

TECHNIQUE FOR SUSTAINABLE DEVELOPMENT ALONG TRISULA WATERFALL (COBAN TRISULA) - RANU PANI, BROMO TENGGER SEMERU NATIONAL PARK: A CASE OF EPIPHYTIC ORCHID CONSERVATION

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ABSTRACT

The purpose of this study is to develop a technique for sustainable development of epiphytic orchid conservation, identify the types of epiphytic orchid host trees and identify the types of epiphytic orchids along the Trisula waterfall (Coban Trisula) to Ranu Pani. This research was conducted in October 2018 - April 2019 in Trisula waterfall (Coban Trisula) to Ranu Pani. A floristic survey with 9.3-miles exploration in Trisula waterfall (Coban Trisula) to Ranu Pani. Observation of host trees was carried out by observing individual morphological characteristics and referring to the *Orchids of Java* literature. It is important for the reforestation of potential trees that can be used as hosts by epiphytic orchids and the limitation of the function shifting of land as settlements, agriculture, plantations so, the forest area is wider and the epiphytic orchids are increasingly preserved. Identification of host trees and identification of epiphytic orchids need to support sustainable development as an effort to conserve epiphytic orchids. The types of host trees, they are: Kukrup (*Engelhardtia spicata*), Cemara gunung (*Casuarina junghuhniana*), Anggrung (*Trema orientalis*), Dadap putih (*Acer laurinum*), Trete (*Celtis* sp.), Bangkongan (*Turpinia spaenocarpa*), Suren (*Toona sureni*), Pamoung (*Macropanax dispermus*), Pasang (*Lithocarpus sundaicus*), Tutup (*Mallotus paniculatus*), Genitri (*Elaeocarpus ganitri*) and *Astronia spectabilis*. The types of epiphytic orchids found are *Eria moluccana*, *Schoenorchis juncifolia*, *Vanda limbata*, *Agrostophyllum* sp., *Appendicula* sp., *Bulbophyllum macrantum*, *Bulbophyllum miniatum*, *Bulbophyllum obtusipetalum*,

Bulbophyllum sp. I, *Coelogyne miniata*, *Dendrobium linearifolium*, *Dendrobium hasseltii*, *Dendrobium sanguinolentum*, *Dendrochilum* sp., *Eria bogoriensis*, *Eria hyacinthoides*, *Eria longifolia*, *Flickingeria aureiloba*, *Liparis parviflora*, *Thrixspermum subulatum*, *Tuberolabium odoratisimum*, *Vanda tricolor*.

Keywords: *Epiphyte, host, orchid, Trisula Waterfall, Ranu Pani*

1. INTRODUCTION

Bromo Tengger Semeru-Arjuno National Park is one of the biosphere reserves on Java and a part of the Indo-Malayan region. Several types of terrestrial ecosystems are found in nature reserves including cultivation areas, secondary forests and primary forests. Primary forests also include lowland rainforests, mountain rainforests, deserts, savannas. Its ecosystem types are Sub-Montana, Montana, and Sub-Alpin with large trees. This type of ecosystem makes the specific habitat of orchid plants; one of them is epiphytic orchids (Pranata, 2005). It is noted that there are around 1,025 flora species including 226 species which are family of Orchidaceae and 260 species which are recorded as traditional medicinal plants and ornamental plants (UNESCO, 2015).

Orchid is one of the plants with a high level of diversity and aesthetic value. Species diversity and orchid varieties spread from tropical and subtropical regions, but they are found in tropical forest areas (Pandey, 2003). The wide distribution and beauty of the flower shape causes the orchid becomes a plant that is often used as the main ingredient for obtaining

commercial hybrid species, making orchids near to extinct. Another factor is the existence of forest degradation caused by the conversion of land functions that are used for residential areas, plantations being one of the disturbers of the existence of flora and fauna (Whitten, 1992).

The threat of epiphytic orchid extinction makes conservation efforts very important. One of them is sustainable development techniques. Sustainable development is a capacity to maintain ecological, social and economic stability in the transformation of biosphere services for human. The sustainable development can be the efforts to fulfill needs at present and in the future, a system that is needed and desired (socio-political or natural) in unlimited time. The other meanings of sustainable developments are the integration of aspects ethics, economics, social and environment on progressing basis so that generations of human and other living beings can live without limits, and live in harmony with nature and maintain the quality of relations between humans and nature (Ordonez & Peter, 2010). One indicator of sustainable development is the existence of environmental ethics which is the guideline of people's lives, so they always strive for environmental sustainability and balance, conservation of natural resources and prioritizing the improvement of quality of life (Sutisna, 2006).

Sustainable development techniques in the preservation or conservation of epiphytic orchids can be replanting trees that are hosted by epiphytic orchids. Epiphytic orchids

naturally live in trees and branches. Host trees are one of the basic needs for getting light and good air circulation for orchids (Puspitaningtyas, 2007).

This study aims to develop sustainable development techniques in conserving epiphytic orchids, identify host tree species for epiphytic orchid habitat and identify types of epiphytic orchids along Trisula waterfall (*Coban Trisula*) to Ranu Pani.

2. METHOD

This research was conducted at along the Trisula Waterfall (*Coban Trisula*) corridors until Ranu Pani located in Bromo Tengger Semeru National Park with altitude about 1.422-2.140 m above sea level. Geographically, Trisula waterfall were located ($8^{\circ}00'06.2''$ S $112^{\circ}52'12.4''$ E) and Ranu Pani were located ($8^{\circ}00'44.7''$ S $112^{\circ}56'52.2''$ E). This research was conducted from November to March 2019. This research with a distance of 15 km (Figure 1).

Observation applied a floristic survey with an exploration method along the road from the entrance to Trisula waterfall (*Coban Trisula*) to Ranu Pani, which was approximately 9.3 miles. The line transect method 100m^2 was used with exploration on a $10\text{m} \times 10\text{m}$ plot in flat location, but in steep terrain, it was used the roaming method. Host tree data collection was conducted using purposive sampling supported by documentation activities. Observation of the location or presence of orchids in the host tree was carried out by the method of transecting

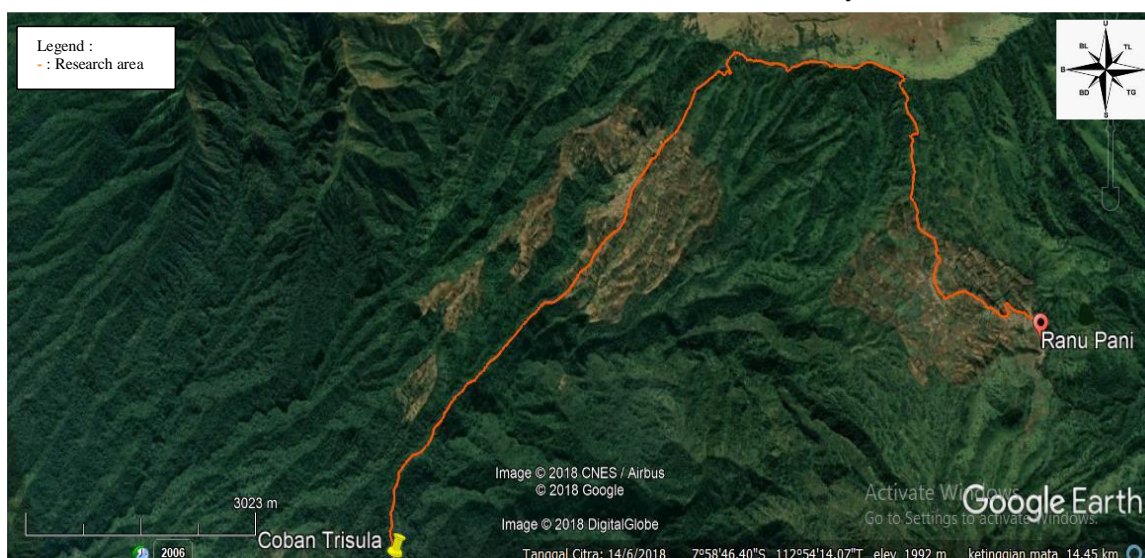


Figure 1. Research areas of Trisula Waterfall – Ranu Pani corridors

along the tree trunk through the zoning system (Figure 2).

Epiphytic orchid was identified by analyzed its morphological descriptions of roots, stems, leaves and flowers when flowering. Observation of field activities was carried out with mentoring and verification from experts from Purwodadi Botanical Gardens - LIPI. The results of the analysis were compared with the guidebook of *Orchids of Java* (Comber, 1990). Then, identification of host trees analysis of the morphology of tree height and stem surface of each individual were analyzed.

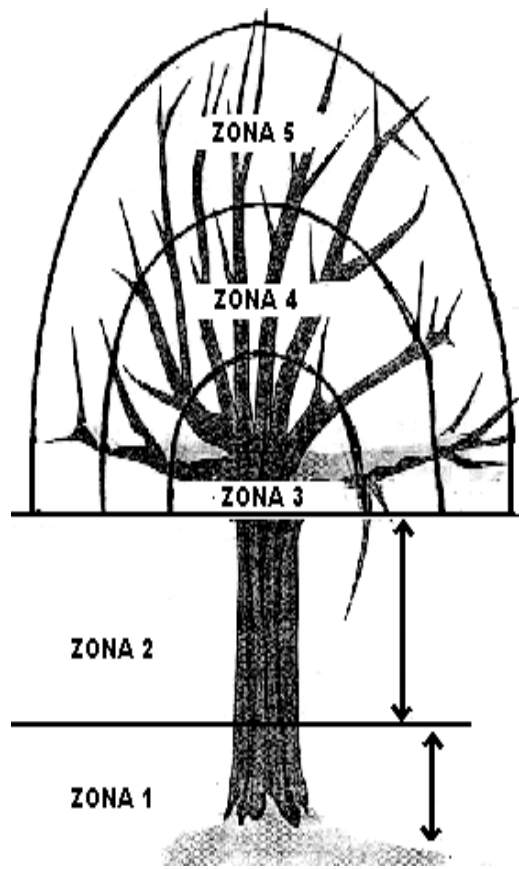


Figure 2. Zoning orchids on the host tree (Johansson, 1975)

Information :

- Zona 1 : base of the tree (1/3 main stem);
- Zona 2 : main stem until the first branching (2/3 the main upper stem);
- Zona 3 : basal branching (1/3 branch length);
- Zona 4 : middle of branching (1/3 middle of branching);
- Zona 5 : outermost branching (1/3 of the outermost branching).

Data Analysis

Data from the floristic survey were analyzed by descriptive analysis and interpreted with graphs and diagrams. Floristic survey data includes the number, type, and zoning of orchids on host trees, and types of host trees.

3. RESULT AND DISCUSSION

Sustainable development techniques as an effort to conserve epiphytic orchids

Due to the extinction of a species, the conservation efforts were urgently needed. One of them was the technique of sustainable development. Law No. 32 of 2009 concerning Protection and Management of the Environment, sustainable development was defined as a conscious and planned effort that integrates environmental, social and economic aspects into development strategies to ensure the integrity of the environment for safety, capability, welfare, and quality life of present and future generations.

Sutamihardja (2004) stated that the concept of sustainable development encompassed the existence of reasonable boundaries in the control of ecosystems and emphasized the lowest possible exploitation of natural resources, safeguards against the preservation of existing natural and environmental resources and prevention of ecosystem disturbances, natural resource management and environment that had long-term benefits. In accordance with the concept of sustainable development regarding the preservation of natural resources and the environment, this study was used conservation efforts to support sustainable development that would be applied along Trisula Waterfall (*Coban Trisula*) -Ranu Pani. Reforestation of potential trees that could be used as hosts by epiphytic orchids (especially trees that dominate the area and limit the transfer of functions of land as settlements, agriculture, plantations so that the forest area) was wider and epiphytic orchids were increasingly preserved. Identification of host trees and identification of epiphytic orchids need to support sustainable development as an effort to conserve epiphytic orchids.

Types and distribution of epiphytic orchid host trees along trisula waterfall-Ranu Pani

The results of observations were found 33 trees that were used as the host by epiphytic orchids. The host trees found in waterfall forest area were *Engelhardia spicata* (Kukrup), *Lithocarpus sundaicus* (Pasang), *Trema orientalis* (Anggrung), *Macropanax dispermus* (Pampung), *Celtis* sp. (Trete), *Turpinia sphaenocarpa* (Bangkongan), *Toona sureni* (Suren), *Astronia spectabilis*, *Elaeocarpus ganitri* (Jenitri), *Acer laurinum* (White Dadap), *Mallotus paniculatus* (Tutup), while in the forest area around Lake Ranu Pani, there was the *Casuarina junghuhniana* (Mountain Cypress). These types of host trees were overgrown with various types of epiphytic orchids (Figure 3)

The most dominant tree species were *Engelhardia spicata* (Kukrup) and *Casuarina junghuhniana* (Mountain Cypress). Both of these trees had character of non-flaking stems, and they had the rough surfaces, cracks and woody.

Engelhardia spicata (Kukrup) had a bark texture that is stable or not peeling, the texture of the cracked surface was shallow, hard and woody. *Engelhardia spicata* (Kukrup) tree habitat was in dense primary forest, more common on mountain slopes or in valleys up to 2,500 masl (Soepadmo et al., 2002).

Casuarina junghuhniana (Cemara gunung) was found in Indonesia on the slopes of volcanoes at an altitude of 1,500-3,100 m above sea level (Hanum & van der Maesen, 1997). *Casuarina junghuhniana* was also a type of plant which was tolerant to the dry season, so it was usually more resistant to fires. *Casuarina junghuhniana* was a fast growing type of plant that could reach a maximum height in 35 meters so it was suitable for use as a tree for mountainous restoration. The diameter of this tree was between 30-50 cm. The others characters were hard wood texture, reddish-brown in color, large stems, straight, cylindrical, tend to flake easily and appear deep cracked with a depth of 16-31 mm and width 9-15 mm (Hidayat & Hansen, 2001).

According to Tarmudji and Latifah (2001) *Casuarina junghuhniana* was capable of being hosts of epiphytic orchids, because it was flat host trees, rough (chipped), and slightly

cracked, so that a lot of dust sticks to the trunk compared to the skin smooth stem.

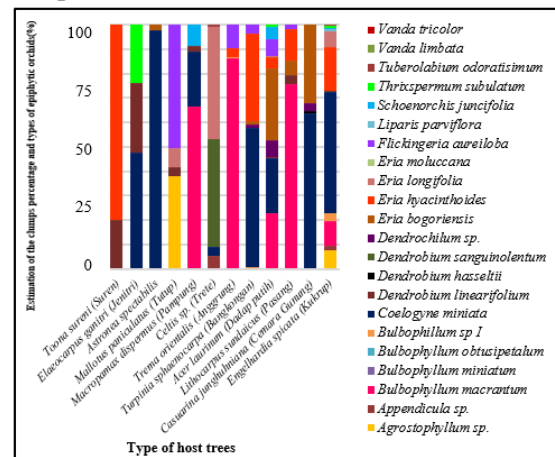


Figure 3. Estimation of the clumps percentage and types of epiphytic orchids in each type of host tree

Types of epiphytic orchids along trisula waterfall-Ranu Pani

The results of observations that had been done, found as many as 22 epiphytic orchid species (Figure 4). The types of epiphytic orchids found along Trisula Waterfall to Ranu Pani were *Eria moluccana*, *Schoenorchis juncifolia*, *Vanda limbata*, *Agrostophyllum* sp., *Appendicula* sp., *Bulbophyllum macrantum*, *Bulbophyllum miniatum*, *Bulbophyllum obtusipetalum*, *Bulbophyllum* sp. I, *Coelogyne miniata*, *Dendrobium linearifolium*, *Dendrobium hasseltii*, *Dendrobium sanguinolentum*, *Dendrobium* sp., *Eria bogoriensis*, *Eria hyacinthoides*, *Eria longifolia*, *Flickingeria aureiloba*, *Liparis parviflora*, *Thrixspermum subulatum*, *Tuberolabium odoratisimum*, *Vanda tricolor*.

The most common epiphytic orchid was *Coelogyne miniata* orchid. One of the influencing factors was the existence of environmental conditions that made it possible for these types of epiphytic orchid plants to grow well. *Coelogyne* had the ability to grow in environment with high light intensity and usually found on trees around the river (Soepadmo et al., 2002).

The few types of epiphytic orchids found were *Bulbophyllum obtusipetalum*, *Dendrobium sanguinolentum* and *Tuberolabium odoratisimum*. *Tuberolabium odoratisimum* is often found at an altitude of 500-1400 (Comber, 1990). Observations were

carried out in an area of 1,422 - 1,459 masl so that the orchids were rarely found because the surrounding environment did not provide conditions that supported the growth of epiphytic orchids, so orchids could not grow optimally.

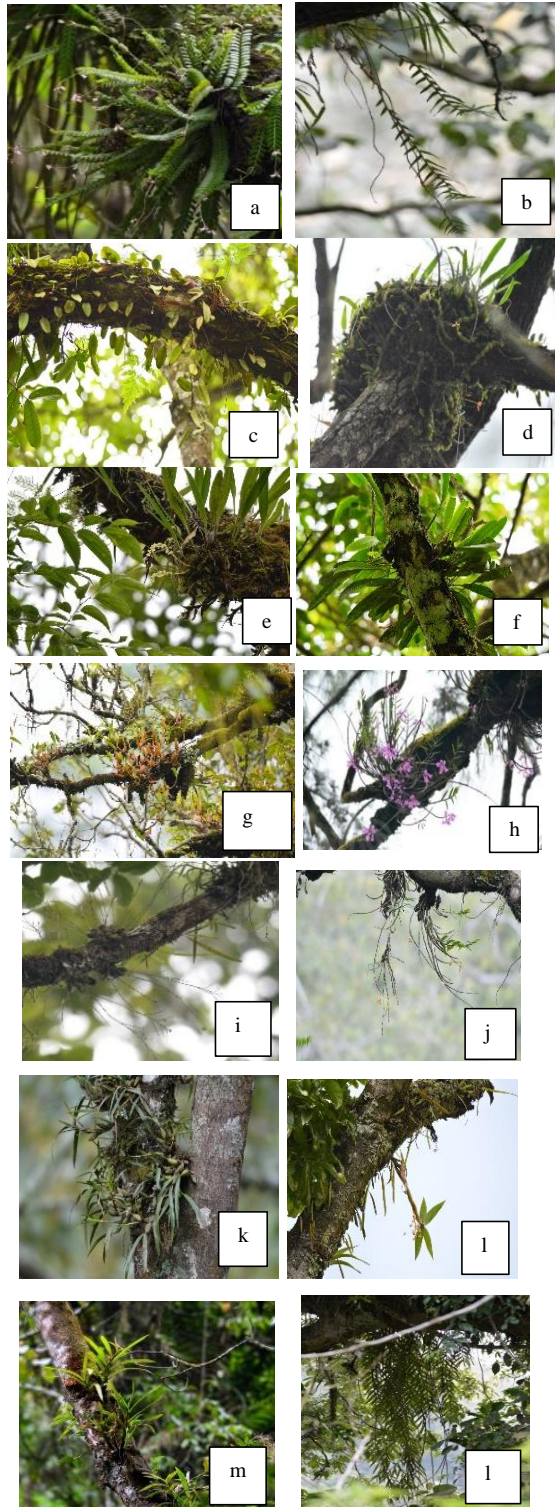


Fig 4. a) *Agrostophyllum* sp., b) *Appendicula* sp., c) *Bulbophyllum macrantum*, d) *Bulbophyllum miniatum*, e) *Bulbophyllum obtusipetalum*, f) *Bulbophyllum* sp I., g) *Coelogyne miniata*, h) *Dendrobium linearifolium*, i) *Dendrobium hasseltii*, j) *Dendrobium sanguinolentum*, k) *Dendrochilum* sp., l) *Eria bogoriensis*, m) *Eria hyacinthoides*, n) *Eria longifolia*., o) *Eria moluccana*, p) *Flickingeria aureiloba*, q) *Liparis parviflora*, r) *Schoenorchis juncifolia*, s) *Thrixspermum subulatum*, t) *Tuberolabium odoratisimum*, u) *Vanda limbata*, v) *Vanda tricolor*

4. CONCLUSION

1. Sustainable development techniques through reforestation of potential trees that could be used as hosts by epiphytic orchids was important to be applied, especially trees that dominate the area and limited the function of land conversion as settlement, agriculture,

- plantations so that wider forest areas and epiphytic orchids were maintained.
2. Tree species found in Waterfall region that was used as host of epiphytic orchids were *Engelhardia spicata* (Kukrup), *Lithocarpus sundaicus* (pairs), *Trema orientalis* (Anggrung), *Macropanax dispermus* (Pampung), *Celtis* sp. (Trete), *Turpinia sphaenocarpa* (Bangkongan), *Toona sureni* (Suren), *Astronia spectabilis*, *Elaeocarpus ganitri* (Jenitri), *Acer laurinum* (Dadap putih), *Mallotus paniculatus* (Tutup), while in the forest area around Lake Ranu Pani was *junghuhniana Casuarina* (Cemara gunung).
 3. Types of epiphytic orchids found along Trisula Waterfall - Ranu Pani were *Eria moluccana*, *Schoenorchis juncifolia*, *Vanda limbata*, *Agrostophyllum* sp., *Appendicula* sp., *Bulbophyllum macrantum*, *Bulbophyllum miniatum*, *Bulbophyllum obtusipetalum*, *Bulbophyllum* sp I, *Coelogyne miniata*, *Dendrobium linearifolium*, *Dendrobium hasseltii*, *Dendrobium sanguinolentum*, *Dendrochilum* sp., *Eria bogoriensis*, *Eria hyacinthoides*, *Eria longifolia*, *Flickingeria aureiloba*, *Liparis parviflora*, *Thrixspermum subulatum*, *Tuberolabium odoratisimum*, *Vanda tricolor*.

5. ACKNOWLEDGE

This research was supported by Ecology and Taxonomy Laboratory of Brawijaya University and Bromo Tengger Semeru National Park. Authors would like to thank all of the author's friends, Mr. Rifai, and Mr. Kiswoyo in assissting the author sampling in field.

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