value of irrigation water utilization in the Nipa-Nipa Grand Forest Park area are 78 people. The total area of irrigated rice fields is around 102 ha.

Data collection and analysis

Research data was collected through field surveys, observations, and questionnaires and supported by literature studies (secondary sources). The data obtained was then analyzed, as explained below.

Economic value according to a total of visits

Starting from projecting the number of visits based on data on the number of visits per 1,000 residents in each tourist area of origin. The total of visits per 1,000 residents is calculated using the equation:

$$TV1000i = \frac{\left(\frac{TSi}{TNV}\right)TP2020\ x1.000}{TRi} \quad \text{(i)}$$

Where: TV1000*i*: total of visits/1,000 residents/year from zone *i*, TSi: total of samples /1,000 inhabitants/year from zone *i*, TNV: total number of visitors, TP2020: total of visits in the year of observation, TR*i*: total of residents of zone *i* in the year of observation.

Estimate the average total travel costs per 1,000 residents of all zones (where tourists come from) using the equation:

$$U = \int_0^y f\ (Y)\ dy \quad \text{(ii)}$$

Where: U: average total trip cost, F(Y): tourism demand function, *a*: average number of visits per 1,000 residents.

Determining consumer surplus per 1,000 population is the total willingness to pay minus (-) the value paid. Determining the total tourism value or total economic value (TEV) using the equation:

$$TEV = \frac{Average\ value\ x\ Population}{1000} \quad \text{(iii)}$$

Direct economic value according to the use of water resources

Direct use value analysis in the research was obtained from household water use. Data on the value of clean water availability or sources, volume of water demand, water procurement costs, and willingness to pay for environmental services (WTP) for water (Rodríguez-Tapia et al. 2017). The amount of domestic water demand can be calculated using a market engineering approach, namely the method of calculating the Economic Value of Household Water Utilization (NART for Indonesia) (Kusumaningsih et al. 2022) with the following equation:

$$NART = RTPA \times JA \times KP \times HAS \quad \text{(iv)}$$

Where: NART: economic value of household water utilization (IDR/year), HUW: number of households using water (head of family), TFM: average total of family members (person), WC: average water consumption (m^3/ household /month), SPW: the standard price of water (IDR /m^3).

The next step is calculating the estimated average usage value based on Willingness to Pay for water (WTP) services. WTP is calculated using the equation (Hasddin

2019; Platania and Rizzo 2018; Ramdas and Mohamed 2014; Yang et al. 2022).

$$EWTP = \sum_{i=1}^{n} WiPfi \quad \text{(v)}$$

Where: EWTP: estimated average WTP, Wi: WTP value *i*, Pfi: relative frequency, n: total of respondents, i: Respondent *i*, who is willing to make payment.

After estimating the median WTP value, the total TWTP value of the household can be estimated using the formula (Hasddin 2019; Platania and Rizzo 2018; Ramdas and Mohamed 2014; Yang et al. 2022).

$$TWTP = \sum_{i=1}^{n} WTPi \left(\frac{ni}{N}\right) P \quad \text{(vi)}$$

Where: TWTP: total WTP (IDR), WTPi: WTP of individual sample *i*, ni: the total of samples who are willing to pay the WTP, N: total of samples, P: total population, I: respondent *i*, who is willing to pay the contribution payment.

Indirect economic value (existence value) of agricultural irrigation

Agricultural economic value is an indirect value of the existence of water resources for agricultural activities in the Nipa-Nipa Grand Forest Park area. Calculate the use value of water for agricultural irrigation/VWAI (NAUT for Indonesia) using the equation:

$$VWAI = ALC \times WSC \times PSY \quad \text{(vii)}$$

Where: VWAI: useful value of water for agricultural irrigation (IDR), ALC: the area of land cultivated (ha), WSC: water supply costs (IDR/ha/planting season per year), PSY: planting season every year

Economic value of carbon sequestration

The economic value of carbon sequestration is calculated using the equation:

$$CAV = [(Pf \times Sf) + (Apcs \times Kcs)] \times Cp \quad \text{(viii)}$$

Where: CAV: carbon absorption value (IDR), Pf: primary forest area (ha), Sf: secondary forest area (ha), Apc: ability to absorb primary forest carbon (ton/ha), Ksc: ability to absorb secondary forest carbon (ton/ha), Cp: carbon price (IDR/ton).

The carbon value calculation is converted based on the assumption of an average value of carbon savings. This conversion standard refers to the opinion of Brown & Pearce in May (Kossoy and Guigon 2012) that in primary natural forests, the average carbon store is 283 tonnes/ha, in secondary forests 194 tonnes/ha, and in open forests 115 tonnes/ha; the value of 1 ton of carbon is assumed to be USD.5. Another allowance is the World Bank standard, USD.10 ton/ha (Kossoy and Guigon 2012). The final value is the Nipa-Nipa Grand Forest Park area's total economic value (TEV). The value is obtained from the summarized economic value of tourism, water, and carbon absorption.

RESULTS AND DISCUSSION

The economic value of tourism according to the total of visitors

According to data from the Nipa-Nipa Grand Forest Park Management, 3,652 tourists visited. This number came from Kendari City, Konawe District, and South Konawe District, which have a population of around 269,339 people. Then, the data is transformed by the percentage of research respondents as a percentage of the number of tourist visits in the previous year into a prediction of the number of visitors from the region (zone). After that, find the number of visitors per 1,000 residents by dividing the number for each zone by the number per 1,000 residents. The assumed results for the highest number of visits came from Kendari City at 3,116 people or 91.03 visits per 1,000 population, followed by Konawe and South Konawe. The analysis is presented in Table 2.

Next is the estimated cost of tourist travel per day, as presented in Table 3. It is known that for 158 (rounded from 158.22) people per 1,000 population, the average total cost of tourist travel per day is around IDR.842,755; these include the required costs during the trip (consumption) and transportation costs. The total cost of the trip is generated from the average monthly income (in Rupiah), which is IDR.11,204,306, with an average visit time at the tourist spot of around 98.08 hours.

Determining the total economic benefit value of tourism in the Nipa-Nipa Grand Forest Park (from the value of willingness to pay, the value paid, and consumer surplus) is based on travel costs and built with the assumption that other variables are constant (in this case, the average value is used). The summary of the results of calculating the total value of economic benefits from tourism in question is presented in Table 4.

The calculation results in Table 4 above show that the value paid (IDR1,319,767.68) is smaller than the visitor's willingness to pay (IDR1,444,903.88), resulting in a surplus. Finally, the economic benefit of tourism activities in the Nipa-Nipa Grand Forest Park is IDR355,464,907.16 per year. The paid-price was still below what visitors are willing to pay because several visitors pay travel costs that are still below the average cost during their visit. The lower the value paid compared to the willingness to pay, it will be easy to maximize entry ticket pricing (market demand for recreation).

Estimating the visits per 1,000 residents with different ticket price levels is obtained by entering new costs into a linear equation. The new cost referred to in this research is the sum of the average travel cost and the specified ticket price. Then, to find out the number of visitors in one year from each zone with different ticket prices, the visit rate per 1,000 residents is converted into the number of visitors based on the population of each zone as a multiplying factor. From the calculation results, the number of visitors in one year from each zone with different ticket prices is obtained, as shown in Table 5.

Table 5 shows that the higher the ticket price set, the lower the number of visits per 1,000 residents from each zone where visitors come from. At that time, the ticket

price was set at IDR6,000. This price is warned that there is no longer a visit rate per 1,000 residents from zones V, VII, and X. Meanwhile, currently, the ticket price is set at IDR33,000 with the assumption that there is no longer a level of visits per 1,000 residents from each regional zone where visitors come from.

Table 5 provides information on the estimated number of visitors for one year with the ticket prices set above so that the demand curve for natural tourism in the Nipa-Nipa Grand Forest Park can be depicted. This curve uses the number of visitors as the ordinate axis (X-axis), and ticket prices are determined as the abscissa axis (Y-axis). The demand curve for natural tourism for one year is obtained in Figure 3. Based on the demand curve above, it can be seen that the higher the costs incurred, the lower the number of visitors will be. Ticket prices on this curve indicate the availability of costs visitors incur to get tours at the Nipa-Nipa Grand Forest Park Nature Tourism Park. If the costs incurred are IDR33,000, the number of visitors will reach zero.

Table 2. Number of visits/1,000 population

Region (zone)	Amount population (people)	Sample (people)	Prediction of total of visitors (people)	Visits per 1,000 population (people)
Kendari City	236,091	128	3,116	91.03
Konawe District	14,283	17	414	60.77
South Konawe District	18,965	5	122	6.42
Total	269,339	150	3,652	158.22

Table 3. Number of tourist visits by zone, average total costs, income, and length of visit

Region (zone)	Visits per 1,000 population	Amount average travel cost from each zone (IDR/person)	Average income per month (IDR)	Length of tourist visit (hours)
Kendari City	91.03	600,880.23	7,507,877	68.37
Konawe District	60.77	146,875.00	2,946,429	21.71
South Konawe District	6.42	95,000.00	750,000	8.00
Total	158.22	842,755.23	11,204,306	98.08

Table 4. Calculation results of the total economic benefit value of tourism

Economic benefit value	Average cost per 1,000 residents (IDR/visit)	Population	Amount value (2x3)/1000 (IDR/year)
Willingness to pay	1,444,903.88	269,339	389,168,966.14
Value paid	1,319,767.68	269,339	355,464,907.16
Consumer surplus	125,136.88	269,339	33,704,242.12

Table 5. Calculation results of estimating the total number of visitors in one year at ticket prices set

Ticket Price (IDR)	Region/zone										Total visitors (people)
	I	II	III	IV	V	VI	VII	VIII	IX	X	
0	958	776	291	495	184	356	162	107	282	80	3692
3,000	824	687	222	384	91	240	66	91	256	24	2884
6,000	690	598	152	273	0	125	0	75	229	0	2141
9,000	556	510	82	161	0	0	0	59	202	0	1570
12,000	422	421	13	50	0	0	0	42	176	0	1124
15,000	288	333	0	0	0	0	0	26	149	0	796
18,000	154	244	0	0	0	0	0	10	122	0	530
21,000	20	156	0	0	0	0	0	0	96	0	271
24,000	0	67	0	0	0	0	0	0	69	0	136
27,000	0	0	0	0	0	0	0	0	42	0	42
30,000	0	0	0	0	0	0	0	0	16	0	16
33,000	0	0	0	0	0	0	0	0	0	0	0

Note: Zone I: West Kendari Sub-District, Zone II: Kendari Sub-District, Zone III: Kambu Sub-District, Zone IV: Poasia Sub-District, Zone V: Baruga Sub-District, Zone VI: Mandonga Sub-District, Zone VII: Wua-Wua Sub-District, Zone VIII: Lalonggasumeeto Sub-District, Konawe District, Zone IX: Soripia Sub-District, Konawe District, Zone X: Ranomeeto Sub-District, South Konawe District

Economic value of tourism according to the use of water resources

The economic assessment of water resources assigns a monetary value (IDR) to some or all potential water resources in the Nipa-Nipa Grand Forest Park. The value considered is water that is used/beneficial for the community and the wider community. Calculate the economic assessment (environmental services) of Nipa-Nipa Grand Forest Park based on value-forming components: direct use value, existence value, and total economic value.

Direct use value

The Nipa-Nipa Grand Forest Park is an upstream area that functions as a water catchment area that can control or regulate the flow of river and spring water around the area. The community uses water resources to meet household water needs. As presented in Table 6, five water sources are used by communities around the area. Based on Table 6, it is known that the majority (64.78%) of the people living in the Nipa-Nipa Grand Forest Park area use springs as a source of household water needs such as cooking, drinking, bathing, stealing, toilets, and other agricultural activities. The data above also showed that around 16.88% of respondents met their household water needs from wells and rivers (13.44%), and the others were from wells and springs as well as wells and rivers. The average depth of respondents' wells ranged from -2-4 meters (m). The volume of water used varies from one family head to another. This difference is based on differences in the number of family members, meaning that the more family members there are in an area, the more water will be used to meet their daily needs. Likewise, the volume of water the community uses is the total water requirement the surrounding community uses to meet their individual needs.

The average amount of water needed in this study is the number of family members of each respondent interviewed who also use the spring. The average water needs of respondents in the Nipa-Nipa Grand Forest Park area are in Table 7. Average daily water use is dominated by 1-2 (m^3/day) or 75.88%, while the lowest is >8 (m^3/day) or 2.14%.

The cost of providing community water in the Nipa-Nipa Grand Forest Park ranges from IDR500 to > IDR 2,500 m^3. Meanwhile, some communities do not need money for water procurement; usually, the community takes water directly from the water source. Respondents' costs for water procurement can be presented in Table 8. This table shows that most of the population requires costs above IDR2,500/m^3 to procure water, while some residents require IDR500-2,500 to procure water for domestic needs.

The community's willingness to pay for water environmental services is based on interview results, which show that all communities are willing to pay for the sustainability of water environmental service products (Bhat and Sofi 2021). The amount the community is willing to pay for the sustainability or availability of water environmental service products in Nipa-Nipa Grand Forest Park varies from IDR 5,000/month/head of household to IDR 100,000/month/head of household. The complete distribution of Willingness to Pay (WTP) values is presented in Table 9. This table shows that the value offered by the community and willingness to pay for water environmental services ranges from IDR0-100,000, with the highest percentage of people's willingness to pay IDR5,000, as many as 653 people. In comparison, the lowest percentage of people's willingness to pay was IDR70,000 for as many as 3 people. Furthermore, the community will pay IDR50,000 for water environmental services for 245 families, or 16.88%.

Table 6. Community water sources in fulfilling household water needs from water resources

Water sources	Amount (head of family)	Percentage (%)
Water springs	940	64.78
Wells and springs	45	3.10
Wells and rivers	26	1.79
Rivers	195	13.44
Wells	245	16.88
Total	1.451	100.00

Table 7. Average water used daily

Average water requirement (m^3/day)	Amount (head of family)	Percentage (%)
1-2	1,101	75.88
3-4	119	8.20
5-6	163	11.23
7-8	37	2.55
>8	31	2.14
Total	1,451	100.00

Table 8. Costs of providing community water

Water procurement costs (IDR/m^3)	Amount (head of family)	Percentage (%)
Don't pay	47	3.24
500-1,000	3	0.21
1,000-1,500	2	0.14
2,000 -2,500	5	0.34
>2,500	1,394	96.07
Total	1,451	100.00

Table 9. Respondents' willingness to pay for water environmental services

Willingness to pay for water (IDR/Month)	Amount (head of family)	Percentage (%)
0	41	2.83
5,000	653	45.00
10,000	83	5.72
15,000	110	7.58
20,000	46	3.17
25,000	117	8.06
30,000	52	3.58
40,000	96	6.62
50,000	245	16.88
70,000	3	0.21
100,000	5	0.34
Total	1,451	100.00

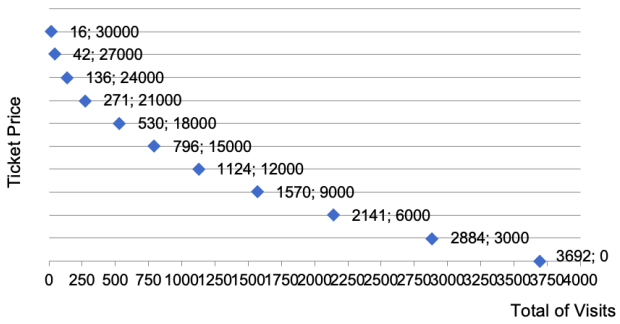

Figure 3. Demand curve for nature tourism parks in the Nipa-Nipa Grand Forest Park

The calculation of the community's willingness to pay for the use of water resources in this research is water sourced from springs and rivers in the Nipa-Nipa Grand Forest Park area, which is spread across 32 villages in 5 sub-districtts, namely Kendari, West Kendari, Mandonga (Kendari City), Lalonggasumeeto, and Soropia Sub-Districts (Konawe District). The direct value of the Nipa-Nipa Grand Forest Park water source is that it is used for domestic household needs such as cooking, drinking, washing, and bathing.

The results of the analysis of the magnitude of respondents' household water needs can be calculated using a market engineering approach, namely the NART equation (equation iv). The basic price of water used is equivalent to the standard water price set by the Tirta Anoa Kendari Regional Drinking Water Company (PDAM- Tirta Anoa) as a provider of clean water using a market technique approach, namely IDR5,000/m^3. Analysis of water use for household needs was carried out on 1,451 families spread across 32 villages. The results of the analysis of the value of water use for domestic household needs around the Nipa-Nipa Grand Forest Park are presented in Table 10. This table shows that the total economic value of water for domestic household needs in the Nipa-Nipa Great Forest Park area is IDR30,187,993,200/year or around IDR2,515,666,100/month. The water value in question is an assessment (valuation) of the water contained in the Nipa-Nipa Grand Forest Park area in the form of money (IDR).

Table 10. Value of water used for domestic household needs around

Villages	Amount (head of family)	Average amount of family members (people)	Average water consumption (m^3/household/month)	Standard price of water (IDR/m^3)	Economic value of household water use/NART (IDR/month)
Kendari City					
Gunung Jati	49	4	84.18	5,000	82,496,400
Mangga Dua	49	4	100.10	5,000	98,098,000
Mata	49	3	45.92	5,000	33,751,200
Purirano	49	3	50.51	5,000	37,124,850
Benu-Benua	7	3	79.29	5,000	8,325,450
Kemaraya	39	3	97.04	5,000	56,768,400
Lahundape	7	4	130.71	5,000	18,299,400
Ponggaloba	41	4	101.94	5,000	83,590,800
Sanua	35	4	72.55	5,000	50,785,000
Sodoho	49	4	76.84	5,000	75,303,200
Tipulu	39	4	64.74	5,000	50,497,200
Watu-Watu	45	4	95.43	5,000	85,887,000
Bumi Indah	49	4	73.16	5,000	71,696,800
Lalomboda	49	4	113.57	5,000	111,298,600
Niitanasa	49	3	74.39	5,000	54,676,650
Rapambinopa	49	4	87.86	5,000	86,102,800
Toli-Toli	49	4	109.9	5,000	107,702,000
Wawobungi	49	5	120.31	5,000	147,379,750
Alolama	49	5	62.14	5,000	76,121,500
Angilowu	49	4	105.61	5,000	103,497,800
Labibia	49	5	71.94	5,000	88,126,500
Mandonga	49	4	64.59	5,000	63,298,200
Wawombalata	41	4	56.63	5,000	46,436,600
Konawe District					
Atowu	49	4	93.37	5,000	91,502,600
Bajo Indah	49	3	123.37	5,000	90,676,950
Mekar	49	4	70.71	5,000	69,295,800
Sawapudo	56	4	71.79	5,000	80,404,800
Soropia	49	5	81.73	5,000	100,119,250
Sorue Jaya	56	4	78.21	5,000	87,595,200
Tapulaga	49	4	123.37	5,000	120,902,600
Telaga Biru	56	4	145.18	5,000	162,601,600
Waoraha	49	4	76.84	5,000	75,303,200
Amount/month					2,515,666,100
Per year					30,187,993,200

WTP*i* can be estimated by calculating the average value of the total WTP value divided by the number of people as users. The estimated average WTP is divided by the EWTP formula (equation v). The community's estimated WTP (EWTP) value is calculated based on respondents' WTP distribution data. This data grouping uses an interval scale, namely the Struges rule (Nasution et al. 2015). The respondent's WTP class is obtained by first determining the lowest to highest WTP value offered to the respondent (Table 9). The distribution of WTP/EWTP of water user respondents in the Nipa-Nipa Grand Forest Park can be presented in Table 11. This table shows that the average WTP (EWTP) value is IDR13,253.15/Head of family/ Month, which is the willingness to pay for the community around the Nipa-Nipa Grand Forest Park area. Data is added by converting the median value of the offer to the total population in question. After estimating the median WTP value, the WTP value of the household can be estimated using the formula in equation vi.

The respondent's total value (TWTP) is calculated based on the respondent's WTP distribution data. This data grouping uses an interval scale (Nasution et al. 2015). Table 12 shows the number of WTP of community respondents regarding payment for spring environmental services. The average value (EWTP) of willingness to pay for environmental services for water use per household head is then calculated to obtain the total WTP value. The calculation results in Table 12 yielded a total WTP (willingness to pay) value of IDR464,623,847.21/month or about IDR5,575,486,166.52 annually, which is the total willingness to pay of the community in the Nipa-Nipa Grand Forest Park area. This means that the total economic value of community environmental services in the use of water in Nipa-Nipa Grand Forest Park is IDR5,575,486,166.52 per year.

Existence value (indirect use) of agricultural irrigation and commercial business

The economic value of using water for irrigation in the Nipa-Nipa Grand Forest Park area is based on research results from 78 informants. The area of cultivated land is around 102 ha. Water procurement costs range from IDR50,000 to IDR200,000 annually, with an average harvest frequency of 2 times annually. The land area of each community varies, so the average cost of providing water per person annually is calculated, resulting in approximately IDR70,513 per person and IDR24,755 per harvest. Thus, the total procurement cost for arable land (102 ha) is IDR5,050,020 annually. Next, calculate the value of water used for agricultural irrigation using the NAUT/VWAI equation (equation vii) thus:

VWAI = 102 x24,755 x 2 = 5,050,020

The economic value of using water for agricultural land in the Nipa-Nipa Grand Forest Park area is IDR5,050,020. Irrigation water is water taken from rivers or springs through irrigation canals and channeled to agricultural land to maintain water balance and agricultural interests. It can come from surface rainwater or rivers. Utilizing irrigation water in this area is a water requirement that farmers use to determine planting patterns.

The benefit of water resources in the Nipa-Nipa Grand Forest Park area is that apart from being used for agricultural needs, the community also uses the water for commercial businesses, namely selling tower water per 1,200 L, refilling gallon water (19 L) and making ice cubes. The value of water used for commercial businesses, water refills, and ice cubes can be presented in Table 13. Based on this table, the economic value of water used from selling refilled water (tendons) and ice cubes is IDR 7,970,310,000 annually. Based on this information, the economic value of the existence of water utilization in the Nipa-Nipa Forest Park for agricultural irrigation and commercial businesses (sales of tower water, refillable gallon water, and ice cubes) is IDR. 7,975,810,000/year.

Table 11. Distribution of WTP/EWTP by spring user communities

Willingness to pay (IDR/head of family/month)	Frequency of respondents (people)	Relative frequency (Pfi)	WTP/EWTP (IDR/month)
0-14,286	737	0.508	0.00
14,287-28,573	337	0.232	3,318.21
28,574-42,860	136	0.094	2,678.20
42,861-57,147	235	0.162	6,941.65
57,157-71,433	2	0.001	78.78
71,434-85,720	0	0.000	0.00
85,721-100,000	4	0.003	236.31
Total WTP	1,451	1.000	13,253.15

Table 12. Total WTP of community respondents regarding payments for water resources and environmental services

Willingness to pay (IDR/Head of Family//Month)	EWTP	Middle value	Ni	N	Population*	Value (IDR/month)
0-14,286	13,253.15	7,143.0	737	1,451	22,780	82,648,399.02
14,287-28,573	13,253.15	21,430.0	337	1,451	22,780	113,380,502.96
28,574-42,860	13,253.15	35,717.0	136	1,451	22,780	76,260,595.01
42,861-57,147	13,253.15	50,004.0	235	1,451	22,780	184,484,089.04
57,157-71,433	13,253.15	64,295.0	2	1,451	22,780	2,018,800.96
71,434-85,720	13,253.15	78,577.0	0	1,451	22,780	0.00
85,721-100,000	13,253.15	92,860.5	4	1,451	22,780	5,831,460.21
Total/Month						464,623,847.21
Annual Average						5,575,486,166.52

Note: **Total Number of Heads of Families in 32 Villages (research locations)

Total economic value of water resources

Techniques for calculating total economic value and resource valuation have been widely described for the Indonesian case, among others, by Sihite (2001), Suparmoko (2008), Roslinda et al. (2017), and Roslinda and Yuliantini (2014). Total economic value calculates the total economic value of water in the Nipa-Nipa Grand Forest Park area by adding up values such as direct use and existing benefits. The economic value/benefit of water in the Nipa-Nipa Grand Forest Park area is presented in Table 14.

The assessment of the total value of water use in the Nipa-Nipa Grand Forest Park area is calculated using the concept of total economic value, namely adding up all the benefit values. So, the estimated total economic value of water use in the Nipa-Nipa Grand Forest Park area is IDR38,163,803,200 annually.

By obtaining the total economic benefit value from using water resources in the Nipa-Nipa Grand Forest Park area, it is hoped that it can be used as a reference for the community in managing and utilizing springs in the Nipa-Nipa Great Forest Park. The economic value shows that the area has quite large beneficial values that can support the lives and even the economy of the people around the area. In this way, the community is expected to be able to support each other and work together to maintain and preserve the existence of water in the Nipa-Nipa Grand Forest Park.

Economic value of carbon sequestration

The data show that the land cover area of the Nipa-Nipa Grand Forest Park is 7,395.28 Ha. The existing land cover is primary forest covering an area of 6,391.20 ha and secondary forest covering an area of 1,004.08 ha. The land cover area is presented in Table 15.

The carbon uptake value calculation from the land cover area uses the World Bank standard assumption of USD10 US/ton/ha. The carbon conversion value of the land area in the Nipa-Nipa Grand Forest Park is calculated as follows (referring to equation viii):

(i) Primary forest
= 6,391.2 x 283 x 5 x 14,796.40
= IDR133,811,953,627.20

(ii) Secondary forest
= 1,004.08 x194 x 5 x 14,796.40
= IDR14,411,066,232.64

So, the economic benefit value of carbon absorption is IDR148,223,019,859.84.

The value of the carbon absorption benefits of the Nature Tourism area in the Nipa-Nipa Grand Forest Park is around IDR148 billion annually, which is quite a large benefit value provided to the community in general from maintaining the quality of the forest ecosystem in the Nipa-Nipa Grand Forest Park. As a tropical natural forest, this area has the vital function of supporting life and absorbing carbon gas emissions, which are very detrimental to many people.

If these values can be translated into real value, it will greatly contribute to the Nipa-Nipa Grand Forest Park, especially management costs. The value of these benefits will increase if the world community (leaders of countries in the world) continues to commit to increasing the value of the carbon market. This assumption is very likely to occur so that the value of environmental services from the existence of the Nipa-Nipa Grand Forest Park will increase, which will ultimately provide economic benefits from upstream to downstream.

Table 15. Area of forest cover in the Nipa-Nipa Grand Forest Park, Southeast Sulawesi, Indonesia

Land cover types	Land area (ha)	Percentage (%)
Primary forest	6,391.20	86.42
Secondary forest	1,004.08	13.58
Total	7,395.28	100.00

Table 13. Value of water use for commercial businesses, water refills, and ice cubes per month

Type of business	Sold per month (L)	Unit	Price (IDR)	Water procurement costs (IDR/m^3)	Cost of water procurement costs (IDR/m^3/month)	Water value (IDR/year)
Commercial (seller of 1,200-liter tank water)	7,320	Piece	50,000	3,000	21,960,000	4,128,480,000
Refill gallon water (19 L)	2,550	Piece	4,000	2,500	127,500	3,626,100,000
Ice	9,000	Seeds	2,000	2,500	22,500	215,730,000
Total water value						7,970,310,000

Table 14. Total value/economic benefits of water

Water utilization	Value/benefits (IDR/year)	Percentage (%)
Domestic Household	30,187,993,200	79.10
Agricultural Irrigation	5,500,000	0.01
Commercial (Seller of 1,200-liter tank water)	4,128,480,000	10.82
Refill Gallon Water (19 L)	3,626,100,000	9.50
Ice	215,730,000	0.57
Total	38,163,803,200	100.00

Table 16. Total economic benefit value of environmental services

Benefit value	Value (IDR/year)
Tourism benefit value (value paid)	355,464,907.16
Value of water resources	38,163,803,200.00
Carbon absorption value	148,223,019,859.84
Total	186,742,287,967.00

The vegetation composition shows most of the Nipa-Nipa Grand Forest Park is of three types: Eha (*Castanopsis buruana*), Pooti (*Hopea gregaria*), and Sisio (*Cratoxylon formosum*). With this assumption, the carbon uptake value produced is the absorption capacity of vegetation for the three types in question. Therefore, conservation measures for these species are necessary.

The total value of economic benefits in the Nipa-Nipa Grand Forest Park

Based on all calculations of the total economic benefit value of environmental services from the development of natural tourism in the Nipa-Nipa Grand Forest Park, the total benefit value can be obtained as presented in Table 16. This table shows that the total economic benefit value (TEV) of Nipa-Nipa Grand Forest Park is IDR 186,742,287,967.00 annually. This value is more dominant than the carbon conversion value (79.37%). The second largest value is the use of water resources, amounting to IDR38,668,943,200.00 annually or (20.44%). Meanwhile, the value of tourism benefits in general is still low (0.19%), which comes from the value paid by tourists based on the average cost of tourist visits per 1,000 residents. This low tourism benefit value because no ticket costs are included in the average travel costs for tourist visitors. The economic value obtained from using natural resources in the area can be achieved by implementing inputs (management models) so that natural tourism management remains sustainable. Inputs based on research results are as follows: (i) determination and implementation of entrance ticket rates for natural tourist attractions; (ii) implementation of water use fees by communities around the area; (iii) investment in the use of environmental services to reduce global warming; (iv) investment in tourism; (v) determination of regional regulations regarding entrance ticket levies; and vi) good service to natural tourism visitors.

The total economic value of environmental services from the development of natural tourism in the Nipa-Nipa Grand Forest Park is IDR186,742,287,967.00 annually, equivalent to USD11,694,269.91 (assuming USD1= IDR15,968.70). Compared with Southeast Sulawesi Province's Gross Regional Domestic Product (GRDP) at Constant Prices in 2023, this economic value equals 40% of the GRDP for the Forestry business sector (IDR466,850,000,000).

Discussion

The total economic value of environmental services from the development of natural tourism in Nipa-Nipa Grand Forest Park is USD 11,694,269.91 per year. The greatest value is generated from the carbon absorption conversion value of 79.37% and then the value of water resource use of around 20.44%. The economic value of environmental services from tourism activities according to the number of visits is still relatively small, namely 0.19% of the total economic value.

The large value of environmental services developing of natural tourism in the Nipa-Nipa Grand Forest Park theoretically emphasizes the important role of environmental services in the economy and human survival in general. At a practical level, for policymakers to be careful in adopting development policies that could have bad consequences for the Nipa-Nipa Grand Forest Park ecosystem, it would be better than now to formulate a sustainable management model based on the data found in this research. For local communities, practitioners, and environmental activists to work together to build awareness and concrete efforts to preserve the Nipa-Nipa Grand Forest Park.

The analysis estimates that the total economic value of environmental services in the Nipa-Nipa Grand Forest Park, based on tourist visits, water resource utilization, and carbon absorption, is significant-equivalent to 40% of the Gross Regional Domestic Product (GRDP) of the forestry sector in Southeast Sulawesi Province. This highlights the crucial role of environmental services in both the economy and human survival.

The weakness of this research lies in the cross-sectional type of data, namely observational results at a certain time of the observed variables. The second weakness is that the carbon uptake calculation data is limited to the area of vegetation so it could be stronger in generalizing vegetation. We highly recommend using longer time series data in future studies to address and enhance the current research. This approach holds great potential to overcome the limitations of cross-sectional data and provide a more comprehensive understanding of the observed variables. Additionally, we suggest calculating the conversion of carbon uptake according to vegetation type. Identifying sources of carbon absorption and other carbon reserves is crucial, as this will allow us to visualize the balance curve between reserves and carbon absorption capacity, further enhancing our research outcomes.

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