

The Positive Effect of The Forest Environment in The Ecotherapy Healing Forest Program on The Physical and Mental Health After COVID-19

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Abstract. This research is aimed at students who are currently experiencing excessive coursework and high emotional stress after COVID-19. Where if these conditions are not immediately addressed, it can cause mental illness. The Ecotherapy Healing Forest program offers several activities in it, such as relaxation programs to relieve stress, walks in the forest, and sensory elements to be given to the participants. In this study, 44 student participants were used from class 2018 – class 2021 at Kapuas Sintang University. Participants will be measured their blood sugar levels and oxygen saturation by medical personnel, and given the DASS 42 questionnaire to measure participants' stress levels. Measurements will be accrued out 5 repetitions of the Ecotherapy Healing Forest program at different times. The results of this study revealed that there was a significant decrease in blood sugar levels, oxygen saturation and stress levels in the participants after participating in the Ecotherapy Healing Forest program. However, for smoking students, the Ecotherapy Healing Forest treatment does not have a significant effect on oxygen saturation values. Therefore, the authors propose Ecotherapy Healing Forest as a non-pharmacological intervention to relieve stress while improving physical health (blood sugar levels and oxygen saturation) for students.

1 Introduction

Humans and nature have nurtured each other for a long time. Nature and humans are not that different. Hence, there are limits to how natural resources can be used to satisfy cultural needs and wants. Nature is respected, and there is a natural relationship between humans and nature. In human view, nature is not a commodity that must be consumed to meet human needs. Due to urbanization, globalization, and technological advances, people are increasingly away from the “free nature”. They were away from the “outdoors” and focused more on television, computers, and games as these advances accelerated the environment. These changes reduce our concern for the natural environment [1]. Lack of exposure to nature causes psychological functioning to change, as our natural resources are depleting, our psychological framework is also affected, which has been neglected for quite some time. In the past, research has shown that being in touch with nature can improve many aspects of well-being.

The coronavirus disease 2019, or COVID-19, started spreading rapidly in Wuhan City, Hunan Province, China, in December 2019, and has killed many people around the world. Everyone agrees that the acts of violence imposed in the aftermath of this pandemic have not only had an impact on physical health but also have

had a devastating impact on mental health and well-being [2]. It is a known fact that reduced social interaction and increased loneliness are known risk factors for several mental disorders, including major depression, anxiety, post-traumatic stress and schizophrenia. Worries about the health of oneself and those of their loved ones (especially the elderly or individuals who suffer from physical ailments), as well as great uncertainty about the future, can exacerbate fear, depression, and anxiety. Prolonged exposure to these worries can increase the risk of serious and disabling mental health conditions including anxiety disorders such as panic, obsessive-compulsive disorder, stress and trauma-related disorders [3]. This also has an impact on students who are currently experiencing changes in the learning system after COVID-19, so that they experience excessive lecture loads and high emotional stress. Where if these conditions are not immediately addressed, it can cause mental illness. Therefore, measures to mitigate these mental health consequences demand top priority before the impact of this pandemic gets worse.

Ecotherapy Healing Forest is a non-pharmacological method that uses the power of nature to improve human health, especially mental health after COVID-19. A core element of Ecotherapy Healing Forest is getting to know the forest environment with a focus on the five senses,

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and there are many activities to do there, such as wellness, yoga, walking in the forest, and many more. Ecotherapy Healing Forest can reduce stress or physical fatigue, anxiety, improve mood, and improve quality of life. In addition, this Ecotherapy Healing Forest also uses forests, which are conservation areas in Indonesia, with beautiful natural scenery and easy access, so they can not only be used by depressed patients but can also support conservation. Therefore, this study aims to determine the effect of the Ecotherapy Healing Forest program using the Gunung Kelam Natural Tourism Park conservation area on the physical and mental health of post-COVID-19 students.

2 Materials and methods

2.1 Participants

Participants in this study consisted of 44 students from the Forestry Study Program, Kapuas Sintang University from the 2018 – 2021 class. They are between 18 and 35 years old. Assuming that this is an age group that is prone to psychological health problems. The sampling method uses the slovin formula to calculate the number of participants. Confidentially of participants and all data collected will be protected for the purpose of this research only. To avoid everyday stressors during the study, all participants were asked to carry out daily work assignments and personal responsibilities as normal as students [4].

2.2 Study design

This study took samples with stratified random sampling. Where students are divided according to their class on campus, with the consideration that each generation brings different burdens and problems that must be faced on campus. Each batch will participate in the Ecotherapy Healing Forest program which includes six locations with five repetitions at different times. In each Ecotherapy Healing Forest program activity, participants will have their physical condition measured at the start and end of treatment by medical personnel, in the form of measurements of blood pressure, blood sugar levels, oxygen saturation and pulse rate. Participants will also be given a pre-test and post-test for the DASS 42 measurement.

Analysis of the sustainability of Ecotherapy Healing Forest management in the Bukit Kelam Nature Tourism Park adapts the Rapfish or Rapid appraisal for Fisheries method which is modified with the MDS method, which involves attribute components or dimensions to evaluate the influence of each component. In research on Ecotherapy Healing Forest Management in the Bukit Kelam Nature Tourism Park, the attributes chosen reflect the level of sustainability, there are four dimensions that are considered influential, including Social Economics, Ecology, Institutions and Health. After each attribute used is determined, it is then given a scale between 1 and 4. Scale 1 indicates a poor/poor measure of sustainability, while a maximum scale of 4 means a measure of sustainability in the good or high

category. The feasibility of the Ecotherapy Healing Forest sustainability model in the Bukit Kelam Nature Tourism Park is carried out by measuring the level of goodness of fit through calculating the S-Stress value. using the algorithm of scale (ALSCAL) method. A low S-stress value indicates high accuracy (good fit), and vice versa. The measure usually used as a reference is if the S-Stress value is less than 0.25, then the sustainability model has a good fit. However, if it is more than 0.25, it means the model is poor fit.

S – Stress

$$= \sqrt{\frac{1}{m} \sum_{k=1}^m \frac{\sum_i \sum_j (d_{ijk}^2 - o_{ijk}^2)}{\sum_i \sum_j o_{ijk}^2}} \quad (1)$$

From the results of these measurements, a representative site will then be designed for future EHF program activities, so that it can be more useful in the physical and mental healing process after COVID-19.

2.3 Study site

The conservation area of Mount Kelam Natural Tourism Park (Fig.1), located in Sintang Regency, has enormous potential to become a beautiful natural tourist spot with stunning views and an area of 1,121 hectares based on the Decree of the Minister of Forestry of the Republic of Indonesia Number SK. 45/Kpts/I/1999 dated 14 June 1999. The location of this study is also very representative because it is easily accessible to the participants. The research was conducted in a lowland forest ecosystem with 96 species and 35 plant families. The most common tree species come from the families Dipterocarpaceae, Euphorbiaceae, and Moraceae. Each type of plant has unique benefits and functions, such as water storage, medicinal plants, animal habitats, or plants that maintain the balance of the ecosystem.

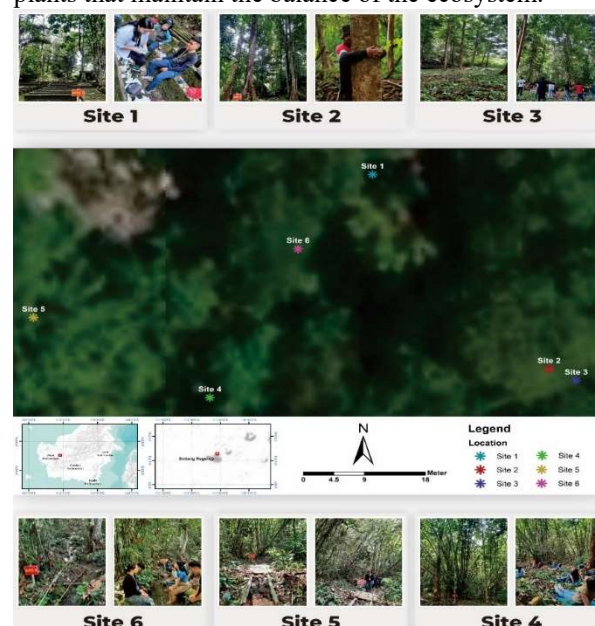




Fig. 1. Study site of Ecotherapy Healing Forest.

3 Results and discussion

3.1 Site identification

The species richness index for seedlings, stakes, poles, and trees has a value of more than 4. This indicates that the species richness of the vegetation is high. The Dominance Index (ID) was quite small (0-1) indicating that the location has a pattern of species dominance that is spread over several dominant species. The species diversity index value is greater than 3 which indicates that the species found in the study site have a high level of stability. The higher the value of the species diversity index (H), the more stable the species in the community. The level of species stability in the community is used for the evenness index value (e). The higher the value of e, the more stable the stability of species diversity in the community. The results of the vegetation analysis can be seen in table 1.

Table 1. Vegetation analysis.

No	Description	Level			
		Seedling	Stake	Pole	Tree
1	Species richness index (D)	31.563	29.367	30.099	29.584
2	Dominance index (ID)	0.021	0.028	0.017	0.027
3	Species diversity index (H')	4.215	4.094	4.242	4.002
4	Species abundance index (e')	2.146	2.122	2.211	2.097

Overall, it can be seen that the average value of the vegetation density index from site 1-site 6 is still in the very good category. Temperature measurement values at site 1-site 6 have temperature values that are still in

the range of 25 C – 26 C and according to SNI 9006:2021 and the results of air temperature measurements are still in the range of 24-28 C, still included in the thermally comfortable category. The air humidity measurement value at site 1-site 6, has a value ranging between 83%-87% and is included in the high category. This is because the research location is in Sintang Regency, which is part of the territory of West Kalimantan Province. This condition of high density of vegetation causes the humidity to be higher, due to litter covering the surface of the soil tightly, causing water vapor to be locked in it. Thermal Humidity Index (THI) measurement values at site 1 – site 6 range between 24-25 C and are include in the comfortable category. The light intensity measurement values range between 318-415 Lux and are included in the ideal category. Light intensity with an ideal value range tends to be comfortable for humans in their activities and does not cause eye fatigue. The average value of the slope index is included in the sloping and rather steep category, so it can still be recommended considering that it is not included in the steep or very steep category. The average value of noise is included in the ideal category (quiet). The average value of wind speed is included in the above ideal category (> 1m/sec). the average value of negative value of negative ion content is included in the health category. The highest negative ion value is at site 6 (near a water source). Site analysis is shown in table 2.

Table 2. Site analysis.

Description	Site					
	1	2	3	4	5	6
Vegetation density (NDVI)	0.76	0.75	0.75	0.73	0.76	0.74
Microclimate(temperature)	25.73	25.70	25.73	25.20	26.58	25.75
Microclimate(humidity)	24.87	24.87	24.91	24.59	25.61	24.90
Microclimate (thermal humidity index)	24.87	24.87	24.91	24.59	25.61	24.90
Light intensity	415.60	381.50	380.55	325.38	435.70	381.38
Slope	14.08	17.49	17.9	18.24	17.59	14.08
Noise	22.95	21.05	21.45	21.70	21.55	31.50
Wind velocity	2.53	2.55	2.53	2.63	2.48	2.54
Negative ions	87,450	87,500	87,250	109,900	79,550	110,450

3.2 Health response and DASS-422

The selected respondents are students from the 2018-2021 class, with an age range of 18-30 years with the assumption that this age range is an age that is vulnerable to psychological health conditions. The initial condition of the blood pressure of all respondents was 124.37/84.69 mmHg which means higher than normal blood pressure (Fig. 2). The heart rate at the respondent's initial condition was 85.68 beats per minute which is still in the normal category. The results of measuring blood pressure for all respondents (class of 2018-2021) at 6 sites obtained different values which tended to decrease from the starting point to the end, so that this decrease in blood pressure was a change in the desired health response. Trekking in the forest is

suitable for patients with hypertension to stabilize blood pressure as found in this study.

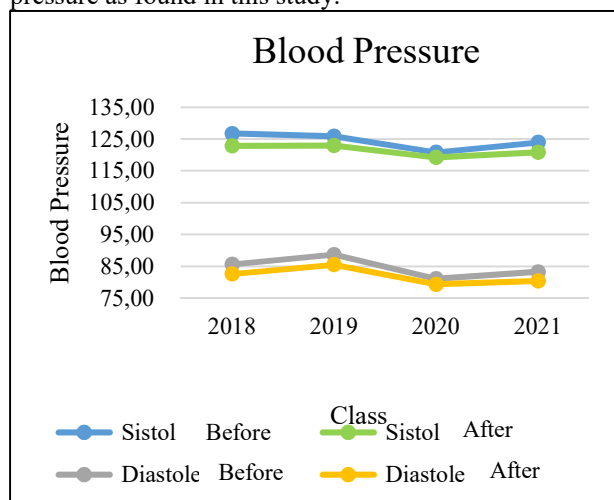


Fig. 2. Blood pressure.

Respondents' blood sugar levels decreased after tracking and passing all Site 1 – Site 6. Respondent's blood sugar levels decreased by 3.47 mg/dL from 94.87 mg/dL to 91.40 mg/dL after passing all Ecotherapy Healing routes Forest (Site 1 – Site 6) (Fig. 3). This decrease is a desired change, especially for respondents who have a history of high blood sugar levels.

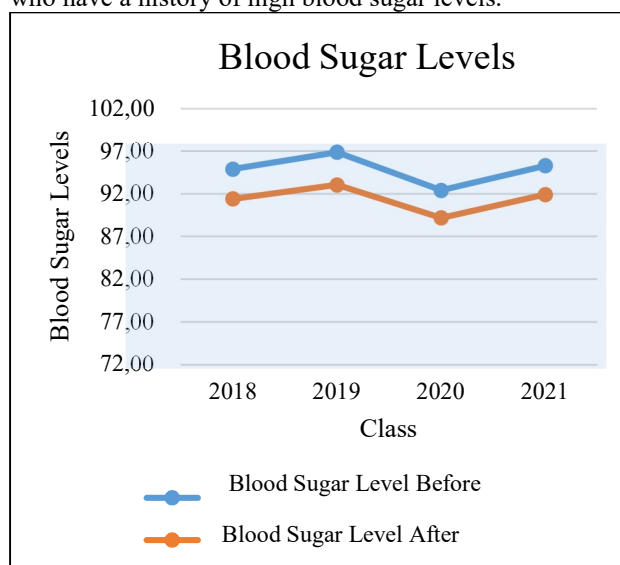


Fig. 3. Blood sugar levels.

Respondents' Oxygen Saturation levels increased by 0.39% after passing through the Site 1 – Site 6 Ecotherapy healing Forest route (Fig. 4). An increase in oxygen saturation is the desired change because it moves away from the minimum value of oxygen saturation, which is 95%. However, the results were different in the 2019 class, where participating in the Ecotherapy Healing Forest activity had no effect on fluctuating increases in Oxygen Saturation values. This could be because the majority of the 2019 class of respondents were male and smokers.

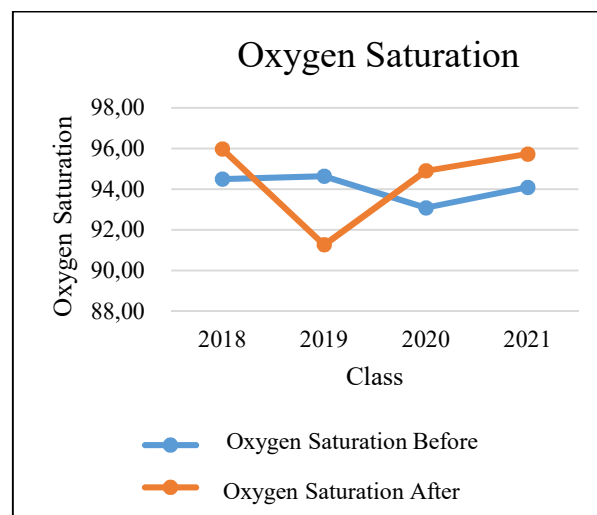


Fig. 4. Oxygen saturation.

The respondent's pulse value decreased by around 2.93 BPM after passing through the Ecotherapy Healing Forest site 1 – site 6 (Fig. 5). The pulse value changed, still within the normal range. The decreased pulse rate can be caused by the respondent feeling relaxed.

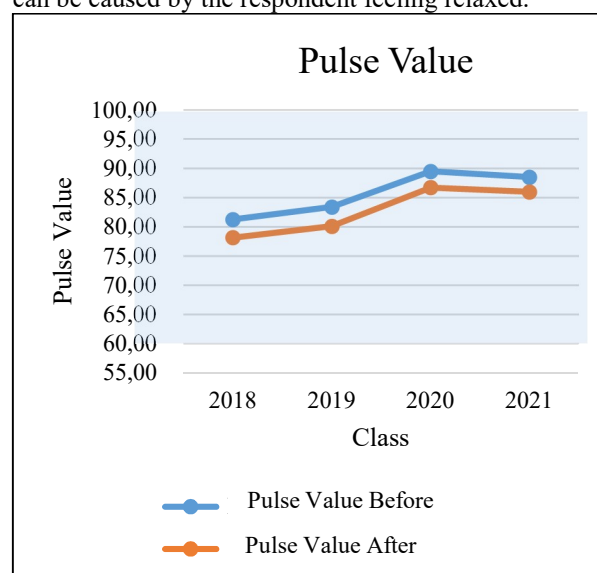


Fig. 5. Pulse value.

Based on DASS 42 in the class of 2018, the Initial Values of Moderate Depression, Severe Anxiety, and Severe Stress were obtained. After experiencing the Ecotherapy Healing Forest treatment 5 times, slowly there was a change towards normal. However, new significant changes appeared during the initial 3rd treatment, this could be due to the severe Anxiety and Stress values, because on average they experienced problems in the form of fear of the future, including fear of opportunities to get a job after graduating from studying.

Based on DASS 42 in the class of 2019, the initial values for depression, anxiety and stress were severe. After experiencing the Ecotherapy Healing Forest treatment 5 times, slowly there was a change towards normal. However, new significant changes appear at the end of the 3rd time, this can be caused by the severe Depression, Anxiety and Stress values. Based on the results of interviews and observations, their problems

include: field practice (implementation of theory in the world of work); report field practice activities; presentation of the results of field practice activities; preparing submissions for titles or themes; preparing large costs for research and thesis preparation.

Table 3. Depression anxiety and stress scale DASS (42) 2018 until 2021.

Class of 2018				
Treatment	Treatment	Depression	Anxiety	Strees
1	Before	20,00	18,40	29,20
	After	16,80	13,40	23,80
2	Before	14,90	11,90	21,70
	After	12,20	8,70	16,60
3	Before	9,00	7,90	13,70
	After	7,40	6,20	11,40
4	Before	6,30	5,40	11,40
	After	5,10	4,40	10,00
5	Before	5,20	4,00	10,00
	After	4,10	2,90	8,00
Class of 2019				
Treatment	Treatment	Depression	Anxiety	Strees
1	Before	25,36	18,00	29,73
	After	21,45	12,91	23,91
2	Before	16,64	11,91	21,82
	After	12,45	9,00	16,55
3	Before	11,64	8,45	15,36
	After	8,55	6,73	11,27
4	Before	8,45	6,73	11,27
	After	7,36	5,36	9,91
5	Before	6,45	5,36	9,91
	After	5,27	3,82	7,91
Class of 2020				
Treatment	Treatment	Depression	Anxiety	Strees
1	Before	12,91	8,73	16,64
	After	10,91	8,00	15,09
2	Before	8,64	7,00	13,73
	After	7,55	6,27	12,45
3	Before	7,45	6,27	11,91
	After	6,27	5,27	10,73
4	Before	6,27	5,27	10,36
	After	5,27	4,36	8,64
5	Before	5,27	4,27	8,18
	After	4,55	2,91	4,91
Class of 2021				
Treatment	Treatment	Depression	Anxiety	Strees
1	Before	10,83	15,25	14,58
	After	9,33	8,67	13,33
2	Before	8,42	7,25	12,50
	After	5,92	5,50	10,33
3	Before	6,17	4,83	9,83
	After	5,08	3,92	8,92
4	Before	5,08	3,08	8,58
	After	4,17	2,25	7,17
5	Before	4,17	2,33	6,83
	After	3,67	1,33	4,08

Based on DASS 42 for the 2020 and 2021 batches, the Initial Values for Depression, Anxiety and Stress are Mild. After experiencing the Ecotherapy Healing Forest treatment 5 times, slowly there was a change towards normal. Significant changes were seen during the 2nd

Ecotherapy Healing Forest treatment, this could be due to the mild Depression, Anxiety and Stress values. On average, they only have problems in the form of anxiety to adapt, because they will enter face-to-face for the first time after the COVID-19 pandemic, so they will interact directly with lecturers and fellow students and the campus environment. DASS 42 is shown in table 3.

3.3 Statistic test

The correlation value of systolic data with temperature, air humidity and THI data has a very strong relationship with the relationship between parameters directly proportional or unidirectional. The correlation value of Systole data with data on light intensity, noise, wind speed and negative ions has a weak relationship, with the relationship between parameters for Systole and noise directly proportional or unidirectional. The correlation value of the Diastolic data with the Temperature, Air Humidity and THI data has a very strong relationship with the relationship between parameters directly proportional or unidirectional. The correlation value of the Diastolic data with the light intensity, noise, wind speed and negative ion data has a weak relationship, with the relationship between parameters for Diastole with noise and negative ions being directly proportional or unidirectional. The correlation value of Pulse Rate data with Temperature, Air Humidity, THI and Negative Ion data which has a moderate relationship with the relationship between parameters for Pulse Rate and Temperature, Air Humidity, THI is directly proportional or unidirectional. Correlation value of Pulse data with light intensity, noise and wind speed data has a weak relationship, with the relationship between parameters for Pulse with light intensity and noise directly proportional or unidirectional. Correlation value of Blood Sugar Levels data with Temperature, Air Humidity and THI data which has a very strong relationship with the relationship between parameters directly proportional or unidirectional. Correlation value of Blood Sugar Levels data with light intensity, noise, wind speed and negative ion data has a weak relationship, with the relationship between parameters for Blood Sugar Levels and negative ions directly or in the same direction. The correlation value of Oxygen saturation data with Temperature, Air Humidity and THI data which has a very strong relationship with the relationship between parameters is inversely proportional or opposite. The correlation value of oxygen saturation data with light intensity, noise, wind speed and negative ion data has a weak relationship, with the relationship between parameters for oxygen saturation with light intensity, and wind speed is directly proportional or unidirectional. Correlation test results of health data with site identification data after treatment is shown in table 4.

Table 4. Correlation test results of health data with site identification data after treatment.

Spearman's rho		Correlation Test Results						
		Temp	Humidity	THI	Light Intensity	Noise	Wind Velocity	Negative Ions
	Sistol	Correlation Coef.	0,83	0,85	0,81	-0,233	0,084	-0,274
		Sig.	0	0	0	0,323	0,724	0,243
		Amount of Data	20	20	20	20	20	20
	Diastole	Correlation Coef.	0,617	0,669	0,687	-0,258	0,086	-0,324
		Sig.	0,004	0,001	0,001	0,272	0,72	0,164
		Amount of Data	20	20	20	20	20	20
	Pulse	Correlation Coef.	0,314	0,367	0,42	0,212	-0,201	-0,121
		Sig.	0,177	0,112	0,066	0,37	0,396	0,61
		Amount of Data	20	20	20	20	20	20
	Blood Sugar Levels	Correlation Coef.	0,756	0,792	0,858	-0,058	-0,202	-0,164
		Sig.	0	0	0	0,807	0,394	0,49
		Amount of Data	20	20	20	20	20	20
	Oxygen Saturation	Correlation Coef.	-0,831	-0,761	-0,741	0,183	-0,172	-0,161
		Sig.	0	0	0	0,44	0,469	0,498
		Amount of Data	20	20	20	20	20	20

The correlation value of Oxygen Saturation before and after the Ecotherapy Healing Forest treatment shows a weak association. Then the significance value between Oxygen Saturation before and after the Ecotherapy Healing Forest treatment showed no significant effect on the Oxygen Saturation value. Correlation values of Systole, Diastole, Pulse Rate and Sugar Levels before and after the Ecotherapy Healing Forest treatment showed a very strong relationship. Then the significance value between Systole, Diastole, Pulse and Sugar Levels before and after the Ecotherapy Healing Forest treatment showed that it had a significant effect on the values of Systole, Diastole, Pulse Rate and Sugar Levels.

Table 5. Test results for different health parameter values before treatment.

Different Test				
		Amount Of Data	Correlation	Sig.
Pair 1	Sistol (before) & Systol (after)	20	0,872	0,004
Pair 2	Diastole (before) & Diastole (after)	20	0,931	0,004
Pair 3	Pulse (before) & Pulse (after)	20	0,873	0,039
Pair 4	Blood Sugar Levels (before) & Blood Sugar Levels (after)	20	0,982	0,000
Pair 5	Oxygen Saturation (before) & Oxygen Saturation (after)	20	0,340	0,576

The correlation value of depression, anxiety and stress before and after the Ecotherapy Healing Forest treatment has a value above 0.75. This shows that the values of depression, anxiety and stress before and after the Ecotherapy Healing Forest treatment have a very strong relationship. The significance value between

depression, anxiety and stress before and after the Ecotherapy Healing Forest treatment has a value of 0.000. This shows that the existence of treatment has a real influence on the value of depression, anxiety and stress. Test Results for Different Health Parameter Values After Treatment is shown in table 6.

Table 6. Test results for different health parameter values after treatment.

Different Test			
	Amount Of Data	Correlation	Sig.
Pair 1	Depression (before) & Depression (after)	20	0,994
Pair 2	Anxiety (before) & Anxiety (after)	20	0,974
Pair 3	Stress Scale (before) & Stress Scale (after)	20	0,983

3.4 Sustainability analysis of MDS-RAPFISH

The first step for MDS analysis using Rapfish is the feasibility/goodness of the MDS-Rapfish analysis in terms of the Stress and R-square values for the five dimensions used as shown in Table 1. The reference value as the basis for determining the goodness-of-fit in MDS is the value of Stress less than 0.25 and R-square more than 0.90. Based on Table 1, it can be seen that the three-dimensional Stress values all show a value less than 0.25. On the other hand, the fifth R-Square value for each dimension also shows a value above 0.90. Therefore, it can be said that this MDS analysis meets the criteria of goodness-of-fit so it deserves further discussion/analysis (table 7).

Table 7. Results of feasibility/benefits of MDS-RAPFISH analysis.

Dimensions	Stress (S)	R-Square (R)
Socioeconomic	0,20684	0,9561499
Ecology	0,20707	0,9556416
Institutional	0,21666	0,9517841
Health	0,20737	0,9556418

Based on Fig. 6 it can be seen that the sustainability index for the control dimension is 61.28. The index value is in the range of 50.00 – 74.99, which means that this dimension is quite sustainable. Based on the results of the analysis, it is known that the attributes that greatly determine the sustainability of the socio-economic dimension are the benefits that can be obtained by the community in the form of financial benefits and benefits of environmental services in the form of fresh air.

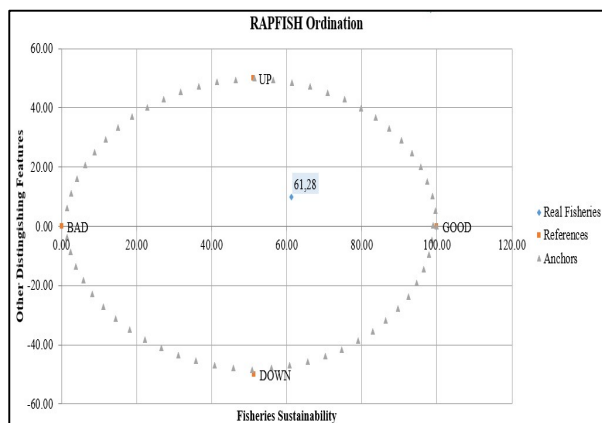


Fig. 6. Sustainability status Socio-Economic dimension.

Based on Fig. 7 it can be seen that the sustainability index value for the ecological dimension is 90.41 which is in the range of 75.00 – 100.00 which means good (very sustainable). Therefore, these results show that from an ecological perspective it strongly supports sustainability. Based on the results of the analysis, it is known that the attribute of the ecological dimension that most influences the sustainability of this dimension is that the ecosystem in the middle of the Gunung Kelam TWA is a steep slope so that most of it does not grow vegetation but bare rocks.

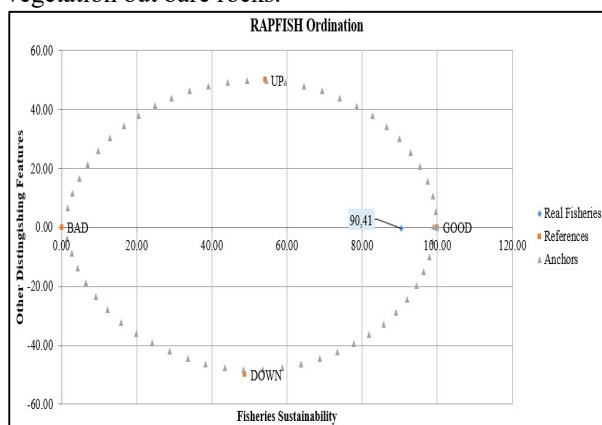


Fig. 7. Ecological dimension Sustainability status.

Based on Fig. 8 the sustainability status index of the implementation dimension is 87.88. This index is in the range of 75.00 – 100.00 which means good (very sustainable). Therefore, these results show that from an institutional and institutional perspective it is very supportive of sustainability. From the results of the analysis it is known that the attributes that greatly influence the sustainability of the institutional and institutional dimensions are conducting comparative studies to areas that have implemented EHF tourism management.

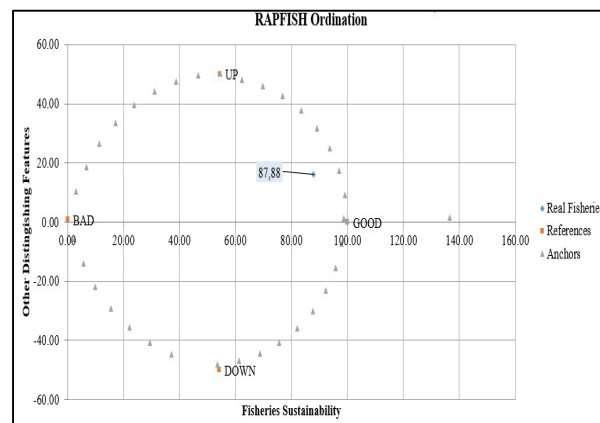


Fig. 8. Sustainability status implementation dimension.

Based on Fig. 9, the implementation dimension of the sustainability status index is 89.51. This index is in the range of 75.00 – 100.00 which means good (very sustainable). Therefore, these results show that from an institutional perspective it is very supportive of sustainability. Based on the results of the analysis it is known that the attributes that greatly influence the sustainability of the institutional dimensions are a healthy environment, which will be able to donate oxygen which is very influential for public health.

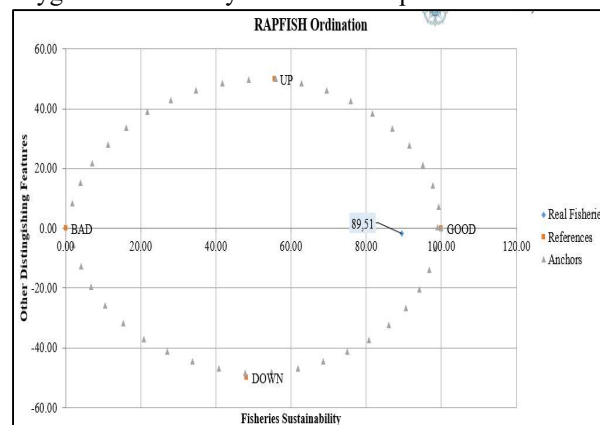


Fig. 9. Health dimension Sustainability status.

The dimension that has the most excellence in terms of sustainability is the ecological dimension, while the dimension that has the lowest sustainability index is socio-economic. Therefore, socio-economic problems in particular need to receive more serious attention so that they can run sustainably. Activity on site 1 – site 6 are shown in Fig. 10 – Fig. 15.



Fig. 10. Activities on Site 1.

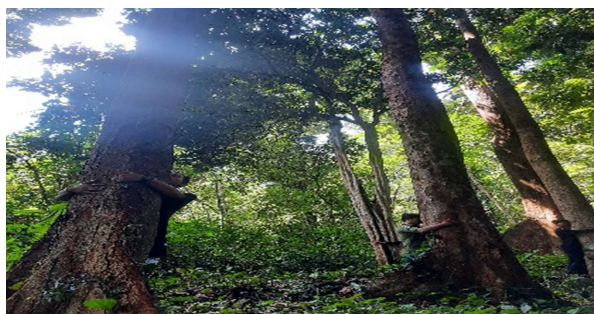


Fig. 11. Activities on Site 2.

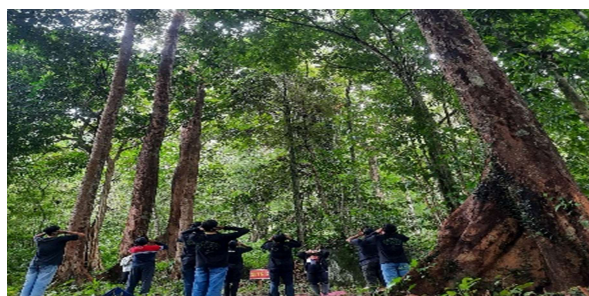


Fig. 12. Activities on Site 3.



Fig. 13. Activities on Site 4.



Fig. 14. Activities on Site 5.



Fig. 15. Activities on Site 6.

4 Conclusions

The Ecotherapy Healing Forest Program at Mount Kelam Natural Tourism Park which was attended by 44 student participants from the 2018 – 2021 in Kapuas Sintang University gave good results for reducing stress and health. The results of this study revealed that there was a significant decrease in blood sugar levels, oxygen saturation and stress levels in the participants after participating in the ecotherapy healing forest program. However, for smoking students, the Ecotherapy Healing Forest treatment does not have a significant effect on oxygen saturation values. Therefore, the authors propose Ecotherapy Healing Forest therapy as a non-pharmacological intervention to relieve stress while improving physical health (blood sugar levels and oxygen saturation) for students.

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