Open Science and Technology
Vol. 04 No. 01, 2024 (19-26)
ISSN (Print) :2776-169X
ISSN (Online) :2776-1681

Opportunities and Challenges for Orchid Plant Cultivation and Development in Indonesia

Peluang dan Tantangan Budidaya dan Pengembangan Tanaman Anggrek di Indonesia

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Submitted:16 April 2024 Accepted: 13 June 2024 Published: 23 June 2024

ABSTRAK

Keanekaragaman hayati di Indonesia, terutama anggrek sebagai tanaman hias, memiliki sebaran luas. Indonesia memiliki tidak kurang dari 6.000 spesies anggrek, namun sering menghadapi tantangan terkait konservasi dan budidayanya. Dalam menjaga kekayaan keanekaragaman hayati ini, program konservasi anggrek belum dikelola secara optimal sebagai bagian dari upaya pembangunan berkelanjutan untuk mempertahankan kualitas kehidupan manusia dan alam. Metode penelitian dalam studi ini bersifat kualitatif menggunakan pendekatan deskriptif terhadap objek penelitian, yaitu model analisis SOAR. Analisis ini berfokus pada kekuatan (*strengths*), peluang (*opportunities*), aspirasi (*aspirations*), dan hasil (*results*) melalui studi pustaka dari beberapa buku atau jurnal ilmiah terpublikasi dengan batasan tahun. Budidaya dan pengembangan anggrek akan berfokus pada kekuatan dan peluang terutama yang berkaitan dengan pelestarian keanekaragaman anggrek sehingga kelemahan dan ancaman dapat berkurang. Tantangan budidaya yang dihadapi dalam hal perbanyakan generatif anggrek akan diatasi dengan memanfaatkan teknik kultur *in vitro* agar budidaya dapat dilakukan dalam waktu yang lebih singkat dengan hasil yang lebih banyak. Teknik kultur *in vitro* dapat digunakan pula untuk mempertahankan berbagai spesies anggrek alam sebagai salah satu upaya konservasi.

Kata kunci: Angggrek, Budidaya, Konservasi, Keanekaragaman hayati.

ABSTRACT

Biodiversity in Indonesia, especially orchids as ornamental plants, is widespread. Indonesia has no less than 6,000 orchid species, but often faces challenges related to orchid conservation and cultivation. In maintaining this wealth of biodiversity, orchid conservation programs have not yet been managed optimally as a part of sustainable development effort to sustain the quality of human life and nature. This study employed a qualitative method through a descriptive approach on the research object, namely the SOAR analysis model. This analysis focused on strengths, opportunities, aspirations, and results through literature studies using several books or published scientific journals with year restriction. The cultivation and development of orchids will focus on the strengths and opportunities, especially concerning the preservation of orchid diversity so that the weaknesses and threats can be reduced. The cultivation challenge faced in terms of orchid generative propagation will be overcome by utilizing in vitro culture techniques so that the cultivation can be carried out in a shorter duration and produce larger yields. In vitro culture technique can also be carried out to maintain various nature orchid species as one of the conservation efforts.

Keywords: *Biodiversity, Cultivation, Conservation, Orchids.*

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INTRODUCTION

Forests in Indonesia harbor an enormous wealth of plant species diversity with wide distribution. The Ministry of Forestry of the Republic of Indonesia is authorized to manage forest areas for conservation purposes. Indonesia's conservation forest covers a total area of 21.7 million ha (Central Bureau of Statistics, 2023). However, the managed area has not been optimized due to several problems, such as land conversion, forest fires, and illegal logging that cause deforestation every year, beside also disrupt the natural distribution of vegetation, and greatly contribute to the decline in biodiversity (Kurniawan & Mustika, 2022). One major effort that can be carried out to overcome the declining of biodiversity is a conservation program with the aim of preserving and maintaining the environment, as it is one form of important sustainable efforts for developing sustainable human life and nature (Nuraini & Hidayah, 2023).

In addition to biodiversity conservation, ornamental plant conservation is an important sector, considering that these types of plant, especially in the form of floriculture, are one of the valuable commodities of the agricultural sector. Nonetheless, the conservation of ornamental plants in Indonesia is still not well implemented. Whereas, based on the data of several ornamental plants in the LIPI's Bogor Botanical Garden plant conservation center, there are around 60% of plant species in Indonesia, including orchids, from a total of 2 million of plant species worldwide (Merinda et al., 2023).

Orchid plants (Orchidaceae family), which can be classified into epiphytes and terrestrial types, belong to the Angiospermae group with species number at around 25,000. Indonesia itself has about 5,000 to 6,000 species of orchid, making it one of the countries with the richest orchid germplasm worldwide (Karoy et al., 2022). It is estimated that Indonesia's total orchid diversity of no less than 6,000 species has not yet been thoroughly identified. Many regions in the country have the potential for high orchid diversity, especially high-altitude regions because they comprise a suitable habitat type for orchids' life and growth (Setiawan et al., 2020).

Orchids are widely distributed in subtropical and temperate climate regions, and have the highest distribution in tropical regions. Areas that can become orchid habitats are widespread almost globally, except the Antarctic region, whose harsh conditions do not support orchids' growth (Kurniawan & Mustika, 2022). The distribution of orchids in Indonesia is wide. For instance, 731 orchid species are distributed in Java Island, with 295 species can be found in Central Java and 390 species can be found in East Java. The variety of species found in Java also includes several endemic species (Kurniawan et al., 2020). It is widely known that Papua Island has the most extensive distribution of orchids in Indonesia, as this region has the highest orchid diversity domestically, followed by Kalimantan and Sumatra Island, respectively, at the second and third position in terms of orchid diversity (Febrianti, 2020).

Exploration needs to be carried out appropriately by involving inventory on each orchid species in the selected region so that these activities can be further directed for research purposes that support conservation and utilization programs. Exploration aims to take samples of plants that have both economic and important scientific values, while inventory aims to record and document every plant species in a particular area as database on flora diversity. Nowadays, exploration and inventory activities are

necessary, considering that the natural habitats of many orchid species have been experiencing damage (Riandinata et al., 2022).

Exploration and inventory activities on orchids can increase public knowledge and awareness about the structure, species composition, ecological aspects, uses, and types of orchids. Orchid as ornamental plants have beautiful and attractive flowers with a quite high variety of shapes, colors, and sizes to be favored by many people worldwide (Merinda et al., 2023). The high attractiveness of ornamental orchids makes them a promising economic prospect for ornamental plant cultivators. However, several orchid species have not been thoroughly identified. In addition, the damage that continues to occur in nature makes conservation effort of orchids very important to be carried out to protect them from the threat of extinction.

Therefore, based on the aforementioned background, this article discusses the opportunities and challenges in orchid cultivation, and the development that needs to be carried out to increase the value of orchid plants and determine the types of orchid that have advantages to be further developed.

METHODS

This study was conducted from March to May 2024 in Yogyakarta Special Region. This study employed qualitative method using a descriptive approach on the research object, namely the SOAR analysis model built by Stavros and Hinrichs (2009), which focuses on strengths, opportunities, aspirations, and results (Cole & Stavros, 2019). The SOAR analysis is a technique that integrates strengths and opportunities rather than exploring problems, weaknesses, and threats. Weaknesses are not ignored. Instead, focus is directed on opportunities so that the weaknesses and threats can be reduced (Zamista & Hanafi, 2020). By investigating previous similar cases as references, a literature study was carried out using several books and published scientific journals with year restriction. Overall, this study emphasizes Indonesia's actual opportunities and challenges for orchid cultivation and development, especially concerning the orchid diversity for floriculture development.

RESULTS AND DISCUSSION

It is widely known that orchid species in Indonesia have diverse habitat characteristics (Karoy et al., 2022). High orchid diversity in Indonesia's forests is possible due to optimal conditions for their growing needs, namely an altitude of 1,000–2,500 meters above sea level (masl), temperature of ± 25°C, humidity of ± 75%, sufficient water sources, and adequate canopy conditions that help regulate humidity and light intensity in the forests (Kurniawan & Mustika, 2022). Indonesia's tropical conditions meet the environmental requirements for orchids to grow so that the cultivation poses a great opportunity. In addition, orchids have the benefit of being a habitat and shelter for certain animals (ecological benefit) and also can be utilized as ornamental plants with high market values (economic benefit) (Wati et al., 2024).

Enthusiasts in ornamental orchids have been increasing every year. This can be an opportunity for further development of orchid plants. Moreover, the suitability between the conditions required for orchids' growth and the climatic conditions in Indonesia is also favorable for orchid development. Another factor is that orchid cultivation is attractive because the plants have a variety of beautiful flowers, providing orchid enthusiasts with many choices in terms of color, shape, fragrance, aesthetics, and art (Chika et al., 2021). Orchid plants are often used for improving aesthetic functions in certain area, thus influencing the increasing demand from enthusiasts and collectors. Aesthetic functions of orchids include the function of room decoration (indoor), gardening landscape (outdoor), and complementary element. In addition to these functions, orchid plants are also often used as an important element in several religious ceremonies (Anggraeni, 2022).

Table 1. Strengths and opportunities of orchid cultivation in Indonesia.

Strengths (S)	Opportunities (O)
Indonesia has high orchid diversity.	There are high demands for orchids as ornamental plants.
Conditions in Indonesia are suitable for orchids' growth.	Orchid development can be directed as an export opportunity.
Orchids as ornamental plants have high economic value.	Digital marketing tools can be utilized to increase orchid sales.

The orchid diversity in Indonesia is one of the great potentials for orchid plant development. Indonesia's tropical climate is suitable for orchid cultivation, as this country has 23% of the total orchid species worldwide. Thus, the rich variety of orchids and the vast market opportunity to abroad buyers can be viewed as a great way to improve the domestic economy (Harniati & Jamil, 2020). Orchid plants have always been in the top five priority plants that are regularly monitored for their import and export values. However, one of the problems faced by orchid farmers so far is their inability to obtain uniform and high quality seeds (Solichatun et al., 2020).

Various orchids with high economic value include those from the genus *Dendrobium, Cattleya, Vanda, Oncidium, Phalaenopsis, Cymbidium, Grammatophyllum,* and *Paphiopedilum* (Anggraeni, 2022). The high variety of orchid species makes each of them has its own enthusiasts. For instance, *Dendrobium* is a genus whose demand continues to grow every year owing to its various colors and flower shapes. This is mainly thought to be due to the resistance of this genus when dealing with extreme environmental conditions, both hot and cold. In addition, its leaves that do not fall off easily are also favored by orchid cultivators, making it easier to pack the cut flowers that will be sent to buyers (Chika et al., 2021; Latif et al., 2020; Tikasari et al., 2023).

Generative propagation of orchids is considered difficult to carry out due to the low regeneration ability and long germination time of orchid seeds. This is mainly because orchid cultivation requires adequate basic knowledge and skills on plant propagation technology (Solichatun et al., 2020). In addition, the challenge faced when cultivating orchids is orchid conservation. The declining abundance of orchid

germplasm also makes it difficult for orchid farmers to carry out cultivation in a sustainable manner (Restanto et al., 2023).

Natural conditions that tend to be unstable can also cause scarcity of germplasm as a source of orchid diversity. Orchids that experience scarcity in nature will be difficult to obtain. For this reason, greenhouse technology has been widely used to overcome the changing nature conditions that can unfavorably affect plants' growth. Greenhouse is a specific building for plant cultivation with a translucent wall and roof structure so that sunlight can enter quite easily (Hidayah & Fatimah, 2023). Greenhouse is designed in a particular way so that plants' growth parameters, such as temperature, humidity, and light intensity can be regulated and controlled from inside the building. Beside greenhouse, another alternative is hydroponic, which allows the cultivators to control the environmental parameters and plant nutrition intake. This technique was applied by previous study (Hariyanto, 2023) to support agriculture practices as an effort to control climate change.

Many of the challenges pertaining to orchid cultivation usually arise from orchid business actors, namely farmers. Orchid farmers must master basic knowledge and skills to be able to perform orchid cultivation. For this reason, orchid farmer groups need to participate in counseling or training on orchid cultivation using materials they already owned or obtained from various sources. Through this training, the farmers are expected to acquire necessary knowledge and skills in orchid cultivation so that they can develop the quality of orchids to expand the marketing scope (Arobaya et al., 2021; Restanto et al., 2022). Further skill expected from this type of training is for the farmers to be able to recognize and protect threatened orchid species to support conservation effort (Arobaya et al., 2021).

Table 2. Aspirations and results of orchid cultivation in Indonesia.

Aspirations (A)	Results (R)
Regional conservation to protect threatened orchid species.	Orchid species are preserved in nature.
Utilizing the greenhouse facilities for orchid cultivation.	Orchid plants can be developed and benefit the community.
Training of orchid farmer groups in their own areas using their own materials.	Knowledge and skills of orchid farmer groups on orchid cultivation will increase.

In terms of time needed and yields resulted, orchid cultivation from the seeds using conventional technology in Indonesia is considered not competitive compared to the cultivation performed by other countries. For this reason, it is necessary to carry out orchid cultivation using advanced technological inputs, such as in vitro culture or tissue culture for orchid propagation (micropropagation) to germinate orchid seeds. Germination using tissue culture method will maintain the superior genotypes of the orchid species (Solichatun et al., 2020). In addition, as a useful effort in orchid conservation, tissue culture can be used to maintain orchid genotypes because the process of propagating orchids using this technique is able to produce many new seeds. Furthermore, in vitro culture technique is also highly suggested because the products can be resulted in a shorter duration with a very large quantity (Restanto et al., 2022).

The results of in vitro technique can make it easier for orchid farmers to reproduce the orchids again so that orchids in nature are not threatened.

The tissue culture process of orchid plants requires several stages that sometimes experience obstacles. For example, the maturity aspect of the fruits used in tissue culture greatly affects the results. Another more important factor in this technique is the difficulty to avoid contamination. In addition, tissue culture that uses seeds to produce orchid seedlings will usually result in non-uniform orchids' growth. This is certainly not a good material when it comes to meet the international criteria of commercial plants for export purpose. Therefore, it is necessary to grow orchids uniformly through in vitro vegetative propagation using root, stem, and leaf parts (Restanto et al., 2023).

Technology is constantly developing so that it can be used to improve the quality of orchids by forming new variations to produce the desired color, style, amount, and size. One of the methods commonly employed to produce new plant variations is plant genetic transformation, namely the use of bacterial species known as *Agrobacterium tumefaciens* to insert the functional genes into the genome of the target plant. This method is most commonly used to produce transgenic plants. For instance, researchers at the Faculty of Biology, Gadjah Mada University had performed a target genome editing using a technology known as CRISPR/Cas9 (Clustered Regularly Interspaced Short Palindromic Repeats) on *Phalaenopsis amabilis* orchids and successfully produced different plant colors between transformant *P. amabilis* and non-transformant *P. amabilis* (Kesuma et al., 2020).

Overall, the use of genetic engineering technology has not been widely practiced by orchid cultivators in Indonesia so that it is a challenge to be implemented. However, if this technology can be successfully applied in Indonesia, it will further increase the economic value of orchids because it can increase the variety of these ornamental plants that will attract more orchid enthusiasts from abroad.

CONCLUSIONS

The diversity of ornamental orchids in Indonesia is very valuable as a form of wealth of Indonesian orchid germplasm. Ideal climatic conditions in Indonesia for orchids' growth make these plants, such as the genus *Dendrobium*, superior commodities among many enthusiasts and collectors. The abundance of orchid species in Indonesia is one of the wealth of biodiversity, but its cultivation often faces several challenges in terms of generative propagation, germplasm conservation, and development. The knowledge and skill on orchid plants cultivation and development in Indonesia itself are still not yet evenly mastered among many orchid farmers as the cultivators. To overcome this obstacle, the use of advanced technology, such as tissue culture, has been introduced to orchid farmers through training so as to provide hope to improve the quality of orchid cultivation and conservation. In addition, another advanced technology, such as genetic engineering, also needs to be developed to optimize the potential of orchid cultivation that not only be able to support economic growth, but also orchid conservation.

ACKNOWLEDGMENT

The authors would like to thank the contributing parties from National Research and Innovation Agency (BRIN) of Yogyakarta region, which had helped in the writing and completion of this article.

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