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Assessment of Forest Health Using Biodiversity and Productivity Indicators in Gunung Sasak, West Lombok

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ABSTRACT

The community forest of Mount Sasak plays a pivotal role in maintaining ecological functions while supporting community-based forest management. This study aims to assess forest health conditions in the Mount Sasak community forest, West Lombok Regency, using the Forest Health Monitoring (FHM) approach. The research was conducted from November 2024 to January 2025 in an area of approximately 477 hectares, with a sampling intensity of 1%, resulting in 12 cluster plots. Forest health assessment was based on two ecological indicators: biodiversity and productivity, measured using the Shannon–Wiener diversity index and basal area, respectively. The results indicate that the final forest health scores (FFHS) across cluster plots ranged from good to poor conditions. Overall, the forest health status of the Mount Sasak community forest was classified as moderate, with an average FFHS value of 2.65. These findings suggest that although certain areas exhibit favorable ecological conditions, more targeted and sustainable management efforts are required to maintain and improve forest health

INTRODUCTION

Forests are ecosystems consisting of land areas dominated by trees, in which all components interact with one another and function as an inseparable unit (Law No. 41 of 1999 on Forestry). Efforts to improve community welfare through forest management have been promoted by the Indonesian government through the Social Forestry Program, as regulated under Law No. 11 of 2020 on Job Creation. One of the social forestry schemes implemented in state forest areas is the Community Forest, which aims to empower communities living in and around forest areas.

Mount Sasak is designated as a protected forest and was subsequently granted Community Forest status, covering an area of approximately 477 ha, based on the Decree of the Minister of Forestry Number 469/Menhut-II/2014. According to Rani and Chaniago (2017), during the 1980s, Mount Sasak Forest exhibited high tree species diversity, including *Diospyros macrophylla*, *Dalbergia latifolia*, *Tectona grandis*, *Cassia siamea*, *Acacia mangium*, and *Arenga pinnata*. However, since the early 2000s, forest utilization has intensified, accompanied by extensive logging activities carried out by local communities.

Deforestation and land-use conversion have been reported to significantly affect forest functions and overall forest health (Safe'i & Tsani, 2016). Forest health can be evaluated using ecological indicators, particularly biodiversity and productivity, which reflect ecosystem stability and stand growth capacity (Safe'i et al., 2019). Based on these conditions, this study aims to assess the forest health status of the Mount Sasak Community Forest in West Lombok Regency using biodiversity and productivity indicators through the Forest Health Monitoring (FHM) approach.

METHODS

Schedule and Study Area

The study was conducted from November 2024 to January 2025 in the Mount Sasak Community Forest, located in West Lombok Regency, Indonesia. The study area covers approximately 477 hectares and is managed under a community-based forest management scheme.

Data Collection Procedure

Forest health data were collected using the Forest Health Monitoring (FHM) method. A sampling intensity of 1% was applied in accordance with the National Forest Inventory standard, resulting in the establishment of 12 FHM cluster plots. The placement of cluster plot points followed a systematic sampling method with a random start, as described by (Shiue, 1959). This approach was applied to ensure an even spatial distribution of sampling points across the study area while minimizing initial sampling bias.

The configuration of the FHM cluster plot design is presented in Figure 1.

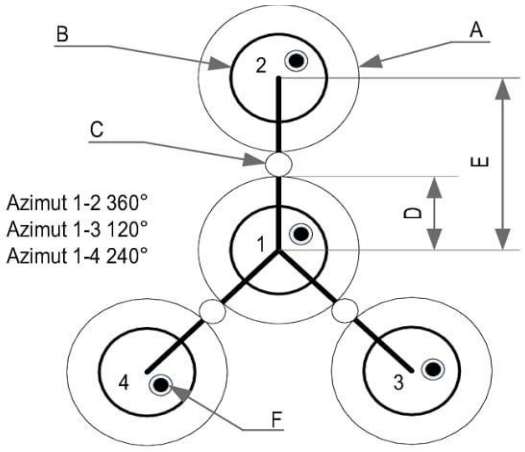

Figure 1. FHM Plot Cluster Design

As shown in Figure 1, the cluster plot design follows the Forest Health Monitoring guidelines. It consists of an annular plot with a radius of 17.95 m for the tree stratum, a subplot with a radius of 7.32 m for the pole stratum, and a microplot with a radius of 2.07 m for the seedling and sapling strata.

Data Analysis

The biodiversity indicator was analyzed using the Shannon–Wiener diversity index (H′) (Soerianegara & Indrawan, 2005; Safe'i et al., 2021). The productivity indicator was assessed based on the basal area (BA) parameter. The final forest health score was then determined by multiplying the weighted value and score of each indicator, namely biodiversity and productivity, following the Forest Health Monitoring (FHM) approach (Safei et al., 2019). The assessment results were subsequently classified into three forest health condition categories: good, moderate, and poor (Safe'i et al., 2015).

RESULTS AND DISCUSSION

Indicator Assessment

The results of the biodiversity indicator analysis using the Shannon–Wiener diversity index (H′) and the productivity indicator based on basal area (BA) are presented in Table 1.

Table 1. Values of Biodiversity and Productivity Indicators

Cluster Plot	Shannon-Wiener Index (H')	Basal Area (BA)
1	2,49	3,10
2	2,24	3,13
3	1,76	2,77
4	1,81	2,35
5	1,8	3,00
6	2,03	2,97
7	2,11	2,70
8	1,78	2,61
9	2,33	2,30
10	1,94	2,76
11	2,15	2,14
12	2,05	2,70

Based on Table 1, the Shannon–Wiener index (H′) values across the 12 cluster plots ranged from 1.76 to 2.49. The highest value was recorded in cluster plot 1 (H′ = 2.49), while the lowest value occurred in cluster plot 3 (H′ = 1.76). For the productivity indicator, basal area values ranged from 2.14 to 3.13, with the highest value observed in cluster plot 2 (3.13) and the lowest in cluster plot 11 (2.14).

Forest Health Assessment

1. Scoring Values

Forest health scores in the Mount Sasak Community Forest were determined using an interval scoring technique based on the Forest Health Monitoring (FHM) approach. The scoring intervals for biodiversity and productivity indicators are presented in Table 2.

Table 2. Scoring Intervals for Forest Health Indicators

Score	*Shannon-Wiener Index* (H')	Basal Area (Ba)
1	1,76-1,83	2,14-2,23
2	1,84-1,91	2,24-2,33
3	1,92-1,99	2,34-2,43
4	2,00-2,07	2,44-2,53
5	2,08-2,15	2,54-2,63
6	2,16-2,23	2,64-2,73
7	2,24-2,31	2,74-2,83
8	2,32-2,39	2,84-2,93
9	2,40-2,47	2,94-3,03
10	2,48-2,49	3,04-3,13

Based on Table 2, the Shannon–Wiener index values ranged from 1.76 to 2.49 and were classified into 10 evenly distributed score classes with an interval width of 0.073. Similarly, basal area values ranged from 2.14 to 3.13 and were divided into 10 score classes with an interval width of 0.099. Higher scores represent greater species diversity and higher productivity, indicating better forest health conditions (Rochmah et al., 2020). The scores for each cluster plot are presented in Table 3.

Table 3. Indicator Scores for the 12 Cluster Plots

Cluster Plot	*Shannon-Wiener Index* (H')	Score (H')	Basal Area (BA)	Score (BA)
1	2,49	10	3,10	10
2	2,24	7	3,13	10
3	1,76	1	2,77	7
4	1,81	1	2,35	3
5	1,8	1	3,00	9
6	2,03	4	2,97	9
7	2,11	5	2,70	6
8	1,78	1	2,61	5
9	2,33	8	2,30	2
10	1,94	3	2,76	7
11	2,15	5	2,14	1
12	2,05	4	2,70	6

2. Weighted Values

The weighting values used in this study refer to Safe'i et al. (2019), where biodiversity was assigned a weight of 0.14 and productivity a weight of 0.33. This weighting indicates that productivity plays a more dominant role in assessing forest health conditions. According to Safe'i et al. (2015), productivity tends to respond more rapidly to forest degradation, while biodiversity is relatively more stable and reflects long-term ecological changes.

3. Final Forest Health Score and Classification

The Final Forest Health Score (FFHS) was calculated by multiplying the weighted value and score of each indicator (Safe'i & Tsani, 2016). Forest

health categories were determined based on threshold values derived from the highest and lowest FFHS values, which were subsequently classified into good, moderate, and poor categories (Safei et al., 2019). The threshold values are presented in Table 4.

Table 4. Threshold Values for Forest Health Categories

Threshold Value	Category
3,49- 4,70	Baik
2,26 - 3,48	Sedang
1,03 - 2,25	Buruk

Based on these thresholds, the forest health category of each cluster plot was determined Table 5.

Table 5. Final Forest Health Scores and Categories

Claster Plot	Weight (H')	Score (H')	Weight (BA)	Score (BA)	FFHS	Forest health category
1	0.14	10	0.33	10	4.70	Good
2	0.14	7	0.33	10	4.28	Good
3	0.14	1	0.33	7	2.45	Fair
4	0.14	1	0.33	3	1.13	Poor
5	0.14	1	0.33	9	3.11	Fair
6	0.14	4	0.33	9	3.53	Good
7	0.14	5	0.33	6	2.68	Fair
8	0.14	1	0.33	5	1.79	Poor
9	0.14	8	0.33	2	1.78	Poor
10	0.14	3	0.33	7	2.73	Fair
11	0.14	5	0.33	1	1.03	Poor
12	0.14	4	0.33	6	2.54	Fair
Average					**2.65**	**Fair**

The FFHS values in the Mount Sasak Community Forest ranged from 1.03 to 4.70, with an average value of 2.65. The classification results indicate that forest health conditions were predominantly in the moderate category, with several cluster plots classified as good and poor. Overall, the forest health status of the Mount Sasak Community Forest can be categorized as moderate.

This condition suggests that the forest ecosystem continues to function ecologically; however, the balance between biodiversity and productivity indicators has not yet been optimally achieved across all cluster plots. According Safe'i et al.2019), optimal forest health is attained when ecological indicators are in balance. Furthermore, Putra (2004) emphasized that, within the FHM framework, indicator balance reflects ecosystem stability against environmental pressures and human activities. Therefore, more targeted forest management strategies are required to enhance the balance between biodiversity and productivity to sustainably improve forest health conditions in the Mount Sasak Community Forest.

CONCLUSION

Based on the Forest Health Monitoring (FHM) analysis of 12 cluster plots in the Mount Sasak Community Forest, forest health conditions were classified into three categories. Three clusters (Clusters 1, 2, and 6) were classified as having good forest health, five clusters (Clusters 3, 5, 7, 10, and 12) were categorized as moderate, and four clusters (Clusters 4, 8, 9, and 11) were classified as poor. Overall, the forest health condition of the Mount Sasak Community Forest was categorized as moderate, with an average Final Forest Health Score (FFHS) of 2.65, based on biodiversity and productivity indicators.

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