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In Situ Conservation of Wild Orchid Species Diversity in Papua at the Base Camp of PT. Wijaya Sentosa, Teluk Wondama Regency, West Papua

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ABSTRACT

This study aims to preserve the diversity of orchid species that are used as useful plants and have economic value. The methods used in this study are exploration, observation, species description. The technique used in sampling was carried out purposively when orchid species were found in the roaming area which was carried out randomly in an area of 10 hectares. It was revealed from the results of observations that 128 individuals were collected which were classified into 25 genera and 31 species were identified. The observed orchid habitus lives as epiphytic and terrestrial or lithophytic plants. Generally, species that live as epiphytes are more often found. Orchid habitats can be significantly distinguished in lowland tropical rainforests and swamp forests with humidity ranging from 80-85% and temperatures between 26-28% at night and 30-34% during the day. Topographic conditions are relatively flat to a slope of 45%. Vegetation cover is quite dense, but in some location, there are gaps in the canopy, providing opportunities for breakthroughs in sunlight intensity during the day. Conservation efforts are carried out on species that are often hunted and used as ornamental plants such as *Bulbophyllum phalaenopsis, Coelogyne beccarii, Coelogyne asperata, Dendrobium antennatum, Dendrobium macrophyllum, Dendrovium shiraishii, Dendrobium spectabile, Grammatophyllum scriptum, Grammatophyllum speciosum* and *Pomatocalpa marsupiale*. The Conservation Status of the collected species is generally categorized under IUCN Redlist as Data Deficiency (DD) and Least Concern (LC) clusters.

Key words: Eksploration, Collection, Identification, Orchid, Wondama-Bay Regency.

INTRODUCTION

Knowledge about the diversity of wild orchids in Papua is still limited to the recognition of species that are often hunted and collected by orchid enthusiasts because of the uniqueness of their flowers. On the other hand, habitat degradation and deforestation due to logging and forest clearing for development purposes, such as the New Autonomous Region (DOB), have contributed to the decline in habitat area, which has impacted the existence of orchids. Worldwide, there are approximately 30,000 species of orchids (O'Byrne, 1994), a sixth of which, or approximately 5,000 species, are found in Indonesia. There are

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around 233 of the 3,000 species of orchids found in Papua (Handoyo, 2021). Information regarding the details of species diversity and its distribution across various environmental gradients has not yet been fully revealed, as there are still areas that have not been explored and properly identified.

Orchids are flowering plants that can live in various habitat conditions. Orchids can live as epiphytes, terrestrial or lithophytes, aquatic and amphibious plants (Dressler, 1993). In addition, orchids also grow in various types of ecosystems, ranging from coastal forests and mangroves (littoral forests) to high mountain forests (alpine forests) (Millard, 1990). These ecosystem conditions can be found in various forest areas in Papua (Petocz, 1987), where there are still many unexplored forest areas with undiscovered biodiversity, including various types of flora such as orchids (Johns *et al*., 2006).

The microclimate required by orchids for growth and development varies greatly in terms of temperature, humidity, rainfall, light intensity, and water requirements (Baker & Baker, 1996). Orchids in lowland tropical areas that grow well terrestrially or epiphytically are very sensitive to very cold conditions, which will stunt their growth when the temperature drops drastically to 8°C. These conditions can be seen in orchid species with limited resources and capacity, such as those in the Vandoid genus, including Phalenopsis. Such species require a temperature range of 18-20°C to survive during winter (Jones, 2010). These growing requirements are essential when orchids are removed from their natural habitat and cultivated as ornamental plants or even prepared as superior plants for various purposes such as exhibitions (Baker & Baker, 1996) and plant breeding programs (Ormerod, 2012). Humidity and watering are other important indicators in maintaining the health of cultivated orchids (Baker & Baker, 1996). These two aspects are often overlooked when orchids are replanted in home gardens (Allen, 2013) or cultivated in screen houses (Arditti, 1992).

The usefulness of Papua's native orchids is well known both locally and internationally. This has led to increased hunting of orchids, especially those with large flowers and unique colors and shapes. Intensive cultivation methods are not yet well understood by most farmers or local breeders who have orchid collections. Generally, orchids are extracted from their habitat in large clumps and divided into 4-5 stems to be replanted in fern media or pots. These orchids are then traded to orchid and ornamental plant enthusiasts. This vegetative cultivation technique is often practiced by local farmers. The generative cultivation technique is not yet well understood. This condition also has an impact on the existence of orchids in nature because the level of hunting for orchids is quite high.

The purpose of this study is to document the collection and identification of species that are hunted and replanted in concession forest areas by orchid enthusiasts working around the PT. Wijaya Sentosa area in Teluk Wondama Regency. This paper is expected to serve as a basis of information on the diversity of orchid species and conservation efforts for species that are collected as ornamental plants and are highly sought after by the community.

MATERIALS AND METHODS

Research location and time

The research was conducted in the forest concession area managed by PT. Wijaya Sentosa and several locations in Teluk Wondama Regency. The research location is at 132°35' - 134°45' East Longitude and 0°15' - 3°25' South Latitude (Figure 1). The research was conducted during two periods, namely July-August 2021 and September-October 2024.

Materials and equipment

The main materials for this study were the main objects, namely orchids and their host plants. In addition, orchids growing on soil and rocks at the study site were also collected and recorded. The equipment used during the study included: GPS to determine the location of orchids and host plants, field notebooks, clinometers to measure the topographic slope at the study site, digital cameras

to document collected and uncollected orchid samples, a tape measure to measure the height of the host tree or the location of the orchid, a phyband to measure the diameter of the host stem in the form of mature trees (pole and tree levels), and a thermohygrometer to measure the temperature and humidity at the research site.

Data collection techniques

Orchid species data was obtained from exploration at each research site by exploring mapped forest areas. The species of orchids found on each host plant was recorded and collected for further identification. Generally, epiphytic orchid species were collected and planted back as ornamental plants in the base camp area, while species collected outside the concession area were planted in home gardens and along roadsides. Flowering species were described based on the morphological characteristics of their leaves, stems, flowers, and fruits. The results of the description were then identified and validated using herbarium material collected at the Manokwariense Herbarium and orchid identification guidebooks (O'Byrne, 1994; Lavarack et al., 2000; Handoyo, 2021) and journals (Cribb, 1986). In addition to orchid data, host species data were also recorded to provide an overview of the orchids growing on each host species encountered.

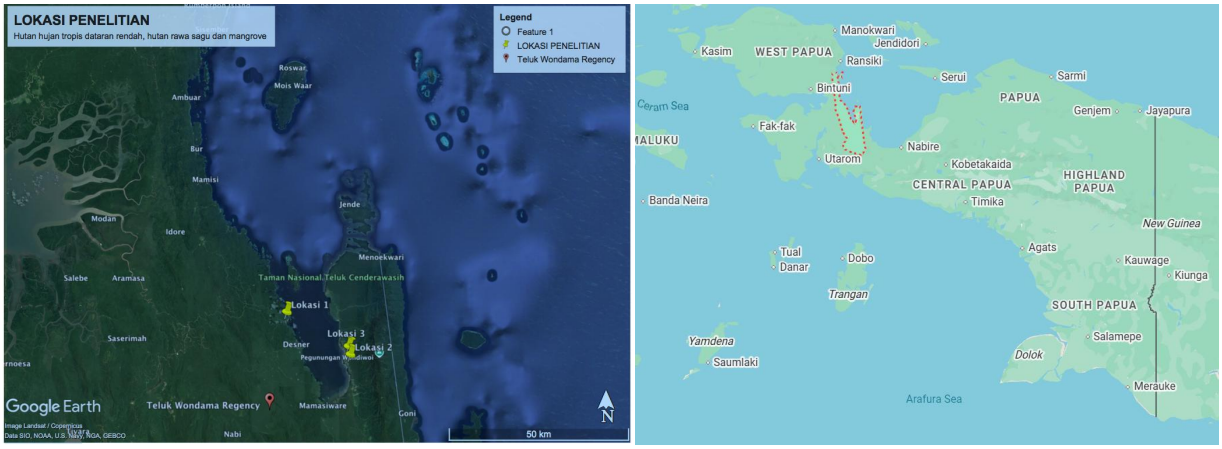

Figure 1. Research location map.

Figure 2. Orchid species *Bulbophyllum phalaenopsis* (A) and *B. gjellerupii* (B) epiphytic on host plants.

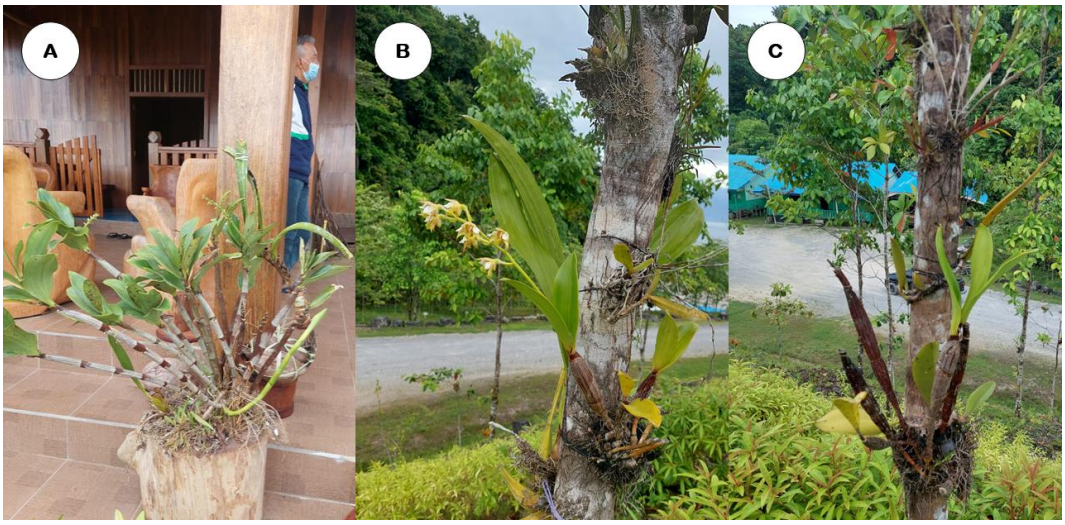

Figure 3. *Dendrobium* section Latouria group: A) *Dendrobium* sp., B) *Dendrobium* aff. *shiraishii*, C) *Dendrobium macrophyllum* planted on host plants growing in the yard of PT Wijaya Sentosa.

Data analysis

The research data were analyzed using PATN software (Belbin, 2013) to determine the similarity index and characteristics that group species. The analysis results were presented and projected on a dendrogram.

RESULTS AND DISCUSSION

Orchid diversity

The exploration recorded 42 species consisting of epiphytic and terrestrial orchids, but not all of them were collected due to conservation considerations. Some species were rarely found during the exploration. Eighteen species of epiphytic orchids were often hunted and collected as ornamental plants and even traded by orchid enthusiasts. Five of the eight terrestrial orchid species recorded during the study are also highly sought after by ornamental plant enthusiasts in general, and orchid enthusiasts in particular, for collection as ornamental plants, such as *Macodes* sp. and *Goodyera* sp.

A total of 42 orchid species were collected and identified in the concession area of PT. Wijaya Sentosa in Teluk Wondama Regency, which can be classified into 25 genera (Table 1). Thirty species could be identified based on morphological and flowering characteristics, while the rest could only be identified to genus level because they were not flowering at the time of field observation. The most numerous genera were Dendrobium and Bulbophyllum. These two genera are the largest in the Orchidaceae family (Lavarak *et al*., 2000 and O'Byrne, 1994) (Figure 1; Figure 2). The genus Dendrobium itself consists of 41 sections (Schuiteman 2013, Cribb 1986, Ossian 1981 and 1982, Kraenzlin 1901), and the sections most commonly found in nature, nurseries, and herbaria are *Spatulata* and *Latouria* because of their flowers' varied sizes, shapes, distinctive colors, and durability. The unique morphological characteristics of the flowers of these two *Dendrobium* groups make them a target for orchid and ornamental plant enthusiasts, and they are often used in crossbreeding programs to obtain flowers with better qualities than the originals (Ormerod, 2012). Other genera recorded as flowering during the observation were *Acriopsis liliifolia, Coelogyne asperata, Grammatophyllum scriptum*, and *Grammatophyllum speciosum* (Handoyo 2021, Lavarack and Harris 2002) (Figure 4). Other orchid species could not be identified because they did not flower during the field observation, such as *Diplocaulobium* (Figure 3).

The orchid species collected grow well in accordance with the temperature, humidity, and lighting in their habitat. The research location has a humidity ranging from 80-85% with an average temperature of 26 to 28°C at night and 30° to 34° Celsius during the day. At this location, there are tolerant species (do not require shade) and intolerant species (require shade), and there are even species that can grow in both conditions. Dendrobium bifalce requires a maximum average temperature ranging from 256 to 30.1°C. The minimum temperature is between 20.6 and 22.3°C. *Dendrobium antennatum* grows well in these conditions, Dendrobium canaliculatum prefers a growing environment with humidity below 75%, while Dendrobium macrophyllum requires humidity above 80%. The lighting aspect for Dendrobium devosianum ranges from 1500-2000 fc (footcandles) and *Dendrobium macrophyllum* requires lighting intensity ranging from 2500-3500 fc (Baker and Baker 1996). These lighting conditions indicate that these species are quite

Figure 4. *Diplocaulobium* genus: A) *Diplocaulobium* aff. *centrale*, B) *Diplocaulobium* sp2. and *Agrostophyllum* sp. planted on fern medium.

Figure 5. *Grammatophyllum* genus. A. *G. scriptum*, B) *G. speciosum* planted in wood medium.

tolerant of light because they are in the range of 1000-4000 fc (intermediate), not too high (above 4000 fc) and also not too low (below 1000 fc).

Orchids can grow at various altitudes, from mangrove forests and beaches to high mountains reaching 3000 meters above sea level. They also spread across various topographical conditions, from flat to slopes reaching 60% (Riry, 2023). At the research site, the topography of the orchid's growing environment is fairly flat to a slope of 45%.

Host diversity

The association between orchids and hosts is mutualistic symbiosis, sometimes commensalism, but rarely parasitism. Thirteen host species are colonized by various orchid species recorded during observation. The types of hosts colonized by orchids are generally trees, but there are also shrubs and ferns. One of the tree species that also serves as a home for orchids is *Myristica arfakensis* W.J.de Wilde, *Terminalia catappa* L., *Terminalia mantaly* H. Perrier (a species introduced as an ornamental plant), *Timonius uniflorus* (Banks ex C.F. Gaertn) Govaerts, which grows abundantly on the coast of Pantai (Figure 5; Table 2) (Plant of The World, 2024). Shrub species that are often found as hosts for orchids include: Ficus sp., Macaranga sp., (Camara-Leret *et al*., 2020) and tree-like ferns; *Alsophila arfakensis* A. Gepp., *Alsophila calsicola* Lehnert, *Alsophila excelsior* Lehnert, *Diksonia* sp., *Cyathea* sp. (Lehnert & Camara-Leret, 2019).

Orchids growing in the research location, both epiphytic and terrestrial, have a wide distribution area. The two genera that are also published as the genera with the largest number of species, *Bulbophyllum* and *Dendrobium*, can be found growing in various types of environmental gradients from mangroves to high mountains. This was revealed in a study conducted in the Gunung Simpan Nature Reserve, Simpang Barat Resort, which is a highland forest area to high mountains (Puspitaningtyas, 2005). The same

Figure 6. Lowland tropical rainforest (A), mountain forest (B), sago swamp forest (C), and mangrove forest (D) habitats inhabited by terrestrial, epiphytic, and host orchids (Photo: Frans E. Mosmafa, 2025).

Table 1. List of orchid species collected and identified in the field and their conservation status based on the IUCN Red List of Threatened Species (2024).

Species	Type			Sum of individual	IUCN Redlist category	Section
	E	T	L			
Acanthophippium splendidum	✓			1	-	
Acriopsis liliifolia	✓			2	-	
Agrostophyllum sp1.	✓			1	-	
Anoecticylus sp.		✓		1	-	
Bulbophyllum aff. *gjellerupii*	✓			2	-	
Bulbophyllum phalaenopsis	✓			2	-	
Bulbophyllum sp1.	✓			1	-	
Bulbophyllum sp2.	✓			1	-	
Bulbophyllum sp3.	✓			4	-	
Calanthe triplicata		✓		2	-	
Coelogyne asperata	✓			2	-	
Corymbrochis veratrifolia		✓		3	-	
Dendrobium antennatum	✓			4	LC	Spatulata
Dendrobium biloculare	✓			1	LC	Latouria
Dendrobium bifalce	✓			6	LC	Latouria
Dendrobium litrorale	✓			2	LC	Aporu
Dendrobium macrophyllum	✓			5	LC	Latouria
Dendrobium mirbelianum	✓			1	LC	Spatulata
Dendrobium nindii	✓			2	LC	Spatulata
Dendrobium odoardi	✓			1	DD	Spatulata
Dendrobium shiraishii	✓			1	DD	Spatulata
Dendrobium sp1.	✓			1	-	
Dendrobium sp2.	✓			1	-	
Dendrobium sp3.	✓			1	-	
Diplocaulobium sp1.	✓			3	-	
Diplocaulobium sp2.	✓			1	-	
Geodorum densiflorum		✓		1	-	
Goodyera reticulata		✓		1	-	
Grammatophyllum scriptum	✓			3	-	
Grammatophyllum speciosum	✓			5	-	
Grastidium niveolabium	✓			2	-	
Macodes sanderiana		✓		3	-	
Pholidota sp.	✓			2	-	
Pomatocalpa marsupiale	✓			3	-	
Vandopsis lissochiloides	✓			1	-	
Vanda hindsii	✓			2	LC	
Plocoglottis lowii		✓		1	-	
Renanthera porphyrodesme	✓			2	-	
Robiquetia hamata Schltr.	✓			2	-	
Spathoglottis papuana		✓	✓	15	-	
Spathoglottis plicata Blume		✓	✓	29	-	
Tropidia sp.		✓		4	-	

conditions can also be seen in the results of research conducted in Australia, which represents

tundra areas or savanna areas of woody plants that are generally overgrown by the Myrtaceae family and lowlands (Lavarack *et al*., 2000). The diversity of orchid species from these two genera continues to grow along with the development of research in the New Guinea Islands, such as Indonesia New Guinea (Handoyo, 2021) and Papua New Guinea (O'Byrne, 1994) and orchid collections published in journals (Cribb, 1986) and books (Handoyo, 2019).

In addition to their significant species diversity, both genera are targeted for hunting by ornamental plant and orchid enthusiasts (Lala & Sudiarta, 2022). Orchid hunting occurs because their economic benefits are far more promising than their ecological and botanical aspects (Andri & Tumbuan, 2015). The hunting of orchids related to botanical aspects can be seen from the uniqueness and variety of colors, shapes, and sizes of the flowers, as well as their long durability when used as ornamental flowers (Rangkuti, 2018). The potential of orchids as ornamental plants has not even been diminished by the challenges of the Covid-19 pandemic (Martoyo *et al*., 2022), with their selling value remaining stable through online marketing (Nugroho *et al*., 2022). Orchids are often sought after as parent plants in crossbreeding programs to obtain flowers with attractive and long-lasting qualities for orchid enthusiasts (Reitano, 2012).

The value of orchids is not only as ornamental plants but also as herbs that function as medicinal plants (Ody, 2000). One form of orchid use as a medicinal plant can be found among the Anak Dalam ethnic group in Central Kalimantan. Research based on local wisdom among these ethnic communities shows that orchids are used as medicine to cure diseases. *Grammatophyllum speciosum* is used as a remedy for cysts, while *Bromheadia finlaysonia* is used as a remedy for back pain (Wahyudiningsih & Nion, 2017). The use of orchids as traditional medicine is also recorded among the Batak ethnic group in North Sumatra to treat fever, maintain stamina, and reduce digestive tract disorders (Silalahi, 2015). Orchids in Papua can also be used as a base material for making noken, especially from the *Diplocaulobium* genus (Runtuboi *et al*., 2023).

In addition to these benefits, orchids are useful as food for communities (Saiba *et al*., 2023). Parts of orchid plants, such as tubers, have generally been used for centuries as food, either raw, roasted or boiled, and even ground into a paste by various cultures and ethnic groups on all continents (Heyne, 1987). The tubers of the species *Disa, Habenaria*, and *Satyrium* are used as juice in Africa. The stems and tubers of the orchids *Aplectrum hyemale*, *Bletia verecunda*, *Habenaria dilatata*, and *Calypso borealis* are consumed by communities in North America (Arditti, 1992). The flowers and fruit of Vanilla planifolia are used as food flavorings and perfume and cosmetic fragrances by various communities (Heyne, 1987). The flowers of the species *Stanhopea tigrina* are used in making tortillas in some regions of Mexico (Arditti, 1992).

Various efforts have been made to maintain the quality of orchids in terms of crossbreeding (Zulkaidah *et al*., 2019), marketing (Putra *et al*., 2021), and modification of planting media (Kurniasih *et al*., 2017). Based on the aspect of hybridization, the parent stock aspect is the main priority in the hybridization process (Hartati *et al*., 2014). In this study, three parent stock species of the *Dendrobium* genus were used, namely *Dendrobium mirbelianum, Dendrobium lineale*, and *Dendrobium biggibum*, resulting in crosses between mirbelianum and lineale, lineale and biggibum, and mirbelianum and biggibum. Regarding the plant medium required during the acclimatization of the cross, the main ingredient of the planting medium is recommended because it has been proven to provide maximum growth for orchids (Hartati *et al*., 2019). In this research, zeolite was used as the main material for acclimatizing *Phalaenopsis amabilis* orchid tissue culture results under various treatments, resulting in the maximum growth expected (Kurniasih *et al*., 2017).

Orchid conservation is promoted by various parties both domestically and internationally, such as in Australia (Backhouse & Cameron, 2005), Madagascar (Wraith & Pickering, 2018), China (Liu *et al*., 2020), and Europe (Kull *et al*., 2016). The

Table 2. Checklist of host species that serve as orchid growth sites.

Host species	Orchid species	Zoning of distribution in hosts				
		Stem			Canopy	
		I	II	III	IV	V
Albizia falcataria	*Dendrobium antennatum*	2		1		
	Dendrobium mirbelianum		1			
	Dendrobium smilliae			1		
Anisoptera sp.	*Bulbophylum* sp1.		2		1	
	Bulbophyllum sp2.		1	1	1	
	Bulbophyllum sp3.		1			
Dipterocarpus sp.	*Bulbophyllum* sp2.			1		
	Bulbophyllum sp4.			1		
	Bulbophylum sp5.	1				
	Grammatophyllum speciosum			1		
Disoxylum sp.	*Garmmatophyllum scriptum*			1	1	
Ficus benjamina	*Dendrobium mirbelianum*	1	1			
	Diplocaulobium sp1.		1			
	Diplocaulobium sp2.		1			
Homaliun foetidum	*Grammatophyllum scriptum*			1		
Macaranga mappa	*Dendrobium mirbelianum*	1	1			1
	Diplocaulobium sp3.		1			1
Octomeles sumatrana	*Dendrobium antennatum*		2			
	Dipodium pictum	1				
	Vanda sp1.		1			
Pometia acuminata	*Grammatophyllum speciosum*			1		
Pometia coriacea	*Gramatophylum scriptum*	1		1		
Pometia pinnata	*Grammatophyllum scriptum*			1		
	Grammatophyllum speciosum			1		
Terminalia catappa	*Bulbophylum* sp1.		1			1
	Bulbophyllum sp2.		1			1
Vatica papuana	*Dendrobium mirbelianum*		2			
	Diplocaulobium sp1.		1	1		

challenges of conserving orchids in their natural habitats continue to increase in line with regional development and land use. Forest areas that are the natural habitat of orchids have undergone many landscape changes as a result of changes in the forest environment that have been designated or established as areas for other uses (APL). Orchid conservation efforts continue to be promoted in various aspects of social life, including in the world of education. Orchid conservation in the context of education needs to be initiated and promoted immediately in order to preserve endemic species in various regions that are the natural habitats of these plants (Nuraini *et al.*, 2023).

CONCLUSION

The concession area of PT. Wukira Sari in Teluk Wondama has a forest area that is home to a diverse range of native Papuan orchids with ecological and economic value. Conservation efforts have been carried out by the company, focusing on species that are often sought after and hunted as ornamental plants. The dominant genera of interest are *Dendrobium* and *Bulbophyllum*, which have the greatest species diversity. Research and collaboration with policy makers and forest area managers are needed in order to conserve Papua's native orchids before the landscape changes due to the clearing of forest

areas for other purposes, such as food estates. This biological wealth is one of Indonesia's treasures that must be preserved because it is useful for communities both inside and outside the forest.

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