Importance and Benefits of Green Audits to Education Institutions and Industrial Sectors

Abstract

Green auditing is a vital process that ensures the diversity of plants on an organization's campus, reducing ecological pollution and soil destruction. It is beneficialintended for biodiversity protection, landscape management, irrigation/economic water utilization, and maintaining natural topography. Green audits are conducted at educational institutions and industrial sectors using the National Building Code (NBC) Part 11 - A 360° Risk Assessment Approach to Sustainability checklist. The importance of green auditing lies in its ability to create an eco-friendly environment and encourage green initiatives was studied at Nehru Arts and Science College, Coimbatore, Tamil Nadu, India. The results revealed that the campus has sufficient number of flora and fauna and established various gardens such as terrace, herbal, kitchen, zodiac, and decorative gardens. All the plants were labelled properly with common and botanical names and used biofertilizers, organic and green manures for the cultivation of plants. Agrochemicals and chemical fertilizers were minimally used to save the soil health and to protect the ecosystem from soil and water pollutions. The benefits of green audit included understanding the organization's internal and external green campus inspection and execution procedures, creating data on plant quantities, recommending biofertilizers, conserving economically valuable, rare, and endangered species, documenting rainwater collection systems, water reservoirs, percolation ponds, and irrigation technologies to the plants were well understood by the Oragnization with respect to the green audit.

Key words: Green auditing, Green campus,Diversity of flora, Landscape management, Gardening, Environmental sustenance

Introduction

Greenauditingensuresthe diversity of trees, herbs, shrubs, climbers and lawns of the Organization’scampuswhich reduces the ecologicalpollution and soil destruction; besidesbeneficialfor biodiversity preservation,management of landscape,irrigation/economicwaterutilization,andmaintenanceofnatural topography on the Organization’scampus in addition to vegetation (Gowri and Harikrishnan, 2014). Following solid waste management, water recycling, discarding of sewage in addition toleft-over materials (biomedical and e-wastes), "zero" usage of plastics, and other practices strengthens the organization's campus. Green Audit processes comprise the description of green inspection, the flow of conducting green audits at educational organizations and industrial segments in accordance with the specification based on the National Building Code (NBC) Part 11 - A 360o Risk Assessment Approach to Sustainability, and the documentation of the results (Arora,2017).

The Organization's Management (Auditee) ought to become enlightened to their intrinsic commitment to creating an eco-friendly environment through green inspecting and be prepared to motivate/follow all forms of green initiatives (Suwartha and Sari, 2013). Administrative authorities should develop "Green and Environment Policies" grounded on green audits technical reports. A hygienic and hale and hearty atmosphere is responsible for improving the effectiveness of the teaching/learning process. Environmental education must

be used on a regular basis to raise awareness about the importance of green activities among students and researchers (Arunint*a et al*.,2017). Green auditing is the most efficient and environmentally friendly method of dealing with environmental issues.

Green auditing is a type of specializedcaution and a modest indigenous method for monitoring the environment in the sense of growing greater numbers of trees, and it's the responsibility of every person who serves as an integral part of the financial, economic, societal, and ecological aspects (Rajalakshmi *etal*.,2022). It is required to do a green inspection a minimum of once every three years, which will assist the institution in setting environmental models ("icon") for the community as a whole. Green auditing is a specialized and beneficial implement for an institute to assess the manner in which they are keeping the siteecological friendly. It may also be utilized to undertake relief measures that benefit both stakeholders in addition the environment. It gives a chance for stakeholders to build ownership, social and personal accountability.

Materials and Methods

There are multiple advantages to doing a green inspection by the organization that could be quite beneficial in considerably improving the campus environment. The green audit contained the following qualitative andquantitative measures.It should understand the state of the Organization's internal in addition to external green campus inspection and implementation procedures.Establishment of a green campus in compliance with current Government and local authority standards to maintain the green campus are playing pivotal role in the welfare of green audit.Creation of terrace, herbal, kitchen, zodiac, and decorative gardens, and others to improve the teaching-learning environment for commercial exploitation is very important with regard to green initiatives which were observed during the audit process.

Green campus audit was conducted at Nehru Arts and Science College, Coimbatore, Tamil Nadu, Indiafor the present study. In order to conduct green campus audit, Lead Auditors and Subject Experts like Botanists, Zoologists and Biotechnologists were selected. During the audit process, labeling of plants with common names and Botanical names were observed. The drip and sprinkler irrigation methods and use of recycled wastewaters for irrigation purposesfor the plant cultivation purpose were observed. In addition, the number of wells, bore wells and water reservoir facilities were also noted towards effective irrigation facilities (Gnanamangai*et al*. 2021). Gathering data on the total number of terrestrial and aquatic vegetation (herbs, shrubs, climbers, twins, and grasses) on campus, as well as a record of the number of oxygen-releasing as well as carbon-dioxide-assimilating plants are playing important role in green campus establishment for the benefit of stakeholders were noted.Apart from flora, the total number of residing and migratory creatures such as animals, insects, flies, butterflies, and nematodes on campus was counted.Suggestions for using biofertilizers, both organic and green, as well as dung from cows and farmyard manures, for crop development to protect soil health and documentation of the state of rainwater collection systems, water reservoirs, percolation ponds, and other structures used to raise ground water levels, as well as irrigation technologies (drip/sprinkler) used to boost water consumption efficiencywere recorded (Leal Filho *et al.*, 2015).

Results and Discussion

The Green audit process includes various target areas, only a few of which have been taken into account in the Indian context. Green auditing emphases on the effective usage of

energy as well as water; minimizing left-overcreation/pollution; and improving financialcompetence. Green auditing might be done at regular periods, and the findings can show progress or alteration over a period. Green auditing attentions on reducing carbon discharges, water ingesting, waste in the direction of landfill, and improving energy safeguarding in order to include environmental concerns into all agreements and amenities that are thought to have substantial environmental implication (Choy and Karudan, 2016). The primary goal of the green audit is to evaluate an organization's green attributes (flora and fauna variety), which have an impact on lowering pollution to the environment, preventing erosion of soil, conserving biodiversity, managing landscape assets, and maintaining the area's natural topography and plant. Further to assessing the treats, risk factors in term of developmental activities of the organization and to resolve the same in a proper way.

Ensuring a high level of biodiversity at the green campus is a critical metric that represents the real-time ecology. Plants may be used to measure the various degrees of environmental quality. It is possible to gauge the various levels of environmental quality using plants. In general, plants improve the quality of the air outside by raising the oxygen content while lowering the ambient temperatures and carbon dioxide. The Organization's environment is improved by the green and other colors of the blooming plants. The track record on plant biomass care and management is critical for green campus endeavours. The presence of such plants in addition to birds on the greens campus may possiblynoteddown for the campus's diverse flora as well as fauna, that are regarded as a value enhancement (Gamble, 1921).

Botanical identification is performed on a variety of vascular plant species gathered around campus (botanical name, family, habitat, and economic relevance). Plant specimens are collected fresh, along with digital pictures of them. Identification of gathered plant specimens is performed using "The Flora of the Tamil Nadu Carnatic" (Matthew, 1983) and validated by equivalent with true specimens in the Botanical Survey of India (BSI), Southern Circle, Coimbatore, Tamil Nadu, and India.According to the observations, the campus contains more than 23% forest vegetation (wild/native plant species) and 53% artificial plant species (ornamental plants/man produced vegetation). The fauna that lives at the location is supported by the features of native plants. Because of this, local creatures such as birds and mammals are able to utilize 25% of the wild. Dry deciduous plants are the most likely type of native vegetation on campus. The campus still has some of this former greenery.

The majority of the plants found were *Tamarindus indica*., *Azadirachta indica* A. Juss., *Pongamiapinnat*, and Cassia fistula, that are prominent tree species distinctive of the campus's environment. *Nerium oleander* L., *Punica granatum*and, *Nerium indicum* Mill, are a few of the shrub species that may be found on campus. Although the soil's flora is not widely dispersed, it is quite rare there. It is demonstrated that several common weeds, such *Euphorbhiahirta* L., predominate. On the campus, *Catharanthus roseus* and *Cynodondactylon* are two common plants. Some common climbers found among the bushes are *Abutilon indicum* L.,*Anisomelesmalabarica, Adhatodavasica.,Coccinia grandis* L., *Cardiospermum halicacabum*, *Tinospora cordifolia* (wild), *Toddalia asiatica* L., and *Citrullus landaus* (Thumb).

The campus is rich in grass species like *Andropogon pumilis, Apludamutica*,*Cenchrusciliaris,Asparagusracemosus*Wild.,and*Commelinabenghalensis*L.
The majority of the species discovered are abundant on campus, with the exception of

Cucumis dipsaceusEhrenb, Hybanthus, Bothriochloacompressa (Hook.F.), and *Caralluma bicolor* Ramach. The campus also has certain indigenous grass species such as *Andropogon pumilus*Roxb., *Panicum psilopodium*Trin., and *Perotis indica* (L.) Kuntze. The number of the aforementioned species has dropped, and a few are in risk of becoming extinct as a result of anthropogenic activity (frequent clearance and construction operations). As a result, in order to conserve the existing flowery plants biodiversity, it is necessary to establish a botanical garden on campus and nurture them while maintaining the plants on the grounds to safeguard the ones that naturally thrive there.A large number of flowering, non-flowering, invasive and economically important plants are observed in the campus (Tables 1 and 2).

The biodiversity of Nehru College campus comprises a 221 species fitting to 85 genera below 65 families in addition to the lichens, mycoflora, pteridophytes and bryophytes. Among the documented higher plants, dicots are dominating followed by monocots.Overallanalysisrevealedthatherbsweredominatingflora followedbyshrubs and trees.Among the documented dicots, Fabaceae is first dominant family and followed, Rutaceae, Apocynaceae, Musaceae,Phyllanthaceae, Nyctagenaceae and Bignonaceae with an average of 25-30 species (Figure 1). On campus, there are several trees, herbs, bushes, climbers, lianas, twiners, and grasses. Every one of the plants are also found to be thriving, growing quickly, and pest- and disease-free. Themajorgrassesare*Cynodondactylon* (ArugamPullu), *Dactylocteniumaegyptium* (Crowfoot grass) and *Cyperusrotundus* (KoraiPullu). Weak stemmed creeperplantsgrowalongside theground,depends anotherplantsupport orclimbupa wallthrough extending their stems or branches. Climbers include herbs or shrubs whose stems æweak which needs support to grow where it climbs up trees and walls as well as propagatedynamicallydeprived ofpestanddiseaseattackwere alsoobservedinthecampus.The variations in flora is due to climatic condition, soil and water quality in the campus (Saranya *et al*., 2023).

Many plants remain considered to be extremelycompetent in oxygen release and assimilating carbon dioxide (Carbon sinks), that reflects on the excellence of the green campus. Stakeholders may not experience different cardiovascular, respiratory, and respiratory issues provided a greater amount of oxygen is rendered organically accessible on campus. *Sansevieria zeylanica*(generallyrecognized as snake plant/mother-in-law's tongue plant) is exclusive for oxygen release during night time and it isable to purify the atmospheric air in terms of removal of toxic gases. Although there are choices to increase the level of oxygen by lowering CO_2 with the use of oxygenators and air purifiers, there are other ways to improve air quality which are helpful to both the body and the mind. The audited organization's green audit found that the campus is properly dispersed with additional oxygen releasing and CO_2 assimilating plants for instance Money plants, Neem trees, Tamarind trees, Arali trees, and Pongam trees.

Earth's climatic conditions have altered recently as a result of a sharp rise in worldwide warming and other changes in the environment, such as increases in the number of people and activity. Additionally, burning mostly fossil fuels and using them extensively raises atmospheric concentrations of greenhouse gases that trap heat. The greenhouse gas emissions caused by humans are contributing to global warming and have significantly changed weather patterns. Generally, the amount of carbon dioxide entering the air is measured at several locations around the campus using a handheld CO_2 detector (Gowri & Harikrishnan, 2014).The comments showed that the atmosphere's CO_2 concentration is perfect because it is below the CO_2 threshold limit. It is also shown that all of the selected places have clean air with no

air pollutants and good air exchange/circulation on campus. Some locations, such as the Canteen and Class Rooms, have significant levels of carbon dioxide owing to student mobilization and the highest numeral of electrical stable equipment from that carbon dioxide emission was detected, followed by all labs, seminar and auditorium halls (Table 3).

The quantity of oxygen accessible in the air or aquatic bodies is referred to as the oxygen level. Except for rare microorganisms, oxygen is created/released as a byproduct of photosynthesis in all green plants through metabolic process. All living creatures' metabolic functions, such as respiration and energy-producing chemistry, rely heavily on oxygen. An oxygen meter is used to quantify the oxygen level. The atmosphere is composed of 18-21% oxygen, 75-78.5% nitrogen, and 2-3% additional gases such as carbon dioxide, neon, and hydrogen. The quantity of oxygen in the surrounding air is controlled by abiotic factors including height, latitude, and longitude, as well as biotic factors such as nearby plantations. Humans get headaches and shortness of breath when the oxygen content in the atmosphere is low. If it is present in excess, it damages human lungs and can lead to oxygen poisoning and oxygen poisoning by making individuals cough and have breathing problems. The carbon dioxide and oxygen level concentration of different places in thecampuswere measured andpresented in the Table 3. The results revealed that both carbon dioxide and oxygen level concentration were found to be within the permissible limits.

In order to cover the soil with green grass and give the region a greenish look, lawns are striking features of vacant property. The space separating the building's parts is hollowed out by the grass. The shady trees that border the grassy area, pathways, and garden benches are significant components of the campus's green project. The benefit of lawn is that it reduces unintentional weed development in unutilized landscaping areas. Trees native to the land with medicinal, ethnic, and environmental significance contribute to green construction. The purpose of trees is to give shade and shelter to a variety of birds. Shrubs are small plants with robust stems that may be able to hold soil more effectively than herbs and hence avoid soil erosion. Herbs are tiny plants with medicinal characteristics. Wall structures can aid in climbers' development, and climbers can improve the value of the wall by adding vegetation.

Rising a variety of herbal floras with therapeutic value on campus develops more appealing and beneficial if gardens remainconserved. Rare Endangered Threatened (RET) plants are the most economically valuable. The tree garden / arborea known to be established in accordance with the zodiac signs, attracting the public and educating them on their functions. In the tree gardens, trees used as campus linings might serve as oxygen corridors. Native trees may be grown to the fullest degree feasible, along with trees of the *Pongamia*, *Azadirachta* and *Ficus* species, which are used to greatly clean the air by removing carbon and dust particles from it. Similar to this, exterior gardens can keep gorgeous plants with lovely blooms to create a pleasant atmosphere (Vinothkumar *et al*., 2023).

On campus, ornamental plants are grown to exhibit appealing characteristics such as different types of leaves and their texture, flowers and their aroma, fruit, stem, and bark. Plants with unique characteristics, such as cactus thorns and snake cactus, are placed in specific areas to attract attention. Many different types of attractive plants are kept in the vicinity of the Organization's site. No plant is ever cut unless it is dead. Plants should be enthusiastically grown on campus using natural or eco-friendly ways to help prevent environmental pollution. To maintain the campus organic, it is important to use biological fertilizers, organic manures (cow dung, vermiculite, and agricultural waste and debris), and

green manures to develop healthy plants. Green manures should be made from plant waste, such as discarded leaves, stems, fruits, nuts, and seeds. All of the plant- and animal-based wastes may be converted into green/organic manures with the use of a concrete or ground-level green manure manufacturing unit and vermicomposting equipment. Although "zero use" of chemical fertilizers is highly commended, little use of chemical fertilizers as part of a Combined Nutrient Management system is permitted.

Conclusion

The organization has achieved significant advances in learning and instruction, research and consulting, technological development and exchange, community service, and quality education. It offers high-quality education to rural regions, tribal, and urban residents across the country, is excellent in terms of educational endeavors, and offers stakeholders a safe and environmentally pleasant atmosphere. The organization has made significant efforts to keep the campus green in a sustainable manner. It has implemented a variety of measures to serve regional and tribal populations while limiting environmental damage. It is significant because a rainwater collecting system and irrigation system were installed to preserve rainfall and enhance ground water levels. On a small scale, the Organization established medicinal, herbal, and ornamental gardens in order to establish a tremendous forest restoration / afforestation initiative in which an extensive variety of tree and shrub species have been planted collectively in order to offer an environmentally sound sustainable environment to stakeholders.

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Table 1. Economically important tree species atNehru Arts and Science College, Coimbatore, India

S.No	Common Name	Botanical Name	Family
1.	Neem Tree	*Azadiracta indica*	Meliaceae
2.	Karivepilai	*Murrayakoenigii* (L.) Spreng.	Rutaceae
3.	Mango Tree	*Mangifera indica* L.	Annacardiaceae
4.	Tamarind Tree	*Tamarindus indica* L.	Caesalpiniaceae
5.	Vaagai	*Albizia lebbeck* (L.) Willd.	Mimosaceae
6.	Indian Almond	*Terminalia catappa* L.	Combretaceae
7.	Naaval	*Syzygiumcumini* (L.) Skeels.	Myrtaceae
8.	Coconut	*Cocus nucifera* L.	Arecaceae
9.	Teak	*Tectona grandis* L.	Lamiaceae
10.	Tamarind	Leucaena leucocephala L.,	Fabaceae
11.	Mango	*Mangifera indica* L.	Anacardiaceae
12.	Guava	*Psidium guajava* L.,	Myrtaceae
13.	Murungai	*Moringa pterygosperma*	Moringaceae
14.	Nelli	*Phyllanthus emblica*	Phyllanthaceae
15.	Jack fruit	*Artocarpus heterophyllus*	Moraceae
16.	Amla	*Phyllanthus acidus*	Phyllanthaceae
17.	Ficus	*Ficus benjamina*	Moraceae

Table 2. Commonly available floweringplantsatNehru Arts and Science College, Coimbatore, India

S.No	Common Name	Botanical Name	Family	Habitat
1.	Nettilingam	*Polyalthia longifolia* Sonn.	Annonaceae	Tree
2.	Pungamaram	*Pongamia pinnata* (L.) Pierre,	Fabaceae	Tree
3.	Monkey Bush	*Abutilon indicum*	Malvaceae	Herbs
4.	Cycas	*Cycas revoluta* L.	Cycadaceae	Shrub
5.	Golden cane palm	*Dypsislutiscens*	Arecaceae	Tree
6.	Trumpet Flowers	*Tecoma stans* (L.) Kunth.	Bignoniaceae	Shrub
7.	Perunkondrai	*Peltophorumpterocarpum* DC.	Caesalpiniaceae	Tree
8.	Palmyra palm	*Borassus flabellifer* L.	Arecaceae	Tree
9.	Hibiscus	*Hibiscus rosa sinensis*	Malvaceae	Shrub
10.	Bottle Palm	*Hyophorbelagenicaulis*	Arecaceae	Tree
11.	Frangipani	*Plumeria*	Apocynaceae	Tree
12.	Flamingo Flower	*Anthurium*	Araceae	Shrub
13.	Yellow bells	*Tecoma stans* (L.) Kunth	Bignonaceae	Shrub
14.	Paper flower	*Bougainvillea glabra*	Nyctaginaceae	Shrub

Table 3. Carbon dioxide and Oxygen concentrationsatNehru Arts and Science College, Coimbatore, India

S.No.	Organization's Campus	Carbon dioxide level (ppm)*	Oxygen Level (%)*	Remarks
1.	Classroom	655.7±2.5	20.8± 0.1	Within permissible limits
2.	Auditorium	465.0±5.3	20.7± 0.2	Within permissible limits
3.	Seminar Hall	520.7±5.2	20.7± 0.2	Within permissible limits
4.	Library	415.3±5.1	20.9± 0.1	Within permissible limits
5.	Laboratory	580.3±5.0	20.5± 0.1	Within permissible limits
6.	Canteen	390.3±5.3	20.6± 0.2	Within permissible limits
7.	Open Area	425.7±4.8	20.7 ± 0.1	Within permissible limits
8.	Car Parking area	390.7±6.3	20.9± 0.1	Within permissible limits

Figure 1. Predominant plant species with respect to family