

Review

Campus Biodiversity Management: A case-specific review of Symbiosis International University

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Abstract

This article discusses the concept of campus biodiversity initiative using the efforts of Symbiosis International University as a model system. It also indicates how campuses can contribute to the biodiversity conservation mission of Govt. of India, focusing on Campus Biodiversity conservation initiatives. As we know, a large chunk of green spaces and land cover is a part of Institutional and academic campuses, and campus biodiversity has a significant role. If appropriately managed, campus biodiversity may support as much, if not more, as any other urban green space and can be effectively maintained. Symbiosis International University can be taken as a model to replicate in other institutions. We also look at the gaps that are currently present in policy and possible solutions. Campuses should be managed periodically since they provide a vital breathing space for growing biodiversity.

Introduction

Almost all cultures are rooted in our biodiversity in one way or another. India's cultural and value system is rich in referring to trees/plants, animals, birds, etc., recognizing their essential role. Biodiversity or biological diversity is a term that describes the variety of living things or the variety of life forms on Earth and can be studied on many levels [46]. At the highest level, one can consider all the different species present throughout the Earth. In contrast, on a much smaller scale, one can study biodiversity in a such as an educational institution, pond, lake, or grassland of a specific region. Biodiversity-the variety of all living things is the foundation of the various ecosystem processes and services. It provides clean air and water and plays a vital role in soil formation, carbon sequestration, nutrient cycling, and pollution reduction and remediation [10]. Biodiversity provides us with landscapes we love and opportunities for recreation-all of which contribute to our health and wellbeing.

Biodiversity study includes the presence, absence, abundance, frequency, and interactions among different living forms present in an area. It aims at encompassing all living beings in a systematic manner of recording. It represents the wealth of biological resources available in the selected ecosystem. It can also be seen as maintaining the natural area of a community of plants, animals and other organisms that begins to shrink steadily as we plan our activities. There are many unmanaged spaces in an urban area from biodiversity conservation point of view, but a large chunk of biodiversity and healthy surroundings can be found in the campuses and institutes, which can act as a learning hub for students, and they can explore the field in their footsteps to begin and aim a larger step in future. Appropriate conservation and sustainability strategies are an integral part of any approach to biodiversity conservation.

Importance of biodiversity from an ecological and environmental point of view

Rich biodiversity is essential to preserving ecological stability and protecting the purity of the water and air in a carefully balanced system. An ecological system's full representation of its flora and fauna enriches the environment, boosts ecosystem functionality, and enhances the ecosystem's aesthetic and cultural qualities. Pollination, pollution clean-up or mitigation, insect control, and the provision of valuable timber, fodder, food, and medicines are just a few of the temporary benefits provided by biodiversity. We must recognise the significance of these as they are provided without charge and can go unrecognized. Biodiversity is the backbone of agriculture and industry and a vital component of the bio-based economy of many nations.

Furthermore, biodiversity regulates services such as soil formation, nutrient cycle, water cycle, carbon sequestration, geochemical cycles, etc [9]. In addition, macroclimatic regulation, microclimatic regulation, and

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hydrological regulation are good examples of other regulatory ecosystem services of biodiversity [26]. Through the provision of ecosystem services, biodiversity generates significant economic value, notably in its function as an ecological process regulator is more critical. These processes not only have many co-benefits, like reduction in greenhouse -gas emissions and facilitating climate adaptation, but also provide lower costs and other economic advantages [9].

The promotion of social cohesiveness, physical and mental welfare, health, and employment prospects within society are all significantly aided by biodiversity. The primary rationale behind the creation of wildlife and communal biodiversity experiences is that they will result in more intense emotional campus encounters, enhanced affinities with natural regions, environmental learning, and ultimately stronger nature-protective conduct [14].

The protection of all remaining primary ecosystems and the preservation of endangered species require increased conservation efforts. It includes mainstream sustainable techniques like preserving productive, regenerative agriculture and preventing nitrogen from entering freshwater. Keep pollinators alive and step-up ecological restoration. "Green" cities provide access to nature, curb urban sprawl, and minimize carbon emissions for the health and well-being of city people.

Importance of Urban Biodiversity Management: As most of the world's population resides in urban areas, urban biodiversity should be important in the bigger picture of biodiversity conservation. This is where campus biodiversity plays a crucial role and should be safeguarded. As universities host people from academia, they can use biodiversity for scientific inquiry and research purposes [22]. Universities should pay special attention to ecological issues for three reasons:

- Their public declaration of support for social responsibility and local, regional, and global sustainability (Think globally).
- Universities can act as a hub for the creation and dissemination of scientific knowledge regarding biodiversity conservation for the students as well as the local community.
- A large portion of land across a variety of habitat types is taken up by university campuses.

Some urban planners are influenced by academic campuses and put enormous spatial expanse to plan campuses like cities with biodiversity conservation provisions. Campus biodiversity conservation initiatives can make campuses rich urban hotspots of biodiversity because it serves as a refuge for different faunal assemblages from an urban landscape. The landscape of urban green cover has been enhanced due to campus biodiversity protection. Urban forests can contain relatively higher biodiversity than suburban green covers [3].

Importance of Academic Campus Biodiversity Conservation

Academic campuses in India are known to harbor rich biodiversity, the Campus Reality Projects run in India, and South Asia has a Green Campus initiative that encourages campuses around India to be green and sustainable (<https://www.climatereality.org.in/>). They focus on the climate consciousness of the campuses and have five primary elements, including water, air, waste, energy, and biodiversity. Two (air and water) out of five elements depend directly on biodiversity. In brief, the biodiversity of any ecosystem encompasses total fauna, flora, microbiota, and genetic materials. According to recent norms of the University Grant Commission (UGC), in India the land required for setting up a university has been reduced from 40-60 acres to 5 acres; however, campuses of schools, colleges, and Universities in India harbor a lot of land cover. The largest is G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand covering 10016.29 acres of land. IITM-Gwalior has an extensive report published on account of the biodiversity encompassed in their biodiversity park. The University of East Anglia has surveyed biodiversity over 145 hectares and has assigned 50 hectares for higher level stewardship (HLS) for better conservation of biodiversity. In a similar manner, the University of Alabama has an active survey on iNaturalist for their campus biodiversity. In India and elsewhere, the majority of campuses that have studied their biodiversity have done so as sustainable campuses. Campuses should be one of the focuses of biodiversity conservation initiatives and should strive to be carbon neutral, if not carbon negative. This is only possible when they have enough viable green cover, which acts as potential carbon sinks. Although small in the area, an excellent green cover supports significant fauna, flora, and microbiota and increases the local area's overall ecological stability [15]. Considering the importance of campuses biodiversity conservation in ecosystem services and sustainable development Symbiosis International University (SIU) established its Biodiversity Cell in 2016 to initiate its campus's biodiversity conservation strategies.

Strategies for biodiversity conservation at Symbiosis International University (SIU)

The surroundings in which we live comprise numerous life forms, such as birds, fishes, plants, and trees. In simple terms, this variability and the variety of living organisms, and the ecological niches that exist are essential for a balanced ecosystem. Over the years, biodiversity has faced rapid depletion due to habitat loss, excessive exploitation of resources, climatic changes, diseases, pollution, poaching of animals, etc. Thus, biodiversity conservation has become a significant issue and should get more attention. To improve the current situation of biodiversity, vital steps for biodiversity conservation must be taken by the level of local populations, government, and social organizations.

Not only is it important for campuses to have green cover, but it's also essential that the green cover is formed majorly by native species and species with high ecological

services [7]. Native tree species are well suited to the local climate and are harder than exotics and invasive.

At symbiosis, our motto is to create an ecosystem that can cater to a larger group of fauna; to achieve this, we are planting and maintaining diverse flora. As indicated earlier, the University has its own Biodiversity Cell and Biodiversity Management Committee, which has formulated its standard protocols and rules, which are followed and updated from time to time. The Biodiversity Management Committee comprises experts from all designations, from higher authorities to the coordinator, to take the decisions. The Committee regularly conducts meetings, keeps the meeting notes for the future record, and tries to implement the action points (decision) immediately before the next session is scheduled.

Our Efforts for Documenting, Maintaining, and Restoring Biodiversity

The entire 325-acre campus of Symbiosis International University is spread out over this area. The university is aware of the negative effects of development and the advantages of natural diversity for human sustainability, particularly for educational institutions. SIU places a great emphasis on developing responsibility for all people to preserve and improve the biodiversity landscape as one of India's top progressive universities. The Biodiversity Cell promotes different activities including awareness through education, encouraging a sense of respect for nature through human interactions with the environment, and assure the conservation of important sites on the University campus.



Figure 1: Map represent the Boundary of Symbiosis International University

Biodiversity related activities and suggestions: SIU are conducting following activities related to biodiversity and ecosystem conservation.

- We are collecting and maintain an herbarium of different plant species available on campus to keep a record of them. Along with maintaining biological data in physical form for future reference, it can be showcased on the campus for outsiders to enhance their biodiversity knowledge.
- We are also creating an inventory of flora and fauna present on campus for their better assessment [3].

Keeping a checklist of flora and fauna on campus and updating it frequently is necessary for a better understanding of climate change impact and preservation.

- Old-growth trees should be preserved since they act as better carbon sinks than new growth [23]. SIU is also promoting the conservation of old-growth trees on its campuses because they are effective carbon trappers and hold a higher conservation value than new growth so far as ecological services are concerned [21]. Out of 123 tree species around 65

species are native of which most are old-growth and well-preserved.

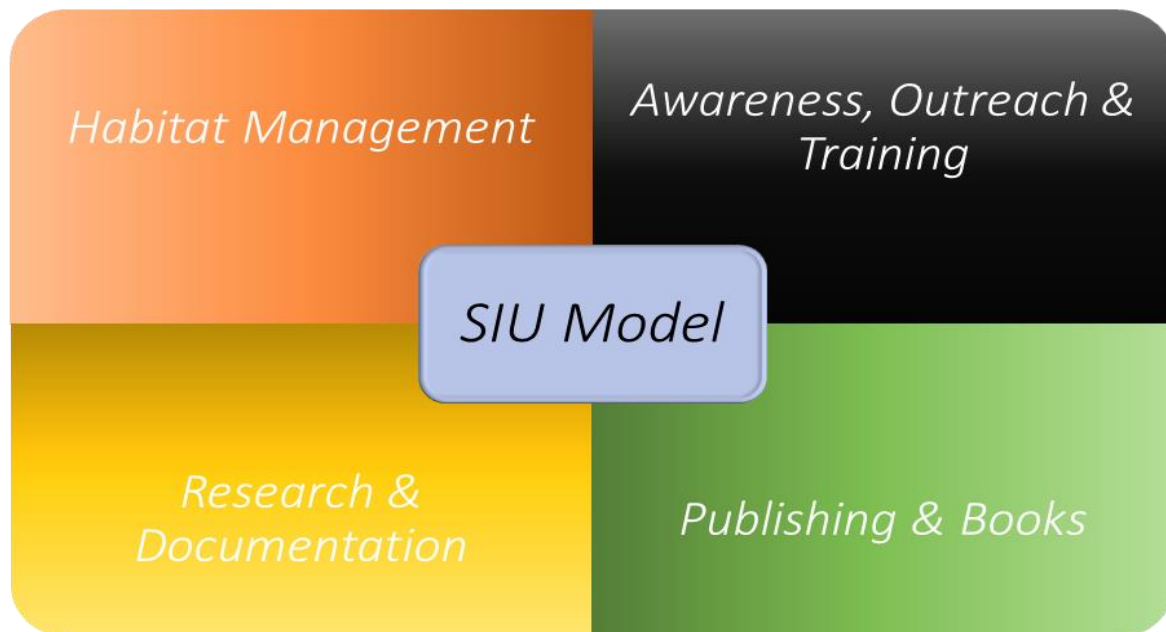


Figure 2: Model for Symbiosis International University followed for Biodiversity Management- A four-pronged model of how symbiosis strives for biodiversity conservation and management.

- Plantation of plant species specifically to cater to different life cycles of butterflies in the form of a butterfly garden. 45 different plant species have been planted in this garden. It attracts more than 45 butterfly species both local and rare.
- Considering wetlands to be an effective part of biodiversity and putting efforts into the preservation of the same. Wetlands serve as a habitat for a lot of unique and habitat-specific flora and fauna. Here at Symbiosis International wetlands cater to migratory birds and a variety of Odonates apart from other water birds and water life.
- Based on the documentation efforts in Symbiosis we have published two books of flora and fauna named as: Nature’s Wonders at Symbiosis (2012) and Fauna of Symbiosis International University (2018)
- We have presented our work in conferences as a Poster Presented at the Students Conference in Conservation Sciences in September 2021 and a Poster presented at the Bird Monitoring Conference in February 2021 was part of the outreach of our work at Symbiosis.

Approaches of Biodiversity Documentation:

The biodiversity surveys conducted at the SIU campus were planned for a certain duration along with opportunistic observational field surveys being done at certain periodic intervals using biodiversity documentation methods discussed below

Duration of the documentation of faunal species

Opportunistic surveys were carried out from April 2016 – December 2020 where field visits were made from April 2016 to June 2017 where 2 days per week of visits were carried out [34] . Simultaneously from July 2017 to August 2019 once monthly field visits were made and from August 2019 to December 2020 visits were made 4 days a week every month. Avifauna data were collected using opportunistic surveys at different habitats such as forest patches, Bandhara, Plateau, Scrub land, and a few lawn patches as well in the campus. Seasonal faunal surveys were conducted for documentation of amphibians and snakes in monsoon. Camera Traps were used for the documentation of mammals.

Duration of the documentation of flora

The survey and visit were carried out between March 2018 – March 2019. A method of Systematic surveys was undertaken where major work was to identify and make an inventory of the vegetation on the campus which was classified as Trees, Shrubs, Climbers, Herbs (once a month for twelve months)

Table 1: List of Total species of Flora and Fauna found on SIU Campus

Types of Flora	Total Number of Species	Types of Fauna	Total Number Species
Trees	86 species	Birds	127 species
Shrubs	31 species	Butterflies	34 species
Herbs	30 species	Snakes	17 species

Climbers	21 species	Geckos/Lizards	7 species
		Mammals	14 species
		Amphibians	7 species
Total	168 Species	Total	206 Species

Importance of Public/ academic outreach in Boosting Biodiversity conservation agenda

Academic institutions can serve as central points in developing man and nature interaction

Biodiversity initiative on academic campuses has the potential to connect directly to the public and nature. The educational campuses can augment their mission to educate students, staff, faculties, and community members about the importance of biodiversity. Communication on the subject will stem from research at the university and projects that are being worked on. In addition, conducting regular nature walks and workshops are a crucial part of interacting with students and faculty on this issue. Academic institutions can conduct regular lecture series and demonstrations to better interact with different researchers working in the same field to know the work happening worldwide. In addition, the celebration of Wildlife week, Environment Day, Biodiversity festival, and Film screenings must be done for better outreach and engagement.



Figure 4: Training of Guards on the importance of Campus biodiversity and how they can contribute to it

At Symbiosis International University we have clubbed students into Nature clubs where they run their own environment engagement activities. We have successfully arranged 50 plus guest lecture sessions, arranged 20 plus workshops for the students with the help of students to engage them in different ways to connect with nature and the environment. Academic Campuses are the best place for biodiversity documentation and with proper support can be transformed into Urban Biodiversity Hotspots. Such campuses can be used as living laboratories to study flora and fauna.

A gap in a biodiversity survey

Even though campus biodiversity is gaining more importance than in the past, a few gaps need to be addressed.

Correct species selection for urban greening is essential due to the following reason.

- Apart from selecting the native species, other attributes should also be considered, like species with wide canopies and dense foliage. Trees with wide canopies elevate oxygen levels, whereas species with dense foliage help purify the air by removing pollutants and providing shade, improving temperature levels [44].
- Planning for green spaces should be an inherent part of campus planning rather than an added one; it gives way to better execution and better space for expansion. Sound knowledge of what species are best suited for the landscape and local environment is essential. Plantation and planning should be done so that there is enough space for roots to grow and water to seep in. Green spaces should be made a mandate for the establishment of newer campuses and existing ones wherever possible.
- Plantation of trees does not necessarily need to be planted in a mass drive; a selected small number can be even more effective in long-term existence. The other important point that needs to be taken care of is the maintenance of saplings. It becomes difficult for each sapling to survive all year until it is fully grown into a plant [33].
- Putting up bird boxes made of wood and eco-friendly material to attract avian life and provide them refuge is a good approach, and we are taking care of that.
- Lawns take up quite a lot of space and water; therefore, lawn culture should be discouraged as much as possible since it does not serve a purpose and act as water sinks. It can be replaced by trees of native species for a better outcome [43]. We also suggest to discourage the lawn culture in Indian academic campuses for better biodiversity conservation point of view.
- The institution's dedication to clearly defined ecological priorities like biodiversity conservation, habitat protection, and restoration, maintaining and boosting the flow of ecosystem services, and maintaining and strengthening ecological integrity should be mentioned during campus establishment. Currently, in position statements and real planning documents, such ecological priorities comprise a relatively small part of universities' environmental considerations [33].
- Accounting and making a checklist for the entire biodiversity rather than a single taxon is

recommended. It provides a better estimation of the biodiversity at hand. Making means and ways for taxa of diverse kinds to coexist is crucial in biodiversity conservation. Identifying areas for specific taxa and letting them flourish accordingly, such as butterfly gardens or wetlands. Promote propagation of plant native flowering species to attract more natural pollinators. Increasing landscape complexity can help improve natural pest management while preserving biodiversity [9].

- Restored habitats further can be studied for impact assessment in long-term studies. Long-term scientific studies are necessary for conservation purposes and can be very effective in terms of future policy drafting of the campus.
- Students and working staff need to be socially responsible and aware of the campus's diversity. Identifying endangered and endemic species and treating them with the utmost respect is important. Spreading awareness regarding the same and updating biodiversity preservation policies in line with threatened species is a must.
- Incorporating citizen science for better biodiversity management can be a way forward in biodiversity preservation. Training students and staff members to use smartphone applications like eBird, Season Watch, iNaturalist, etc. This can help keep records of biodiversity apart from contributing to the larger cause of citizen science.
- Using GIS-based techniques to map different areas of campuses for better estimation of regions covered by biodiversity. With technological advances, it is justified to incorporate them in the management and preservation of the environment. The new techniques can be used to identify and classify the campuses' land use and land cover classification [45]. Also, we can keep track of the urbanization gradient of the area along with the forest cover, whether it has been increasing or decreasing over the years.

Conclusion/ future perspective

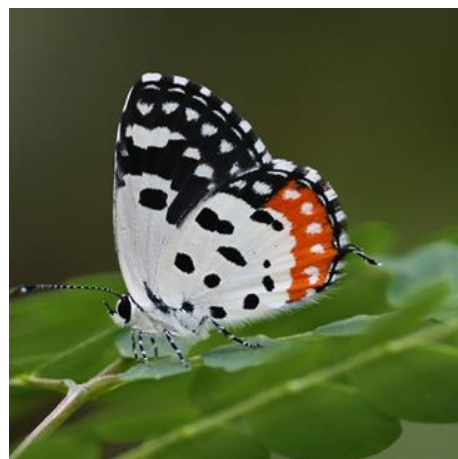
Urbanization, climate change, industrial development, and other factors continuously threaten the extinction of valuable biodiversity. Promoting academic campuses' biodiversity conservation initiatives is one of the best approaches to conserving local biodiversity and nurturing the concept of green campus and sustainable development. The importance of biodiversity survey and assessment has already been established in biodiversity conservation; hence, it must be done promptly. Only when a complete survey gets done will we know what is to be managed and how. More and more campuses should incorporate this approach, and the upcoming campuses should be mindful of biodiversity to be harboured and protected. As discussed above, intervention methods should be used to preserve biodiversity and urban green spaces better.

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Photoplates of Few species found in the campus



Talica niseus



Kallima horsfieldii



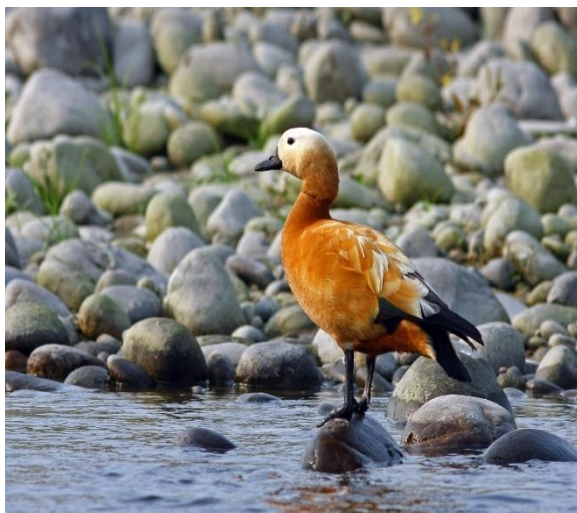
Erythrina Indica



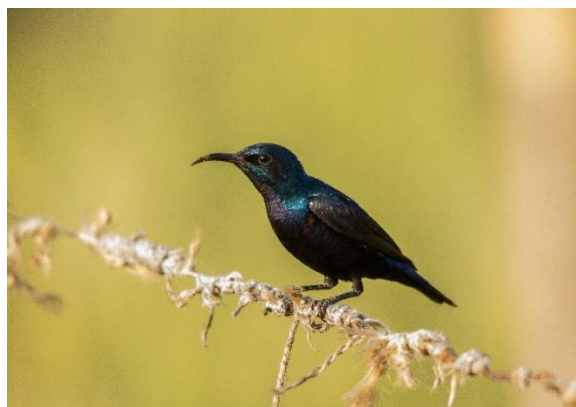
Purple *Bauhinia*



Spotted owl



Ruddy shelduck



Purple sunbird



Skittering frog



Little egret



Common garden lizard



Three striped palm squirrel



Indian flying fox

Table. 2: List of Institutes in India that have taken initiative in documenting the biodiversity (Data taken from published papers and articles at google scholar)

Sr. No	Name of College/ University	Biodiversity mapped
1.	Bharathair University, Tamil Nadu	Flora [38], Avifauna [35]
2.	Guindy Campus, Chennai	Freshwater algae [5]
3.	University of Rajasthan, Jaipur	Keratinophilic fungal flora [17]
4.	Sarojini Naidu College, Kolkata	Butterflies [28], Avifauna [11], Odonates [24]
5.	Yenepoya campus, Mangalore	Macrofungi [30]
6.	Fergusson College, Pune	Fauna [32], Flora [31]
7.	Maharaja Bir Bikram college, Tripura	Avifauna [13]
8.	Bangalore university campus, Bangalore	Avifauna [37]
9.	Karunya University, Coimbatore	Flora [36]
10.	Institute for Social and Economic Change, Bangalore	Flora [29]
11.	Kerala agriculture university, Thrissur	Spiders [2], Odonates [1], Butterflies [4]
12.	NEERI, Nagpur	Fauna [19]
13.	Kalpakkam Nuclear campus, Kalpakkam	Herpetofauna [39]
14.	Banaras Hindu University, Varanasi	Flora [41]
15.	Laxminarayan Institute of Technology, Nagpur	Avifauna [12]
16.	Assam University campus, Cachar	Butterflies [8], Mammals [25]
17.	Gujrat University campus, Ahmedabad	Biodiversity [27]
18.	Zoological survey of India, Jodhpur	Avifauna [42]
19.	University College of Science, Tumakur	Spiders [20]
20.	Yogi Vamana University campus, Kadapa	Butterflies [16]
21.	Lucknow University, Lucknow	Avifauna [18]
22.	Aligarh Muslim University, UP	Teak Insect Pollinators [40]

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