LEUWEUNG
Journal of Ecology and Environment Conservation

Vol. 1 No. 1 2026 | pp. 30-39
e_ISSN: xxxx-xxxx

https://ejournal.auliantech.org/index.php/leuweung

Effectiveness of Community-Based Forest Management in The Economic Perspective of Natural Resources and The Environment

Eef Kurneva Abdiawan[1*], Helen Voviarti[2], Rita Despriana Butarbutar [3], Purnamasari Kebat [4], Reflis[5], Satria Putra Utama[6]

[1234]*Natural Resources Management Study Program, Faculty of Agriculture, University of Bengkulu, Bengkulu, Indonesia*

[56]*Faculty of Agriculture, University of Bengkulu*

E-mail Correspondence*: eephabdiawan@gmail.com

Received: March 29, 2026 Reviced: April 20, 2026 Accepted: April 29, 2026

Abstract

This paper examines the effectiveness of community-based forest management (CBFRM) in the Air Ketahun Limited Production Forest (HPT) Area in Gembung Tengah Hamlet, Tanjung Kemayan Village, Napal Putih District, North Bengkulu Regency. Using a mixed-methods approach that combines qualitative institutional and quantitative economic analysis, this study aims to (1) describe the actual conditions of Air Ketahun HPT management, (2) analyze the effectiveness of community-based forest management institutions, (3) calculate the estimated total economic value (NET) of the area, and (4) identify the environmental impacts of the applied management patterns. The results show that the Village Forest Management Institution (KTH) operating in the Air Ketahun HPT area has achieved an institutional effectiveness level of 68.5% based on a multi-criteria evaluation matrix. The total economic value of the area is estimated to reach IDR 2.87 billion per year, which includes direct use values (timber and non-timber), indirect use values (ecosystem services), and existence value. Ecologically, the Air Ketahun HPT area remains in relatively good condition with 76% canopy cover, but several areas require rehabilitation due to pressure from illegal activities in the buffer zone. Community-based management has proven more effective in maintaining the area's sustainability than conventional management practices, primarily due to the persistence of local wisdom and a strong sense of belonging among the surrounding communities. This paper recommends strengthening institutional capacity, increasing market access for non-timber forest products, and strengthening synergy between local governments, state-owned forestry enterprises, and local communities.

Keyword: effectiveness, community-based forest management, HPT Air Ketahun, natural resource economics, total economic value, North Bengkulu

To cite this article: Abdiawan, E.K., Voviarti, H., Butarbutar, R.D., Kebat, P., Reflis, R,. Utama, S.P, (2026). *Effectiveness of community-based forest management In the economic perspective of natural resources and the environment. Case Study on: Air Ketahun Limited Production Forest Area (HPT) Gembung Tengah Hamlet, Tanjung Kemayan Village, Napal Putih District North Bengkulu Regency.* 1(1) 2026, 30-39.

INTRODUCTION

Indonesia is one of the countries with the largest tropical forest reserves in the world. According to data from the Ministry of Forestry, Indonesia's total forest area will reach 120.5 million hectares by 2025, comprising various forest functions, including conservation forests, protected forests, and production forests (Ministry of Forestry Press Release, 2025). These forest resources hold immense strategic value,

not only as an ecological buffer but also as a source of livelihood for millions of people living in and around forest areas.

Bengkulu Province, as one of the provinces on the island of Sumatra, has a fairly extensive forest area, reaching approximately 43.2% of the province's total area. North Bengkulu Regency, as one of the regencies with the largest forest area in Bengkulu Province, has several production forest areas that serve as the economic pillars of the local community and serve as green lungs crucial for regional ecosystem balance. One such strategic area is the Air Ketahun Limited Production Forest (HPT), located in the Napal Putih District.

The Air Ketahun HPT area holds high ecological significance due to its location within the Air Ketahun River basin, which is the water source for thousands of households in North Bengkulu. Furthermore, this area is also a habitat for various endemic Sumatran flora and fauna, including several endangered species. From a socio-economic perspective, the communities in Gembung Tengah Hamlet and surrounding villages have historically relied heavily on forest resources for their daily needs, from non-timber forest products (NTFPs) to agricultural land use, to building timber.

The paradigm of forest management in Indonesia has undergone a significant transformation, particularly since the 1998 reforms. The previously top-down and centralized approach to forest management has shifted toward a more participatory and community-based model. The emergence of the Social Forestry policy through Minister of Environment and Forestry Regulation Number P.83/MENLHK/SETJEN/KUM.1/10/2016, which has undergone several amendments, most recently with Minister of Environment and Forestry Regulation Number 9 of 2021, is a significant milestone in opening up space for communities to actively participate in the management of state forest areas. This Social Forestry program encompasses various schemes, including Community Forests (HKm), Village Forests (HD), Community Plantation Forests (HTR), Customary Forests (HA), and Forestry Partnerships.

In the Air Ketahun HPT area, community-based forest management is being implemented through the establishment of a Village Institution (LD) in Gembung Tengah Hamlet, Tanjung Kemayan Village. This LD serves as an institutional unit that organizes the community in sustainably utilizing and protecting the forest area. The LD's existence is expected to bridge the gap between the state's interest in preserving forests and the community's interest in meeting their economic needs.

However, the success of community-based forest management cannot be assumed automatically. Various complex challenges remain, ranging from limited institutional capacity, unresolved tenurial conflicts, poor market access for non-timber forest products, minimal technical assistance from the government, and pressure from encroachment and illegal logging. In the context of natural resource and environmental economics, the effectiveness of forest management needs to be measured not only by indicators of ecological sustainability, but also from the perspective of economic efficiency and equitable distribution of social benefits.

The theoretical framework of natural resource economics provides an important foundation for understanding the dynamics of forest resource use. Hardin's concept of the "Tragedy of the Commons" (1968) warned of the potential degradation of natural resources when managed collectively without clear rules. However, Ostrom (1990), in her landmark work "Governing the Commons," successfully demonstrated that local communities are capable of developing effective and sustainable collective resource management institutions, provided they adhere to certain design principles. Ostrom's findings have become the foundation for the development of community-based forest management policies worldwide, including in Indonesia.

From an environmental economics perspective, forests provide a variety of ecosystem services that have high economic value but are often not reflected in conventional market mechanisms. These ecosystem services include carbon sequestration, water regulation, erosion prevention, biodiversity maintenance, and recreational value. Market failure to internalize these values is often a primary cause of forest degradation. Therefore, analysis of forest management effectiveness requires a comprehensive consideration of the area's total economic value.

This paper starts from the premise that community-based forest management in the Air Ketahun HPT has great potential to become a model for effective and sustainable natural resource management, but requires in-depth and comprehensive evaluation from various dimensions. Through a study that combines institutional, natural resource economic, and ecological perspectives, it is hoped that concrete and applicable recommendations will be produced for improving the effectiveness of the Air Ketahun HPT area's management in the future.

METHOD

Types and Approaches

This paper employs a mixed-methods design, an approach that combines qualitative and quantitative research methods in an integrated manner. This mixed approach is based on the consideration that the complexity of community-based forest management issues cannot be adequately understood through a single methodological approach. Qualitative methods are used to understand the institutional dynamics, perceptions, and social processes that occur in forest management, while quantitative methods are used to estimate economic value and measure various indicators of management effectiveness in a measurable manner.

Epistemologically, this research is grounded in a pragmatic perspective, which views truth and knowledge as contextual and guided by the practical consequences of research findings. This approach aligns with the objective of this paper, which is not only to deeply understand the phenomenon of forest management but also to produce applicable, evidence-based policy recommendations.

Limitations of the Discussion Area

This paper limits the scope of the Air Ketahun Limited Production Forest Area (HPT), specifically in Gembung Tengah Hamlet, Tanjung Kemayan Village, Napal Putih District, North Bengkulu Regency, Bengkulu Province. The selection of this location is based on several considerations: (1) Air Ketahun HPT is one of the limited production forest areas actively managed by community groups that have obtained Social Forestry Permits in North Bengkulu; (2) Gembung Tengah Hamlet is one of the most active centers of community-based forest management activities in the area; (3) this area faces significant development pressures so that a study of the effectiveness of its management is very relevant and urgent; (4) the author has been active and interacted directly with Social Forestry administrators through the Community Seed Garden Program collaboration.

Data Sources

Primary Data

Primary data were obtained directly from the field through a series of activities. Primary data sources included: (a) members of the Gembung Lestari Sejahtera Village Institution in Gembung Tengah Hamlet as the main informants, (b) administrators and community leaders who have in-depth knowledge of local forest management, (c) officers of the North Bengkulu Production Forest Management Unit (KPHP) who are responsible for the management of the Air Ketahun HPT area, and (d) representatives of the village and sub-district governments involved in the Social Forestry program.

Secondary Data

Secondary data was obtained from various documentation sources, including: Forest Management Plan (RPH) documents of the North Bengkulu KPHP, permit and legality documents of forest farmer groups, statistical data of North Bengkulu Regency in Figures (BPS), reports on Social Forestry program activities from the Ministry of Forestry, and relevant previous research.

Data Collection Techniques

Several data collection techniques were used in a complementary manner in this study:

1. In-depth interviews: Conducted with key informants purposively selected based on their knowledge and involvement in the management of the Ketahun Water Conservation Area. The interviews used a semi-structured guide to ensure consistency and flexibility in exploring emerging issues.
2. Field observations: Field visits were conducted to various points in the Air Ketahun HPT area to observe the actual condition of the forest, community activities, and management infrastructure.
3. Documentation study: In-depth review of various official documents, reports and archives relevant to the management of the Ketahun Water HPT.

Data Analysis Techniques

Data analysis in this study uses several techniques that are adapted to the type of data and the research questions to be answered:

Institutional Analysis

Institutional effectiveness analysis was conducted using the Institutional Analysis and Development (IAD) Framework approach developed by Ostrom (2005). Assessments were based on

Ostrom's eight design principles using a Likert scale of 1-5, then weighted to produce an Institutional Effectiveness Index (IE).

Total Economic Value Analysis

Total Economic Value (NET) estimation is conducted using a multi-method approach. Direct use value is calculated using market prices for traded products and shadow prices for subsistence products. Ecosystem service value is calculated using the benefit transfer approach from similar valuation studies. Non-use value is estimated using the Contingent Valuation Method (CVM) with the Willingness to Pay (WTP) instrument.

SWOT Analysis

A SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis was used to identify and map internal and external factors influencing the effectiveness of the Ketahun Water Resources Management Unit (HPT). The results of the SWOT analysis were then used as the basis for formulating a more effective management strategy.

RESULTS AND DISCUSSION

Overview of Research Location

Geographical Conditions

The Air Ketahun Limited Production Forest (HPT) is administratively located in Napal Putih District, North Bengkulu Regency, Bengkulu Province. Geographically, this area is located between 101°45' - 102°15' East Longitude and 3°15' - 3°45' South Latitude. The Air Ketahun HPT area is part of a tropical rainforest ecosystem ranging from lowlands to mountains, with elevations ranging from 50 meters to 800 meters above sea level.

The total area of the Air Ketahun HPT (Hint for Conservation of Forestry) according to the Decree of the Minister of Forestry is approximately 45,780 hectares, divided into several management blocks. This area directly borders several villages in Napal Putih District, including Tanjung Kemayan Village to the east, and corporate oil palm plantations to the west and north. The presence of oil palm plantations around the forest area is one of the pressure factors that must be monitored in the context of HPT area management.

Gembung Tengah Hamlet is a hamlet in Tanjung Kemayan Village, directly adjacent to the Air Ketahun HPT area. It is home to approximately 287 families with a total population of over 1,200. Most of the hamlet's residents are farmers, both dryland farmers in the APL (Other Use Area) area and forest farmers who utilize the Air Ketahun HPT area through the Social Forestry scheme.

The following table presents data on the area of the Air Ketahun HPT area based on function and designation:

No.	Block/Area Function	Area (Ha)	Percentage (%)
1.	Core Zone	18,312	40.0
2.	Buffer Zone	13,734	30.0
3.	Community Utilization Block (HKm)	9,156	20.0
4.	Rehabilitation Block	3,207	7.0
5.	Special Block (Enclave)	1,371	3.0
	Total	45,780	100.0

Table 1. Data on the Area of the Annual Water HPT Area Based on Function

Biophysical and Ecosystem Conditions

The Air Ketahun Forest Reserve (HPT) area boasts a rich biodiversity, reflecting the characteristics of Sumatra's tropical rainforests. Based on vegetation surveys conducted by the North Bengkulu Forest Conservation and Management Agency (KPHP), the area has a tree density ranging from 450-600 trees per hectare in the core block, with the highest Importance Value Index (INP) for commercial timber species such as meranti (Shorea spp.), keruing (Dipterocarpus spp.), and kapur (Dryobalanops spp.).

The presence of the Air Ketahun River and its tributaries flowing through this area makes the Air Ketahun Watershed a crucial water catchment area. The stable year-round flow of the Air Ketahun River provides a source of clean water for thousands of households in North Bengkulu. These favorable hydrological conditions are closely linked to the integrity of forest cover in the upper reaches of the Air Ketahun Watershed.

Annual Water HPT Management Profile

History and Development of Management

Formal management of the Air Ketahun HPT began with the designation of the area as a limited production forest through a Decree of the Minister of Forestry in the mid-1980s. During this period, management of the area was fully under the control of the State Forestry Public Company, which later became Perum Perhutani, and subsequently managed by the Directorate General of Forestry Planning through the Forest Area Stabilization Center (BPKH).

Following the post-1998 forestry reforms and the establishment of Forest Management Units (KPH) as forest management units at the site level, management of the Air Ketahun HPT (Hint of Forest Management) was transferred to the North Bengkulu KPHP. In 2019, after a lengthy verification and facilitation process, the Gembung Lestari Sejahtera Village Institution (LD) based in Gembung Tengah Hamlet successfully secured Village Forest Management Approval for 4,945 hectares of the total community utilization block area of the Air Ketahun HPT.

KTH Institutional Structure

LD Gembung Lestari Sejahtera is a forest management institution whose members consist of forest farmers in Gembung Tengah Hamlet. According to the attached Village Forest Management Approval Decree, LD Gembung Lestari Sejahtera has 125 active members. The KTH organizational structure consists of a chairperson, secretary, treasurer, and several technical sections, including nursery, harvesting, and marketing.

Member Categories	Man	Woman	Total
Active Member	121	4	125
Daily Management	10	0	19

Table 2. Composition of Members of the LD Gembung Lestari Sejahtera, Gembung Tengah Hamlet (2025)

The land use patterns of members of LD Gembung Lestari Sejahtera reflect an agroforestry system integrated with forest components. Most members implement a multistratum agroforestry system that combines forestry tree crops (such as durian, petai, jengkol, and rubber) with agricultural crops in the understory (such as coffee, cocoa, and various food crops). This system is known locally as "mixed gardening" and has been practiced by the local community for generations.

Analysis of Institutional Effectiveness

Assessment Based on Ostrom's Design Principles

The assessment of the institutional effectiveness of LD Gembung Lestari Sejahtera was conducted based on Ostrom's eight design principles using a scale of 1-5. The assessment results, obtained from a combination of in-depth interviews and a questionnaire survey, are presented in the following table:

Ostrom's Design Principles	Score (1-5)	Weight (%)	Weighted Value
1. Clear boundaries	3.8	15	0.570
2. Compliance with local rules & conditions	3.5	15	0.525
3. Collective choice settings	3.2	12	0.384
4. Effective monitoring	3.0	12	0.360
5. Tiered sanctions	2.8	10	0.280
6. Conflict resolution mechanism	3.6	12	0.432
7. Recognition of external authority	3.9	12	0.468
8. Nested units	3.3	12	0.396
Total Institutional Effectiveness Index (IEK)		100	3,415/5 = 68.3%

Table 3. Institutional Effectiveness Assessment Matrix of KTH Gembung Lestari

The assessment results show that LD Gembung Lestari Sejahtera has an Institutional Effectiveness Index (IEK) of 68.3%, which can be categorized as "quite effective" based on the categorization scale used (50-69% = quite effective; 70-84% = effective; 85-100% = very effective). The highest score was achieved on the principle of external authority recognition (3.9/5), which reflects that the legality of LD and PPHD owned has received official recognition from the government. The lowest score was on the principle of

graduated sanctions (2.8/5), indicating that the mechanism for implementing sanctions for violations of management rules is still inadequate and has not been implemented consistently.

Institutional Strength

Some institutional strengths identified in the management of the Air Ketahun HPT include: (a) the existence of strong local wisdom in forest management that has been practiced for generations by the Gembung Tengah Hamlet community; (b) a high level of social cohesion among LD members, most of whom come from the same kinship network; (c) clear institutional legality through the PPHD; and (d) the existence of support from Non-Governmental Organizations (NGOs) that provide technical assistance and policy advocacy.

Institutional Weaknesses

On the other hand, there are several institutional weaknesses that require attention: (a) the managerial capacity of KTH administrators is still limited, especially in terms of financial administration and business planning; (b) low participation of women in the institutional decision-making process; (c) the absence of a technologically adequate area monitoring system; and (d) weak sanction mechanisms that result in violations of management rules still occurring.

Economic Analysis of Forest Resources

Direct Use Value

The identified direct use value of the Air Ketahun HPT area includes several main components. First, the utilization of non-timber forest products (NTFPs) is the most significant source of income for KTH members. The most widely harvested and traded NTFPs include: rattan (Calamus spp.), forest honey (from wild bees (Apis dorsata), jelutung sap, resin, various types of forest fruits such as wild durian and tengkawang, cultivated plantation crops, especially coffee, rubber and jengkol, and other multipurpose crops. Based on survey data, the total value of NTFP production from the Air Ketahun HPT area is estimated to reach around IDR 847 million per year.

Land use within agroforestry systems provides significant added value. The main commodities cultivated within agroforestry systems include robusta coffee, cocoa, areca nut, and various types of fruit trees. The production value of agroforestry systems is estimated at IDR 634 million per year. Third, although on a small and limited scale, some LD members utilize wood residue from felling for local building materials, with an estimated annual value of around IDR 98 million.

Indirect Use Value (Ecosystem Services)

The value of the Air Ketahun HPT ecosystem services encompasses several critical components that are often overlooked in conventional analyses. The most important component is water regulation services. Using a benefit transfer approach based on similar studies in Sumatran forest areas, the value of the Air Ketahun HPT's hydrological services in ensuring clean water availability for communities downstream of the Air Ketahun watershed is estimated at Rp 512 million per year.

Carbon sequestration is the largest component of ecosystem services. Based on estimates of the carbon stock of Sumatra's lowland tropical forest area with a canopy density of 76%, the carbon stock of the Air Ketahun HPT is estimated to reach 185 tons of CO2 equivalent per hectare. Using a reference carbon price from the international voluntary carbon market of USD 5 per ton of CO2, the area's carbon sequestration value is estimated to reach IDR 634 million per year (referring to a net sequestration rate of approximately 3.2 tons of CO2/ha/year for protected areas).

Non-Use Value

Existence value estimation was conducted using the Contingent Valuation Method (CVM) with a Willingness to Pay (WTP) question for a sample of households. The average household WTP for the conservation of the Air Ketahun HPT is IDR 25,000 per month per household. Assuming the population of interest includes all households in Napal Putih District (approximately 3,200 families), the existence value is estimated to reach IDR 96 million per year. The option value (possible future use) is estimated at around 15% of the total use value, which is around IDR 238 million per year.

Summary of Total Economic Value

No.	Economic Value Components	Value (Rp Million/Year)	Percentage (%)
	A. Direct Use Value		
1.	Non-Timber Forest Products (NTFPs)	847	29.5
2.	Agroforestry (coffee, cocoa, fruits)	634	22.1
3.	Limited Wood Utilization	98	3.4
	B. Indirect Use Value (Ecosystem Services)		
4.	Hydrology Services/Water Management	512	17.8
5.	Carbon Sink	634	22.1
	C. Non-Use Value		
6.	Existence Value	96	3.3
7.	Option Value	48	1.7
	TOTAL ECONOMIC VALUE (NET)	2,869	100.0

Table 4. Total Economic Value (NET) of the Annual Water HPT Area (2025 Estimate)

Estimates show that the total economic value of the Air Ketahun HPT area reaches approximately IDR 2.87 billion per year. This figure illustrates the significant contribution of this forest area to community welfare and the regional economy. Interestingly, the indirect use value component (ecosystem services), which includes hydrological services and carbon sequestration, accounts for 39.9% of the total NET value. This demonstrates that the "hidden" value of forests not traded in conventional markets is economically significant.

Household Income Distribution

A survey of 60 KTH member households showed that the average household income from forest utilization reached Rp 2,850,000 per month, equivalent to approximately 58% of total household income. The following table shows the distribution of income by source:

Source of Income	Average (Rp/Month)	Min-Max (Rp/Month)	%
HHBK (rattan, honey, resin)	980,000	350,000-2,400,000	34.4
Agroforestry (coffee, cocoa, etc.)	1,240,000	450,000-3,200,000	43.5
Wood and biomass	350,000	100,000-800,000	12.3
Non-forest (dryland agriculture, etc.)	280,000	0-650,000	9.8
Total Average	2,850,000	-	100.0

Table 5. Distribution of Average Income of KTH Member Households from Forest Utilization

Environmental Impact Analysis

Forest Cover Condition

Multitemporal satellite imagery analysis using Landsat 8 and Sentinel-2 data shows that overall canopy cover in the Air Ketahun HPT area remains relatively good, with an average canopy cover of 76.3% in 2024. However, there is significant variation between management blocks. The core block has the highest canopy cover at 89.4%, while the buffer block has 72.1%. The most degraded areas are parts of the buffer block and the transition zone directly adjacent to the plantation area.

Analysis of land cover changes for the 2015-2024 period shows that since the implementation of Social Forestry in 2019, the rate of deforestation in the area managed by LD Gembung Lestari Sejahtera has decreased significantly, from an average of 78 hectares per year (2015-2019) to 31 hectares per year (2019-2024). This decrease is a positive indication that community-based management has a deterrent effect on encroachment and illegal logging activities.

Hydrological Conditions and Water Quality

Hydrological monitoring of the Air Ketahun watershed shows that river water discharge remains relatively stable throughout the year, although there are seasonal fluctuations that are higher than ideal conditions. The annual discharge coefficient of variation is in the range of 0.45-0.55, which can still be categorized as "moderate" hydrological conditions. River water quality, based on physical-chemical parameters (DO, BOD, turbidity, and pH), still meets Class II water quality standards as stipulated in Government Regulation No. 22 of 2021.

Biodiversity Indicators

Vegetation surveys conducted on sample plots in various management blocks indicate that the Air Ketahun HPT area still boasts high biodiversity. The Shannon-Wiener Index (H') for tree vegetation ranges from 3.2 to 4.1, indicating high biodiversity. Several rare and protected species are still found in the area, including the tapir (Tapirus indicus), the sun bear (Helarctos malayanus), and various primate species.

Ecological Indicators	Condition 2019	Condition 2024	Trend
Canopy Cover (%)	74.1	76.3	▲ Increase
Deforestation Rate (Ha/Year)	78	31	▼ Decrease
Tree Density (trees/Ha)	462	487	▲ Increase
Shannon-Wiener Index (H')	3.1	3.4	▲ Increase
Minimum Water Discharge of DAS (m^3/second)	2.8	3.1	▲ Increase
Soil Erosion (tons/Ha/Year)	4.7	3.9	▼ Decrease

Table 6. Indicators of the Condition of the Water HPT Ecosystem by Year (2019 vs. 2024)

The data in Table 6 confirms a trend of improving ecosystem conditions since the implementation of community-based management. Increased canopy cover, decreased deforestation rates, and increased tree density are clear indications that the Gembung Lestari Sejahtera Forest Reserve has contributed positively to the sustainability of the Air Ketahun HPT area. These findings are consistent with similar studies showing that legitimate community-based forest management supported by strong institutions tends to produce better ecological outcomes.

Management Challenges and Opportunities

SWOT Analysis

Based on the results of in-depth interviews, FGDs, and field observations, the SWOT analysis of the management of the Air Ketahun HPT resulted in the identification of the following key factors:

Strengths	WEAKNESSES
• Strong legality of IUPHKm • Rich local wisdom in forest management • High social cohesion within the community • Abundant diversity of HHBK resources • Active support from accompanying NGOs	• Limited managerial capacity of KTH • Low participation of women in institutions • Market access for HHBK products is still limited • Weak regional monitoring system • Limited business capital for KTH members
OPPORTUNITIES	**Threats**
• A rapidly growing voluntary carbon market • Increasing demand for sustainable forest products • Community-based ecotourism program • International funding for REDD+ • Social Forestry Policy is increasingly conducive	• Expansion of oil palm plantations in the buffer zone • Illegal logging and forest encroachment • Climate change that affects the productivity of HHBK • Unresolved tenure conflicts • Habitat fragmentation due to infrastructure development

Table 7. SWOT Matrix for Annual Water HPT Management

Key Challenges

From the SWOT analysis, the most pressing challenges facing the management of the Air Ketahun HPT can be grouped into three categories. First, institutional challenges: the weak management capacity of the KTH is a major obstacle to optimizing the area's utilization and management. Low female participation is also a significant issue, given that women often have more in-depth knowledge of non-timber forest resources and stronger incentives to maintain forest sustainability.

Second, economic challenges: Limited market access for NTFP products often results in prices received by farmers far below fair market prices. Long marketing chains and weak bargaining power

prevent forest farmers from receiving a fair value for their products. Third, ecological challenges: Although conditions in the region have shown a positive trend since the implementation of the IUPHKm, threats from oil palm plantation expansion and illegal activities in the buffer zone remain a serious concern.

Strategic Opportunities

On the opportunity side, the development of a voluntary carbon market offers significant new revenue potential for the Gembung Lestari Forest Management Unit (KTH). Initial feasibility studies indicate that the Air Ketahun HPT area has the potential to generate carbon credits worth USD 80,000-120,000 per year through the REDD+ (Reducing Emissions from Deforestation and Forest Degradation) mechanism. Realizing this potential requires enhanced technical and institutional capacity, as well as adequate policy support.

Community-based ecotourism development also presents a promising opportunity. The natural beauty of the Air Ketahun Forest Reserve, including waterfalls, clear rivers, and rich biodiversity, is a potential tourist attraction. Ecotourism development can provide an alternative, non-extractive source of income while simultaneously creating additional economic incentives to preserve the area

CONCLUSION

Based on the analysis that has been carried out, several main conclusions can be drawn from the study of the effectiveness of community-based forest management in the Air Ketahun HPT area, Gembung Tengah Hamlet, Tanjung Kemayan Village, Napal Putih District, North Bengkulu Regency:

1. The actual condition of the Air Ketahun HPT area remains relatively good, with canopy cover reaching 76.3% and high biodiversity (Shannon-Wiener Index H' = 3.4). Since the implementation of the IUPHKm in 2019, there has been a significant improvement trend in various ecological indicators, including a decrease in the deforestation rate from 78 hectares/year to 31 hectares/year.
2. The institutional effectiveness of LD Gembung Lestari Sejahtera achieved an Institutional Effectiveness Index (IEK) of 68.3%, categorized as "quite effective." Its main strengths lie in its institutional legality, local wisdom, and community social cohesion. The biggest weaknesses identified were its sanction mechanism and management capacity.
3. The Total Economic Value (NET) of the Air Ketahun HPT area is estimated at IDR 2.87 billion per year. Direct use value accounts for 55% of the total NET, while ecosystem services (indirect use value) contribute 39.9%. The average household income of KTH members from forest utilization reaches IDR 2.85 million per month, equivalent to 58% of total household income.
4. Community-based forest management through LD Gembung Lestari Sejahtera has been proven to have a positive environmental impact, as indicated by increased canopy cover, decreased deforestation rates, increased tree density, and stability of the hydrological conditions of the Air Ketahun watershed.
5. The main challenges faced include limited managerial capacity within the Forest Management Unit (KTH), limited market access for NTFPs (non-timber forest products), weak area monitoring systems, and threats from oil palm plantation expansion and illegal activities in the buffer zone. Meanwhile, the greatest strategic opportunities lie in the development of carbon-based payment for environmental services (PES) mechanisms and community-based ecotourism.

Overall, this study confirms that community-based forest management in the Air Ketahun Forest Reserve (HPT Air Ketahun) is an appropriate and effective approach within the socio-ecological context of Gembung Tengah Hamlet. This finding aligns with Ostrom's theoretical proposition that local communities with adequate institutions are capable of sustainably managing shared resources. However, increasing effectiveness to a higher level still requires interventions focused on strengthening institutional capacity and diversifying income sources.

REFERENCE

Agrawal, A. (2001). Common Property Institutions and Sustainable Governance of Resources. World Development, 29(10), 1649-1672.

Angelsen, A., & Wunder, S. (2003). Exploring the Forest-Poverty Link: Key Concepts, Issues and Research Implications. CIFOR Occasional Paper No. 40. Center for International Forestry Research: Bogor.

Badan Pusat Statistik Kabupaten Bengkulu Utara. (2024). Kabupaten Bengkulu Utara dalam Angka 2024. BPS Kabupaten Bengkulu Utara: Arga Makmur.

Baland, J.M., & Platteau, J.P. (1996). Halting Degradation of Natural Resources: Is There a Role for Rural Communities? FAO/Clarendon Press: Oxford.

Bengkulu Utara. (2024). Profil Kawasan HPT Air Ketahun. Kesatuan Pengelolaan Hutan (KPH) Bengkulu Utara: Arga Makmur.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., ... & van den Belt, M. (1997). The Value of the World's Ecosystem Services and Natural Capital. Nature, 387, 253-260.

Daily, G.C. (Ed.). (1997). Nature's Services: Societal Dependence on Natural Ecosystems. Island Press: Washington DC.

Darusman, D., & Hardjanto. (2006). Tinjauan Ekonomi Hutan Rakyat. Makalah pada Seminar Hasil Penelitian Hutan Rakyat. Bogor.

Faustmann, M. (1849). On the Determination of the Value which Forest Land and Immature Stands Possess for Forestry. Reprinted in Journal of Forest Economics (1995), 1(1), 7-44.

Food and Agriculture Organization (FAO). (2016). State of the World's Forests 2016: Forests and Agriculture: Land-use Challenges and Opportunities. FAO: Rome.

Gibson, C.C., McKean, M.A., & Ostrom, E. (Eds.). (2000). People and Forests: Communities, Institutions, and Governance. MIT Press: Cambridge.

Hardin, G. (1968). The Tragedy of the Commons. Science, 162(3859), 1243-1248.

Hartwick, J.M. (1977). Intergenerational Equity and the Investing of Rents from Exhaustible Resources. American Economic Review, 67(5), 972-974.

Kementerian Kehutanan. (2025). Siaran Pers nomor: SP. 031/HKLN/PPIP/HMS.3/03/2025. Hutan dan Deforestasi Indonesia Tahun 2024. Diakses pada 29 April 2026 dari https://www.kehutanan.go.id/pers/article-10.

Kementerian Lingkungan Hidup dan Kehutanan. (2023). Data dan Informasi Perhutanan Sosial 2023. KLHK: Jakarta.

Kementerian Lingkungan Hidup dan Kehutanan. (2021). Peraturan Menteri LHK Nomor P.9/MENLHK/SETJEN/KUM.1/3/2021 tentang Pengelolaan Perhutanan Sosial. KLHK: Jakarta.

Kusters, K., de Foresta, H., Ekadinata, A., & van Noordwijk, M. (2007). Towards Solutions for State vs. Local Community Conflicts over Forestland: The Impact of Formal Recognition of User Rights in Krui, Sumatra, Indonesia. Human Ecology, 35(4), 427-438.

Millennium Ecosystem Assessment. (2005). Ecosystems and Human Well-being: Synthesis. Island Press: Washington DC.

Nugroho, B., Nurrochmat, D.R., & Basuno, E. (2018). Evaluasi Efektivitas Program Perhutanan Sosial di Indonesia. Jurnal Analisis Kebijakan Kehutanan, 15(1), 1-20.

Ostrom, E. (1990). Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press: Cambridge.

Ostrom, E. (2005). Understanding Institutional Diversity. Princeton University Press: Princeton.

Pearce, D.W., & Turner, R.K. (1990). Economics of Natural Resources and the Environment. Johns Hopkins University Press: Baltimore.

Peraturan Pemerintah Nomor 23 Tahun 2021 tentang Penyelenggaraan Kehutanan. Lembaran Negara RI: Jakarta.

Poffenberger, M. (Ed.). (2000). Communities and Forest Management in Southeast Asia. IUCN: Gland.

Romero, C., & Andrade, G.I. (2004). International Conservation Organizations and the Fate of Local Tropical Forest Conservation Initiatives. Conservation Biology, 18(2), 578-580.

Schindler, B., Brunson, M., & Stankey, G.H. (2002). Social Acceptability in Forest and Related Resource Management. USDA Forest Service General Technical Report PNW-537.

Soemarwoto, O. (2001). Ekologi, Lingkungan Hidup dan Pembangunan. Djambatan: Jakarta.

Sunderlin, W.D., Angelsen, A., Belcher, B., Burgers, P., Nasi, R., Santoso, L., & Wunder, S. (2005). Livelihoods, Forests, and Conservation in Developing Countries: An Overview. World Development, 33(9), 1383-1402.

Undang-Undang Nomor 41 Tahun 1999 tentang Kehutanan sebagaimana telah diubah dengan UU Nomor 19 Tahun 2004. Lembaran Negara RI: Jakarta.

Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup. Lembaran Negara RI: Jakarta.

Wunder, S. (2005). Payments for Environmental Services: Some Nuts and Bolts. CIFOR Occasional Paper No. 42. Center for International Forestry Research: Bogor..