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Case Study of Ex-situ Conservation Area Management Strategy at Indrokilo Botanical Garden Boyolali

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ABSTRACT. This study aims to determine the management and strategy of ecoedutourism in the ex-situ conservation area of the Indrokilo Boyolali Botanical Garden (KRIB), located in Mojosongo District, Boyolali Regency. Researcher's main reason of choosing this conservation area is because the existence of this garden takes strategic functions such as flora conservation, ecotourism, and education on middle-to-east Java which spreads widely and there are a variety of endemic flora. In concentration of conservation, KRIB has essential role from Indonesian Ministry of Environment to excavate endemic floras extensively and collect them effectively. This research used data collection method with a combination of primary and reference based, where the primary data was obtained from field observations and in-depth interviews, while the secondary data was obtained from literature study. The data were analyzed with qualitative technique descriptively. SWOT analysis is used to minimize weaknesses and threats and maximize strengths and opportunities. KRIB has strengths which primarily is an only botanical garden area in Central Java, has attractiveness and various supporting functions in accordance with the principles of sustainability, as well as its strategic location and easy access to the location. There are four strategy recommendations that is formulated with SWOT analysis, including SO, WO, ST, and WT strategies where it shows the important to developing an ecoedutourism management that highlight principles of sustainability in not only maximizing the potential and tourist attraction, but also paying attention to maintenance and conservation activities. However, all efforts to manage the conservation area of the Indrokilo Botanical Garden must be supported by all parties in order to successfully maintain the environmental sustainability.

Keywords: conservation, ecoedutourism, ex-situ, indrokilo botanical garden, management.

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1. Introduction

World developments and progress have an impact on the reduction of forests, land, and natural green areas which become the habitat of millions of floras and fauna within the framework of biodiversity (Bicknell et al, 2016). Hutton and Dickson (2000) describe that the massive hunting of illegal animals for one-sided interests has had a major impact on extinction. In addition, natural disasters and climate change are slowly eliminating life in nature, especially in the tropical rainforest biome. Understanding the role of biodiversity for the sake of survival, open and closed conservation efforts are a strategic choice to save the future (Krause and Farina, 2016). Efforts to preserve and preserve the integrity of the remaining flora and fauna are closely related to the ecological-environment where the biotic aspect is a balancer and connector to the natural cycles (Usher, 2013). Various human efforts related to conservation are generally divided into in-situ or in their original place, as well as ex-situ or natural reserves outside the habitat that are made in such a way that conditions are like in the wild (Supriatna, 2018). Conservation areas are protected by binding regulations, in Indonesia itself there is Law Number 5 of 1990 concerning "Konservasi Sumber Daya Alam Hayati dan Ekosistemnya", translated Conservation of Biological Natural Resources and Their Ecosystems. According to the regulation, conservation areas have two main functions, including the main function as an area for preserving the diversity of plants and animals and their ecosystems, as well as a protection area for life support systems.

The function of the conservation area outside of its main function is included in the field of education, namely ecotourism. Students and the general public are educated through a collection of plants and animals that are cared for and given an identity (Lalika et al, 2020). The purpose of the function of education is knowledge, awareness of the biological wealth in the country and cultivating related conservation together. The design of areas with green and natural principles can become environmental services in the form of providers and regulators of air quality (Rahayu et al, 2018). From a psychological point of view, the green area can function as a recreational forest or healing forest (Corazon et al, 2012). In view of Article 3 of Law No. 5 of 1990 which translated "Conservation of living natural resources and their ecosystems aims to achieve the preservation of living natural resources and the balance of their ecosystems so that they can better support efforts to improve community welfare and the quality of human life." This is justified because conservation has succeeded in maintaining the integrity of some biodiversity so that it does not collapse (collapse) and maintains ecosystem stability

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(Soultan et al, 2019). Humans also benefit from it, for example ecosystem nets in which there is a transfer of material and energy. However, beyond that all the roles of conservation are actually broader and general in nature, namely the sustainability of life (Field et al, 2020).

Conservation to protect species can be done in-situ (preservation of their habitat) and ex-situ (outside their habitat). However, over time, in-situ conservation is difficult to rely on because the original habitats of various species have been damaged by exploitation, land conversion, and anthropogenic activities, so ex-situ conservation or outside their habitat is the best alternative to implement, where one the most common form of ex-situ conservation of plants is Botanical Gardens (Warseno, 2015). Wyse and Shuterland (2000) stated that the Botanical Garden is an institution where various collections of plants and other living things are documented for the purpose of scientific research, conservation, exhibition, and education. Botanical Gardens as an ex-situ conservation area in accordance with Article 5 of Presidential Regulation No. 93 of 2011, cannot be converted, so it is hoped that the vegetation cover in the form of collections in botanical gardens will still be guaranteed for its sustainability (Purnomo et al, 2015).

One of the largest conservation areas in Central Java is the Indrokilo Boyolali Botanical Garden or Kebun Raya Indrokilo Boyolali (KRIB). Indrokilo Botanical Garden is located in Kemiri Village, Mojosongo District, Boyolali Regency. The planning for the development of the Indrokilo Botanical Garden was initiated in 2015 and continued its development until it was officially opened in 2019 and continues to this day. KRIB is also an eco-tourism area, which is a tourism development that pays attention to natural rules by implementing integrated development and conservation programs (Fitriyani, 2015). KRIB also has multi functions including conservation, environmental services, research, education, and ecotourism. Researcher's main reason of choosing this conservation area is because the existence of this garden takes strategic functions such as in flora conservation, ecotourism, and education on middle-to-east Java which spreads widely and there are a variety of endemic flora. In concentration of conservation, KRIB has essential role from Indonesian Ministry of Environment to excavate endemic floras extensively and collect them effectively. The other reason is KRIB has huge challenge in order to fight against treats alike climate change and biodiversity collapse, which must be concerned seriously by all the stake holders.

Botanical gardens as nature conservation areas have an important role in supporting eco-tourism management and plant conservation efforts. The botanical garden area is included as a source of information to be able to study the characteristics of plants and their habitats to the management of plant conservation. The existence of a botanical garden also plays a very important role in providing education about conservation and environmental education for the community (Lalika et al, 2020). Management of botanical gardens which also provides economic value, education, and tourism is very important and has the potential to add insight in understanding nature conservation. Therefore, this study aims to determine the management and strategy of ecoedutourism in the ex-situ conservation area of the Indrokilo Boyolali Botanical Gardens.

2. Materials and Methods

2.1 Research Time and Location

This research was conducted approximately 3 months from May to July 2022. This research was carried out objectively from 17 to 18 May 2022, but effectively flexible to be carried out on 17 May to July 2022. The object of the research studied was the Indrokilo Boyolali Botanical Garden (KRIB) conservation area which located in Mojosongo District, Boyolali Regency, Central Java.

Fig. 1 Research Location in Indrokilo Botanical Garden Boyolali.

2.2 Procedures

The tools used in the following research include writing instruments, digital cameras or cellphones for documenting and recording interviews, and PCs (Personal Computers) for processing data. Materials needed include tally sheets, paper, maps or location plans, Indrokilo Boyolali Botanical Gardens as research objects, and documents related to the research location. This research used a data collection method with a combination of primary and reference based. The primary data is carried out from survey or field observation and interviews. Interview is one of the data collection techniques in the form of communication between two or more parties face to face, with one party acting as the interviewer (asker) and the other party as interviewee (answerer) with a specific purpose (Fadhalah, 2020). Sources of information from the interviews came from informants from the management of the Indrokilo Boyolali Botanical Gardens as stakeholders or managers who have responsibility for conservation management activities at the Indrokilo Boyolali Botanical Gardens, namely Mrs. Lilik Tri Wahyuni, S.Hut as Head of Technical implementation Unit or Unit Pelaksana Teknis (UPT) Management of Indrokilo Boyolali Botanical Garden and Mr. Yunus Puratmoko S.P. as Management in charge of the Indrokilo Boyolali Botanical Garden Collection. The interview technique carried out is a semi-structured interview which is a type of in-depth interview with the aim of finding problems more deeply with exploration in interviews that give researchers the opportunity to add questions that have been asked or formulated previously (Sugiyono, 2012). In this type of interview, the researcher can improvise from the questions that have been prepared so that the answers from the informants can be more explored. The interviews conducted in the following research were also formulated in the form of open-ended questions.

Fig. 2 Interview Data Collection.

The working procedure of the following research is carried out starting from the literature study stage which is carried out to collect information and determine the topic and location of the research to be studied. Then, proceed with the stages of problem identification and research planning to prepare research design concepts and field data collection. Field data collection was carried out to collect primary data and secondary data. Primary data is data taken directly from data sources, in the following research it comes from the results of field survey observations, documentation, and interviews. In addition, there is secondary data which is data that is not obtained directly, in the following research obtained from various references and literature studies in the form of books, journals, internal documents, and so on. After collecting field data and the required data have been collected, data analysis and discussion of the results are carried out. Furthermore, from the results of the existing analysis, strategies and recommendations are formulated. After that, conclusions are drawn at the end. The stages of the following research work can be described further according to the diagram shown in Figure 3.

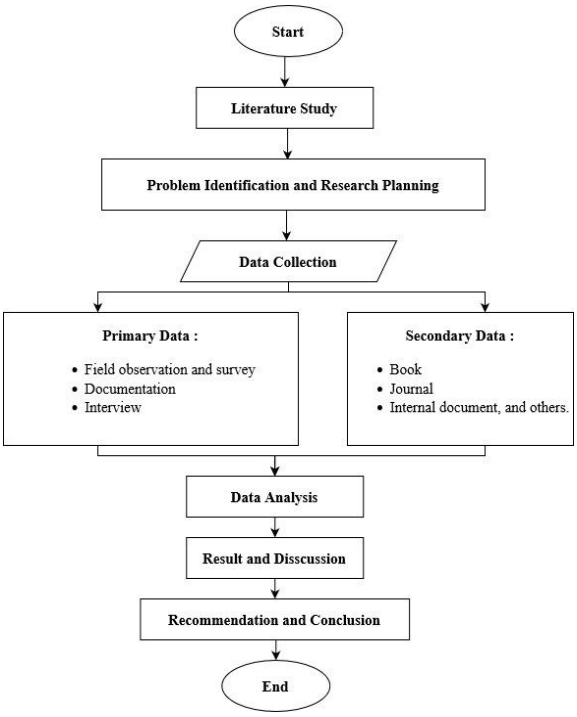

Fig. 3 Flowchart Diagram of Research Procedures

2.3 Data Analysis

In qualitative research, data collection is carried out in natural settings (natural conditions), where primary data sources and data collection are mostly from field observations and participant observations, in-depth interviews, and documentation studies (Sugiyono, 2017). In this research, the primary data were obtained from field observation surveys of KRIB area and interviews with the management of the botanical gardens. Primary data also obtained in the form of documentation and information record about the Botanical Gardens Indrokilo Boyolali conservation area, the management system, and conservation efforts that carried out by the botanical garden managers. The secondary data is obtained in the form of data from the official website of the Indrokilo Boyolali Botanical Garden and literature studies, as well as from various references from journals, books, articles, and so on. Data analysis technique used in this research is a qualitative technique. The data analysis method is a procedure in reviewing the results of data collection, where in qualitative research, starting from a preliminary study as an analysis material for the results of data collection, then it is continued at the data reduction stage to make it easier to analyze (Handayani et al, 2022). In addition, strategy formulation using SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis is carried out, where this analysis is based on confidence in the assumption that an effective strategy will be able to maximize strengths and exploit opportunities and at the same time be able to maximize weaknesses and minimize various threats (Astuti, 2016). The use of this SWOT matrix was chosen as a tool to develop organizational strategic factors that can clearly describe how external opportunities and threats are faced so that they can be adjusted to the strengths and weaknesses within the organization (Fatimah, 2020).

3. Result and Discussion

3.1 Indrokilo Boyolali Botanical Garden Overview

Indrokilo Boyolali Botanical Garden is an ex-situ conservation area in the form of a Botanical Garden located in Kemiri Village, Mojosongo District, Boyolali Regency, Central Java Province with an altitude between 275-300 meters above sea level (masl). Budiharta et al (2020) stated that the construction of the Indrokilo Boyolali Botanical Garden originated from the collaboration between the Indonesian Institute of Sciences (LIPI) and the Boyolali Regency Government since 2013 through a Memorandum of Understanding (MoU) No. 016/KS/LIPI/VII/2013 and No. 650/03286/28/2013 concerning Research, Development, and Utilization of Science and Technology. The MoU contains development agreements, one of which is the construction of the Botanical Gardens in Boyolali. The Indrokilo Boyolali Botanical Garden area was initiated by the Boyolali Regency Government in 2015 from a proposal by the Regent Seno Samodro to the Head of LIPI through letter Number 660.1/03446/28/2015 regarding the Botanical Garden Development Plan. This commitment was then continued with the construction and development of the Indrokilo Boyolali Botanical Garden until it was officially launched on May 3, 2019.

Indrokilo Boyolali Botanical Garden was established with the theme "East Java Lowland Rainforest Plants". KRIB has a plant icon in the form of *'trenggulun'* (*Protium javanicum*) which is a tree from the Bursaceae family which is quite

commonly found in Java, Indonesia. Protium javanicum or also known by the local name "*Kayu Bawang*" or "*Kayu Pahit*'' is commonly used to make tables, furniture, and outer walls because of its durability and is also traditionally used in traditional medicine as an anti-inflammatory (Ahujaa et al, 2019). Based on Boyolali Environmental Service Agency or *Dinas Lingkungan Hidup* (DLH) and LIPI (2019), the aims of the establishment of the Indrokilo Boyolali Botanical Garden are, among others, to conserve various types of plants and their ecosystems that are important for human life, especially plant species according to the theme of the Botanical Gardens; provide educational support facilities and infrastructure for students and students; provide research facilities in the field of plant conservation and utilization; support environmental management in the region; provide recreational facilities that are healthy, comfortable and of educational value; and improve the local economy.

Quoted from the Indrokilo Boyolali Botanical Garden website (2022), KRIB has a vision to become the world's leading botanical garden in the field of plant conservation in the lowland rain forests of eastern Java. In addition, the mission of the KRIB in order to achieve the vision that has been set is as follows:

1. Strengthening the concept of plantations in the management of plant collections;
2. Increase the quantity and collection of plants, especially local, endemic, rare and economic potential species;
3. Provide research facilities in the field of plant conservation in accordance with predetermined themes;
4. Develop environmental education to increase public awareness;
5. Providing tourism facilities that are healthy, comfortable, and of educational value;
6. Provide an impact on improving the quality of the environment around the botanical gardens, which includes aspects of water management, biodiversity, carbon sequestration, and landscape beauty as well as socio-economic impacts;
7. Strengthening cooperation networks with botanical gardens and conservation institutions at home and abroad; and
8. Strengthen the institutional system.

Indrokilo Boyolali Botanical Garden is currently managed by the Technical Implementation or *Unit Pelaksana Teknis* (UPT) of Indrokilo Boyolali Botanical Garden which is a work unit equivalent to Echelon IV which operates under the auspices of the Boyolali Environmental Service Agency or *Dinas Lingkungan Hidup* (DLH) and the Boyolali Regent. The operational implementation of daily activities at the Indrokilo Boyolali Botanical Garden is supported by several other work units, including the administration unit, registration unit, nursery unit, and collection unit. In addition, there are officers in the technical field, cleanliness, security, as well as services and information. Human Resources (HR) from UPT KRIB currently number 20 people consisting of 19 non-PNS employees (Civil Servants) and 1 PNS (Budiharta et al, 2020). The management structure of UPT Indrokilo Boyolali Botanical Garden in 2022 can be shown in Figure 4.

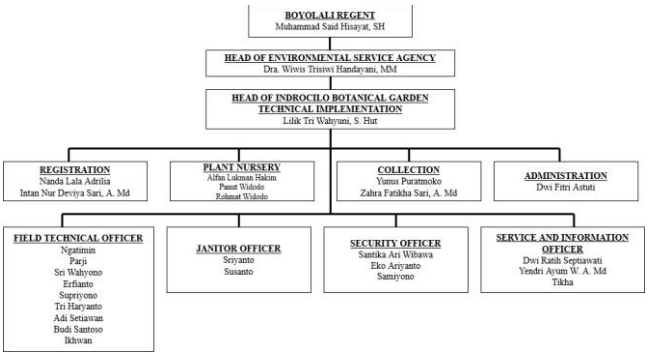

Fig. 4 Indrokilo Boyolali Raya Botanical Garden Management Structure

The location of the Indrokilo Botanical Garden was originally an open space used by the surrounding community for the cultivation of various kinds of food crops, horticulture, and plantations (Budiharta et al, 2022). The Indrokilo Botanical Garden area has an area of 8.9 hectares with the location plan of the KRIB and its descriptions can be shown in Figure 5. The Indrokilo Boyolali Botanical Garden is currently divided into nine (9) thematic parks, which are named after Javanese Wayang figures. Thematic parks contained in KRIB include the following thematic gardens.

1. Arjuna (Local Fruit), is a thematic garden with a collection of local fruit plants. Existing local fruit plants such as tamarind (*Tamarindus indica*), mulwo fruit (*Annona reticulata*), and mundu (*Garcinia dulcis*).
2. Sadewa (*Pangkas*), is a thematic garden with a collection of pruning plants. The existing pruning plants include bonsai, tea or *teh-tehan* (*Acalypha siamensis*), and *sinyo nakal* plant (*Duranta erecta* L.).
3. Nakula (Medicine), is a thematic garden with a collection of medicinal plants. Existing medicinal plants include the pacing plant (*Coctus spiralis*), the *noni* plant (*Morinda citrifolia L.*), and the ferocious plant (*Premna serratifolia* L.) which contain antioxidants in every part.
4. Madrim (Bamboo), is a thematic garden with a collection of bamboo plants. The existing bamboo plants include thorns or reeds (*Bambusa blumeana*), apus or rope bamboo (*Gigantochloa apus*), and yellow bamboo (B*ambusa vulgaris* var. *striata*).
5. Abiyasa (Ferns), is a thematic garden with a collection of ferns. The existing ferns include Elephant Ferns (*Osmunda japonica*), Rane Ferns (Selaginella), Nephrolepis, and others.
6. Kunti (Grapes), is a thematic garden with a collection of vines. The existing vines include bridal tear plant *(Antigonon leptopus* Hook. & Arn.), betel plant (P. betle), and various tiger nail flowers (*Mucuna bennettii* F. Muell).
7. Bima (Soil and Water Conservation), is a thematic park for the collection of plants that play a role in soil and water conservation, such as the banyan tree (*Ficus benjamina*) and the Angsana tree or sonokembang (*Pterocarpus indicus*).
8. Yudhistira (Honorary Collection), is a thematic garden with a collection of honorary plants. Plants of honor that exist include the Gayam *(Inocarpus fagifer (Parkinson) Fosberg*) and lerak (*Sapindus rarak* DC).

Pandu (Ornamental Plants), is a thematic garden with a collection of ornamental plants. The existing ornamental plants or guesthouses include a collection of orchids, Dendrobium

capra orchids, Allamanda (*Allamanda cathartica*), frangipani plants (*Plumeria* sp.), and others.

Fig. 5 Indrokilo Boyolali Raya Botanical Garden Plan Map

3.2 The Function of Ecoedutorism in the Indrokilo Boyolali Botanical Garden

This research was conducted approximately 3 months from May to July 2022 and was carried out objectively from 17 to 18 May 2022, but effectively flexible to be carried out on 17 May to July 2022. The object of the research studied was the Indrokilo Boyolali Botanical Garden (KRIB) conservation area which is located in Mojosongo District, Boyolali Regency, Central Java. Until now, the number of collections that have been embedded in the Indrokilo Botanical Garden has reached 1,683 specimens, 368 species, 267 genera, and 105 tribes. Based on the KRIB website (2022), the Indrokilo Botanical Garden currently has 7 main building icons that characterize it as an eco-tourism area, including the following.

1. Passingsingan Gate, is a welcome gateway monument to the Indrokilo Boyolali Botanical Garden inspired by the Chiang Kai Shek Memorial Hall monument building in Taipei, Taiwan. This gate is made with a height of 12 meters and a width of 25 meters. The name Pasingsingan itself is taken from the story character *Nagasasra Sabuk Inten* by S. H. Mintarja who is described as a virtuous helper, but never introduces his real face because he always wears a mask. In addition, the Pasingsingan gate has a relief depicting learning activities in the open.
2. Niagara Falls, is a miniature replica of Niagara Falls from the United States with a height of 7 meters and a width of 34 meters. This artificial waterfall is accommodated in a small pond located at the bottom of the cliff and then when the pool overflows, the water will flow into the *Segoro Alit Embung.*

Fig. 6 Indrokilo Boyolali Raya Botanical Garden Icons
(1: Pasingsingan Gate, 2: Niagara Falls)

3. Labyrinth Gardens are labyrinthine alleys formed by winding plants trimmed with topiary art (the art of trimming or sculpting plants). The Labyrinth Park at KRIB has a concept in the form of a puppet mountain which has a symbolic meaning as the unity of the Indonesian nation. In addition, there is a Viewing Point which is a high tower building that is used to monitor the situation in the Labyrinth Park.

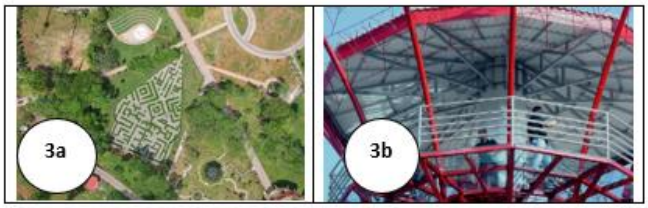

Fig. 7 Indrokilo Boyolali Raya Botanical Garden Icons
(3a: Labyrinth Gardens, 3b: Viewing Point)

4. Ferns Garden, is one of the thematic gardens in KRIB which stores various collections of ferns (Pteridophyta) and is divided into two places, namely the outdoor and indoor sections. The placement of these ferns is based on the order of their evolutionary level, where there are common to rare ferns.
5. Features Painting Pond (Noah's Ark), is a replica of Noah's Ark which is equipped with statues of paired animals that come out of the ark. Inside this building will be equipped with paintings painted by expert artists from various regions.

Fig. 8 Indrokilo Boyolali Raya Botanical Garden Icons
(4: Ferns Garden, 5: Features Painting Pond/Noah's Ark)

6. Ecological House (e-House), is the management office of the Indrokilo Boyolali Botanical Garden, where behind this building there is also an EBU building. EBU is Elektrolisa Banyu Udan (Rainwater Electrolysis), a building that uses technology and equipment to treat rainwater into ready-to-drink water. Before being treated, the rainwater is first collected on the roof of the Ecological House and then the rainwater will be filtered and electrolyzed in the EBU room to produce acidic and alkaline water.
7. The statue of Sosro Birowo, is a 17-meter-high statue of a powerful magic figure in the Nagasasra Sabuk Inten story from a man named Mahesa Jenar, a former

soldier guarding the king who was very tough and strong. When desired, Mahesa Jenar is said to be able to split a rock the size of a buffalo's head using only his hands.

Fig. 9 Indrokilo Boyolali Raya Botanical Garden Icons
(6: Ecological House, 7: Sosro Birowo Statue)

3.3 The Function of Ecoedutorism in the Indrokilo Boyolali Botanical Gardens

Specific to the object of research, namely the Botanical Gardens Indrokilo Boyolali (KRIB – Indrokilo Botanical Garden), has multiple functions within the framework of ecoedutourism, including the functions of conservation, education, tourism, economy, and community participation. Since the beginning of development planning, every vital infrastructure is designed and strategically placed to facilitate visitor access while maintaining the role of conservation. As an area that focuses on preserving the endemic flora of Central and Eastern Java, KRIB provides a place for learning for visitors from all over the world which is published through web pages and other social media (Interview, 2022). The results of the analysis and observations of researchers regarding the function of the KRIB are described below:

1) Conservation Function

Of all the existing vegetation, there is a mapping based on the types of plants called thematic gardens according to the names of Javanese puppet characters including: local fruit (Arjuna), pruning (Sadewa), medicine (Nakula), bamboo (Madrim), nails (Abiyasa), vines (Kunti), soil and water conservation (Bima), honorary collections (Yudhisthira), and guesthouses or ornamental plants (Pandu). In each of the thematic parks above, there is integrated information through digital use in the form of a QR code. By scanning the code, information about the plant in question will appear. In general, each plant has been grown since it was still a sprout, but some are grown by means of transfer. The problem in this conservation effort is that plants that are moved when they are adults are vulnerable to death or collapse because their taproots have not spread properly. In the Bima Thematic Park there is an auxiliary installation that processes groundwater into ready-to-drink water which is distributed at strategic points, but when the researchers visited the water did not flow. Another problem is that on the north side of the KRIB area it is directly adjacent to a textile factory which produces noise pollution and heat that can be felt by visitors at certain times.

2) Education Function

Through web sites and social media, all visitors can get all information related to the history, collections, and galleries of conservation plants at KRIB. Then when visiting the location there is a guide facility that explains all information related to conservation efforts at KRIB, including details of each species. If needed for research or scientific projects, the manager provides support in the form of access to documents related to data collection for each species. With publications related to KRIB, it can optimize the function of education that educates the wider community regarding the conservation of endemic plants in the central to eastern part of Java.

3) Tourism Function

Each visitor can travel to KRIB by paying a fee of Rp 5,500,00 KRIB has 7 main building icons that characterize it as an eco-tourism area ana attract tourists. In order to facilitate access, the manager of KRIB provides a large parking area, environmentally friendly vehicles, wide road access, route instructions, to other facilities such as mosques and toilets that researchers value well. The ecological and aesthetic conditions of the KRIB which are supported by good facilities make it ideal for being a tourist destination.

4) Economic Function

Although it is not targeted to be the main source of income for the Boyolali Regency Government, the existence of KRIB can spearhead the opening of tourism in Boyolali. The location of KRIB is accessible, which is not far from the main road of Surakarta – Semarang and the Trans Java toll road makes KRIB strategic to attract potential visitors. With the support of kiosk facilities in the front yard of the gate, it can become a livelihood for sellers of food, souvenirs, and others.

5) Community Participation Function

Because the location of the KRIB conservation area is close to the settlements and plantations of residents, the community both around and outside the area can take advantage of the KRIB as a helper in raising the economic and ecological level. Although the community is not allowed to freely intervene in conservation management, the community's efforts by maintaining the cleanliness and preservation of the environment around the KRIB can help to succeed in conservation in the internal area of the KRIB.

3.4 Ecoedutourism Management Strategies and Recommendations at Indrokilo Boyolali Botanical Garden

In managing ecoedutourism on the Indrokilo Botanical Garden, an effort or strategy is needed to succeed the development. To achieve certain goals, there are several efforts or methods that can be chosen, one of which is the use of SWOT analysis. SWOT analysis is the identification of several factors systematically in order to formulate a strategy in the activity plan. This method or method is included in the basic strategic plan method. With this analysis, it can better describe and provide a general view and strategy to be chosen (Wahyuni et al, 2015). SWOT analysis is able to minimize weaknesses and threats and can maximize strengths and opportunities.

Based on the observation/survey and interview in the location, the internal and external factors of Indrokilo Botanical Garden conservation area can be identified. Internal factors consist of Strengths (S) and Weaknesses (W), while external factors consist of Opportunities (O,) and Threats (T). From the existing internal and external factors, strategies are formulated in the form of Strengths-Opportunities (SO), Weaknesses-Opportunities (WO), Strengths-Threats (ST), and Weaknesses-Threats (WT) strategies. The results of the analysis and formulation of these strategies can be seen in the matrix in table 1.

Table 1
Internal and External Factors in SWOT Analysis of Indrokilo Botanical Garden

	Strenghts (S)	**Weaknesses (W)**
Internal Factors	a. Indrokilo Boyolali Botanical Garden is the only botanical garden location in Central Java Province b. In addition to having a conservation function, it also has a recreation, education, research, and environmental service functions c. Attractions or interesting tourist spots in the form of 7 building icons d. Has 9 thematic parks that have the concept of preserving flora, and cultural values e. Ease of accessibility, strategic location in the city center, and affordable travel costs	a. Limited Human Resources b. Inadequate or operating facilities and infrastructure, such as the TIC (Tourism Information Center) building which should be operated and used as a display of product information and souvenirs c. Problems in conservation activities, such as mistakes in the initial planting that were not planted from seeds so the plant roots did not grow strong/couldn't adapt for long time, maintenance constraints where several types of plants were damaged/died, and others d. Affected by the Covid-19 pandemic, such as obstacles in exploration activities for new species that have not been carried out as usual, locations that are few of visitors e. Promotional activities that are still low.
	Opportunities (O)	**Treaths (T)**
External Factors	a. Promote economic growth and increase income b. Can create jobs and local community participation c. Become a place to introduce the potential of local flora and fauna and regional culture to the public d. The emergence of unique/distinctive processed products e. Encouraging the development of sustainable tourism	a. Competition with other attractions in Boyolali b. Prone to plants damage by tourists and certain elements c. Prone to environmental pollution because of tourism activity d. Prone to dirty area because of tourism activity e. Development of tourism can damage environmental sustainability

Table 2
SWOT Analysis Strategies of Indrokilo Botanical Garden

Strategies	
Strategy (SO)	**Strategy (WO)**
a. Maximizing the potential and tourist attraction in the KRIB area b. Develop tourism facilities that are as environmentally friendly as possible by saving the use of natural resources, using environmentally friendly energy, and appropriate technology c. Developing an ecoedutourism management system with multi-stakeholder collaboration d. Increase financial support from the central government as well as donations or other collaborations related to the preservation of natural resources and the KRIB conservation area	a. Increase the number of sufficient workforces by involving local communities and providing training to improve the quality of human resources b. Running facilities and infrastructure that are not yet running by bringing up innovations and unique/regional products c. Increase attractive promotional activities both through online media such as the internet, websites, social media, as well as print or offline media such as brochures, leaflets, banners, magazines, newspapers, and others to attract visitors widely d. Pay more attention to the implementation of monitoring and evaluation on plant maintenance conservation activities
Strategy (ST)	**Strategy (WT)**
a. The development and utilization of natural resources in KRIB must pay attention to the principle of sustainability b. Provision of cleaning support facilities, such as trash cans and cleaning tools c. Provision of socialization and education to the public and tourists to maintain cleanliness and environmental sustainability in the KRIB area d. Installation of signs and posters to raise public awareness and as an invitation to preserve the area and prohibition to damage the environment	a. Improve coordination and cooperation with communities, managers, academics, and the government in the development of KRIB and the implementation of various management-related activities b. Establish a security officer and optimizing security post guard including a system of officers who routinely monitor the KRIB area from environmental damage or crime act c. Continue to maintain cleanliness, maintenance of infrastructure, and environmental sustainability d. Optimizing and increasing promotional activities by highlighting tourist attractions

The results of the SWOT analysis show that KRIB has strengths mainly being the unique botanical garden area in Central Java Province that has attractiveness and various supporting functions, in accordance with the principles of sustainability, as well as its strategic location and easy access to the location. The analysis of strategy recommendation shows that the SO strategies to maximize the strengths and opportunities, the management of KRIB should be maximize the potential and tourist attraction in the KRIB area, developing environmentally friendly facilities, collaborating with multi-stakeholder, and increasing the financial support. The WO strategies to take advantage of opportunities to minimize weaknesses is to increase the number of human resources and providing training to improve the quality, running the un-running facilities/infrastructures by bringing up unique innovations, increasing attractive promotional activities, and paying more attention to maintenance of conservation activities. The ST strategies that based on maximizing strengths to overcome threats can be done by developing and utilizing natural resources in KRIB with sustainability principle,

provisioning cleaning support facilities, and installation of signs and posters to raise public awareness to preserve KRIB area and prohibition to damage the environment. The last, WT strategies that is determined by minimizing weaknesses and avoiding threats can be done by improving the coordination and cooperation with the government, stakeholders, and local communities, establishing and optimizing security system to routinely monitor the KRIB area, maintaining cleanliness and environmental sustainability, and optimizing promotional activities.

Hidayat et al (2019) stated that conservation strategies also can be done by implementing conservation policies such as making long-term references by reducing illegal logging activities, taking firm action against encroachment on conservation areas, improving the management and utilization of natural resources in botanical gardens including essential ecosystems, and improve conservation area management institutions (UPT). Then, continue to implement programs, activities, and performance indicators in order to achieve the objectives of implementing the development and management of biological resources and their ecosystems. The program can be carried out with biodiversity conservation and forest protection with the aim of realizing the conservation management of the Indrokilo Botanical Garden to increase so that it becomes an area and habitat for existing species. In this way, the biodiversity and ecosystem of the Indrokilo Botanical Garden will increase in ecosystem function and become an area with ecoedutourism. However, all efforts to manage eco-tourism in the conservation area of the Indrokilo Botanical Garden must of course be supported by all groups, including the Boyolali community, the Forestry Service, and NGO groups related to forest conservation areas in order to maintain the sustainability and sustainable function of biodiversity.

4. Conclusion

Indrokilo Boyolali Botanical Garden is an ex-situ conservation area in the form of a Botanical Garden located in Kemiri Village, Mojosongo District, Boyolali Regency, Central Java Province. This botanical garden was established with the theme "East Java Lowland Rainforest Plants". The management of the conservation area at the Indrokilo Boyolali Botanical Garden is based on ecological principles and has multiple functions, including the functions of conservation, education, tourism, economy, and community participation. The results of the SWOT analysis show that KRIB has strengths which primarily is a unique botanical garden area that has attractiveness and various supporting functions in accordance with the principles of sustainability, as well as its strategic location and easy access to the location. There are four strategy recommendations that is formulated with SWOT, such as SO strategies to maximize the strengths and opportunities, WO strategies to take advantage of opportunities to minimize weaknesses, ST strategies that based on maximizing strengths to overcome threats, and WT strategies that is determined by minimizing weaknesses and avoiding threats. To summarize the strategies, it is important to developing an ecoedutourism management that highlight principle of sustainability in not only maximizing the potential and tourist attraction, but also paying attention to maintenance and conservation activities. However, all efforts to manage the conservation area of the Indrokilo Botanical Garden must be supported by all parties in order to successfully maintain the environmental sustainability.

References

Ahujaa, A., M. Kim, and J. Y. Cho. (2019). *Protium javanicum Burm*. Methanol Extract Attenuates LPS-Induced Inflammatory Activities in Macrophage-Like RAW264.7 Cells. *Hindawi: Evidence-Based Complementary and Alternative Medicine*. 1-13.

Astuti, N. N. S. Strategi Pengembangan Potensi Desa Mengesta sebagai Desa Wisata Berbasis Ekowisata. (2017). *Soshum Jurnal Sosial Dan Humaniora.* 6(1):113-122.

Bicknell, A. W., Godley, B. J., Sheehan, E. V., Votier, S. C., and Witt, M. J. (2016). Camera Technology for Monitoring Marine Biodiversity and Human Impact. *Frontiers in Ecology and the Environment*. 14(8): 424-432.

Budiharta, S., Solikin, Puratmoko, Y., Listyono, B., dan Suprapto A. (2020). Kebun Raya Indrokilo Boyolali: Konservasi Ex-Situ Hutan Hujan Dataran Rendah Jawa Bagian Timur. *Warta Kebun Raya Edisi Khusus.* 18 (2) :56-70.

Corazon, S. S., Stigsdotter, U. K., Moeller, M. S., and Rasmussen, S. M. (2012). Nature As Therapist: Integrating Permaculture with Mindfulness-And Acceptance-Based Therapy in the Danish Healing Forest Garden Nacadia. *European Journal of Psychotherapy & Counselling*. 14(4): 335-347.

DLH Kabupaten Boyolali and LIPI. (2019). *Buku Refleksi 4 Tahun Pembangunan Kebun Raya Indrokilo Boyolali (2015-2019).* Boyolali, Pemerintah Boyolali.

Fadhallah, R. A. (2020). *Wawancara*. Jakarta, UNJ Press.

Fatimah, N. D. W. (2020). *Teknik Analisis SWOT: Menyusun Strategi yang Efektif dan Efisien serta Cara Mengelola Kekuatan dan Ancaman.* Yogyakarta: Penerbit Anak Hebat Indonesia.

Field, K. J., Daniell, T., Johnson, D., and Helgason, T. (2020). Mycorrhizas for a Changing World: Sustainability, Conservation, and Society. *Plants, People, Planet*. 2(2): 98-103.

Fitriyani. (2015). Peran Pemuda dalam Mengembangkan Eco Edu Wisata Mangrove dan Implikasinya Terhadap Ketahanan Lingkungan Daerah'. *Jurnal Ketahanan Nasional*. 21(2): 128-141.

Handayani, K., Y. Sulistyadi, and B. Hasibuan. (2022). Optimalisasi Implementasi Prinsip-Prinsip Ekowisata Berbasis Masyarakat di Pulau Wangiwangi. *Seminar Nasional Pariwisata dan Kewirausahaan (SNPK)*. 1:7-29.

Hidayat, S., A. P. Rumengan, S. Darwisito, M. Ompi, W. M. Mingkid, B. Th. Wagey, and C. P. Paruntu. (2019). Studi Perumusan Strategi Pengelolaan Ekowisata Bahari Kota Manado di era Revolusi Industri 4.0 Berdasarkan Analisis SWOT. *Jurnal Pesisir dan Laut Tropis.* 7(3): 142-156.

Hutton J., and Dickson B. (eds.). (2000). *Endangered Species, Threatened Convention: The Past, Present and Future of CITES*. London: Earthscan Publications.

Indonesia. (1990). Undang-undang Nomor 5 Tahun 1990 tentang Konservasi Sumber Daya Alam Hayati dan Ekosistemnya.

Krause, B. and Farina, A. (2016). Using Ecoacoustic Methods to Survey the Impacts of Climate Change on Biodiversity. *Biological Conservation*. 195(1): 245-254.

Lalika, H. B., S. Herwanti, I. G. Febryano, and G. D. Winarno. (2020). Persepsi Pengunjung Terhadap Pengembangan Ekowisata di Kebun Raya Liwa. *Jurnal Belantara*. 3(1): 25-31.

Pemerintah Boyolali. 2022. http://kebunrayaindrokilo.boyolali.go.id/ [accessed at 18th July 2022].

Purnomo, D. W., H. Helmanto, and A. Yudaputra. (2015). Peran Kebun Raya Indonesia dalam Upaya Konservasi Tumbuhan dan Penurunan Emisi Karbon. *Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia.* 1(1): 66-70.

Rahayu, S., Widayati, W., and Indriasary, A. (2018). Pemetaan Komponen Ekosistem Untuk Pengembangan Edu-Ekowisata (Studi Kasus: Kebun Raya Universitas Halu Oleo). *Jurnal Geografi Aplikasi dan Teknologi*. 2(1): 33-40.

Soultan, A., Wikelski, M., and Safi, K. (2019). Risk of Biodiversity Collapse Under Climate Change in The Afro-Arabian Region. *Scientific reports*. 9(1): 1-12.

Sugiyono. (2012). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D.* Bandung, Alfabeta.

Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D.* Bandung, Alfabeta.

Supriatna, J. (2018). *Konservasi Biodiversitas: Teori dan Praktik di*

Indonesia. Jakarta: Yayasan Pustaka Obor Indonesia.

Usher, M. B. (2013). *Biological management and conservation: Ecological theory, application and planning*. Springer.

Wahyuni, S., B. Sulardiono, and B. Hendrarto. (2015). Strategi Pengembangan Ekowisata Mangrove Wonorejo, Kecamatan Rungkut Surabaya. *Diponegoro Journal of Maquares.* 4(4): 66-70.

Warseno, T. (2015). Konservasi Ex Situ Secara In Vitro Jenis-Jenis Tumbuhan Langka dan Kritis di Kebun Raya "Eka Karya" Bali. *Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia*. 1(5): 1075-1082.

Wyse P.S.J. and L. A, Sutherland, L.A. (2000). *International Agenda for Botanic Gardens in Conservation.* Botanic Gardens Conservation International, U.K.

https://travel.kompas.com/read/2019/05/16/090300527/7-ikon-kebun-raya-indrokilo-boyolali-ada-air-terjun-niagara-?page=all [accessed at 30th July 2022].