Willingness To Participate in a Payment for Environmental Services Program and Preferences of Downstream Water Beneficiaries for The Conservation of the North Batukliang Forest Area of Central Lombok, Indonesia

Addinul Yakin, Amiruddin, L. Sukardi, Halimatussya'diyah

Study Program of Agribusiness, Faculty of Agriculture, University of Mataram, Indonesia

DOI: https://doi.org/10.47772/IJRISS.2026.101000078

Received: 12 October 2026; Accepted: 17 October 2026; Published: 29 October 2026

ABSTRACT

Most of the water used for households, irrigation, and tourism on Lombok Island is derived from the forests of the Mount Rinjani landscape, but downstream beneficiaries contribute little to the maintenance of these hydrological services. The study investigated the willingness of downstream water beneficiaries to participate in PES program and their preferences over payment mechanisms in the North Batukliang forest area, Central Lombok, Indonesia. A survey of 120 beneficiaries (tourists, forest-adjacent households, irrigation farmers, and piped-water utility customers) selected by multi-stage purposive and quota sampling was supplemented by key informant interviews. A binary logistic regression model was used to estimate the determinants of willingness to participate. Almost all respondents (98%) identified water from the Rinjani forests as a source of their water and rated the area as very important. The model was statistically significant ($\chi 2$ (6) = 58.73, $p < 0.001$) and showed a good fit (Nagelkerke R2 = 0.527; Hosmer–Lemeshow p = 0.899; 79.2% of cases correctly classified). Water dependency (OR = 42.94), monthly income (OR = 5.10) and perceived importance of the forest area (OR = 5.55) significantly increased the odds of participation, whereas age, education, and distance from the water source were non-significant. Respondents preferred collecting contributions via water-utility bills (90%) and water-user associations (82.5%), and preferred volume-based charges to flat-rate charges (62.5% vs 37.5%). The findings support a differentiated, bill-based PES scheme focusing on the most dependent users, based on the existing PES experience in Lombok, and combining payments with awareness-raising and transparent reporting.

Keywords: payment for environmental services, willingness to participate, binary logistic regression, watershed services, beneficiary-pays principle, Mount Rinjani, Lombok

INTRODUCTION

The Mount Rinjani landscape connects social dynamics, economic developments, and environmental conservation in complex ways. Mount Rinjani National Park was established in 1997 and covers an area of some 41,330 hectares, but conservation efforts have been hampered by lack of funding and enforcement capacity. Furthermore, important catchment forests lie outside the park boundary in protection forests, buffer zones, and community-managed areas such as the North Batukliang forest in Central Lombok. Forest quality is reflected by its ecological functions (Fang et al., 2023), of which the hydrological function is the most important for the people living around and downstream of the forest (Yakin, 2015). Tropical montane forests regulate flow, sustain dry-season baseflow, limit erosion, and protect water quality (Bruijnzeel, 2004), and a sound understanding of these functions is fundamental to development that integrates environmental, economic, and social benefits (Wang & Tian, 2023).

The Rinjani forests, including the ones in North Batukliang, are the primary source of Lombok's water supply (Rinjani Geopark, 2017). Water percolating through forested catchments is generally less contaminated than runoff from agricultural, urban, or industrial land (Abdullah et al., 2022). Forest cover is important in reducing the costs of drinking water production (Abildtrup et al., 2013). There's pressure on this supply. Parts of the Rinjani landscape have been degraded by encroachment, illegal logging, and conversion to agriculture (Yakin,

2005) and Lombok already experiences seasonal water stress: in the 2023 dry season, the discharge from the sources of the Central Lombok water utility (PDAM) fell by about half (Lombok Post, 2023) and in September 2026 a clean-water supply failure on Gili Trawangan forced hundreds of tourists to leave early (RRI, 2026). This leads to interruptions in supply, increased treatment costs due to sedimentation, flood risk, and the possibility of conflict over water for downstream users.

The hydrological services provided by Rinjani have significant economic value for hotels, farmers, water utilities, bottled-water producers, and urban households, and tourism based on the area generates income, employment, and infrastructure (Ratman, 2016). But these beneficiaries contribute little to maintaining the services they benefit from, free riding on conservation done, often at their own cost, by upstream communities. The beneficiary-pays principle establishes that those who benefit from environmental services should pay for their maintenance (Porras et al., 2008; Salzman et al., 2018). In their absence it is the communities around forests, often the poorest stakeholders, that disproportionately bear the cost of conservation, creating an equity problem that also undermines the effectiveness of conservation (Pascual et al., 2014)

This principle is increasingly recognized in Indonesian law. The Law No. 32/2009 on Environmental Protection and Management (Government of Indonesia, 2009) mandates the development of economic instruments for environmental conservation by the central and regional governments, and the Government Regulation No. 46/2017 on Environmental Economic Instruments (Government of Indonesia, 2017) recognizes payment for environmental services as one such incentive. Lombok provides a clear precedent: West Lombok Regency Regulation No. 4/2007 established a mandatory scheme where PDAM customers pay a small surcharge that is passed on by a multi-stakeholder body to upstream community groups for forest rehabilitation (Prasetyo et al., 2009). The scheme has been described as a hybrid of Coasean and Pigouvian approaches with marginal poverty-alleviation effects (Diswandi, 2017). In particular, Indonesian PES programs continue to be hampered nationally by complicated institutional and fiscal arrangements (Fauzi & Anna, 2013; Suich et al., 2017), as well as by their impermanence once external funding ends (Erbaugh, 2022). There is no similar scheme for the North Batukliang catchment in Central Lombok, as yet.

Conservation payments to maintain forest ecosystem services are usually far cheaper than engineered alternatives like dams, deep wells, desalination, or further sediment treatment, which require heavy capital and operating costs on an island like Lombok. Protection of source watersheds costs a fraction of such alternatives and provides co-benefits for biodiversity, carbon, recreation, and culture (Dudley & Stolton, 2003; Abell et al., 2017). Because the Rinjani forests also store substantial carbon, watershed payments could be bundled with carbon finance to generate multiple sources of income (van Noordwijk et al., 2012), in line with recent calls for multi-targeted payments that balance hydrological and other forest services (Asbjornsen et al., 2022).

PES is a voluntary conditional transaction between users and providers of an environmental service (Wunder, 2015), which seeks to reconcile conservation with the economic interests of the actors involved (Guerra & Ranieri, 2023). PES works best when all beneficiaries and related actors are engaged (Alaoui et al., 2022). By 2018 there were more than 550 active PES programs worldwide, and watershed schemes were the most common (Salzman et al., 2018). The evidence on their performance is mixed, with effects often being modest and context-dependent (Börner et al., 2017), and with environmental and anti-poverty goals sometimes being in conflict (Jayachandran, 2023). A recent global review found that most programs struggle to perform across all dimensions of sustainability (Le et al., 2024a, 2024b). Hence, design choices related to targeting, conditionality, payment level and governance are very important (Engel et al., 2008; Wunder et al., 2018). In Asia, most PES schemes are oriented toward watershed management and include a variety of approaches from regulatory to decentralized and participatory (Pham et al., 2013; Leimona et al., 2015).

Most empirical work on PES participation is on service providers rather than buyers (Jones et al., 2020). On the demand side, contingent valuation has been applied to inform PES design (Whittington & Pagiola, 2012), and studies show that income, ecological cognition, dependence on the service, and proximity to the service are determinants of beneficiaries' willingness to pay (Brouwer et al., 2011; Ren et al., 2024; Cananua-Labid et al., 2025; Wang et al., 2026). Households in eastern Indonesia valued watershed protection as insurance against drought (Pattanayak & Kramer, 2001). Recent evidence shows that individual PES buyers care whether their payments achieve additional conservation (Frings et al., 2023). Local beneficiary financing can increase

ownership, reduce reliance on outside donors (Porras et al., 2008; Goldman-Benner et al., 2012) and move conservation from a government-imposed restriction to a locally valued arrangement (Muradian et al., 2010). This paper therefore analyzes the willingness of the downstream water beneficiaries to participate in a PES program for the North Batukliang forest area, the factors that shape this decision, and the beneficiaries' preferred payment mechanisms.

2. Methodology of research

2.1 Study area, sampling, and data collection

This study employs a descriptive quantitative research design that utilizes field observation, questionnaire surveys with semi-structured interviews, and in-depth interviews with key informants (Bungin, 2008). The object of the research is the Mount Rinjani forest area, namely the Stilling Resort forest area in North Batukliang District, Central Lombok Regency. The respondents were the users or beneficiaries of the water and landscape services of the area, i.e. visitors (tourists), communities living around the forest, farmers using irrigation water, and domestic users supplied by the PDAM.

A multi-stage sampling procedure was used. Districts were purposively selected to represent the distribution of beneficiaries from upstream to downstream. North Batukliang District (upstream): Tourists visiting Aik Bukak and Benang Stokel–Benang Kelambu sites and forest-adjacent households in Aik Berik Village (most managing community forestry plots). Jonggat District (midstream) was represented by the agricultural area of Labulia Village, and Praya District (downstream) was represented by PDAM customers in Praya Sub-district. Then a sample of 120 respondents was selected: 30 tourists (15 at each site), 30 forest-adjacent farm households, 30 irrigation farmers, and 30 PDAM customers. The key informants were village officials, managers of village-owned enterprises (BUMDes), the East Rinjani Protection Forest Management Unit (KPHL Rinjani Timur) and other relevant agencies. Secondary data were collected from KPHL Rinjani Timur, BUMDes, Tourism Office, Regional Development Planning Agency, and Statistics Indonesia (BPS, 2023, 2023a). In 2023 the survey was carried out.

The questionnaire was developed to collect data on socio-economic characteristics of respondents, perception of the forest area as a water catchment, willingness to participate in a PES program for the conservation of the North Batukliang forest (yes/no question), and preferred payment mechanisms.

2.2 Analysis of a model

Since the dependent variable is dichotomous, willingness to participate was modeled using binary logistic regression (Hosmer et al., 2013; Menard, 2010):

$$\ln[Pi / (1 - Pi)] = \beta0 + \beta1X1i + \beta2X2i + \ldots + \beta6X6i \quad (1)$$

where P_i is the probability of respondent i to be willing to participate, β_0 is the constant, and $\beta_1 \ldots \beta_6$ is the coefficient of the explanatory variables shown in Table 1. The exponentiated coefficient, Exp(β), is the odds ratio (OR): the factor by which the odds of participation change when a variable increases by one unit, holding other variables constant. The model was estimated using maximum likelihood and evaluated with the omnibus likelihood-ratio test, the −2 log-likelihood, the Cox & Snell and Nagelkerke pseudo-R^2, the Hosmer–Lemeshow goodness-of-fit test, and the overall classification rate.

Table 1. Definition of variables in the binary logistic model

Variable	Definition and measurement	Expected sign
Y Willingness to participate	1 = willing to participate in and pay for PES; 0 = not willing	
X_1 Age	Respondent's age (years)	±
X_2 Education	Formal schooling (years)	+
X_3 Water dependency	1 = high dependency on water from the area; 0 = low	+
X_4 Distance from source	Distance from residence to the water source (km)	−

X_5 Importance of forest area	Perceived importance of the forest area (1 = very important; 0 = otherwise)	+
X_6 Income	Household income (million IDR per month)	+

RESULTS AND DISCUSSION

3.1 Respondent characteristics

All 120 respondents are aged between 17 and 65 years (mean 43), so they are all part of the working-age population as defined by Statistics Indonesia (15 years and above). Seventy percent were male. Household size varied from 1 to 11 dependents, with a moderate average of four. Most of the respondents were married (87.5%) and employed (87.5%), with a small percentage also having a secondary job. Just over half (54.2%) had senior high school or higher education, and 45.8% had junior high school education or lower (Table 2). Thus the sample is dominated by economically active adults with moderate education—the group whose payment decisions will determine the viability of a PES scheme.

Table 2. Characteristics of respondents, beneficiaries of the North Batukliang forest area, Central Lombok, 2023 (n = 120)

Characteristic	Number	Percentage (%)
Age (years): range; mean	17–65; 43	–
Gender		
Male	83	69.2
Female	37	30.8
Number of dependents: range; mean	1–11; 4	–
Marital status		
Unmarried	15	12.5
Married	105	87.5
Education		
Junior high school or less	55	45.8
Senior high school or higher	65	54.2
Employment status		
Unemployed	15	12.5
Employed	105	87.5

Source: Primary data, 2023.

3.2 Perceptions of the forest area as a water catchment

Perception, the process of interpreting and evaluating an object according to the accessible information, influences people's decisions about that object. Positive perceptions of the ecological, social, and economic role of the Rinjani area might help to encourage beneficiaries to support its protection. Table 3 shows respondents' perceptions.

Table 3. Respondents' perceptions of the Rinjani mountains in the North Batukliang area, Central Lombok, 2023 (n = 120)

Item	Number	%
1. The North Batukliang forest area is an attractive and popular destination		
Yes	118	98.3
No	2	1.7
2. Frequency of visits to the North Batukliang area		
Never	19	15.8

1–2 times	57	47.5
3–4 times	26	21.7
More than 4 times	18	15.0
3. Importance of the area (especially North Batukliang) for human life		
Very important	105	87.5
Important	13	10.8
Quite important	2	1.7
Less important / not important	0	0.0
4. Water needs originate from the Rinjani mountains, including North Batukliang		
Yes	118	98.3
No	2	1.7

Source: Primary data, 2023.

Almost all respondents (98%) considered the North Batukliang forest area as an attractive and popular destination. Most (84.2%) had been there, usually once or twice, but 15.8% had not; many of the latter live in similar surroundings nearby and see little reason to make a special trip. On the question of the area's importance for human life, 98.3% of the respondents answered "important" or "very important," 87.5% were very important, and no respondent considered it unimportant. 98% too knew that their water used for domestic purposes, agriculture, and commerce came from the Rinjani mountains, including North Batukliang. This almost universal understanding of the upstream-downstream relationship is a prerequisite for a beneficiary-funded scheme and suggests considerable potential for community participation in conserving the area as Lombok's main catchment area.

3.3 Determinants of beneficiaries' willingness to participate in PES

The estimated binary logistic regression is reported in Table 4. The fit of the model was statistically significant (omnibus $\chi2(6) = 58.73$, $p < .001$). The Hosmer–Lemeshow test ($\chi^2(8) = 3.506$, $p = 0.899$) was not significant, implying a satisfactory fit between the observed and predicted outcomes (Hosmer et al., 2013). The explanatory variables accounted for 38.7% (Cox & Snell) to 52.7% (Nagelkerke) of the variance in willingness to participate, and the model correctly classified 79.2% of cases. Three variables were significant at the 5% level: water dependency, perceived importance of forest area, and income.

Table 4. Binary logistic regression estimates of willingness to participate in the PES program

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI Exp(B)
Age (X_1)	−0.012	0.030	0.175	1	0.676	0.988	0.932–1.048
Education (X_2)	0.011	0.064	0.030	1	0.863	1.011	0.892–1.146
Water dependency (X_3)	3.760	0.804	21.895	1	0.000*	42.941	8.883–207.647
Distance from source (X_4)	−0.848	0.639	1.765	1	0.184	0.428	0.122–1.498
Importance of forest area (X_5)	1.714	0.642	7.130	1	0.008*	5.549	1.577–19.537
Income (X_6)	1.629	0.461	12.458	1	0.000*	5.097	2.066–12.586
Constant	−5.580	2.186	6.515	1	0.011*	0.004	–
Model fit: omnibus $\chi^2(6) = 58.73$, $p < 0.001$; −2 log-likelihood = 100.939; Cox & Snell $R^2 = 0.387$; Nagelkerke $R^2 = 0.527$; Hosmer–Lemeshow $\chi^2(8) = 3.506$, $p = 0.899$; overall classification accuracy = 79.2%							

Note: * significant at $p < 0.05$. $n = 120$. Confidence intervals are computed as exp(B ± 1.96 S.E.).

Water dependence (X3) . The strongest predictor was water dependency ($B = 3.760$, $p < 0.001$). The likelihood of participation was approximately 43 times greater for highly dependent beneficiaries than for less dependent beneficiaries (OR = 42.94), assuming all other factors remained constant. The confidence interval is large (8.88–207.65) because of the small sample size and the fact that the willing responders were highly dependent users. Therefore, the size should be taken as indicative, but the direction and significance of the effect are clear. This

result is consistent with the evidence that perceived dependence on a service is central to the beneficiaries' decision to pay for that service (Kosoy et al., 2007; Muradian et al., 2010) and with the findings from eastern Indonesia where households experiencing shortages in the dry season valued watershed protection as drought insurance (Pattanayak & Kramer, 2001). In Central Lombok, PDAM customers and irrigators during the dry season directly experience supply failures (Lombok Post, 2023), so the connection between the upstream forest and their own water is tangible.

Importance of the forest area (X_5). Respondents who rated the forest area as critical had 5.55 times the odds of being willing to participate (B = 1.714, p = 0.008; 95% CI 1.58–19.54). This points out the importance of ecological cognition: In the Jinghe River Basin, ecological cognition was one of the strongest positive drivers of willingness to pay for forest compensation (Wang et al., 2026), and watershed knowledge increased willingness to pay in the Philippines (Cananua-Labid et al., 2025). Awareness is growing that we need to understand the multiple values that people give to nature, beyond monetary values, to design acceptable incentive schemes (Pascual et al., 2023). Hence, making the forest-water connection visible through environmental communication is a practical lever to increase participation (Pascual et al., 2014).

Income (X6) For each additional million rupiah of monthly income, the odds of participation rose by approximately five times (B = 1.629, p < 0.001; OR = 5.10; 95% CI 2.07–12.59). The beneficiaries with higher incomes had a higher ability to pay and a higher valuation of environmental quality (Brouwer et al., 2011; Whittington & Pagiola, 2012). Similar patterns have been reported in recent Chinese watershed studies (Ren et al., 2024; Wang et al., 2026). However, not always is participation the highest among the wealthiest users, who may resort to private alternatives (Zbinden & Lee, 2005). Payment mechanisms must not exclude lower-income users from basic water access (Asquith et al., 2008; Pascual et al., 2014). One method to balance the ability to pay and equity is by means of differentiated payments depending on the user category or level of consumption (Aguilar-Gómez et al., 2020).

Insignificant variables. Age (p = 0.676), education (p = 0.863) and distance from the water source (p = 0.184) did not significantly affect it. The lack of importance of formal education is consistent with the results of Wang et al. (2026) who found that education lost its effect once ecological cognition was controlled; in this model, the perceived importance of the forest picks up much of what education might otherwise proxy. The evidence on age is mixed across settings (Cananua-Labid et al., 2025; Wang et al., 2026). The negative sign on distance is consistent with the distance-decay of environmental values (Bateman et al., 2006) but its insignificance suggests that users along the whole gradient, from upstream villages to Praya town, consider themselves to be dependent on the same Rinjani-sourced system. Therefore, a scheme does not have to be limited to users around the forest.

3.4 Preferred payment mechanisms for environmental services

The Rinjani landscape benefits not only tourists but also other water users for domestic, agricultural, and commercial (bottled-water) purposes. Respondents were asked whether these users should set aside funds, i.e., pay for environmental services, to conserve the North Batukliang area, and how payments should be collected and calculated (Table 5; multiple responses were allowed for items 1–3).

Table 5. Water beneficiaries' preferences on modes of payment for conservation of the North Batukliang forest area, Central Lombok

Item	Number	%
1. PDAM users pay a charge included in their water bill	108	90.0
2. Bottled-water consumers pay a charge included in the product price	80	66.7
3. Farmers pay through farmer groups/water-user associations, especially in the dry season	99	82.5
4. Basis for determining the payment amount		
Proportional to water use	75	62.5
Fixed nominal amount	45	37.5

Source: Primary data, 2023. Items 1–3 allow multiple responses; percentages are of all 120 respondents.

A large majority favored payment by all main user groups: 90% agreed that PDAM customers should pay through a charge included in their water bill, 82.5% that farmers should pay through farmer groups or water-user associations (P3A), especially when irrigation water is supplied in the dry season, and 66.7% that bottled-water consumers should pay through the product price. Collecting through existing billing systems and user organizations keeps transaction costs low; in West Lombok, the scheme ultimately came to rest on a regulation-backed surcharge collected through PDAM bills (Prasetyo et al., 2009; Diswandi, 2017).

Regarding the calculation of payments, 62.5% of respondents preferred charges that are proportional to the volume of water used, while 37.5% preferred a fixed amount, such as IDR 1,000 per household per month, which is the rate applied to PDAM customers in West Lombok (Mayung.id, 2019). Proportional charges better reflect each user's share of the service and the beneficiary-pays principle but are slightly more complex to administer; flat charges are simpler but regressive. A hybrid design, with a modest flat fee for households and volume-based charges for commercial users such as hotels and bottled-water firms, could combine the advantages of both (Aguilar-Gómez et al., 2020). Whatever the formula, transparent reporting on how funds are used and on the conservation, they achieve is likely to sustain payers' willingness (Frings et al., 2023), while stable, long-term funding is needed to avoid the loss of conservation gains when payments are interrupted (Hayes et al., 2022; Erbaugh, 2022). Pooling these contributions into a multi-stakeholder fund that pays upstream communities for rehabilitation and protection would channel resources from downstream users to upstream forest stewards and could draw on community participation in monitoring and enforcement (Agrawal & Ostrom, 2001; Leimona et al., 2015).

CONCLUSION AND IMPLICATIONS

This study examined downstream beneficiaries' willingness to participate in a PES program for the North Batukliang forest area. Awareness of the forest–water link was almost universal: 98% of respondents knew that their water originates in the Rinjani mountains and rated the area as important or critical. The binary logistic model was significant ($\chi^2(6) = 58.73$, $p < 0.001$), fitted the data well (Hosmer–Lemeshow $p = 0.899$), explained 52.7% of the variation in willingness to participate (Nagelkerke R^2) and correctly classified 79.2% of cases. Water dependency showed the strongest association (OR = 42.94, $p < 0.001$), followed by the perceived importance of the forest area (OR = 5.55, $p = 0.008$) and income (OR = 5.10, $p < 0.001$); age, education, and distance from the water source were not significant.

Several implications follow for program design. First, the scheme should begin with highly dependent users, namely PDAM customers and dry-season irrigators, whose willingness to participate is greatest. Second, contributions should be collected through existing channels, chiefly PDAM bills and water-user associations, drawing on West Lombok's regulation-backed model and embedding the scheme in a Central Lombok regional regulation under Government Regulation No. 46/2017. Third, payment levels should be differentiated by income and user type, with volume-based charges for commercial users, to protect low-income households. Fourth, environmental communication should strengthen beneficiaries' appreciation of the forest's importance, since perceived importance substantially raises participation. Finally, funds should be managed transparently by a multi-stakeholder institution that reports conservation outcomes to payers.

The study has limitations. The sample of 120 respondents is modest, which widens the confidence intervals of some estimates, and stated willingness to participate may exceed actual payment behavior. The survey did not elicit the amount beneficiaries are willing to pay. Future research should use contingent valuation or choice experiments with a larger sample to estimate payment levels, compare these with upstream communities' opportunity costs, and assess the hydrological additionality of conservation in the North Batukliang catchment.

REFERENCES

1. Abdullah, M., Mamat, M. P., Tuan Ibrahim, T. M., Yacob, M. R., & Tuan Hussain, F. N. (2022). Economic valuation of forest ecosystem for watershed services in Kelantan, Malaysia. IOP Conference Series: Earth and Environmental Science, 1102(1).

2. Abell, R., Asquith, N., Boccaletti, G., Bremer, L., Chapin, E., Erickson-Quiroz, A., et al. (2017). Beyond the source: The environmental, economic and community benefits of source water protection. The Nature Conservancy.
3. Abildtrup, J., Garcia, S., & Stenger, A. (2013). The effect of forest land use on the cost of drinking water supply: A spatial econometric analysis. Ecological Economics, 92, 126–136. https://doi.org/10.1016/j.ecolecon.2013.01.004
4. Agrawal, A., & Ostrom, E. (2001). Collective action, property rights, and decentralization in resource use in India and Nepal. Politics & Society, 29(4), 485–514.
5. Aguilar-Gómez, C. R., Arteaga-Reyes, T. T., Gómez-Demetrio, W., Ávila-Akerberg, V. D., & Pérez-Campuzano, E. (2020). Differentiated payments for environmental services: A review of the literature. Ecosystem Services, 44, 101131. https://doi.org/10.1016/j.ecoser.2020.101131
6. Alaoui, H. I., El Asri, B., Ghazi, S., Brhadda, N., & Ziri, R. (2022). A framework payment for ecosystem services to reconstitute forest areas closed to grazing in the Ifrane National Park (Morocco). IOP Conference Series: Earth and Environmental Science, 1090, 012006.
7. Asbjornsen, H., Wang, Y., Ellison, D., Ashcraft, C. M., Atallah, S. S., Jones, K., Mayer, A., Altamirano, M., & Yu, P. (2022). Multi-targeted payments for the balanced management of hydrological and other forest ecosystem services. Forest Ecology and Management, 522, 120482. https://doi.org/10.1016/j.foreco.2022.120482
8. Asquith, N. M., Vargas, M. T., & Wunder, S. (2008). Selling two environmental services: In-kind payments for bird habitat and watershed protection in Los Negros, Bolivia. Ecological Economics, 65(4), 675–684.
9. Bateman, I. J., Day, B. H., Georgiou, S., & Lake, I. (2006). The aggregation of environmental benefit values: Welfare measures, distance decay and total WTP. Ecological Economics, 60(2), 450–460.
10. Börner, J., Baylis, K., Corbera, E., Ezzine-de-Blas, D., Honey-Rosés, J., Persson, U. M., & Wunder, S. (2017). The effectiveness of payments for environmental services. World Development, 96, 359–374. https://doi.org/10.1016/j.worlddev.2017.03.020
11. BPS [Statistics Indonesia]. (2023). Kecamatan Batukliang Utara dalam angka 2022. BPS Kabupaten Lombok Tengah.
12. BPS [Statistics Indonesia]. (2023a). Kabupaten Lombok Tengah dalam angka 2022. BPS Kabupaten Lombok Tengah.
13. Brouwer, R., Tesfaye, A., & Pauw, P. (2011). Meta-analysis of institutional-economic factors explaining the environmental performance of payments for watershed services. Environmental Conservation, 38(4), 380–392.
14. Bruijnzeel, L. A. (2004). Hydrological functions of tropical forests: Not seeing the soil for the trees? Agriculture, Ecosystems & Environment, 104(1), 185–228.
15. Bungin, B. (2008). Metode penelitian kuantitatif: Komunikasi, ekonomi, dan kebijakan publik serta ilmu-ilmu sosial lainnya (3rd printing). Prenada Media Group.
16. Cananua-Labid, S. A., Quilatan, J. A. M., & Bolante, L. R. A. (2025). Willingness to pay for a restored and protected watershed: Evidence from the countryside. Makara Human Behavior Studies in Asia, 29(2), 103–114. https://doi.org/10.7454/hubs.asia.v29.i2.1535
17. Diswandi, D. (2017). A hybrid Coasean and Pigouvian approach to payment for ecosystem services program in West Lombok: Does it contribute to poverty alleviation? Ecosystem Services, 23, 138–145. https://doi.org/10.1016/j.ecoser.2016.12.005
18. Dudley, N., & Stolton, S. (2003). Running pure: The importance of forest protected areas to drinking water. World Bank/WWF Alliance for Forest Conservation and Sustainable Use.
19. Engel, S., Pagiola, S., & Wunder, S. (2008). Designing payments for environmental services in theory and practice: An overview of the issues. Ecological Economics, 65(4), 663–674. https://doi.org/10.1016/j.ecolecon.2008.03.011
20. Erbaugh, J. T. (2022). Impermanence and failure: The legacy of conservation-based payments in Sumatra, Indonesia. Environmental Research Letters, 17, 054015.
21. Fang, N., Yao, L., Wu, D., Zheng, X., & Luo, S. (2023). Assessment of forest ecological function levels based on multi-source data and machine learning. Forests, 14, 1630. https://doi.org/10.3390/f14081630
22. Fauzi, A., & Anna, Z. (2013). The complexity of the institution of payment for environmental services: A case study of two Indonesian PES schemes. Ecosystem Services, 6, 54–63.

23. Frings, O., Abildtrup, J., Montagné-Huck, C., Gorel, S., & Stenger, A. (2023). Do individual PES buyers care about additionality and free-riding? A choice experiment. Ecological Economics, 213, 107944. https://doi.org/10.1016/j.ecolecon.2023.107944
24. Goldman-Benner, R. L., Benitez, S., Boucher, T., Calvache, A., Daily, G., Kareiva, P., et al. (2012). Water funds and payments for ecosystem services: Practice learns from theory and theory can learn from practice. Oryx, 46(1), 55–63.
25. Government of Indonesia. (2009). Law No. 32 of 2009 on Environmental Protection and Management.
26. Government of Indonesia. (2017). Government Regulation No. 46 of 2017 on Environmental Economic Instruments (State Gazette 2017 No. 228).
27. Guerra, B. R., & Ranieri, V. E. L. (2023). Guidelines for planning and designing payment for environmental services schemes. Ambiente & Sociedade, 26. https://doi.org/10.1590/1809-4422asoc20220060r1vu2023L1OA
28. Hayes, T., Murtinho, F., Wolff, H., López-Sandoval, M. F., & Salazar, J. (2022). Effectiveness of payment for ecosystem services after loss and uncertainty of compensation. Nature Sustainability, 5, 81–88. https://doi.org/10.1038/s41893-021-00804-5
29. Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). Applied logistic regression (3rd ed.). John Wiley & Sons.
30. Jayachandran, S. (2023). The inherent trade-off between the environmental and anti-poverty goals of payments for ecosystem services. Environmental Research Letters, 18, 025003. https://doi.org/10.1088/1748-9326/acb1a7
31. Jones, K. W., Powlen, K., Roberts, R., & Shinbrot, X. (2020). Participation in payments for ecosystem services programs in the Global South: A systematic review. Ecosystem Services, 45, 101159. https://doi.org/10.1016/j.ecoser.2020.101159
32. Kosoy, N., Martinez-Tuna, M., Muradian, R., & Martinez-Alier, J. (2007). Payments for environmental services in watersheds: Insights from a comparative study of three cases in Central America. Ecological Economics, 61(2–3), 446–455.
33. Le, T.-A. T., Vodden, K., Wu, J., Bullock, R., & Sabau, G. (2024a). Payments for ecosystem services programs: A global review of their contributions towards sustainability. Heliyon, 10, e22361. https://doi.org/10.1016/j.heliyon.2023.e22361
34. Le, T.-A. T., Vodden, K., Wu, J., Bullock, R., & Sabau, G. (2024b). Benefits and risks from payments for ecosystem services programs across the globe. Frontiers in Environmental Science, 12, 1419821. https://doi.org/10.3389/fenvs.2024.1419821
35. Leimona, B., van Noordwijk, M., de Groot, R., & Leemans, R. (2015). Fairly efficient, efficiently fair: Lessons from designing and testing payment schemes for ecosystem services in Asia. Ecosystem Services, 12, 16–28.
36. Lombok Post. (2023, August 31). Musim kemarau, debit sumber air PDAM Lombok Tengah turun 50 persen. https://lombokpost.jawapos.com/praya/1502902860/musim-kemarau-debit-sumber-air-pdam-lombok-tengah-turun-50-persen
37. Mayung.id. (2019). Jasa lingkungan, partisipasi publik menjaga lingkungan (2). https://mayung.id/jasa-lingkungan-partisipasi-publik-menjaga-lingkungan-2/
38. Menard, S. (2010). Logistic regression: From introductory to advanced concepts and applications. SAGE Publications.
39. Muradian, R., Corbera, E., Pascual, U., Kosoy, N., & May, P. H. (2010). Reconciling theory and practice: An alternative conceptual framework for understanding payments for environmental services. Ecological Economics, 69(6), 1202–1208.
40. Pascual, U., Balvanera, P., Anderson, C. B., Chaplin-Kramer, R., Christie, M., González-Jiménez, D., et al. (2023). Diverse values of nature for sustainability. Nature, 620, 813–823.
41. Pascual, U., Phelps, J., Garmendia, E., Brown, K., Corbera, E., Martin, A., et al. (2014). Social equity matters in payments for ecosystem services. BioScience, 64(11), 1027–1036. https://doi.org/10.1093/biosci/biu146
42. Pattanayak, S. K., & Kramer, R. A. (2001). Pricing ecological services: Willingness to pay for drought mitigation from watershed protection in eastern Indonesia. Water Resources Research, 37(3), 771–778.
43. Pham, T. T., Bennett, K., Vu, T. P., Brunner, J., Le, N. D., & Nguyen, D. T. (2013). Payments for forest environmental services in Vietnam: From policy to practice (Occasional Paper 93). CIFOR.

44. Porras, I., Grieg-Gran, M., & Neves, N. (2008). All that glitters: A review of payments for watershed services in developing countries. International Institute for Environment and Development.
45. Prasetyo, F. A., Suwarno, A., Purwanto, & Hakim, R. (2009). Making policies work for payment for environmental services (PES): An evaluation of the experience of formulating conservation policies in districts of Indonesia. Journal of Sustainable Forestry, 28(3–5). https://doi.org/10.1080/10549810902791531
46. Ratman, D. R. (2016). Pembangunan destinasi pariwisata prioritas 2016–2019. Deputi Bidang Pengembangan Destinasi dan Investasi Pariwisata, Kementerian Pariwisata.
47. Ren, J., Bie, X., Li, X., & Peng, Z. (2024). Analysis of the factors influencing willingness to pay and payout level for watershed eco-compensation of the Huangbai river basin. Water Supply, 24(4), 1102–1116. https://doi.org/10.2166/ws.2024.058
48. Rinjani Geopark. (2017). Gunung Rinjani sumber air utama Pulau Lombok, melestarikannya adalah harga mati. https://rinjanigeopark.com (accessed 13 December 2022).
49. RRI. (2026, September 6). Clean water crisis forces hundreds of tourists to leave Gili Trawangan early. Voice of Indonesia. https://rri.co.id/voice-of-indonesia/tourism/2709904/clean-water-crisis-forces-hundreds-of-tourists-to-leave-gili-trawangan-early
50. Salzman, J., Bennett, G., Carroll, N., Goldstein, A., & Jenkins, M. (2018). The global status and trends of payments for ecosystem services. Nature Sustainability, 1(3), 136–144.
51. Suich, H., Lugina, M., Muttaqin, M. Z., Alviya, I., & Sari, G. K. (2017). Payments for ecosystem services in Indonesia. Oryx, 51(3), 489–497. https://doi.org/10.1017/S0030605316000259
52. van Noordwijk, M., Leimona, B., Jindal, R., Villamor, G. B., Vardhan, M., Namirembe, S., et al. (2012). Payments for environmental services: Evolution toward efficient and fair incentives for multifunctional landscapes. Annual Review of Environment and Resources, 37, 389–420.
53. Wang, J., & Tian, G. (2023). Sustainability of forest eco-products: Comprehensive analysis and future research directions. Forests, 14, 2008. https://doi.org/10.3390/f14102008
54. Wang, X., Shu, L., & Wang, Y. (2026). Residents' perceptions and willingness to pay for multifunctional ecological compensation in watershed forests: Evidence from the Jinghe River Basin, the Loess Plateau. Forests, 17(2), 189. https://doi.org/10.3390/f17020189
55. Whittington, D., & Pagiola, S. (2012). Using contingent valuation in the design of payments for environmental services mechanisms: A review and assessment. World Bank Research Observer, 27(2), 261–287.
56. Wunder, S. (2015). Revisiting the concept of payments for environmental services. Ecological Economics, 117, 234–243.
57. Wunder, S., Brouwer, R., Engel, S., Ezzine-de-Blas, D., Muradian, R., Pascual, U., & Pinto, R. (2018). From principles to practice in paying for nature's services. Nature Sustainability, 1(3), 145–150.
58. Yakin, A. (2005). Community involvement and environmental management of Rinjani National Park, Lombok Island. In Mitsuda & Sayuti (Eds.), Sustainable Lombok: The rich nature and rich people in the 21st century (pp. 93–120). Universitas Mataram Press.
59. Yakin, A. (2015). Ekonomi sumber daya alam dan lingkungan: Teori, kebijakan, dan aplikasi bagi pembangunan berkelanjutan. Akademika Pressindo.
60. Zbinden, S., & Lee, D. R. (2005). Paying for environmental services: An analysis of participation in Costa Rica's PSA program. World Development, 33(2), 255–272.