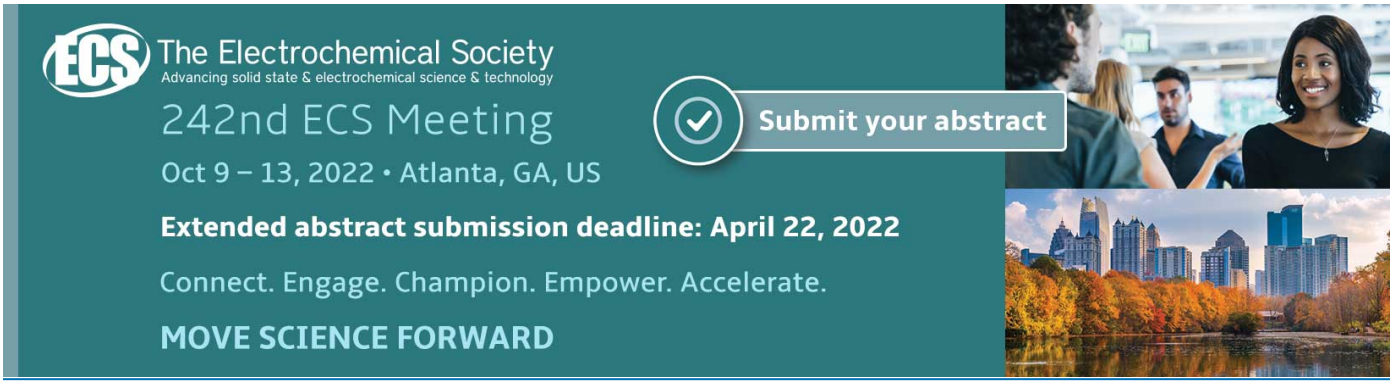
Forestry Value for Health Status: An Ecological Review



Forestry Value for Health Status: An Ecological Review

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Abstract. Community forest (HKm) is a social forestry scheme located in the country's forests by empowering people around forest areas. Management carried out by communities around forests must enhance ecological aspects with sustainable forest management Forest health can be an option to support sustainable forest management. Through forest health assessment, one can find out the status, changes, and tendencies experienced by a forest. This research aims to find out the value of forest health status in community forest management Gapoktan Margo Rukun and Harapan Sentosa, KPHL Batu Tegi, Tanggamus Regency, Lampung. The stages of the implementation of this study are the determination of plot clusters, the collection of data on forest health indicators (productivity, biodiversity, vitality, and quality of the site), and the final assessment of forest health. This study obtained the value of forest health with a range of values of 3.30 – 8.75. The average health status value of the community is 5.95, which is in the moderate category. Thus, the value of health status community orangutans managed in the condition of medium forest health.

Keywords: community forest, social forestry, forest health

1. Introduction

Community forest (HKm) is a social forestry scheme located in the country's forests by empowering communities around forest areas to improve the ability and independence of local communities in improving the economy and optimizing the utilization of forest resources [1]. The implementation of HKm is intended to provide access and develop the capacity of communities around forests in managing forests sustainably to ensure the availability of jobs to solve economic and social problems that occur in the community [2]. The Community Forest Utilization Business License (IUPHKM) is expected to reduce deforestation rates in protected forests. The concept of forest management involving community participation is expected to be a source of income for the community around the forest [3]. Forest management carried out by Gapoktan Margo Rukun will affect the health status of managed forests [4].

If the forest can still carry out the essential functions that have been identified before, then the forest can be said to be healthy [5]. Forest health is a picture of the condition of a forest ecosystem that can carry out its primary function well [6]. Monitoring forest health can be done with ecological indicators of forest health consisting of vitality, productivity, biodiversity, and tread quality [7, 22]. One of them is by paying attention to supporting factors that affect the ability of forests to carry out

their functions [8]. Determine the health condition of the forest is monitored using *Forest Health Monitoring* (FHM). Forest health monitoring (FHM) is an attempt to determine the status, changes, and trends that occur about the condition of a forest ecosystem at a given time and is assessed based on the purpose and function of a forest and forest area.

Forest health can be an option to support the achievement of sustainable forest management [10]. Through forest health assessment, one can find out the status, changes, and tendencies experienced by a forest. The health value of forests is obtained through observation and evaluation of the ecological factors of forests. Environmental factors include productivity, vitality, and tread quality [11]. The better the health value of the forest, the better the ability of the woods to carry out its functions, so this research was conducted aimed at knowing the value of forest health status in HKm Gapoktan Margo Rukun dan Harapan Sentosa , KPHL Batu Tegi, Tanggamus Regency, Lampung.

2. Method

Sampling was conducted in November 2021 on HKm Gapoktan Margo Rukun community forest management land, KPHL Batu Tegi, Tanggamus Regency, Lampung Province. Data retrieval is done using the following equipment: tally sheet, mica paper, permanent marker, tacks, tape meter, meter, Global Positioning System (GPS), and magic card. Observations are made to the entire tree in the measurement plot of the statement (**FIGURE** 1).

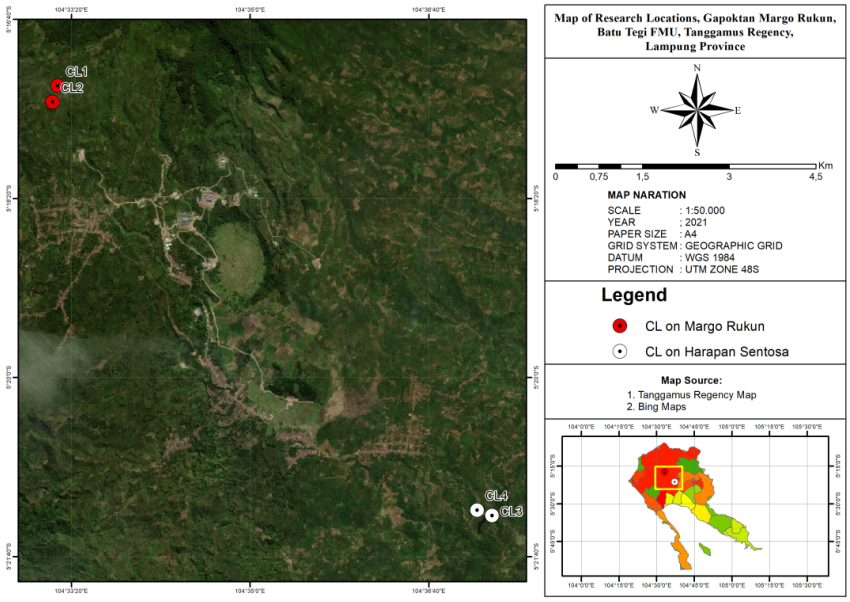

Figure 1. Research location map

2.1. Implementation of Data Retrieval

The implementation of the study was conducted by directly assessing several indicators that include productivity, biodiversity, vitality, and tread quality. The implementation stages involve determining the number of-plot, the creation of plot clusters, data retrieval based on FHM techniques, and data processing and analysis. The number of plot clusters is determined based on farmers' management land that agroforestry and monoculture. So that the number of plot clusters used in this observation is three plot clusters. Naming plot clusters using numbers where plot cluster 1 is agoforestry in Margo Rukun, plot cluster 2 is monoculture in Margo Rukun, plot cluster 3 is agoforestry in Harapan Sentosa, and plot cluster 4 is monoculture in Harapan Sentosa.

Observational plot clusters are made based on plot cluster designs in FHM techniques. Each of the 1-plot clusters consists of 1 annular plot, one subplot, and one micro plot with each radius 17, 95 m,

7.32 m, and 2.07 m. A cluster plot can represent one hectare of land because the plot-cluster in FHM engineering has an area of 4,046.86 $m^{2,}$ so that it can mean 1 ha of forest area as in **FIGURE** 2 [7].

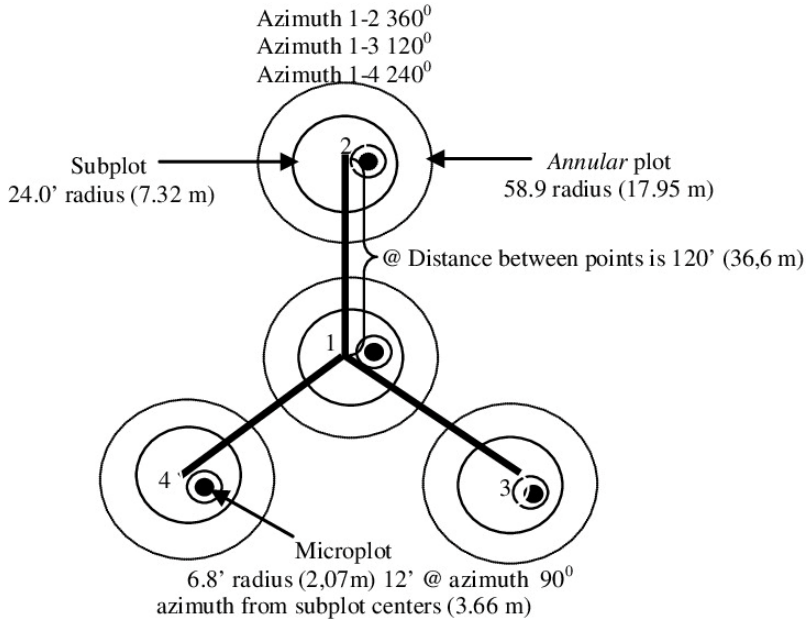

Figure 2. FHM cluster-plot design

Data collection measures forest ecological indicators, including productivity, biodiversity, vitality, and tread quality. The experimental parameters are LBDs, tree diversity (H'), tree damage (CLI) and crown conditions (VCR), and soil pH.

2.2. Data Processing and Analysis

The parameter data of each forest ecological indicator is processed and analyzed by calculating the final value of community forest health (NKHKm). The absolute value is obtained by multiplying each forest health indicator by a weighted value [9]. The weighted values on each indicator are used to refer to other studies with a value of 0.20 for productivity, 0.36 for biodiversity, 0.25 for vitality, and 0.19 for site quality [4]. The formula used is as follows:

$$NKHKm = \mathbf{\Sigma}\ (NT \times NS) \quad (1)$$

With: NKHKm is the final value of the health condition community forests; NT is the parameter-weighted value of each community forest health indicator; NS is the parameter score of each indicator of community forest health used.

3. Result and Discussion

Community Forest aims at the optimal, fair, and sustainable utilization of forest resources to improve the welfare of the people around the forest. One of the country's forests designated as HKm work area is a protected forest [12]. . Forest health monitoring is an activity that can report and assess the current health status of forests using measurable ecological indicators, namely productivity, biodiversity, vitality, and tread quality. The results of forest health monitoring have been analyzed/assessed for each environmental indicator of forest health [13].

3.1. Productivity indicators

Productivity is a picture of good management. The higher the value of productivity, the greater the success rate of land productivity [8]. Productivity can be measured by looking at the tree's essential

field (LBDs) [14]. The value of tree LBDs was chosen because it has high consistency properties and in its application is accessible to. Trees that are said to be healthy will have an appropriate increase in LBDs so that productivity is more optimal. The LBDs values of plot clusters are presented in table 1 below.

Table 1. The average value of LBDs in each cluster

Cluster-plot	LBDs (m^2)
CL1	0.036
CL2	0
CL3	0.031
CL 4	0

Table 1 shows the highest LBDs value obtained in plot cluster 1, while the lowest value is in plot cluster 2 and 4 because there are no plants that fall into the poles or trees where there are only coffee plants. The value of LBDs is influenced by the measurement of the diameter of each observation tree. The greater the tree's diameter, the greater the value of the tree's LBDs. Similarly, research [15] states that the productivity of a tree is affected by the type of tree and the diameter of the tree. Therefore, the tree's diameter can show how small the tree's growth is seen from the results of its LBDs [15].

3.2. Biodiversity indicators

Type diversity is calculated to determine the level of diversity in the HKm region of the research object. Such diversity provides an overview of the adaptability power of the populations that will be part of the interaction of species [16]. Type diversity is obtained by analyzing inventory data on observational plots, categorized into three levels. In this study, an H' in each growth rate in each plot cluster was presented in **TABLE** 2 below.

Table 2. Biodiversity value in each cluster-plot

Cluster-plot	H’
CL1	1.31
CL2	0
CL3	1.40
CL4	0

Table 2 shows the highest diversity value in plot cluster 3 and the lowest diversity value in plot cluster 2 and 4, where there are only coffee plants and no trees in the house. If the value of H' < 1, then the vegetation community has less stable environmental conditions; if the value of H' is between 1-2, then the vegetation community has a stable ecological condition; if the value of H' >2, then the vegetation community has callous environmental conditions [17]. HKm Margo Rukun and Harapan Sentosa area are a function of protected forest area, so that the management of HKm by farmers groups needs to pay attention to ecological aspects. The diversity of vegetation species needs to be preserved to maintain the function of forest areas as a regulator of water systems, maintain soil fertility, and control erosion [18].

3.3. Vitality Indicator

Tree damage and header condition are parameters of the vitality indicator. Tree damage is usually caused by poor management. Vitality can be characterized by the condition of tree damage and header condition. The vitality of the tree is a factor that is very influential on the tree's growth so that if there is an optimal nest can affect the quantity and quality of processed wood to be produced [19]. Assessment of tree damage conditions can be known through the tree damage value of plot cluster level (Cluster plot Level Index-CLI) presented in **TABLE** 3 below.

Table 3. CLI value in each plot cluster

Cluster-plot	CLI
CL1	2.15
CL2	0
CL3	3.16
CL4	0

Some of the tree damage in rubber plants can be found at the location of stems, branches, and leaves with types of open wound damage, damaged leaves, and termite attacks. The stems and leaves are the most vulnerable parts that are damaged. Open wounds are conditions where the splitting of the skin of the trunk and until the dermis part becomes two parts. This condition can affect the free entry of microorganisms such as bacteria, fungi, pests, and viruses into the tree's trunk that can cause the condition of the tree to decrease [20].

Figure 3. Open wound damage

Figure 4. Termite attack

In addition to the condition of tree damage, the condition of the tree header becomes a supportive parameter in conducting a health assessment of the forest. The condition of the tree header describes

the health condition of the tree. Wide or not header will affect tree growth rate [8]. Wide headers describe the rapid growth rate, while small or non-broad headlines describe the condition of slow growth. Measurement of tree header condition is based on forest health monitoring (FHM) method with several measurements based on the value of Visual Crown Ratio (VCR) [21]. The determination of VCR values is measured based on the parameter Live Crown Ratio (LCR), Crown density (Cden), Foliage Tranparancy (FT), Crown Diameter Width and Crown Diameter at 90^o, and dieback (CDB). The VCR values in each cluster can be seen in **TABLE** 4 below.

Table 4. VCR value in each plot cluster

Cluster-plot	VCR
CL1	2.25
CL2	0
CL3	2.82
CL4	0

The header condition value in each plot cluster is shown in Table 4, where the highest header condition value is in cluster 3. The header is the part of the plant that has leaves. The condition of the title can describe how the health of the forest. If the condition of the title is lush and wide, then it shows good tree growth conditions. While the header is not overgrown and narrow, indicating poor tree growth conditions [10].

3.4. Tread Quality Indicator

Tread quality assessment is a way to find out the fertility rate of the soil. In addition, tread quality assessment can also be used to determine the state of acid bases in the soil using soil pH parameters [23]. Determination of tread quality value based on the FHM method can be measured by looking at the pH condition of the soil where mangrove trees are represented in each cluster-plot observation. The pH value of the soil in each plot cluster can be seen in **TABLE** 5 below.

Table 5. Value of pH on each plot cluster

Cluster-plot	pH
CL1	5.64
CL2	5.00
CL3	6.20
CL4	4.90

The site's quality is an indicator that is also quite influential in assessing the health of people's forests with monoculture planting patterns [7]. The value of tread quality is measured by looking at the pH value of the soil. The degree of acidity of the soil at the location has an average of 5.44. Tree will grow well if supported by the optimal tree growing tread quality conditions. Good tread quality conditions indicate the quality of organs material at the place of forest growth. Organic matter has a role in the carbon and nutrient cycle and changes in soil pH [8].

3.5. Forest Health Assessment

Forest health assessment is conducted to determine forest health conditions' final value and status. To obtain a score, it is necessary to subtract between the highest and lowest values in each cluster [7]. The score value has intervals of 1-10. A high score describes the forest getting healthier except for tree damage. The score values on each parameter measured are presented in **TABLE** 6.

Table 6. Interval score for each measurement parameter

Score	LBDs	H' Tree	CLI	VCR	pH
1	0 - 0.004	0 - 0.13	2.84 - 3.16	0 - 0.27	4.90 - 5.02
2	0.0036 - 0.0071	0.14 - 0.27	2.53 - 2.83	0.28 - 0.55	5.03 - 5.15

3	0.0072 - 0.0107	0.28 - 0.41	2.21 - 2.52	0.56 - 0.84	5.16 - 5.28
4	0.0108 - 0.0143	0.42 - 0.55	1.90 - 2.20	0.84 - 1.12	5.29 - 5.41
5	0.0144 - 0.0179	0.56 - 0.69	1.58 - 1.89	1.13 - 1.40	5.42 - 5.54
6	0.018 - 0.0215	0.70 - 0.83	1.26 - 1.57	1.41 - 1.68	5.55 - 5.67
7	0.0216 - 0.0251	0.84 - 0.97	0.95 - 1.25	1.69 - 1.96	5.68 - 5.80
8	0.0252 - 0.0287	0.98 - 1.11	0.63 - 0.94	1.97 - 2.25	5.81 - 5.93
9	0.0288 - 0.0323	1.12 - 1.25	0.32 - 0.62	2.26 - 2.53	5.94 - 6.05
10	0.0324 - 0.0360	1.26 - 1.40	0 - 0.31	2.54 - 2.82	6.07 - 6.20

The threshold value is a value that categorizes forest health into certain conditions. For example, the threshold value of community forest (**TABLE** 7) is obtained based on the reduction of maximum value with a minimum value then divided by three to be used as three classes of forest health conditions, namely good, medium, and bad.

Table 7. Forest health status threshold

No. Cluster-plot	Final Grades	Category of Community Forest Health Status
1	6.93 – 8.75	Good
2	5.12 – 6.92	Medium
3	3.30 – 5.11	Bad

The threshold value contains a range of values that describe the health condition of a forest. Interval the value, which then becomes a reference about how healthy the condition of the forest. Based on this, the value and health status of people's forests based on rubber plants in each plot cluster, in **FIGURE** 5.

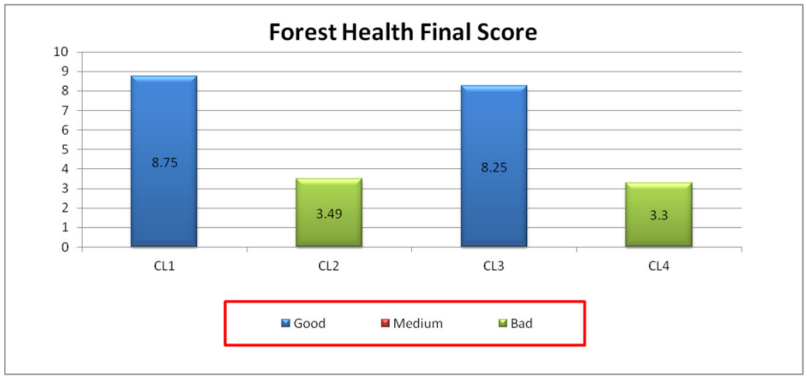

Figure 5. Forest health final score for each measurement parameter

The final status of community forest health in cluster-plot 1 is in good health, cluster-plot 2 is in bad condition, cluster-plot 3 is in good condition and cluster-plot 4 is in bad condition. So, based on these calculations, the average health of community forests at the research site is in a medium condition with a value of 5.95. Poor health status of forest conditions can be caused due to cluster-plot 2 and 4 that have low tree diversity. This is because if the lower the value of tree type diversity in an area, it will also decrease the diversity of ecological functions so that there is a decrease in the level of

environmental stability. The good final value of the status of forest health conditions at the research site was influenced by the small weighted value and score value of each parameter of the ecological indicator of forest health. The greater the weighted value and score value of each parameter of the environmental indicator of forest health, the higher the final value of the forest health condition [10].

4. Conclussion

Community forests managed by Gapoktan Margo Rukun have forest health value with a value range of 3.30 – 8.75. The average health status value of the community is 5.95, which is in the medium category. Thus, the value of health status of community managed by Gapoktan Margo Rukun and Harapan Sentosa, KPHL Batu Tegi, Tanggamus Regency, Lampung Province is in a medium forest health condition.

5. Acknowledgments

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