Integration of Educational and Conservative Landscapes: Designing a Biology Department Garden for Local Biodiversity Conservation

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ABSTRACT

Purpose of the study: This study aims to design a Local Biodiversity Conservation Garden in the Biology Department, evaluate changes in community appreciation after the garden redesign, compare the richness of local and exotic plant species, and identify plant species with the largest canopy cover to support ecological and aesthetic functions.

Methodology: Field observation, vegetation inventory, questionnaire survey, canopy cover analysis, species classification based on regional distribution references, manual garden design sketching and scanning, descriptive quantitative analysis. Tools used included measuring tape, lux meter, plant identification references, questionnaire forms, digital scanner, statistical analysis software, and biodiversity documentation records.

Main Findings: The redesigned conservation garden significantly improved aesthetic appreciation among Biology Department community members. Plant species richness increased substantially, with local species dominating over exotic species. Community perception shifted positively toward the reorganized garden. Vegetation stratification showed clear ecological structuring, while canopy analysis identified dominant species contributing most to shade formation and microclimate regulation within the conservation area.

Novelty/Originality of this study: This study introduces an integrated campus garden design model that combines biodiversity conservation, ecological restoration, and landscape aesthetics using predominantly local plant species. It advances existing knowledge by demonstrating how academic green spaces can function simultaneously as conservation areas, educational laboratories, and ecological infrastructure supporting biodiversity enhancement within higher education institutions.

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1. INTRODUCTION

Local biodiversity is an ecological asset that plays a crucial role in maintaining environmental balance and supporting ecosystem sustainability in various regions [1], [2]. Indonesia, as a mega-biodiversity country, boasts an abundance of flora, including local plant species with the potential to be developed as conservation and educational resources. However, development pressures, land-use changes, and the dominance of introduced plants in green open spaces have increasingly marginalized local species [3], [4]. This situation demands area-based conservation efforts that can be integrated with education and research functions. One implementation approach is the development of conservation parks within higher education institutions [5], [6].

Universities have a strategic role in supporting biodiversity conservation by providing ecologically planned green open spaces. Campus areas serve not only as centers of academic activity but also as natural laboratories for learning and research [7], [8]. The Biology Department, as an academic unit focused on the study of living organisms, has a moral and scientific responsibility to sustainably manage the campus environment [9], [10]. Utilizing campus land as a conservation park can be a concrete way to introduce the importance of local flora conservation to the academic community. Furthermore, the existence of a conservation park can strengthen the ecological identity of educational institutions [11], [12].

A well-designed conservation garden can be an effective educational tool for raising ecological awareness within the campus community [13], [14]. By providing a collection of local plants, interpretive boards, and a layout that supports observational activities, the garden can function as a contextual learning platform [15], [16]. Students can utilize the garden for practical work, research, and direct observation of the characteristics of local species. Beyond its academic function, a conservation garden also has the potential to create a comfortable and aesthetically pleasing social interaction space. Thus, the garden's existence not only has ecological value but also social and educational benefits [17], [18].

Biology gardens in many universities generally serve a limited purpose, serving as plant collection areas without structured conservation planning [19], [20]. Vegetation design often fails to consider local species composition, ecological aesthetics, or conservation-based learning needs. In some cases, exotic plants dominate over local plants, which often have higher conservation value [21], [22]. This situation is also evident in the Biology Garden within the Biology Department, which has the potential to be developed into a thematic conservation area [23], [24]. Therefore, a redesign is needed that takes into account the principles of conservation, education, and environmental aesthetics.

Previous research on conservation gardens in educational settings has generally focused on the aesthetic function of the landscape, vegetation inventory, or the influence of green space on learning comfort [25], [26]. Studies specifically integrating garden design based on local flora conservation with evaluation of appreciation by the academic community are relatively limited. Furthermore, research comparing the composition of local and exotic plants within the context of campus conservation gardens is scarce. In-depth analysis of vegetation dominance through canopy closure as an indicator of ecological design success is also rare. These limitations indicate a research gap that needs to be filled through a more comprehensive approach. The novelty of this research lies in the integration of conservation garden design, species richness analysis, vegetation structure evaluation based on canopy closure, and measurement of changes in the academic community's appreciation of the reconfigured green space. This approach not only produces a physical garden design but also evaluates its impact on user perception and engagement. By placing native plants as a central element, this research contributes to strengthening ex-situ conservation within the university environment [27], [28]. The results are expected to serve as a model for the development of similar conservation gardens in other educational institutions. This innovation also expands the function of the biology garden from simply a collection space to a center for conservation and education based on local biodiversity.

The urgency of this research is heightened given the need for concrete steps to preserve local biodiversity through sustainable campus space management. Reconfiguring the biology garden into a conservation park could be a strategic solution to improve ecological function while strengthening conservation awareness among the academic community. Based on the gap and needs analysis, this study aims to design a Local Biodiversity Conservation Park in the Department of Biology, determine changes in the appreciation of the Biology Department community towards the Biology Garden which was reorganized into a Local Biodiversity Conservation Park in the Department of Biology, determine the richness of local plant species compared to exotic plants in the Local Biodiversity Conservation Park in the Department of Biology, and determine plant species with the greatest canopy cover. The achievement of these objectives is expected to produce recommendations for effective and sustainable conservation park management. Thus, this study has strategic value for the development of conservation, education, and strengthening ecological culture in the university environment.

2. RESEARCH METHOD

2.1. Time and Place of Research

This research was conducted over a period of over a year in a garden within the Department of Biology, Faculty of Mathematics and Natural Sciences, Brawijaya University, Malang. All field observations were conducted in the garden, which served as the primary research location. Data processing and analysis were conducted in the Animal Ecology and Diversity Laboratory within the Department of Biology, Faculty of Mathematics and Natural Sciences, Brawijaya University, Malang [29], [30]. This location was chosen based on the availability of research facilities to support optimal study implementation.

2.2. Description of the Study Area

The Biology Department's garden covers an area of approximately four hundred square meters, with soil characteristics of sandy loam, rocky, and mixed with building material debris. The surface soil in this area is dark brown, indicating a relatively high organic matter content [31], [32]. These physical conditions offer good potential for vegetation growth if optimally managed. During the dry season, the garden area tends to appear dry and barren, resulting in some plant growth being less than optimal. The trees shed their leaves in large numbers, leaving the soil surface covered by a thick layer of litter. Conversely, when the rainy season arrives, the garden returns to its green state, with reduced litter thickness and increased ground cover growth. These changes indicate a significant seasonal influence on vegetation dynamics in the garden area. Initial inventory indicates that the garden has a fairly diverse plant diversity, although its distribution is not yet optimally organized [33], [34]. In addition to vegetation, the presence of soil fauna is also an important indicator in assessing the area's ecological condition.

Analysis of the soil fauna community structure indicates a relatively low level of diversity, with ants being the most dominant organism found. The presence of this fauna plays a crucial role in the formation and transformation of soil within the garden environment. Lighting conditions in various parts of the garden also show significant variation. Shaded areas receive lower light intensity than open areas exposed to direct sunlight [35], [36]. This difference in light intensity affects vegetation growth and the distribution of plant species in each zone of the garden. This factor is an important aspect to consider in designing a conservation garden. Based on the perceptions of the user community, the garden area is considered to have low aesthetic value and does not provide optimal function for academic or ecological activities. This condition indicates the need for reorganization of the area to improve its function. Developing the garden into a park with a natural garden approach is seen as an appropriate solution. This concept is expected to enhance aesthetic value while supporting ecological functions, conservation, and sustainable educational use.

2.3. Selection and Preparation of Plant Material

The plants used as the main components of the garden were selected through a selection process based on the diversity of local Indonesian plants. The selection was made taking into account the plant's origin, distribution patterns, aesthetic value, functional benefits, and ease of maintenance. This approach aims to ensure that each selected species supports conservation functions while providing attractive visual value. Aesthetics are a key consideration in plant selection. All parts of the plant are assessed, including the shape of the roots, stems, leaves, flowers, fruit, crown, and even the aroma they produce. The color of the leaves, stems, and flowers is considered to create visual harmony, while the branching structure, crown shape, and stem character play a role in building the garden's landscape composition.

In addition to aesthetic value, the plant's adaptability to environmental conditions is also a key criterion. Selected plants must have a high tolerance for variations in temperature, light intensity, drought, soil conditions, and resistance to pests and diseases. The plant's ability to withstand pruning and transplanting is also considered to facilitate long-term management and maintenance. Species selection is also tailored to each plant's light requirements [37], [38]. Plants that require prolonged exposure to direct sunlight are placed in open areas, while shade-tolerant plants are allocated to zones with lower light intensity. Based on their function in garden design, plants are grouped into ground covers, shrubs, border plants, and shade or space-filling trees.

After the selection process is complete, the plants undergo an acclimatization phase before being planted at the research site. Several plant species are propagated based on their biological characteristics. Most of the plants used are selected from species with relatively fast growth rates to support the establishment of the garden structure in a more efficient manner. Plant sources are obtained from various sources, including donations, plant conservation organizations, and existing vegetation in the garden area that is maintained.

2.4. Conservation Park Design and Implementation

The selected plant species were then analyzed based on their morphological characteristics, growth requirements, and visual appearance. This information was used as the basis for developing a garden design that suited the environmental conditions of the research location. In addition to plant characteristics, abiotic factors of the land were a primary consideration in determining the placement of vegetation in each area of the garden. One of the environmental factors that served as a primary reference in the design was sunlight intensity [39], [40]. Areas that received limited direct sunlight exposure were allocated to plants that tolerate shade. Conversely, areas that received longer exposure were used to accommodate plants that require high levels of sunlight for optimal growth. This adjustment aimed to ensure successful plant adaptation while maintaining the garden's aesthetic quality.

The garden area was divided into several zones based on the appropriate light intensity and plant composition. This zoning allowed for a more structured grouping of vegetation according to the ecological needs of each species. Each zone was designed to have complementary visual characteristics and ecological functions, creating a harmonious landscape. The design phase involved creating symbols representing each element of the garden, including vegetation and other supporting elements. These symbols were then arranged in a design sketch that illustrated the overall layout of the garden. The design process is carried out manually using draft drawings, which are then documented digitally and supplemented with species names at each planting point.

Once the design is complete, the land is prepared for implementation. The preparatory phase includes tilling the soil to loosen it and removing any material that could potentially hinder plant growth. Planting is carried out according to the previously designed layout to ensure alignment between the design concept and the actual field implementation. Plant maintenance is carried out regularly through watering and caring for the plants according to the needs of each species. The intensity of maintenance is adjusted to environmental conditions and the plant's growth stage to ensure optimal adaptation [41], [42]. This effort is crucial to ensure that all components of the garden can develop according to the planned conservation and aesthetic goals. Long-term maintenance is a primary concern in the realization of a conservation garden. The success of a garden is measured not only by its initial visual appearance but also by its ability to sustainably maintain its aesthetic quality and ecological function. Therefore, the garden design is designed with ease of maintenance in mind so that the garden can continue to benefit the environment and the academic community.

2.5. Evaluation of the Biology Department Community's Appreciation and Biodiversity of the Local Biodiversity Conservation Park in the Biology Department

The success of the Local Biodiversity Conservation Park design was evaluated based on two main aspects: aesthetic quality and ecological function. The evaluation was conducted after the entire park development and landscaping process was completed. This approach aimed to assess the extent to which the park met its conservation objectives while providing positive visual value for users. The aesthetic assessment was conducted through a questionnaire distributed to the Biology Department community, consisting of students, lecturers, and educational staff. This instrument was used to obtain insights into changes in user appreciation of the garden's condition after its redevelopment as a conservation park. The data obtained were then analyzed to determine the community's level of acceptance and perception of the park as an ecological and educational space.

The ecological function evaluation was conducted by measuring the plant biodiversity within the park. This stage began with an inventory of all plant species growing in the study area. The inventory results were then used to determine species richness as an indicator of the success of local vegetation conservation within the park. Each identified plant species was then classified based on its distribution status. Local species were defined as plants that are naturally distributed in Southeast Asia or have undergone naturalization in that region [43], [44]. Meanwhile, exotic species are categorized as plants originating from outside the area. This classification is important for comparing the proportion of local and exotic plants within the conservation park.

In addition to species richness analysis, an ecological evaluation is also conducted through vegetation analysis based on the canopy cover area of each species. This measurement aims to determine the dominance of vegetation in shaping the park's spatial structure. Canopy cover area is a crucial indicator for assessing each species' contribution to ecological functions such as shade provision, microclimate regulation, and soil protection [45]. To facilitate the analysis, plant species are grouped into several strata based on canopy height. Low-height plants are placed in the lower strata, medium-sized plants are grouped in the middle strata, and plants with higher canopy heights are placed in the upper strata. This grouping provides an overview of the vertical structure of vegetation within the conservation park. Through an evaluation that includes aspects of community perception and biodiversity analysis, the effectiveness of the Local Biodiversity Conservation Park can be comprehensively assessed. The results of this evaluation serve as a basis for determining the success of the garden's restructuring as an education-based conservation area. Furthermore, the findings can be used as a reference for the park's future sustainable development and management.

2.6. Research Design

This research is experimental in nature with the independent variable being the time before and after the creation of the Conservation Park. The dependent variables are flora diversity, the extent of canopy cover of plant species in the park and appreciation of the park's aesthetics, which includes appreciation of the overall appearance of the Local Biodiversity Conservation Park, its structural composition, shape, texture, color, level of plant diversity within it and the zones that are most appreciated well and poorly.

2.7. Data Analysis

The data obtained were analyzed using descriptive statistics. Flora diversity data and its status were displayed in tables, along with the richness values of local and exotic species, compared with the flora diversity at the beginning of the study. The results of the vegetation analysis were presented in map form. The data from the academic community's appreciation questionnaire for the aesthetics of the Biological Park were processed using Microsoft Excel and statistically tested (Chi-square test using Minitab) to determine whether there was an influence of respondents' backgrounds on their appreciation of the park. The data were then presented in graphical and descriptive form. The results of the park design were presented in graphical form and accompanied by photographs.

3. RESULTS AND DISCUSSION

3.1. Design of the Biology Department's Biodiversity Conservation Park

The design of the Biology Department's Biodiversity Conservation Park is based on the basic concept of developing land into a green space that functions not only as a park but also as a conservation area. This concept utilizes the potential of local biological resources, planned and arranged to create a space with balanced aesthetic value and ecological function. The primary emphasis is placed on the use of local plants due to their high adaptability to local environmental conditions. Furthermore, the presence of local plants contributes significantly to maintaining ecosystem stability and supporting sustainable environmental balance.

The design adjusts the vegetation composition by removing several exotic plants and replacing them with local species. This step is taken to minimize the potential ecological impacts of the dominance of introduced plants on the local ecosystem. Local species are prioritized because they have a stronger ecological relationship with their native environment and are better able to support the sustainability of local fauna. This approach also serves as a conservation effort for native Indonesian plants, whose existence is increasingly being marginalized by popular cultivated plants. Spatially, the park is divided into four main zones, each with distinct layout characteristics. The zoning is based on the composition of plant species, light intensity, vegetation form, and the desired visual impression. This variation is designed to avoid a monotonous impression in the garden, but rather to showcase the diverse structure of the plant community. Each zone has its own visual identity, complementing each other in forming a unified conservation landscape.

The garden's design adopts an informal design approach with a natural character that emphasizes the harmonious relationship between humans and nature. The forms used tend to be free-flowing, dynamic, and dominated by curved lines and organic patterns. Visual balance is not established through rigid symmetry, but rather through the proportional distribution of elements. This approach creates a stronger sense of nature than formal designs, which tend to be rigid and geometric. In addition to providing aesthetic value, informal design is also more efficient in terms of maintenance because it allows plants to grow more naturally. The plants selected for the garden are local species with high utility value, relatively fast growth, and educational potential. In addition to their visual function, these plants play a role in microclimate control, erosion prevention, providing habitat for fauna, and improving environmental quality. Vegetation selection is carried out selectively so that each species can simultaneously support ecological and aesthetic functions. Thus, the garden becomes not only a decorative green space but also a living conservation laboratory.

The first zone is designed with ferns and dense, dense vegetation dominating the natural atmosphere of a tropical forest. The layout resembles a wild garden, with a free-flowing, unorganized arrangement of vegetation. This approach creates a strong ecological impression while highlighting the character of Indonesian tropical vegetation. This zone is designed to create a visual experience resembling a natural ecosystem with a shady, humid feel. The second zone maintains the lush feel, but with a more diverse plant composition. The main visual element in this zone is created through a combination of uniquely structured vegetation that serves as a focal point. The arrangement is designed to create visual contrast between canopy shape, leaf color, and vegetation texture. This provides visual dynamics that enrich the spatial experience for park users.

The third and fourth zones are designed with a more organized pattern than the previous two. These areas feature open expanses of vegetation utilizing dynamic geometric shapes such as circles and ellipses. The high light intensity in both zones allows for the use of flowering plants and boldly colored plants as the main aesthetic elements. This arrangement creates a more formal feel while maintaining a natural feel through the selection of local vegetation. Overall, the garden design demonstrates the integration of biodiversity conservation principles, landscape aesthetics, and management efficiency. The diverse layout of each zone reflects an effort to create a landscape that is both adaptive to environmental conditions and visually rich. This design demonstrates the utilization of the richness of local flora as a key element in the development of campus conservation spaces. Through this approach, the park is expected to serve as a model for developing educational landscapes relevant to the context of Indonesia's biodiversity.

3.2. Aesthetic Appreciation of the Biology Department's Biodiversity Conservation Park

The implementation of the Biology Department's Biodiversity Conservation Park design demonstrated a significant change in the aesthetic appreciation of the user community. Prior to the redevelopment, most respondents considered the area to be unattractive. After the park's completion, this perception changed significantly, with positive assessments of the area's beauty dominating. This change demonstrates that user-centered planning effectively enhances the visual quality of the space. This increased aesthetic appreciation is closely related to a design approach that incorporates the aspirations and needs of the Biology Department community. During the design process, user preferences for a garden that balances naturalness and order were a primary consideration. As a result, the garden exhibits a visual character that aligns with user expectations. The presence of zones with distinct characteristics provides a more dynamic and engaging spatial experience.

The aesthetic assessment of the garden can be further analyzed through responses to the composition of plant structure, texture, shape, and color. Overall, the composition of the vegetation structure received the highest appreciation, as its arrangement was deemed to create a harmonious visual balance. The arrangement of trees, shrubs, bushes, and ground cover resulted in a well-organized spatial composition. The tiered placement of vegetation creates visual depth while enhancing the park's natural feel. The composition of plant textures also received positive reviews from the majority of respondents. The combination of smooth- and rough-leafed plants creates a visual contrast that emphasizes the shape of each vegetation element. This strategy prevents the garden from feeling monotonous and creates a richer visual dynamic. This textural variation is an important factor in building the overall aesthetic quality of the garden.

However, the composition of shape and color still received relatively lower evaluations compared to other aspects. This is because some plants are still in their early growth phase, so their morphological characteristics have not yet developed optimally. The immature crown shape and branching structure prevent the visual expression of some plants from being fully visible. This situation suggests that the garden's aesthetic quality is expected to improve as the vegetation develops. In terms of color, the dominance of green vegetation creates a shady, cool, and natural impression, but the garden's color variation is not yet very prominent. This limitation is influenced by the largely shaded conditions of most areas, making them more suitable for shade-tolerant plants. Nevertheless, several areas of the garden still feature color accents through flowering plants and ornamental foliage. The presence of these elements serves as visual accentuations to enrich the landscape appearance.

Overall, the harmony between the garden's components has been highly appreciated by the user community. This demonstrates that the integration of structure, texture, color, and form of vegetation has successfully created a strong visual unity. The principles of balance, rhythm, and repetition in the design appear to have been successfully implemented. This combination creates a distinctive character for the conservation park, distinguishing it from conventional green open spaces. In addition to enhancing aesthetic value, the park's reorganization has also significantly increased vegetation biodiversity. An inventory revealed a surge in the number of plant species following the conservation park's establishment. This increase demonstrates the successful integration of conservation functions into the park's design. The high species richness indicates that the park can function as an effective ex-situ conservation space within the campus environment.

Despite the significant increase in species richness, the community's knowledge of plant names and functions remains low. Most respondents were unfamiliar with the various plant species found in the park or their ecological benefits. This situation indicates the need to strengthen the educational function through the provision of interpretative media, plant labels, or garden-based learning programs. This way, the park's conservation potential can be optimized not only ecologically but also educationally. Based on visual preferences, the third zone was rated as the most attractive area. This zone was deemed superior due to its more regular layout, more diverse color composition, and clear spatial structure. In contrast, some respondents still considered the first zone less appealing due to its overgrown appearance, which tended to resemble wild vegetation. This difference in perception suggests that design characteristics significantly influence users' level of aesthetic acceptance of each park zone.

3.3. Vegetation Structure of the Biodiversity Conservation Park, Department of Biology

The results of the vegetation structure analysis indicate that the park's reorganization has had a significant impact on increasing the dominance of local species in the conservation area. The proportion of local species richness increased significantly, while the presence of exotic species decreased after adjustments to the vegetation composition. These changes demonstrate that the park's design has successfully directed the vegetation structure toward an ecosystem more representative of local biodiversity. This is an important indicator of the successful implementation of the native flora-based conservation concept. The increase in the number of local species has had a positive impact on the park's ecological quality. This is evident in the increased presence of various fauna that utilize the area as habitat, particularly insects. Furthermore, field observations also revealed the presence of other organisms such as amphibians and spiders, indicating the formation of more complex ecological interactions. The presence of these fauna indicates that the park is beginning to function as an ecosystem capable of supporting a more balanced chain of life.

The high species richness within the park contributes to environmental stability by increasing the complexity of interactions between organisms. Vegetation diversity allows for the formation of various ecological niches that can be utilized by herbivores, predators, and decomposers. This supports the creation of a natural balance mechanism within the park's ecosystem. Thus, increasing vegetation biodiversity not only enriches the plant collection but also strengthens the overall ecological function of the area. The park's vegetation structure is arranged in several strata based on canopy height, from the understory to the shade tree layer. This stratified diversity reflects the complexity of the vertical structure of the vegetation, resembling a natural ecosystem. Each stratum has its own ecological function, from ground cover, providing microhabitats, to regulating the microclimate through shade formation. This tiered structure reinforces the park's character as a dynamic conservation area.

In the upper strata, the species with the greatest canopy cover are shade trees, which dominate much of the park. The dominance of these species significantly impacts microclimate conditions, particularly by reducing the intensity of light reaching the ground surface. In addition to providing ecological shade, excessive canopy cover also presents challenges because it can inhibit the growth of understory plants. From an aesthetic perspective, the accumulation of fallen leaves during certain seasons also affects the park's visual appearance. In the middle strata, several local species exhibit relatively even canopy cover. Vegetation in this layer plays a crucial role in creating a visual transition between shade trees and ground cover vegetation. In addition to providing aesthetic benefits through variations in canopy shape and leaf texture, the middle layer also serves as a habitat for a variety of small fauna. The presence of this layer enriches the garden's spatial structure both ecologically and visually.

In the lower strata, vegetation is dominated primarily by various types of grasses and ground cover plants. These species play a crucial role in maintaining soil moisture, preventing erosion, and strengthening the stability of the land surface. However, some exotic vegetation species that remain exhibit aggressive growth tendencies, potentially suppressing local species. This situation highlights the need for continued management to ensure local vegetation remains dominant. Although the park's vegetation structure generally shows positive developments, field observations identified several challenges in its implementation. Some plant species are susceptible to herbivore and disease attacks, while others experience growth constraints due to inadequate light intensity. Furthermore, some plants exhibit seasonal growth characteristics, impacting the park's aesthetic continuity throughout the year. These factors are important considerations in evaluating vegetation design.

The differences in biological characteristics between species demonstrate the importance of a thorough understanding of each plant's ecological characteristics in the conservation park design process. Species selection should consider not only aesthetics but also resilience to environmental pressures and interactions with other organisms. A harmonious combination of vegetation will enhance the park's carrying capacity for ecosystem sustainability. Therefore, regular evaluation of vegetation structure is a crucial step to ensure the long-term success of park management. Overall, the vegetation structure of the Biology Department's Biodiversity Conservation Park demonstrates that a local plant-based approach can create a more stable, complex, and functional ecosystem. This success is reflected in the increased dominance of local flora, the formation of diverse vegetation stratification, and enhanced ecological interactions within the area. These findings confirm that local conservation-based vegetation management has significant potential for application to other campus green spaces. With sustainable management, this park can continue to develop as a model for biodiversity conservation at an educational institution scale.

Designing a biodiversity conservation park within an academic environment is a strategic approach to supporting the sustainable conservation of local biological resources. This concept emphasizes not only the aesthetic aspects of the landscape but also prioritizes ecological functions. Within a campus context, a conservation park can serve as a natural laboratory that supports educational activities, research, and community service. The integration of ecological and academic elements makes this area a model for multifunctional green open space management [46], [47]. Thus, the development of a local conservation-based park is a concrete example of implementing sustainable development principles within a higher education environment.

The use of local species in garden design has significant ecological value because these species have adapted to local environmental conditions. This natural adaptation makes local plants more resilient to environmental stress than introduced species. Furthermore, the presence of local vegetation fosters more stable ecological relationships with native fauna, particularly pollinating insects, herbivores, and natural predators [48], [49]. This relationship forms a more balanced trophic network, supporting the stability of the micro-ecosystem. Therefore, the use of local species serves not only as a greening element but also as a foundation for establishing a resilient conservation ecosystem.

From a landscape architecture perspective, the success of a conservation park is greatly influenced by the designer's ability to combine aesthetic value with ecological function. Vegetation arrangement based on canopy strata, variations in leaf texture, color, growth form, and spatial patterns are crucial elements in creating an attractive and functional landscape. A balance between visual order and natural dynamics is essential to ensure the park remains visually pleasing without losing its ecological character [50], [51]. This approach demonstrates that biodiversity conservation does not have to be at odds with aesthetics; rather, the two can work synergistically. This concept is crucial for educational settings to enhance the academic community's appreciation of the environment.

Educationally, biodiversity conservation parks have the potential to be effective contextual learning media. Students can utilize these areas for direct observation of plant ecology, interactions between organisms, and the dynamics of environmental change. This experiential, field-based learning can reinforce conceptual understanding gained in the classroom. Furthermore, parks can foster ecological awareness through regular interactions between campus users and the natural environment. In the long term, this educational function contributes to the formation of an academic culture that is more concerned with environmental conservation.

The impact of this research is quite broad, both ecologically and socio-academically. Ecologically, the development of a conservation park can improve the habitat quality of local flora and fauna, improve microclimate conditions, and support the stability of the campus ecosystem. Socially, this park can serve as a space for interaction, enhancing the comfort and psychological well-being of the academic community. Academically, the results of this research can serve as a reference for developing conservation-based green open spaces at other educational institutions. Implementing a similar concept has the potential to expand campus contributions to supporting biodiversity conservation at the local level.

However, this research has several limitations that require consideration. The evaluation of the success of the park design is limited to a specific observation period, thus not fully reflecting long-term ecological dynamics. Vegetation responses to seasonal changes, biotic disturbances, and other environmental pressures require ongoing monitoring. Furthermore, limited resources for park maintenance can impact the consistency of the design implementation. The participation factor of area users has not been analyzed in depth, even though campus community involvement is crucial for the sustainability of the park's conservation function.

Going forward, similar research should be directed at long-term monitoring of changes in flora and fauna community structure and evaluating the park's effectiveness as a medium for conservation education. A multidisciplinary approach combining ecology, landscape design, environmental education, and social participation will result in a more comprehensive park management model. Furthermore, the integration of technologies such as digital mapping and sensor-based biodiversity monitoring can improve the accuracy of ecological evaluations. By strengthening these aspects, campus conservation parks can develop into innovative models for adaptive and sustainable local biodiversity conservation.

4. CONCLUSION

The Biology Department Biodiversity Conservation Park was designed with the concept of a 'wild garden' and the philosophy that humans are part of nature, where this park has aesthetic and functional values and is a conservation area for local resources. From the results of this study, it can be concluded that the realization of the design of the Biology Department Conservation Park has an impact on increasing appreciation of the appearance of the park, initially only 7% of respondents considered it beautiful, this percentage increased to 90%. The richness of local species increased from 61% to 81% of the total species, while the richness of exotic species decreased from 24% to 5% of the total species, and species with unknown status changed from 15% to 14%. The species with the largest canopy cover are Panicum sp. (stratum E), Bambusa vulgaris (stratum D) and S. macrophylla (stratum C). Further research is recommended to evaluate the long-term effectiveness of biodiversity conservation parks by monitoring changes in flora and fauna composition, the dynamics of ecological interactions, and their impact on campus ecosystem stability. Furthermore, further studies should integrate a socio-ecological approach to assess park user perceptions and develop an adaptive management model that can be applied to similar biodiversity conservation areas in educational settings.

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AUTHOR CONTRIBUTIONS

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

Not applicable.

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