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Green Audit: A Case Study of Sophia Girls College (Autonomous), Ajmer, Rajasthan

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Abstract: ***The only planet in the cosmos that sustains life is Earth and no life can exist without sustainable development. In present scenario of breakneck industrial and economic development all over the world, Green audit is an indispensable component of functioning of Academic institutions. The present study focuses on assessment of the status of environment sustainability within the premises of Sophia Girls' College, Ajmer. Green audit is a significant tool for evaluation of impact of the day-to-day activities of an institution on its natural resources and environment. The intention of conducting Green audit is to ensure that the practices followed in the campus are in conformance with the Environment policy adopted by the college. The present study will help in acquiring information and data on various parameters viz. plant diversity, soil quality etc. of the environment of Sophia college campus. These parameters would then be analyzed to understand the present status of environmental quality and will give an idea of what needs to be done further to improvise the same. The results of the present case study indicate that Sophia Girls College campus has a rich biological diversity comprising of different kind of trees, shrubs, herbs, birds, insects, reptiles etc. The soil quality is also good and supportive for cultivation of varied kind of vegetation. The environment of the college is green, clean and sustainable as reflected and evidenced by the Green audit report.***

Keywords: Academic institutions, Conservation, Environment, Green campus, Sustainable

I. INTRODUCTION

In the present era of hasty industrialization, urbanization and economic development nature and environment are over-exploited to gain the profit. Around the globe, biological communities that took millions of years to develop are being devastated by human activity (Sharma P.D.)[6]. This act of mankind is reflected in terms of frequent occurrence of natural calamities like earthquakes, flood, landslides and sudden outbreak of epidemic and pandemic diseases. This is high-time and we urgently need to think and act in the direction of replenishing and restoring our Mother Nature to keep the life flourishing on the planet Earth. For the conservation of environment, we need to make judicious decisions and choices over selfish demands and greed. Realizing the need of responsibility towards environment, NAAC, an autonomous body under UGC has added the concept of environmental audit in accreditation methodologies of Universities and Colleges. In this context it becomes mandatory to adopt the concept of Green campus for Academic institutes which will lead to development and expansion of sustainable environment on earth (Bhosle B.B. 2018)[2]. Green audit is useful to find out the cause and sources of environmental degradation. It also encompasses other aspects of environmental monitoring like waste management, energy consumption, and quality of air, water and soil (Patil et al., 2019)[4]. Maintenance of proper accounts on environment and natural resources will check their depletion and degradation and ultimately protect the loss of economic growth and public health and assist to measure economic performance more accurately (Arora P. 2017)[1].

Environment consciousness is a deep concern at Sophia Girls' College and it works on several dimensions of 'Green campus', including survey of biodiversity, tree plantation, water conservation, use of alternate energy and waste management. A whole realm of environment related activities and programmes are conducted in the college to impart sensitization towards environment. Continuous and regular monitoring of the institutional activities having an impact of environment sustainability is important to make sure the development with green practices in the college campus (Sahu et al., 2018)[5]. The reckless exploitation of environment witnessed during the last century has led to environmental degradation. It is imperative to nurture the values of care and concern for the environment, use of natural resources in a rationale and constructive way and for living in harmony with nature (Gulati S. & Pant D., 2012)[2].

A. About The College

Sophia Girls' College (Autonomous), Ajmer, founded in 1919 as a small primary school, gradually grew and acquired the degree status 1959 with the main objective of education of girl child in the state of Rajasthan. Presently the institution is an autonomous A grade college affiliated to MDS University, Ajmer. The institution got the Autonomous status in the year 2015 by NAAC. This is one of the pioneering institutes in the field of women education in Rajasthan, striving for the wholesome development of personality including ethical development which is fundamental for responsible decision making.

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Making students sensitive to the environment and the need for its protection is an immediate social concern. Environment protection and conservation has always been of prime concern at Sophia College and on this background we have taken the initiative of Green audit of the campus since 2018. The college has Nature club which is long been working for creating awareness about environmental issues among students. The NSS and NCC units also contribute their efforts frequently in saving and conserving environment by conducting activities like tree plantation, nukkad natak etc. Self audit (of environment) by the internal audit committee helps to assess the performance of the college in environmental sustainability and also in evaluating the degree to which departments are in compliance with the applicable policies and standards.

B. Objectives of The Study

1) To collect the basic information and data on practices employed by the college for resource utilization and conservation.
2) To analyze the pattern and extent of resource utilization on campus.
3) To examine the status of biodiversity in the campus.
4) To suggest best appropriate measures to be taken for achieving environment sustainability.

II. METHODOLOGY

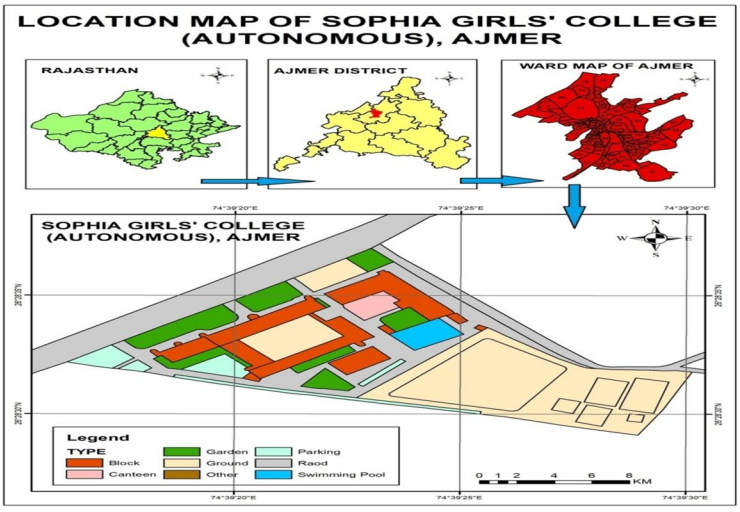
A. Stages of Green audit

To achieve the objectives of Green audit following stages were implemented:

1) Pre-audit Stage
a) Establishment of Environment and energy audit committee
b) Declaration of Environmental policy
c) Implementation and operation
2) Audit-Stage
a) Physical inspection of the campus by an external auditor accompanied with the internal audit committee
b) Verification of documents
c) Suggestions and recommendations by the external auditor
3) Post-audit Stage
a) Evaluation of the audit report
b) Preparation of an action plan as per the recommendations of audit committee
c) Follow-up of the programmes and activities

B. Geographical location of the study site

Established in the year 1959, Sophia Girls' College situated in Ajmer, Rajasthan, has been accredited 'A' Grade by NAAC and is affiliated to Maharishi Dayanand Saraswati University, Ajmer. The Campus of Sophia Girls' College spreadsover an area of 9.9 acres and is located on $26^0 28' 20.24''$ N latitude and $79^0 39' 20.24''$ E longitude.



Source: Green audit report of Sophia Girls' College, Ajmer, Rajasthan

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C. Survey of the College Campus

For studying the plant diversity of the campus and for data collection the campus was thoroughly surveyed by the members of the audit committee from the department of Botany. Data was collected specifying the variety of trees, medicinal plants, cacti and ornamental plants distributed in the campus.

D. Analysis of Soil Quality

Soil samples were collected from different sites in the campus and were sent to Krishi Vigyan Kendra, Tabiji, Ajmer for determination of various parameters viz. soil pH, conductivity, organic carbon, phosphate and potash.

III. RESULT AND DISCUSSION

A. Plant Diversity of the Campus

Sophia Girls' College, Ajmer has a rich biodiversity embracing variety of trees, shrubs, herbs and large number of animal species.

Following are the lists of plants and trees present in the college campus:

Table 1. List of Trees Specifying their Common Names, Scientific Names and Families

S.No.	Common name	Botanical name	Family
1	Areca palm	Dypsis spec.	Arecaceae
2	Banana	Musa spec.	Musaceae
3	Benjamin fig	Ficus benjamina	Moraceae
4	Bottle brush	Callistemon citrinus	Myrtaceae
5	Bougainvillea	Bougainvillea spec.	Nyctaginaceae
6	Buddha tree	Polyalthia longifolia	Annonaceae
7	Burrawong	Macrozamia spec.	Arecaeae
8	Camel's foot tree	Bauhinia variegata	Caesalpinaceae
9	Chamror	Ehretia laevis	Boraginaceae
10	Coconut	Cocus nucifera	Arecaceae
11	Crape jasmine	Tabernaemontana divaricata	Apocynaceae
12	Desert teak	Tecomela undulata	Bignoniaceae
13	Drumstick	Moringa oleifera	Moringaceae
14	Fire of forest	Butea monosperma	Fabaceae
15	Flamboyant	Delonix regia	Fabaceae
16	Glue berry	Cordia dichotoma	Boraginaceae
17	Guava	Psidium guajava	Myrtaceae
18	Indian elm	Holoptelea integrifolia	Ulmaceae
19	Indian gooseberry	Phyllanthus emblica	Euphorbiaceae
20	Indian laburnum	Cassia fistula	Fabaceae
21	Indian plum	Zizyphus mauritiana	Rhamnaceae
22	Indian rosewood	Dalbergia sisso	Fabaceae
23	Jasmine	Nyctanthes arbor-tristis	Oleaceae
24	Java plum	Syzygium cumini	Myrtaceae
25	Lemon	Citrus spec.	Rutaceae
26	Mango	Mangifera indica	Anacardiaceae
27	Margosa tree	Azadirachta indica	Meliaceae

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28	Monkey puzzle tree	Araucaria spec.	Araucariaceae
29	Naseberry	Manilkara zapota	Sapotaceae
30	Orange jasmine	Murraya paniculata	Rutaceae
31	Palmyra palm	Borassus flabellifer	Arecaceae
32	Plum	Zizyphus spec.(hybrid)	Rhamnaceae
33	Pomegranate	Punica granatum	Lythraceae
34	Popcorn tree	Casssia siamea	Fabaceae
35	Prosopis	Prosopis cineraria	Fabaceae
36	Rock palm	Brahea calcarea	Arecaceae
37	Royal palm	Roystonea regia	Arecaceae
38	Sacred fig	Ficus religiosa	Moraceae
39	Sago palm	Cycas spec.	Cycadaceae
40	Sugar apple	Annona aquamosa	Annonaceae
41	Temple flower	Plumeria alba	Apocynaceae
42	Tree of heaven	Ailanthus excelsa	Simaroubaceae
43	White lead tree	Leucaena leucocephala	Mimosaceae
44	White-cedar	Thuja spec.	Cupressaceae

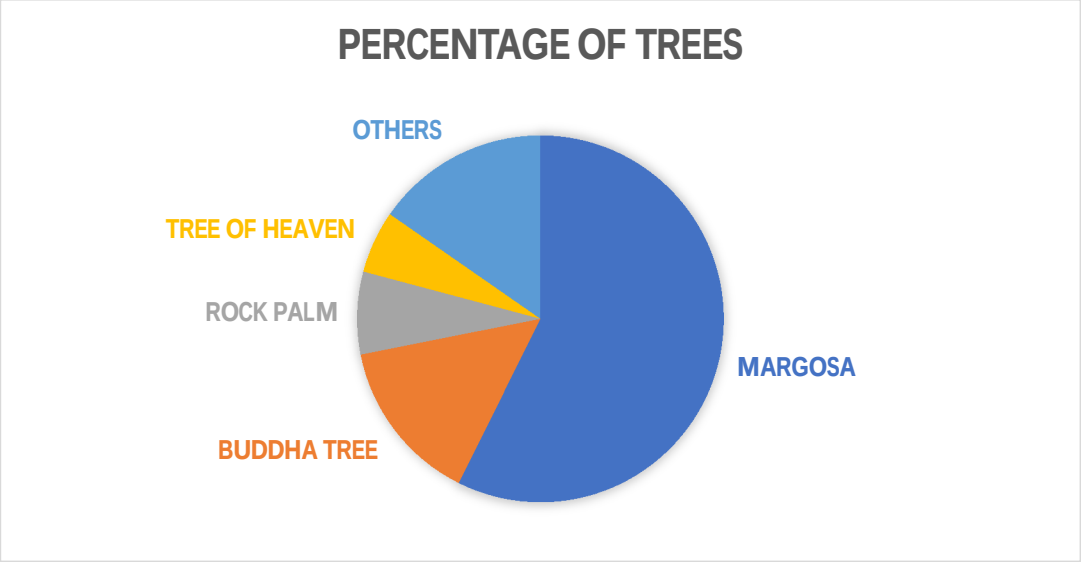

Fig. 1. Percentage of Tree Diversity in the Campus

The list specified in Table 1 indicates that Sophia College has rich tree diversity which, in turn, implies that the college campus provides a favorable environment for the luxuriant growth of different kinds of plant species. As shown in Fig. 1, more than 50% of the campus flora comprises of Neem which is the most versatile, multifarious tree with immense potential. It possesses maximum useful non-wood products such as leaves, bark, flowers, fruits, seeds, gum, oil and neem cake than any other tree species. Neem tree has a high rate of photosynthesis and liberates more oxygen than many other tree species, thus purifying the atmosphere. The plant debris is a potential source of organic manure. Another important tree present in the campus is Aru- 'the tree of heaven' which is a fast growing and drought tolerant tree. It prevents soil erosion. Palm trees improve air quality and their symmetric shape adds another dimension to the miraculous beauty of our college. *Polyalthia longifolia* provides dense shade and also adds to the spectacular view of the college due to its elegant appearance.

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Table 2. List Of Medicinal Plants Specifying their Common Names, Scientific Names and Families

S. No.	Common name	Botanical name	Family
1	Aloe	Aloe vera	Liliaceae
2	Bengal currents	Carissa carandas	Rutaceae
3	Bishop's weed	Trachyspermum ammi	Apiaceae
4	Castor plant	Ricinus communis	Euphorbiaceae
5	Drumstick	Moringa oleifera	Moringaceae
6	Flamboyant	Delonix regia	Fabaceae
7	Flame of forest	Butea monosperma	Fabaceae
8	Flaming katy	Kalanchoe blossfeldiana	Crassulaceae
9	Holy basil	Ocimum sanctum	Lamiaceae
10	Indian asparagus	Asparagus racemosus	Asparagaceae
11	Indian ginseng	Withania somnifera	Solanaceae
12	Indian gooseberry	Phyllanthus emblica	Phyllanthaceae
13	Indian laburnum	Cassia fistula	Fabaceae
14	Java plum	Syzygium cumini	Myrtaceae
15	Lemon	Citrus limon	Rutaceae
16	Madar	Calotropis procera	Asclepediaceae
17	Malabar nut	Adhatoda vasica	Acanthaceae
18	Margosa	Azadirachta indica	Meliaceae
19	Mint	Mentha piperita	Laniaceae
20	Orange jasmine	Murraya paniculata	Rutaceae
21	Papaya	Carica papaya	Caricaceae
22	Prosopis	Prosopis cineraria	Fabaceae
23	Rosy periwinkle	Catharanthus roseus	Apocynaceae
24	Shoe flower	Hibiscus rosa-sinensis	Malvaceae
25	Sprout leaf plant	Bryophyllum pinnatum	Crassulaceae
26	Temple flower	Plumeria alba	Apocynaceae
27	Thorn apple	Datura stramonium	Solanaceae
28	White leadtree	Lucaena leucocephala	Fabaceae
29	Wild jujube	Zizyphus nimmularia	Rhamnaceae
30	Wood sorrel	Oxalis spec.	Oxalidaceae

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The above table (Table 2) presents the diversity of medicinally important plants flourishing in the Sophia College campus. Neem tree contains a large number of biologically active compounds. All the parts of this plants i.e. leaves, flowers, fruits, bark etc. are used in the treatment of inflammation, skin diseases, fever and dental problems. Aloe vera is a short succulent plant which is widely used in a large number of herbal remedies. It is an antioxidant and has anti-microbial properties. Ashwagandha has multiple health benefits and is used in treating anxiety and stress, fights depression and boosts fertility in men. Likewise *Phyllanthus emblica* is also an extensively useful medicinal plant. It is rich source of vitamin C which improves immunity and boosts metabolism. The healing properties of amla are innumerable and therefore it is considered as a divine tree. *Catharanthus roseus* is a profusely branched, perennial plant which is popularly grown as an ornamental but it is also a potent medicinal plant. It contains medicinally active alkaloids like vincristine and is useful in the treatment of cancer. Another plant of this list i.e. Kalanchoe is beneficial in wound healing and curing inflammations. Sophia College cultivates a large number of medicinally important, miracle plants which makes the campus a healthy place to live.

Table 3. List Of Vegetables Specifying their Common Names, Scientific Names and Families

S.No.	Common name	Botanical name	Family
1	Beet root, chukander	*Beta vulgaris*	Amaranthaceae
2	Bitter melon, karela	*Momordica charantia*	Cucurbitaceae
3	Brinjal, bengan	*Solanum melongena*	Solanaceae
4	Carrot, gajar	*Daucus carota*	Apiaceae
5	Cauliflower, gobhi	*Brassica oleracea*	Brassicaceae
6	Cluster bean, guar	*Cymopsis tetragonoloba*	Fabaceae
7	Coriander, dhania	*Coriandrum sativum*	Apiaceae
8	Cucumber, kheera	*Cucumis sativus*	Cucurbitaceae
9	Fenugreek, methi	*Trigonella foenum-greakum*	Fabaceae
10	Garlic, lehsun	*Allium sativum*	Amaryllidaceae
11	Green chilli, mirch	*Capsicum annuum*	Solanaceae
12	Indian squash, tinda	*Praecitrullus fistulosus*	Cucurbitaceae
13	Mint, pudina	*Mentha piperita*	Lamiaceae
14	Onion, pyaz	*Allium cepa*	Amaryllidaceae
15	Pea, matar	*Pisum sativum*	Fabaceae
16	Potato, aalo	*Solanum tuberosum*	Solanaceae
17	Radish, muli	*Raphanus sativus*	Brassicaceae
18	Ridge guard, turai	*Luffa acutangle*	Cucurbitaceae
19	Spinach, palak	*Spinacia oleracea*	Amaranthaceae
20	Tomato, tamatar	*Lycopersicon esculentum*	Solanaceae

A good number of seasonal vegetables are cultivated in Sophia College as evident by the above table (Table 3). All these vegetable are grown by organic farming and are used for consumption in the college hostel. The list of vegetables includes a wide variety like vegetables obtained from underground plant parts viz. beet root, potato, radish, carrot etc., green leafy vegetables such as spinach, mint and coriander.

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Table 4. List Of Ornamental Flowering Plants Specifying their Common Names, Scientific Names and Families

S.No.	Common name	Botanical name	Family
1	Barbina	*Verbena* spec.	Verbenaceae
2	Bougainvillea	*Bougainvillea* spec.	Nycatginaceae
3	Carnation	*Dianthus* spec.	Caryophyllaceae
4	China rose, gudhal	*Hibiscus-rosa-sinensis*	Malvaceae
5	Cockscombs	*Celosia* spec.	Amaranthaceae
6	Crossvine	*Bignonia* spec.	Bignoniaceae
7	Dahlia	*Dahlia* spec.	Asteraceae
8	Daisy	*Gerbera* spec.	Asteraceae
9	Daisybush	*Osteospermum* spec.	Asteraceae
10	Dombeya	*Dombeya* spec.	Malvaceae
11	Genda, marigold	*Tagetes* spec.	Asteraceae
12	Guldaudi	*Chrysanthemum* spec.	Asteraceae
13	Marigold	*Calendula* spec.	Asteraceae
14	Nasturtium	*Tropaeolum* spec.	Tropaeolaceae
15	Oleander, kaner	*Nerium oleander*	Apocynaceae
16	Pattharchatta	*Kalanchoe blossfeldiana*	Crassulaceae
17	Periwinkle, sadabahar	*Catharanthus* spec.	Apocynaceae
18	Petunia	*Petunia* spec.	Solanaceae
19	Poinsettia	*Euphorbia pulcherrima*	Euphorbiaceae
20	Rose, gulab	*Rosa* spec.	Rosaceae
21	Sage	*Salvia* spec.	Lamiaceae
22	Snnezeweed	*Helenium* spec.	Asteraceae
23	Sword lily	*Gladiolus* spec.	Iridaceae
24	Violet	*Viola* spec.	Violaceae

Sophia Girls' college has a spectacular view owing to its beautiful gardens and green landscaping. Being an institution concerned for nature and environment, the college always keeps on augmenting its flora by nurturing diverse types of traditional and novel ornamental plants. The list of ornamental plants includes annuals like guldaudi, dahlia, cockscomb, petunia and perennials like bougainvillea, catharanthus, rose, nerium etc.

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Table 5. List of Varieties of Cactus

S.No.	Common name	Botanical name
1	Agave	*Agave* spec.
2	Barrel cactus	*Ferocactus* spec.
3	Branched pencil cholla	*Cylindropuntia* spec.
4	Bunny cactus	*Opuntia microdasys*
5	Carmine cob	*Echinopsis* spec.
6	Cereus	*Cereus* spec.
7	Claret cup hedgehog	*Echinocereus* spec.
8	Crown of thorns	*Euphorbia* spec.
9	Drunkard's dream	*Hatiora* spec.
10	Needle palm	*Yucca* spec.
11	Peanut cactus	*Chamaelobivia* spec.
12	Pincushion cactus	*Mammilaria* spec.
13	Starry ball	*Coryphantha* spec.

Sophia College is situated in Rajasthan, which is a dry state as it receives very scanty rainfall. The college has grown a range of drought resistant and drought tolerant plants i.e. cacti and succulents, which also adds to the biodiversity of the campus. Cacti are capable of thriving in the regions where little vegetation can survive due to harsh and arid environment. These plants are succulent perennials with thick fleshy stem and leaves and require very little water. A good number of distinct varieties of cactus are planted in the campus which complements the aesthetic view of the college.

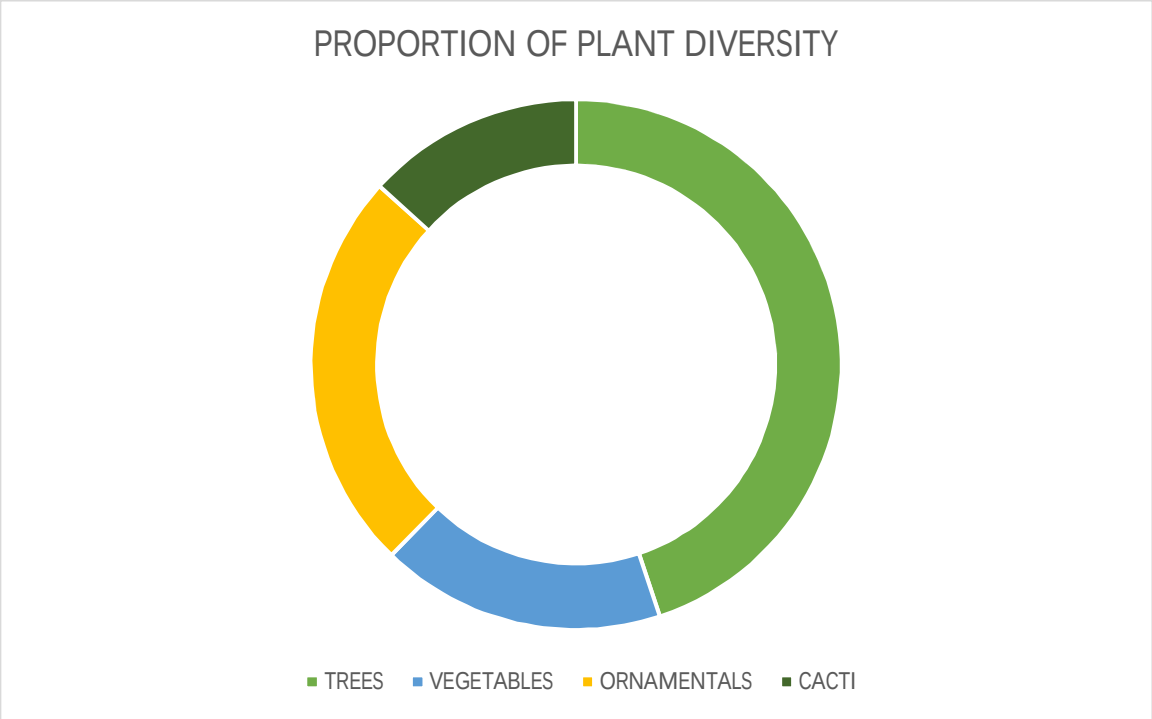

Fig. 2. Proportion of Plant Diversity in the Campus

Fig. 2 manifests that, of the total plant diversity in Sophia College campus, trees represent the maximum proportion followed by ornamental plants. A large number of trees in the campus help in mitigating the adverse effects of pollution and making the environment placid and relaxing. The ornamental plants play an important role in reducing stress and increasing concentration and work efficiency. The rich biological diversity of Sophia College reveals that it has a wholesome and sustainable environment.

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B. Soil Quality Analysis

Soil samples from different locations of Sophia College campus were sent to Krishi Vigyan Kendra, Tabiji, Ajmer for quality testing. The data obtained from soil testing is as follows:

S.No.	Sample site	pH	Conductivity (mmho/cm)	Organic carbon %	Phosphate (Kg/ Hec.)	Potash (Kg/ Hec.)
1	Sophia Girls' College Garden	8.9	0.12	0.27	25	215
2	Sophia Girls' College Hostel Garden	8.7	0.15	0.33	23	172
3	Sophia Girls' College Field	8.7	0.13	0.30	20	218

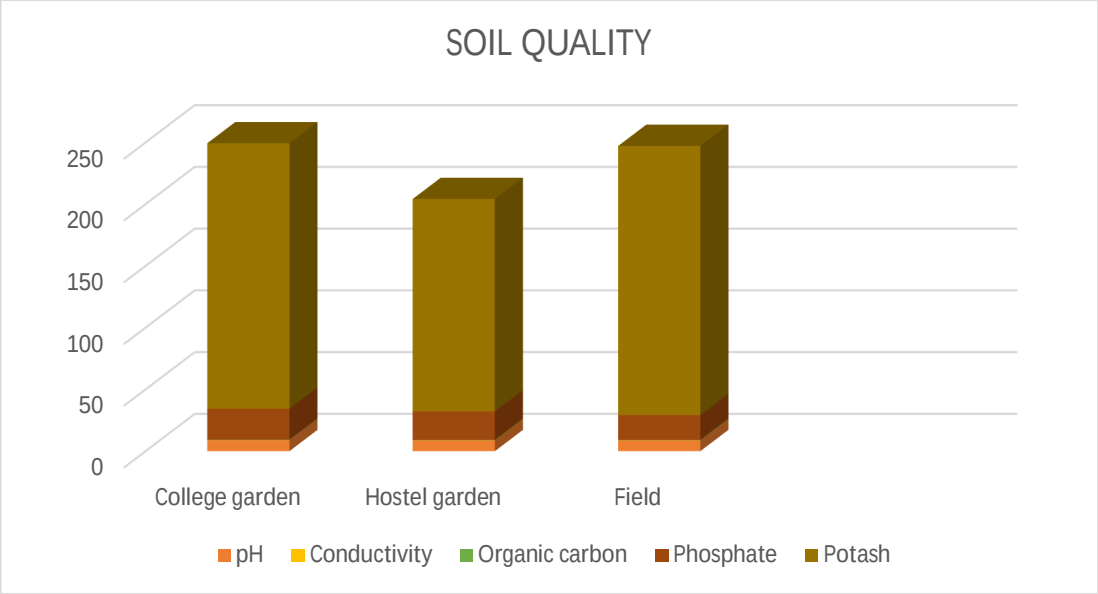

Fig. 3. Soil Quality Analysis

The soil pH of samples taken from the campus is slightly alkaline which affects nutrient absorption by plants. Soil conductivity is a measure of soil salinity which affects growth of micro-organisms and nutrient absorption. The value of conductivity in college soil samples is acceptable for proper plant growth. Organic carbon determines the soil fertility, soil structure and water holding capacity of the soil. The soil samples of Sophia College have less organic carbon which needs to be increased for improving soil fertility. Phosphorous is needed for flowering and potash affects the disease resistant ability of plants, thus these are quite important minerals for plant growth. The values of these two nutrients in college samples are within optimum range.

IV. CONCLUSION

The results of Green audit of Sophia college campus, conducted by an external auditor accompanied with the internal audit committee, revealed that various parameters of environment like soil quality, green landscaping etc. are up to the mark. The college maintains proper standards of environmental sustainability and has an effective environment policy with implementation. The ecological diversity and soil quality are well in the prescribed limits and hence the college can be considered as a green and serene place with apt environment for higher education. The campus is embellished with variety of plant species including Neem, Ashoka, Aru, Palms, Roses, cacti etc. which makes the environment pure and refreshing. The soil pH is slightly alkaline and other parameters are within the permissible limits. The overall outcome of the Green audit indicates that Sophia Girls' College has a captivating and sustainable environment and is always committed in making it better every day. After successful completion of the audit the college has been honored with the certificate by external auditor.

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V. ACKNOWLEDGEMENT

I extend my sincere gratitude to Krishi Vigyan Kendra, Tabiji, Ajmer for providing the results of soil quality testing parameters of Soil samples of Sophia Girls' College, Ajmer.

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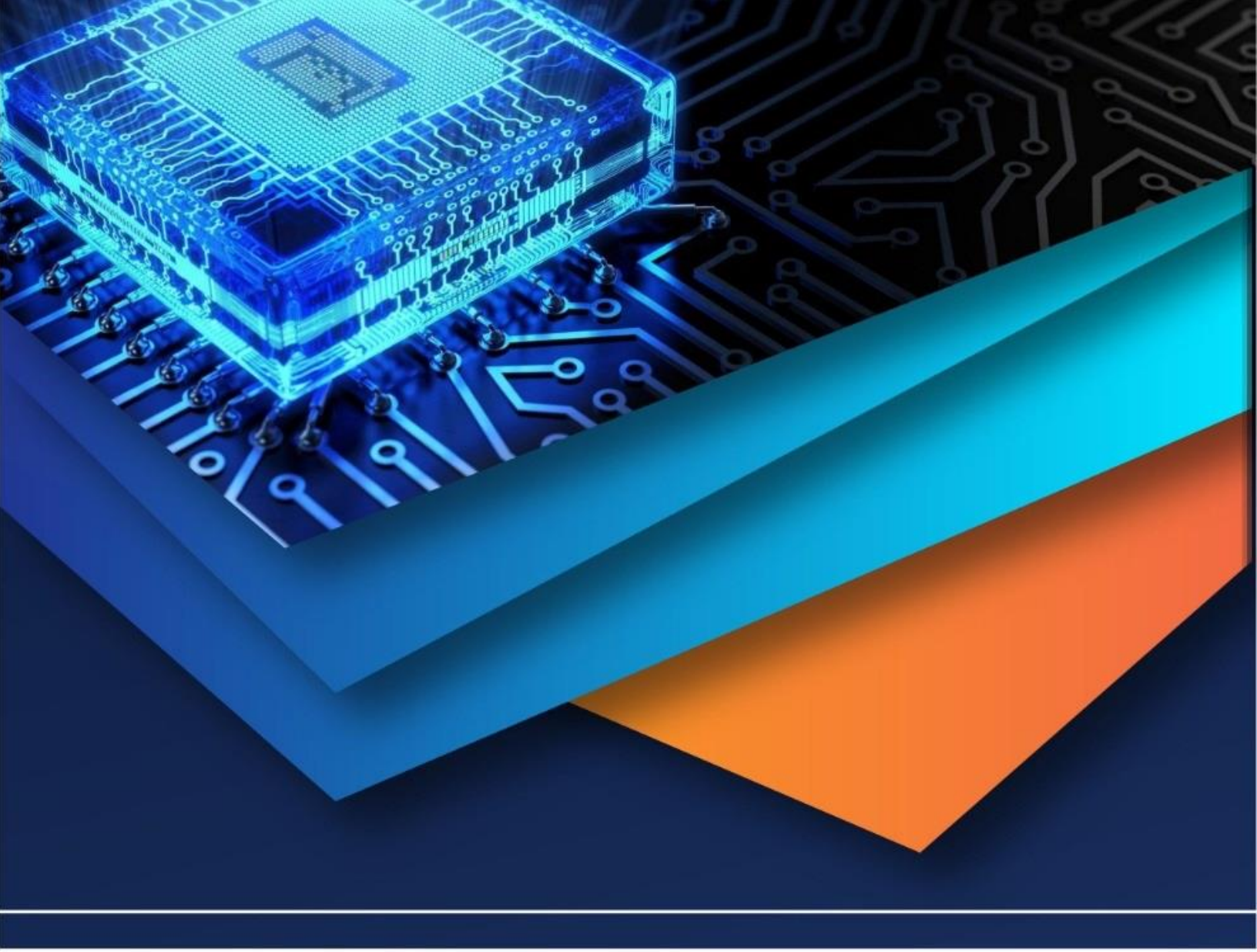

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