VEGETATION DIVERSITY IN THE HOT SPRING AREAS OF IE SUUM AND IE JUE IN SEULAWAH AGAM MOUNTAIN, ACEH BESAR DISTRICT ACEH PROVINCE INDONESIA

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Abstract: The structure and composition of vegetation in hot spring areas of Ie Suum and Ie Jue in Seulawah Agam mountain are influenced by the temperature of hot spring zones. Given that the geology and geomorphology of the hot spring area will undoubtedly influence the structure and composition of the vegetation, it is critical to know the data that comprise the vegetation. This study aims to identify plant species, vegetation habitus, and vegetation diversity index. This research was conducted in the area of hot springs Ie Suum and Ie Jue Seulawah Agam mountain Aceh Besar district Aceh province Indonesia. The quadratic technique was employed in this study to determine the research location through purposive sampling divided into four points (stations) of observation based on wind direction. Quadrat size was determined based on plant habitus, namely 1x1 m^2 (Herbsceous), 2x2 m^2 (shrub) at stations dominated by Herbsceous and shrub/shrub species, 5x5 m^2 (pole) and 10x10 m^2 (tree). The sample plots were placed methodically, with each transect running north, south, west, and east, with the hot spring at the middle of the transect. Each observation station contained up to 5 quadrat plots. And then, plant sampling was carried out for identification. The results of the study showed that 36 plant species were discovered in the Ie Suum area, with a total of 511 plants. Most individuals are found in Herbsceous habitus plants, namely *Borreria laevis* (42 individuals), shrub habitus plants, specifically *Chromolaena odorata* (36 individuals), and tree habitus plants, specifically *Phyllanthus emblica* (46 individuals). While in the Ie Jue hot spring area 96 species with a total of 2918 individuals. The most species that grow in the area is the *Vitex pinnata* tree (14 individuals), while the most dominant herbaceous plant was *Axonopus compressus* (251 individuals) and the shrub habitus was dominated by *Ocimum sanctum* (260 individuals). The plant vegetation diversity index of the Ie Suum hot spring area is H'= 3.373. At the same time, plant vegetation in the Ie Jue hot spring area is H'= 3.651. According to Shannon-Wiener diversity index standards, the plant index of Ie Suum and Ie Jue hot spring is high, H'> 3, placing both of them in the high diversity group.

Keywords: Diversity; Geothermal; Hot Spring; Herbsceous; Vegetation diversity index

Abstrak: Struktur dan komposisi vegetasi di kawasan sumber air panas Ie Suum dan Ie Jue di Gunung Seulawah Agam dipengaruhi oleh suhu zona sumber air panas. Mengingat

bahwa geologi dan geomorfologi daerah sumber air panas pasti akan mempengaruhi struktur dan komposisi vegetasi, maka sangat penting untuk mengetahui data-data yang menyusun vegetasi tersebut. Penelitian ini bertujuan untuk mengidentifikasi jenis-jenis tumbuhan, habitus vegetasi, dan indeks keanekaragaman vegetasi. Penelitian ini dilakukan di kawasan sumber air panas Ie Suum dan Ie Jue Seulawah Gunung Agam Kabupaten Aceh Besar, Provinsi Aceh, Indonesia. Metode kuadrat digunakan dalam penelitian ini untuk menentukan lokasi penelitian melalui *purposive sampling* yang dibagi menjadi empat titik (stasiun) pengamatan berdasarkan arah mata angin. Ukuran kuadrat ditentukan berdasarkan habitus tumbuhan, yaitu 1x1 m^2 (herba), 2x2 m^2 (perdu) pada stasiun yang didominasi oleh jenis herba dan semak/belukar, 5x5 m^2 (tiang), dan 10x10 m^2 (pohon). Plot-plot sampel ditempatkan pada garis setiap transek yang membujur dari utara, selatan, barat, dan timur, dengan sumber air panas berada di tengah-tengah transek. Setiap stasiun pengamatan terdiri dari 5 plot kuadrat. Kemudian dilakukan pengambilan sampel tumbuhan untuk diidentifikasi. Hasil penelitian menunjukkan bahwa 36 spesies tumbuhan ditemukan di kawasan Ie Suum, dengan total 511 tumbuhan. Individu terbanyak ditemukan pada tumbuhan habitus herba yaitu *Borreria laevis* (42 individu), tumbuhan habitus semak yaitu *Chromolaena odorata* (36 individu), dan tumbuhan habitus pohon yaitu *Phyllanthus emblica* (46 individu). Sedangkan di kawasan pemandian air panas Ie Jue ditemukan 96 spesies dengan total 2918 individu. Spesies yang paling banyak tumbuh di kawasan tersebut adalah pohon *Vitex pinnata* (14 individu), sedangkan tumbuhan herba yang paling dominan adalah *Axonopus compressus* (251 individu) dan habitus semak didominasi oleh *Ocimum sanctum* (260 individu). Indeks keanekaragaman vegetasi tumbuhan di kawasan air panas Ie Suum adalah H'= 3,373. Sedangkan vegetasi tumbuhan di kawasan sumber air panas Ie Jue adalah H'= 3,651. Berdasarkan standar indeks keanekaragaman Shannon-Wiener, indeks tumbuhan di kawasan air panas Ie Suum dan Ie Jue tergolong tinggi, yaitu H'>3, sehingga menempatkan keduanya dalam kelompok keanekaragaman tinggi.

Kata kunci: Keanekaragaman; Geotermal; Mata Air Panas; Herba; Indeks keanekaragaman vegetasi

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Introduction

Hot spring areas are those where deep underground water rises to the surface at temperatures higher than the surrounding air temperature. Hot spring manifestation zones are typically found near volcanoes or active tectonic plates where hot spring heat can seep to the surface (Sarmiento et al. 2015). The formation of fissures and fractures beneath the earth's surface can be triggered by tectonics, allowing underground water to circulate more freely and reach heated rock strata. Furthermore, the presence of magma beneath the earth's surface can affect the formation of hot spring manifestation places. Research by Giggenbach (1988) shows that magma can heat the surrounding underground water and produce hot fluids that rise to the earth's surface through rock crevices. The establishment of hot spring manifestation zones is also influenced by hydrogeologic circumstances. According to Oelkers et al. (2014), vigorous and rapid circulation of underground

water can accelerate the formation of hot springs. On the other hand, the presence of impermeable rocks can help maintain heat within the hot spring. The chemical characteristics of the underground water can also influence the establishment of hot spring manifestation zones. According to Arnórsson (2011), underground water rich in minerals such as sulfur and iron can assist in raising the temperature of the water and increase the formation of hot springs. Finally, the climatic and environmental conditions in the area can influence the formation process of hot spring manifestation zones. Research by Yang et al. (2015) shows that The presence of impermeable rocks, on the other hand, can aid in the retention of heat within the hot spring. The chemical characteristics of the underground water can also influence the establishment of hot spring manifestation zones. According to Arnórsson (2011), underground water rich in minerals such as sulfur and iron can assist in raising the temperature of the water and increase the formation of hot springs. Finally, the climatic and environmental conditions in the area can influence the formation process of hot spring manifestation zones. According to Yang et al. (2015), heavy rainfall can affect the flow of underground water and cause the formation of hot springs in hilly places.

The formation of hot springs on Mount Seulawah Agam is caused by hot spring activity within the mountain. According to research by Ibrahim et al. (2018), this manifestation consists of many hot springs and fumaroles spread over the slopes of Mount Seulawah Agam. The temperatures of these hot springs range from 40 to 90°C and can be used for bathing, treatment, and power generation. Heryudono et al. (2019) discovered that the hydrothermal system at Mount Seulawah Agam has distinct characteristics, namely the presence of elements such as boron, chloride, and sodium in hot water formed from the interaction of meteoric water with mineral-rich bedrock. Furthermore, this hydrothermal system contributes to the formation of wetlands and supports biological sustainability near hot springs, such as the presence of plants and microbes (Kusumah et al., 2019). Although it has the potential to be used as a renewable energy source, the existence of hot springs on Mount Seulawah Agam requires protection and appropriate management to ensure the hydrothermal system's long-term viability. This is significant considering the potential for environmental damage and the presence of climate-vulnerable species (Heryudono et al., 2019).

Ie Suum hot water and Ie Jue hot water are two of the hot springs discovered in Seulawah Agam. According to Suhaimi et al. (2016), the depth of hot springs in Ie Jue is deeper than in Suum, and the temperature of hot water in Ie Jue is higher than in Suum. Hot water in Ie Jue has a higher Na^+, K^+, and Cl^- content, while hot water in Suum has a higher $Ca2^+$ content, according to chemical analysis. Furthermore, the volume of water produced by Ie Jue exceeds that of Suum. Amien et al. (2017) also showed that the difference in heat sources between the two regions is related to the location and type of rocks under the earth's surface. The rocks in the Ie Jue area are igneous, whereas the rocks in the Ie Suum area are sedimentary.

The physical and chemical qualities of the hot water produced by the two locations may be affected as a result. Both, however, share the fact that they are located in hilly terrain and have a significant mineral content. Another study by Amien et al. (2017) also showed that the Seulawah Agam area has significant hot spring energy potential, with the heat source coming from magma beneath the earth's surface. Sarmiento et al. (2015) also added that hot spring is a renewable energy source that can be utilized efficiently and environmentally friendly.

Research by Ye et al. (2017) showed that the presence of vegetation around hot springs can affect the hydrological and chemical conditions of the hot spring. Plants can absorb water and nutrients from the soil, reducing the availability of water for the hot spring. On the other hand, vegetation can also affect the availability of nutrients in the hot spring by releasing organic compounds into the soil. Choi et al. (2018) discovered that the availability of nutrients, pH, and soil temperature near hot springs can influence the types of plants that can grow there. According to Wang et al. (2017), the presence of flora around hot springs can also assist prevent soil erosion. Plant roots can stabilize slopes and hold soil, reducing the risk of landslides.

On the other hand, hot spring areas can also help the growth of vegetation in areas that are difficult to grow. Research by Hidayat et al. (2019) showed that hot springs in mountainous areas can accelerate growth and improve the quality of plants in the area. However, the presence of hot springs that are not well managed can endanger the surrounding vegetation. Research by Wang et al. (2018) showed that increased temperature and metal content in leaked hot water can cause damage to plants and damage soil fertility around the hot spring area. Fadilah et al. (2020) in another hot spring area also showed that mineral content in hot spring water can affect the presence and diversity of surrounding plant species. However, this influence may vary depending on the plant species and other environmental factors. A study conducted by Hidayat et al. (2017) in the Gunung Masigit hot spring area, West Java, showed that the sulfate and silicate content in hot spring water affects the presence of certain plant species. Some plant species were found to grow only in areas with high sulfate content, while other species were more often found in areas with higher silicate content.

Similarly, Wahyuni et al. (2019) did research in the Pancuran Pitu hot spring area of West Java. According to this study, the amount of sulfate, silicate, and calcium in hot water influences the types of plants that develop around it. *Ficus benjamina*, *Syzygium cumini*, and *Citrus hystrix* were found to grow more frequently in locations with greater sulfate concentration, whereas Musa paradisiaca and Carica papaya were found to grow more frequently in areas with higher calcium content.

Based on the above information, each hot spring location has distinct plant vegetation and diversity. As a result, identifying the vegetation found in the Ie Suum and Ie Jue hot spring areas in the Seulawah Agam hot spring manifestation area is

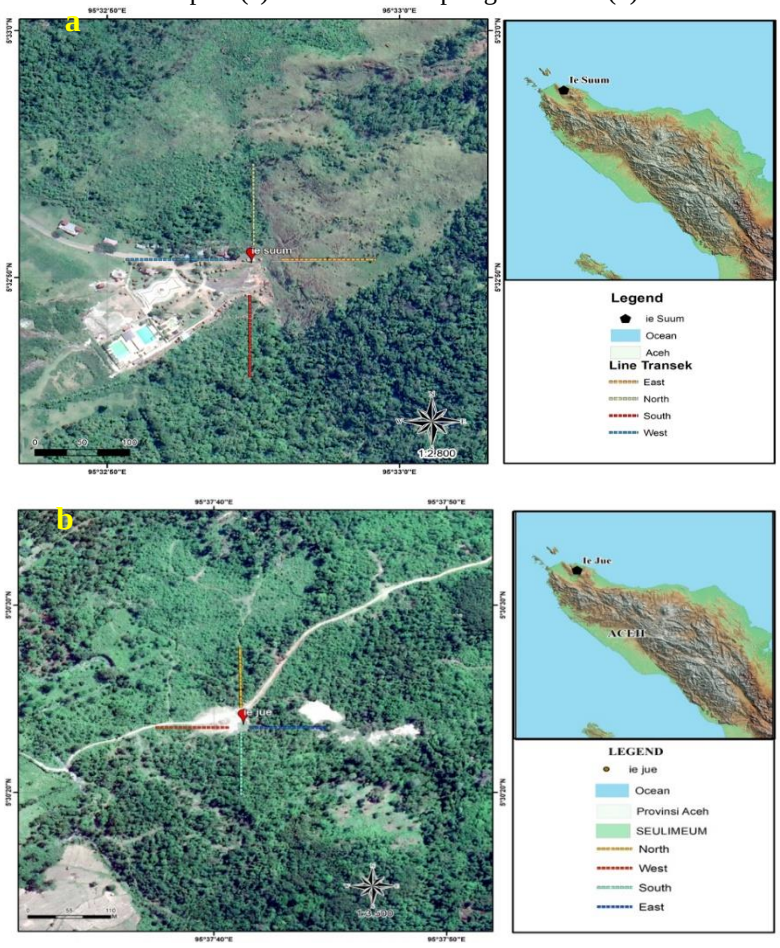
also important. The purpose of this research is to determine the vegetation and the impact of Ie Suum and Ie Jue hot springs on the diversity of plant species around them. This study could give crucial information for preserving and managing biodiversity in hot spring areas impacted by human activity.

Materials and Methods

Location of Research

This research was conducted in the Ie Suum hot spring area with coordinates 5°32'24.4 "LU and 95º32'26.26 "BT and Ie Jue hot spring area located at coordinates 5°30'23.742"LU and 95°37'41.022 "BT.

Figure 1. Research Location Map of (a). Ie Suum Hot Spring Area and (b). Ie Jue Hot Spring Area



Procedures

This study used a hybrid approach of Line Transect and Quadrat. The Line Transect method is by drawing a line along 100 meters that will be divided into four transects based on the cardinal directions of the point, namely east, south, west, and north. The quadrat method is a method of making sample plots with a size of 10×10 m^2 for tree habitus, 2×2 m^2 for shrub habitus, and 1×1 m^2 for herbaceous habitus. On each plot that has been determined, each plant is observed and sampled.

The following equipment was used in this research a meter, GPS Garmin 64s SEA, wood plot, camera Canon EOS 1300D, hygrometer HTC-2, soil tester Takemura DM-15, stationery, raffia rope, stakes, meter, 1.3 m wooden stick, plastic bag, identification book and observation sheet. The parameters observed include species type, number of species, number of individuals, and level of plant diversity. All activities carried out from the preparation stage, data collection, identification and analysis will be documented during the research.

Data Analysis

Data analysis was carried out qualitatively (to describe plant species (herbs, shrubs, poles and trees) and quantitatively (to calculate the Diversity Index).

The Diversity Index of a plant community can be determined using the Shannon-Wienner equation (H′) using the formula:

$$H' = -\sum \frac{ni}{n} \ln \frac{ni}{n} \text{ or better known as } H' = -\sum pi \ln pi \quad \text{.....(1)}$$

The results obtained can then be categorized into 3 categories, namely:

H′ < 1 then the diversity index is categorized as Low.

H′ 1 < H′ < 3 then the diversity index is categorized as Medium.

H′ > 3 then the diversity index is categorized as High (Krebs, C. J., 2014).

Results and Discussion

Based on the results of this research in the Ie Suum hot spring area consisting of 36 species with a total of 511 individuals spread over 4 observation stations. The plant diversity index is worth 3.373 with a high diversity category. The most common plant species found in each habitus are different. The most dominant herbaceous habitus level is *Borreria laevis* (42 individuals), the shrub habitus level is *Chromolaena odorata* (36 individuals) and the tree habitus level is *Phyllanthus emblica* (46 individuals) (Table 1).

Table 1. Plant Diversity in the Ie Suum Hot Spring Area

Species Names	Ie Suum				Total	Habitus	H'
	I (East)	II (South)	III (North)	IV (West)			
Paspalum conjugatum	-	14	-	9	23	Herbs	0.140
Paspalum commersonii	18	-	16	-	34	Herbs	0.180
Bidens pilosa L.	-	7	4	-	11	Herbs	0.083
Cyperus rotundus	5	-	4	3	12	Herbs	0.088
Panicum repens	-	7	9	10	26	Herbs	0.152
Cyathula prostata	-	-	-	4	4	Herbs	0.038
Axonopus compressus	-	-	12	9	21	Herbs	0.131

Species Names	Ie Suum				Total	Habitus	H'
	I (East)	II (South)	III (North)	IV (West)			
Eleusine indica	12	-	-	5	17	Herbs	0.113
Physalis angulata L	6	-	5	7	18	Herbs	0.118
(Abrus precatorius L.)	14	-	13	-	27	Herbs	0.155
Borreria laevis	23	19	-	-	42	Herbs	0.205
Hedyotis diffusa	8	10	-	-	18	Herbs	0.118
Portulaca grandiflora	2	-	-	-	2	Herbs	0.022
Chromolaena odorata	-	13	23	-	36	Shrubs	0.187
Urena lobata L	-	-	7	-	7	Shrubs	0.059
Sida rhombifolia L.	-	2	-	1	3	Shrubs	0.030
Clidemia hirta D.Don.	-	1	-	-	1	Shrubs	0.012
Piper aduncum	2	-	-	6	8	Shrubs	0.065
Leucaena leucocephala	3	-	1	4	8	Shrubs	0.065
Moringa oleifera	-	-	-	5	5	Shrubs	0.045
Calotropis gigantea	-	-	3	3	6	Shrubs	0.052
Jatropha curcas L	1	3	2	-	6	Shrubs	0.052
Lantana camara	3	-	4	-	7	Shrubs	0.059
Muntingia calabura	-	-	14	-	14	Trees	0.099
Carallia brachiata		-	-	12	12	Trees	0.088
Phyllanthus emblica	16	18	3	9	46	Trees	0.174
Vitex pinnata	3	4	-	5	12	Trees	0.088
Eusideroxylon zwagery	4	-	7	5	16	Trees	0.108
Vitex pinnata	3	4	-	5	12	Trees	0.088
Leucaena leucocephala	4	-	-	3	7	Trees	0.059
Lannea coromandelica	-	3	-	5	8	Trees	0.065
Ficus variegata	-	-	5	1	6	Trees	0.052
Aleuritus moruccana	-	6	-	5	11	Trees	0.083
Eusideroxylon zwagery	6	2	-	-	8	Trees	0.065
Syzygium cumini	5	4	-	-	9	Trees	0.071
Ficus benjamina	-	2	-	5	8	Trees	0.065
	138	**116**	**132**	**121**	**511**		**3.373**

According to Maifarus (2016), herb-level plants are plants that grow and develop effectively in environmental circumstances that are not shaded and have adequate sunshine. This is consistent with the research site, which is primarily an open space with plenty of sunshine. The *Borreria laevis* species predominates in all four research spots. This is due to the fact that it spreads rather easily and uniformly. *Borreria laevis* grows well in areas with plenty of sunshine (Auliandari *et al*., 2019). This is consistent with Zaenal's (2004: 5) assertion that the value of *Borreria laevis*

indicates that the forest of Mount Manglayang has suffered significant damage because this species is a type of herb that grows quickly in open areas or areas subject to human disturbance. *Borreria laevis* is a plant species that is usually found in mountainous secondary forest regions that are open or semi-open. This species is commonly seen along forest paths (Amarullah et al., 2017).

On the other hand, *Chromolaena odorata* is the dominating plant in the Ie Suum area for the shrub habitus type. *Chromolaena odorata* can grow in a wide variety of soils, including poor soils or even contaminated soils. Its ability to live in different soils allows it to spread widely and grow in a variety of environments (Koutika & Rainey, 2010). This plant can grow well in various climatic conditions, both in hot and cold areas. This makes it able to adapt to changes in temperature and different weather conditions (Mandal & Joshi, 2014). Chromolaena odorata can reproduce quickly and efficiently through seeds. This allows it to quickly cover large areas and compete with other plants (Saranya *et al*., 2021). This plant has the ability to efficiently use the resources available around it, including water and soil nutrients. This helps it survive in environmental conditions that may not favor the growth of other plants (Te Beest et al., 2013).

Phyllanthus emblica may grow in hot environments like those found in hot spring zones. *Phyllanthus emblica* thrives in soil with an acidic pH level. According to the research of Khoiriyah et al (2015: 99), *Phyllanthus emblica* is discovered at pH 6.5 - 7 and grows on several various soil types. This malacca plant has different gene diversity and adaptations in dry areas and wet areas. gene diversity and adaptation and population abundance of malacca plants are higher in dry areas than in wet areas (Liu *et al*., 2020). *Phyllanthus emblica* is widely distributed in mixed dryland agriculture. In addition, open landscapes, secondary dryland forests, industrial plantation forests, and dryland agriculture can all support *Phyllanthus emblica* (Susilowati *et al*., 2021).

The diversity of vegetation structures increases as environmental factors change away from hot springs. These environmental factors have an impact on the typical form of plant types, as well as the structure and composition of vegetation in the hot spring area. A plant community's diversity index is determined by the number of species and the number of individuals in each species (species richness). The diversity of species can be used to indicate the structure of communities. Species variety can also be used to assess community stability, or a community's ability to remain stable despite shocks to its constituents (Pei *et al*., 2018).

The value of the Diversity Index of plant vegetation in the Ie Suum hot spring area, is H'= 3.373, according to the results of the diversity analysis in Table 1. The plant index of the Ie Suum hot spring area, Mesjid Raya District, Aceh Besar Regency, according to the Shannon-Wiener diversity index standards, is classed as high, H'=> 3. The study was carried out by locating stations away from the heat source. Plant species that occupy a region will be Shrubs in diverse if it is located away from a heat source. According to the findings of this study, plants that dwell

in this hot spring area are plants that can adapt to high physical-chemical environmental circumstances.

Based on the results of research conducted in the Ie Jue Seulawah Agam Hot Springs area consisting of 96 species with a total of 2918 individuals. At the tree habitus level, 41 tree species which belonged to 12 families with a total of 138 individuals. The most species that grow in the area is the *Vitex pinnata* tree with 14 individuals while the lowest tree species are *Erioglussum rubigosum* Roxb Blume, *Pterospermum diversifolium* L,. *Spathodea campanulata* P.Beauv,. *Mangifera koetida L,. Barringtonia asiatica L, and Ficus carica L, with a total of 1 individual. Plant species that dominate the area are from the Moraceae family consisting of Brosium alicastrum L, and Ficus carica L, The Lauraceae family consists of the types of Persea americana L, and Cinamomum verum sey C,*.in the other hand, the most dominant herbaceous plant was *Axonopus compressus* (251 individuals), while the shrub habitus was dominated by *Ocimum sanctum* (260 individuals) (Table 2).

Table 2. Plant Diversity in the Ie Jue Hot Spring Area

Species Names	Ie Jue				Total	Habitus	H'
	I (East)	II (South)	III (North)	IV (West)			
Brosium alicastrum L,.	3	2	2	-	7	Trees	0,014
Terminalia catappa L,.	2	-	-	-	2	Trees	0,005
Pterospermum diversifolium	1	-	-	-	1	Trees	0,003
Ficus Carica L,	1	-	-	-	1	Trees	0,003
Eriglosum rubigiosum Roxb Blume,.	-	-	-	1	1	Trees	0,003
Spathodea campanulata P.Beauv,.	-	-	-	1	1	Trees	0,003
Aleorites moluccana L,.	2	1	-	-	3	Trees	0,007
Grewia microcos L,	3	2	5	3	13	Trees	0,024
Erythroxylum ceneatum Miq Kuiz,	2	-	-	-	2	Trees	0,005
Mangifera Koetida Lour,.	-	1	-	1	2	Trees	0,005
Baringtonia asiatica Kurz,.	-	-	-	1	1	Trees	0,003
Cinamomun verum sey C,.	-	3	-	-	3	Trees	0,007
Fegraea fragrans Roxb,	4	-	-	-	4	Trees	0,009
Persea Americana L,	-	-	-	1	1	Trees	0,003
Plumeria tourn Ait,.	-	-	5	-	5	Trees	0,011
Delonix regia Hook,	-	-	5	-	5	Trees	0,011

Species Names	Ie Jue				Total	Habitus	H'
	I (East)	II (South)	III (North)	IV (West)			
Sophora tetraptera	1	-	-	1	2	Trees	0,005
Aralia Sp.	-	1	-	-	1	Trees	0,003
Streblus asper	1	5	-	-	6	Trees	0,013
Vitex pinnata	2	2	5	5	14	Trees	0,026
Bischofia javanica Blume	-	1	-	-	1	Trees	0,003
Microcos tomentosa	-	-	2	2	4	Trees	0,009
Flacourtia rukam	-	-	2	-	2	Trees	0,005
Syzyemum polyanghuaurn	1	1	1	-	3	Trees	0,007
Clerodendrum angustifolium Standl.	-	-	-	1	1	Trees	0,003
Species 1	1	-	2	-	3	Trees	0,007
Randia rhagocarpa	3	2	1	2	8	Trees	0,016
macaranga trichocarpa	-	-	1	-	1	Trees	0,003
Alstonia scholaris (L.) R. Br.	2	-	3	3	8	Trees	0,016
Alangium nobile (C.B. Clarke) Harms	1	1	-	1	3	Trees	0,007
Cryptocarya ferrea Blume	1	-	-	1	2	Trees	0,005
Melia azedarach L	4	-	6	3	13	Trees	0,024
Fagraca fragrans	1	-	2	2	5	Trees	0,011
falcoutia rukam	-	-	1	-	1	Trees	0,003
Ceiba petandra L.Gaertn.	-	1	-	1	2	Trees	0,005
Bridelia stipularis	1	-	-	-	1	Trees	0,003
Trema orientalis (L.) Blume	-	-	1	-	1	Trees	0,003
Species 2	-	-	-	1	1	Trees	0,003
Mangifera foetida Lour.	-	-	1	-	1	Trees	0,003
Chukrasia tabularis A. Juss.	-	-	-	1	1	Trees	0,003
Calophyllum inophyllum L.	-	-	-	1	1	Trees	0,003
Ocimum sanctum	104	53	-	103	260	Shrubs	0,215
Pluchea indica	-	9	9	14	32	Shrubs	0,049
Calotropis gigantean	3	1	-	3	7	Shrubs	0,014
Oxalis barrelieri	-	17	-	32	49	Shrubs	0,069
Chromolaena odorata	11	14	66	42	133	Shrubs	0,141
Ficus septic	12	1	-	-	13	Shrubs	0,024
Buxus microphylla	30	43	1	14	88	Shrubs	0,106

Species Names	Ie Jue				Total	Habitus	H'
	I (East)	II (South)	III (North)	IV (West)			
Lantana camara	47	2	14	56	119	Shrubs	0,130
Clidemia hirta	-	11	10	-	21	Shrubs	0,036
Ziziphus oenopolia	-	1	9	-	10	Shrubs	0,019
Dipsacus pilosus	-	8	16	-	24	Shrubs	0,039
Ocimum tenuiflorum	-	-	32	-	32	Shrubs	0,049
Solanum indicum	-	-	9	-	9	Shrubs	0,018
Crotalaria pallid	-	-	2	9	11	Shrubs	0,021
Caesalpinia decapetala	-	-	14	3	17	Shrubs	0,030
Indigofera tincrotria	35	-	-	64	99	Shrubs	0,115
Blumea balsamifera	-	-	-	16	16	Shrubs	0,029
Melastoma malabathricum	3	-	-	-	3	Shrubs	0,007
Imperata cylindrical Beauv	45	-	-	-	45	Herbs	0,064
Commelina diffusa	-	18	-	-	18	Herbs	0,031
Amaranthus spinosus L	17	5	30	39	91	Herbs	0,108
Amaranthus spinosus	-	16	-	-	16	Herbs	0,029
Acalypha lanceolata	-	2	-	5	7	Herbs	0,014
Ageratum conyzoides	10	-	-	-	10	Herbs	0,019
Oxalis berrelier L.	-	-	3	2	5	Herbs	0,011
Ludwigia hyssopilofia. L	-	9	5	14	28	Herbs	0,045
Physalis angulata L	18	8	-	-	26	Herbs	0,042
Cyclea barbata	22	-	-	7	29	Herbs	0,046
Oxalis corniculata	-	1	3	-	4	Herbs	0,009
Monochoria vaginais	20	-	-	7	27	Herbs	0,043
Commelina benghalensi	-	3	-	-	3	Herbs	0,007
Achyranthes bidentata	-	-	-	9	9	Herbs	0,018
Axonopus compressus	-	65	86	100	251	Herbs	0,211
Cyperus brevifolius	-	59	-	-	59	Herbs	0,079
Euphatorium oderatum L	-	-	-	4	4	Herbs	0,009
Portulaca oleracea	14	17	2	-	33	Herbs	0,051
Scirpus grossus	15	20	9	-	44	Herbs	0,063
Phyllanthus ninuri	-	-	5	15	20	Herbs	0,034
Scirpus grossus	-	-	-	4	4	Herbs	0,009
Euphorbia hirta	30	6	28	31	95	Herbs	0,111
Mimosa pudica	20	6	37	2	65	Herbs	0,085
Eleusine indica	-	-	150	18	168	Herbs	0,164
Paspalum commersonii	-	76	-	50	126	Herbs	0,136
Chrysopogon aciculatus	50	50	28	78	206	Herbs	0,187

Species Names	Ie Jue				Total	Habitus	H'
	I (East)	II (South)	III (North)	IV (West)			
Borreria laevis	-	19	17	10	46	Herbs	0,065
Hedyotis corymbosa L	20	-	-	-	20	Herbs	0,034
Mimosa pudica	-	-	-	27	27	Herbs	0,043
Achyranthes bidentata	-	2	-	84	86	Herbs	0,104
Acalypha lanceolata	-	-	6	-	6	Herbs	0,013
Blumea balsamifera	-	-	8	3	11	Herbs	0,021
Mikania micrantha Kunth	-	-	-	5	5	Herbs	0,011
Peperomia pellucida L	32	-	18	-	50	Herbs	0,070
Phyllatnthus ninuri	24	12	5	5	46	Herbs	0,065
Cyperus cyperoides	-	-	-	64	64	Herbs	0,084
Cyperus malaccensis	34	-	34	15	83	Herbs	0,101
	653	**577**	**701**	**987**	**2918**		**3,651**

Trees found in plot one based on the cardinal directions of east, west, south and north have a total of 15 individuals. The number of individual trees in plot two is 19 individuals. At the same time, the third plot has 20 individuals. Plots two and three have the most individuals because they are the furthest away from hot springs. Meanwhile, plot one has only a few individuals due to the near proximity of plot one and the hot spring. Based on the results of this study conducted in the hot spring area of Ie Jue Seulawah Aceh Besar from all observation stations, there are 20 species of shrubs belonging to 14 families. Based on these results, the Asteraceae family, which includes *Chromolaena odorata*, *Pluchea indica*, and *Blumea balsamifera*, and the *Lamiaceae* family, which includes *Ocimum sanctum*, *Ocimum tenuiflorum*, and *Vitex trifolia*, dominate the area. This is because shrubs may be found in a wide range of habitats and situations, and they are easy to grow in a wide range of soils, including damp and dry soils.

Shrub plant species obtained a total of 1617 individuals in all observations. With 440 individuals, the most common species is *Ocimum sanctum* of the *Lamiaceae* family. This is because basil (*Ocimum sanctum*) is an annual plant that grows wild and can be found on the edge of the road and in the yard. This plant prefers open or slightly shaded soil and is not drought-tolerant. It grows around 300 meters above sea level (Pattanayak *et al*., 2010). Basil plants (*Ocimum sanctum*) are widely available plants; basil plants are a form of hermaphroditic plant that thrives in the tropics; this plant is a member of the *Lamiaceae* family, which is abundant in Indonesia (Mahajan *et al*., 2013).

Vitex pinnata from the *Lamiaceae* family is the least common, with only 14 individuals. *Vitex pinnata* grows in a variety of soil types but prefers slightly dry and open areas. This plant is a shrub or small tree 1.5-5 meters high that can grow

up to 1000 meters above sea level. The stems are woody, round, hairy twigs and dirty white. The leaves are compound, alternate opposite, and green, with three ovate leaflets, a blunt tip and base, flat edges, and pinnate repeat. The flavor is bitter and astringent (Van Stenis, 1992).

Competition between existing plants can also influence the dominant plant. If the environmental circumstances are excellent and suited for plants, such as complete and plentiful nutrients in the soil, the number of individual species will be Shrubsin numerous. High species richness in a habitat is caused by physico-chemical environmental variables that are conducive to the growth and development of plants in the area (Wiens, 2011). Based on the results of research from all observation stations in the Ie Jue Seulawah Agam hot spring area, there are 34 species from 15 orders. Paitan grass (*Axonopus compressus*) from the Poales order had the most individuals obtained from all observation stations, with a total of 824 individuals. The presence of *Axonopus compressus* species is about average across the entire sample observation plot. The least numerous species are *Oxalis berrelier* L of the *Lamiales*, *Solonum caroliense* of the *Solanales*, *Eupatorium conyzoides*, and *Mikania micrantha Kunth* of the *Asterales*.

The types of Herbs that are in station one of the most widely obtained is the type of *Axonopus compressus* from the order Poales, with a total of 491 individuals. While *Oxalis corniculata* from the order Poales and *Euphatorium oratum* L from the order Asterales each had four individuals, *Commelina benghalensis* from the order Commelinales and *Ageratum conyzoides* from the order Asterales with an average of 3 individuals. The presence of Herbs species at station two is most commonly found in the same order as station one, namely *Axonopus compressus* from the order Poales with 333 individuals and Ijem grass (*Cyperus cyperoides*) from the order Cyperales with 125 individuals, while a smaller number of individuals have species similarities with station one, namely *Oxalis corniculata* from the order Solanales and *Eupatorium oratum* L from the order Asterales. Two types of Herbs can only be found at the second station: *Centella asiatica* from the Umbelliferae order with a total of 8 and Spilanthes acmela Murk from the Asterales order with a total of 5.

Plants such as mensiang (*Scirpus grossusi*) and purslane (*Portulaca oleracea*) are more typically found at the boiling point of the Ie Jue hot springs or the first plot of the entire transect direction at station 1. *Scirpus grossusi* and *Portulaca oleracea* are plants that can survive by growing perfectly because the environmental variables and nutrients in the area are adequate for growth, and both plants can live in a variety of soils, both moist and dry soils. The number of herb species continues to increase along with the location of the hot springs. This is in accordance with the results of Susanti's research which states that the structure of vegetation will increase as environmental factors change away from hot springs (Susanti, 2005). This situation will greatly affect the temperature and pH of the soil where the plant grows. The density value of a species of vegetation shows the total number of

individuals of a particular species in the vegetation contained in a certain unit area (Lestari, 2020).

Conclusion

Overall, the value of the Diversity Index of plant vegetation in the Ie Suum and Ie Jue hot spring area may be classified as high (H'= 3.373 and H'= 3.651). According to the Shannon-Wiener diversity index standards, is classified as high, H'> 3. The Ie Suum hot spring area consists of 36 species of vegetation with a total of 511 individuals. The most dominant herbaceous habitus level is *Borreria laevis* (42 individuals), the shrub habitus level is *Chromolaena odorata* (36 individuals) and the tree habitus level is *Phyllanthus emblica* (46 individuals). On the other hand, the Ie Jue hot spring area consists of 96 species with a total of 2918 individuals. The most species that grow in the area is the *Vitex pinnata* tree (14 individuals), while the most dominant herbaceous plant is *Axonopus compressus* (251 individuals) and the shrub habitus was dominated by *Ocimum sanctum* (260 individuals)

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