

Green Imperialism: A Case Study of Saharanpur Botanical Garden (1850-1947)

DISSERTATION

Submitted to

Babasaheb Bhimrao Ambedkar University

(A Central University)

Lucknow



For the Award of the Degree of

MASTER OF PHILOSOPHY

IN

HISTORY

Submitted By:

SHUBHAM YADAV

ENROLLMENT NO: 435/15

Under the Supervision of

Prof. S. Victor Babu

DEPARTMENT OF HISTORY

SCHOOL FOR AMBEDKAR STUDIES FOR SOCIAL SCIENCES

BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY

(A Central University)

VIDYA VIHAR, RAEBARELI ROAD, LUCKNOW-226025 (U.P), INDIA

2022

DECLARATION

I hereby declare that the dissertation entitled "**Green Imperialism: A Case Study of Saharanpur Botanical Garden (1850-1947)**" submitted to the Babasaheb Bhimrao Ambedkar University, Lucknow, for the award of the Degree of **Master of Philosophy** in History is an authentic record of original and independent research work carried out by me under the supervision of Prof. S. Vitor Babu, Head, Department of History, School for Ambedkar Studies, Babasaheb Bhimrao Ambedkar University (A Central University) Lucknow. I further declare that this research work has not been previously submitted before for the award of any other degree or diploma to any University or Institution. In keeping with the ethical practice in reporting research information, due acknowledgement has been made wherever the findings of others have been cited. This is also declared that the M. Phil Dissertation is free from all kinds of plagiarism.

Place: Lucknow

Date:

**Shubham Yadav
Research Scholar
Department of History
SASSS
BBAU, Lucknow**

CERTIFICATE

This is to certify that the M. Phil. Dissertation titled "**Green Imperialism: A Case Study of Saharanpur Botanical Garden (1850-1947)**" submitted by Mr. Shubham Yadav Enrollment No. 435/15, is an original research work and has not been previously submitted in part or full for the award of any other degree or diploma to this or any other university.

The dissertation submitted to Babasaheb Bhimrao Ambedkar University Lucknow satisfies all the requirements as stipulated in the Master of Philosophy (M. Phil) Regulations, 2019 and it is fit for submission and evaluation for the award of the degree of Master of Philosophy of the University.

Place:

Date:

Supervisor

Head of the Department

Document Information

Analyzed document	Chapter 1, 2, 3, 4.docx (D141490311)
Submitted	6/30/2022 7:33:00 AM
Submitted by	O. P. Saini
Submitter email	gbl.bbau@gmail.com
Similarity	4%
Analysis address	gbl.bbau.bbau@analysis.orkund.com

Sources included in the report

W	URL: http://www.isca.in/IJBS/Archive/v4/i6/3.ISCA-IRJBS-2015-052.pdf Fetched: 1/4/2022 8:26:15 AM	 1
W	URL: https://en.wikipedia.org/wiki/Botanical_garden Fetched: 11/3/2019 6:37:57 PM	 44

Entire Document

Chapter-I

Introduction

Botanic gardens are mostly visited by those who want to enjoy the plants and the beautiful surroundings. But very few of them are aware that plants have a fascinating history as well as several practical applications? Botanic gardens today play an important role in conservation by encouraging people and fostering an interest in nature and its preservation. Botanic gardens also play an important role in increasing awareness about the environmental issues, which includes the loss of genetic variety. As a result, botanic gardens serve a dual purpose of conservation and education. Each year, it is estimated that 100 million people visit botanic gardens around the world. Botanic gardens, with their living collections, seed banks, and trained specialists and scientists, are like an insurance policy mechanism that protects species from extinction.

Because the biosphere is a global garden, there is no doubt that the first garden was discovered rather than created. A belt of trees, plants with flowers and fruits added to the beauty of a natural setting. No one cares about these gardens, and they flourish on their own. According to the earliest reports, such places are the Gods' gardens or those beloved by the Gods; therefore, there is no need to make a special effort to maintain the site clean.

One of the human race's redeeming characteristics is its continued desire to create gardens and grow plants for pleasure rather than utility. Many of the beautiful gardens of the past are said to have perished without a trace, but this is an attempt to examine the loveliness and most fragile history of the best among the vanished and nearly vanished, as well as current gardens. Many of the spectacular gardens that can be found in South Africa, North and South America, Latin America, and the Caribbean are descended from previous gardens. The words grove, paradise, park, landscape, wilderness, and orchard are all used to describe gardens.

According to King (1979), the word "Paradise" was originally used by Xenophon, the Greek historian who lived around 400 BC to describe the nature of imitating parks of the Persian king and nobility. The term 'pleasure garden' was given the name paradise for many years and in various places. One of the first Persian gardens, known as the, "Old Man of the Mountains." This garden, according to Marco Polo, was cultivated with all of the world's finest fruits.

ACKNOWLEDGEMENT

This research work is my collective work with the help of various persons and institutions. Therefore, I express my gratitude to those helpers who really help me at every step in this research work, since it is not possible to acknowledge all from whom I received invaluable assistance from time to time in making the work a complete one. I would like to acknowledge those individuals and institutions without whom this would have remained incomplete. I had moments of joy and happiness during the period of this research.

*I must express my innate sense of gratitude to my supervisor **Prof. S. Victor Babu** for his imperative encouragement, support and much needed motivation. In spite of his busy schedule, he devoted considerable time in checking my draft and made valuable suggestions and corrections to it. His productive criticism throughout this period has been very useful.*

*I wish to thank **Prof. Shura Darapuri** for her scholarly guidance for my research. Her inspiring and indispensable moral support has been the dynamic force behind all my effort as a research scholar.*

*I also wish to express my deep sense of indebtedness to other faculty members of the Department of History, **Dr. V. M. Ravi Kumar (Associate Professor), Dr. Siddharth Shankar Rai (Assistant Professor)**, who has been a source of constant encouragement and guidance and thanks that they always kept their doors open for me to enrich my research with their valuable ideas and thoughts despite their busy schedule.*

*I wish to express my thanks to my friends, colleagues and senior research scholars **Dr. Isha Tamta, Assistant professor, Department of History, Lovely Professional University,***

Punjab, Dr. Becha Lal Research Assistant, CSSEIP, BBAU, Lucknow, Dr. Arvind Swaroop, Dr. Md. Ashraf Wani, Dr. Shivangi, Owais Ismail, Satish Kumar Chevuri, Kausalya Kumari, Shivangi Maindola, Trishala Raj, Basant Kumar Kanaujia, Rajeev Kumar Pandey, Satyamev Bharteey, Prerna Rai, Neeraj Kumar and Toolika Rani. I am thankful to the office Staff Jitendra Kumar Gautam and Satish Kumar for their cooperation in the Department.

I am also grateful to the staff members of many libraries who keep me well provisioned. These are: Gautam Buddha Central Library, BBAU (Lucknow), Saharanpur Botanical Garden Library, CSIR- National Botanical Research Institute Library, National Archives of India, U.P state Archives, Amir- Ud- Daula Public Library, Lucknow.

I extend my heartfelt thanks to the staff members of Government Garden Horticulture Experiment and Training Centre, Saharanpur, Shri Bhanu Prakash Ram (Joint Director), Shri Himanshu (Jr. clerk), Shrimati Rekha Sharma (Lab Attendant), without whose support it would very difficult to perform the required duties in every step of official work.

I wish to express my sincere thanks to Shiv Kumar Yadav, Archivist, U.P State Archive, Lucknow.

I wish to express my deep sense of indebtedness to the three most important influential persons of my life Prof. S. Victor Babu (Supervisor and Head of Department, BBAU, Lucknow), Dr. V. M. Ravi Kumar (Associate Professor, BBAU, Lucknow) and my Elder Brother Shivam Yadav (Ph.D. Scholar, Department of Chemistry, University of Lucknow, Lucknow). They have been my local guardians and a source of extraordinary support to me.

*I wish to express my special thanks to **Abhishek Singh (Senior research fellow), Centre for the Environment Indian Institute of Technology, Guwahati, Assam, India, and Shalini Yadav (M.phil Scholar)** whose wise suggestions and encouraging conversation infused in me a spirit of enquiry and hard work throughout the period.*

*I also wish to express sincere thanks to my best friend, **Anshika (M.sc in Life Science), Babasaheb Bhimrao Ambedkar University, Lucknow, Abhay Pandey (Senior research fellow) department of history, University of Lucknow, Lucknow.***

*My father **Mr. Mukesh Yadav** and mother **Mrs. Kusum Yadav** have always been my source of inspiration. They guided me to develop my personality and source of all my inspirations as a researcher. I learnt the basic ideas for inclusive thoughts from my father **Mr. Mukesh Yadav**. I would also like to record my sincere respect to my other family members and due thanks to my sister **Shivani Yadav (Bachelor of Ayurvedic Medicine and Surgery)**, and elder brother **Shivam Yadav (Ph.D. Scholar, Department of Chemistry, University of Lucknow, Lucknow)** for their constant encouragement and emotional support in every step of my life.*

Last, but not the least, I would like to thank one and all, whose best wishes kept me afloat amidst the storm.

Place:

Date:

(Shubham Yadav)

CONTENTS

Declaration		Page No.
Certificate		
Acknowledgement		
List of tables & figures		
Chapter-I: Introduction		1-7
1.1	Scope of the study	7
1.2	Context of the study	7-9
1.3	Objectives	9
1.4	Assumptions	10
1.5	Methodology	10-11
1.6	Review of literature	11-38
1.7	Chapterisation of the study	39-40
Chapter-II: The idea of Botanical Garden in India		41-44
2.1	Global perspective	44-62
2.2	Indian perspective	62-67
2.3	Regional perspective: Saharanpur Botanical Garden	67-69
Chapter- III: Functions, Scientist Contribution and Experiments of Saharanpur Botanical Garden		70-116
3.1	Contribution of Scientists	116-120
3.2	Experiments of Saharanpur Botanical Garden	120-142
3.3	Advocacy to farmers	142-145
3.4	Uniqueness of Saharanpur Botanical Garden	145-149

Chapter-IV:	Conclusions	150-156
Bibliography		157-182
Appendix-I		
Appendix-II		

LIST OF TABLES AND FIGURES

S.No.	Title	Page No.
Table No. 1.1	Plants Produced at the Centre's Nursery and Availability	89-90
Table No. 1.2	Spices	90
Table No. 1.3	Bougainvillea	90
Table No. 1.4	Medicinal Plants Trail	97
Table No. 1.5	Cultural Plants Trails	97-98
Table No. 1.6	Ethnobotanical Trail	98
Table No. 1.7	Rare Plants Trail	99
Table No. 1.8	Energy Trail	99
Table No. 1.9	Orchid Trail	100
Table No. 1.10	Experiments and Acclimatisation (1924-1925), Plants	131
Table No. 1.11	Experiments and Acclimatisation (1924-1925), Shrubs	131-132
Table No. 1.12	Experiments and Acclimatisation (1924-1925), Seeds	132
Table No. 1.13	Experiments and Acclimatization (1926-1927), Vegetable and Flower Gardens, amount of seeds	141
Table No. 1.14	Experiments and Acclimatization (1926-1927), Vegetable and Flower Gardens, quantity collected	141

LIST OF FIGURES

S. No.	Title	Appendix-I: Page No.
Figure 1	Oldest Map of Saharanpur Botanical Garden	1
Figure 2	Latest Map of Saharanpur Botanical Garden	1
Figure 3	Gate No. 1 (Nawab ganj)	2
Figure 4	Gate No. 2 (AlsiBag)	2
Figure 5	Gate No. 3 (Beri Bag)	2
Figure 6	Main Office of SBG	2
Figure 7	Side view of Main Office	2
Figure 8	Main Gate of Green House	3
Figure 9	Green House of SBG	3
Figure 10	GAAV (Diospyros Embryopteris Fabaceae): World Oldest Tree	3
Figure 11	GAAV (Diospyros Embryopteris Fabaceae): World Oldest Tree	3
Figure 12	Nursery for Farmers Training	4
Figure 13	Kashmiri vrakshon ka Teela	4
Figure 14	121 mangoes varieties have been planted on this tree by Root Stock System.	5
Figure 15	List of Multi species ideal Mango tree	5
Figure 16	List of South Indian Mango Species	5
Figure 17	Butterfly Park	6
Figure 17(a)	Side view of Butterfly Park	6
Figure 17 (b)	Butterfly Park Area Board	6
Figure 17 (c)	Interesting Facts of Butterfly Park	6
Figure 17 (d)	Butterfly Introduction	6
Figure 18	Laboratory of Saharanpur Botanical Garden	7

Figure 19	Mango Species (Alfanzo)	7
Figure 20	Mango Species (Chaunsa)	7
Figure 21	Mango Species (Swarn Rikha)	7
Figure 22	Mango Species (Langda)	7
Figure 23	Turmeric Species (CLS-16)	7
Figure 24	Potato Species (Badshah)	7
Figure 25	Potato Species (Anand)	7
Figure 26	Loquat (Tanaka)	7
Figure 27	Milky Mushroom	8
Figure 28	Button Mushroom	8
Figure 29	Oyster Mushroom	8
Figure 30	Carrot (Zeno)	8
Figure 31	Carrot (Royal king)	8
Figure 32	Turnip White-4	8
Figure 33	Pointed gourd (F.P.-1)	8
Figure 34	Pointed gourd (Banarashi Local)	8
Figure 35	Radish (white icicle)	8
Figure 36	Radish (Pusa Himani)	8



Chapter-I
Introduction

Introduction

Botanic gardens are mostly visited by those who want to enjoy the plants and the beautiful surroundings. But very few of them are aware that plants have a fascinating history as well as several practical applications? Botanic gardens today play an important role in conservation by encouraging people and fostering an interest in nature and its preservation. Botanic gardens also play an important role in increasing awareness about the environmental issues, which includes the loss of genetic variety. As a result, botanic gardens serve a dual purpose of conservation and education. Each year, it is estimated that 100 million people visit botanic gardens around the world. Botanic gardens, with their living collections, seed banks, and trained specialists and scientists, are like an insurance policy mechanism that protects species from extinction.¹

Because the biosphere is a global garden, there is no doubt that the first garden was discovered rather than created. A belt of trees, plants with flowers and fruits added to the beauty of a natural setting. No one cares about these gardens, and they flourish on their own. According to the earliest reports, such places are the Gods' gardens or those beloved by the Gods; therefore, there is no need to make a special effort to maintain the site clean.²

One of the human race's redeeming characteristics is its continued desire to create gardens and grow plants for pleasure rather than utility. Many of the beautiful gardens of the past are said to have perished without a trace, but this is an attempt to examine the loveliness and most fragile history of the best among the vanished and nearly vanished, as well as current gardens. Many of the spectacular gardens that can be found in South Africa, North and South

¹ Ballantyne, R., Packer, J., & Hughes, K. (2008). Environmental awareness, interests and motives of botanic gardens visitors: Implications for interpretive practice. *Tourism management*, 29(3), 439-444.

² Thacker, C. (2016). *The wildness pleases: The origins of romanticism*. Routledge. P. 12-13.

America, Latin America, and the Caribbean are descended from previous gardens. The words grove, paradise, park, landscape, wilderness, and orchard are all used to describe gardens.³

According to King (1979), the word "Paradise" was originally used by Xenophon, the Greek historian who lived around 400 BC to describe the nature of imitating parks of the Persian king and nobility. The term 'pleasure garden' was given the name paradise for many years and in various places. One of the first Persian gardens, known as the, "Old Man of the Mountains." This garden, according to Marco Polo, was cultivated with all of the world's finest fruits.⁴

Theophrastus (B.C. 370-286) built the gardens of the Academy in the 4th century BC in Athens, and it was the first garden we heard about. Theophrastus' garden was less well-documented, although it has long been a favourite subject of painters and illustrators. We just knew he had a garden where he taught plants to his friends, disciples, and students. So, in his will, he bequeathed the garden to them, implying that it was a botanic garden.⁵

One of the countries for which we have documentation of early gardens is China, whose mythological early traditions appear to date back to 2000 BC. Ancient Mesopotamian monarchs were similarly enthusiastic about plants and gardens. According to reports, Egyptians were so enamoured of their gardens that they built miniature gardens around graves, and some of their inscriptions appear to imply that the deceased would continue to enjoy his gardens even after his death. The ancient Persians, like the Egyptians, relied on the shade of trees and the coolness of the pool to make their living spaces more comfortable, and thus the traditional Persian garden was born. The Hebrews were known to have a fondness for gardening, according to the Bible.

³ Meeker, N., & Szabari, A. (2019). *Radical botany: Plants and speculative fiction*. Fordham University Press, p. 1-177.

⁴ Bremmer, J. N. (2008). Chapter Three. The birth of Paradise. In *Greek Religion and Culture, the Bible and the Ancient Near East* (pp. 35-55). Brill.

⁵ Colburn, T. C. (2012). Growing gardens: botanical gardens, public space and conservation, p. 6-12.

Following the fall of the Roman Empire, the popularity of garden art declined. The number of plants in mediaeval gardens was limited, with herbs being the most common, followed by vegetables and fruit trees. Here, too, first hand experience of comprehension and delight has come via poets' works and other such documents.⁶

Botanic gardens, or gardens of a similar nature, have a long history in the world, especially in India. Ancient Saints, known as 'Rishis,' produced a variety of therapeutic herbs in their meditation centres, hermitages, or cottages in the woods. This was done so that their disciples and followers would have easy and quick access to life-saving medications for their ailments. The Charak Samhita makes specific reference to such old herbal gardens (which is dated as 1000-800 B.C.). Many gardens were built by the Mughuls of India, primarily for relaxation and decoration. Leiden's gardens date from 1587. In India, there are only around a dozen botanical gardens in the real sense of the term, that is, gardens with vast collections of classified, labelled, and methodically planted trees and shrubs, as well as scientific study and technical knowledge on plant resources. The Indian Botanic Garden in Shibpur, Howrah, the National Botanical Research Institute in Lucknow; the Lloyd Botanic Garden in Darjeeling; the Lalbagh Botanical Garden in Bangalore; the Botanic Garden in Ootacamund, Victoria Garden in Poona; the Agri-Hort. Soc. Garden in Calcutta; the Experimental gardens of the Botanical Survey of India in Allahabad, Pauri (Tamilnadu). Several Indian institutions have tiny botanic gardens that are primarily used for teaching purposes.⁷

⁶ Spencer, R., & Cross, R. (2017). The origins of botanic gardens and their relation to plant science, with special reference to horticultural botany and cultivated plant taxonomy. *Muelleria*, 35, 43-93.

⁷ Project Report on Establishment of Temperate Botanic Garden for Directorate of Environment. Government of Uttar Pradesh Lucknow, u. p., 1989, p. 8-10.

Howrah's East India Company's Garden, formerly known as the East India Company's Garden, is located on the west bank of the Hooghly River. Col. Robert Kyd advocated the creation of a horticultural and economically vital plant garden. He had his own private garden, in which he grew economically valuable plants. In 1787, the East India Company approved his idea, and he was appointed Honorary Superintendent of the Garden, where he introduced numerous economically significant species such as cardamom, pepper, nutmeg, cotton, tobacco, indigo, coffee, sago and teak.⁸

In 1793, William Roxburg (1751-1815) became the first salaried Superintendent. He developed a huge herbarium and laid the groundwork for taxonomy in India, in addition to his interest in the growth of the Garden. He published *Hortus Bengalensis* (1814) and *Flora Indica* during his stay (1820-24). As a result, he is rightfully known as the "Father of Indian Botany."⁹

Another important phase in the Indian Botanic Garden's history is the introduction of tea. Despite the fact that tea was successfully cultivated in the Indian Botanic Garden in Canton (China), there was not enough commercial interest in the development of tea as a plantation crop. As a result, tea discovery and other gathering efforts began in the Gangetic plain. Approximately 9000 specimens and a considerable number of plants were obtained throughout these comprehensive expeditions. Cinchona trees were planted in the garden in 1853, and it was suggested that they be grown in the Nilgiri hills.¹⁰

⁸ Chanin, E. (2022). 'The Attention of the Curious': Robert Kyd and Cultivating Knowledge in Eighteenth-Century Bengal. In *Transnational Spaces of India and Australia* (pp. 159-177). Palgrave Macmillan, Cham.

⁹ Law, S. (2007). Liverpool/Calcutta Exchanges: William Roscoe's Reappraisal of the First Linnaean Order of Plants. *Garden History*, 180-196.

¹⁰ Hastings, R. B. (1986). The Relationships between the Indian Botanic Garden, Howrah and the Royal Botanic Gardens, Kew in Economic Botany. *Nelumbo*, 28(1-4), 1-12.

The seeds were brought in from Kew, and the botanic garden also cultivated many Cinchona species. This contributed significantly to the reduction of malarial fever. In 1890, botanists from various provincial governments formed the Botanical Survey of India, which was eventually renamed. Aside from the well-known Great Banyan tree and the large palm house, the Garden is proud of its diverse collection of Palms, Bamboos, Pandanus, and Bougainvilleas. In the open, over 15,000 trees and shrubs from 2,350 species, as well as several thousand herbaceous plants, are grown in 25 divisions, five glass houses, and five greenhouses and conservatories. One octagonal glass house for growing cactus and succulents, as well as one huge greenhouse, are now being built and planned. Bamboos, Bougainvilleas, Citrus, Jasmines, Palms, Pandanus, Water Lilies, and other germplasm collections are kept at the garden. Orchids from 32 genera and 80 species make up the Orchidarium's 1500 sets. The medicinal plants garden contains 1000 plants from 450 species.¹¹

Medicinal and aromatic plants are conserved to highlight the Indian legacy of using and utilising these natural resources in the treatment of human illnesses. Experimental botanic gardens have already been established by the Botanical Survey of India in the Eastern, Western, Northern, Southern, and Central Regional Circles covering different agro climatic zones of the country in order to introduce and propagate rare, endangered, endemic plants and wild flora of the regions, as well as to build up germplasm collections of wild relatives of economic plants for use in plant improvement programmes. The Indian botanical garden and its network of experimental gardens are considered the country's primary conservation centres. Calcutta Botanical Garden, Saharanpur Botanical Garden, Lalbagh Botanical Garden, and Ootacamund Botanical Garden were all founded by the British in India. The primary goal of these botanical

¹¹ Jones, D. S. (1998). The Penang Botanic Gardens, 1794–1905: the design and development of a tropical botanic garden. *Studies in The History of Gardens & Designed Landscapes*, 18(2), 145-160.

gardens was to encourage the growth of exotic and hybrid trees while also increasing the productivity of Indian agriculture.¹²

The fundamental goal of this research is to bring the history of Saharanpur Botanical Garden to light, as it has never been researched from a historical perspective before. Saharanpur is a town located in the upper Gangetic plain at 29°58' N latitude and 77°33' E longitude. The Saharanpur botanical garden, presently known as the Horticultural Experiment and Training Centre, Saharanpur, began in 1779 when Muslim monarch Zabita Khan opted to spend the earnings from seven villages on the upkeep of the Saharanpur garden. The East India Company purchased Saharanpur Garden in 1817, and Sir George Govan was appointed as its first Superintendent. The introduction of tea plants from China was one of the garden's most notable accomplishments. The Saharanpur Botanical Garden became a major site for taxonomical research during the British Empire. It also became a key scientific agency in the United Provinces for experimental investigations on a variety of crops and timber species. It now has over 235 trees, shrubs, and climbers.¹³

The proposed study attempts to capture the history of Saharanpur Botanical Garden and the role of the British Empire in making it. As Richard Grove said, “The colonial rule has introduced several innovations in terms of horticulture, agriculture and crops.” In this study an attempt is made to document the role played by Saharanpur Botanical Gardens in shaping agricultural science.

¹² Rokaya, M. B., Münzbergová, Z., Timsina, B., & Bhattarai, K. R. (2012). Rheum australe D. Don: a review of its botany, ethnobotany, phytochemistry and pharmacology. *Journal of Ethnopharmacology*, 141(3), 761-774.

¹³ Malik, V. Trees and Shrubs of Saharanpur, Botanical Garden, India, p. 10.

This chapter deals with the introductory aspects of the study. The following themes are elaborated: the context of the study, objectives of the study, hypothesis of study, review of the literature and a brief note on chapterisation of the study. In order to elucidate the topic that has been undertaken, this chapter offers a thematic narrative on introductory aspects of the proposed study. This study attempts to explore the history of Saharanpur Botanical Garden.

1.1 Scope of the Study

This study aims at documentation of a brief history on Saharanpur Botanical Garden and other botanical gardens that have evolved. This study documents what are the botanical gardens. What are the objectives of botanical gardens, how botanical gardens emerge at world perspective and how they emerged by colonial scientists, botanists and Britishers in India and how they evolved at regional level.

This study narrates the involvement of colonial scientists engaged with Saharanpur Botanical Garden. This study explores the experiments of Saharanpur Botanical Garden in promoting varieties of a Sugarcane, Wheat, and Mustard Etc. In Short, this study is an attempt to propose a brief history of Saharanpur Botanical Garden, which has not been documented in the existing literature.

1.2 Context of the Study

When different foreign companies established different colonies, at development stages of Renaissance, Humanism, Scientific Revolution, Imperialism, Commercialization, Mercantilism, Capitalism and Colonialism. In order to get maximum profit from these colonies at this stage of colonisation, the British established different companies in India and other colonies, keeping in

mind the objective to profit Britishers started Deforestation and promotion of agricultural and commercial Crops after that emergence of different land settlement systems arose.

Deforestation results in a bad impact on Ecology and Environment and thus colonies face a lot of problems. The colonial scientist, Environmentalist, Botanist and Doctors paid attention to this side to protect themselves from criticism caused by this harm; they had enforced Forest Protection Act, Laws and Amendments. In this direction they promoted different Botanical Gardens in India, out of them the first Botanical Garden is Calcutta Botanical Garden, and on the basis of this garden another Botanical Garden is built naming Saharanpur Botanical Garden. Different Commercial Crops and plants species are planted here according to environment and another purpose of impact and explore in different Colonies. Most important Crops among them are Jute, Tea, Silk, Fruit varieties and different species and different varieties of plants

Firstly, the Botanical Garden becomes a medium of profit for colonists and then becomes a medium of Conservation of Ecology, varieties of plants and Botanical but it is observed that historical stages of scientific development results in conservation and a hub of Botanical research development of agriculture and agricultural crops. It plays an important role in agriculture-based countries like India is benefited a lot by these Botanical Gardens One of them is Saharanpur Botanical Garden located in north India plays an important role in context to Botanical Garden study.

It is noticeable that agricultural science plays a significant role in shaping the destiny of the Nation. Particularly a country like India which is heavily dependent upon agriculture and its Innovations. In this context, a study on the history of botany and botanical garden is useful in tracing the roots of modernization of Indian agriculture initiated by the British. This study thus

focuses on the history of Saharanpur Botanical Garden and its significance in shaping the agriculture of Northern India.

In the present study, we will observe how science and technology development in the world served in promoting food production and horticulture. Due to which the second green revolution takes place in India and in context to this many scientific institutions were established. In this Research these scientific institutions are the medium to explain history creation: history of science and botany, environmental history and history of Botanical Garden. Beneath of which many public policies were formed in India which are useful in development of science and agriculture.

1.3 Objectives

1. To document the history of Saharanpur Botanical Garden.
2. To analyse the nature of biological experiments undertaken by the Saharanpur Botanical Garden.
3. To understand the role played by Saharanpur Botanical Garden in the development of new agricultural varieties and their promotion.
4. To narrate the involvement of colonial scientists engaged with Saharanpur Botanical Garden.
5. To explore the experiments of Saharanpur Botanical Garden in promoting varieties of sugarcane, wheat, mustard etc.

1.4 Assumptions

1. Saharanpur Botanical Garden played a significant role in modernising agriculture in North India.
2. Colonial state promoted exotic plants and promoted them in enhancing the productivity of Indian agriculture.
3. Saharanpur Botanical Garden played a unique role in meeting the requirement of the Empire by the way of understanding several experiments that had not been done by other Botanical Gardens.

1.5 Methodology

An Analytical, Descriptive, Historical methodology will be used in present study. Moreover, we have used different approaches for collection of data which are described briefly as follows:

Primary data:

The primary data will include Archival material, particular of Surgeon General Records, Board of Revenue Proceedings of United Provinces, Saharanpur Gazette, and district level records of Saharanpur (Experimental Report, Reports of Seeds, Plants, Vegetables, and Fruit, Agricultural Reports, Annual Reports, Maintenance Reports, Textiles Reports, Improvement Reports, Fodder Reports, Report on the Management of the Provincial and District Gardens from the year (1905-1915), and General Administration Reports), texts, newspapers, and administrative reports etc.

Secondary data:

The secondary data will consist of the relevant books, dissertations, articles and papers both published and unpublished in various journals and magazines.

1.6 Review of Literature

There is no study available on the history of Saharanpur Botanical Garden and no work has been conducted exclusively from an ecological point of view. Secondary sources are less available in comparison to primary sources. The present study attempts to explore the agro-ecology of the region with focus on forestry, horticulture and geo-ecological conditions in order to have a fuller understanding of the environmental history of Saharanpur Botanical Garden which until now is not being explored by the environmental historians. Some significant work of Environmental Historians, Environmental Scientists, Colonial Botanical historians, which are somehow related to the theme, are reviewed under the four headings.

Richard Grove's, *Green Imperialism* (1996): has highlighted the origins and early history of environmentalism, concentrating especially on its hitherto unexplained colonial and global aspects. Grove also highlights the significance of Utopian, Physiocratic, and medical thinking in the history of environmentalist ideas. The book shows how the new critique of the colonial impact on the environment depended on the emergence of a coterie of professional scientists, and demonstrates both the importance of the oceanic island "Eden" as a vehicle for new conceptions

of nature and the significance of colonial island environments in stimulating conservationist notions.¹⁴

Satpal Sangwan, *Indian response to European science and technology 1757–1857 (1988)*:

have a document that colonial botanists and experts play a significant role in the field of agriculture and bring out the dynamic changes to increase the production of crops. In other words, we can say Satpal argued that they changed the nature of Indian agriculture.¹⁵

Richard Drayton, *Nature's Government (2000)*: have highlighted that the history of botanical

gardens is closely linked to the history of botany itself. The botanical gardens of the 16th and 17th centuries were medicinal gardens, but the idea of a botanical garden changed to encompass displays of the beautiful, strange, new and sometimes economically important plant trophies being returned from the European colonies and other distant lands. Later, in the 18th century, they became more educational in function, demonstrating the latest plant classification systems devised by botanists working in the associated herbaria as they tried to order these new treasures. Then, in the 19th and 20th centuries, the trend was towards a combination of specialist and eclectic collections demonstrating many aspects of both horticulture and botany.¹⁶

Henry J. Noltie, *Botanical Art from India: The Royal Botanic Garden Edinburgh Collection*

(2017): have explored the links between the Royal Botanic Garden Edinburgh and India go back

¹⁴ Grove, R., & Grove, R. H. (1996). *Green imperialism: colonial expansion, tropical island Edens and the origins of environmentalism, 1600-1860*. Cambridge University Press, p. 16-32, p. 47-59, p. 79-94, p. 95-133.

¹⁵ Sangwan, S. (1988). Indian response to European science and technology 1757–1857. *The British Journal for the History of Science*, 21(2), 211-232.

¹⁶ Drayton, R. (2005). *Nature's Government: Science, Imperial Britain, and the Improvement of the World*, Orient Longman, New Delhi, p. 26-78, p. 83-124, p. 170-220, p. 221-269.

for two and a half centuries. Surgeons who had studied botany at the Garden laid the foundations of western knowledge of the Indian flora.¹⁷

Arun Bandopadhyay (2010): in his article "Colonial Legacy of Forest Policy in India" has discussed the colonial forest policies in India in three distinct phases, one from 1796-1850, second from 1850s to the 1880s, and the third from 1894-1947. The author has highlighted the role of Brandis in framing the forest policies in India. The author also highlighted that the infrastructure developed during the colonial period proved inadequate during the post-independence period. The paper mentions about the conditions of forests in post-colonial period in Madras and Bengal and the measures taken by the respective governments in checking the wanton destruction of trees. The author points out that scientific forestry and people's participation in forests are the two aspects of colonial forest policies which continued in the post-colonial period as well.¹⁸

Deepak Kumar (1997): in his book "Science and the Raj" has focussed on the development of colonial science in British India. It analyses the relationship between techno-scientific imperatives and colonial requirements by looking at the close link between science and the raj. The early exploratory activities, scientific research works, problems in science administration and Indian responses to these issues had also been mentioned. The author has also examined the role of technology and science in the history of imperialism and considers pre-colonial science in India.¹⁹

¹⁷ Noltie, H. J. (2017). *Botanical Art from India: The Royal Botanic Garden Edinburgh Collection*. Edinburgh: Royal Botanic Garden Edinburgh, p. 1-40.

¹⁸ Bandopadhyay, A. (2010). The colonial legacy of forest policies in India. *Social Scientist*, 38(1/2), 53-76.

¹⁹ Kumar, D. (1997). *Science and the Raj*. New Delhi: Oxford University Press, p. 1-115, p. 152-263.

Gadgil and Guha (1993) in their book "This Fissured Land: An Ecological History of India" had analysed various forms of social conflict between different groups of resource users. This book highlights the interdependence of ecological and social, Changes that came in the wake of colonial rule and also shows the socio-ecological consequences of European colonialism in India. This book also sheds light on socio ecological history of forests in India and focuses on the ecological encounter between Britain and India. The authors had pointed out that the most tangible outcome of colonialism was its global control of resources and the forest management was the most significant element in taking over natural resources.²⁰

Gosh and Rita (2003) in their book Social Forestry and Forest Management mentioned that during the period from 1900 to 1925 there was good progress in the different fields of forestry. This book is the best source to understand the urgent need to promote a new paradigm on social forestry and rural development based on integration and application of principles of ecologically sustainability, social equity and economic viability.²¹

Guha and Gadgil (1989) in their article "State Forestry and Social Conflict in British India" has pointed out that the general policy of forest management was framed, only after the construction of the railway network in India. The main thrust of the paper is on reactions of village communities and other tribal people against the regulations of traditionally exercised rights. The colonial government established its control over the large woodlands which earlier were under the hands of local communities, then intervened in their day to day life to a great extent. Authors also pointed out that colonial forestry also changed the composition of Indian forests by applying

²⁰ Gadgil, M., & Guha, R. (1993). *This fissured land: an ecological history of India*. Univ of california Press, p. 1-67, p. 71-87, 113-172, p. 233-239.

²¹ Ghosh, S. K., & Singh, R. (2003). *Social Forestry And Forest Management (2 Vols. Set)* (Vol. 1). Global Vision Publishing House, p. 51-131, p. 287-323.

silvicultural techniques, turning the mixed forests into single species forest for their personal motive. The paper has also focused on the genesis of these conflicts, their geographical spread and different causes of their origin in different locations. It also points out that the forest management practices also contributed in declining the different artisanal industries by restricting their source of raw material.²²

In his book *Forests and Ecological history of Assam, 1826–2000*, **Arup Jyoti Saikia (2011)**, has highlighted some changes which took place from colonial to postcolonial period with respect to Assam's forest management. The author has pointed out that it was only under colonial rule that alarming growth in commercial exploitation was noticed. The colonial regime was unable to stop the growing pressure from local and immigrating peasants despite demarcating the forests on the model of Indian Forest Act 1878 and this was so because the land titles were not being granted to them in both periods. The last chapter of the book sheds its light on the game hunting and which the author considers was as a matter of ruling elite. The hunting by rulers was merely for a game while as for the indigenous people it was meant for their sustenance.²³

Irfan Habib (2010), in his book *Man and Environment: The Ecological History of India* has tried his best to develop understanding among the readers about the different aspects of environmental and ecological history of South-Asia. The book focuses much on the Neolithic Revolution as it is the time when the visible change was caused by the interaction between man and environment for the first time. Keeping in view the forestry and forest management, the

²² Guha, R., & Gadgil, M. (1989). State forestry and social conflict in British India. *Past & Present*, (123), 141-177.

²³ Saikia, A. (2011). *Forests and ecological history of Assam, 1826–2000*. Oxford University Press, p. 1-167.

book does not have pointed out the continuities from pre-colonial period to post-colonial period and neither has it explained the colonial legacy.²⁴

John MacNeill et.al (2010) in their volume *Environmental History: As if Nature Existed*, have discussed a variety of articles related to environmental history in broader perspective and not related to any particular period or a subject. The whole content in the book is discussed in three parts-global studies, macro-regional studies and micro regional studies. Under macro-regional studies, a comparative study related to environmental changes like the colonial impact and assault on tropical forests in Brazil, China and South-Asia. In the micro-regional studies an attempt has been made to highlight the impact of globalisation on the eastern Indian tribal territories. The book discusses a special attention mostly by the scholars of environmental history as it opens the new ways by explaining the environmental history both in national and international perspective.²⁵

Mahesh Rangarajan (1999) in his book "Fencing the Forests" challenges the views of imperial historians who gave credit to scientific forestry for the conservation of forests. The author argues that their only motive was to generate revenue and fulfil the strategic needs of the empire. The author very clearly explained the attitude of people towards forests in pre-colonial India. Moreover he sheds light on the changes brought out by colonial rulers in the forest management. The Forest Department provided a unified focus at an all India level for a major revolution in styles of land management.²⁶

²⁴ Habib, Irfan. (2010). *Man, and Environment. The Ecological History of India*, "A People's History of India", Vol. 36. New Delhi, p. 36- 45, p. 56-69, p. 80-110.

²⁵ McNeill, J. R. (2010). *Environmental History: As if Nature Existed*, Oxford University Press, New Delhi, p. 6-75.

²⁶ Rangarajan, M. (1996). *Fencing the Forest: Conservation and Ecological Change in India's Central Province, 1860-1914*, p. 1-160.

NeenaAmberi Rao (2008) in her book *Forest Ecology in India: Colonial Maharashtra 1850-1950* has successfully attempted a *longue-duree* environmental history of the Marathi speaking region of the British Empire's Bombay Presidency. Tracking the transition from pre-colonial to colonial period, this study shows that the transformation during the late nineteenth century not only exposed British imperialism, but also triggered massive population protest that eventually led to the demise of the British Empire. The book however does not make a mention of the opposition between destruction and conservation while taking in view the long-term ecological impacts of colonial rule.²⁷

R.C. Guha (2000) in his book *The Unquiet Woods* has tried to bring ecological dimensions to the study of agrarian history and peasant resistance. He has mentioned that the landmark in the history of Indian forestry is undoubtedly the building of the railway network. The large-scale destruction of accessible forests in the early years of railway expansion led to the hasty creation of a forest department in 1864.²⁸

Ravi Rajan (2006) in his book *"Forestry and Imperial Eco-Development 1800-1950"* has pointed out that colonial masters viewed the forests of India as their timber mines and source of other minor products. He has mentioned that it was the colonial doctors and botanists who started the process of systematic forest management through the support of the government. The acute shortage of timber during the First World War led the foresters to be serious and the author gives credit to the Empire Forestry Conferences which served as informal coordinating agency and a

²⁷ Iqbal, I. (2008). *Forest Ecology in India. Colonial Maharashtra 1850-1950*, p. 334.

²⁸ Guha, R. (2000). *The unquiet woods: ecological change and peasant resistance in the Himalaya*. Univ of California Press, p.1-191.

massive institution framework for the management of colonial forests was built. This book stresses more on ideologies of colonial forestry and the impact of colonial forest policy.²⁹

Richard Tucker (2012) has compiled an extra volume of his scholarly articles under the title *A Forest History of India* and without any doubt Tucker has been one of the pioneers of forest history of South-Asia. He has mostly touched the colonial and imperial forest management under the British colonial rule in South Asia. His other areas of interest have been the wildlife reserves and the non-timber products mostly in the western Himalayas.³⁰

S. Abdul Thaha (2009) in his book on *Forest Policy and Ecological change* has pointed out that the forest management in the Hyderabad state until 1951 has begun only in the second half of the 19th century and so was the case with the irrigation schemes. The book augments further the established environmental narrative which stresses mostly on the deforestation, arable land expansion, natural and man-made upheavals which had showed their impact during colonial rule in India and also in the Princely State of Hyderabad.³¹

Srabani Sen (2010) in the article "Scientific enquiry in agriculture in Colonial India" has explained in a best way the historical evolution of Agricultural research and institutions in colonial India. The writer has mentioned the role of some agricultural chemists in the improvement of Indian agriculture by scientific means and has given a description of some crops like sugarcane, rice and wheat on which a number of experiments were conducted from time to time to increase their productivity and identify the best soils for their cultivation. The author

²⁹ Rajan, S. R. (2006). *Modernizing nature: forestry and imperial eco-development 1800-1950*. Oxford University Press, p1-199.

³⁰ Tucker, R. P. (2011). *A forest history of India*. SAGE Publishing India, p. 1-50.

³¹ Thaha, S. A. (2009). *Forest policy and ecological change: Hyderabad state in colonial India*. Cambridge India, p. 1-80.

points due to series of famines during the nineteenth century which felt the need of scientific enquiry in the field of agriculture.³²

The book *Himalayan Degradation* of **Dhirendra Datt Dangwal (2009)** is also an important contribution with respect to the environmental history of South Asia. In this work the stress has been laid on the continuities and changes that took place between the pre-colonial, the colonial and the post-colonial regimes. The author argues that the policies which were being adopted for scientific forest management in both the colonial and post-colonial period were meant more for the extraction of forest products and the restrictions on the grazing by the cattle.³³

In his book *An Environmental History of the World*: **J.D. Hughes (2001)** deals with extensively with nature's role in the unfolding of human events and their everyday lives. This book places humans within the community of life circle and views the correlation between humans and the environment. He emphasises the importance of environmental history and argues for its importance in understanding the present state of the world's ecological problems. Since the beginning of the process of writing environmental history in the early 1970s, the regions of America and several countries in Europe became the focal point of most histories. This book exhaustively deals with how natural forces and resources have shaped societies on a global extent and about the reciprocal relationship shared by people and the environment in the past.³⁴

Another fascinating and fabulous study by **Krech, and McNeil (2004)** and others entitled *Encyclopedia of World Environmental History* is an analytical handbook of natural phenomena and events and their impact on human societies in the past. Many articles in the encyclopedia are

³² Sen, S. (2010). "Scientific enquiry in agriculture in Colonial India": A History Perspective, *Indian Journal of History of Science*, Vol. 45(2), p. 1-65, p. 66-90.

³³ Dangwal, D. D. (2009). "Science Forestry and Sustainable Management of Forests in India: Myth and Reality", *Economic and Political Weekly*, p. 24-30, p. 54-65.

³⁴ Hughes, J. D. (2001). *An Environmental History of the World*, Routledge, New York, p. 1-84, p. 268-278.

written in a spirit of commonality with environmentalism, but without stoic commitment to any specific school of environmentalism. Therefore, it is useful both for environmentalist and environmental historians as it offers a chronological overview of extensive historical coverage on how human beliefs and actions have not only altered the natural world, but also covers the latest advancement in the field.³⁵

An exhaustive account of human engagement with nature in the past has been offered by **Simmons's (2008)** study entitled *Global Environmental History*. It proposes a multidisciplinary approach and with a humanistic perspective furnishes an enormous amount of details, theoretical concepts and trends. With a time-frame ranging from 10,000 BCE to the modern day to present, he brings under consideration how human technological evolution changes over the years affected the natural world. By putting contemporary environmental preoccupations into a long-term perspective, Simmons demonstrates the history of some current anxieties on ecological issues. The book provides a deep time overview of how we have come to our current state of ecological crises.³⁶

Writing environmental history from a global perspective is indeed a challenging task. This task was taken up by **Radkau's (2008)** book entitled *Nature and Power: A Global History of the Environment*. He writes this book on environmentalism from a predominantly European approach but its reach is indeed global as it covers an amazingly rich outline of many of the central themes of environmental history. His strength is in his approach to the theme of environmental history made somewhat with scepticism and some apprehension about grand

³⁵ Merchant, Carolyn, M, McNeill, J. R., and Krech, S. III. (2004). *Encyclopaedia of world environmental history*, Routledge, New York, p. 416-418.

³⁶ Simmons, I. G. (2008). *Global Environmental History: 10,000 BC to AD 2000: 10,000 BC to AD 2000*, Edinburgh University Press, Edinburgh, 1-245.

generalisations on large scale projects and their exaggerated assertions and sometimes stereotypical conclusions. The key argument that he proposes is that human ecological behaviour and thought has been shaped in profound ways by the scale on which human relations with the environment are managed, a subject whose historiographical and political significance is becoming more and more evident. Another important theme of this book is that human ecological behaviours are often most destructive when best aligned with the cycles and rhythms of the natural world. He makes a contrast between the North American environmental historians who have been fascinated by the idea of abundance in the wilderness, unlimited resources and spaces not yet touched by humans and open to exploitation (or protection), and German historians who have focused their scholarship on a more anthropogenic and more limited "natural" world in which the problem of sustainability was always present. One of the main focal point elucidated by the work is that human relations with the environment are mediated by power relations."³⁷

John Robert McNeil (2001) in his book *Something New under the Sun* attempts to reconstruct the environmental history of the world over the past hundred years by stressing on the synthesis of humanity's relationship to and modification of the environment during the 20th century. He interprets the human impact on the earth politically, economically, and socially, noting the influence of history and ecology on each other. His claims are substantiated by alarming evidence he presents in a comprehensive and balanced survey. His arguments are important because it highlights the role and development strategies of humanity as having a significant impact on ecosystems. He contends that these strategies may be extremely damaging in the long

³⁷ Radkau, J. (2008). *Nature and Power: A Global History of the Environment*, trans. *Thomas Dunlap* (New York: Cambridge Univ. Press, 2008), 152-94.

run to the ecology. The book is also important to have a reference point to comprehend within a capsule history of the environmental movement, gauging its successes and influence."³⁸

Beinart and Hughes (2007) study entitled *Environment and Empire* offers a pioneering account on the environmental history of the British Empire, with ample attention on the former British Empire's interactions with different environments in locations such as Africa and India. He proposes that imperialism was inseparable from the history of global environmental change. He also illustrates various environmental themes in the history of the British Empire stating that the social and political issues were related to environmental change. But the fundamental theme of the book is the tension between exploitation and conservation; stating that the British colonists sought to regulate natural resources and at the same time commodity items. This book is significant as it highlights the adaptation of key issues like conservatism, co modification, in the context of the natural resources of British colonies. This study concludes with a focus on political reassertions by colonized peoples over natural resources. The authors in a post imperial age have found a new voice, reformulating ideas about nature, landscape, and heritage and challenging, at a local and global level, views of who has the right to resources.³⁹

Tucker, (2012) *A Forest History of India* describes the history of forest use in India in a rich collection of articles. The author documents Indian forest history from the colonial era to the post-independence legacy. The main highlight of the book is to stress first, the tension between the subsistence needs of the local population and the commercial needs of the local population and the commercial needs of the colonial state, and second, the clash between the forest department, which sought to preserve and manage forests, and the revenue department, which

³⁸ McNeill, J. R. (2001). *Something New Under the Sun: An Environmental History of the Twentieth-Century World (the global century series)*, W. W. Norton & Company, p. 3-116, p. 118-357.

³⁹ Beinart, W., and Hughes, L. (2007). *Environment and Empire*, Oxford University Press. P. 1-60..

was driven by the need to expand agriculture and industry. It contributes significantly to the understanding of the colonial legacy for post-Independence management of India's natural resources.⁴⁰

Rangarajan and Sivaramakrishnan's (2014) volume entitled *India's Environmental History*, two volume series are a competently written colossal work covering India's history within a two-volume set. It is academically solid and being ambitious in its approach, wide in scope covering a chronological time period from India's ancient past to colonial times. The first volume from *Ancient Times to the Colonial Period*, pertaining mostly with India's ancient ecological history starting from the Harappa civilization closes with the coming of the East India Company. The second volume entitled *Colonialism, Modernity, and the Nation* hold more recognizable and current issues. The two very distinct features are the relentless documentation of colonial deforestation and the impact of this deforestation on the people of India. Thus, these two volumes are essential as it provides critical inputs to those concerned about land management, forests, forest rights, and climate change.⁴¹

Ramachandra Guha's (1993) *Writing Environmental History of India* can be considered as one of the pioneering studies on historiography on the environmental history of India. This article underscores the potential of ecology as a tool of historical analysis and its potential contribution to the contemporary debate on environmental policies of India. This paper indeed inspired the entire generation of young historians who are interested in the ecological aspects of India from historical perspective.⁴²

⁴⁰ Tucker, R. (2012). *A Forest History of India*, Sage Publications, p. 1-130.

⁴¹ Rangarajan, M and Sivaramakrishnan, K. (2014). *Shifting Ground: People, Animals, and Mobility in India's environmental history*, Oxford University Press, p. 10-84.

⁴² Guha, R. (1993). "Writing Environmental History in India", *Studies in History*, Vol.9, No.1.4, pp.119-150.

Mahesh Rangarajan (1996) in another pioneering study "Environmental Histories of South Asia: A Review essay explores historiographical aspects of the environmental history of India. In this essay, he attempted to capture the new dimension of environmental history that has evolved in India. This essay indeed highlights the existing possibilities and futurist dimensions of the environmental history of India.⁴³

Sivaramakrishnan's (1995) penetrating analysis entitled *Colonialism and Forestry in India* documents the impact of the contemporary debate on forest policy of India on the forest history of India is indeed a fascinating study. He highlights how to present compel historians to seek questions and answers in the past. He proposes that environmental history is an offshoot of contemporary demands of society to engage with ecological issues by using past knowledge.⁴⁴

Ranjan Chakraborty's (1993) study *Situating Environmental history of India* attempts to capture the emerging literature on the environmental history of India. He frankly accepts the fact that it is difficult to review the vast literature on the environmental history of India. He, however, proposes that we can track the general trend on writings of the environmental history of India. His study makes a serious attempt to document the major trends that are followed in writing the environmental history of India.⁴⁵

In the due course of time, environmental historians evolved a binary of destructive and constructive dimension of British colonial rule. Not subscribing to these essentialist categories,

Sinha, et al., (1997) entitled: *The New Traditional Discourse of Indian Environmentalism* highlights the limitations to the nationalist narratives of perceiving everything is good in Indian

⁴³Rangarajan, M. (1996). Environmental histories of South Asia: a review essay. *Environment and History*, 2(2), 129-143.

⁴⁴Sivaramakrishnan, K. (1995). "Colonialism and Forestry in India: Imaging the Past in Present Politics" *Comparative Studies in Society and History*, Vol.37, No.1.4, pp.3-40.

⁴⁵Chakraborty, R. (2007). *Situating Environmental History*, Manohar, New Delhi, p. 10-83.

culture and everything is bad in British colonial rule in the domain of ecology. This study was critical of a genre which emerged as nationalist environmental history of India.⁴⁶

Focusing on forest history of British India, **Sivaramakrishnan's (2009)** study *Forests and Environmental History of Modern India* presents an exhaustive review of the environmental history of modern India however with particular reference to forest history of British India. His main argument is that the interventionist policies of the British for management of Indian forests had become the site for the struggle of the power between foresters backed by the British and tribal chiefs supported by their clan members at another level.⁴⁷

McNeill,(2003) study entitled *Observations on the Nature and Culture of Environmental History*, has brought about an exhaustive review of literature on the environmental history of in different parts of the world including India. He proposes that the South Asian region, especially India had witnessed a vibrant form of environmental history which can be classified into the following categories: material environmental history, political environmental history, and intellectual environmental history.⁴⁸

In his recent study **Ravi Kumar (2017)** entitled: *History of Environmental History of India*, proposes that environmental history emerged as one of the established fields of historical research in India. Besides a review of environmental history studies, he also highlighted some shortcomings such as lack of focus on the social dimension of the environmental history of India,

⁴⁶ "Sinha, S, Gururani, S and Greenberg, B. (1997). *"The New Traditional Discourse of Indian Environmentalism," The Journal of Peasant Studies*, Vol, 24, pp. 65-99.

⁴⁷Sivaramakrishnan, K. (2009). *"Forests and Environmental History of Modern India, " The Journal of Peasant Studies*, Vol. 36, pp. 299-324.

⁴⁸ McNeill, J. R. (2003). *"Observations on the Nature and Culture of Environmental History"*, *History and Theory*, Vol. 42, No. 4, pp. 5-44.

less focus on the role of castes in shaping access of individual to resources of nature in India, etc.⁴⁹

Biodiversity is basically an ecological topic, but biodiversity problems and issues are connected to every fabric of our global society. It is reported that during the next 20 to 30 years, the world could lose more than a million species of plants and animals-primarily because of environmental changes due to humans. At 100 species per day, this extinction rate will be more than 1,000 times the estimated "normal" rate of extinction. The list of lost, endangered and threatened species includes both plants and animals. About 10% of temperate region plant species and 11% of the world's 9,000 bird species are at some risk of extinction. In the tropics, the destruction of forests threatens 130,000 species which live nowhere else. This alarming rate of extinction is the global problem which has kindled world-wide interest in "biological diversity" or "biodiversity". Biodiversity implies more than simply the number of species that inhabit our planet. The ecological interactions among these diverse species and the physical environment make up the ecosystems upon which the human species depends for survival. Loss of biodiversity is the problem: conservation biology is the science to understand the problem and propose solutions. Environmental education is the means of getting solution implemented (**Connect, 1992**).⁵⁰

The planet's biodiversity is important to human beings in many ways. For example, it provides a potential resource for food, medicine and industrial material. Presently, approximately 80% of the world food supply is provided by fewer than two dozen species of plants and animals. It is estimated that more than 25% of all medicines available today are derived from tropical plants. This makes even more pronounced the need to preserve genetic diversity needed to find food

⁴⁹ Kumar, V. M. (2017). "History of Environmental History of India: A Historiographical Review," *The Research Journal of Social Sciences*, Vol. 8, No. 12, pp. 63-70.

⁵⁰ Connect (1992). *UNESCO UNEP Environmental education* News letter xvii, 4, p. 90-110.

species which can adapt to new conditions. To control the ecological imbalance our country has set up 122 wildlife sanctuaries, 47 National Parks and 11 Biosphere reserves, besides all these, a number of seed banks, pollen banks, tissues and cell culture. And biotechnological centre are also opened (**Tani, 1997**).⁵¹

According to **Nair (1989)**⁵² there can be no better learning laboratory, than the environment itself as far as environmental education is concerned. The first step in any educational effort related to natural habitats and conservation must be the creation of an interest in knowing the plants and animals that constitute their natural environment. Most children lack any curiosity to identify a bird, a plant or insect that they pass by. Concern for conservation can emanate only from a love for nature and an understanding of how nature works. **Sabata (1997)**⁵³ reported that it was of paramount importance to create love and concern for nature in young minds so that they grow up with an awareness that would lead to action. Hence proper inventory methods are to be taken for identifying and later monitoring and conserving the biodiversity for protection of the plants.

Traditionally Botanic gardens have always placed education high on their list of priorities and many owe their existence to universities. Now with the appointment of their own education officers, the role of Botanic garden is being further extended to provide a service to schools.

Botanic gardens themselves as a physical and thoughtful establishment play an important part in environmental education. They are the main thrust of the hidden curriculum for environmental education in the formal education centre. The fabric of the place must be functional and

⁵¹ Tani, K. (1997). *Decaying biosphere and its conservation*. In SP Shukla, N. Sharma & BC Sabata, *Planet protection*. (p.215-218). New Delhi: Mittal Publications.

⁵² Nair, Chithra (1998). *Development of certain models for creating awareness of environmental protection among the secondary school children of Kerala*. Ph.D. Thesis, University of Kerala, p. 145-164.

⁵³ Sabata, B.C. (1997). *Biodiversity and its importance towards protecting the Planet*. In. S. P. Shukla, N. Sharma & B. C. Sabata. *Planet protection*. (p.77-79). New Delhi: Mittal Publications.

attractive the display areas should stimulate the visitor and incumbent alike so at any time every child can say quite simply, it is a nice place. (Palmer & Neal, 1994)⁵⁴ Botanic gardens are wonderful places for people to learn more about plants - where they come from, what they are for and why they are important. They give people a chance to see plants, not only from the country they live in, but also from other countries (Willison, 1993)⁵⁵. Here arises the question what Botanic gardens offer in terms of education.

Swaminathan (1989)⁵⁶ in his Forward to The Botanic Gardens Conservation Strategy pointed out that by enabling village schools to develop small botanic gardens with the active involvement of students in the planning, planting and protection of such gardens, awareness of beauty and necessity of biological diversity can be generated through field level action.

The traditional role of botanic gardens and arboreta has been to collect, identify, classify and grow plant species from all over the world. The general practice is to display the various plant species under the best and visually most attractive conditions (Balick, 1986).⁵⁷ Thousands of people of all ages visit botanic gardens everyday for recreation as a part of their leisure activities. This passive and generally unplanned show of a wide spectrum of plant life in fact creates an element of education informing society on the protection and rational use of natural resources. This public education component has been actively pursued by some of the world's botanic gardens. Gradually a realisation came, whether the people come informally to walk around the garden or more formally to participate in an educational activity. This opportunity must be utilized to promote the conservation of biodiversity. Therefore botanic gardens are gradually

⁵⁴ Palmer, J. & Neal, P. (1994). *The handbook of environmental education*. London: Routledge, p. 54-70.

⁵⁵ Willison, J. (1993). *An environmental education strategy for botanic gardens*. In Julio D. Rodrigo Perez (Ed.), *Cultivating Green Awareness. Lass Palmas: Jardin BotánicoCanario*, p. 10-80.

⁵⁶ Swaminathan, M. S. (1989) Foreward - *The botanic gardens conservation strategy 1989*. Cited in Anonymous (1997). *Teaching about plants everywhere*. India: Zoo Outreach Organisation, 25-40.

⁵⁷ Balick, M.J. (1986) *Botanic gardens and arboreta: Future directions*. New York: American association of botanic gardens and arboreta, p. 18-30.

intensifying their efforts and resources in order to educate the population paying special attention to the school children (**Torre, 1993**).⁵⁸ Thus, one of the principal roles of botanic gardens is public education, and the best teachers are the plant themselves in their infinite variety. These plant collections including the rare, endangered, endemic species can be a considerable economic asset to enhance biodiversity of their own region if they are well presented and interpreted.

A botanic garden's responsibility under the Convention on Biological Diversity includes the transfer of information (**Articles 12 and 13**) to as wide an audience as possible. With necessary resources there is enormous potential to promote wider learning opportunities, and to increase visitor numbers and raise awareness of the importance of plants.

Heywood (1987)⁵⁹ in the second International Botanic Gardens Conservation Congress pointed out that Botanical Gardens are globally concerned with conservation of the enormously rich biological resources of the tropics and seeking ways of developing and using them in a sustainable manner so that they will be available for future generations. He reiterated that today in accepting a major conservation role, it is the botanic gardens in those countries with rich floras that have a clearly defined role to play. Perhaps most important is to find out new ways of using botanic gardens more effectively for environmental education.

Boden & Boden (1985)⁶⁰ accepts the fact that education in botanic gardens has been slow to develop as an accepted function and **Willison (1993)**⁶¹ exclaims that for many educators working in botanic gardens is a daunting task to set up environmental education programmes.

⁵⁸ Torre, F. V. (1993). La educación en los jardines botánicos de la AIM. JB, España. In Julio D Rodrigo Perez (Ed.), *Cultivating green awareness*. (pp.19-28) Spain: Jardín Botánico Canario.

⁵⁹ Heywood, V. H. (1987). *Changing role of botanic gardens*. In D. Bramwell, O. Hamann & V Heywood (Eds.), *Botanic garden and the world conservation strategy*, New York: Academic Press, p. 28-40.

⁶⁰ Boden, R.W. & Boden, E.A. (1985) *Botanic Gardens and Community Education in Australia*. In D. Bramwell, O. Hamann V. Heywood (Eds.), *Botanic gardens and the World conservation strategy*. New York: Academic Press IUCN, 35-54.

⁶¹ Willison, J. & Green, J. (1994). *Environmental education in botanic gardens: Guidelines for developing individual strategies*. UK: Botanic Garden Conservation International (BGCI), 10-76.

There are several examples where gardens have developed a comprehensive programme of environmental education stressing the need for the conservation of biodiversity. These programmes are developed by the garden and then offered to the schools. Literature on environmental education through botanic gardens and their effect on the students of India is not sufficient in terms of quantum and diversity. However, such literature from other countries especially developed countries is satisfactorily available. Therefore, most of the research studies referred to here are from developed countries.

Visitor surveys carried out in many gardens indicate that visitors come attracted by a variety of reasons like enjoying the garden as a whole package, offering an attractive setting for relaxation and refreshment and some gentle intellectual stimulation through its educational displays and the exotic plant collections. (Willison & Green, 1994).⁶² Schools are now frequently looking outside their own institutions for professional guidance and botanic gardens are increasingly focusing their education programmes on supporting classroom teachers. Consequently, this presents opportunities for zoos, botanic gardens, public parks, etc., to make valuable contributions to enhance public education with their thousands of visitors. and the incredibly diverse collections of plant and animal species they house, Botanic and zoological gardens have the potential to influence public attitudes towards plant conservation, providing one of the most exciting educational tools - living collection'

Pushpangadan (1994)⁶³ reported that botanic gardens are visited by millions of people each year. They are thus ideally suited to perform a very important role in education in the whole field of nature conservation. This aspect is very explicitly seen in the mission statements of various

⁶² Willison, J. (1993). *An environmental education strategy for botanic gardens*. In Julio D. Rodrigo Perez (Ed.), *Cultivating Green Awareness. Lass Palmas: Jardin BotanicoCanario*, p. 1-30.

⁶³ Pushpangadan, P. (1994). *Conservation biology and role of botanic garden in conservation of rare and endangered plants*. In Suhirman et.al. (Eds.). *Strategy for flora conservation in Asia* (pp. 99-106). Indonesia: Kebun Raya Boger.

botanic gardens and it clearly define the vital role they play in the conservation of plants both insitu and exsitu.

(Leadlay 1993)⁶⁴ The mission of the Royal Botanic Garden Sydney, Australia is: "To increase knowledge, awareness and understanding about plants, their importance and their conservation, by managing and displaying living and preserved collections and through botanical and horticultural research".

The purpose of Limbe Botanic Garden Project, Cameroon is: "To become a regional centre for the conservation and sustainable utilisation of biodiversity in Equatorial Moist Central West Africa." There of the Royal Botanic Garden, Kew, UK is: "to enable better management of the earth's environment by increasing knowledge and understanding of the plant kingdom-the basis of life on earth. National Botanical Institute, South Africa is to provide the facilities, knowledge and expertise necessary to ensure the conservation, sustained use, appreciation and enjoyment of South Africa's exceptionally rich flora and vegetation."

There have been some successful co-operative programmes where garden educators have developed the plant conservations. Mexican Botanic Gardens have developed course lectures, workshops, guided tours and varied research programmes for various sections of the society. They have designed programmes for teachers from elementary school to high school who are working with a large number of students. **(Linares, 2001)**.⁶⁵

The success of botanic garden education is that they include a practical activity where the participants can touch the plant material or smell it. These activities help the students to feel and

⁶⁴ Leadlay, E. (1993). *Mission statements of corporate strategies and networks for botanic gardens*. In Anonymous (Ed.) (1997). *Teaching about plants Everywhere*. India: Zoo outreach Organisation, p. 106-130.

⁶⁵ Linares, E. (2001). *Traditions and medicinal plants: A valuable field of knowledge and a great challenge for science*. In Lucy A Sutherland and T. K. Abraham (Eds.). *The power for change*. (pp 171-176), U.K: Botanic Garden. Conservation International.

familiarise with the plants. This will motivate them to know more about the plants that they use every day.

Royal Botanic Garden, Kew, became the cradle of environmental education instrumentalising it as a very effective tool for propagating ecological education especially among the school children. This has produced a new teaching resource, Plants across the curriculum to introduce children between 8 and 13 to world's treasury of plant life and the vital role it plays in our lives. Ten to fifteen courses are given throughout the year. Each course consists of 30 hours of instruction and is taught by the staff of Botanic Garden and the Department of Botany at the university. The courses include plant classification and identification, plant use, gardening, etc.

Field trips, workshops and visits to garden and exhibitions are included in these courses. Sir Harold Hillier Garden and Arboretum (SHGA) provides educational service for schools. Besides giving information and advice to schools on the best methods to address environmental education, certain programmes are also conducted in the garden for students. The most commonly used activity is the 'Leaf Slide' programme. Each child collects a leaf, or an assortment of leaves, according to its shape, colour, etc. Each leaf is placed between the halves of the slide frame and the slide is held up to the light. In summer, freshly picked green leaves are translucent due to water content, autumn leaves appear darker. South (1999) claims that this activity can be used in a number of contexts and programmes (a) leaf shape and form (b) distribution patterns (c) discussion of a plant's water | needs. (d) Photosynthesis (e) classification and keys (venation is used) (f) colour comparisons (g) listening (b) talking and describing (i) stimulation for imagination and creativity.

The Fautino Miranda Museum and Botanic Garden has been running an annual summer course since 1993. The course which runs for 15 days is for children between the ages of eight and fifteen years old. All themes developed during the course are in relation to the use, conservation, and biology of plants.

The Botanic Garden Foundation, Colombia has developed a 45-hour theoretical environmental course. The principal objective of the course for primary and secondary levels is to train volunteers, students and community leaders in new educational methods, basic ecological concepts and teaching applications. The methodology includes individual and group work, analysis of videos and library text and occasional trips to zones of ecological interest.

Botanic gardens have an obvious vital role in supporting classroom teachers. Research in the United Kingdom indicates that teachers want programmes that are practical in nature, giving them models and activities that they can easily apply to their everyday work. It also indicates that teachers appreciate in-service training which takes place outside the school, giving them a chance to stand back' from the normal workplace. (Ailene & Julia 1995).⁶⁶

The State botanic garden of Georgia initiated a workshop for students to work with endangered plant networks in 1996. Through this project students work to increase the number of plants on their school grounds by adding common and endangered plant species to their sight. **Shenk & Ceska (2001)**⁶⁷, claim that the project offers many opportunities for student involvement in science inquiry. Teachers spend time observing native plants and learning answers to the questions.

⁶⁶ Ailene, L. & Julia, W. (1995) (Eds.), *Botanic gardens: Education for conservation*. Roots BGCi Education News letter December 1995, p. 184-190.

⁶⁷ Shenk, Anne. & Ceska, Jennifer. (2001). *The green plant blues: Engaging students in science inquiry while encouraging a conservation ethic*. In Lucy a Sutherland and T.K. Abraham (Eds.) 2001, *The power for change*. (pp 245-252) U.K: Botanic Garden Conservation International.

Teachers quickly discover that there are a multitude of inquiry possibilities to interest and challenge their students Chelsea Physic Garden runs a one-day In-Service training course for secondary and tertiary teachers. The aims of the one-day course were:

- to demonstrate the diversity of plants
- to discuss what a species is
- to explore the properties of materials using plants
- to present the Chelsea Physic Garden as an educational resource (TR-TR)

Conservatoire et Jardin Botaniques (CJBG), Geneva, Switzerland has transformed a small house within the garden to provide a classroom and meeting place. The building which can accommodate 20 people is equipped with basic audio-visual materials as well as office and storage space. CJBG has produced two new volumes in their educational series which include worksheets and drawings. The volumes are (i) What does a Botanic Garden do? (An introductory programme for teachers) (ii) Tropical discoveries and observations focusing plants useful to humans. (Ailena & Julia 1995).⁶⁸

Providing educational experiences for the public was selected by the highest percentage of garden directors as a very important purpose of North American public gardens. Therefore, public gardens conduct a varied array of programmes to fulfill the educational, aesthetic interpretative and entertainment purposes. Some of the programmes are aimed specifically for children, students or professional horticulturists while others are designed for adults or general groups. These activities may take place in the garden, at nearby schools or community centres or in home through radio or TV. Among the programmes that are most often scheduled are guided

⁶⁸ Ailene, L. & Julia, W. (1995) (Eds.), *Botanic gardens: Education for conservation*. Roots BGC I Education News letter December 1995, p. 84-90.

tours and walks for general groups, special lecture demonstrations for children, classes for adults and special exhibits. (Correl, 1980).⁶⁹

In New York Botanic Garden, educational activities for the public are arranged at all levels from the very simplest observation of plants to serious formal courses for adults. Formal course work for the public is very diverse, ranging from single courses of one to eight sessions to formal two-year programmes that lead to certificates in Botany, Horticulture or garden design. The Children's Garden Craft Programme is very effective because it deals with how to grow vegetables and flowers. In its effort to bring successfully accurate information about plants to the general public, in addition to the classes and exhibits the Botanic Garden has embarked on a major programme of publications (Steere, 1969).⁷⁰

Gardens the South east, West and Canada place the most emphasis on children's programmes and gardens in the North East, Midwest and mountain plains selected adult educational programmes as most important. 24% of the gardens supplement school programmes with preparatory or follow-up activities in the schools. (Correl, 1980).⁷¹

In a co-operative programme with New York City schools, approximately 20,000 children come to Brooklyn Botanic garden each year for instruction by staff teachers. A leisure time programme on Saturday and in the summer attracts more than 1000 additional children. In-service courses for teachers are still another educational offering. Thus, (Balgooyen & Avery, 1969)⁷² reports that this garden is acting in the dual role of offering people popular level educational opportunities in horticulture and gardening and serving as a conservator of the world.

⁶⁹Correl, P. G. (1980). *Botanical garden and arboreta of North America: Anorganizational survey*. California. American Association of Botanical gardens & Arboreta Inc, p. 8-20, p. 30-50.

⁷⁰Steere, W. C. (1969). *Research and education at the New York Botanic Gardens*. In James E. Gunckel (Ed.) Current Topics in plant science, London Academic Press Inc. Ltd, p.115-130.

⁷¹Correl, P.G. (1980). *Botanical garden and arboreta of North America: Anorganizational survey*. California. American Association of Botanical gardens & Arboreta Inc, 120-154.

⁷²Balgooyen, W. & Avery, G.S. (1969). *Research and education at botanic gardens*. In James E. Gunckel (Ed.), Current Topic in plant science (p 262 -259). London: Academic Press Inc.Ltd, p. 119-150.

Nanjing Botanic garden and six other institutions have joined together to provide an after-school scientific and educational base for middle and primary schools in Nanjing. The theme Love, Learn and Apply science have been adopted in the hope that students will take advantage of the wealth of educational resources. Nanjing Botanic Garden introduced biology and horticulture to students through environmental education.

The Young Ecologists' Club was set up with Moscow university botanic garden with the aim of using the garden as a teaching resource for children living in the city. After-school sessions were conducted for the students to learn more about the natural world through observation, experimentation and practical work. The aim of YEC is to,

- Develop the interest of children in plants and their life;
- Teach children to observe nature;
- Teach some specific aspects and general perspectives on the complex relationships of man and the biosphere;
- Study the relationships between plants and other components of ecosystems; and
- Teach children practical skills to enable them to work with plants. (**Andreeva & Parshin, 1999**).⁷³

A short-term work of environmental education applied to the medicinal plants is going on in the Botanical Garden of Asuncion, through the CREAM (Centro de Education Ambiental de la Muncipalidad), the Centre of Environmental Education of the city of Asuncion. It consists of courses and workshops on medicinal knowledge of the living plants, toxicity fund measuring, the problems of misuse and self-medication, familial planning, etc. These courses are primarily aimed at sellers of medicinals, teachers, healthcare and environmental promoters in the different

⁷³ Andreeva. Alla&Parshin. Artyom. (1999). *Revitalising of educational activities in the oldest botanic garden of Russia*. In Lucy A Sutherland and T. K. Abraham (Eds.) (2001). *The power for change*. (pp.31-36) U.K: Botanic Garden Conservation International.

districts of the capital. The educational activities could also be decentralised through a small and mobile interactive exhibition presented in a bus. (Roguet, 1999).⁷⁴

More than 1000 students and visitors visited an exhibition entitled 'Promoting biodiversity conservation' organised by Shenzhen Fairy Lake botanic garden. Many of them asked questions about biodiversity conservation and the visitors were supplied with a souvenir set of four bookmarks, all of which were in the shape of different leaves aimed at demonstrating plant biodiversity. (Lucy & Julia, 2000).⁷⁵

As far as India is concerned Indian Botanic Garden, Calcutta with its picturesque vistas, some delightful lakes with marvelous lotus, water lilies and vast greeneries serve as a source of inspiration, education, research and recreation to millions of visitors to this garden throughout the year from India and abroad. Special facilities for visitors are available in the form of guided botanical trips inside the garden on Sundays and holidays. Other activities include extension services. through open week exhibitions, flower shows, film shows and distribution of materials during Vanamahotsava (Chakraverty & Mukhopadhyay, 1990).⁷⁶

In the Gurukula Botanical Sanctuary at Kodaikanal workshops and programmes are undertaken for school students, youths, nature clubs, botany students etc., around the central theme of conservation and sustainable living. Seshan (1999)⁷⁷ reports that during local school visits enough time is spent in looking at and discussing the forest world and exploring the feelings and impressions it arouses in their minds. And this is done through a playful exploration of plants, an

⁷⁴ Roguet, D.J. (1999), *Ethnobotany, the scientific vector in education for conservation*. In Lucy A Sutherland and T. K. Abraham (Eds.) (2001). The power for change. (pp. 237-244) UK: Botanic Garden Conservation International.

⁷⁵ Lucy Sutherland & Julia Willison (2000). *Botanic gardens: Education for Sustainability*. Roots. BGCI Education Review. July 2000, p. 10-18, p. 31-45.

⁷⁶Chakraverty, R.K. & Mukhopadhyay, D.P. (1990). *A directory of botanic gardens and parks in India*. (pp 10-12). Calcutta: Botanical survey of India.

⁷⁷ Sheshan, S. (1999). *School in the forest-Educating the young at the gurukula botanical sanctuary*. In Lucy A Sutherland and T. K. Abraham (Eds.). 2001. The power for change. (pp 157-164) U.K: Botanic Garden Conservation International.

excited and eager rediscovery of their native landscape and wild community. She emphasises that the understanding of nature needs a direct involvement, in whatever way, and it can happen in city parks, with a home garden, or trips out to the wilderness.

Tropical Botanic Garden and Research Institute (TBGRI), Trivandrum is playing a significant role in providing Environmental Education through botanic infrastructure available in the garden. Presently in South India TBGRI is undertaking innovative ecological education programmes both for students and the general public. The plant wealth of this garden consists of more than 750 medicinal plants, thousands of wild trees, apart from orchidarium, palmctum, conservatory, bamboosetum and fernarium. There exists in TBGRI an incredible opportunity for imparting environmental education to students and the general public. Pushpangadan, the Director, in his presidential address on the occasion of the inauguration of the environmental education programmes in TBGRI in 1995 stated that institutions like TBGRI can function as a nodal agency in evolving and developing suitable interpretative educational materials and co-ordinating, implementing and monitoring the action programmes at various schools and colleges in the State. Accordingly, TBGRI is engaged in structuring, developing and implementing environmental education programmes to students to observe, understand and appreciate the natural resources and to use these resources judiciously for our sustenance. The present research attempt is the outcome of such an environmental activity conducted in TBGRI.

Having reviewed some of the important studies on Environmental History, Environmental Science, Colonial Botanical history, History of Science, and History of Botanical Gardens at global level in general and at India level in particular, the study proposes that in spite of some studies on systematic documentation on History of Saharanpur Botanical Garden of India have yet to be done. This study is a humble beginning towards this direction.

1.7 Chapterisation of the Study

In order to narrate the narrative of the history of Saharanpur Botanical Garden in India, this study has been organised into the following chapters:

Chapter-I: Introduction

This first chapter deals with the introductory aspects of the study. A systematic and modest narration has been an attempt on the context of the study, objectives of the study, hypothesis, and review of the literature and Chapterisation of the study. The main objective of this chapter is to explore the thematic illustration of the study and various aspects to it.

Chapter-II: The Idea of Botanical Garden in India

The Second Chapter of this study entitled the idea of Botanical Garden in India deals with what is botanical garden, its definition and objectives and evolution of the idea of botanical garden in global perspective (Modern) India perspective and regional perspective (Saharanpur Botanical Garden).

Chapter-III: Functions, Scientist Contribution and Experiments of Saharanpur Botanical Garden

Third Chapter of this study entitled functions of botanical garden in India and Biological experiments undertaken by Saharanpur Botanical Garden deals with factors for establishment of Saharanpur Botanical Garden, Experiment of Seeds (listing of seeds, method of experiments), Experiments on plants (food crops, commercial crops, horticulture crops etc), advocacy to farmers, Uniqueness of Saharanpur Botanical Garden.

Chapter-IV: Conclusion

The fourth chapter highlights the entire study in the form of a summary followed by a rational conclusion and the main findings of my study indicating scopes for further research in this area. The conclusion is very brief and reflects the major and most important findings of the history of Saharanpur Botanical Garden written by environmentalists, environmental scientists, environmental historians, botanist with their methodology and approaches. It is expected, the outcome of the study will serve the self-same purpose for which it has been undertaken.



Chapter-II

The Idea of Botanical Garden in India

The Idea of Botanical Garden in India

Plants in botanic gardens are frequently labelled. Such passport data provide us with information about plants such as their common name, scientific name, family, specific characteristics, uses, and parts used, among other things. Sometimes the labels will tell us more about the plant, such as when and where it was taken, its habitat, and its range of distribution.

Botanic gardens are particular areas for plants, with scientifically managed collections. It provides information about a variety of plant species. Botanic gardens provide excellent care and research for rare and endangered plants. It is a horticulture and training centre of excellence. Another key activity is plant scientific research, which serves as a resource and information hub. Botanic gardens, in a nutshell, are a particular goal and targeted settings for plants. Beautifully groomed gardens pale in comparison to a Botanic Garden. It is a botanical collection that serves as a resource for study, education, and pleasure. The gardens are also responsible for growing and displaying flora.¹

As a result, botanic gardens are good locations for teaching people about:

1. The plant kingdom's diversity
2. The complex associations that plants have formed with their surroundings
3. How plants are used economically, culturally, and artistically by humans.
4. What are the most serious dangers to plants, as well as the repercussions of their extinction?
5. What can we do to keep the system from collapsing?

¹ Walter, K. S., & Gillett, H. J. (Eds.). (1998). *1997 IUCN red list of threatened plants*. IUCN, P. 1-175.

Evolution of the idea of Botanical garden

The first garden we hear about was Theophrastus' Academy Gardens in Athens in the 4th century BC (B.C. 370-286). Theophrastus' garden was less well-documented, yet it remained a popular subject for artists and illustrators throughout history. We just knew he had a garden where he educated his friends, disciples, and students about plants. So, because he bequeathed the garden to them in his will, it's possible that this garden was one where plants were researched, and thus it may be considered the first botanic garden.²

China is one of the few places where we have any documentation of early gardens, with fabled early traditions dating back to 2000 BC. Ancient Mesopotamian monarchs were equally passionate about plants and gardens. According to reports, Egyptians were so enamoured of their gardens that they built small gardens around graves, and some of their inscriptions appear to imply that the deceased would continue to enjoy his gardens after his death. The Hebrews had a fondness for gardens, according to the Bible. Following the fall of the Roman Empire, the popularity of garden art declined. For the next seven or eight hundred years, great gardens were unheard of in the west, save in fiction, where, as we will see, writers and painters frequently used the garden as a centre for their imagined depiction of spiritual or worldly delights. The number of plants in mediaeval gardens was limited, with herbs being the most common, followed by vegetables and fruit trees. Firsthand experience of comprehension and delight has also come from poets' writings and other such texts.³

We still rely on literature and artworks for knowledge on early Italian Renaissance gardens, rather than actual gardens. However, it is a confusing thrill to discover that other Renaissance Italian gardens exist, many of which are outstanding in terms of design, landscape,

² Colburn, T. C. (2012). *Growing gardens: botanical gardens, public space and conservation*, P. 1-84.

³ Delumeau, J. (2000). *History of paradise: the Garden of Eden in myth and tradition*. University of Illinois Press, P. 3-88.

and display. When the French formal gardens became famous in the 1660s. For a while, the Italian Renaissance garden was quiet. Gardening, as well as hunting, shooting, and fishing, were popular in the seventeenth century. Nurseries developed to supply plants for the gentry's gardens, which had become a popular pastime. Gardens were becoming status symbols, and nurseries were being raided for their varieties during the time, with the wealthy dispatching plant collectors to bring species back from distant nations. At the time, the first books on gardening were appearing, and it was able to determine what was being cultivated based on that record.

Systematic study of plants in Western Europe can also be traced back to the 16th century. The first university botanic garden in Italy was established at Padua in 1545, followed by others in Leiden, Leipzig, and Heidelberg. The first garden in England was established in 1621 at Oxford. These botanic gardens were designed with the purpose of collecting and studying plants in mind, rather than being aesthetically pleasing.⁴

Early botanic gardens, constructed in the 16th century, were most likely established with the goal of producing plants native to the area as well as those obtained through collection or exchange from elsewhere. The goal was to get as many plants together as possible, so the garden's ranking or status was mostly determined by the amount of surprises it included.

The study of systematic botany, or taxonomy, was the next step in the evolution of botanic gardens. Plants were divided into groups based on their diagnostic characteristics, and each group was grown together. Botanic gardens evolved into centres of natural aesthetic beauty, taxonomic studies, and general instruction as these institutions became sites of study of the diversities and mysteries of plant life.

⁴ Hill, A. W. (1915). The history and functions of botanic gardens. *Annals of the Missouri Botanical Garden*, 2(1/2), 185-240.

The next step in the evolution of botanic gardens appears to have been in three distinct directions.

Phases and Directions of Botanic Garden Development

(1) Plants in the garden and the herbarium are compared for modern taxonomy and experimental botany.

(2) As research institutes for economic plants. Before being released for cultivation, economically promising plants native to one region of the world were introduced to other botanic gardens that acted as acclimatisation centres.

(3) As horticultural research institutes, where thousands of new and improved kinds of both practical and attractive plants were trialled, selected, hybridised, and released into the horticultural commerce. Higher standards of display and decorating were also encouraged by the botanic gardens.

Now we will see the history, various type of Botanical Garden and type of Plant in Botanical Garden in many ways Such as:

- Global Perspective
- Indian Perspective
- Regional perspective

2.1 Global Perspective

Botanical gardens have a long history that is intertwined with the history of botany. The first botanical gardens were medicinal gardens in the 16th and 17th centuries, but the concept of a botanical garden evolved to include exhibits of the beautiful, exotic, novel, and often commercially valuable plant prizes returned from European colonies and other faraway regions.

Later in the eighteenth century, they took on a more educational role, exhibiting the most up-to-

date plant categorization systems created by botanists working in the linked herbaria as they attempted to organise these new treasures. Then, in the nineteenth and twentieth centuries, there was a movement toward a mix of expert and eclectic collections displaying a wide range of horticulture and botany.⁵

Grand gardens of ancient history

Near-eastern royal gardens set aside for economic use or display and containing at least some plants gained by special collecting trips or military campaigns abroad, are known from the second millennium BCE in ancient Egypt, Mesopotamia, Crete, Mexico and China.⁶ In about 2800 BCE, the Chinese Emperor Shen Nung sent collectors to distant regions searching for plants with economic or medicinal value. It has also been suggested that the Spanish colonisation of Mesoamerica influenced the history of the botanical garden as gardens in Tenochtitlan established by king Nezahualcoyotl,⁷ also gardens in Chalco (altépetl) and elsewhere, greatly impressed the Spanish invaders, not only with their appearance, but also because the indigenous Aztecs employed many more medicinal plants than did the classical world of Europe.

The 11th-century Huerta del Ray garden of physician and author Ibn Wafid (999-1075 C.E.) in Toledo is an example of early mediaeval gardens in Islamic Spain that resembled botanic gardens of the future. Until the Christian takeover in 1085 C.E., it was taken up by garden chronicler Ibn Bassal (fl. 1085 C.E). The majority of the plants in Ibn Bassal's garden at Seville were acquired during a botanical journey that took him through Morocco, Persia, Sicily,

⁵ Hill, Arthur W. (1915). *"The History and Functions of Botanic Gardens"*. Annals of the Missouri Botanical Garden. 2 (1/2). 185-240.pp-219-223.

⁶ Day, Jo. (2010). *"Plants, Prayers, and Power: the story of the first Mediterranean gardens"*. In O'Brien, Dan (ed.). *Gardening Philosophy for Everyone*. Chichester: Wiley-Blackwell. pp. 65-78.

⁷ Toby Evans, Susan. (2010). *"The Garden of the Aztec Philosopher-King"*. In O'Brien, Dan (ed.). *Gardening Philosophy for Everyone*. Chichester. Wiley Blackwell pp. 207-219.

and Egypt. The medical school at Montpellier was founded by Spanish Arab physicians and contained a physic garden by 1250 CE, but the site was not designated as a botanic garden until 1593.⁸

Physic gardens

Botanical gardens, in the contemporary sense, evolved from physic gardens, whose primary objective was to plant medicinal herbs as well as conduct research and experiments. These kinds of gardens have a long history. In Europe, for example, Aristotle (384 BCE - 322 BCE) is reported to have had a physic garden in the Lyceum in Athens, which was used for educational purposes and botany research, and which was inherited, or maybe established, by his pupil Theophrastus, the "Father of Botany."⁹ Some science historians argue that this garden was not orderly or scientific enough to be deemed "botanical," and that the earliest known botanical garden in Europe should be attributed to Antonius Castor, a botanist and pharmacologist reported by Pliny the Elder in the first century.¹⁰

Though these ancient gardens had some of the same qualities as current botanical gardens, the forerunners of modern botanical gardens are widely thought to be the mediaeval monastic physic gardens that arose after the Roman Empire fell apart during Emperor Charlemagne's reign (742-789 CE). These included a hortus, a vegetable garden, and a herbularis or hortus medicus, often known as a physic garden, as well as a viridarium or orchard, which was set aside for specially labelled medicinal plants. When Charlemagne issued the Capitulary de Villis, which designated 73 herbs to be utilised in his dominions' physic gardens, these gardens

⁸ Taylor, Patrick (2006). *The Oxford Companion to the Garden*. Oxford: Oxford University Press.p-57.

⁹ Young, Michael (1987). *Collins Guide to the Botanical Gardens of Britain*. London:Collins,p-7

¹⁰ Sarton, George (1952). *Ancient Science Through the Golden Age of Greece*. Dover classics science and mathematics. Dover Publications, p-556.

were likely to be given a boost. Many of these were discovered in British gardens despite the fact that they only exist naturally in continental Europe, indicating that they were introduced earlier. In 1447, Pope Nicholas V set aside a portion of the Vatican grounds for a medical plant garden, which served as a predecessor to the University gardens of Padua and Pisa, which were constructed in the 1540s. Many early botanic gardens were unquestionably founded by members of the medical profession.¹¹

16th- and 17th-century European gardens

Botanical gardens began to contribute to a deeper scientific curiosity about plants in the 17th century. If a botanical garden is characterised by its scientific or intellectual connection, the first authentic botanical gardens were constructed during the Renaissance renaissance of learning in Europe. These were secular gardens that served as teaching and research resources at universities and medical colleges. The superintendents of these gardens were frequently internationally renowned botany professors, a circumstance that helped to establish botany as a distinct field rather than a descriptive adjunct to medicine.¹²

Origins in the Italian Renaissance

Botanical gardens in Southern Europe were created in Italy at Orto botanico di Pisa (1544), Orto botanico di Padova (1545), Orto Botanico di Firenze (1545), Orto Botanicodell'Università di Pavia (1558), and Orto Botanicodell'Università di Bologna (1568). The physicians (called apothecaries in English) gave lectures on the Mediterranean "simples" or "officials" that were being grown on the premises. The relatively recent invention of printing and the publication of

¹¹ Holmes, Edward M. (1906). *"Horticulture in Relation to Medicine"*. Journal of the Royal Horticultural Society. p-49-50.

¹² Williams, Roger L. (2011). *"On the establishment of the principal gardens of botany: A bibliographical Jean-Phillipe-Francois essay by Deleuze"*. Huntia. P-147-176.

the first herbals undoubtedly boosted student instruction.¹³ All of these botanical gardens are still in operation, with the majority of them in their original locations.

Northern Europe

The tradition of these Italian gardens passed into Spain (Botanical Garden of Valencia, 1567) and Northern Europe, where similar gardens were established in the Netherlands (Hortus Botanicus Leiden, 1587; Hortus Botanicus (Amsterdam), 1638), Germany (Alter Botanischer Garten Tübingen, 1535; Leipzig Botanical Garden, 1580; Botanischer Garten Jena, 1586; Botanischer Garten Heidelberg, 1593; HerrenhäuserGärten, Hanover, 1666; Botanischer Garten der Christian-Albrechts Universität zu Kiel, 1669; Botanical Garden in Berlin, 1672), Switzerland (Old Botanical Garden, Zürich, 1560; Basel, 1589); England (University of Oxford Botanic Garden, 1621; Chelsea Physic Garden, 1673); Scotland (Royal Botanic Garden Edinburgh, 1670); and in France (Jardin des plantes de Montpellier, 1593; Faculty of Medicine Garden, Paris, 1597; Jardin des Plantes, Paris, 1635), Denmark (University of Copenhagen Botanical Garden, 1600); Sweden (Uppsala University, 1655).

Beginnings of botanical science

The first plants were introduced to these great Western European gardens from Eastern Europe and adjacent Asia (which offered many bulbs) during the 16th and 17th centuries, and they found a place in the new gardens, where they could be examined by the plant specialists of the time. Carolus Clusius (1526-1609), for example, who was director of the Botanical Garden of the University of Vienna and Hortus Botanicus Leiden, described Asian introductions. Many plants, particularly bulbous plants from Turkey, were collected from the Near East. Clusius laid the

¹³ Hill, Arthur W. (1915). "The History and Functions of Botanic Gardens". *Annals of the Missouri Botanical Garden*. p-190-197.

groundwork for Dutch tulip breeding and the bulb industry, and he assisted in the creation of one of Europe's first formal botanical gardens at Leyden, where his comprehensive planting lists have allowed the garden to be recreated near its original location. In 1601, the hortus medicus of Leyden was a perfect square divided into quarters for the four continents; by 1720, however, it had become a rambling system of beds, fighting to hold the novelties rushing in,¹⁴ and it was renamed the hortus academicus. His *Exoticorum libri decem* (1605), a comprehensive review of exotic flora and animals, is being used today.¹⁵ Botanic gardens' scientific importance was expanding with the addition of new plant introductions, as botany steadily asserted its independence from medicine.

The Paris Jardin des Plantes was a hotspot of interest in the mid- to late-eighteenth century, with the greatest number of new introductions to entice visitors. The Chelsea Physic Garden, also known as the "Garden of the Society of Apothecaries," was founded in 1673 in England. The Chelsea garden contained heated greenhouses, and Philip Miller (1691-1771) was named chief gardener in 1723. As plants flooded in from all over the world, he had a huge impact on botany and horticulture. The garden reached its pinnacle in the 18th century, when it became the world's most comprehensive botanical collection. Its seed-exchange programme began in 1682 and is still going strong today.¹⁶

18th century

As maritime trade increased, more plants were brought back to Europe as treasures from faraway regions, and they were triumphantly displayed in the wealthy's private estates, commercial

¹⁴ Drayton, Richard (2000). *Nature's Government Science, Imperial Britain, and the 'Improvement of the World*. London: Yale University Press.p-34

¹⁵ Ogilvie, Brian W. (2006). *The Science of Describing: Natural History in Renaissance Europe*. Chicago University of Chicago Press.

¹⁶ Minter, Sue (2000). *The Apothecaries' Garden* Stroud, UK: Sutton Publishing.

nurseries, and public botanical gardens. Many botanical gardens began to include heated conservatories known as "orangeries," such as the one at Kew. Plants susceptible to cold were kept during winter in increasingly intricate and expensive heated conservatories and glasshouses as industrial expansion in Europe and North America resulted in new building capabilities.¹⁷

The Cape, Dutch East Indies

The introduction of Ericas, geraniums, pelargoniums, succulents, and proteaceous plants from the Cape of South Africa marked the 18th century, while Dutch trade with the Dutch East Indies resulted in a golden era for the Leiden and Amsterdam botanical gardens and a boom in the construction of conservatories.

Royal Botanic Gardens, Kew

The Royal Gardens at Kew were established in 1759 as part of the Royal Garden, which was originally set aside as a physic garden. The initial curator, William Aiton (1741-1793), was instructed by Chelsea Physic Garden garden chronicler Philip Miller, whose son Charles became the first curator of the original Cambridge Botanic Garden (1762). The "Physic Garden" was established in 1759, and by 1767, "the Exotic Garden is by far the richest in Europe." Gardens like the Royal Botanic Gardens, Kew (1759), the Orotava Acclimatisation Garden (in Spanish), Tenerife (1788), and the Real Jardn Botánico de Madrid (1755) were established to cultivate new species returned from tropical expeditions, as well as to assist in the establishment of new tropical botanical gardens. Amateur collectors were reinforced by official horticultural and botanical plant hunters beginning in the 1770s, following the lead of the French and Spanish.

¹⁷ Hill, Arthur W. (1915). *"The History and Functions of Botanic Gardens".Annals of the Missouri Botanical Garden*.p-200.

The flora being shipped back to Europe from various European colonies around the world bolstered these botanical gardens.¹⁸

At this time, British horticulturists were importing many woody plants from Britain's North American colonies, and horticulture's popularity had skyrocketed, thanks to horticultural and botanical collecting expeditions abroad facilitated by Sir William Jackson Hooker's directorship and keen interest in economic botany. Under the direction of Sir Joseph Banks, Kew enjoyed a golden age of plant hunting at the end of the 18th century, sending out collectors to the South African Cape, Australia, Chile, China, Ceylon, Brazil, and other parts of the British Empire, and acting as "the great botanical exchange house of the British Empire."¹⁹ From its beginnings to the present, Kew has represented botanic garden ideals in many ways, and is renowned for its scientists' published work, horticultural student education, public programmes, and scientific basis of its horticulture.²⁰

Plant classification

The huge number of plants that needed to be described was frequently published in garden catalogues, and Carl Linnaeus invented the binomial nomenclature system at this time, which considerably helped the listing procedure. Dried plant specimens mounted on card (a hortus siccus or garden of dried plants) were stored in buildings called herbaria, which were frequently associated with botanical gardens, many of which by then had "order beds" to display the classification systems being developed by botanists in the gardens' museums and herbaria. Botanists produced descriptions of new exotic species, which were also recorded in detail for

¹⁸ Drayton, Richard (2000). *Nature's Government Science, Imperial Britain, and the 'Improvement of the World*. London: Yale University Press.p-43.

¹⁹ Idib p-xiii.

²⁰ Desmond, Ray (2007). *The History of the Royal Botanic Gardens Kew*. London: Kew Publishing.

posterity by excellent botanical pictures, transforming botanical gardens into scientific collections. In this century, botanical gardens effectively abandoned their medicinal function in favour of scientific and aesthetic priorities, and the term "botanic garden" came to be associated with the herbarium, library (and later laboratories) housed there rather than the living collections, on which little research was conducted.²¹

19th century

Tropical botanical gardens were established as a weapon of colonial expansion (for trade and commerce, and, secondarily, science) in India, Southeast Asia, and the Caribbean during the late 18th and early 19th centuries, primarily by the British and Dutch.²² During Captain James Cook's circumnavigations of the globe and explorations of Oceania, Sir Joseph Banks' botanical collections represented the final stage of large-scale plant introduction.

2.1.1 Tropical botanical gardens

There are around 230 tropical botanical gardens in existence today, with a concentration in southern and south-eastern Asia. The Pamplemousses Botanical Garden on Mauritius was the first botanical garden in the tropics, founded in 1735 to offer food for sailors visiting the port, but later trialling and distributing numerous economically important plants. The West Indies (Botanic Gardens of St. Vincent, 1764) followed, as did the Acharya Jagadish Chandra Bose Botanical Garden in Calcutta, India, which was created in 1786 during a period of prosperity when the city was a trading centre for the Dutch East India Company. Other gardens were built in Brazil (Rio de Janeiro Botanical Garden, 1808), Sri Lanka (Botanical Garden of Peradeniya,

²¹ Heywood, Vernon H. (1987). "The changing role of the botanic gardens". In Bramwell, David; et al. (eds.). *Botanic Gardens and the World Conservation Strategy*. London: Academic Press. pp. 3-18.p-7

²² Idib, p-9.

1821 and on a site dating back to 1371), Indonesia (Bogor Botanical Gardens, 1817 and Kebun Raya Cibodas, 1852), and Singapore (Bogor Botanical Gardens, 1817 and Kebun Raya Cibodas, 1852), and Singapore (Bogor Botanical Gardens (Singapore Botanical Gardens, 1822). These had a significant impact on the economies of the countries, particularly in terms of the foods and medicines that were introduced. The introduction of rubber trees to the Singapore Botanic Garden sparked the Malay Peninsula's vital rubber industry. Teak and tea were also introduced to India at this period, as were breadfruit, pepper, and starfruit to the Caribbean.²³

The exploration of the local flora for its economic value to both the colonists and the local people was included in the charter of these gardens. Cloves, tea, coffee, breadfruit, cinchona, sugar, cotton, palm oil, and *Theobroma cacao* were among the crop plants brought by or through these gardens, which were often in conjunction with European botanical gardens like as Kew or Amsterdam (for chocolate). The rubber plant was brought to Singapore at this period. 150 larger gardens, especially in the tropics, were typically coupled with a herbarium and a museum of economy. The Peradeniya Botanical Garden had a significant impact on the development of agriculture in Ceylon, where the para rubber tree (*Hevea brasiliensis*) was introduced from Kew, which had imported the species from South America. Cotton from the Chelsea Physic Garden to the Province of Georgia in 1732 and tea from the Calcutta Botanic Garden to India are two such examples. The transfer of germplasm between temperate and tropical botanical gardens is unquestionably responsible for the wide variety of agricultural crops now grown in tropical countries.²⁴

²³ Ibid, p-8-13.

²⁴ Hill, Arthur W. (1915). *"The History and Functions of Botanic Gardens"*. *Annals of the Missouri Botanical Garden*. p-222.

All of the industrialised countries of the globe have recognised the value and utility of botanical gardens to the point where many of them now have dozens of them.

2.1.2 Great Botanic Gardens

Botanic Gardens around the world have a long history and heritage in education, and many are still closely affiliated with institutions. For example, Cambridge and Utrecht have a large formal education component that is interwoven into their work. The first gardens in Europe, such as those in Padua and Pisa, were established specifically for the cultivation of medicinal plants for use in teaching medicine at ancient city universities, and later gardens, such as the Oxford Botanical Garden, were established for the teaching of botany as a separate science from medicine.²⁵

2.1.3 Glasgow Botanic Garden

Throughout the 18th century, Glasgow maintained a physic garden in the university area. This was for the purpose of medical education. It had a small arboretum, a systematic garden, a herbal garden, and other outdoor features that many such gardens had. The glass houses are the primary points of interest. It has a significant collection of tree ferns as well as a geographically organised plant collection. Several plant groups were planted in the garden to serve as "conservation. collections." Plant products such as jute, coffee, and cocco were displayed in the garden to demonstrate the economic importance of plants. Because the general public frequently encounters the usage of botanical names in exhibits, common names are utilised on labels whenever possible. In fact, the botanical name piques people's curiosity in the information they

²⁵ Bramwell, David (1993) Botanical gardens and environmental education. In Julio D Rodrigo Perez (Ed.) *Cultivating green awareness* (p.15-18). Spain: Jardin BotanicoCanario.

provide.²⁶ The Glasgow Botanic Gardens formal relationship with the University of Glasgow had resulted in the creation of a wide range of educational and informative resources for the general public and students.

2.1.4 Munich Botanic Garden

The first Munich Botanic Garden opened in 1812, and it was replaced in 1914 by a new one. The new garden was not just a pure scientific institution, but also a university-level teaching and research institute. It also acts as a public gathering space for information, knowledge, relaxation, and recreation. As a result, a multipurpose garden arose, which was novel at the time and is still considered a model today. The garden is used for teaching by a number of university departments. Plant material from the garden is used extensively in lectures on systematic botany and numerous practical courses. In addition, this garden acts as a "living textbook" for all biological science students. The number of students who visit the garden each year is estimated to be around 45000. The garden is used for practical learning by classes of primary and secondary schools, accompanied by their teachers (about 20000 pupils every year).²⁷

2.1.5 Durham Botanic Garden

This is one of the British Islands' newest botanic gardens, being opened in 1967. The idea behind the garden was to give instructional materials to the botany department, and it was hoped that the

²⁶ Curtis, W. E.(1990). Glasgow Botanic Gardens: History and present day work in education and conservation. In. M.P. Nair (Ed.) *Net Work of botanic gardens*. (pp. 129-134) Calcutta: Botanical survey of India.

²⁷Schotz & Bogner, (1987) Munich botanical garden. In M.P. Nair (ed.) *Net work of botanic gardens*. Calcutta: Botanical survey of India. pp. 38-57

gardens would play a significant role in meeting these needs. Another objective for the garden was the preservation of the regional flora.²⁸

2.1.6 Botanic Gardens in Copenhagen

It is owned by the University of Copenhagen and was built primarily to facilitate scientific research and education. With around 7,00,00K) visitors annually, this serves as a popular recreational place for both Copenhageners and tourists due to its central location in the capital.²⁹

2.1.7 Royal Botanic Gardens, Kew

The Royal Botanic Gardens at Kew, located within Greater London's built-up area, has a particular place in the hearts of its many lovers. Every year, more than a million people visit the Garden, some as repeat visitors and others as part of a botanical pilgrimage, for which there may be only one chance in a lifetime. The popularity to which all of this attest is partly based on Kew's reputation as a pleasure garden with extraordinary ornamental beauty. Many people are familiar with its pastoral appeal, which includes bluebell woodlands, expansive lawns, and a quiet lake. The beautiful rose gardens, glorious Azaleas, and interesting species in the rock garden will be the main attractions for others. The unusual tropical collections in the greenhouses, which include orchids, insectivorous plants, and huge water lilies, will captivate even the most jaded visitor. With about 50000 plant species and kinds in the gardens, visitors are unlikely to be disappointed by a lack of variety. Plants from most regions of the world's mild, temperate, subtropical, and tropical climates have been introduced to Kew's sensitive collections. The vast variety of plant life uncovered on early exploration journeys provided a tremendous

²⁸ Boutler, D & Ansdel, S. (1987). Durham university botanic garden. In MP Nair (Ed.) *Net Work of botanic gardens*. (pp 33-35) Calcutta: Botanical survey of India.

²⁹ Moller, J.D. (1987). Botanical Gardens in Copenhagen. In M P Nait (Ed.) *Net Work of botanic gardens*. (pp. 36-37) Calcutta: Botanical survey of India.

boost to the development of exotic collections in Europe. As a result, Kew's greenhouse collections have evolved substantially under the twin spurs of species introduction and plant house technical advancement over the past two centuries. The Kew greenhouses offer a diverse range of settings for its floral residents. Plants from the tropics to the arctic, from the rainforest to the desert, and from the salt flat to the mountain top all have a home in Kew. To meet this wide range of needs, the collections are separated into two categories: herbaceous and woody, with the latter taking up the bigger structures. Plants that are strange and fascinating in their development or behaviour, as well as those that are helpful to man, such as those from tropical forests, desert cactus, and British woodland trees, can all be found at Kew. There are botanical exhibitions in the Museums and Orangery in addition to these living plants.

One of Kew Gardens main functions is public environmental education, which it excels at, and the best teachers are the plants themselves in their limitless variety. Labels hang from every tree and are positioned amid the plants, so it's impossible to pass through the gardens without discovering the names. Visitors who are knowledgeable examine the labels attentively, but the difficulty is that only a few of the species growing in botanic gardens have a popular name. Public museum exhibits must communicate a story using words, photos, and botanical objects in an evolving manner that is both entertaining and understandable to the general public and students. They are treasure troves of woods and resins, fruits and seeds, fibres and fabrics, paintings, pictures, and models, among other things. The Living Collections Division arranges several special exhibits in the green houses. Orchid and carnivorous plant displays are among them. Several educational displays with suitable labelling can be found in the open air. Kew and Wakehurst provide one-of-a-kind and limitless possibilities to learn about plants in all of their forms. Various aspects of Kew are displayed to groups of students by arrangement. A total of

5000 individuals are given guided tours each year. There are an increasing number of booklets and guides available to buy. The handouts and quiz sheets have been quite successful, especially with school parties, because they encourage youngsters to study the exhibits in order to finish their sheets, resulting in an ideal environmental education process. A visit to this garden provides insight into Kew's operations, as well as career ideas for young people and a method of appreciating the worth of plant life to the world.

With over 30,000 different types of plants, the Royal Botanic Gardens, Kew, and Wakehurst Place's combined living collection is the world's largest and most diverse, accounting for one out of every ten flowering plant species. This is a tremendously valuable resource for educational institutions.

A thorough examination of plant biological characteristics ensured the selection of the most useful plants for practical usage. The almost 50000 species and kinds of plants growing at Kew and Wakehurst Place make up one of the world's most extensive collections of living specimens kept for scientific study. Almost every ecosystem is represented, including arctic tundra, temperate lowland, tropical rain forest, and equatorial desert.

2.1.8 National Botanic Garden of Wales, UK

A new national and international botanic garden and research institute dedicated to horticulture, conservation, research, environmental education, and recreation. It is Wales' first botanical garden, and it marks a watershed moment in the country's cultural history. It is also the first major new botanical garden to be established in the United Kingdom in more than two centuries. One of the garden's main goals is to educate the general public about the connection between plants and global well-being. The garden's objective for its education programme is to create

environmental activities that will assist the people of Wales in becoming a part of a sustainable world. The garden authorities persuaded the public that the long-term quality of natural habitats, the countryside, and the diversity of living animals is dependent on their preservation and improvement, and that these projects will complement and extend environmental education. By 2010, the garden will have established itself as a major environmental teaching centre, offering a diverse range of courses, tours, workshops, seminars, conferences, public talks, and educational resources. This garden is a living example of sustainability, as well as a place to learn about how to live and work in harmony with nature.³⁰

2.1.9 Moscow Botanic Garden

The Russian Academy of Sciences' main Botanical Garden in Moscow, Europe's largest, has evolved into a unique scientific institution of the Russian Federation, with plant collections of significant national, scientific, and practical importance. The number of living plants in the collection could reach 21,000 or more. In the former Soviet Union, there are 120 botanic gardens in various towns and regions. All of them have made significant contributions to the country's botanical resources, which has resulted in the protection of the plant kingdom and the preservation of the gene pool. This Garden's vast plant collections provide tremendous opportunities for scientific research and education.

According to Kutcherov (1990), the old USSR Botanic Gardens were conducting research on two issues: biological principles of rational utilisation, modernization and conservation of plants, and plant introduction and acclimation. Their research focuses on both

³⁰ Stirton, C. (1998) *Education for sustainability A garden for a sustainable future. Roots.* (Dec) pp 38-41.

wild and introduced plants from the former Soviet Union and Russian Federation, as well as imported plants from other countries.³¹

2.1.10 Botanic Gardens in China:

The South China Botanic Garden is one of the city's most well-known gardens, and it was recently named one of Guangzhou's Eight Most Scenic Places by locals. This garden serves as a botanical research, environmental education, and plant conservation institution as well as a place of pleasure. Visitors will find a flower garden, well-kept lawns, green hills, and the quiet water of the large artificial lake, which reflects the surrounding forest of palms, conifers, and trees. This garden is linked with the South-China Institute of Botany as a botany and horticulture research centre. There are currently 48000 plant species in its living collection. The garden is separated into three sections based on the many functions: the experiment area, show area, and propagation area. Here are around 500 orchid species, the majority of which are native to China. When compared to the majority of botanic gardens around the world, this one is quite new.

2.1.11 Botanic Gardens in Canada

The Royal Botanic Garden in Hamilton, Canada, is a cultural institution and an independent, autonomous organisation that focuses on research, environmental education, and amenity. Arboretum features such diverse collections as flowering crab apples, lilacs, magnolias, and rhododendrons, as well as native trees and shrubs of Ontario, providing habitat for a wide diversity of native plants and animals. Hendrie Park, which is next to the Royal Botanic Garden,

³¹Kutcherov, E.V. (1990). Botanic Gardens in the southern urals. In MP Nair (Ed.) *Net Work of botanic gardens*. (pp. 135-138) Calcutta: Botanical survey of India.

houses a number of noteworthy collections that have been established for aesthetic effect and ease of study.

Plant culture, plant studies, and other parts of the natural world are explained and promoted through a range of courses and demonstrations at the Royal Botanic Garden. Plant-related instruction is given at all levels for persons of all ages. Arts and crafts, field study in horticulture and natural history, botanical studies, children's programme, flower arrangement, and plant propagation are some of the basic courses, lectures, and demonstrations offered as part of environmental education and recreation. Nature courses, such as horticulture therapy and interior plants, are among the activities offered by the garden.

2.1.12 Botanic Garden in the United States of America

South Carolina's Brookgreen Gardens are a haven for common, unusual, endangered, and vulnerable flora. The collection and identification of the many indigenous flora is also the work of renowned botanists and horticulturists. Plants are labelled so that the general people may identify them. The public is given the opportunity to learn about the importance of the natural landscape and, as a result, acquire an appreciation for it.³²

The National Arboretum of the United States is a living plant museum. While the Arboretum's many and varied gardens and collections draw visitors all year, it is not a park in the traditional sense. On trees, shrubs, and herbaceous plants, research and teaching initiatives are done. Guided tours of the garden and plant collections are led by trained volunteers.³³

³² Tarbox, G. L. & Salmon, R. (1987). Brookgreen Garden: A society for Southeastern flora and fauna. In. M.P. Nair (ed) *Net Work of botanic gardens*. (pp 98-102) Calcutta: Botanical survey of India.

³³ Neuman, E. A. (1987). Washington's hidden treasure The US National arboretum. In. M.P. Nair (ed) *Net Work of botanic gardens*. Calcutta: Botanical survey of India pp 113-119.

2.1.13 Brooklyn Botanic Garden

The Brooklyn Botanic Garden's principal aim is education. BBG has been a globally recognised pioneer and developer in environmental education programmes since its founding in 1910. These educational programmes help young people and adults alike have a better understanding of the natural world and recognise that we all have a responsibility to play in conserving and improving the quality of our environment. Furthermore, they engage over 37,000 adults and children in neighbourhood conservation efforts by collaborating with schools, libraries, block associations, and other community organisations to create and maintain gardens as well as raise awareness about the importance of preserving green spaces in their communities. Each year, our on-site adult education programmes offer more than 175 different horticulture courses and excursions to the community.

2.2 Indian Perspective

Major Botanical Gardens in India Early history and its role in plant conservation the Indian Botanical Garden

Howrah's East India Company's Garden, formerly known as the East India Company's Garden, is located on the west bank of the Hooghly River. Col. Robert Kyd advocated the creation of a horticultural and economically significant plant garden. He had his own private garden, in which he grew economically valuable plants. In 1787, the East India Company approved his idea, and he was appointed Honorary Superintendent of the Garden, where he introduced numerous economically significant species such as cardamom, pepper, nutmeg, cotton, tobacco, indigo, coffee, sago, and teak. In 1793, William Roxburg (1751-1815) became the first salaried Superintendent. He developed a huge herbarium and laid the groundwork for taxonomy in India,

in addition to his interest in the growth of the Garden. *Hortus Bengalensis* (1814) and *Flora Indica* (1820)-24 were published during his time. As a result, he is rightfully known as the "Father of Indian Botany." Another important phase in the Indian Botanic Garden's history is the introduction of tea. Despite the fact that tea was successfully cultivated in the Indian Botanic Garden in Canton (China), there was not enough commercial interest in the development of tea as a plantation crop. As a result, tea discovery and other gathering efforts began in the Gangetic plain. Approximately 9000 specimens and a considerable number of plants were obtained throughout these comprehensive expeditions. *Cinchona* trees were planted in the garden in 1853, and it was suggested that they be grown in the Nilgiri hills. The seeds were brought in from Kew, and the botanic garden also cultivated many *Cinchona* species. This contributed significantly to the reduction of malarial fever. Botanists from various provincial governments banded together in 1890 to form the Botanical Survey of India.

The Indian Botanic Garden in Howrah is widely regarded as one of the best landscape botanical gardens in the world, preserving natural scenic splendour. Unlike other Indian gardens, which have been converted into horticulture gardens or fruit gardens under the auspices of agricultural departments; this one contains the best collections of local and exotic species, as well as numerous endangered species. There is less concrete and masonry inside the garden than in other gardens, and there are more plants and a canopy of trees. Aside from the well-known Great Banyan tree and the large palm house, the Garden is proud of its diverse collection of Palms, Bamboos, Pandanus, and Bougainvillea. In the open, over 15,000 trees and shrubs from 2,350 species, as well as several thousand herbaceous plants, are grown in 25 divisions, five glass houses, and five greenhouses and conservatories. One octagonal glass house for growing cactus and succulents, as well as one huge greenhouse, are now being built and planned. Bamboo

and Bougainvillea germplasm collections are kept at the garden. Citrus, jasmines, palms, pandanus, and water lilies are just a few examples. Orchids from 32 genera and 80 species make up the Orchidarium's 1500 sets. The medicinal plants garden contains 1000 plants from 450 different types. Medicinal and aromatic plants are conserved to highlight the Indian legacy of using and utilising these natural resources in the treatment of human illnesses. The garden's tremendous aesthetic attractiveness, with its stunning panoramas, some wonderful lakes with magnificent lotus and water lilies, and wide greenery, serves as a source of inspiration, education, study, and recreation to millions of tourists from India and outside throughout the year. Visitors can enjoy guided popular botanical journeys by departmental omnibus inside the garden on Sundays and holidays, the distribution of thousands of plant materials during Vanamahotsava every year, and extension services like as exhibitions, flower shows, and film shows.³⁴

Experimental botanic gardens have already been established by the Botanical Survey of India in the Eastern, Western, Northern, Southern, and Central Regional Circles covering different agro climatic zones of the country in order to introduce and propagate rare, endangered, endemic plants and wild flora of the regions, as well as to build up germplasm collections of wild relatives of economic plants for use in plant improvement programmes. India's principal conservation centres include the Indian botanical garden and its network of experimental gardens.

The National Botanical Research Institute (NBRI) in Lucknow was founded in 1953 and has played an important role in the exploration and utilisation of the country's economic plant resources. It's primarily a learning facility with a wide range of activities. The garden's main

³⁴ Chakravarty, R.K. and Mukhopadhyay, D.P. (1990) *A directory of botanic gardens and parks in India* (p. 10) Calcutta: Botanical survey of India.

goals are to introduce, conserve, document, propagate, protect, and use natural species as well as exotic plant wealth from subtropical and tropical climates, with a focus on non-agricultural and non-traditional plants of economic importance and ornamentals, as well as to identify and develop production technology for new plant resources of commercial importance.

2.2.1 Government Botanical Garden, Ooty

The Government Botanic Garden, Ooty's objectives are to promote horticulture and serve as an object lesson for botany students, to introduce exotic, ornamental, and economic plants, to serve as a centre for information on the intensive flora of the hills and other exotic collections, to distribute seeds and plants, to assist sister institutions by supplying valuable botanical specimens, to distribute cut flowers, bouquets, wreaths, and other floral arrangements to the public, and to help sister institutions by supplying valuable botanical.

Sims Park, Coonoor, which is an annex of the Government Botanic Gardens in Ooty, was designed as a primary leisure destination for locals and visitors. However, the Park today performs the tasks of a botanic garden, including conservatories and a resource documentation centre.

2.2.2 Lalbagh Garden, Bangalore

For the entire state of Karnataka, Lalbagh Gardens in Bangalore has become the guiding point for horticulture research, outreach, and development. The plant richness includes several interesting collections of attractive flowering trees, avenue trees, shrubs, and annuals. The floral clock, which was installed in the garden in 1983 and is the first of its kind in India and Asia, is the first of its kind in India and Asia. Around 36 to 40 lakh visitors from India and outside visit this pioneering institution each year, mainly between the months of June to October.

2.2.3 The Bryant Park, Kodaikanal

Despite being designated as a park, Bryant Park in Kodaikanal has been able to establish itself as one of India's most recognised gardens due to its extensive plant collection and commitment to the advancement of botanical and horticultural knowledge. This garden provides a major source of enjoyment for seasonal visitors and hill dwellers of Kodaikanal, promotes horticulture, and educates botany students.

2.2.4 Botanic Gardens in the State of Kerala

Zoo and Botanic Garden

It began operations in Trivandrum in 1870 and is now managed by the Kerala Government's Department of Museums and Zoos. The goal of this garden was to draw visitors to the Museum. It is a public garden that has a mix of formal and informal styles. Over 800 kinds of tropical and decorative flowering trees, shrubs, leaves, and green house plants may be found in this garden. There are two greenhouses and one conservatory on the property. It also promotes horticulture, provides botanical specimens to the general public, and hosts yearly flower displays, among other things.

Malabar Botanical Garden (MBG)

The state government established it in Olavanna, Kozhikode, in 1990. It covers 35 acres and is currently working on creating a botanical museum and contemporary herbarium for the Malabar region's vegetation. Over a thousand native plants were studied for distribution, habit, nativity, phenology, economic/medicinal relevance, and other factors (Ansari, 2000). In conjunction with the opening of Star Forest, MBG hosted a three-day botany show. This is a Kozhikode

Panchayat-funded Eco Tourism Project and a Developing Eco Tourism Center. The garden provided high-quality planting materials to the local community, and STEC provided funding for a two-year study to inventory the Flora of MBG. (From the STEC Review, 1998-99).

2.3 Regional perspective

2.3.1 Saharanpur Botanical Garden

Since ancient times, Saharanpur, has been the principal centre of India for the collecting, research, and development of botanical plants. It was founded in the form of a royal pleasure house in 1750 under the last Mughal administration. In 1786, Ruhela Samant Ghulam Qadir donated revenue from seven villages in order to run the garden. Following that, the garden was cared for by the Maratha kings, and subsequently by the East India Company, which mostly cultivated medicinal, beautiful, and useful plants here. Dr. Govan was chosen as the garden's first director when it came under British authority in 1817. Following Dr. Govan, several famous botanists such as Dathi, Royle, Hartless, and others dedicated their lives to the advancement of botany in this park. After Dr. Govan, in 1823, Dr. Royle gathered many species of plants from all over the world in the garden and adapted them to the local environment, with the primary species being Papaya, Japanese persimmon, Locust, Pear, and others. Aside from that, seedlings were grown and made available for large-scale planting in public parks, riverbanks, and churches in western Uttar Pradesh and Punjab. Dr. Dathi wrote "Flora of the Indo-Gangetic Plain," which is widely used as a reference book even today.³⁵

The Royal Horticultural Society of England taught courses that were recognised all around the world. Plants such as papaya and locust were grown in India. The first 230 mango

³⁵ Proposal to develop Horticulture Experiment and Training Centre, Saharanpur as "Center of Excellence in Food and Vegetable", 2015, p-1

cultivars and three species were grown here. Dr. Royle merged the Company Bagh, Mussoorie's Nabi Garden, and Chakrata Nagau Garden, and appointed an overseer. Seeds and plants were brought in from all over the world and developed here. When Lord William Bentinck arrived in 1831, he discovered the overseer was missing; therefore he lowered the Company Garden's fund from 10780 to 4200 rupees. Some initiatives were established by the King, and medicinal plants were imported from all over the world and developed here. The medicinal plants henbane and kuni were first discovered here.

Dr. Railey established a special department here in 1823, where plants were imported from all over the world and grown in accordance with the local environment. In India, papaya was found and developed. The method of extracting seeds from cabbage was first discovered here. A Papain chemical element coming out of papaya was discovered here by Dr. L. B. Singh patented it. It was here that the invention of growing Locat on other plants took place. The old trees on both sides of the national highway were taken from here. The mahogany tree in Sardhana Church is also an invention of this. From here the distribution of plants across the country continued till 1870. During that time 17136 fruit trees and 56 thousand other trees were distributed from the company garden. Along with this 700 orchards were planted here within a radius of five miles. Strawberry was developed here and the tea gardens of Dehradun were also given here.

Seeing the inventions of the British rulers here, the Royal Horticultural Society, England started courses here in 1880 in Company Garden. Overseer (four years), Chowdhury (three years) and Mali (one year) courses were conducted, which were recognized all over the world. In 1880, Dr. J. S. Datthi sat here and wrote texts like Flora of Upper Gangetic Plain. After

independence, in 1973, the state government changed its form and made it a major training centre. The world's largest glass house is still here.

The modern tissue culture lab was built here in 1952, even today, there are 230 varieties of mangoes, three species are present, in comparison to the advanced laboratories being built for research on tissue culture in the world today. It was here that they were invented. There are also 16 varieties of guava and 15 varieties of litchi were developed here. The world's largest Locat collection is also near this company Bagh.³⁶

In the last half-century of the eighteenth century, various species of botanical plants were collected and created here, which are known as very valuable treasures in the present era, such as cinchona, tea, linseed etc. At that time, this botanical park has always maintained its national level and has been providing seeds, plants and scientific information for different types of trees and economic botany in all other states including its state. The entire area of 61.86 ha of this park is full of various trees, shrubs, vines and fruit plants, many of these trees are 100 to 200 years old. There are many such old trees of Mahogany, Teak and Eucalyptus which are of historical importance and are not available anywhere else. In 1950, research work on various aspects of horticultural crops was started at the centre and in the year 1974 this centre was transferred to the department after the formation of Horticulture Department.³⁷

³⁶ Dainik Jagran, "Bemisalhai company baghke 269 saal", 11 July 2009, p-5

³⁷ Proposal to develop Horticulture Experiment and Training Centre, Saharanpur as "Center of Excellence in Food and Vegetable", 2015, p-1



Chapter-III
Functions, Scientist Contribution and
Experiments of Saharanpur Botanical
Garden

Functions, Scientist Contribution and Experiments of Saharanpur Botanical Garden

Saharanpur is a city and a municipal corporation in the Indian state of Uttar Pradesh. It also serves as the administrative centre for the Saharanpur district. The city of Saharanpur was named after the saint Shah Haroon Chishti. In Saharanpur, there is a well-known temple dedicated to "Shakumbhri Devi." During the navratras, thousands of pilgrims go to the temple. Some believe it was founded by Sah Ranbir Singh, a Katheriya Rajput lord who built the present-day city on the site of an army cantonment. As part of the Government of India's Smart Cities Mission; MOUD has named Saharanpur as one of the 100 Smart Cities.

Maratha Rule (1757-1803 AD)

The Maratha Army invaded the Saharanpur district in 1757, and Najeeb-ud-Daula lost control of Saharanpur to Raghunath Rao and Malharao Holkar, two Maratha lords. With the capture of Ghulam Qadir, the grandson of Najeeb-ud-Daula, who was defeated by the Maratha General Mahadaji Scindia on December 18, 1788, the battle between Rohillas and Marathas came to an end. Nawab Ghulam Qadir's most notable gift to Saharanpur is the Nawab Ganj area and the Ahmedabadi stronghold that still exists there. Ghulam Qadir's death ended the Rohilla governance in Saharanpur, and it became the Maratha Empire's northernmost district. Its first Maratha governor, Ghani Bahadur Banda, was appointed. The Bhuteshwar Temple and Bagheshwar Temple in Saharanpur were built under the Maratha Empire. Saharanpur obtained British suzerainty in 1803, after the British East India Company destroyed the Maratha Empire in the Second Anglo-Maratha War.

British Colonial Period (1803-1947 AD)

The Saharanpur and present-day Muzaffarnagar Districts were part of the revolt against the British Company's occupancy of India in 1857, today known as the First War of Indian Independence. Shamli, a small village in the Muzaffarnagar district that had been liberated for some time, was the epicentre of freedom fighters' operations. The British retaliation was harsh once the insurrection failed. Muslims in the region were targeted for death and destruction by the British, who saw them as the principal instigators of the uprising; Muslim society was completely destroyed. When social reconstruction began, Deoband and Aligarh became focal points in Muslim cultural and political history. At 1867, Maulana Muhammad Qasim Nanotvi and Maulana Rashid Ahmad Gangohi, both supporters of reformer Shah Waliullah's idea for social and political renewal, founded a school in Deoband. As the Darul Uloom, it gained fame and global reputation. The mission of its founders was twofold: to raise and spread a team of scholars capable of awakening Muslims' religious and social consciousness through peaceful methods and making efforts to educate Muslims in their faith and culture through them; and to instil a sense of nationalism and national unity by promoting the concept of Hindu-Muslim unity and a united India. The Mazahirul Uloom Saharanpur theological seminary was founded six months later by Muslim scholars in Saharanpur who were enthusiastic proponents of this doctrine.

Geography and Climate of Saharanpur

Saharanpur is around 140 kilometres (87 miles) south-southeast of Chandigarh, 170 kilometres (110 miles) north northeast of Delhi, 65 kilometres (40 miles) north northeast of Shamli, and about 61 kilometres (38 miles) south-west of Dehradun, at 29.97°N 77.55°E. It has a 269 metre

average elevation (883 ft). Saharanpur is located in the Doab region of India. Himachal Pradesh, Uttar Pradesh, Uttarakhand, and Haryana are all represented in the Saharanpur district.

Functions of Botanical Gardens

As evident from the brief historical account, the botanic gardens served the basic function of making available for study, research and use, at one place diverse kinds of trees, shrubs and other plants. The definition of a botanic garden as “a three-dimensional text book about plant life, offering the opportunity for structural, functional, spiritual communion with the plant world” (Irwin, 1974) amply shows the vast and multifarious functions.

To elaborate on this, the botanic gardens, through the architecture of stem, leaf and flower, convey beauty of plants; they inform the lay people about the diversity in plant life, and the ecological balance promoted by this diversity ; they display through economic species, Man’s dependence on the green world for his many needs and even for his mere existence, they provide solace and respite from the increasing pollution and dirt of urban settings; they serve as repositories for many rare or unique plants no more seen or common in the wild, and they provide an environment for our cultural and even spiritual proximity to nature.

To distinguish from ordinary parks or gardens, it is enough to state that the important word is Botanic; Botany is a Science, and gardening an Art. In a Botanic Garden, emphasis is maintained scientific aspects. In today’s context an active botanic garden must aim at becoming an agency and catalyst for conservation of plant resources, a source for continuing education for the community, a place for appreciation of natural beauty and a centre for relevant research.¹

¹ Project Report on Establishment of “*Temperate Botanic Garden*” , for Directorate of Uttar Pradesh, Lucknow, U.P. ,1989, P-10.

Factors for Establishment of SBG

Selection of Site

It was considered that for proper development of all relevant activities, the garden should have an area of about 150-200 ha. It was also clear that a large piece of private land (150-200 ha.) at 2000 meter. altitude could not possibly be purchased by the Govt. and should be an area already under the Government or Forest Department. The Forest Department was, therefore, constantly consulted about possible sites, meeting the minimum requirements. The Headquarters of the Forest Department in turn consulted their CFs and DFOs by correspondence and through meetings.

We, on our own, also personally consulted several knowledgeable persons and about thirty areas (listed on following pages) in different hilly regions of Uttar Pradesh were suggested to us. After preliminary screening, some of these were considered totally unsuitable, due to small size, very remote, or other reasons. certain criteria were decided for judging the suitability and a proforma for inspection report was prepared.

In order to assess availability of water, several sites were visited both in the rainy and dry season. The legal and conservation status of the sites was also an important consideration. As the development of the Institution will involve making few essential buildings, plant houses and other structures, the land should not be burdened by many restrictions.

Thereafter, considering all the factors, one site was considered, overall, to be far more suitable than others.²

Location

The city is close by, as are the civil lines. The grounds are beautifully landscaped, with great avenues of wood and ornamental trees, water tanks, shrubberies, and flower beds, and while it is

²Ibid, P-12.

no longer cultivated as a pleasure garden to the same extent as it once was, it is still a very attractive and picture-perfect site. The garden's primary importance today is in the production and acclimatisation of fruit trees, vegetables, and flowers, thanks to its geographical location, which is particularly well adapted for this purpose. The Saharanpur Garden, both botanically and commercially, ranks first among comparable organisations in India, with business ties stretching not only to all areas of the peninsula and Burma, but also to Egypt and South Africa. The garden proper covers roughly 125 acres, excluding the farm, which covers 38 acres and is utilised for the production of vegetable seeds. The huge fruit and plant nurseries, glass and chick houses for propagation, and the conservatory, a big chick house for attractive plants requiring protection from the scorching heat and frost, are all located inside the garden.³

Felling of Trees on the Site

The policy will be not to fell any trees unless there are compelling reasons in the interest of developing essential structures for running and maintaining of the garden. Here also, the location size or architecture of structures may be compromised to save large trees, particularly rare or unique trees. Minor fellings of dead or smaller trees for making paths and public facilities etc. will be carried out under approval and supervision of appropriate authority, the Technical Advisory Committee of the Garden.⁴

³H.r Nevill, *District Gazetteers for the United Provinces*, Vol. II, *Saharanpur (1999)*, pp. 50-51.

⁴ Project Report on Establishment of “*Temperate Botanic Garden*” , for Directorate of Uttar Pradesh, Lucknow, U.P. ,1989, P-34.

Fencing/Protection

To protect the plant cover in the garden from stray cattle, and the properties and equipment from burglaries/damage, a proper fencing on all sides of the SBG is the first requirement. Presently only three entry gates. There is only one entry gate of alsibagh garden.⁵

Geography of Saharanpur Botanical Garden

It is located at a height of 275 meters. Every year, the tract receives up to 100 centimeters of rain. The temperature ranges from 20 to 43 degrees Celsius. A diverse assortment of tropical and subtropical plants can be found in this garden. In addition, there are two greenhouses and five glasshouses.⁶

Objectives and Activities of the New Garden

There are several things that can be done, or at least be expected, of a newly established botanic garden. But, space, funds, and qualified manpower often become limiting factors. And, whereas there may be small representation of several activities, it is better to specialize in a few areas. Much thought and consideration has been given to this, advice also sought from several knowledgeable persons in the country.

The garden should have following main objectives:

1. Conservation of plant resources.
2. Research in biology of rare and economically important species.
3. Utilisation of local plant resources.
4. Education and extension work.

⁵ Ibid, P-35..

⁶H.rNevill, *District Gazetteers for the United Provinces*, Vol. II, *Saharanpur (1999)*, pp-1.

With these main objectives in view, the S.B.G should undertake interalia, the following activities:

1. It should have a representation collection of Himalayan flora.
2. It should undertake research in conservation of rare plants and in utilisation of local plant resources.
3. Many species of useful groups of plants like bamboos and gymnosperms whose germplasm collection cannot be created in plains, can very well be done in the S.B.G.
4. The S.B.G. should undertake experiments on introducing and acclimatising plants, particularly species of significant economic and ornamental value. Hence, almost as a policy, the beautification of the landscape, lawns or borders and buildings of the S.B.G. should be done by a judicious mix of subtropical, temperate and sub temperate wild flowers. The rich Indian flora provides a wide choice of habit, habitat and colour for this.

Patronising indigenous flora for ornamental aspects has four main advantages:-

1. They will be easy to establish.
2. They will upset the microbiota of soil.
3. They will not run wild at the expense of other species.
4. They will attract only the familiar local birds and insects.

As an educational and public liaison activity, the garden must organise short training courses on a variety of topics and themes.

A few could be:-

- a) Making a small home garden.
- b) Bonsai

- c) Cacti
- d) Window plants/house plants.
- e) Herb (Green salad) Garden.
- f) Care of plants in beds/pots.⁷

Since they were first set out under the supervision of the East India Company a century and a half ago, the Government Botanical Gardens at Saharanpur in the old United Provinces of India, now known as Uttar Pradesh, have been well recognised. The only botanical gardens in India at the time of the Company's creation were those in Calcutta and Bangalore, where the tropical climate severely limited their utility for acclimatisation and culture of species from other countries. Saharanpur was an ideal location for a botanical garden because it was near the northern limit of India's flora while also being close enough to the Himalayas to make it ideal for the production and acclimatisation of fruit trees, vegetables, flowering shrubs, tea, coffee, and tobacco, as well as medicinal plants. All of the plantations along the canal banks in northern India, as well as many of the roads, have been stocked from Saharanpur, and seeds, plants, and trees will continue to be traded with comparable organisations across the world under the new political dispensation.

History of George Govan

If the gardens' reputation for their attractive open landscape effect is well-deserved, it's remarkable that so little is known about their originator and first Superintendent, Dr. George Govan, who was also a Civil Surgeon in Saharanpur at the time. The latest edition of the district's official Gazetteer, issued in 1909, simply states that the gardens were given to Dr. Govan in

⁷ Project Report on Establishment of “*Temperate Botanic Garden*” , for Directorate of Uttar Pradesh, Lucknow, U.P. ,1989, P-39.

1817, and that he was succeeded by Dr. Royle in 1823, based on information provided by the then Superintendent. The only aspect of Govan's supervision described in this work is his introduction of henbane (*Hyoscyamusniger*) for use by the government's numerous medical departments.⁸In these conditions, Govan's absence from the Dictionary of National Biography and Buckland's conventional Dictionary of Indian Biography is perhaps less surprising. Crawford does not mention him at all in his History of the Indian Medical Service, despite the fact that Crawford details the work of numerous of Govan's predecessors as Superintendent at Saharanpur, including Royle, Falconer, and Jameson, all of whom were almost doubt better renowned botanists. Britten and Boulger, however, have included him in their biographical index of British botanists, where it is noted that a species of St. John's wort was named after him (*Hypericum govanianum*).⁹

In Calcutta, he began his service career at the Presidency General Hospital. In the initial phase of the Nepal campaign, he accompanied Sir David Ochterlony's expedition against the Gurkhas. In the autumn of 1814, he was serving in the field as an Assistant Surgeon; he remained with the army in the highlands until the end of hostilities in April 1815, following the capture of Almora and the conquest of Kumaon.¹⁰

⁸H.r Nevill, *District Gazetteers for the United Provinces*, Vol. II, *Saharanpur* (1999), pp. 51-2. See also E.T. Atkinson, *Gazetteer North –Western Provinces of India*, Vol. II, *Meerut Division*, Part I (1875), pp. 17-15, for an earlier account of the Saharanpur gardens.

⁹ By Wallich in Calcutta. See James Britten and George S. Boulger, *British and Irish Botanists*, ED. A .B Rendle (1931), at p. 127.

¹⁰ Some year later he wrote: “It were vain to attempt describing the enthusiasm and delight experienced by admirers of nature on first entering these districs with the invading army in the end of 1814”: *Edinburgh Journal of Science* (1825), II, 19.

George Govan and Early Ideas for Saharanpur Botanical Garden

Govan was later assigned to Saharanpur as Civil Surgeon, presumably at his request, as he must have grown acquainted with the station during Sir Rollo Gillespie's Gurkha campaign base headquarters. Govan spotted the remains of what were obviously once excellent pleasure gardens when arriving for duty at Saharanpur in June 1815. These forty-acre gardens, known as Farhatbaksh, were created in the 1770s by Rohilla chieftain Zabita Khan, who had seized the resources of seven villages to finance them. This endowment, which covered the salary of a native Superintendent, was continued by Zabita Khan's son, Ghulam Qadir, and lasted until the Mahrattas broke the Rohilla dominance of Saharanpur in 1788, when the amount available for the upkeep of the gardens was reduced to the income from two villages, which amounted to about 1,500 rupees per year. This was the situation in 1803, when the Mahratta chief Scindia was defeated and Saharanpur, along with the remainder of the Doab, fell into British hands. For the next dozen years, none of the revenues appear to have been devoted to the intended purpose, while the native Superintendent's services were also eliminated. Indeed, when Dr. Govan arrived, the garden had devolved into "nothing more than a grove so densely planted with mango trees that it prevents or impedes the growing of anything else except in a small section of it." The fences were shattered, the former barns were in ruins, and the majority of the cattle on the nearby farm had died of old age, while the entire place was "beset" by all of Saharanpur's "idle cows," "to whom its shady situation presented compelling attractions."¹¹

¹¹Govan to R. Grindall and T.P. Calvert, November I, 1816: N.A.I. National Archives of India, New Delhi.

Govan then proposed to the Company's Agents in Saharanpur that, in addition to his duties as Civil Surgeon, he assumes charge of the Farhat baksh grounds, with the goal of converting them into botanical gardens for the Company's and local residents' benefit.¹²

Proposal and Plan for the Saharanpur Botanical Garden

The Agents were impressed by the Civil Surgeon's presentation and agreed to promote his initiative with the Governor General at Fort William. Meanwhile, Govan was put in charge of the gardens, such as they were, pending official approval, and he immediately began making necessary changes, such as mending the fences, removing unnecessary trees, and replacing the animals that had perished. He also rented a 700-maund boat "for the purpose of transporting plants from Calcutta given by the Botanic Garden there."

Govan travelled to Calcutta in early 1816 to present his plan to Lord Hastings and the Governor-Council. General's He did so in a detailed report that he submitted through the Calcutta Botanical Gardens Superintendent.¹³ He argued, in this letter, that "the closeness of the foot of one of the noblest mountain ranges in the world would render a garden here (Saharanpur) well adapted for the collecting and description of a large variety of vegetable production." He argued that the wide range of climates would allow the new institution's Superintendent to "effect the naturalisation of many of the valuable vegetable productions of colder climates," and that "the more tender inhabitants of the south might be gradually inured to a colder atmosphere here, also if anywhere." In this regard, he proposed the establishment of a smaller garden in the hills. "Were some additions made to the establishment as originally established under the native government to allow part of it to be employed in the bordering hills, where elevation of soil compensates for

¹²Govan to Dr. James Hare, April 18, 1816: N.A.I.

¹³ Dated April 17, 1816: N.A.I. it consists of 21 folio pages.

difference in latitude in allowing the mean temperature, the Superintendent would be able to control a range of climate in a small space."¹⁴

Plans for Crops to Be Grown Early Proposal

Govan favoured the cultivation of cacao or chocolate ("Though the plant grows in the [Calcutta] Botanic Garden, yet the fruit of it has never come to any perfection"), sarsaparilla, guaiacum, cassia, liquorice, vanilla, and "various species of cinchona furnishing the Peruvian bark," among other things. He noted that "political situations in S. America, the laziness of the populace, and the approaching revolution" had hampered production of the latter, from which quinine with its priceless therapeutic characteristics was obtained. He advocated for the cultivation of domestic foods like as potatoes, tapioca, and sago palm as a hedge against the potential of starvation in the plains and food scarcity among the hill people. Common European fruits like apricots and pears, as well as Persian gum resins and medicinal herbs like asafetida, labdanum, musk, opopanax, galbanum ammoniacum, olibanum, or frankincense, which would be futile to try to cultivate in Calcutta."

Financial Support for the Garden

After nearly a year of waiting, during which time Lord Hastings appears to have visited Saharanpur, and a letter from Govan to the East India Company's Agents, the Governor-General in Council was pleased to express the opinion that "considerable advantages would result not only to Science but also to the interests of the Honourable Company from the proper management of the Botanic Garden at Saharanpur." After making the necessary inquiries on the

¹⁴ This was eventually established in Nahan (Sirmur), but was later closed down by Govan's successor, Dr. Royle, in preference for a more suitably situated branch garden at Mussorrie.

subject, report to Government the allowance which would, in their opinion, be sufficient for the maintenance of the Garden on a system of management calculated to secure the benefits of such an institution in the utmost practicable degree, as well as the rate of salary which they would recommend to be granted to the Civil Surgeon at Saharanpur for superintending the Garden," Lord Hastings directed the Board of Commissioners.¹⁵

The Governor-instructions general's were followed to the letter, and a further sum of 900 sicca rupees was permitted, on top of the incomes from the two villages previously appropriated, bringing the total annual income for the gardens and personnel to 2,400 sicca rupees. The establishment provided for the employment of three chaudhary and 30 mails in addition to the Superintendent, who was to receive a monthly salary of 200 rupees in addition to his pay as Civil Surgeon, as well as a daily travel allowance of six rupees when in the hills "for purposes connected with the Garden."The Superintendent was also provided clerical help in the form of a "writer," whose monthly salary was not to exceed 50 rupees. These arrangements were formalised by a Governor-General in Council resolution of June 13, 1817, which confirmed Govan's appointment as Superintendent. After much correspondence, the Government at Fort William agreed that the Superintendent's pay and allowances should be retroactive to June 1, 1815, the month in which he took possession of the gardens for the first time.¹⁶

Landscaping for the Garden

Meanwhile, Govan had cleared his jungle growth and levelled, drained, and grassed a large portion of the ancient gardens, as well as creating roads and boundaries along the roadways. He

¹⁵ Home Department, Public Consultations, No. 25 of March 8, 1817: N.A.I.

¹⁶ Government Secretary to Board of Commissioners, June 13, 1817: N.A.I.

also brought in water, and he began planting trees and establishing nurseries for hill plants, fruit trees, cuttings, seedlings, and bulbous plants. He also built a ninety-by-thirty-foot conservatory, a rock garden, medicinal and agricultural gardens, and a Linnean garden, which has beds ordered according to the Linnean classification. According to the plan developed after his departure by his successor as Superintendent, Dr. Royle, and replicated here, the open landscape effect was also Govan's intention, so that the location became a half-way plaisance, partly park and partly gardens, on the lines of the French *jardinanglais*.

Unlike his immediate successor, the first Superintendent in Saharanpur under the East India Company was not placed subject to the Superintendent of the Calcutta Gardens. The latter, at the time the prominent botanist Nathaniel Wallich, was officially told of Govan's position and instructed to cooperate with him by providing him copies of any records and plant specimens he might require at Saharanpur, with Govan expected to reciprocate in kind. Wallich took an early interest in the new institution, and by the beginning of 1818, he could report to the government that the Saharanpur Superintendent's "botanical researches" had already yielded "a large assortment of seeds, mostly if not all belonging to new and hitherto unknown plants, and promising a most valuable addition to the riches of this garden."¹⁷

Saharanpur was used as a base for officers of the Bengal Army who were conducting the first trigonometrical survey of the newly captured regions at the time. The Himalayan explorer Alexander Gerard, who was surveying the Saharanpur district for revenue purposes, and John Hodgson and James Herbert, afterwards Surveyor General of Bengal and Deputy Surveyor

¹⁷Wallich to Government, January 17, 1818: N.A.I. most of the plants which Govan communicated to Wallich are now in the Wallich Herbarium at Kew, including *Hypericum govanianum* noted above (No. 4815). Royle, who succeeded Govan in 1823, paid tribute to the first Superintendent's industry in this respect in his *illustration of the Botany of the Himalayas, Mountains* (London, 1839), Vol. I, at p. 2.

General, who were doing similar work in the Simla Hill States, were among these officers. Govan, who was familiar with all three, joined Gerard on an exciting journey across the Upper Sutlej Valley and Kanawar during his first summer as Superintendent, collecting plant specimens along the way.¹⁸

On August 27, 1817, they left Subathu. They arrived in Simla, a small native settlement with a few mud homes, three days later and camped on the side of Mount Jakko. While Govan was exploring for mountain flowers, Gerard wrote in his diary, "Had a very large and magnificent prospect and was lucky enough to get the bearing and altitude of all the important peaks. "The Himalaya appeared to be magnificent." They next travelled through Mahasu, Theog, Kotgrah, and Rampur on the Hindustan-Tibet road, which was eventually, renamed the Hindustan-Tibet road. Govan left Gerard to work with his theodolite after crossing the river at Wangtu. Gerard delayed so long that darkness fell before he could rejoin his partner, "being directed alone by the flash and report of muskets which Govan fired regularly to apprise me of the direction of the camp," as he put it. Gerard was to march three marches beyond Chini and then back across the mountains through the Shatul Pass to the Pabar river, starting from Meru, where they arrived on September 17. The mountains to the south had received a significant amount of snow the night before, and Govan was concerned that the pass might be blocked by the time they arrived. Govan then turned around, allowing Gerard and his carriers to complete the voyage on their own, which they did without incident.

¹⁸ This area was then virtually unknown and Gerard was the first to survey it almost up to the Tibetan border. See Alexander Gerard, *Account of Koonawar*, edited by George Lloyd (London, 1841), pp. 191-267.

Establishment of a Second Branch at Sirmur

Govan allegedly decided on a spot for the little branch botanical garden he had in mind and which he now established on a ridge near Nahan while on his trip to Subathu from Saharanpur (Sirmur). The variation in climate could not have been significant because the height (2,993 feet) was only 1,000 feet higher than Saharanpur. This reason, together with the establishment of a new path to the Simla highlands from Saharanpur, undoubtedly justified Govan's successor Royle's decision to close the Nahan garden and open a new one in Mussoorie ((6,600feet) in 1826.¹⁹

Govan suffered from numerous spells of fever, most likely malaria, while in Saharanpur, and his health seemed to have deteriorated significantly. Early in 1821, he received a sick certificate allowing him to go on sick leave to the Cape of Good Hope. "Should the state of my health upon my return from the Cape still rendered me incapable of doing justice to the medical duties of the civil station at Saharanpur, the severity of which I can bring numerous documents to attest during part of the year, I should be enabled to hold the position of Superintendent of the Garden separately and devote my time to the peasantry," he suggested. Early in 1821, he received a sick certificate allowing him to go on sick leave to the Cape of Good Hope. "Should the state of my health upon my return from the Cape still rendered me incapable of doing justice to the medical duties of the civil station at Saharanpur, the severity of which I can bring numerous documents to attest during part of the year, I should be enabled to hold the position of Superintendent of the Garden separately and devote my time to the peasantry," he suggested.

¹⁹ Information communicated to Mr. I.H Burkill. See his articles on the history of botany in India in the *Journal of the Bombay Natural History Society*, Vol. 54 (December, 1953; December, 1956).

Govan set out for Capetown, intending to return to Calcutta on the next outward bound vessel when the Governor-General declined his plea. However, due to terrible weather, his ship was unable to dock at the Cape to discharge passengers, and he was instead transported to Europe. In these conditions, the Company awarded him a sick certificate and granted him leave beginning February 17, 1821.²⁰

During his furlough, Govan presented a paper to the Royal Society of Edinburgh titled "On the Natural History and Physical Geography of the Districts of the Himalayan Mountains lying between the River-Beds of the Yamuna and Sutlej," which received a lot of attention and was later published in *The Edinburgh Journal of Science*. "Govan was particularly interested in the area's mineralogical possibilities, in addition to its topographical and floral features." "I am anxious to add as much to the accuracy of my mineralogical knowledge during my residence in Britain," he said at the time, "and to derive as many suggestions for the direction of my future inquiries as possible from my intercourse with the members of a society, to communicate with whom I consider such a high privilege, in case I may ever return to the districts in question, the period of my first acquaintance with which will ever form a marked era in my life."

Succession of Charge

Govan did not return to Saharanpur as Civil Surgeon or Superintendent of the Botanical Gardens, despite plans to travel to the Himalayas. Dr. John Royle was appointed to succeed him in both

²⁰Govan to Lushington, January 20, 1821. Home Department, Public Consultations. No. 60 of January 26, 1821: N.A.I.

capacities in February 1823, as he was scheduled for promotion to the rank of Surgeon before the end of his vacation.²¹

Gorge Govan ought to be better remembered today, especially for his contribution to the gardens at Saharanpur, even though he cannot be compared to botanists like Wallich and Royle. Despite initial objections from the Board of Commissioners, he urged from the beginning of his supervision that the gardens' fruit be made freely available to the public. In 1816, he presented the Governor-General and Council with a plan to convert the original gardens at Saharanpur to botanical gardens.²²

Final Words

Of course, not every plant that Govan's supervisor at Saharanpur experimented with was a success, especially when transplanted elsewhere in India. Cinchona, like the vine, did not grow in the damp heat of the plains or the cold of the highlands, and its cultivation, which had been attempted in Dehra and the Kangra valley, had to be reluctantly abandoned. Tea, on the other hand, would go on to be a huge hit. Although the plant's growth did not reach perfection during Govan's time, credit must undoubtedly go to Govan for introducing and promoting the production of a domestic commodity that one of his successors at Saharanpur described sixty years later as the most lucrative enterprise ever carried out in India under the British Government, despite the fact that he was unaware of the existence of the indigenous variety in

²¹ Home Department, Public Consultations, No.3 of February 13, 1823:N.A.I. John Forbes Royle (1799-1858) was later Professor of Materia Medica at King's College, London. His handsomely produced *Illustrations of the Botany and Natural History of the Himalayas Mountains* appeared in 1839.

²² In 1906-7, over 17,000 fruit trees and 55,000 other plants as well as 9,500 lb. of seeds, were sold, yielding an approximate profit of Rs. 17,000: Nevill, *op. cit.*, 54.6.

Assam. Govan deserves some credit for being the first in the country to experiment with oat farming.²³

The institution's primary feature, which its first Superintendent never tired of promoting whenever he had the opportunity, was its utility to the broader population. "Where it capable of effecting nothing further than the supplying of our wretched fellow subjects in the hills with such esculent plants as they stand in need of, in exchange for their own vegetable curiosities, it would be well worthy of the attention of the friends of humanity," he wrote in his original report to Lord Hastings.

Instructional Structure of SBG

Industrial Experimentation and Training Centre (Company bagh) Saharanpur is a centre established in the year 1750. In 1950, research work on various aspects of horticultural crops was started at the centre and in the year 1970 this centre was transferred to the subdivision of the Horticulture Department. After the form of the centre was converted into an experiment and training centre in the year 1976 and a nursery was established at the centre for fruit plant production, old medicinal and botanical plants were located in the main campus of the centre and its adjoining part (Alsibagh). Along with the pages, planting and maintenance of mother trees is being done for fruit plant production. At present, out of the total area of 154.5 acres of the centre, there is germplasm of about 3000 botanical / mother trees of different species of botanical and horticultural crops in 85 acres located in the campus, whose maintenance work is being done. Along with this, in about 45 acres area of the center campus, maintenance of nurseries and potch

²³ Superintendent's Report for 1817-7, cited Nevill, 55. The statement by Robert Fortune in his *Tea District of China and India* (London, 1852), at p. 390, that Dr. John Royle "was the first to recommend the cultivation of tea in the Himalayas," is of course, incorrect.

production work, office / residential training hostel / guest house building etc. have been constructed in about 15 acres area. Irrigation drains are constructed in about 11000 running meters and boundary wall in 5000 running meters in about 11 km / link road in the centre premises.

At present, 195 varieties of mango, 04 of Lidhi, 03 of Lokat, 07 of Peach, 04 of Bael. 07 of Guava, 03 of Jackfruit, 01 of Pear, 04 of Pomegranate, 04 of Amla, 04 of Chiku 02 and 103 of Neembu. is. Apart from this, the work of new collection is also going on in fruits, vegetables and minor fruits, the information of which is conveyed to the farmers through trainings.²⁴

Table No. 1.1 Plants Produced at the Centre's Nursery and Availability

Mangoes Species	Dussehri, Chaunsa, Lagda, Ramkela, Perennial, Saurabh, Gaurav, and Rajiv.
Guava Species	Allahabadi, Safeda, Lucknow-49, Shweta, Lalit, Lalima, and Dhawal.
Species Of Litchi	Late Bedana, Early Bedana, Kalkatyan, Rosentid, and Shahi.
Peach	Saharanpur Prabhat, Saharanpur Bahar, and Sahane Punjab 1633.
Lokat	Tanaka, Golden Yellow, Golden White Baatarsurkh, Batia White, California, and Saharanpur Early.
Pullam	Pullum Titro.
Pear	Nail (Babugosha).
Jackfruit	CJ-1, CJ-2, and perennial.
Jamun	Badami Jamun.
Papaya	Pusa Dwarf, Pusa Nanda, Coorg Honeydew, and Section 11.
Lemon	Paper Art, Eureka, and Seedless.

²⁴ Proposal to develop Horticulture Experiment and Training Centre, Saharanpur as "Center of Excellence in Food and Vegetable",2015,p-1.

Kinno	Desi.
--------------	-------

Table No. 1.2 Spices

Turmeric	Roma, Riodigeno, Vaima, NH-5, Rajendra Sonia, CL-321, CEL-324, CEL-318, CL-68, CL-320, CL-73, CL-67, CL-72, CL-08 . CLS-16, CEL-315, CL-69, CL-70, CEL-06, CEL-64, Roma Hill, and Mango Ginger.
Tejpatta	Desi.
Medicinal Plants	Aloe vera, Sarpagandha, Shatavari, Kalmegh, Ashwagandha, Arjuna, and Konch.
Ornamental Plants	Gold Mohar, Amaltas, Kurjia, Tikomastens, Jacaranda, Saptaparni, Ashokan, Harsingar etc.
Ornamental Shrubs	Gudhal, Queen of the night, Jatropha, Chandni, Gandraj, Badi Champa, Cassiagalaka, Miniarecta, Duranta, Manokamni, Motia etc.

Table No. 1.3 Bougainvillea

Double Varieties	Mahara, Cherryblossom, and Alok Mohan.
Single Varieties	RR Pal, Sobhra, Gulabra, Marypalmer, Thema, Dr. Rao, Dr. Bhabha, Blendy, Lancasta, Snowquin, Partha, Ladyhudson etc.
Potted Plants	Daphne baccia, Aglaonema, Sagonian, Peperomia croton, Coleus, Dracaena, Chlorophytum etc. and Other varieties.
Ornamental Vines	Bignonia venusta, Adenocalimapassiflora, Rangoon, Creeper, Bignoniagracilis etc. and Other varieties. ²⁵

²⁵ Ibid, P-2.

Training Program

Apiculture - 45 two days and 90 two days silence rearing training.

Mushroom Production - 07 Two Day Training.

Gardener Training - 30 Second (200 Hrs).

Horticulture Farmer Training - Garden Planting, Flower Production, Vegetable and Spices Production and Drip/Sprinkle Establishment Training (01 Two Days).

Solving Farmers' Problems - By the scientists of the centre, the solutions of contemporary problems related to the horticultural crops of the region and the state are done on the request of the farmers, on their fields and in the laboratories of the centre, by testing/suggestions.

Operation of Farmers Club - For the integrated solution of the problems of northern India horticultural farmers, self-financed industrial farmers' union has been formed at the centre, whose membership amount can be obtained by paying 400/- cash.²⁶

Instructional Structure of SBG

Technical Programme

Agrragment of Trees, Shurbs and other Plants in The Garden

The earliest convention in this regard was to have the plants arranged according to natural affinities, i.e. some system of classification of plant kingdom, like primitive families, advanced families, plants with polypetalous flowers, plants with gamopetalous flowers, or dicots, monocots, gymnosperms and cryptogams.

²⁶ Ibid, P-3.

Later, when plant collection activity did not remain confined to one country only and seeds and seedlings were collected or procured from various parts of the world, plant geography became a common criterion of grouping plants in gardens. The Calcutta Garden has this lay-out, and the map of the garden somewhat shows the location of continents on a world map.

The systematic or taxonomic arrangement of plants was assigned to one section of the garden, called systematic garden or students garden (because it is usually the students who benefit most by this). A reasonable mix of the two systems, the systematic and the phytogeographic is usually more convenient and practical. The guiding principle has to be that no section looks disproportionately desolate and sparse, or too dense and overcrowded.

The arrangement of plants gets a free hand and can become a major consideration in lay out when the garden is being planted on an almost barren land. The present situation is not of a barren land. It is a place which is fairly wooded already and where removal of existing tree cover is not permitted, or even if allowed is not considered desirable. Labels on existing and new trees can provide data on native country or region.²⁷

Habit: As for the habit of the plants, it is more practical to have trees and shrubs grouped and placed separately from herbs or small low shrubs. The latter often do not blend properly with the physiognomy of larger plants, and also their cultural requirements are somewhat different. Certain plant groups of course always need special locations or houses for them, the chief among these are the succulents, rock plants, bulbous plants, palms and orchids.

Plant House: The garden should have several plant houses, trails, and reserved areas. Visitors to the garden particularly students and researchers will want to see some species of lower

²⁷ Project Report on Establishment of “*Temperate Botanic Garden*”, for Directorate of Uttar Pradesh, Lucknow, U.P., 1989, P-42.

altitudes and warm regions of the country. They will have to be grown in houses which will be kept at suitable temperatures. Some selected economic plants of plains and peninsular region will be grown in these houses. A few examples are fruits and vegetables of the plains like guava, melons, and cucurbits. Similarly, plants of alpine and subalpine regions (say between 2500-3500 m. alt.) will have to be grown in a separate house. The main purpose will be to attempt acclimatisation of medicinal plants of high altitudes to lower altitudes in gradual stages. The names of some such genera are given under medicinal plants trail.

Orchid House: Orchids require special conditions for healthy growth and flowering. Usually a good humid and warm climate suits them. An Orchid house with some facilities of cooling/heating and maintaining humidity will be essential for years round blooming of various species.²⁸

Succulent House: Some groups of plants, especially plants growing in drier conditions adopt succulent nature. Their stems or leaves become fleshy. Many such plants are very ornamental and are of much biological curiosity and educational value. They are grown in specially made houses which save them from rainfall and frost. Other plants of drier climates, such as the thorny bushes can also be grown in such houses. One glass house devoted to succulents including cacti and other arid zone plants should be made in the garden.

Fern House: Specially constructed houses for growing ferns, fern allies and other leafy plants are called fern houses or green houses. They are usually covered with climbers to cut off excessive light and heat, and are kept humid by sprinklers or through many small water filled tanks and troughs in the house.

²⁸ Ibid, P-43.

Palm House: They are made almost like fern houses but are not kept so shaded and humid. A collection of potted palms comes in very handy for decorating sidewalks, large staircases or open places, or on special occasions.²⁹

Bambusetum: A collection of live bamboo in a garden is called bambusetum. Bamboos are a very important group of plants, and are used for house building, household articles, agricultural tools, basketry, and even food medicine.

Collection of several bamboos of India and abroad are maintained at Indian Botanic Garden at Shibpur, Calcutta and at Forest Research Institute, Dehradun, but they are naturally of plains regions. There is an urgent need for a germ plasm collection of mountain bamboos. A bambusetum in the S.B.G will be a great scientific attraction for research workers from India and abroad.

The following genera should be attempted in particular: Arundinaria, Chimonobambus, Phyllostachys, Thamnocalamus.

Rare and Endemic Plants Section: India has about 5000 endemic flowering plants. North-eastern Himalaya is one of the areas rich in endemics. Most of the endemics are rare. All endemics are not rare, nor are all rare plants endemic. Emphasis can therefore be given in the S.B.G on growing plants which are both rare and endemic and are peculiar to high altitudes. Examples have been indicated under Trails. It will be useful and practical to have in the beginning selected one or two hundred rare species, and to have several plants of each species for 'viability of population', exchange, etc. This activity will be almost unique in India, and certainly the first at this altitude.

²⁹ Ibid, P-44.

Aquatic Section: Plants which grow normally in or under water are called aquatic. Such plants have certain peculiar morphological and physiological adaptations. For research, education and conservation, it will be necessary to have a section of aquatic plants. Initially, they could be grown in tubs and tanks, but eventually effort should be made to have small artificial ponds in the garden. Efforts can be made to grow aquatic plants, such as in the genera *Nymphaea*, *Nelumbo*, *Hydrilla*, *Utricularia*, *Ceratophyllum*, *Euryale*, *Ipomoea*, *Neptunia*, *Ottelia*, *Vallisneria*, and *Woffia*.³⁰

Lawns: Garden lovers are fond of lawns. Making good lawns needs knowledge and experience. Making good green lawns at higher altitudes has both advantages and problems. Large flats are rarely available. Often they have to be created by levelling, filling and artificial earthwork. But scorching sun or hot winds do not bother so much. It will be useful if the S.B.G can, over the course of years, develop techniques of growing different shades of green and with different grasses. Once developing this, the S.B.G can render consultancy in this area. It should maintain around its laboratories and offices, small patches of lawns with different grasses as demonstration plots.

Students Garden: The earlier concept of the students' garden was a row of taxonomic or systematic beds of plants, i.e. a few hundred small beds having samples of different families of flowering plants, mainly those which are taught at Intermediate or degree level.

There are certain difficulties and shortcomings in this. All families do not have perennial plants. The annuals die in a few months, and it "is nearly impossible to keep a regular cycle of replanting. The habit and color of flowers vary so much that an aesthetically sound arrangement is difficult.

³⁰ Ibid, P-45.

Combining student garden with economic plants garden can solve those problems. The criterion should be the economic use, e.g. cereal, pulse, fruit, vegetable, dye, fibre, medicine, etc. knowledge of economic use brings the student closer, and while telling through level or legends the economic aspects, the facts of taxonomy and generic and family affinities can be brought in. in this manner effort can be made to cover a large number of genera and families.³¹

Trails: Walks or footpaths in a garden are specially designed and planted to lead the visitor through trees and shrubs depicting a particular theme.

For example a medicinal trail is so designed, and the selected species so planted that as a visitor walks along, he sees trees with descriptive plaques on them giving succinct information on their medicinal importance.

Trails are comparatively a new trend in gardening. They provide the same function as special houses of collections of educating or familiarising the visitor with a particular area of his interest but are different in the sense that:

- a. They save the visitor from the formality or monotony of standing and studying plants in a closed environment.
- b. They do not suffer the limitation of space (horizontal or vertical).
- c. They save the cost of construction of special houses.

Sometimes, to help a visitor who is short of time, the garden is divided into 4 or 5 trails, each emphasising on some aspect, and the visitor can choose depending on time with him, what to see and how much to see.

³¹ Ibid, P-46-47.

A long trail can take a visitor through most of the features and activities of the garden, taking almost a whole day, and including steep climbs and descents. Shorter trails can be designed to take a visitor through most of the features and activities of the garden, taking almost a whole day, and including steep climbs and descents. Shorter trails can be designed to take him at one level avoiding climbs and slopes, but giving an idea of many features of the garden.³²

Medicinal Plants Trail:

Trees, shrubs and climbers of medicinal value planted along this trail. e.g. species of:

Table No. 1.4

Abies	Crataegus
Acacia	Desmodium
Acer	Elaeagnus
Aesculus	Embelia
Alnus	Ficus
Artemisia	Juniperus
Asparagus	Myristica
Berberis	Papules
Buddleja	Prunus
Cassia	Punica
Cinnamomum	Rosa
Cornus	Rubus
Cotoneaster	Terminalia

Cultural Plants Trails: Plants which are associated with our culture, such as mythology, religion and customs, etc. can be grown or aligned along cultural trails. Such a trail will give knowledge of our past and present faiths, traditions and customs. Some of the recommended species are:

Table No. 1.5

Adansonia digitata	Alstonia scholaris
Aegle marmelos	Betula utilis
Cannabis indica	Nyctanthesarbortristis
Curcuma domestica	Ocimum sanctum

³² Ibid, P-47-48.

Datura spp	Oryza sativa
Ficus religiosa	Saccharum spontaneum
Ficus krishnae	Saracaasoca

The plants should have labels with significant features.³³

Economic Plants Trail: Plants used by man for food, fibre, tannia, gum, etc. can be grown in this trail. There is a very large variety available and in fact already growing at the site. One has to identify and label them, with suitable legends, highlighting main economic uses. It is such a lovely sight to see a plant whose name only has been familiar to us. Passing through this trail, a visitor will come across plants which he uses for timber (Teak, Sal, Pine), gum (Acacia), fibre (Jute, Cotton), dye (Indigofera, Butea, Catechu), and furniture (Cane, Bamboo), etc.

Ethnobotanical Trail: This will have plants used particularly by tribal people in the hills, and not so far in common usage among urban societies. A few examples are:

Table No. 1.6

Aconitum atrox	Myrica esculenta
Angelica glauca	Parnassia nubicola
Asparagus curillus	Prinsepia utilis
Bergenia spp	Rheum webbianum
Hedychium spicatum	Rhododendron arboreum
Lyonia ovalifolia	

Exotic Species Trail: Exotics are species which do not belong to natural Indian, Indian flora, but have been introduced deliberately or accidentally. The S.B.G can have a trail exclusively for exotics of significance or exotic species interspersed in some other trail. There is a danger in growing any new exotics in gardens, as they can sometimes run wild and aggressive and even eliminate local species. A strict watch is, therefore, to be kept on their specimens, or populations.

³³ Ibid, P-48-49.

(Eichchorina or Water Hycinth and Lantana are some old examples, and Parthenium and Mikania are comparatively recent examples of very aggressive exotics, which are damaging the local species).³⁴

Rare Plants Trail: Species which grow in small areas and whose total area of distribution or occurrence is small or even if it is large, the number of their plants is very small are called rare. Sometimes, the rate of their natural regeneration is not able to keep pace with their removal or exploitation, and their very survival for long becomes endangered. Growing them in botanic gardens has many advantages. It attracts attention to their precarious existence, provides material for their study and also ensures one more home for them. It is useful to encourage their cultivation in more locations. Few examples from northwestern Himalayas are:³⁵

Table No. 1.7

Acnotium spp	Impatiens podocarpa (and other spp.
Chaerophyllum cachemirium	Berberis kashmiriana (and other spp.
Ferula thomsonii	Arnebia benthamii
Picrorhiza kurroa	Circeaster agrestis
Sassurea spp.	Nardostachys grandiflora
Heracleum jacquemontii	Wulfenia himalacia
Ligustricum marginatum	Dendrobium primulinum
Peucedanum thomsonii	Dactylorhiza hatagirea

Energy Trail: There is much concern these days about new sources of energy. Plants which are being raised as quick growing species for fuel or species under experiments for getting hydrocarbons can be grown in this trail for education. Examples are:

Table No. 1.8

Eucalyptus spp.	Simmondsia chinensis
Leucaena leucocephala	Casuarinas equisetifolia
Euphorbia tirucalli	

³⁴ Ibid, P-49-50.

³⁵ Ibid, P-50.

Orchid Trail: Orchids provide the most fanciful ornamental flowers. Mountainous regions of India have over six hundred orchids. Though the eastern Himalayas, particularly the region of Sikkim and Darjeeling is the richest region, northwestern Himalayas also have several hundred orchids. Due to its favourable altitude and rich trees cover, the S.B.G can have a rich collection of orchids.

Many ornamental species can be planted as epiphytes on trees and many on the ground. One of the shady northern aspects can be developed into an orchid trail. The following are some of the orchid genera which can be grown:

Table No. 1.9

Aerides	Eulophia
Arachnanthe	Ottochilus
Arundina	Paphiopedilum
Bulbophyllum	Peristylus
Calanthe	Phaius
Coelogyne	Pholidota
Cymbidium	Pleione
Dendrobium	Rhynchostylis

An Orchidarium for growing orchids indoors was already suggested but many could come up satisfactorily in the open also and a trail should be attempted. It will be unique in India.³⁶

Germplasm Collection: There is no botanic garden in the northwestern Himalayas where diversity of useful or potential groups of plants could be grown, studied and conserved.

The S.B.G will have this as one of its priority activities. Due to limitation of space (particularly because it is not proposed to remove existing tree cover to any noticeable extent)

³⁶ Ibid, P-51-52.

critical analysis will be done to decide the groups for germplasm collection. The following are proposed: Germplasm of important medicinal genera, like Podophyllum, Aconitum, Nardostachys, Valeriane, Picrorhiza. Germplasm of bamboo of higher altitudes.

The S.B.G could serve a good place for germplasm of certain tree species of forestry importance. It is learnt that pines are being maintained at a plantation at Kalka near Ranikhet. Some broadleaved species like Populous or Juglans could be considered, depending on the scientific work programme.

Shrubberies: Collection of shrubs of various sizes along paths in the garden or in special sections are called Shrubberies. The mountainous regions of India have many very ornamental and also economically useful shrubs, e.g. species of Ixora, Prnus, Rosa, Rubus, Cotoneaster, Spirea, Viburnum, etc. The site already has good variety and cover of shrubs. With addition of more plants of species, good shrubberies can be developed at various altitudes and aspects. It is reiterated that in developing shrubberies also, the indigenous species should predominated; they have representation of all needs for the garden.³⁷

Seasonal Plants Section: A collection of ornamental seasonal flowers has many advantages. Most visitors wish to know names of flowers they have seen in the wild along roadsides or near picnic spots and in houses. Hence, labelled specimens are a great attraction and have much educational value.

Seasonal flowers should be grown preferably in pots and baskets and only occasionally in beds. This helps in replacements and rearranging according to needs for exhibitions, flower

³⁷ Ibid, P-52-53.

shows, special occasions, etc. the Himalayas provide a large variety of natural flowers in all possible colours. Seed material of such beautiful but uncommon flowers can have much demand.

Bonsai: Bonsai are miniature plants, manipulated to retain short size. They are fancied for curiosity, e.g. a Citrus or Pomegranate plant of 20-30 cm height bearing fruits, or a Banyan tree plant of 30 cm height throwing aerial roots is very attractive.

A variety of weird sizes and shapes can be manipulated by appropriately mechanically obstructing or supporting different organs. Due to this curiosity, many visitors evince keen interest in Bonsai plants. A few plants showing this aspect of horticultural techniques will be a good addition to the display or visitor sector in the garden. They may not deserve a separate section but may even be accommodated in or near the Reception or Visitor Facilitation counters.³⁸

Ecological Reserves: Ecological Reserves are those 'closed' areas where no human activity whatsoever is permitted and the flora and fauna are allowed to follow natural succession under those conditions. This area will be closed by barbed wire fencing to exclude any grazing, lopping etc. Access will be permitted only for scientific observations on natural changes in flora over long periods. A census of all spp. each reserve will be maintained and monitored to study species completion. They serve as open air Laboratory for study of forestry, ecology and flora.

As the site provides a variety of altitudes, aspects and vegetation associations, at least the following five ecological reserves of about 2 ha each are proposed.

1. In the Deodar area a little below the top on eastern face.
2. In a mixed forest type on the south western slope.

³⁸ Ibid, P-53.

3. In a mixed forest type on the north western slope.
4. In the Chsir pine area.
5. An open area (to observe the effect of closure).

Wilderness Areas: These will be areas having entirely natural vegetation, forest cover as well as undergrowth, but will be different from ecological reserves in the sense that they will be accessible to visitors for enjoying the beauty of natural forest cover and of understanding some features of the vegetation.

As the site is covered on its larger parts by natural forest, and there is no proposal to remove many trees from any area what-so-ever, several areas in the garden can fall under this feature.³⁹

Other Scientific Units

A botanic garden planned and run on scientific lines has some essential and several desirable technical units or adjuncts. They keep scientific interests of workers active and alive and aid in better maintenance and service activities.

Essential Units

Herbarium: A methodically prepared and systematically kept collection of dried and preserved samples of all plants growing in the garden, and also those representing the full flora of that region is essential for identification, reference and permanent technical record. It is not expensive to start and maintain it. It has value in education, environmental awareness and in all botanical research on plant resources of the area.

³⁹ Ibid, P-54.

Museum: A small museum not only showing the history, growth, functions and activities of the garden, but also displaying general botanical knowledge is essential for education and awareness.

The Museum of S.B.G can have 'interalia' the following: Charts to show role of plants in life. Map showing layout of S.B.G.

- Activities of S.B.G.
- Services to the public.
- Bot. Gardens of the World.
- Bot. Gardens of India.
- Charts, models, specimens showing major economic plants and their products.
- Curious plants.⁴⁰

Seed Herbarium/Museum: A small collection of seeds useful for identification, research and for exchange purposes. Seed herbarium/museum will have catalogues of holdings and illustrations, etc.

Laboratory: A small laboratory for dissection and routine study of plants or plant parts is essential not only for identification of species, but also for identification of pests and pathogens, processing of material for exchange, and preservation of samples.

The institution can in course of time, have sponsored research schemes and consultancy worked with this laboratory as nucleus.

Library: A small collection of relevant books is essential for introduction propagation, maintenance, and identification of plants, as also for appreciation of ever expanding utility and role of plant resources in life.

⁴⁰ Ibid, P-55-56.

Due to serve limitations of space and funds for libraries, care has to be taken from the very beginning to confine to very relevant literature (books as well as journals). Literature not directly useful and relevant should not be added. Some more common and useful Indian and foreign journals can be subscribed e.g. Ind. J. bot., Indian Farming, “Kheti”, “Vigyan Pragati”. Back volumes of any journals are not usually necessary in such newly established botanic gardens.⁴¹

Meteorological Station: Data on rainfall, temperature and humidity on the site will be required for many experiments, and a small met. Unit essential. It may be possible to establish it within the activities of the Met. Deptt. Of Govt. of India, and without much expense to the garden.

Desirable Units

Training Unit: The expertise of staff can be utilised for creating facilities of training of different kinds, e.g. in-house plants, bonsai, flower arrangements, field botany, herbarium techniques, growing vegetables, and even at gardener or skilled Mail level. Such short courses make gardens very popular.

Plant and Seed Supply Unit: The garden can earn some revenue by preparing standard sets of herbarium specimens or viable seed packets for sale, based on natural but perishable products such as foliage, inflorescence and seeds.

It can create nursery samplings of selected indigenous ornamental trees or shrubs for encouraging new native flowers in Indian houses in mountainous regions.

Iconotheca: It can have the following: -

- Illustrations and photographs of sections, and individual plants.

⁴¹ Ibid, P-56.

- Photo Negatives Library.
- Slides Library
- They should have proper index cards, right form beginning.⁴²

Extension Activities: The S.B.G can organise on a regular basis other activities or public relation like flower shows, open days, special lectures, thematic exhibitions based on plant resources or plant beliefs. The S.B.G can organize essay or painting competitions based on flowers and plants. It can give to all visitors or only to student visitors at point of entry, some quiz type or objective test paper to be returned by them while leaving the garden. Good performance can be rewarded through a free pass to garden for a year, invitation or garden functions and activities, etc.

Administrative Buildings: A small building for housing the following offices/ laboratories/facilities will be essential- Director's office, Laboratory, Library, Herbarium, Museum, Seminar room, another two small buildings can house general and garden stores, and manure and seeds, etc.⁴³

A Word of Caution

Pitfall: (To be avoided): Eotamic gardens have been accused, even in affluent countries, of becoming a luxury to be enjoyed only by the upper classes. In India, where the common tourist, or visitor to places interest is usually a middle-income group person, all amenities, entry fees, and cost of services have to be so planned and priced as to attract and not scare the visitor.

Also, the entry point of the garden has to be within easy reach by economic common public transport.

⁴² Ibid, P-57.

⁴³ Ibid, P-58.

Botanic Gardens can in course or time be subjected to demands of personal favours like free supply of plants, night stay of guests, and camping facilities. Strict watch and discipline are necessary from the very beginning. Any expectations can mean opening the flood gates which the small manager on the spot may not be able to resist.

In our view, the S.B.G should not have facilities of night stay even for research scholars coming for scientific work. the facility can be grossly misused.

The Director of the S.B.G, the Garden Curator, and some bare essential staff, like pump-operator, driver and a few watchmen only should stay in the garden. Too many families inside the garden have adverse impact on security, as well as serenity of the Institution.⁴⁴

Social and Economic Aspects

Good and mutually useful relationship should be established with the neighbourhood. The residents on peripheral lands must be explained sincerely that the establishment, growth, popularity and game name of the garden will bring them credit and also some direct or indirect gains like employment to their dependents, income from visitors, and overall general improvement of the area by the location of a prestigious useful public amenity.

Further, whatever be the enthusiasm and assurances of support at the time of establishment of a botanic garden, occasion can come (and have come in the life of most botanic gardens) when their utility, and economic feasibility come to be questioned, and funds tend to dry up. It is necessary, therefore, from the very beginning to focus attention on cost/benefits ratio, even if the benefits are in the terms of abstract things like aesthetic, cultural, educational, etc.

⁴⁴ Ibid, P-59.

Public Relations: The Public relation activities of the garden can have several aspects:

Visitors: Except for a few scientific and administrative sections, the grounds and plant houses will be open to the public on payment of small entry fee. This needs due emphasis that to avoid entry of undesirable elements, vandalism, and other evils, an entry fee, (say of Rs 1/= for adults, and 0.50 for children below 12 years, free below 3 years) must be put from the very beginning. Research workers and groups of students formally brought by their teachers by prior arrangement can be exempted.

- One day a week, entry can be made free.
- There should be public conveniences like shelters from rain and sun, drinking water taps, toilets and resting places at every ca 500 m of the road/foot paths.
- The Reception counter must give a simple layout map of the garden to each visitor.
- Priced booklets of 2-3 pages with colour photographs can also be made available at Reception counters.
- Provision must be made for a few trained guides to conduct (on request and payment) tours of groups of visitors.
- A parking lot, canteen or cafeteria is essential amenities.⁴⁵

Resources and Facilities in a Botanic Garden:

Bank: It will be in the interest of the S.B.G to have a branch or an extension counter of a bank near the Reception counter with access from outside the protected area. It will save the staff of S.B.G the trouble of going to town and will save much loss of time.

⁴⁵ Ibid, P-60-61.

Post Office: A small post office (with letter-box) with facility of essential postal services is also necessary on the same location as a bank.

Parking Lot Sheds: A parking lot for the vehicles of visitors is essential near the gate of the garden, again outside the protected area. No vehicles (except staff vehicles) should be allowed inside the garden. Sheds/gardens for official vehicles, and tractors, etc. should be made inside the garden at lower levels where open spots already available.⁴⁶

Garden Collections: Collections in botanic gardens preserve biodiversity. Considering the sheer diversity of plants in a botanic garden native, common, rare, endangered, endemic and exotic plants, the scope for environmental education is endless. Thus, botanic gardens are ideal places to teach people about

- The richness of the plant kingdom
- The morphology of these plants with their adaptations
- The importance of plants in our lives.
- The use of plants economically, culturally and aesthetically.
- The threat to plants from all sides.
- The need to conserve these plants.

Environmental Education Staff: Environmental education can be successfully conducted only with the help of an environmental education officer supported by his/her assistants. Knowledge of the standard and the previous experience of the target group is very essential. The education officers need to integrate Environmental Education themselves fully into the staff structure of the garden Environmental Educators themselves need training to plan, organise and implement

⁴⁶ Ibid, P-61-62.

different types of programmes. for different target groups. From this analysis it is very evident that most botanic gardens have Environmental officers.

Support: It is important for other members of staff to support the officer(s) in whatever way they can. There needs to be good communication within the garden about the role each member of staff can play in education and the officer has to play a central coordinating role as far as the outreach programmes are concerned.

Education Materials: Even though plants are the major attraction of the garden, other teaching materials like posters, panels, slides, video clippings, Environmental education packs, books etc. can be used for outreach programmes. Gardens collections like herbarium, museum etc. can also be used as Environmental education materials.

Budget: The garden must allocate a budget to maintain the garden and the officer must be responsible for managing the budget. The money should be used for the implementation, planning, coordination, organisation and management of the garden. Moreover the kind of programmes to undertake also depends upon the money available.

Visitors: The success of a good activity in the botanical garden depends on the visitors. Officer has to identify the target group for the programme. The main target groups for most gardens include

- Schools: (primary and secondary)
- Colleges and Universities: plant science / botany, ayurveda and researchers.
- Teachers: both in-service and pre-service.
- Youth clubs and General public.

It is impossible to target all these groups. Each garden has to set priorities. according to the message they want to get across and the facilities that are available.

Developing Programmes: Living collections serve as a support in the development of the important programmes. The collections and the expertise. The staff is ideal in enabling us to conduct a variety of activities that aim to make the public aware of the importance of protecting our plant heritage. With appropriate labels, displays and other interpretive information materials, the botanic gardens can sensitise and motivate people to protect biodiversity and instill a sense of care and concern over the protection of the environment.

Many botanic gardens have developed comprehensive environmental education programmes and in this programme a more popular public education component can be actively pursued through the following programmes.

- Nature trail
- Guided tours
- Interactive exhibitions.
- Field excursions
- Demonstration of collections
- Practical horticulture and arboriculture
- Botany courses
- Quiz and essay competitions
- Interpretive signs and posters.
- Outreach programmes

More specific programmes can be conducted in addition to the daily work undertaken at the botanic garden, such as guided tours and attending to the general visitors. Certain programmes can be arranged for one or two days whereas specific areas can be covered.

These areas are:

- Know the medicinal plants and their therapeutic values
- Know the common plants and their uses
- Know the aquatic plants and their use and adaptations
- Know the orchids
- Know the rare plants and their extinction
- Know the common trees in the arboretum
- Plant adaptations A walk through the garden
- Training in horticulture.
- A Workshop on wild edibles
- A Study of plants across the curriculum.

Role of Botanic Gardens in Environmental Education

From these analytical results it is very evident that botanic gardens have long been associated with history, environmental education, environmental history, environmental science and Environmental conservation. But very recently gardens are turning their attention to the general public aim is to provide firsthand knowledge about the local, rare, endangered, endemic, exotic and the medicinal plants, their habitats, therapeutic values and cultivation, for effective conservation for future. The field visit has great potential to sensitise and increase environmental knowledge and awareness and to educate people about the urgent need to conserve plants. The

diversity within the plant kingdom provides a shop window for conservation education. All botanical gardens hold a large collection of living plants.

The role of botanic gardens as evident from the analysis is given below.

Learning Centre

Some of our gardens are floundering without a serious role, debased to parks and pleasure gardens. The visitors take particular pleasure in observing the most beautiful flowers, some of the more unusual plants within the peaceful and beautiful surrounding of the garden.

Botanic gardens can set up and implement environmental education programmes within the framework of their infrastructure facilities. Each visitor in the garden becomes an explorer, gusser, curious and questioning through learning centre activities. Visitors develop a skill of observation even if the visit is planned or for fun. They are a major catalyst or act as a facilitator in learning about the flora of the world.

Botanic gardens contain plants from all over the world. Properly planned field study can provide the opportunity to be close to the wide spectrum of plants, observing its diversity, similarity and variations. As they see more species, species diversity and the importance of biodiversity will become more meaningful concepts. Botanical gardens also teach us how plants are made eco-friendly. Botanic gardens thus became the centres of natural aesthetic beauty and taxonomic studies and education.

Conservation Centre

Throughout the world wild plants and their habitat are under increasing threat. Botanic gardens are a repository of endemic, rare and endangered species of plants all over the world. They will

be growing a fraction of native flora. Highest priority is given to those plants thought to be endangered or of known economic potential either for horticulture, medicine or wild relatives of agricultural crops. It is realised that botanic gardens have an obvious and vital role to play in conserving plants. In the present era of dwindling living plant resources, botanic gardens are the last resort because they can augment maximum resources towards the conservation of plant diversity.

The medicinal value of the plant is also mentioned. Ayurvedic education and knowledge of making Ayurvedic medicines is also done through the Botanical Garden. Conservation of medicinal plants is to be addressed in a comprehensive way in order to strengthen the resource base of our traditional systems of medicine.

Importance of Saharanpur Botanical Garden

1. Biodiversity
2. Plant Classification
3. Plant Adaptations
4. Sacred Groves
5. Rare and Endangered Plants
6. Useful but Deadly
7. Protection, promotion and economic importance of biodiversity.

Economic Importance

(a) Plants as Edibles

1. Cereals
2. Fruit plants

3. Leafy vegetables
4. Herbs for cooking

(b) Plants for Health

1. Folk Cures
2. Plants used in Modern medicine
3. Plants used in Ayurveda and other Indian systems of medicine

(c) Plants as Industrial Raw Material

1. Trees
2. Ornamentals
3. Aromatic Plants,
4. Herbs as Repellents against insects
5. Fibre yielding Plants

(d) Conservation

1. Role of Forest
2. Growing Native trees
3. Growing Avenue trees
4. Propagation Methods
5. Habitat conservation
6. Extinction of species
7. Sustainable Utilisation
8. Biodiversity Conservation

(e) Activities

1. Practicing Propagation Methods

2. Field Visit
3. Awareness Programmes
4. Plant Identification Competition
5. Gardening competition

3.1 Contribution of Scientists

The late Mr. J. E. Duthie was in charge of the Saharanpur Botanic Garden, which is located in the ancient North-Western Provinces of India, and was responsible for putting the herbarium there in an extraordinary position. This herbarium was later given to the DehraDun Forest Research Institute. Mr. Duthie left several handwritten notes on the herbarium, and with their help, forest botanist Mr. R. N. Parker produced "The Herbarium of the Forest Research Institute."

Mr. Parker informs us that: "The Forest Research Institute's herbarium is divided into two parts, the larger of which is the Botanical Department of Northern India's herbarium, also known as the Saharanpur Herbarium, which was transferred to DehraDun in 1908 and amalgamated with the Forest School's herbarium. The proportional sizes of the two herbaria are unknown at this time. On January 1, 1929, the current collection was expected to contain 222,000 sheets." This brings the herbarium's current state approximately up to date. However, for many, the main concern is. Mr. Parker's narrative can be found in his brief history of the Saharanpur Botanic Garden, as well as the long line of illustrious botanists who had some association with it. Names like Govan, Wallich, Royle, Falconer, Helfer, Griffith, Hooker, Jameson, and J. L. Stewart will bring those familiar with India's botanical and, one may say, forestry history back to earlier work done in the first half of the twentieth century. For this reason, it is suggested that we take a quick

look at some of the more important moments in this history of botany and the Botanic Gardens at Saharanpur, with which the name of Duthie (whose superb photograph is featured in the Bulletin) will be forever connected.

The Botanic Gardens were founded in 1816 on the site of an existing native garden that had been greatly expanded over the years. Dr. Govan was the first superintendent, and he mostly collected flora in what is now Sirmoor State in the Simla area. In Wallich's Catalogue, a portion, if not all, of his collections were listed with others. The plants' fate is unknown, although a collection of drawings was eventually sent to Kew. Dr. Royle succeeded Govan in 1823, and after retiring, he published the results of his collections in "Illustrations of the Botany of the Himalayan Mountains," which appeared in sections between 1833 and 1840. Royle discusses the area he studied in this study and mentions a herbarium with 3500 species. Because there were no facilities for storing the collection in Saharanpur, he took the majority of it home with him. After his death, his herbarium was auctioned in London for HS, and it is thought to have ended up in Russia! However, Royle donated a collection of his plants to the Linnean Society, and many of his species may now be found at Kew, with some having been given to Hooker or Bentham and arriving at Kew with their herbaria. The fact that DehraDun still has some of Royle's flora is largely owing to the fact that Duthie discovered some of the former's plants at Saharanpur in 1876 and conserved them.

Royle was unable to take any botanical tours for the first three and a half years of his tenure at Saharanpur due to his medical duties (as station surgeon), but according to a letter he wrote on June 28, 1828, he explored part of the Siwaliks and the Dun plateau, went up to Mussoorie, where he established an experimental physic garden, and marched across to Simla and on to Kotgarh. He returned to this region of the Himalaya the following year for a more

detailed tour. Wallich, the superintendent of the Calcutta Botanic Gardens, had made the first botanical tour to the huge forests of the newly acquired Province of Tenasserim the previous year, and had produced some significant collections.

In 1831, Dr. Falconer succeeded Royle. By adopting Royle's practice of sending indigenous to accompany caravans into the interior of the highlands, he was able to increase his collections. With the exception of a few bundles discovered by Duthie among Royle's, these collections were delivered to India House in London. In the prologue to the "Catalogue of the Plants given at the Royal Gardens, Kew, from the Herbaria of Griffith, Falconer, and Helfer," Hooker mentions them. Falconer was also a geologist who studied the Siwalik fossil fauna. In 1838-39 and 1849, Helfer and Falconer were dispatched to report on and collect in the woods of Tenasserim Province, respectively, after the Government and the Court of Directors were concerned about the uncontrolled feelings in the teak of that region.

Dr. Jameson took over for Falconer in 1842 and left in 1876. Despite the fact that he was not a botanist, he is credited with founding the tea industry in Northern India. Dr. J. L. Stewart (first conservator of forests in the Punjab, 1864, and author of "Punjab Plants") officiated for him in 1861, and Dr. G. King, later superintendent of the Royal Botanic Gardens, Calcutta, officiated for him in 1868, during brief periods of leave.

Dr. Duthie arrived in Saharanpur in December 1876 as superintendent of the Botanic Gardens, a position he held until April 1, 1887, when he was promoted to director of the Botanical Department of Northern India, allowing him to devote his full attention to botanical research until his retirement in December 1902."On my arrival at Saharanpur, I found the Museum (founded in 1859) loaded with varied collections containing animals, especially birds, as well as different sorts of vegetable products such as fibres, pharmaceuticals, and so on, and in

one of the glass cases, sundry articles used in the making of tea." Other cases held a variety of rock specimens,⁴⁷ including some of Falconer's initial Siwalik fossil animal remains specimens. The Museum's herbarium, such as it was, had a lowly position because the specimens were unorganised, unmounted, and for the most part nameless, and the collection could not be regarded of any practical service to the public in that state. The majority of the material came from natives who were hired by Dr. Jameson to collect specimens related to tea culture during his trips. There were also a few bundles of specimens labelled in Royle and Falconer's handwriting that they had collected in various locations of North West India. These, on the other hand, were only pieces and remnants of their original collections."

A study of the ways by which Duthie dealt with the problem and built up the wonderful herbarium, which finally proved to be such a sturdy foundation upon which the DehraDun Forest Research Institute could be constructed, requires a reference to Mr. Parker's work.

The Dehra Forest School Herbari has been mentioned. Mr. Gamble, who became director of the School in 1890 and held the job for eleven years, started this. Gamble began the collection by presenting a set of his own duplicates that he had gathered in Bengal and Madras. During his tenure at Dehra, he diligently gathered and received several gifts from forest officers and others. Duthie also contributed, while the School's instructors, particularly Upendra Nath Kanjilal and Birbal, gathered a variety of native tree and shrub species. There were also some private herbaria constructed by forest officers on display.

Mr. Parker discusses some fascinating information about former collectors and their direct or indirect influence on the current Dehra Dun herbarium. Roxburgh, Wallich, Strachey, Winterbottom, Griffith, Helfer, Hooker fils, Thomson, Stocks, Dalzell (Bombay), Wight (South India), Thomson, Beddome (conservator of woods, Madras and Bombay), Falconer, and Jameson

⁴⁷ Nature Publishing Group, February 6, 1932, p-190.

are just a few of the names on the list. Col. Davidson, R.E. (Kumaon), Dr. Aitcheson (Punjab and Afghanistan), Dr. Good enough (collection obtained from Kew), Sir D. Brandis (larger portion of herbarium received from Kew), and Thwaites are among the later collectors (Ceylon).

Mr. Parker discusses some fascinating information about former collectors and their direct or indirect influence on the current Dehra Dun herbarium. Roxburgh, Wallich, Strachey, Winterbottom, Griffith, Helfer, Hooker fils, Thomson, Stocks, Dalzell (Bombay), Wight (South India), Thomson, Beddome (conservator of woods, Madras and Bombay), Falconer, and Jameson are just a few of the names on the list. Col. Davidson, R.E. (Kumaon), Dr. Aitcheson (Punjab and Afghanistan), Dr. Good enough (collection obtained from Kew), Sir D. Brandis (larger portion of herbarium received from Kew), and Thwaites are among the later collectors (Ceylon). A. V. Munro (conservator of forests, Hazara, Multan, Baluchistan), C. W. Hope (many ferns), W. Gollan (superintendent of the Botanic Gardens, Saharanpur, 1887-1901-many plants and mosses), W. A. Talbot (conservator of forests-Bombay plants), C. B. Clarke, C. F. Elliott (conservator of forests, Punjab (grasses). A range of plants gained through overseas exchanges are also housed in the Herbarium.⁴⁸

3.2 Experiments of Saharanpur Botanical Garden

The cultivation of therapeutic medications and exotic fruit trees has already been mentioned. Importation of the latter began in 1833 and has continued consistently since that time. The majority of the imports were produced for the hill gardens, but it was later realised that most types could be effectively grown at Saharanpur. There are currently 37 different species and 287 different cultivars growing here. From 1879 to 1901, returns by species are available, and about 163,000 trees of the more important sorts were dispersed during that time, primarily mangoes,

⁴⁸ Nature Publishing Group, February 6, 1932, p-191.

plums, oranges, peaches, loquats, limes, apples, and pears. The La Conte pear, the only kind that ripens in the lowlands, and the Japanese persimmon, a fruit with a great flavour and outstanding keeping qualities, are two of the more recent successful arrivals. Acclimatization of flower and vegetable seeds for hospitals and military gardens has also been mentioned. Trials of cereals, fibres, fodder, lumber, and other exotic goods have become more economically significant. For many years, experiments in strictly agricultural crops were undertaken here, but with the development of agricultural stations in various regions of the country, they were terminated. Many various types of fodder have been tried with varying degrees of success, including guinea grass, lucerne, and teosinte; however, they cannot compete with some of the indigenous grasses, whose seeds are largely collected for distribution. Mahogany and eucalyptus are two of the most common timber trees imported from other nations. The former was imported here from the West Indies in 1828; however, despite some excellent specimens, the tree does not produce seed in India, thus the stock must be replaced annually from overseas. Many varieties of eucalyptus have been explored, but only six cultivars are now grown for distribution because of high demand. Fibres, both alien and indigenous, have received a lot of attention over the years, and the most successful trials have been those involving rhea and agave, which are now exported in ever-increasing amounts from the gardens. The introduction of the sweet chestnut, now so prevalent in the Dun and elsewhere, the cultivation and dispersion of numerous mulberry trees for sericulture, and experiments of coffee, tobacco, and tapioca are only a few of the items listed. The tea plant, however, is the finest achievement of acclimatisation yet accomplished at Saharanpur and by the garden crew in other sections. Dr. Royle proposed its introduction into northern India in 1828, and operations were carried out on a small scale by Dr. Falconer; but the real success of the experiment must be attributed to Dr. Jameson, and his achievements in this direction were

described in the report of 1876-77 as the most lucrative enterprise carried out in India under the British Government. Although the history of the tea gardens is not related to this district, no description of the Saharanpur institution would be complete without mentioning Dr. Jameson's monumental endeavour, which he worked on for more than thirty years.

Although it was not intended to be a profitable under-finance in the outset. From a business standpoint, the gardens have long generated a large profit. The overall expenditure in 1906-07, including the Mussoorie branch, was Rs. 27,707, while real cash receipts were Rs. 34,896, to which should be added Rs. 8,913 in the form of indirect or book receipts from other Government agencies. The gardens' usefulness as a horticultural information bureau is an essential component of the gardens that has yet to be mentioned. The staff spends a significant amount of time answering inquiries and providing advice on any issue that is in any way related to the institution's activities; and possibly no component of the work is held in higher regard, especially by the native population.⁴⁹

Character of the season, state of garden, irrigation and experiments and acclimatisation held in saharanpur botanical garden from 1922 to 1927-

1922-1923

Character of the Season: The season has not been favourable to the class of plants grown in these gardens. The rainfall was 37.69 inches which although not too much was late and lasted till the 3rd week in September, this proved to be disastrous to the first sowing of all our vegetable seeds, those above the ground as well as seeds sown being washed away. The cold season was severe and frost was registered on several occasions, this at once killed tomatoes and did a great deal of damage to Peas. French Beans were

⁴⁹H.F. Nevill, *District Gazetteers for the United Provinces*, Vol. II, *Saharanpur* (1909), pp. 54-56.

also killed. Two severe hail storms occurred but did not appear to do as much damage as the cold high winds that followed.⁵⁰

State of Gardens: As mentioned in my report last year the garden from an ornamental point of view is not satisfactory as far as such things as lawns, flower beds, etc go, yet the fact remains that this garden contains one of the best collections of trees in India. Many fine specimens are rare and unique, this is sometimes forgotten. It has been suggested that a portion of the garden should be treated as ornamental and a sum of money set apart for this portion. I hope it will receive the consideration it merits.

Irrigation: It is important to record that canal water is again available in these gardens; the supply received has been very valuable, it was necessary to alter the level of the channels to take the water and to make new ones in several cases. Much more is required in the way of deepening and widening existing channels, which will be carried out as funds permit.

The Brownlie Tube Well in the Saharanpur Garden continues to give a good supply of water, but with the canal water available its use has been curtailed as much as possible.⁵¹

Experiments and Acclimatisation: Although strictly speaking acclimatisation of seeds really come under this heading. Attempts have been made to acclimatise the Golden Ball Turnip, a new beet root and an improved variety of carrot, the turnip failed to flower although treated and grown in the same manner as our own seen plants. We have several

⁵⁰ Annual Report on Saharanpur and Dehra dun Gardens, 1922-23, P-14.

⁵¹ Ibid, P-15

good kinds of turnip, but the beet and carrots are poor, the results of the other trials made are not known yet. Several imported varieties of tomatoes were tried and a small amount of seed saved, the plants as mentioned before were eventually killed by frost, further seed has been sown for a hot and rainy weather crop. Pine crops for seed were saved from peas, broad beans, radish, cabbage, cauliflower, turnip and lettuce, and we were fortunate not to have plants attacked by an insect “*Bagrada Picta*” which usually does a great deal of harm to the seed at the ripening period.

The following new varieties of flower seeds have been added this year.

Brachycome alba and blue, Chrysanthemum (3 varieties) Nasturtium (4 varieties) Phlox dark red, Poppy Shirley mixed, Salvia splendens triumph, Schizanthus hybrid grandiflorus, Statice blue and rosea superba and Verbena (4 varieties).

Fruit: The propagation of fruit trees of all saleable kinds has continued and demands have generally been met in full. The standing fruit crop was a splendid one, and was sold by contract before I took over charge of the garden. The coming year’s crop which does not promise to be very heavy, especially mangoes, has recently been sold and it is strange to say the highest offer was Rs 500/- higher than the previous year, this appears to be satisfactory. A good deal of work has been carried out in the Alsi Bagh fruit garden which forms part of these gardens, nearly 1000 fruit trees comprising mangoes, pears, loquats, quinces, litchis, oranges, limes and plums have been planted, some to fill up vacancies, other to fill up vacant land. All standing fruit trees in this garden have been pruned and shaped as well as thalass forked and weeded, it appears that although this work should be done annually it has not been

done for years, trees have been benefited by it considerably the leased land adjoining the Alsi Bagh has been given up. I noted in my last report that the installation of a new oil engine for this garden had been completed by the Agricultural Department but was not quite ready for working, trials have since been made which do not appear to me to be quite satisfactory, the water gave out on several occasions when the engine was worked at full capacity, and it seemed that the supply was continuous only when running at speed. I have suggested further tests be made.

Propagation of Roses: The stock raised this year is between 2 and 3 thousand, last year we had 2 or 3 hundred only. I hope to import some of the more recent varieties during the next cold season.⁵²

1923-1924

Character of The Season: This may be considered satisfactory the cold season was not severe and no frost was registered. A record of rainfall and temperatures has this year been maintained, this practice has been in abeyance for many years, the rainfall for the year was 45.06 inches while the highest temperature was 112 registered on 6th June 1923 and the lowest 41 on the 20th January 1924.

State of Gardens: Attention as far as funds permitted has been paid to the ornamental portion of the garden but no separate allotment has yet been set apart for this class of work. The rose garden having become worn out and the varieties old and useless it was dug up and redesigned and 104 varieties of new roses planted.

⁵² Ibid, P-15-17.

Sufficient plants could not be obtained to fully plant the beds. The intervening spaces were filled with Edward roses, these will be budded as soon as the bud wood on the new plants become available, a few plants have already been dubbed the remainder can be done during the rains. New plans of both the Saharanpur and Alsi Bagh garden have been prepared during the year.⁵³

Irrigation: The Brownlie tube well in the Saharanpur continues to give a good supply of water, but the Alsi Bagh tube has not been satisfactory since its installation. This has been reported several times to the Agricultural Engineer and recently they have fitted a new fly wheel of a small size. I personally believe that the water supply is insufficient and a new boring is necessary, this view is not accepted by the Agricultural Engineering staff, they have now been engaged for many months in boring and installing a third engine to irrigate the land planted this year with fruit trees, which was to be ready by Christmas so I was informed, and funds were handed over to them some months ago but very little progress has been made. It does not seem clear which Christmas was meant 1924 or 1925. Meanwhile seven or eight hundred plants require water, canal water has been received as usual, but as we are at the tail of the distributor we have to be content with what other people leave, so to speak, certainly the supply to Alsi Bagh is insufficient.⁵⁴

Experiments And Acclimatisation: An experiment was tried with a new pabco paper mulch on tomatoes it consists of a roll of treated paper which is placed flat on the ground and the plants, tomatoes in our case grow through the paper, it being claimed that the growth or weeds and the evaporation or moisture are prevented. The mulch has been

⁵³ Annual Report on Saharanpur and Dehra dun Gardens, 1923-24, P-64.

⁵⁴Ibid, P-65.

successfully used on pine-apple plantations elsewhere. We grew a line of tomatoes from planting to fruiting stage without irrigation with the use of the mulch. The number of watering and weedings required by the non-control plot, planted at the same date may be taken as 4 and 2 respectively. No caking of the soil surface under the mulch occurred but it was found that white ants tended to collect there.

Experiment were carried out with the budding of Loquats, the grafting of the persimmon on Peach seedlings and on Persimmon seedlings, these were also tried on pear stock but we had no success with either, Peach stock will be tried again I have succeeded with this stock elsewhere, but at a different period of the year.

A further trial has been made with the acclimatisation of a superior variety of Beetroot and Carrot. Trials with Endive and Asparagus have also been made, two varieties of Endive are following and we expect to have seed from them. The trial last year made with Sutton's Golden Ball Turnip failed, the plants grew well but failed to flower for no apparent reason, the only conclusion I have arrived at is that the season is too short for this variety to seed.

A small consignment of fruit trees were imported which included new varieties of apples, pears, figs, plums, nectarines, damson, loganberry and English Raspberry. The latter three should do well and fruit both here and at Dehra Dun. The apples and pears will not fruit in either place but will produce wood for propagation purposes.

Twelve new varieties of sweet Peas were introduced this year and all are in flower, Most of the old kind have been discarded, many of which were old, useless and mixed a great deal. We have now about 20 really good kinds in self colours.

The standing crop of fruit trees bore an exceptionally good normal crope, roughly 20,000 fruit trees were propagated during the year and also 20,000 Timber and Ornamental trees and shrubs.

Roses: All the plants budded last year were sold and about 3000 have been budded during the current cold weather. We have now worked up a very large stock of Edward plants for budding purposes and should next year be in a position to bud 10,000 plants. A spare plot of land near the pot nursery has been utilised for the extension of roses and about 50,000 cuttings have been rooted both Edward for budding, and stock roses on their own roots for sale next year.

Vegetable Garden and Flower Garden: The usual vegetable crops have been grown and most of these will give large quantities of seed. Peas have done exceptionally well, and given very heavy crops. The vegetable seeds collected during the year amounted to 1476 Lbs. while 104 Lbs. of flower seeds have been collected and miscellaneous amounting to 217 Lbs. was saved.

Ornamental Trees and Plants: Large stocks of these are available but the demand is not large except for Eucalyptus plants of these we raised and sold 5000 during the year and have now several orders registered for the coming year. Seedling plants are now being potted about 10,000 having been transplanted upto date.⁵⁵

⁵⁵ Ibid, P-66-67.

1924-1925

Character of the Season: Marked features were excessive flood rains in September which did a considerable amount of damage, over 20 inches rain being registered here in three days, and severe cold weather in January coupled with ground frost for five successive nights, and unusual cold winds. The highest temperature recorded was 112 degree on June 17th while the lowest registered was 35 on January 14th while as much as 4 degree of frost was recorded on the ground on this occasion, the rainfall for the year was 40.46 inches. The heavy rains fell late in September which flooded a greater part of the district, the Saharanpur record being September 27th 4.90, 28th 7.50, 29th 8.10 inches. These figures were obtained from the Remount Depot, as our own gauge, a small one, was quite unsuitable to measure rain in such quantities.

State of the Garden: Most of our attention has been given to raising and growing such seeds and plants as would be likely to produce revenue, very little has been spent on either ornamental or experimental work, at the same time it must be remembered that a certain amount of expenditure for which no direct returns are shown has to be incurred under the head of ornamental, such as the upkeep and cleaning of roads, shrubberies, borders, rose garden, and etc, also the irrigation of such ground that has been permanently planted. The new rose garden laid out and partly planted last year has been completed and although the plants made little or no growth during the cold weather they have since started made good, and become fully established.⁵⁶

⁵⁶ Annual Report on Saharanpur and Dehra dun Gardens, 1924-25, P-35.

Irrigation: A new tube well has been made during the year and an oil engine installed. This well is intended to irrigate all the high-level ground which could not be reached either by canal water or the old Brownlie tube well in the Saharanpur gardens. Most of the land commanded by the new well was planted last rains with fruit trees. The balances will be completed this year. The engine ran a good trial in my presence with the Assistant Agricultural Engineer, and gave a very fine supply of water. However instead of being ready by the beginning of the hot weather as promised it was not complete till the rains had set in. We were consequently put to some loss and trouble in having to water by hand some hundreds of small trees. It was unfortunate also that the well borer M.Azimuddin met with his death during the work. The man accidentally got struck with the boring tube and fell into the well and struck an iron pipe, He was removed to hospital at once, but died the same day from a fracture of the skull I believe.

The Alsi Bagh well was subjected again to a long trial, the pump was removed, altered and refixed by our own staff and the supply was considerably improved.

The canal water supply has been unsatisfactory. The price has increased while the supply has decreased. The canal Department appears to have taken no interest whatsoever during the last year in our water supply. although we pay Rs 1998-14-6 per annum for what little we got.⁵⁷

Experiments and Acclimatisation: An experiment with budding loquat was tried during the year both ring and shield buds were inserted in April on one two or three plants we were

⁵⁷ Ibid, P-36-37.

successful with ring butts but beyond establishing the fact that it is possible to bud loquats we have not succeeded, the percentage being about 10 per cent cannot be profitable. Trials of the following imported seeds were made-

Beans dwarf canadian wonder, Beetround red globe, Choice dwarf dark, Brussel sprout prolific Exhibition, Carrot james scarlet intermediate, Cabbage perfect Model, Cauliflower large asatic early, Celery solid white, Onion ailsa craig, Giant Rocca, Parsnip the student, Rhubarb Victoria, Tomato Bides Recruit, Kondine red, Turnip golden melon, Vegetable Marrow mixed, Knolkhol, Seed was obtained from some of above but at the time of writing the trials are incomplete. Beans were killed by frost just as they reached the flowering stage.

Two plots have been sown with Lucerne seed both Acclimatize and imported seed. Seed germinated well but is not yet in flower. The object or the trial is to see if it will pay us to grow this plant for seed for which there now appears to be a big demand in India. Many enquiries were received during the year.

The following have been planted in the garden the year.

Table No. 1.10

Fruit trees	1990
Flowering shrubs & decorative plants	4163

Propagation comprises the following-

Table No. 1.11

Fruit trees	28551
Flowering shrubs	7000

Flowering trees	1600
Ornamental trees	14367
Timber trees	2009
Climbing	800
Palms	2672
Decorative plants	623
Roses	5239

Seed produced include-

Table No. 1.12

Vegetable seed	1020 Lbs.
Flower seed	89 Lbs.
Miscellaneous seeds	482 Lbs.

Two new varieties of figs were introduced from Australia and planted out both are doing well.

9 seedless guavas and 12 seedless grapes have also been introduced and planted. Both are established. The grapes are the Bedana variety from quetta while the guavas were obtained from Messrs. D.M. Dutta & Co., kanhuliagardena, muzaffarpur.

The standing fruit crop was a poor one. Mangoes failed completely in the sharanpur district on account of the Mango-hopper. The small fly attacks and feeds on the juice of the flowers and so prevents fertilisation of the flowers. The sticky substance one sees on the foliage being simply excremental. The Indian version of this disease which they call shait is somewhat different. However, it is difficult to

combat unless one had large spraying machines, in America they have recently been doing similar spray work by Aeroplanes Flying over the tops of the trees, a stage to which have not yet reached in Saharanpur.

Fruit Nursery: The propagation of fruit trees of all saleable kinds has continued; the sale of fruit trees amounts to Rs 6920/ during the year. We have this year for the first time a useful lot of strong seedling mangoes for stock purposes, also a speeding mango for stock purposes, also a splendid lot of loquat seedlings ready for grafting. The trouble is to obtain suitable wood to graft on to both stock plants of Loquats & mangoes year after year. All the lower branches used for grafting purposes and the only mango tree now in the garden with low branches are those kinds for which there is little demand. It is hoped that the loquats plants both last year and this will in a few years solve this little difficulty. I have sold roughly 2453 plants during the last three years.

Ornamental Trees and Plant: He has slowed down the Propagation in this line with the exception of eucalyptus of which we raised and sold 5410 during the year. The demand for other plants is not great, and it will pay to divert some of the staff in this department to that of rose growing which as a matter of fact we have done, and over 5000 plants have this year been budded while probably 50000 cuttings of stock plants been rooted.⁵⁸

⁵⁸ Ibid, P-37-39.

1925-1926

Character of the Season: Considered generally, the season has been favourable. Three hail storms passed over the garden during March which badly barked the young fruit of Loquats and somewhat damaged the flowers of the earlier mangoes, which will, to some extent, affect this year's crop. The monsoon commenced on the 29th May and the rainfall of the year measured 42.25 inches, 7.25 inches of this fell on the 15th July.

State of the Garden: Owing to the short duration of my charge here I have been unable to make any great alterations in the state of the gardens but they are undoubtedly capable of much improvement. To improve the productivity of crops and to obtain better grown plants, greater attention is needed to the tillage and the enrichment of the land for there is evidence that the value and importance of these two factors have in the past been somewhat overlooked.

Referring to the Annual Reports of latter years, the necessity for treating the ornamental and Botanical work of the garden as of secondary importance has been stated. I am however of the opinion that the production of the seeds of the flowering annuals is capable of considerable improvement and which, if undertaken with careful supervision would not only be found remunerative work but it would greatly enhance the ornamental features in the centre and conspicuous part of the garden.

I may also mention that several of the trees including some of the rarer species, are showing signs of decay and to prevent this spreading, and to prolong the life and botanical interest of such trees, much more needs to be done in the removal

of their dead branches and in relieving them from the clutches of rank growing creepers.⁵⁹

Irrigation: For the botanic garden the supply of water from the tube wells and the canal has been satisfactory. The same cannot however be said for Alsi Bagh where the canal water is given for a much shorter period which is never sufficient for the proper irrigation of the whole area. Although I have not found it possible during the time I have been in charge I consider it advisable to have the Alsi Bagh well put into working order so as to have a reserved supply in case of emergency.

Experiments and Acclimatisation: Pruning of fruit trees may perhaps rightly come under this heading as no proof appears to have yet been established as to which method should be adopted in this locality in pruning the various types of trees grown.

Winter pruning was commenced in December and different of which may be later on ascertained and noted in future reports to serve as useful records. Further trials were made with ring and shield budding of loquats and so far, that experimental evidence shows that a slightly higher percentage of success may occur by shield budding, whilst the former methods is likely to result in better unions. The budding undertaken during February and March has produced quick results and this is attributed to the fact that the budding wood is at this time of the year, in a more suitable condition and thereby justify the trials, which we have been and are now making on a large scale.

One dozen loquats in four varieties, imported from Australia, arrived in good condition, and upto date, have done well. As an experiment, seven varieties of

⁵⁹ Annual Report on Saharanpur and Dehra dun Gardens, 1925-26, P-29.

potatoes in small quantities, were obtained from Government Gardens, Chaubattia and planted out in the garden. The experiment is being made with a view to testing the value of these varieties for their yield and for producing an earlier crop than which is obtained from varieties usually grown in the plants.

The Lucerne crop, mentioned in last year's report as being on trial has upto the time of writing failed to produce seed. Very little has been done in acclimatising work and from the small selection of vegetable and flower seeds which was imported for trial several varieties totally failed in germination. The following may be mentioned as having done well and show promise of producing a fair amount of seed which should be given a second-year trial: Pea onward, Cauliflower Asiatic large late, Tomato Stirling Castle, and Cabbages are seldom known to seed at Saharanpur.

Referring to the more delicate seeds, the Glass House which is now being put into good repair should prove a useful structure in which proper attention can be given to such seed, thereby ensuring a more satisfactory germination.

Fruit Trees: The demand for oranges and peaches was considerably greater than the available supply and arrangements will consequently be made for propagating these plants in larger numbers. The sale of fruit trees amounted to Rs 6235/- as against Rs 6920/- of the previous year and the total propagated, which includes 20000 mango seedlings, is 43942 as against 28551 in the previous year. The mango crop is reported as having been below the average due largely to many of the trees having failed to produce flowers.

Vegetable Garden and Flower Garden: Referring to garden peas, acclimatised and imported seeds of two varieties have been grown side by side and the extent to which the former has degenerated during the course of 5 years is very obvious. To a lesser extent, degeneration is noticeable amongst other kinds of acclimatised vegetables and also flowers and in order to meet the demand for acclimatised seed of a good standard, importing new stock more frequently and careful supervision in the selection of stock seed will be essential.

Many new varieties of Cannas, Sweet peas, Chrysanthemum and Roses were obtained and added to the garden during the year and of such plants, the garden now contains good representative collections. Vegetable seeds, flower seeds and miscellaneous seeds collected during the year amounted to 1037 lbs., 49 lbs. and 732 lbs. respectively.

Ornamental Trees and Shrubs: Approximately 2627 flowering shrubs, decorative and ornamental trees were planted out in the Botanical Garden during the year and 38702 have been propagated. Considerable attention has been paid to the pruning, cleaning and through overhauling of the shrubberies, which work has considerably improved the appearance of the garden. Menuring and constant tillage in the rose section has also been carried out with beneficial results and in continuing this cultivation we hope to obtain much greater supply of bud wood for propagation purposes and so enable us to meet the demand for rose plants, which has, during the past year considerably exceeded the available supply. The valuation of trees has

been revised and is now based on the local value of the wood which has considerably reduced the total valuation placed on the trees in the previous year.⁶⁰

1926-1927

Character of the Season: Intense heat was experienced during May and June and the monsoons did not break till the 10th of July. The hail storm that occurred during March of 1926 badly affected the mango and other fruit crops, but still the season on the whole was favourable.

The total rainfall for the year was 30.31 inches compared with 42.25 inches of the previous year. Severe frost was experienced during the latter part of December. The highest temperature recorded was 115⁰ C and lowest 31⁰ C.

State of the Garden: On account of the late rains every Endeavour was made to protect the pot and newly planted plants from the hot winds and strong sun, which necessitated the use of the Oil Engine very often when canal water was not available with the result that casualties among the newly planted trees were fewer compared to other years. Supervision and careful attention were paid to the upkeep of the New Plantation and all the sections of the garden and certain improvements effected which were much marked in the flower garden.⁶¹

Irrigation: Two out of the three Tube Wells were worked very frequently and gave us good supplies of water in times of urgent need. The well at Alsi Bagh was tried once and the result was as reported in one of my letters. I have now come to know the cause of it not working properly and hope to get the defect fixed soon.

⁶⁰ Ibid, P-31-33.

⁶¹ Annual Report on Saharanpur and Dehra dun Gardens, 1926-27, P-47.

We still have to depend upon the Canal Department to supply us with the bulk of our water and with their charges increasing year by year it falls hard on our insufficient grant to meet these expenses. Another difficulty awaits us is that they are going to charge us by volume, which rate as worked out by the Executive Engineer will amount to almost double the sum we are already paying.

I have objected to the proposed rate of Rs 1/- per 5,000 gallons and requested that Rs 1/- per 10,000 gallons should be fixed, but the Chief Engineer Irrigation Branch replied that the rate proposed by him was quite sound.

It is not at all fair that the gardens which are situated at the very end of the supply should be made to pay by volume for the amount of water that is used, when the cultivators and others taking water from the same channel are charged on the area irrigated and at the rate of Rs 8/- per acre, whereas we are paying double these rates. Another great advantage the cultivator has is that his guls are at a lower level than ours, which facilitates his getting water quite easily from the main channel when the canal is open.⁶²

Experiments and Acclimatization: Many experiment dealing with propagation and pruning of broou, control of rungua and insects, office of artificial manuring and wood killers were tried and their Cronulta in noucaseumont beneficial. Further trials were mado with the budding of Loquat and Mangoon and out of 21 Ring Budded 12 were successful and out of 21 Shield Budded 14 books. Out of 55 Mangoonbuddod both in photo and in the ground Egret to say none were successful. We have now from our experiments with the Budding of Loquats found out the most

⁶² Ibid, P-49-50.

suitable time and best methods for the propagation of this most useful fruit on a commercial scale. Regarding Mangoes I still have hopes of meeting with success.

Pruning experiments on certain lines of Pears, Peaches and Plums were carried out and their result will be noted later.

A Lime Stock experiment has been started using six varieties of Limes with Malta and Santara Orange's being budded on each variety. A small plot of Ring budded, Shield budded and Inarched plants of Loquats were planted out under the same conditions in the Fruit Nursery and it will prove very interesting to note their development in view of our success with the propagation of these fruits by budding.

Spraying was tried to prevent the damage caused by Green Fly on Peaches. Two lines of 15 trees were sprayed. and the results are noticeable on the same of the trees, which are quite free. The curly leaf disease that often appears in early grown Tomatoes and which we are always troubled with, can I think be prevented by spraying with Potassium Sulphate three weeks before the appearance of the disease, as advised by Dr. Butler in one of his letters to the late Mr. Gollan in 1901, which I came across on looking up old records.

Specimens of diseased plants of Tomtots, Bans and Pees were sent to Cawnpore and Lyallpur for examination. but I regret to say that no satisfactory advice was received so to the case and remedy to control the trouble. An experiment on 8 varieties of Hill Potatoes grown under three different kinds of artificial manures has been tried and the result will be recorded when the potatoes are harvested. Different weed killers were tried to discover a cheaper method of keeping roads and paths free from weeds and the results in some cases have been good.

Fruit Nursery: The demand for fruit trees continues especially for Oranges, Loquats and Mangoes and if a larger stock of these were available we would have sold much more than what

we did this year. Arrangements are being made to work up a large and healthy stock of the fruit trees most in demand, as I regret to say that what remains of our present stock is very poor and not worth sending out. The sale from Fruit trees amounted to Rs. 7424/- against Rs. 6235/- of the previous year. 486 fruit trees were planted out in the gardens. The fruit crop was auctioned in December and fetched Rs. 1900/- the whole amount being realised at once and so avoiding any Risk likely to occur by the instalment system.

Vegetable and Flower Gardens: The usual vegetables and Annuals were grown with the addition of new kinds, some of which have seeded well and will take the place of some of our deteriorated acclimatised seed. Due to want of supervision and attention there have been a tendency during the past few years to grow and produce seed far above what is required approximately for sale. This I have gone into and curtailed the amounts usually sown.

The sale from Beede amounted to Rs. 2560/- and the following amounts of seeds were sold.

Table No. 1.13

Vegetable	466Lbs.
Flower	9 Lbs.
Miscellaneous	493 Lbs.

The total quantity collected during the year was as follows-

Table No. 1.14

Vegetable	458 Lbs.
Flower	71 Lbs.
Miscellaneous	492 Lbs.

Ornamental Trees and Shrubs: About 13,373 flowering shrubs, decorative and ornamental trees were propagated and 2532 planted out in the garden. 23599 were sold and Rs. 2557/- was

realized, an increase of Rs. 737/- compared to last year. All the shrubberies were attended to, pruned and forked up during the rains and cold weather; a start has been with the labelling of all the large and important trees in the garden and one section has been done.⁶³

3.3 Advocacy of Farmer

From ancient time India was agriculture based country, Farmers here are specialized in growing few crops namely wheat, rice, millet and barley lesser knowledge of season, pesticides and commercial crops are present among farmers. Farmers have to face many problems due to this little knowledge in which knowledge of prevention of crops from pests is also included, Farmers do irrigation of their fields through rainwater, underground water, river, ponds and puddle water. They don't have the organised knowledge of water conservation and management.

In north India during colonisation Britishers established Kolkata Botanical Garden and keeping in mind another Botanical Garden is also established namely Saharanpur Botanical Garden which includes Tropical plants conservation of species that are about to extinct, Boosting commercial crop and Tropical wood, More and more revenue generated crops are encouraged. In this direction export and import of various commercial and protected crops was done within different colonies.

Due to development of industrialization environment was vigorously destroyed and Britishers were condemned extremely so environment conservation is also a process in development of Botanical Garden. When the British saw that there is no immense rise in agriculture and revenue then they started providing agricultural training programme and information related to pesticides that is important to preserve commercial crops.

⁶³ Ibid, P-50-52.

Under which important programmes are given as below result on establishment of these institution were-

- According to the local geo-climate, making experiments/testing on different species of horticultural crops like fruits, vegetables, spices, flowers, etc., to make them available to the farmers.
- To provide information about newly developed horticultural techniques to the farmers through training.
- To solve the problems related to horticulture of the farmers in the laboratory and in the fields.

At present, various experiments and training and plant production programs are being implemented at the centre as follows-

3.3.1 Plant Production Program: In the two major nurseries established at the centre, about 35000 Kalmi plants of different species are being produced annually that includes mango litchi, peach, laucat and other ornamental/ornamental plants. It is worth mentioning that along with the prevalent Dussehri, Chausa, Lagdha, Amrapali, Stole and Ramkela of mangoes in Saharanpur division and surrounding areas (including Uttarakhand), there is a constant demand of farmers of the centre's litchi and Saharanpur Prabhat variety of potato. The fulfilment is being done by the Centre. Apart from this, the demand of Golden Yellow and Tanaka species of Loquat is also increasing continuously in the area, under which about seven to eight thousand plants are being produced annually and made available to the farmers.

3.3.2 Farmer Training Program: Under the training programs, every year about 1000 farmers selected in various horticultural development schemes run by the Centre under the State

Horticulture Mission, provide training to about 600 people of the area for two-day horticulture development training and 300 persons for mushroom production is done.

3.3.3 Research / Experimental Program: Newly developed production techniques of use in various horticultural crops and new species developed by various agricultural universities, by experiment and demonstration in the context of the geo-climatic of the area, and training their findings through dissemination to the farmers. 07 sections have been established at the centre, in which studies on the growth and productivity of hybrid varieties of mango in local condition by the Horticulture section and use of Peclobudrajal to prevent irregular fruit in mango, flowering and fruiting of Dehradun species of litchi by chemical section. Effect of zinc boric acid on bursting and fall and use of effect of organic cropping on Amrapali species of mango and punning and peach and peach in branches from December to January for different lengths for the control of floral gumma disease in Amrapali species of mango by mycology section. The study of the effect of litchiper organic home products has been a major program.

3.3.4 Operation of Farmers Club: Farmers Club of progressive gardeners is established in Saharanpur division. Three meetings of the club are organised in a year, in which the scientists of the centre are given detailed information on cropping and traction activities carried out in the orchards from time to time to get high quality results and to solve the problems of the gardeners.

3.3.5 Organising Flower Show: In order to increase the information and enthusiasm of the flower growers and the residents of the circle, every year in the month of February-March, the divisional flower and vegetable exhibition is organised by the centre.

3.3.6 Operation of the Garden Development Committee: Every day around 3500 to 4000 local citizens visit the centre premises in the morning and evening, for the development of whose

facilities, the cleaning of about 4 km of the excursion route of the centre is around it and about 5 acres of parks. Maintenance and maintenance work is done. A Horticulture Development Committee has been constituted under the chairmanship of the Divisional Commissioner for the development and maintenance of facilities like beautification of the centre premises.

Medicinal plants (Aloe vera, Sarpagandha, Shatavari, Kalmegh, Ashwagandha, Arjuna, Konch), **Ornamental plants** (Gold Mohar, Amaltas, Kurjia, Tikomastens, Jacaranda, Saptaparni, Ashokan, Harsingar etc.), **Ornamental shrubs** (Gudhal, Queen of the night, Jatropha, Chandni, Gandraj, Badi Champa, Cassiagalaka, Miniarecta, Duranta, Manokamni, Motia etc.), **Fruits, Flowers, Spinach and vegetable, boosting crops related to textile, Bee keeping section, boosting Horticulture**, Saharanpur Botanical Garden plays an important role.

Revenue earned from above mentioned programme and experiment are important medium of money earning and important to encourage economical condition of farmers. Saharanpur Botanical Garden was used for development more and more expansion of better and better commercial crop and Tropics wood useful plants. Hence, we can say that Saharanpur Botanical Garden plays an important role in encouragement of condition of farming and farmers in north India.⁶⁴

3.4 Uniqueness of Saharanpur Botanical Garden

In Saharanpur Botanical Garden world oldest tree Gao (*Diospyros embryopteris*) is present which is 7 million to 1 million years old. One of the world's largest greenhouses is present here which is very beautiful and adorable, One hump where timber wood related trees are available here. Hear Bee keeping section is also available. Here strawberries is developed and the

⁶⁴ Proposal to develop Horticulture Experiment and Training Centre, Saharanpur as "Center of Excellence in Food and Vegetable", 2015,p-4.

Dehradun tea orchard is also an origin of this botanical garden. Here a mango tree is also present in which 121 varieties of mango are planted through route stock method. Here 52 mango species are present from south India. Here a butterfly garden is also constructed whose area is spreaded around 16.188 meetre square where every year different varieties of butterfly migrated at specific season. At present, the facilities related to experiment training and production are available at the centre as follows-

3.4.1 Resources and Facilities available for Research/Experimentation and Training Programs:

For conducting research/experimental work at the centre, one laboratory each in the sections, namely, Fruit and Vegetable Section, Chemical Section, Insect Section, Biochemistry Section and Plant Disease Section, in this way a total of 05 laboratories are established, about 70 acres of land is available in the centre premises for various experimental works.

3.4.2 Resources and Facilities available for Farmer Training Programs:

3.4.2.1 Plantation Farm: In the main campus of the centre, various species of botanical medicinal and ornamental plants as well as various species of fruit trees like litchi, mango, guava, bael, pear, locat, jackfruit, jamun, tamarind, mulberry etc. Huge collection. In the Alsibagh field, mango chaunsa, Lagda, Dussehri, perennial species of Litchi, Calcutta, Shahi, Early Large Red, Allahabad Safeda L-49 of Guava, Peach and Plum orchards have been established. There are 05 tube wells, tractors and other agricultural implements for agricultural work for irrigation of the basic field of the centre.

3.4.2.2 Nursery: For the production of different types of fruit plants, ornamental plants and other ornamental plants, two nurseries are established at the centre as follows-

(a) Central Nursery: The area of Central Nursery is 15 acres. In this, quality saplings of various fruit trees like mango, guava, litchi, lemon, pear, jackfruit, pomegranate, and adu are prepared.

(b) Showroom Nursery: The area of the ornamental nursery is 15 acres. Plants of different types of seasonal and other flowers are prepared in this. There is also a collection of different species of roses in 5 acres under this nursery.

3.4.2.3 Plant Health Clinic: Under the State Horticulture Mission, a Plant Health Clinic is established at the centre to identify diseases, pests and problems related to soil fertility in horticultural crops, in which necessary technical advice is given to the farmers visiting the centre. And if required, the collected samples are tested in the clinic by experts during their field visits.

3.4.2.4 Silence Training Centre: A monastery of 52 Maunvansh is situated at the centre. One long term (three months), three short term (one and a half months) training programs are conducted by the Maun Palan Kendra in a year.

3.4.2.5 Meteorological Observatory: A weather observatory is established at the centre to collect meteorological data. In which equipment like Sunshine Recorder, Wind Van, Anemometer, Rain Gauge, Stevenage Screen etc. are available. The data received from this is sent to the Deputy Director General, Meteorology, Pune as well as made available to the local administration and farmers on demand.⁶⁵

The Royal Horticultural Society of England taught courses that were recognised all around the world. Plants such as papaya and locust were grown in India. The first 230 mango cultivars and three species were grown here.

⁶⁵ Proposal to develop Horticulture Experiment and Training Centre, Saharanpur as "Center of Excellence in Food and Vegetable", 2015, p-5.

Dr. Railey established a special department here in 1823, where plants were imported from all over the world and grown in accordance with the local environment. In India, papaya was found and developed.

The method of extracting seeds from cabbage was first discovered here. A Papain chemical element coming out of papaya was discovered here by Dr. L. B. Singh and patented. It was here that the invention of growing Locat on other plants took place. The old trees on both sides of the national highway were taken from here. The mahogany tree in Sardhana Church is also an invention of this. From here the distribution of plants across the country continued till 1870. During that time 17136 fruit trees and 56 thousand other trees were distributed from the company garden. Along with this 700 orchards were planted here within a radius of five miles. Strawberry was developed here and the tea gardens of Dehradun were also given here.

Seeing the inventions of the British rulers here, the Royal Horticultural Society, England started courses here in 1880 in Company Garden. Overseer (four years), Chowdhury (three years) and Mali (one year) courses were conducted, which were recognized all over the world. In 1880, Dr. J. S. Datthi sat here and wrote texts like Flora of Upper Gangetic Plain. After independence, in 1973, the state government changed its form and made it a major training centre. The world's largest glass house is still here.

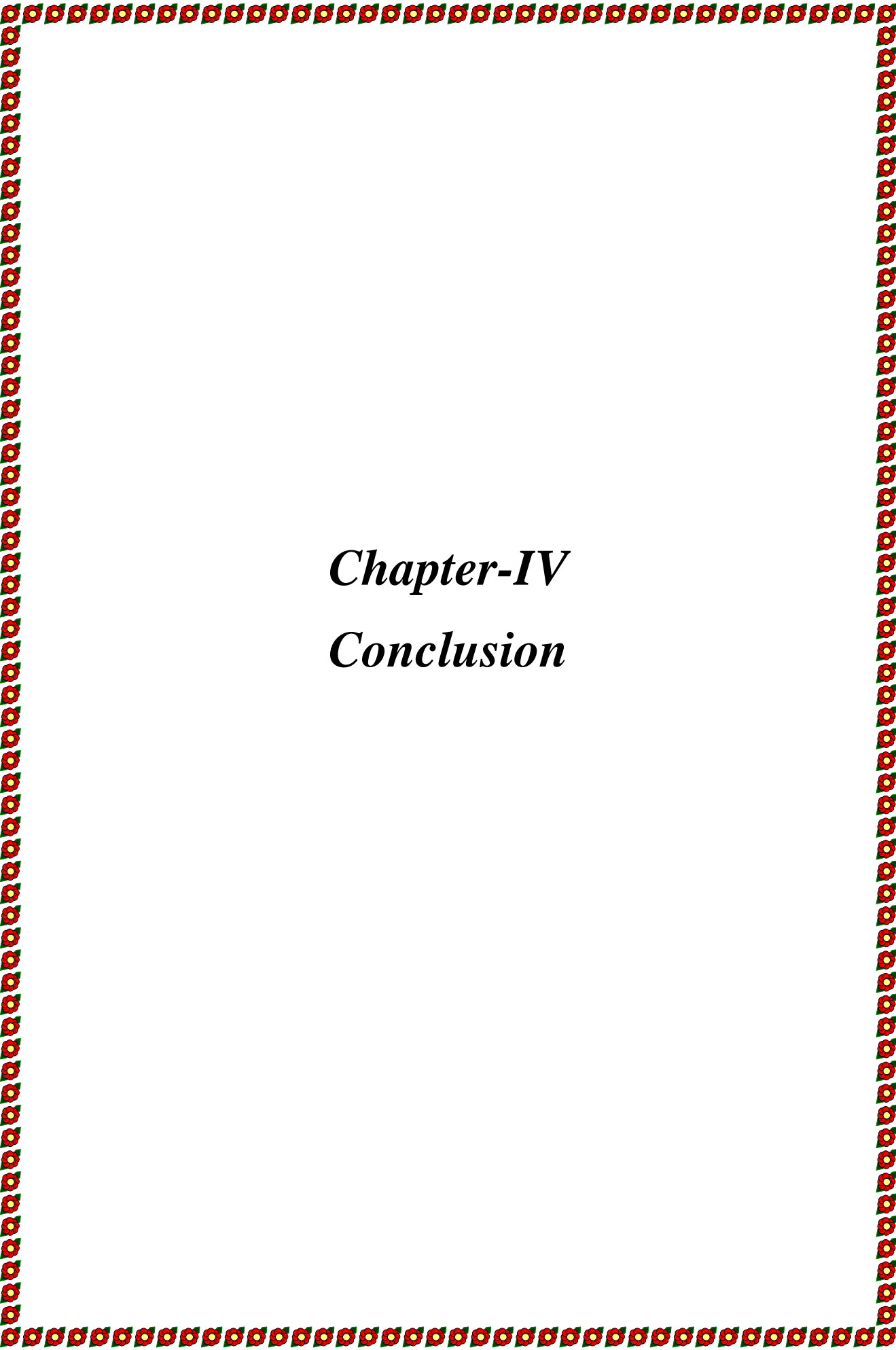
The modern tissue culture lab was built here in 1952, even today, there are 230 varieties of mangoes, and three species are present, in comparison to the advanced laboratories being built for research on tissue culture in the world today. It was here that they were invented. There are

also 16 varieties of guava and 15 varieties of litchi. The world's largest Locat collection is also near this company Bagh.⁶⁶

In the last half-century of the eighteenth century, various species of botanical plants were collected and created here, which are known as very valuable treasures in the present era, such as cinchona, tea, linseed etc. At that time, this botanical park has always maintained its national level and has been providing seeds, plants and scientific information for different types of trees and economic botany in all other states including its state. The entire area of 61.86 ha of this park is full of various trees, shrubs, vines and fruit plants, many of these trees are 100 to 200 years old. There are many such old trees of Mahogany, Teak and Eucalyptus which are of historical importance and are not available anywhere else. In 1950, research work on various aspects of horticultural crops was started at the centre and in the year 1974 this centre was transferred to the department after the formation of Horticulture Department.⁶⁷

⁶⁶Dainik Jagran, "Bemisalhai company baghke 269 saal", 11 July 2009, p-5

⁶⁷ Proposal to develop Horticulture Experiment and Training Centre, Saharanpur as "Center of Excellence in Food and Vegetable",2015,p-1.



Chapter-IV
Conclusion

Conclusion

The potential of botanic gardens as an outdoor learning centre is mainly determined by the content they emphasise and the kind of activities they present. Hence data collection consisted of a combination of theoretical and empirical methods. Content analysis and experimental study which are the most exact and difficult of all methods and most important from the strictly scientific point of view are the major techniques of research employed in the study.

Science is one of the manifestations of man's intellectual endeavours, and it has been linked to intellectual resurrection on numerous occasions. The Renaissance in Europe in the 16th and 17th centuries saw the birth of modern science. The works of Dutch naturalists from the 16th, 17th, and 18th centuries influenced modern botany in India. The English developed their "Flora Indica" in their own language during the nineteenth century. The seeds sown by Dutch workers in the 16-18th century flourished in the English period, i.e. the 19th to the first half of the twentieth century. The imprint of the West on the Indian psyche in the 16th and 19th centuries stimulated positive thinking and modernism.

Global botanical exchanges were much more a part of the quotidian life of people and cultures involved in remaking their landscapes and cultural practices in response to the rhythms of climatic and vegetation change, according to the history of global botanical exchanges. Botanical exchanges happened as a result of various combinations of land, coastal, and maritime human mobility. 'Seafaring and maritime exchange were more diversely composed of diffused networks of actors in communication across a variety of scales, rather than concentrated in the hands of a few significant players.

The colonial pursuit of products, money, and power around the world provided the institutional and ideological settings for the development and consolidation of botanical knowledge, even as the new science helped to expand the empires that had given rise to it. Nature, culture, and social structure are all concurrently and fluidly implicated in the development of scientific knowledge, as numerous researchers have argued.

It is critical for Great Britain to convert knowledge into profit power in order to grow their political authority and build a powerful trading power. Botanic gardens were one of the most important physical, intellectual, social, and cultural locations where colonial power was practically anchored. In the global unequal distribution of colonial interests, social structure and professional network entanglement, as well as union organisation, play a significant role in environmental history changes. Observation, analysis, and clarification are all part of environmental history. A wide range of players, amateurs and scientists, individuals and institutions, metropolitan and local, changed the same systems of society and knowledge that had enabled their action in the colonial context throughout the creation of modern botany.

Botanic gardens are commonly thought of as beautiful green sanctuaries filled with rare trees and flowers, complete with a laboratory where botanists investigate the mysteries of plant cytology, or, more recently, the ecology of the biosphere. But, like other institutions, botanic gardens adapted to the practical necessities and ethos of their cultural epoch, and botanic gardens enjoyed a period of great activity in support of Western colonial expansion. They improved the comparative advantage of the Western core of nations over the rest of the globe through the use of overwhelming power as well as scientific expertise. The coming together of science, capital, and political power has systemic consequences that we are still grappling with today.

European sciences were established to allow European empires to expand at the expense of those Europeans who came into contact with them, and the empires' continual expansion justified the continued exploitation of nature's resources. Naturalists who could witness flora "in the field" gave travellers' views more credibility, allowing them to depict the plants they found' and claim scientific authority over them. Linnaeus' classification system was regarded as the most efficient in these endeavours because it allowed scientists to disregard local culture and claim botany's natural and universal order of natural history and nature had previously been represented to conform to particular gendered notions of colonising social and economic systems. Instruments, books, maps, and tables are still used to bridge the gap between people (as subjects) and environment (as object). Linnaeus' classification system, as well as the botanical exploration that before and followed it, were instrumental in colonial conquest and served to cement gendered divisions in science and botany.

Such research into classification systems and scientific exploration is historiographically significant because it shows how the history of science, particularly botany, has risen from the margins of a historical field to take centre stage in critical historical processes like capitalist expansion, globalisation, and colonisation. Botanical exchange was thus a highly contested and complex procedure previously taken for granted in political analysis, and it provides a means of demonstrating insights into indigenous understandings of nature and worldviews before Western disciplinary specialisation took hold, especially in light of the current focus on these plants from the colonial world and their applications in pharmaceutical research, biotechnology, and other fields, as well as the possibility of demonstrating insights into indigenous understandings of nature and worldviews before Western disciplinary specialisation took hold .

An overarching concentration on European naming and colonisation continues to marginalise the colonial world, and international botany is still governed by politics rather than science. Botany "both facilitated and profited from colonialism and long-distance trade," but in light of current biotechnological efforts and international development practice, we need to dig deeper into the connections between botany, science history and classification, and European commercial and territorial expansion. Such research opens us new avenues for comprehending the natural and theoretical worlds, as well as science's preservation of gender, race, empire, and science ideologies that we often take for granted.

Botany became an important and strategic disciplinary topic in the 18th century, and it is fast growing towards professional conceptualization and applicability. The spread of new (economic) plants and their varieties in Europe and European colonies around the world was aided by advances in theoretical botany, particularly in terms of categorising, classifying, and denominating plants (taxonomy and nomenclature), as well as experimentation in botanists' cabinets and botanical gardens.

Botanical advances from the West and East Indies were investigated for their utility and adapted to the needs and values of contemporary civilization in Great Britain and the British Empire. The aim of botanical activity is not theoretical, but cultural, socioeconomic, commercial, and, eventually, colonial. During this time, botany rapidly changes towards the sub-type - and subsequently autonomous discipline - known as economic botany, in which plants are explored, studied, transferred, and exploited based on their potential uses, whatever they may be. Plants are grown in the colonies, and the crops are exported to be processed into food and medicinal medicines. Tea, coffee, chocolate, sugar, and cinchona were introduced to the market for their alleged medical and alimentary benefits, as well as to meet the wants of British genteel society.

Their commercial importance as cash crops became the focus of colonial ambitions, implying a significant effort to establish commercial monopolies: it is no coincidence that the British parliament passed a series of acts aimed at defining clear import-export rules, all of which are well documented in encyclopaedias, to protect any product.

As a result, British socio-cultural and national identity is moulded by economic factors and then reflected in British encyclopaedias: these reference works clearly reinforce and support societal habits and demands while also disseminating (useful) knowledge. Encyclopaedias are not only expressions of 18th-century values, but also commodities to be used by members of the polite society that favoured - and, in some ways, encouraged - their progress and cultural purpose.

By analysing this type of Date system, it is helpful in the nomenclature of these plants and in knowing the financial importance of plants included in research work. The main objective of this analysis is to identify the Role of Saharanpur Botanical garden in Environmental history. Effort was made in this research to find the importance and condition of the Botanical garden in Environmental History and to find Basic in methodology and facility in Tropic Botanical garden & research institutes.

The availability of plant systems is examined first by analysing the available secondary data. Several books in the areas of the plant diversity and conservation aspects of botanic gardens were critically analysed. Though the above analysis succeeded in establishing the nature and working of botanic gardens, Details were not available with the above data. When the earlier analysis was able to ascertain the general infrastructure facilities of each botanic garden, the analysis of the second set of parameters provided a clearer picture.

There are some parks where a wide spectrum of plants is displayed for the general public. Each botanic garden is unique and has a vital role to play in environmental history. They are important centres close to nature and to learn about plants. The medicinal value of the plant is also mentioned. Ayurvedic education and knowledge of making Ayurvedic medicines is also done through the Botanical Garden. Conservation of medicinal plants is to be addressed in a comprehensive way in order to strengthen the resource base of our traditional systems of medicine.

The evidence leads to the following findings. Through these, it helps to know the botanical, scientific and ecological aspects and dimensions of plants.

- plants which are medicinal

- plants which are culturally important

- rare and endangered plants

- structure variations in plants

- conservation aspects

- habitat and the need for its protection

Botanic gardens can be considered as a Learning Resource Centre with live examples. It is an Exploratory centre to facilitate the free flow of qualitative and quantitative information on all types of plants including economic plants. Moreover, it is a Learning laboratory that provides a framework for training in horticulture and tissue culture. Thus, botanic gardens can be considered as the Second biggest classroom in nature. Success depends on the unique

combination of facilities, opportunities, expertise and the link with other gardens. Moreover, modern botanic gardens have a role in society with new and extremely important elements in it. These include the "ex situ" maintenance of rare and endangered species, "in vitro" cultivation, field gene banks research on reproductive biology.

Economic importance, sustainable development and environmental education aspects of different groups like fruit trees, medicinal plants, bamboos, ornamentals etc. are to be explained within the framework of its ecological economic inter linkage and relationships. How each of these items sustain our ecological system and as a result how we can formulate a stable ecological base for economic development? Such questions will create awareness among the scholars to protect the entire system. Sustainable use of biodiversity requires the application of both traditional and modern knowledge of biodiversity and biological resources.

Thus, the Botanical Garden is the second largest class in nature. The Botanical Garden has a unique contribution to the environment, environmental history, science and environmental education. In this way, Botanical Gardens help to introduce researchers to local plants and thereby provide more information about the identification, use and economic value of more plants. And they also provide us information about medicinal properties of plants and commercially important plants. The Botanical Garden creates awareness about an entirely new world of nature that researchers were not aware of before.



Bibliography

Bibliography

Primary Sources

Annual Reports of Saharanpur Botanical Garden and others

- Annual Report Horticultural Research Institute Saharanpur, 1954-56.
- Annual Report Horticultural Research Institute Saharanpur, 1960.
- Annual Report Horticultural Research Institute Saharanpur, 1962.
- Annual Report Horticultural Research Institute Saharanpur, Dec. 1961.
- Annual Report on Saharanpur and Dehra dun Gardens, 1922-23, P-14.
- Annual Report on Saharanpur and Dehra dun Gardens, 1923-24, P-64.
- Annual Report on Saharanpur and Dehra dun Gardens, 1924-25, P-35.
- Annual Report on Saharanpur and Dehra dun Gardens, 1925-26, P-29.
- Annual Report on Saharanpur and Dehra dun Gardens, 1926-27, P-47.
- Annual Report on the Working and Administration of the Archaeological Gardens of United Provinces for the Year 1922-23.
- Annual Report on the Working and Administration of the Archaeological Gardens of United Provinces for the Year 1923-24.
- Annual Report on the Working and Administration of the Archaeological Gardens of United Provinces for the Year 1924-25.
- Annual Report on the Working and Administration of the Archaeological Gardens of United Provinces for the Year 1925-26.
- Annual Report on the Working and Administration of the Archaeological Gardens of United Provinces for the Year 1926-27.

- Annual Report (1985). Thiruvananthapuram: Tropical Botanic Garden and Research Institute. Jawaharlal Nehru Tropical Botanic Garden & Research Institute.
- Annual Report, (1986). Thiruvananthapuram: Tropical Botanic Garden and Research Institute. Jawaharlal Nehru Tropical Botanic Garden & Research Institute.
- Annual Report, (1991-1992). Thiruvananthapuram: Tropical Botanic Garden and Research Institute. Jawaharlal Nehru Tropical Botanic Garden & Research Institute.
- Annual Report, (2001-2002). Thiruvananthapuram: Tropical Botanic Garden and Research Institute. Place. Jawaharlal Nehru Tropical Botanic Garden & Research Institute.
- Extracts from the Saharanpur Garden Fodder Report, 1880-1891.
- Extracts from the Saharanpur Garden Improvements Report, 1875-1901.
- Extracts from the Saharanpur Garden Textiles Report, 1893-1909.
- Extracts from the Saharanpur Garden Vegetables Report, 1873-1888.
- Fruit Research Workshop Hyderabad for May, 24-28, 1976.
- General Administration Report for 1922-23, Horticultural Research Institute Saharanpur.
- General Administration Report for 1924-25, Horticultural Research Institute Saharanpur.
- General Administration Report for 1925-26, Horticultural Research Institute Saharanpur.
- General Administration Report for 1926-27, Horticultural Research Institute Saharanpur.
- Gernal Administration Report for 1923-24, Horticultural Research Institute Saharanpur.
- Govan to Dr. James Hare, April 18, 1816: N.A.I.
- Govan to Lushington, January 20, 1821. Home Department, Public Consultations. No. 60 of January 26, 1821: N.A.I.
- Govan to R. Grindall and T.P. Calvert, November I, 1816: N.A.I. National Archives of India, New Delhi.

- Government Secretary to Board of Commissioners, June 13, 1817: N.A.I.
- H. R. Nevill. (1909). *District Gazetteers for the United Provinces*, Vol. II, *Saharanpur* (1999), pp. 50-51.
- H. R. Nevill. (1909). *District Gazetteers for the United Provinces*, Vol. II, *Saharanpur* (1999), pp-1.
- H. R. Nevill. (1909). *District Gazetteers for the United Provinces*, Vol. II, *Saharanpur*, pp. 51-2. See also E.T. Atkinson, *Gazetteer North –Western Provinces of India*, Vol. II, *Meerut Division*, Part I (1875), pp. 17-15, for an earlier account of the Saharanpur gardens.
- H. R. Nevill. (1909). *District Gazetteers for the United Provinces*, Vol. II, *Saharanpur*, pp. 54-56.
- Home Department, Public Consultations, No. 25 of March 8, 1817: N.A.I.
- Home Department, Public Consultations, No. 3 of February 13, 1823:N.A.I. John Forbes Royle (1799-1858) was later Professor of Materia Medica at King’s College, London. His handsomely produced *Illustrations of the Botany and Natural History of the Himalayas Mountains* appeared in 1839.
- In 1906-7, over 17,000 fruit trees and 55,000 other plants as well as 9,500 lb. of seeds, were sold, yielding an approximate profit of Rs. 17,000: Nevill, *op. cit.*, 54.6.
- Order Book Government Garden Saharanpur from 1904-1905.
- Project Report on Establishment of “*Temperate Botanic Garden*”, for Directorate of Uttar Pradesh, Lucknow, U.P., 1989, P-10.
- Project Report on Establishment of “*Temperate Botanic Garden*”, for Directorate of Uttar Pradesh, Lucknow, U.P., 1989, P-34.

- Project Report on Establishment of “*Temperate Botanic Garden*”, for Directorate of Uttar Pradesh, Lucknow, U.P., 1989, P-39.
- Project Report on Establishment of “*Temperate Botanic Garden*”, for Directorate of Uttar Pradesh, Lucknow, U.P., 1989, P-42.
- Project Report on Establishment of Temperate Botanic Garden for Directorate of Environment. Government of Uttar Pradesh Lucknow, u. p., 1989, p. 8-10.
- Proposal to develop Horticulture Experiment and Training Centre, Saharanpur as "Center of Excellence in Food and Vegetable", 2015, p-1.
- Proposal to develop Horticulture Experiment and Training Centre, Saharanpur as "Center of Excellence in Food and Vegetable", 2015, pp-4.
- Proposal to develop Horticulture Experiment and Training Centre, Saharanpur as "Center of Excellence in Food and Vegetable", 2015, pp-5.
- Report on Agra Gardens for 1922-23.
- Report on Agra Gardens for 1923-24.
- Report on Agra Gardens for 1924-25.
- Report on Agra Gardens for 1925-26.
- Report on Agra Gardens for 1926-27.
- Report on Allahabad Gardens for 1922-23.
- Report on Allahabad Gardens for 1923-24.
- Report on Allahabad Gardens for 1924-25.
- Report on Allahabad Gardens for 1925-26.
- Report on Allahabad Gardens for 1926-27.
- Report on Chaubattia Orchards for 1922-23.

- Report on Chaubattia Orchards for 1923-24.
- Report on Chaubattia Orchards for 1924-25.
- Report on Chaubattia Orchards for 1925-26.
- Report on Chaubattia Orchards for 1926-27.
- Report on Kumaun Gardens for 1922-23.
- Report on Kumaun Gardens for 1923-24.
- Report on Kumaun Gardens for 1924-25.
- Report on Kumaun Gardens for 1925-26.
- Report on Kumaun Gardens for 1926-27.
- Report on Lucknow Gardens for 1922-23.
- Report on Lucknow Gardens for 1923-24.
- Report on Lucknow Gardens for 1924-25.
- Report on Lucknow Gardens for 1925-26.
- Report on Lucknow Gardens for 1926-27.
- Report on the Management of the Provincial and District Gardens in the Central Provinces for the year, 1905-1906.
- Report on the Management of the Provincial and District Gardens in the Central Provinces for the year, 1906-1907.
- Report on the Management of the Provincial and District Gardens in the Central Provinces for the year, 1907-1908.
- Report on the Management of the Provincial and District Gardens in the Central Provinces for the year, 1908-1909.

- Report on the Management of the Provincial and District Gardens in the Central Provinces for the year, 1909-1910.
- Report on the Management of the Provincial and District Gardens in the Central Provinces for the year, 1910-1911.
- Report on the Management of the Provincial and District Gardens in the Central Provinces for the year, 1911-1912.
- Report on the Management of the Provincial and District Gardens in the Central Provinces for the year, 1912-1913.
- Report on the Management of the Provincial and District Gardens in the Central Provinces for the year, 1913-1914.
- Report on the Management of the Provincial and District Gardens in the Central Provinces for the year, 1914-1915.
- Research Programmer of Horticultural Experiment and Training Centre, Saharanpur, 1990-1991.
- Saharanpur Garden Fruit Culture Report, 1883-1913.
- Saharanpur Garden Letter Collection, 1940-1946.
- Sixth Annual Report of the Indian Institute of Horticultural Research Hessargatta, Bangalore for the year 1st January, 1973-31stDecember, 1973.

News Paper

- Dainik Jagran, “Bemisalhai company baghke 269 saal”, 11 July 2009, pp-5.

Journals of Horticultural Advance of Saharanpur Botanical Garden

- Journals of Horticultural Advance, Vol. III, December, 1959.

- Journals of Horticultural Advance, Vol. IV, December, 1960.
- Journals of Horticultural Advance, Vol. V, December, 1961.
- Journals of Horticultural Advance, Vol. VI, December, 1962.
- Journals of Horticultural Advance, Vol. VIII, December, 1969-71.

Secondary Sources

- Ailene, L. & Julia, W. (1995) (Eds.), *Botanic gardens: Education for conservation*. Roots BGCi Education News letter December 1995, p. 184-190.
- Ailene, L. & Julia, W. (1995) (Eds.), *Botanic gardens: Education for conservation*. Roots BGCi Education News letter December 1995, p. 84-90.
- Andreeva, Alla & Parshin, Artyom. (1999). *Revitalising of educational activities in the oldest botanic garden of Russia*. In Lucy A Sutherland and T. K. Abraham (Eds.) (2001). *The power for change*. (pp.31-36) U.K: Botanic Garden Conservation International.
- Andreeva, Alla & Parshin, Artyom. (1999). *Revitalising of educational activities in the oldest botanic garden of Russia*. In Lucy A Sutherland and T. K. Abraham (Eds.) (2001). *The power for change*. (pp.31-36) U.K: Botanic Garden Conservation International.
- Axelby, R. (2008), *Calcutta Botanic Garden and the colonial re-ordering of the Indian environment*, *Archives of natural history* 35 (1): 150-163.
- Baber, Z. (2016) *The Plants of Empire: Botanic Gardens, Colonial Power and Botanical Knowledge*, *Journal of Contemporary Asia*, 46:4, 659-679.
- Balgooyen, W. & Avery, G. S. (1969). *Research and education at botanic gardens*. In James E. Gunckel (Ed.), *Current Topic in plant science* (p 262 -259). London: Academic Press Inc.Ltd.

- Balgooyen, W. & Avery, G.S. (1969). *Research and education at botanic gardens*. In James E. Gunckel (Ed.), *Current Topic in plant science* (p 262 -259). London: Academic Press Inc.Ltd, p. 119-150.
- Balick. M.J. (1986) *Botanic gardens and arboreta: Future directions*. New York: American association of botanic gardens and arboreta, p. 18-30.
- Ballantyne, R., Packer, J., & Hughes, K. (2008). Environmental awareness, interests and motives of botanic gardens visitors: Implications for interpretive practice. *Tourism management*, 29(3), 439-444.
- Bandopadhyay, A. (2010). The colonial legacy of forest policies in India. *Social Scientist*, 38(1/2), 53-76.
- Beinart, W., and Hughes, L. (2007). *Environment and Empire*, Oxford University Press. P. 1-60.
- Bhattacharyya, P. K. (1982) *Beginning of Modern Botany in India by Dutch in 16th-18th Century (Basic Features and Characteristics)*, Indian Journal of History of Science, Botany Department, Kalyani University Kalyani, pp. 17 (2): 365-376.
- Boden, R.W. & Boden, E.A. (1985) *Botanic Gardens and Community Education in Australia*. In D. Bramwell, O. Hamann V. Heywood (Eds.), *Botanic gardens and the World conservation strategy*. New York: Academic Press IUCN, 35-54.
- *Botanic Gardens and the World Conservation Strategy*. London: Academic Press. pp. 3-18.p-7.
- Boutler, D & Ansdel, S. (1987). Durham university botanic garden. In MP Nair (Ed.) *Net Work of botanic gardens*. (pp 33-35) Calcutta: Botanical survey of India.

- Bramwell, D. (1993) Botanical gardens and environmental education. In Julio D Rodrigo Perez (Ed.) *Cultivating green awareness* (p.15-18). Spain: Jardin BotanicoCanario.
- Bremmer, J. N. (2008). Chapter Three. The birth of Paradise. In *Greek Religion and Culture, the Bible and the Ancient Near East* (pp. 35-55). Brill.
- Brockway, L. H. (Aug.,1979), *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens*, Wiley on behalf of the American Anthropological Association, American Ethnologist, Vol. 6, No. 3, Interdisciplinary Anthropology PP. 449-465.
- Chakraborty, R. (2007). *Situating Environmental History*, Manohar, New Delhi, p. 10-83.
- Chakraverty, R. K. & Mukhopadhyay, D.P. (1990). *A directory of botanic gardens and parks in India*. (pp 10-12). Culcutta: Botanical survey of India.
- Chakraverty, R.K. & Mukhopadhyay, D.P. (1990). *A directory of botanic gardens and parks in India*. (pp 10-12). Culcutta: Botanical survey of India.
- Chanin, E. (2022). ‘The Attention of the Curious’: Robert Kyd and Cultivating Knowledge in Eighteenth-Century Bengal. In *Transnational Spaces of India and Australia* (pp. 159-177). Palgrave Macmillan, Cham.
- Colburn, T. C. (2012). Growing gardens: botanical gardens, public space and conservation, p. 6-12.
- Colburn, T. C. (2012). Growing gardens: botanical gardens, public space and conservation, P. 1-84.
- Connect (1992). *UNESCO UNEP Environmental education* News letter xvii, 4, p. 90-110.
- Correl, P. G. (1980). *Botanical garden and arboreta of North America: An organizational survey*. California. American Association of Botanical gardens & Arboreta Inc, p. 8-20, p. 30-50.

- Correl, P.G. (1980). *Botanical garden and arboreta of North America: Anorganizational survey*. California. American Association of Botanical gardens & Arboreta Inc, 120-154.
- Curtis, W. E. (1990). Glasgow Botanic Gardens: History and present day work in education and conservation. In. M.P. Nair (Ed.) *Net Work of botanic gardens*. (pp 129-134) Calcutta: Botanical survey of India.
- Dangwal, D. D. (2009). "Science Forestry and Sustainable Management of Forests in India: Myth and Reality", *Economic and Political Weekly*, p. 24-30, p. 54-65.
- Day, Jo. (2010). "*Plants, Prayers, and Power: the story of the first Mediterranean gardens*". In O'Brien, Dan (ed.). *Gardening Philosophy for Everyone*. Chichester: Wiley-Blackwell. pp. 65-78.
- Delumeau, J. (2000). *History of paradise: the Garden of Eden in myth and tradition*. University of Illinois Press, P. 3-88.
- Drayton, R. (2000). *Nature's Government Science, Imperial Britain, and the 'Improvement of the World*. London: Yale University Press. p-34.
- Drayton, R. (2000). *Nature's Government Science, Imperial Britain, and the 'Improvement of the World*. London: Yale University Press.p-43.
- Drayton, R. (2005). *Nature's Government: Science, Imperial Britain, and the Improvement of the World*, Orient Longman, New Delhi, p. 26-78, p. 83-124, p. 170-220, p. 221-269.
- Favretti, R. J., & DeWolf, G. P. (1971). Colonial garden plants. *Arnoldia*, 31(4), 172-255.
- Gadgil, M., & Guha, R. (1993). *This fissured land: an ecological history of India*. Univ of california Press, p. 1-67, p. 71-87, 113-172, p. 233-239.
- Ghosh, S. K., & Singh, R. (2003). *Social Forestry And Forest Management (2 Vols. Set)* (Vol. 1). Global Vision Publishing House, p. 51-131, p. 287-323.

- Grove, R., & Grove, R. H. (1996). *Green imperialism: colonial expansion, tropical island Edens and the origins of environmentalism, 1600-1860*. Cambridge University Press, p. 16-32, p. 47-59, p. 79-94, p. 95-133.
- Guha, R. (1993). "Writing Environmental History in India", *Studies in History*, Vol.9, No.1.4, pp.119-150.
- Guha, R. (1993). "Writing Environmental History in India", *Studies in History*, Vol.9, No.1.4, pp.119-150.
- Guha, R. (2000). *The unquiet woods: ecological change and peasant resistance in the Himalaya*. Univ of California Press, p.1-191.
- Guha, R., & Gadgil, M. (1989). State forestry and social conflict in British India. *Past & Present*, (123), 141-177.
- Habib, Irfan. (2010). Man, and Environment. *The Ecological History of India*, "A People's History of India", Vol. 36. New Delhi, p. 36- 45, p. 56-69, p. 80-110.
- Hastings, R. B. (1986). The Relationships between the Indian Botanic Garden, Howrah and the Royal Botanic Gardens, Kew in Economic Botany. *Nelumbo*, 28(1-4), 1-12.
- Heywood, V. H. (1987). *Changing role of botanic gardens*. In. D. Bramwell, O. Hamann & V Heywood (Eds.), *Botanic garden and the world conservation strategy*, New York: Academic Press, p. 28-40.
- Hill, A. W. (1915). The history and functions of botanic gardens. *Annals of the Missouri Botanical Garden*, 2(1/2), 185-240.
- Hill, Arthur W. (1915). "The History and Functions of Botanic Gardens". *Annals of the Missouri Botanical Garden*. 2 (1/2). 185-240.pp-219-223.

- Hill, Arthur W. (1915). *"The History and Functions of Botanic Gardens"*. *Annals of the Missouri Botanical Garden*. p-190-197.
- Hill, Arthur W. (1915). *"The History and Functions of Botanic Gardens"*. *Annals of the Missouri Botanical Garden*. p-200.
- Hill, Arthur W. (1915). *"The History and Functions of Botanic Gardens"*. *Annals of the Missouri Botanical Garden*. p-222.
- Holmes, E. M. (1906). *"Horticulture in Relation to Medicine"*. *Journal of the Royal Horticultural Society*. p-49-50.
- Hughes, J. D. (2001). *An Environmental History of the World*, Routledge, New York, p. 1-84, p. 268-278.
- Hyde, H. M. (1962). Dr. George Govan and the Saharanpur botanical gardens. *Journal of the Royal Central Asian Society*, 49(1), 47-57.
- Iqbal, I. (2008). *Forest Ecology in India. Colonial Maharashtra 1850-1950*, p. 334.
- Jones, D. S. (1998). The Penang Botanic Gardens, 1794–1905: the design and development of a tropical botanic garden. *Studies in The History of Gardens & Designed Landscapes*, 18(2), 145-160.
- Kumar, D. (1997). *Science and the Raj*. New Delhi: Oxford University Press, p. 1-115, p. 152-263.
- Kumar, V. M. (2017). *"History of Environmental History of India: A Historiographical Review," The Research Journal of Social Sciences*, Vol. 8, No. 12, pp. 63-70.
- Kumar, V. M. (2017). *"History of Environmental History of India: A Historiographical Review," The Research Journal of Social Sciences*, Vol. 8, No. 12 , pp. 63-70.

- Kutcherov, E. V. (1990). Botanic Gardens in the southern urals. In MP Nair (Ed.) *Net Work of botanic gardens*. (pp. 135-138) Calcutta: Botanical survey of India.
- Law, S. (2007). Liverpool/Calcutta Exchanges: William Roscoe's Reappraisal of the First Linnaean Order of Plants. *Garden History*, 180-196.
- Leadlay, E. (1993). *Mission statements of corporate strategies and networks for botanic gardens*. In Anonymous (Ed.) (1997). *Teaching about plants Everywhere*. India: Zoo outreach Organisation, p. 106-130.
- Linares, E. (2001). *Traditions and medicinal plants: A valuable field of knowledge and a great challenge for science*. In Lucy A Sutherland and T. K. Abraham (Eds.). *The power for change*. (pp 171-176), U.K: Botanic Garden. Conservation International.
- Linares, E. (2001). *Traditions and medicinal plants: A valuable field of knowledge and a great challenge for science*. In Lucy A Sutherland and T. K. Abraham (Eds.). *The power for change*. (pp 171-176), U.K: Botanic Garden. Conservation International.
- Lonati, di Elisabetta. (2013), *Plants from Abroad: Botanical Terminology in 18th-century British Encyclopaedias*, Università degli Studi di Milano, pp. 20-38.
- Lucy Sutherland & Julia Willison (2000). *Botanic gardens: Education for Sustainability*. *Roots*. BGCi Education Review. July 2000, p. 10-18, p. 31-45.
- Malik, V. *Trees and Shrubs of Saharanpur*, Botanical Garden, India, p. 10.
- McNeill, J. R. (2001). *Something New Under the Sun: An Environmental History of the Twentieth-Century World (the global century series)*, W. W. Norton & Company, p. 3-116, p. 118-357.
- McNeill, J. R. (2003). "*Observations on the Nature and Culture of Environmental History*", *History and Theory*, Vol. 42, No. 4, pp. 5-44.

- McNeill, J. R. (2003). "*Observations on the Nature and Culture of Environmental History*", *History and Theory*, Vol. 42, No. 4, pp. 5-44.
- McNeill, J. R. (2010). *Environmental History: As if Nature Existed*, Oxford University Press, New Delhi, p. 6-75.
- Meeker, N., & Szabari, A. (2019). *Radical botany: Plants and speculative fiction*. Fordham University Press, p. 1-177.
- Merchant, Carolyn, M, McNeill, J. R., and Krech, S. III. (2004). *Encyclopaedia of world environmental history*, Routledge, New York, p. 416-418.
- Moller, J. D. (1987). Botanical Gardens in Copenhagen. In M P Nait (Ed.) *Net Work of botanic gardens*. (pp. 36-37) Calcutta: Botanical survey of India.
- Nair, Chithra (1998). *Development of certain models for creating awarness of environmental protection among the secondary school children of Kerala*. Ph.D. Thesis, University of Kerala, p. 145-164.
- Nature Publising Group, February 6, 1932, p-190.
- Nature Publising Group, February 6, 1932, p-191.
- Neuman, E. A. (1987). Washington's hidden treasure The US National arboretum. In. M.P. Nair (e.d) *Net Work of botanic gardens*. Calcutta: Botanical survey of India pp 113-119.
- Noltie, H. J. (2017). *Botanical Art from India: The Royal Botanic Garden Edinburgh Collection*. Edinburgh: Royal Botanic Garden Edinburgh, p. 1-40.
- O'Donnell, R. (June 2010). *Imperial Plants: Modern Science, Plant Classification and European Voyages of Discovery*, Graduate Journal of Social Science, Vol. 7, pp. 59-72.
- Palmer, J. & Neal, P. (1994). *The handbook of environmental education*. London: Routledge, p. 54-70.

- Pushpangadan, P. (1994). *Conservation biology and role of botanic garden in conservation of rare and endangered plants*. In Suhirman et.al. (Eds.). *Strategy for flora conservation in Asia* (pp. 99-106). Indonesia: Kebun Raya Boger.
- Pushpangadan, P. (1994). *Conservation biology and role of botanic garden in conservation of rare and endangered plants*. In Suhirman et.al. (Eds.). *Strategy for flora conservation in Asia* (pp. 99-106). Indonesia: Kebun Raya Boger.
- Radkau, J. (2008). *Nature and Power: A Global History of the Environment*, trans. *Thomas Dunlap* (New York: Cambridge Univ. Press, 2008), 152-94.
- Rajan, S. R. (2006). *Modernizing nature: forestry and imperial eco-development 1800-1950*. Oxford University Press, p1-199.
- Rangan, H., Carney, J., & Denham, T. (2012). Environmental history of botanical exchanges in the Indian Ocean World. *Environment and History*, 18(3), 311-342.
- Rangarajan, M and Sivaramakrishnan, K. (2014). *Shifting Ground: People, Animals, and Mobility in India's environmental history*, Oxford University Press, p. 10-84.
- Rangarajan, M. (1996). Fencing the Forest: Conservation and Ecological Change in India's Central Province, 1860-1914, p. 1-160.
- Rangarajan, M. (1996). Environmental histories of South Asia: a review essay. *Environment and History*, 2(2), 129-143.
- Roguet, D. J. (1999), *Ethnobotany, the scientific vector in education for conservation*. In Lucy A Sutherland and T. K. Abraham (Eds.) (2001). *The power for change*. (pp. 237-244) UK: Botanic Garden Conservation International.

- Roguet, D.J. (1999), *Ethnobotany, the scientific vector in education for conservation*. In Lucy A Sutherland and T. K. Abraham (Eds.) (2001). *The power for change*. (pp. 237-244) UK: Botanic Garden Conservation International.
- Rokaya, M. B., Münzbergová, Z., Timsina, B., & Bhattarai, K. R. (2012). *Rheum australe* Don: a review of its botany, ethnobotany, phytochemistry and pharmacology. *Journal of Ethnopharmacology*, 141(3), 761-774.
- Ronald, K. (1979). *Great gardens of the world*. London: Peerage books. p.11.
- Sabata, B. C. (1997). *Biodiversity and its importance towards protecting the Planet*. In. S. P. Shukla, N. Sharma & B. C. Sabata. *Planet protection*. (p.77-79). New Delhi: Mittal Publications.
- Sabata, B.C. (1997). *Biodiversity and its importance towards protecting the Planet*. In. S. P. Shukla, N. Sharma & B. C. Sabata. *Planet protection*. (p.77-79). New Delhi: Mittal Publications.
- Saikia, A. (2011). *Forests and ecological history of Assam, 1826–2000*. Oxford University Press, p. 1-167.
- Sangwan, S. (1988). Indian response to European science and technology 1757–1857. *The British Journal for the History of Science*, 21(2), 211-232.
- Sarton, G. (1952). *Ancient Science Through the Golden Age of Greece*. Dover classics science and mathematics. Dover Publications, p-556.
- Schotz & Bogner, (1987) Munich botanical garden. In M.P. Nair (ed.) *Net work of botanic gardens*. Calcutta: Botanical survey of India. pp. 38-57.
- Sen, S. (2010). “Scientific enquiry in agriculture in Colonial India”: A History Perspective, *Indian Journal of History of Science*, Vol. 45(2), p. 1-65, p. 66-90.

- Shenk, Anne. & Ceska, Jennifer. (2001). *The green plant blues: Engaging students in science inquiry while encouraging a conservation ethic*. In Lucy A Sutherland and T. K. Abraham (Eds.) 2001, *The power for change*. (pp 245-252) U.K: Botanic Garden Conservation International.
- Shenk, Anne. & Ceska, Jennifer. (2001). *The green plant blues: Engaging students in science inquiry while encouraging a conservation ethic*. In Lucy a Sutherland and T.K. Abraham (Eds.) 2001, *The power for change*. (pp 245-252) U.K: Botanic Garden Conservation International.
- Sheshan, S. (1999). *School in the forest-Educating the young at the gurukula botanical sanctuary*. In Lucy A Sutherland and T. K. Abraham (Eds.). 2001. *The power for change*. (pp 157-164) U.K: Botanic Garden Conservation International.
- Sheshan, S. (1999). *School in the forest-Educating the young at the gurukula botanical sanctuary*. In Lucy A Sutherland and T. K. Abraham (Eds.). 2001. *The power for change*. (pp 157-164) U.K: Botanic Garden Conservation International.
- Simmons, I. G. (2008). *Global Environmental History: 10,000 BC to AD 2000: 10,000 BC to AD 2000*, Edinburgh University Press, Edinburgh, 1-245.
- Sinha, S, Gururani, S and Greenberg, B. (1997). "*The New Traditional Discourse of Indian Environmentalism*," *The Journal of Peasant Studies*, Vol, 24, pp. 65-99.
- Sinha, S., Gururani, S and Greenberg, B. (1997). "*The New Traditional Discourse of Indian Environmentalism*," *The Journal of Peasant Studies*, Vol, 24, pp. 65-99.
- Sivaramakrishnan, K. (1995). "*Colonialism and Forestry in India: Imaging the Past in Present Politics*" *Comparative Studies in Society and History*, Vol.37, No.1.4, pp.3-40.

- Sivaramakrishnan, K. (1995). "Colonialism and Forestry in India: Imaging the Past in Present Politics" *Comparative Studies in Society and History*, Vol.37, No.1.4, pp.3-40.
- Sivaramakrishnan, K. (2009). "Forests and Environmental History of Modern India," *The Journal of Peasant Studies*, Vol. 36, pp. 299-324.
- Sivaramakrishnan, K. (2009). "Forests and Environmental History of Modern India, " *The Journal of Peasant Studies*, Vol. 36, pp. 299-324.
- Spencer, R., & Cross, R. (2017). The origins of botanic gardens and their relation to plant science, with special reference to horticultural botany and cultivated plant taxonomy. *Muelleria*, 35, 43-93.
- Steere, W. C. (1969). *Research and education at the New York Botanic Gardens*. In James E. Gunckel (Ed.) *Current Topics in plant science*, London Academic Press Inc. Ltd, p.115-130.
- Stirton, C. (1998) *Education for sustainability A garden for a sustainable future*. *Roots*. (Dec) pp 38-41.
- Swaminathan, M. S. (1989) Foreward - *The botanic gardens conservation strategy 1989*. Cited in Anonymous (1997). *Teaching about plants everywhere*. India: Zoo Outreach Organisation, 25-40.
- Tani, K. (1997). *Decaying biosphere and its conservation*. In SP Shukla, N. Sharma & BC Sabata, *Planet protection*. (p.215-218). New Delhi: Mittal Publications.
- Tani, K. (1997). *Decaying biosphere and its conservation*. In SP Shukla, N. Sharma & BC Sabata, *Planet protection*. (p.215-218). New Delhi: Mittal Publications.
- Tarbox, G. L. & Salmon, R. (1987). Brookgreen Garden: A society for Southeastern flora and fauna. In. M.P. Nair (ed) *Net Work of botanic gardens*. (pp 98-102) Calcutta: Botanical survey of India.

- Taylor, P. (2006). *The Oxford Companion to the Garden*. Oxford: University Press.p-57.
- Thacker, C. (2016). *The wildness pleases: The origins of romanticism*. Routledge. P. 12-13.
- Thaha, S. A. (2009). *Forest policy and ecological change: Hyderabad state in colonial India*. Cambridge India, p. 1-80.
- Toby Evans, Susan. (2010). "*The Garden of the Aztec Philosopher-King*". In O'Brien, Dan (ed.).*Gardening Philosophy for Everyone*. Chichester. Wiley Blackwell pp. 207-219.
- Torre, E. V. (1993). La educación en los jardines botánicos de la AIM. JB, España. In Julio D Rodrigo Perez (Ed.), *Cultivating green awareness*. (pp.19-28) Spain: Jardín BotánicoCanario.
- Torre, F. V. (1993). La educación en los jardines botánicos de la AIM. JB, España. In Julio D Rodrigo Perez (Ed.), *Cultivating green awareness*. (pp.19-28) Spain: Jardín BotánicoCanario.
- Tucker, R. (2012). *A Forest History of India*, Sage Publications, p. 1-130.
- Tucker, R. P. (2011). *A forest history of India*. SAGE Publishing India, p. 1-50.
- Vijai, M. (2015). A checklist of grasses (Poaceae) of Saharanpur forest division. *Indian Journal of Fundamental and Applied Life Sciences*, 5(2), 74-80.
- Wallich and Boulger, S. (1931). *British and Irish Botanists*, ED. A .B.Rendle, at p. 127.
- Walter, K. S., & Gillett, H. J. (Eds.). (1998). *1997 IUCN red list of threatened plants*. IUCN, P. 1-175.
- Williams, R. L. (2011). "*On the establishment of the principal gardens of botany: A bibliographical Jean-Phillipe-Francois essay by Deleuze*". *Huntia*. P-147-176.

- Willison, J. & Green, J. (1994). *Environmental education in botanic gardens: Guidelines for developing individual strategies*. UK: Botanic Garden Conservation International (BGCI), 10-76.
- Willison, J. (1993). *An environmental education strategy for botanic gardens*. In Julio D. Rodrigo Perez (Ed.), *Cultivating Green Awareness*. Lass Palmas: Jardin BotanicoCanario, p. 10-80.
- Willison, J. (1993). *An environmental education strategy for botanic gardens*. In Julio D. Rodrigo Perez (Ed.), *Cultivating Green Awareness*. Lass Palmas: Jardin BotanicoCanario, p. 1-30.
- Young, M. (1987). *Collins Guide to the Botanical Gardens of Britain*. London:Collins, p-7.

Books and Research Articles

- Abraham, Mercy & Nair, Chitra (1998). Secondary school students' attitude towards environmental protection: Differential effect of gender and locale. *Pedagogics (Journal of Schools of Pedagogical Sciences)*, 1 (1), 27-31.
- Agarwal, A. (2006). *Environmentality: Technologies of Government and Making is*, Oxford University Press, New Delhi.
- Agarwal, H. O. (1999). *International law and human rights* (p.562). Allahabad: Central law publications.
- Agarwal, Y.P. (1993). *New dimensions in education* (p.284). Kurukshetra! Kurukshetra University Ailene, I. & Julia, W. (1995) (Eds.), *Botanic gardens: Education for conservation*. Roots BGCi Education News letter December 1995.
- Alam, A. (2007). *Becoming India: Western Himalayas under British Rule*, Cambridge University Press, New Delhi.

- Ali, Imam. (1988). *The Punjab under Imperialism, 1885-1947*, Princeton University Press, Prince-ton.
- Almond, Eve. (1993). Changing images. In Julio D. Rodrigo Perez (Ed.) *Cultivating green awareness* (pp.65-68) Spain: Jardin BotanicoCanario-Vieray Clavijo.
- Amakye, S. O. (1993). Sacred groves. The forgotten traditional botanical gardens in Tropical Africa. In Julio D. Rodrigo Perez (Ed.) *Cultivating green awareness* (pp.53-57) Spain: Jardin BotanicoCanario-Vieray Clavijo.
- Ambika. (1993). Potentialities of field trip for learning Biology of standard IX.M.Ed. thesis, University of Kerala, Trivandrum.
- Amold, D. (1982). "Rebellious Hillman;" *The Gudem-Rampa Raisings*", in Guha Ranajit, *Subaltern Studies: Writings on South Asian History and Society*, Vol. 1, Oxford University Press, New Delhi.
- Amold, D. (1994). The colonial prison: power, knowledge and penology in nineteenth century India. *Subaltern Studies VIII: essays in honour of Ranajit Guha*, pp. 148-187.
- Amold, D. (1996). *The Problem of Nature Environment, Culture and European Expansion*.
- Amold, D. and Guha, R. (1996). (ed.), *Nature, Culture, Imperialism: Essays on the Environmental History of South Asia*, Oxford University Press, New Delhi.
- Amold, D., & Hardiman, D. (Eds.). (1994). *Subaltern Studies: Essay in Honour of Ranajit Guha*, Vol. 8, Oxford University Press.
- Anderson, M. R. (1996). *The Conquest of Smoke. Legislation and Pollution in Colonial Calcutta*.

- Andreeva, Alla & Parshin. Artyom. (1999). Revitalising of educational activities in the oldest botanic garden of Russia. In Lucy A Sutherland and T. K. Abraham (Eds.) (2001). The power for change. (pp.31-36) U.K: Botanic Garden Conservation International.
- Andrews, Michael D. (1978). The inter-relationship among the cognitive, affective and the behavioural domains in outdoor environmental education program, Dissertation Abstracts International, p. 3493-A.
- Ansari, R. (2000). Malabar botanical garden society. STEC review (1999-2000), Govt. of Kerala, p. 27.
- Arenson, Lauren J. (1996). An assessment of zoo reach program as a model for the development of informal education programs. (Ph.D. thesis, University of Southern California). Dissertation Abstracts International, 57(2), 1996,p.627.
- Atwal, A.S. (1980). Environmental education for India A proposed plan. In Trilochan S Bakshi & Zev Naveh (Eds.). Environmental education: Principles methods and applications. New York: Plenum Publishing Corporation.
- Backman, S.J. & Crompton, J.L. (1984). Education and experiences contribute to cognitive development. Journal of Environmental Education, 16(2), 4-14.
- BakicK, M.J. (1986). Botanical gardens and arboreta: Future directions. New York: American Association of Botanic Gardens and Arboreta.
- Balasubramaniam, S & Fonseka, R.N. (1987). Opportunities and constraints for training ecologists and environmental scientists in Sri Lanka. In DeshBandhu & G. Berberet (Eds.). Environmental education for conservation and development. New Delhi: Indian environmental society. pp.100-103.

- Balgooyen, W. & Avery, G.S. (1969). Research and education at botanic gardens. In James E. Gunckel (Ed.). *Current Topic in plant science* (p 262-269). London: Academic Press Inc.Ltd.
- Bandhopadhyay, J and Shiva, V. (1988). "Political Economy of Social Movements", *Economic and Political Weekly*, Vol.23, No.24, pp. 1223-1232.
- Bandhu, D. (1987). Introduction. In D. Bandhu& G. Berberet. (Eds.), *Environmental education for conservation and development*. New Delhi:Indian Environmental Society.
- Barry, G. J. (2010). "Environmental History: Methods, Research, and Practice" *Education and Human*
- Barthakur, S. K. Jain. S. K. (1979) Botanical aspects of some traditional medicines among the Nikire of Assam. *The Journal of the Indian Botanical Society*,58, 113.
- Bartlemus, P. (1994). *Environment growth and development: The concepts and strategies of sustainability*. London: Routledge.
- Barton, G.A. (2002). *Empire Forestry and the Origins of Environmentalion*, Cambridge University Press, Cambridge.
- Bateson, G. (2000). *Steps to an Ecology of Mind: Collected Essays in Anthropology. Psychiatry, Evolution, and Epistemology*. University of Chicago Press.
- Bawa, R. & Singh, R (1987). Heritage conservation of natural protected area. In D. Bandhu& G. Berberet. (Eds.) *Environmental education. for conservation and development*. New Delhi: Indian Environmental Society.
- Beinart, W and Coates, P. (1995). *Environment and History: The Taming of Nature in USA and South Africa*, Rutledge, London.
- Bennett, Brett. (2011). "A Global History of Australian Trees", *Journal of the History of Biology*, Vol-40, pp. 125-145.

- Bhandary, B. S., Mehta, J. P., Nautiyal, B. P. and Tewari, S. C. (1997). Structure of a chir pine (*Pinus roxburghii*Sarg.) community along an altitudinal gradient in Garhwal Himalayas. *International Journal of Ecology and Environmental Science*, Vol-23, No.1, pp. 67-74.
- Bhargava, G. (1992). *Environmental challenges and ecological disaster*, Mintal Publications, New Delhi.
- Bhargava, M. (1999). *State, Society and Ecology. Gorakhpur in Transition, 1750-1830*, Manohar, Delhi.
- Bin, A. H. (1993). The perceptions of grade 6 school teachers regarding the status of Alam Dan Manusia (Man and Environment) in primary school curriculum in Sabah, Malaysia. *Dissertation Abstracts International Vol. 54*, (p.136-A).
- Binu, T. (1997). An investigation into the curricular potentials of select plants bearing commercially important flowers for the study of certain major concepts in Botany at B.Se level. M.Ed. thesis, University of Kerala, Thiruvananthapuram.
- Biswas, M.R & Biswas A.K. (1987). Global environmental trends. In DeshBandhu& G. Berberet (Eds.). *Environmental education for conservation and development* (pp. 100-103). New Delhi: Indian environmentalsociety.
- Blum, A. (1982). Assessment of subjective usefulness of an environmental science.curriculum. *Science Education*, No 1, 66, 25-34.
- Boden, R.W. & Boden, E.A. (1985). Botanic Gardens and Community Education in Australia. In D.
- Boutler, D &Ansdel, S. (1987). Durham university botanic garden. In M P Nair (Ed.) *Net Work of botanic gardens*. (pp 33-35) Culcutta: Botanical survey of India.

- Bradley, J. (1995). Experimental evaluation of an environmental science curriculum and its effects on Texas secondary school students environmental knowledge. And attitudes, Ph.D dissertation, Texas A&M University. Dissertation Abstracts International, 57 (1), 1996 pp. 84.A-85 A.
- Bramwell, D. (1993). Botanical gardens and environmental education. In Julio D Rodrigo Perez (Ed.), *Cultivating green awareness* (p.15-18). Spain: Jardin BotanicoCanario.
- Bramwell, David (1993) Botanical gardens and environmental education. Julio D Rodrigo Perez (Ed.) *Cultivating green awareness* (p.15-18). Spain: Jardin BotanicoCanario.
- Bramwell, O. Hamann V. Heywood (Eds.), *Botanicgardens and the World conservation strategy*. New York: Academic PressJUCN.
- Branch, C. (1983). A developmental study in earth and environmental science education with junior high school students: The study of a local stream and science related community problems. Dissertation Abstracts International pp. 1407-A-1408-A.
- Brandis, D., cited in R. Guha. (1990). "An Early Environmental debate: The making of the 1878 Forest Act', *The Indian Economic and Social History Review*, Vol-27, No.1.
- Brandis, S. D. (1994). *Forestry in India: Origins & Early Developments*. Natraj Publishers.
- Braudel, F., & Wallerstein, I. (2009). *History and the social sciences: the longue durée*. Review (Fernand Braudel Center), pp. 171-203.
- British Government Panel on Sustainable Development (1995). *First Report*. Cited in Sutherland, Abraham & Thomas (Eds.) (2001), *The Power for Change*(p. 86) Richmond, UK: BGCI.

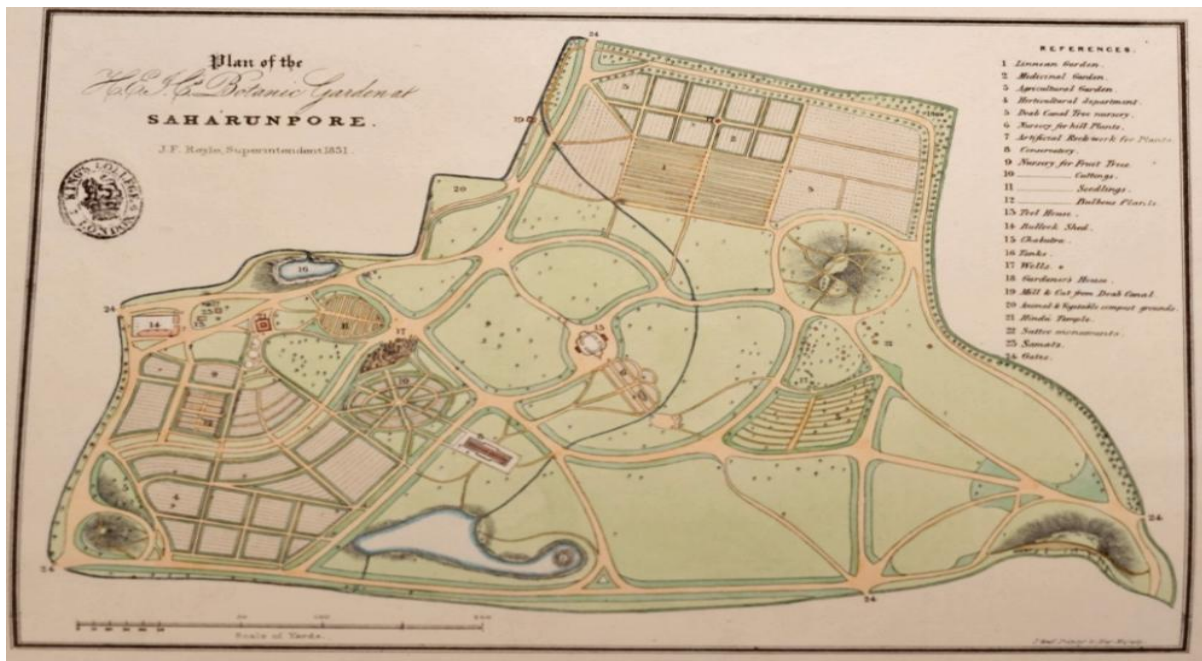
- Brooking, T. (2009). "Green Scots and Golden Irish': The environmental impact of Scottish and Irish Settlers in New Zealand: Some Preliminary Ruminations", *Journal fish & Scottish Studies*.
- Brooking, T., & Pawson, E. (2010). *Seeds of Empire: The Environmental Transformation of New Zealand*, Vol. 4. IB Tauris.
- Brower, J. (2000). Practices are not without concepts Reflections of the use of indigenous knowledge in artisanal and agricultural projects in India. *Journal of Social Science*, 4 (1), 1-9.
- Bukinshaw, (1997). Indian botanic gardens and plant conservation. In Anonymous (ed.) *Teaching about plants Everywhere India: Zoo Outreach Organisation / CBSG*.
- Carr, E. H. (2018). *What is History?* Penguin UK.
- Carson R. (1962), *Salient Spring*, Houghton Mifflin., Boston.
- Carson, R. (1962). *Silent spring*. London: Penguin.
- Carson, R. (2002). *Silent spring*. Houghton Mifflin Harcourt.
- Cederlof, G.(2005). "The Agency of the Colonial Subject Claims and Rights in Forest Lands in the Early 19th Century Nilgiris', *Studies in History*, Vol. 21, No.2, June December.
- Chakrabarti, R. (Ed.). (2006). *Does Environmental History Matter? Shikar. Subsistence, Sustainance, and the Sciences. Readers Service.* . Chakraborty, Ranjan (2009). *Situating Environmental History*, Delhi.
- Chakraborty, R. (2002). *Situating Environmental History*, Manohar, New Delhi.
- Chakravarthy, R.K. and Mukhopadhyay, D.P. (1990) *A directory of botanic gardens and parks in India* (p. 10) *Culcutta: Botanical survey of India*.
- Chakraverty, R.K. & Mukhopadhyay, D.P. (1990). *A directory of botanic gardens and parks in India*. (pp 10-12). *Culcutta: Botanical survey of India*.



Appendix-I
List of Tables & Figures

Appendix-I

Source: Captured by Shubham yadav during his field work on 27.06.2021



Plan of the botanic garden at Saharanpur. From: John Forbes Royle. Illustrations of the botany and other branches of the natural history of the Himalayan Mountains. Volume 2. London: WH Allen and Co, 1839 [Early Science Collection FOL. QK341 ROY]

Figure 1: Oldest Map of Saharanpur Botanical Garden

Source: Kings college London, Online Exhibitions (fruits of the Earth: Plants in the service of mankind)
<https://kingscollections.org/exhibitions/specialcollections/fruits-of-the-earth-plants-in-the-service-of-mankind/the-botanical-garden/the-garden-at-saharanpur>



Figure 2: Latest Map of Saharanpur Botanical Garden



Figure 3: Gate No. 1 (Nawab ganj)



Figure 4: Gate No. 2 (AisiBag)



Figure 5: Gate No. 3 (Beri Bag)



Figure 6: Main Office of SBG



Figure 7: Side view of Main Office



Figure 8: Main Gate of Green House



Figure 9: Green House of SBG

GAAV (*Diospyros Embryopteris* Fabaceae): World Oldest Tree

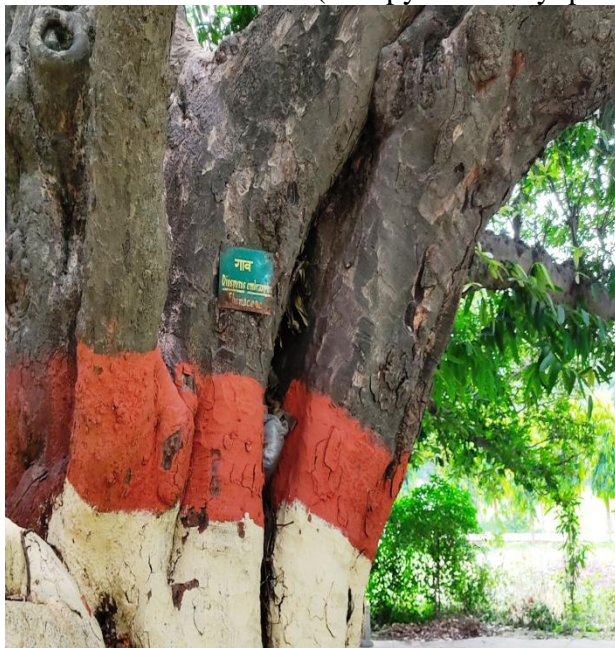


Figure 10

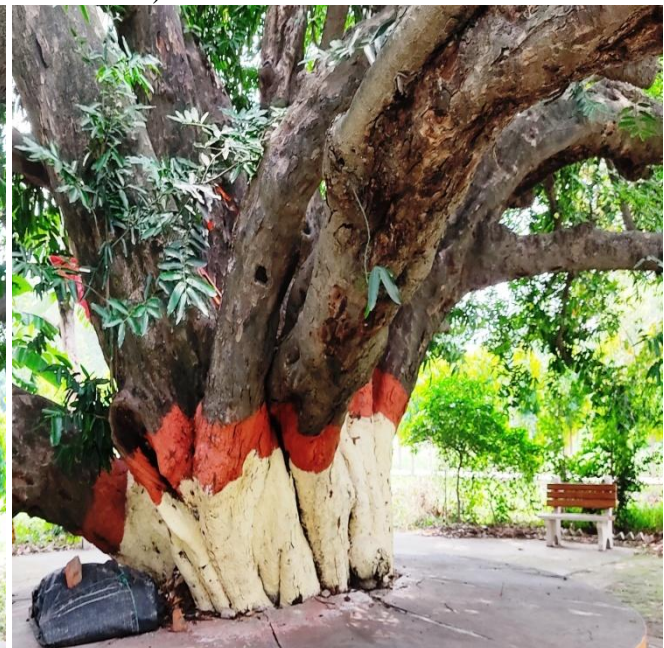


Figure 11



Figure 12: Nursery for Farmers Training



Figure 13: Kashmiri vrakshon ka Teela



Figure 14: 121 mangoes varieties have been planted on this tree by Root Stock System.

बहु प्रजाति आदर्श आम वृक्ष संकलित प्रजातियाँ

1 खराही	24 जहंगीर	51 गुलाब खास	76 केसर केकर	101 रसबुनिया रेंड राजपूरी
2 खैया	27 लोट परलट्टी	52 पौरी	77 महली बाटवाली	102 ककडन
3 खोसा	28 रवणी रेश्मा	53 अमोहर	78 केलवार मुद्द बाटवाली	103 खैया
4 आठनावा	29 कावला पेड़ो	54 पुरमिथिया	79 मलकावा बाटवाली	104 विजोत गीला
5 आठनावा	30 अमनास	55 मुसुदु बहार	80 अमठीबहार	105 दिला धसद
6 बादाखुर अकला	31 पौषा	56 केसर	81 सिलान	106 तिकका भदौरिया
7 बादाखुर अकला	32 मीरार	57 बरखन	82 कुर्या भोग	107 अजयराज
8 बादाखुर अकला	33 चिनाखन	58 मन्दराजी	83 यो. एस. नं. 2	108 ककडन जाफरान
9 बादाखुर अकला	34 हिमालयदोम	59 अनामाल	84 मुराया	109 नौल म
10 भादखुर अकला	35 बेराया	60 अनामाल	85 पिलाम	110 सिधिया (ह)
11 अनामाल	36 कुरुकन	61 बंगाली	86 मौसबासा	111 सिधिया पसद
12 लोमा हेड किंग्स	37 किज्या	62 अजु दान	87 रावली	112 सिधिया
13 फुसा खरी	38 प्रभात	63 बंगाली	88 कजरी जाफरान	113 बरली कोपर
14 खैया	39 जलाल	64 बंका	89 केलवा छम्पा	114 सास भदौरिया
15 रदौल	40 मुलगावा	65 बुदु का केलवा	90 तैमुरिया	115 सास भदौरिया
16 कुनमी मालदा	41 सिखावाल	66 एस. बी. रामखुर	91 सफखन	116 राजजत बमशा
17 मालदा	42 सिखावाल	67 केलवा भगलखुर	92 बेगमखसद	117 आंडु आक कोरिया
18 सिधिया	43 सोनालोल	68 एस. बरख	93 भोगल टाहर	118 सुखी पित्त फिरोजी
19 मीरफेरा ओडीदा	44 खैयावाला	69 फुसी खाला	94 सिधिया खुरखसद	119 खाल जी
20 मीरफेरा जमीरिया	45 बुन्दारनी	70 फट्टु किरवा	95 अमन खुर	120 असीजिया देवबन्द
21 लोमा कुलद शहर	46 हिमिया सिधिया	71 मल्लिका	96 रसपुनिया	121 सुखी जहानाबाद
22 लखवा	47 योम	72 गोरजीत	97 चित्तवा	
23 लखवा	48 लखकर सिधिया	73 मिर्वा गाजीपुर	98 तोपारी पैडमाल	
24 आलमपुर बीमिया	49 लखहर पसद	74 सिन्धिया बाटवाली	99 खोसा	
25 विलपुदुटी	50 पजा पसद	75 मकखर	100 खोसा	

एम. या. अग्रवाल पवन कुमार राजेश प्रजापत

Figure 15: List of Multi species ideal Mango tree

अ सण्डः दक्षिण भारतीय आम की प्रजातियों का संग्रह प्रजातियों के नाम

1 मीरफेरा ओडीदा	14 पसद	27 सुखा	40 केसर
2 मीरफेरा आलोनिका	15 चिनाखन	28 खनिमन सिधिया	41 लखवा
3 बुलदखर गीला	16 हिमालयदोम	29 भोग	42 मरदावाली
4 खैया	17 सोनालोल	30 खैया	43 अमनास
5 लखवा	18 विजान	31 लखवा सिधिया	44 अजयराज
6 पल. आ. रसपुनिया	19 प्रभात	32 कीरखुर	45 पीला
7 अजयराज	20 जलाल	33 लखवा पसद	46 इण्डोनेशिया
8 चिलखुर	21 मलाजोबा	34 फुसा पसद	47 खैया
9 जहंगीर	22 खिरखन	35 गुलाब खास	48 खैया
10 लोट परलट्टी	23 खिरखन	36 पौरी	49 विलाई कोलम्बन
11 लखवा	24 सोनालोल	37 अलफनदो	50 सिधिया
12 कावला पेड़ो	25 शादवाला	38 जहानाबाद	51 कुरुकन
13 अमनास	26 बुन्दारनी	39 महबूद बहार	52 बंगलीया

Figure 16: List of South Indian Mango Species



Figure 17: Butterfly Park



Figure 17: (a) Side view of Butterfly Park



Figure 17:(b) Butterfly Park Area Board

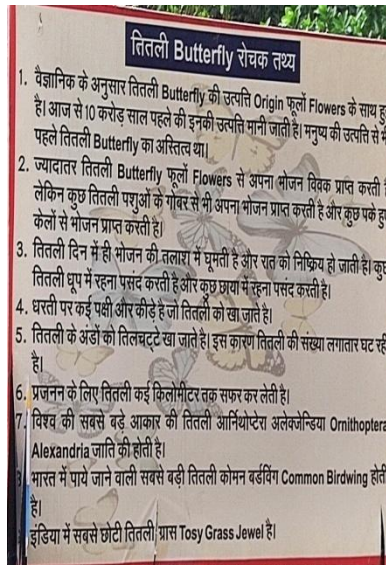


Figure 17:(c) Interesting Facts of Butterfly Park



Figure 17:(d) Butterfly Introduction



Figure 18: Laboratory of Saharanpur Botanical Garden



Figure 19: Mango Species (Alfanzo)



Figure 20: Mango Species (Chaunsa)



Figure 21: Mango Species (Swarn Rikha)



Figure 22: Mango Species (Langda)



Figure 23: Turmeric Species (CLS-16)



Figure 24: Potato Species (Badshah)



Figure 25: Potato Species (Anand)



Figure 26: Loquat (Tanaka)



Figure 27: Milky Mushroom



Figure 28: Button Mushroom



Figure 29: Oyster Mushroom



Figure 30: Carrot (Zeno)



Figure 31: Carrot (Royal king)



Figure 32: Turnip White-4



Figure 33: Pointed gourd (F.P.-1)



Figure 34: Pointed gourd (Banarashi Local)



Figure 35: Radish (white icicle)



Figure 36: Radish (Pusa Himani)



Appendix-II
Research Paper &
Attended Seminars



**SARDAR PATEL INSTITUTE OF
ECONOMIC AND SOCIAL RESEARCH**

anvesak

A bi-annual journal

CERTIFICATE OF PUBLICATION

This is to certify that the paper entitled

**HISTORY OF PLANT TAXONOMY IN INDIA ANCIENT TO MODERN
PERIOD**

Authorred by

Shubham Yadav

Research Scholar, Department of History, Babasaheb Bhimrao
Ambedkar University, Lucknow.

UGC

University Grants Commission

Approved Journal

vol. 52 No.1(I)

in

Anvesak A bi-annual Journal

UGC Care Group - 1

ISSN : 0378 - 4568

January – June 2022



A bi-lingual journal

HISTORY OF PLANT TAXONOMY IN INDIA ANCIENT TO MODERN PERIOD

Shubham Yadav

Research Scholar, Department of History, Babasaheb Bhimrao Ambedkar University, Lucknow.

S. Victor Babu

Professor, Department of History, Babasaheb Bhimrao Ambedkar University, Lucknow.

V. M. Ravi Kumar

Associate Professor Department of History, Babasaheb Bhimrao Ambedkar University, Lucknow.

Abstract: India's scientific tradition is not just long, but also broad and diverse. Plant taxonomy was known in the Indian subcontinent from the beginning in ancient forms, when scientific knowledge was conveyed through the customary method of oral narrative. Plant taxonomy's foundational works can be traced all the way back to ancient India. The study includes particular references to show that the study of plant taxonomy was practised in ancient India. According to historical and literary evidence, the science of plant taxonomy and nomenclature existed in ancient India. It served as the foundation for other disciplines of study such as herbal medicine, anatomy, physiology, and agriculture, among others. We have enough textual evidence to believe that plant taxonomy was first studied between 250 and 200 BC. In this discipline, Theophrastus and Aristotle are well-known figures. However, evidence from antiquity suggests that Parasara's Vriksayurveda is one of the earliest works on plant classification. The Rig-Veda, Manusmriti, Charak Sambita, and Susuruta Sambitas demonstrate that ancient India had a diverse culture and awareness of plant taxonomy. These classifications are based on the morphology of plants in comparison. This branch's form has changed as a result of this origin. Herbs, shrubs, and trees begin the path, which leads to oil-producing fibres. It began with natural systems, progressed to artificial systems, and is now based on phylogenetic or microscopic research. Many literary materials on the subject were available in ancient India, but they were primarily destroyed by foreign invaders, leaving only a few for our study.

Keywords: Plant Taxonomy (Plant Classification), Botany, Botanical Garden, Botanical Research, Species, Specimens, Herbarium, Natural System, Artificial System, Phylogenic, Microscopic Research, flora.

Introduction

The human-plant interaction dates back to primordial times. Man had lived in India virtually since prehistoric times, and he had been on a mission to learn everything he could about his immediate surroundings, partly to ensure his survival and partly to satisfy his natural curiosity.

The people of the Indus Valley lived in villages and towns. They used to grow wheat, barley, millet, dates, melons, vegetables, and other fruits and cottons, worship trees, glaze their pottery with plant juices, and then paint it with a variety of plant motifs. Indus valley civilization seals discovered in several parts of India reveal the presence of *Ficus religiosa*, *Ziziphus mauritiana*, and other plants that were utilised in some form or another.

Taxonomical Studies during Ancient & Vedic Period in India

Early examples of plant taxonomy can be found in the Rig Veda, which separates plants into three categories: Vriksha (tree), Osadhi (human-use herbs), and Virudha (creepers), each of which is further subdivided. Plants are divided into eight types in the Atharvaveda: Visakha (spreading branches), Manjari (leaves with lengthy clusters), Sthambini (bushy plants), Prastanavati (which expands), Ekasrng (monopodial growth), Pratanavati (creeping plants), Amsumati (many stalks), and Kandini (with numerous stalks) (plants with knotty joints). Vriksha, Vana, and Druma (trees), Visakha (shrubs with spreading branches), Sasa (herbs), Amsumali (a spreading or deliquescent plant), Vratati (climber), Stambini (bushy plants), Pratanavati (creeper), and Alasala (those spreading on the ground). Manusmriti also proposed an eight-category classification system for plants. A detailed Plant Taxonomy is also presented in the Charaka

Samhita, Susruta Samhita, and the Vaisesikas¹.

Soma is the most well-known plant, with numerous references in the Rig-Veda and later Samhitas. Soma is revered as the Lord of the Forest by Vedic Indians (Vanaraja). The botanical identity of the Soma plant, on the other hand, has remained a mystery until today. Ephedra (a Gymnosperm), Sarcostemma (a flowering plant), and mushroom are the most likely genres (a fungus)².

The following plant is the Vedic period's Peepal or Asvattha (*Ficus religiosa*). Utensils and containers made from the Asvattha tree's wood are mentioned in the Rig Veda. Silk cotton (*Salvia malabaricum*), Khadira (*Acacia catechu*), and Simsapa are only a few of the other trees mentioned in the Vedas (*Dalbergia sissoo*). Sami Vibhitaka (*Terminalia bellerica*), Vibhitaka (*Terminalia bellerica*), Vibhitaka (*Terminalia belle* (*Prosopis* sp.)). Plaksa is a traditional Serbian dish (*Ficus infectoria*). In the Atharvaveda, Maitaryani Samhita, and other literature, iksu (sugarcane- *Saccharum officinarum*) is listed as a cultivated plant. Many flowering and fruiting plants were known to the Vedic Indians, including Palasa (*Butea monosperma*), two types of lotus - white (*Pundarika*) and blue (*Puskara*), white lily (*kumuda*), cucumber (*Urvaruka*), Jujuba (*Zizypus jujuba*), udumbara (*Ficus glomerata*), kharjura (*Phoenix dactylifera*) and Bilva (*Aegle marmelos*) etc³.

Sanskrit and several other Indian languages have written records in the form of manuscripts. The Vedas, Upanisadas, and epics like the Ramayana and Mahabharata are all examples of Sanskrit literature. The lay literature contains prose, poetry, and drama authored by a variety of Sanskrit authors, including Kalidasa, Magha, and Bhabhuti, in which plant information is only mentioned as a comparison. Medical works like the Charaka and Susruta Samhitas, lexicons like Medinighantu and Amarakosa, and encyclopaedic works like Arthashastra and Brahatsamhita make up technical literature. In addition, under the title of Vriksayurveda, there are a number of unique compositions. The Vriksayurveda of Parasara, written between the first and second centuries BC and AD, is thought to be the oldest work in genuine botany. Botany was thoroughly systematised and taxonomy was well developed even in the first millennium BC, according to literary evidence⁴.

Sophocles (505-495 BC) notably noted rice, sandalwood, and other Indian items that the Greeks only knew by their Tamil names. Several Indian words have been translated into Greek as plant names; for example, Arise and Vetiver in Tamil became *Oryza* and *Vetiveria*, respectively. In Malayalam, Injiver and Elathari became *Zingiber* and *Elataria*, respectively. *Santalum* and *Saccharum* were created from Sandanam (*Chandanam*) and Sarkare, respectively. The sacred lotus (*Nelumbo nucifera*), which was used to wrap around the head of the Sun-god, was the most popular flower. Plants were divided into two categories: wholesome and edible plants, and unwholesome or dangerous plants⁵.

The binomial nomenclature system was also used: for example, Bala is the contemporary genus *Sida*, and the specific names are suffixed to the generic names. The specific names in Sanskrit, on the other hand, are prefixed to the generic name. Naga bala= *Sida spinosa*, Atibala= *Sida thomlifolia*, etc⁶.

Cardamom, Black Pepper, Ginger, Cinnamon, Sugarcane, Sandalwood, Rosewood, Turmeric, Indigo, and other Indian economic plant items were known in various regions of the western world as oriental luxury several centuries before the birth of Christ⁷.

Taxonomical Studies from pre-British to post-British period and modern India

¹ Rmananda, Tewari, K. R. (2017). *Dravyaguna Vijyana, Chaukhambha Orientalia Varanasi*, Vol. II, pp 13-23.

² Deshpanday, M. M. (2020). *Dravyaguna Vijyana, Chaukhambha Sanskrit Pratishthan Delhi*, Vol. I, pp 315-394.

³ Deshpanday, M. M., Deshpanday, A. P. (2020). *Chaukhambha Sanskrit Pratishthan Delhi*, Vol. II, pp (10-434).

⁴ Lucas, D. S. (2006). *Dravyaguna Vijyana, Chaukhambha Bharati Academy Varanasi*, pp 3-86.

⁵ Misra, B. L. (2006). *Dravyaguna Hastamalak, Publication Scheme Jaipur*, pp 1-57, pp 122-162.

⁶ Sharma, A. P., Talmale, S. R. (2002). *Plants and other Drugs of Susrutasamhita Saptadhyayi, Rashtriy Ayurveda Vidyapeeth New Delhi*, pp 1-139, 140-151.

⁷ Jain, D. K., Sawant, B. (2017). *Advanced Protocols in Dravyaguna Practical, Chaukhambha Orientalia Varanasi*, pp 1-123.

In his book "Chapters on the History of Botany in India," I.H. Burkil (1965) mentions the history of modern Botany in India, which was almost exclusively concerned with exploration and systematic Botany of higher plants until the beginning of the twentieth century, spanning four centuries beginning with 1500 AD. Botany, or natural science, was first introduced to India as an alien system of knowledge. Botany began as a science or practise of healing in a specific section of Europe at the beginning of the 16th century⁸.

The ancient Greeks were well-known for their healing abilities. Then came the Arabians, who, during the reign of Khalif Al Mansur, reached out to the Indus from Baghdad" (745-775 AD)⁹. From Sanskrit to Arabic and Persia, they translated the Charaka Samhita and the Susurut Samhita.

After a 10 month and 12 day expedition from Lisbon, Vasco da Gama rounded the Cape of Good Hope and moored Calicut (Kozhikode) on May 29, 1498. Apart from the need for Indian spices and other luxury goods, the scarcity of wood on the Red Sea's coastlines was also a major reason in the expansion of Portuguese territories in India, which continued until December 1961, when it was annexed to the Indian union¹⁰.

Garcia de Orta (1490-1570 AD), a physician and pharmacist from Elva, moved to Goa to research native medications and their uses. In the year 1563, he published his study in a book called Coloquios¹¹, in which he documented 57 more regularly used Indian medicinal plants in detail. The Latin summary of Clusius, published in 1567, helped to popularise the book in Europe¹².

The Governor of Dutch Possession in India, Van Rheede Drankenstein, began publishing his enormous Hortus Malabaricus, an illustrated study of the area's floristic treasures, for the exploitation and profit of all. Plants from Cochin and the surrounding area were brought in, illustrated, and described, and the narratives were then translated into Latin. Cochin prepared the manuscript, which was then transported to the Netherlands¹³.

Hortus Indicus Malabaricus was the title of the first volume of this magnificent collaborative production, which was released in 1678. The next 11 volumes were also printed in Amsterdam. There are 794 outstanding drawings in this collection, which cover around 780 species¹⁴. When Van Rheede was organising the work on Hortus Malabaricus, the English had a strong relationship with the Dutch, and they were inspired by them to start collecting plants around the Madras coast with the support of ship captains and other East India Company employees. Among these English collectors, James Petiver, Charles Du Bois, an East India Company official, deserves special note¹⁵.

Leonard Plukenet (1641-1707 AD)¹⁶ began publishing Phytographia, a collection of copper-plate illustrations of plants, in 1697. Petiver began publishing plant reports as well. Plukenet and Petiver's plants eventually made their way to the British Museum. Petiver brought the Pre Liumean enquiry into India's

⁸ Burkill, I. H. (1965). Chapters on the History of Botany in India.

⁹ Robinson, C. F. (Ed.). (2010). *The New Cambridge history of Islam: Volume 1, The formation of the Islamic world, sixth to eleventh centuries*. Cambridge University Press.

¹⁰ Salahudheen, O. P. (2016, January). MALABAR AND THE PORTUGUESE. In *Proceedings of the Indian History Congress* (Vol. 77, pp. 179-191). Indian History Congress.

¹¹ Teoh, E. S. (2019). Medicinal Orchids in the Malay Archipelago. In *Orchids as Aphrodisiac, Medicine or Food* (pp. 255-289). Springer, Cham.

¹² Marr, J. R. (1972). An examination of some plant-names and identities in India. *Journal of the Royal Asiatic Society*, 104(1), 40-56.

¹³ Pols, H. (2016). 9 Jamu: The Indigenous Medical Arts of the Indonesian Archipelago. In *The Bright Dark Ages* (pp. 161-185). Brill.

¹⁴ Fournier, M. (1987). Enterprise in botany: Van Reede and his Hortus Malabaricus—Part I. *Archives of natural history*, 14(2), 123-158.

¹⁵ Damodaran, V., Winterbottom, A., & Lester, A. (Eds.). (2014). *The East India Company and the natural world*. Springer.

¹⁶ Casada, J. (1984). Botanical Exploration of Southern Africa: An Illustrated History of Early Botanical Literature on the Cape Flora [with] Biographical Accounts of the Leading Plant Collectors and Their Activities in Southern Africa from the Days of the East India Company until Modern Times by Mary Gunn; LE Codd. *Isis*, 75.

Flora to a close¹⁷.

There were no universally agreed conventions for naming plants in the 17th and early 18th centuries. The publication of Linnaeus' species Plantarum (1753) and Genera Plantarum (1754, 5th ed.) heralded the beginning of a new era in botanical history. He constantly employed binomial nomenclature in Species Plantarum. To validate names, the description of Genera Plantarum is accepted.¹⁸

The arrival of J. G. Koenig, a student of Linne, in India in 1768 is considered the start of Post-Linnaean Botany in India. As a surgeon and naturalist, Koenig joined the Tranquebar Mission, where he worked alongside United Brethren such as Klein, Rottler, and others¹⁹.

The Brethren sent their specimens to other botanists in Europe after making a great collection in the Madras area. Around 1768, Tranquebar also had a botanical garden. The contract to sell dried plants to Joseph Banks was awarded to Moravian brothers, who kept their word from 1775 until 1778. This transaction sparked the idea of forming a learned organisation of Botanists in Madras, which was named "United Brothers" and founded in 1775²⁰.

Botany was associated with Johan Fleming, Sir William Jones, Roxburgh, Wallich, Buchanan-Hamilton, and others in Bengal. Robert Kyd built the Botanical Garden of Calcutta in 1787, and it has played a pivotal role in the development of botanical research in India since then²¹.

Alexander Gibson, John S. Law, J. E. Stocks, and Johan Graham were all involved in the early development of botany in Bombay. Mr. A. Gibson (1847) was the first Conservator of Forest in India, and his principal responsibility was to put an end to the senseless destruction of trees within the province.²²

J. F. Royle's name is well-known in the country's north and north-west regions. He undertook some exploration work in the Himalayas and in the Saharanpur Botanical Garden. W. S. Webb, William Moorcroft, Alexander and James S. Gerard, Henry Strachey, Richard Strachey, and others were early explorers in the North-West. Many of their collections were obtained at the Saharanpur Botanical Garden (later moved to Dehra Dun), and Royle based his magnificent pictures on both these and his own.²³

The Tranquebar Brethren, Roxburgh (at the start of his tenure in India), and Robert Wight all did excellent botany work in Madras. Wight was rightfully dubbed the finest plant collector of his day. He was tireless in his field trips to the northern sections of Madras, Tanjore, and later other parts of South India, as well as in the publication of great volumes that are still required reading for any professional botanist today. Wight described 38 new genera and over 3000 species during his 35-year stay in India. He contributed 28 works, the most notable of which being "Illustrations of Indian Botany" (1831-1832, 1840, and 1850)²⁴.

The first volume of "Flora of India" was published in 1855 by Sir J. D. Hooker and Thompson. However, this project was quickly abandoned in favour of the more extensive book "Flora of British India," which began in 1872 and ended in 1897. Despite the fact that the work was groundbreaking, Hooker himself admitted that in a project of this magnitude, neither fullness nor completeness are possible in the current

¹⁷ Coulton, R. (2020). 'What he hath gather'd together shall not be lost': remembering James Petiver. *Notes and Records*, 74(2), 189-211.

¹⁸ Stafleu, F. A. (1971). Linnaeus and the Linnaeans: The Spreading of their Ideas in. *Systematic Botany*, 1735-1789.

¹⁹ SIKARWAR, R. HISTORY AND FOOTPRINTS OF PLANT EXPLORATIONS IN INDIAN SUB CONTINENT.

²⁰ Wight, R., & Arnott, G. A. W. (1834). *Prodromus Florae Peninsulae Indiae Orientalis: containing abridged descriptions of the plants found in the peninsula of British India, arranged according to the natural system* (Vol. 1). Parbury, Allen & Company.

²¹ Axelby, R. (2008). Calcutta Botanic Garden and the colonial re-ordering of the Indian environment. *Archives of natural history*, 35(1), 150-163.

²² Rodrigues, L. (2006, January). DR. ALEXANDER GIBSON AND THE EMERGENCE OF CONSERVATIONISM AND DESICCATIONISM IN BOMBAY: 1838 TO 1860. In *Proceedings of the Indian History Congress* (Vol. 67, pp. 655-665). Indian History Congress.

²³ Hyde, H. M. (1962). Dr. George Govan and the Saharanpur botanical gardens. *Journal of the Royal Central Asian Society*, 49(1), 47-57.

²⁴ Hedge, I. C., & Lamond, J. M. (1987). Edinburgh's Indian Botanical Connections and Collections. *Nelumbo-The Bulletin of the Botanical Survey of India*, 29(1-4), 272-285.

state of science. Despite its flaws, "Flora of British India" is regarded as a monumental work that reflects Hooker's brilliance and perseverance, and has served as the foundation for all subsequent provincial editions^{25,26}.

A new age of botanical research began with the establishment of the Indian Botanical Garden. This garden has been a hotbed of plant taxonomy research for many years. Many species of Indian plants were meticulously conserved in the Herbarium, which has the most precious collection of plants from India and neighbouring countries. Because of the huge number and variety of specimens (estimated to be in the millions), the Herbarium is India's most precious nucleus of botanical specimens and deserves special attention from Indian botanists.

A concerted effort was made to carry out the goal of having publications on the floras of the peninsular provinces that lacked them. Under the direction of the Botanical Survey of India, extensive exploration took place across the country, with minimal assistance from universities. Other fields of Biological Sciences, such as Embryology, Physiology, and so on, seemed to entice the latter. In reality, with the closure of the Botanical Survey of India, plant taxonomical research in the country slowed to a halt. Despite the difficulties, a few active centres of activity continued to operate.

Calcutta, like it was in the previous century, has remained at the forefront of Systematic Botany in Peninsular India in this century. D. Prain published his book on Bengal flora at the turn of the century and made several significant contributions. The Botanical Survey of India's records were published in 16 volumes²⁷. Between 1900 and 1950, the annals of the Royal Botanic Garden, Calcutta, were published in six volumes, the most recent of which was on Dioscorea by I. H. Burkill and D. Prain. Despite a severe lack of funds and people, the Botanical Garden's succeeding superintendents and their helpers have maintained the Garden's traditions²⁸.

J. S. Gamble released the first part of his "Flora of Madras" in 1915, and the book was hailed as one of the best works on Indian floras at the time. The first seven parts were published under Gamble's supervision²⁹. C. E. C Fischer, who had done extensive research on the province's flora, completed the work in 1936 after his death in 1925³⁰. P. F. Fyson researched the flora of the Nilgiris and other South Indian highlands³¹. P. V. P. Mayuranathan published a book on the flowering plants of Madras and the surrounding area in 1929. This was one of the most important works on local or restricted floras published in the twentieth century. Mayuranathan's book was supplemented by E. Barnes in 1938. A group of young and active botanists from Bangalore and Mysore have demonstrated tremendous dedication over the last few years. It is anticipated that their passion would last until the entire flora of Mysore has been discovered³².

Floristic investigations under the auspices of the Botanical Survey of India were enhanced with the formation of the southern circle at Coimbatore in 1955. Over 325 research papers have been written, with over 75 new taxa and 360 extra records for the area³³.

Subramanyam Sebastine and his colleagues conducted extensive research in a variety of locations across the country. During this time, scientists from other BSI units, mainly from Calcutta, collected specimens in

²⁵ Hooker, J. D. (1872). The Flora of British India, Vol. 1. *The Flora of British India, Vol. 1*.

²⁶ Hooker, J. D. (1879). Flora of British India, Vol. II. *Flora of British India, Vol. II*.

²⁷ Prain, D. (1903). *Flora of the Sundribuns*. Periodical Experts Book Agency.

²⁸ Prain, D., & Burkill, I. H. (1927). The genus *Dioscorea* in Siam. *Bulletin of Miscellaneous Information (Royal Botanic Gardens, Kew)*, 1927(6), 225-247.

²⁹ Gamble, J. S. (1915). Flora of Madras, Vol. 2.

³⁰ Fischer, C. E. C. (1935). Contributions to the Flora of Burma: XII. *Bulletin of Miscellaneous Information (Royal Botanic Gardens, Kew)*, 1935(10), 572-576.

³¹ Fyson, P. F. (1932). The flora of the South Indian hill stations, Ootacamund, Coonoor, Kotagiri, Kodaikanal, Yercaud and the country round, Vols. 1 & 2. *The flora of the South Indian hill stations, Ootacamund, Coonoor, Kotagiri, Kodaikanal, Yercaud and the country round, Vols. 1 & 2*.

³² Mayuranathan, P. V. P., Livingstone, C., & Henry, A. N. (1994). Flowering plants of Madras city and its immediate neighbourhood.

³³ Subramanyam, K. (1959). Southern Circle of the Botanical Survey of India. *Nelumbo-The Bulletin of the Botanical Survey of India*, 1(1), 70-73.

Tamil Nadu³⁴. K. S. Srinivasan and T. A. Rao gathered flora from Tamil Nadu's coastal districts³⁵. BSI employees were not the only ones doing floristry work. Tiruchirapally's Rapinat Herbarium is a hotbed of floristic activity³⁶. Fr. K. M. Matthew and his colleagues worked here and contributed significantly to our understanding of Tamil Nadu plants. Matthew gathered information for the three-volume "The Flora of Tamilnadu Carnatic" (1983), the Flora of Palni Hills (1996)³⁷, and other publications. Bharathidasan University's Dr. T. Senthil Kumar and K. V. Krishnamurthy conducted substantial research on Ethnobotanical studies in the Shervaroy Hills in the Eastern Ghats³⁸. Calicut University researchers investigated the vegetation of Manilal in Northern Kerala and released the book "Flora of Silent Valley" (1988)³⁹. With its publication "Flowering Plants of Kerala," the Kerala Forest Research Institute (KFRI) at Peechi is another excellent location for floristic activity (2004). In Kerala, the Tropical Botanical Garden & Research Institute (IBGRI), Palode, Trivandrum, is also particularly important for plant taxonomy⁴⁰. The institute focuses on the plants that grow on the Agasthyamala hills and a few small islands in Kerala. TBGRI's "Flora of Kerala" is a nice database of over 4000 blooming plants found in Kerala over the previous five years⁴¹.

In Andhra Pradesh, notable publications include W. Elliot's "Flora Andhrica" (1859)⁴², S. M. Khan's "Forest Flora of Hyderabad State" (1953)⁴³, Pullaiah & Moulali's "Flora of Andhra Pradesh" (1997)⁴⁴, and G. V. Subba Rao and G. R. Kumari's "Flora of Visakhapatnam District, Andhra Pradesh" in two volumes⁴⁵.

Dehra Dun's Forest Research Institute has been one of India's most active centres. Botanists have used such institutes to extend and spread their work across the country. J. E. Duthie, R. N. Parker, C. E. Parkinson, M. B. Raizada, N. L. Bor, and others have made significant contributions to the flora of the Upper Gangetic Plain and other portions of Northern India⁴⁶.

Pune was the epicentre of Botanical expeditions in the western sections of the country at the turn of the

³⁴ Bagavathi, A., & Kalyani, M. E. (2020). A Study on the Impact of Researchers of the Botanical Survey of India (BSI). *Asian Journal of Information Science & Technology (AJIST)*, 10(2).

³⁵ Rao, T. A., & Meher-Homji, V. M. (1985). Strand plant communities of the Indian sub-continent. *Proceedings: Plant Sciences*, 94(2), 505-523.

³⁶ Mohanasundari, C., Natarajan, D., Srinivasan, K., Umamaheswari, S., & Ramachandran, A. (2007). Antibacterial properties of *Passiflora foetida* L.—a common exotic medicinal plant. *African Journal of Biotechnology*, 6(23).

³⁷ Matthew, K. M. (1996). *Illustrations on the flora of the Palni Hills, South India*. Rapinat Herbarium, St. Joseph's College.

³⁸ Kannan, M., Kumar, T. S., & Rao, M. V. (2016). Ethnomedicinal plants used for Wound Healing purposes by Malayali Tribes of Kalrayan Hills, Salem district, Tamil Nadu, India. *Global Journal of Research on Medicinal Plants & Indigenous Medicine*, 5(7), 203.

³⁹ Udayan, P. S., Tushar, K. V., George, S., & Balachandran, I. (2006). PHYLLANTHUS KOZHIKODIANUS SIVAR. & MANI.(EUPHORBIACEAE)-A NEW RECORD FOR THE STATE OF ANDHRA PRADESH, INDIA. *ZOOS'PRINT JOURNAL*, 21(4), 2259-2260.

⁴⁰ Jose, P. A., Hussain, K. H., & Sreekumar, V. B. (2014). Developing an Information System for the Rare Endangered and Threatened (RET) Plants of Southern Western Ghats. *Kerala Forest Research Institute: Peechi, India*, 42.

⁴¹ Janakiram, T., Safeena, S. A., & Prasad, K. V. (2019). *Status of indigenous ornamental plants in India*. Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa New Delhi.

⁴² Udayan, P. S., Tushar, K. V., George, S., & Balachandran, I. (2006). PHYLLANTHUS KOZHIKODIANUS SIVAR. & MANI.(EUPHORBIACEAE)-A NEW RECORD FOR THE STATE OF ANDHRA PRADESH, INDIA. *ZOOS'PRINT JOURNAL*, 21(4), 2259-2260.

⁴³ Khan, M. S. (1953). Forest Flora of Hyderabad State. *Govt. Press, Hyderabad*, 73.

⁴⁴ Pullaiah, T. (2015). Flora of Telangana-the 29th state of India. *The Journal of Indian Botanical Society*, 94(1and2), 1-8.

⁴⁵ Rao, G. S. (1977). Flora of Visakhapatnam District, Andhra Pradesh. *Nelumbo-The Bulletin of the Botanical Survey of India*, 19(1-4), 122-126.

⁴⁶ Shukla, S., Beg, S., Negi, R., Chandra, A., & Verma, P. K. BIODIVERSITY CONSERVATION: ROLE OF HERBARIUM AND ITS DIGITIZATION. *PERSPECTIVES ON BIODIVERSITY OF INDIA*, 357.

century. T. Cooke, G.A. Gammie, R. K. Bhide, G. M. Woodrow, and others did outstanding work⁴⁷. W. A. Talbot focused his research on the flora of the forest, notably in the Bombay Presidency⁴⁸. W. T. Saxton and L. J. Sedgwick studied the plants of Northern Gujarat. In Dharwar, Sedgwick amassed a sizable collection⁴⁹. G. L. Sha of Sardar Patel University, Vallabh Vidhyanagar, and his students discovered and published many records throughout Gujarat. In 1978, he published the Flora of Gujarat in two sections, which includes an extensive bibliography⁵⁰. E. Blatter established a school of systematic botany in Bombay, and he and his students conducted significant explorations across the province. After a long apprenticeship in Bombay⁵¹, Jayakrishana Indrajai Thaker travelled to Saurashtra and explored the Barda highlands. His findings are documented in a historic book, the first scientific work on systematic botany in India written in a regional language (Gujarati)⁵².

Theodore Cooke (1836-1910) arrived in India as a railway engineer in 1860 and eventually became the Principal of the Pune Civil Engineering College⁵³. He was also affiliated with the Agricultural College, where he studied Bombay Presidency flora. The first volume of Cooke's "Flora of Presidency of Bombay" was published in 1901, followed by the second book in 1908⁵⁴. The Botanical Survey of India reissued these volumes in 1958 with some changes. Sind, Gujarat, and North Karnataka were also included in Cooke's flora⁵⁵.

Rev. Ethelbert Blatter (1877-1934), a Swiss botanist, headed the next botanical phase in Maharashtra, which included extensive field work. He was the chairman of the Biology Department at Bombay's St. Xavier's College⁵⁶.

H. H. Haines worked extensively in Bihar and Orissa's Chota Nagpur plateau⁵⁷. H. F. Mooney, who lately published a complete supplement to Haines Botany, resumed his study⁵⁸. The study of Madhya Pradesh's vegetation is currently generating a lot of attention, and the preparation of regional flora is well underway. In 1997, the Botanical Survey of India published "Flora of Madhya Pradesh."⁵⁹

In Assam, the last of the major provincial floras bloomed. The series of volumes on Flora of Assam took a large team of botanists several years to complete under the ardent guidance of U. N. Kanjilal⁶⁰. C. E. C.

⁴⁷ Singh Jalal, J., & Jayanthi, J. (2018). An updated checklist of the orchids of Maharashtra, India. *Lankesteriana*, 18(1), 23-62.

⁴⁸ Talbot, W. A. (1902). *The trees, shrubs and woody-climbers of the Bombay Presidency*. Printed at the Government Central Press.

⁴⁹ Saxton, W. T., & Sedgwick, L. J. (1918). *Plants of northern Gujarat*. Superintendent Government Printing, India.

⁵⁰ Shah, G. L. (1978). Flora of Gujarat state.

⁵¹ Datta, S. C. (1988). *Systematic botany*. New Age International.

⁵² Vegda, V. R. (2012). *Rediscovery and potential of folk-biological knowledges as adaptive resource management of grasses in Gujarat* (Doctoral dissertation, Saurashtra University).

⁵³ Khyade, M. S., Kolhe, S. R., & Deshmukh, B. S. (2009). Wild edible plants used by the tribes of Akole Tahasil of Ahmednagar District (Ms), India. *Ethnobotanical leaflets*, 2009(10), 12.

⁵⁴ PAITHANE, V. A., NEEL, R. S., & BHUKTAR, A. S. J. A. FURTHER ADDITIONS TO FLORA OF MARATHWADA REGION, MAHARASHTRA.

⁵⁵ Cooke, T. (1987). Note on the Flora of Mahabaleshwar and Matheran. *J. Bombay Nat. Hist. Soc*, 2, 133-140.

⁵⁶ RHD. (1934). Reverend Ethelbert Blatter, SJ (1877—1934). *Current Science*, 58-59.

⁵⁷ Kumar, P., Jalal, J. S., & Rawat, G. S. (2007). Orchidaceae, Chotanagpur, state of Jharkhand, India. *Check List*, 3(4), 297-304.

⁵⁸ Bisoi, S. S., Biswal, A. K., & Satapathy, M. K. (2018). Nicandra Adans.: A new generic addition for the flora of Odisha, India. *Tropical Plant Research*, 5(2), 224-226.

⁵⁹ Verma, D. M., Balakrishnan, N. P., & Dixit, R. D. (1993). *Flora of Madhya Pradesh: Pteridophytes and Angiosperms (Ranunculaceae to Plumbaginaceae)* (Vol. 1). Botanical Survey of India.

⁶⁰ Bordaloi, C., Deka, R., & Bhattacharyya, D. N. A TAXONOMIC APPROACH TO POLYPETALOUS PLANT SPECIES OF JALUKBARI AREA OF ASSAM, INDIA.

Fischer has published a number of publications on Assam novelties on his own⁶¹, while N. L. Bor has done excellent work on the province's grasses⁶². However, there are still many districts in Assam where botany is unknown.

Conclusion

The most recent advancements in the field of systematic botany are quite promising. The world at large, and our own national laboratories in particular, have realised that many disciplines of science rely heavily on plant-based raw materials. As a result, we can see that ancient scientists recognized the necessity to classify plants based on their unique characteristics. They come near to modern classification in certain circumstances. The Science of plant taxonomy and nomenclature existed in ancient India. A new age of botanical research Began with the establishment of the Indian botanical garden. The Science of plant taxonomy served as the foundation for other disciplines, classification of plants began with natural systems, progressed to artificial system and phylogentic or microscopic research.

References

1. Axelby, R. (2008). Calcutta Botanic Garden and the colonial re-ordering of the Indian environment. *Archives of natural history*, 35(1), 150-163.
2. Bagavathi, A., & Kalyani, M. E. (2020). A Study on the Impact of Researchers of the Botanical Survey of India (BSI). *Asian Journal of Information Science & Technology (AJIST)*, 10(2).
3. Bisoi, S. S., Biswal, A. K., & Satapathy, M. K. (2018). Nicandra Adans.: A new generic addition for the flora of Odisha, India. *Tropical Plant Research*, 5(2), 224-226.
4. Bor, N. L. (1953). Notes on Asiatic Grasses: XII: New Species. *Kew Bulletin*, 8(2), 269-276.
5. Bordaloi, C., Deka, R., & Bhattacharyya, D. N. A TAXONOMIC APPROACH TO POLYPETALOUS PLANT SPECIES OF JALUKBARI AREA OF ASSAM, INDIA.
6. Burkill, I. H. (1965). Chapters on the History of Botany in India.
7. Casada, J. (1984). Botanical Exploration of Southern Africa: An Illustrated History of Early Botanical Literature on the Cape Flora [with] Biographical Accounts of the Leading Plant Collectors and Their Activities in Southern Africa from the Days of the East India Company until Modern Times by Mary Gunn; LE Codd. *Isis*, 75.
8. Cooke, T. (1987). Note on the Flora of Mahabaleshwar and Matheran. *J. Bombay Nat. Hist. Soc.*, 2, 133-140.
9. Coulton, R. (2020). 'What he hath gather'd together shall not be lost': remembering James Petiver. *Notes and Records*, 74(2), 189-211.
10. Damodaran, V., Winterbottom, A., & Lester, A. (Eds.). (2014). *The East India Company and the natural world*. Springer.
11. Datta, S. C. (1988). *Systematic botany*. New Age International.
12. Deshpanday, M. M. (2020). Dravyaguna Vijyana, Chaukhamba Sanskrit Pratishthan Delhi, Vol. I, pp 315-394.
13. Deshpanday, M. M., Deshpanday, A. P. (2020). Chaukhamba Sanskrit Pratishthan Delhi, Vol. II, pp (10-434).
14. Fischer, C. E. C. (1935). Contributions to the Flora of Burma: XII. *Bulletin of Miscellaneous Information (Royal Botanic Gardens, Kew)*, 1935(10), 572-576.
15. Fournier, M. (1987). Enterprise in botany: Van Reede and his Hortus Malabaricus—Part I. *Archives of natural history*, 14(2), 123-158.
16. Fyson, P. F. (1932). The flora of the South Indian hill stations, Ootacamund, Coonoor, Kotagiri, Kodaikanal, Yercaud and the country round, Vols. 1 & 2. *The flora of the South Indian hill stations, Ootacamund, Coonoor, Kotagiri, Kodaikanal, Yercaud and the country round, Vols. 1 & 2*.
17. Gamble, J. S. (1915). Flora of Madras, Vol. 2.

⁶¹ Hossain, M. M., Sharma, M., & Pathak, P. (2013). In vitro propagation of *Dendrobium aphyllum* (Orchidaceae)—seed germination to flowering. *Journal of Plant Biochemistry and Biotechnology*, 22(2), 157-167.

⁶² Bor, N. L. (1953). Notes on Asiatic Grasses: XII: New Species. *Kew Bulletin*, 8(2), 269-276.
Vol. 52, No.1(I) January – June 2022

18. Hedge, I. C., & Lamond, J. M. (1987). Edinburgh's Indian Botanical Connections and Collections. *Nelumbo-The Bulletin of the Botanical Survey of India*, 29(1-4), 272-285.
19. Hooker, J. D. (1872). The Flora of British India, Vol. I. *The Flora of British India, Vol. I*.
20. Hooker, J. D. (1879). Flora of British India, Vol. II. *Flora of British India, Vol. II*.
21. Hossain, M. M., Sharma, M., & Pathak, P. (2013). In vitro propagation of *Dendrobium aphyllum* (Orchidaceae)—seed germination to flowering. *Journal of Plant Biochemistry and Biotechnology*, 22(2), 157-167.
22. Hyde, H. M. (1962). Dr. George Govan and the Saharanpur botanical gardens. *Journal of the Royal Central Asian Society*, 49(1), 47-57.
23. Jain, D. K., Sawant, B. (2017). Advanced Protocols in Dravyaguna Practical, Chaukhambha Orientalia Varanasi, pp 1-123.
24. Janakiram, T., Safeena, S. A., & Prasad, K. V. (2019). *Status of indigenous ornamental plants in India*. Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa New Delhi.
25. Jose, P. A., Hussain, K. H., & Sreekumar, V. B. (2014). Developing an Information System for the Rare Endangered and Threatened (RET) Plants of Southern Western Ghats. *Kerala Forest Research Institute: Peechi, India*, 42.
26. Kannan, M., Kumar, T. S., & Rao, M. V. (2016). Ethnomedicinal plants used for Wound Healing purposes by Malayali Tribes of Kalrayan Hills, Salem district, Tamil Nadu, India. *Global Journal of Research on Medicinal Plants & Indigenous Medicine*, 5(7), 203.
27. Khan, M. S. (1953). Forest Flora of Hyderabad State. *Govt. Press, Hyderabad*, 73.
28. Khyade, M. S., Kolhe, S. R., & Deshmukh, B. S. (2009). Wild edible plants used by the tribes of Akole Tahasil of Ahmednagar District (Ms), India. *Ethnobotanical leaflets*, 2009(10), 12.
29. Kumar, P., Jalal, J. S., & Rawat, G. S. (2007). Orchidaceae, Chotanagpur, state of Jharkhand, India. *Check List*, 3(4), 297-304.
30. Lucas, D. S. (2006). Dravyaguna Vijyana, Chaukhambha Bharati Academy Varanasi, pp 3-86.
31. Marr, J. R. (1972). An examination of some plant-names and identities in India. *Journal of the Royal Asiatic Society*, 104(1), 40-56.
32. Matthew, K. M. (1996). *Illustrations on the flora of the Palni Hills, South India*. Rapinat Herbarium, St. Joseph's College.
33. Mayuranathan, P. V. P., Livingstone, C., & Henry, A. N. (1994). Flowering plants of Madras city and its immediate neighbourhood.
34. Misra, B. L. (2006). Dravyaguna Hastamalaka, Publication Scheme Jaipur, pp 1-57, pp 122-162.
35. Mohanasundari, C., Natarajan, D., Srinivasan, K., Umamaheswari, S., & Ramachandran, A. (2007). Antibacterial properties of *Passiflora foetida* L.—a common exotic medicinal plant. *African Journal of Biotechnology*, 6(23).
36. PAITHANE, V. A., NEEL, R. S., & BHUKTAR, A. S. J. A. FURTHER ADDITIONS TO FLORA OF MARATHWADA REGION, MAHARASHTRA.
37. Pols, H. (2016). 9 Jamu: The Indigenous Medical Arts of the Indonesian Archipelago. In *The Bright Dark Ages* (pp. 161-185). Brill.
38. Prain, D. (1903). *Flora of the Sundribuns*. Periodical Experts Book Agency.
39. Prain, D., & Burkill, I. H. (1927). The genus *Dioscorea* in Siam. *Bulletin of Miscellaneous Information (Royal Botanic Gardens, Kew)*, 1927(6), 225-247.
40. Pullaiah, T. (2015). Flora of Telangana—the 29th state of India. *The Journal of Indian Botanical Society*, 94(1and2), 1-8.
41. Rao, G. S. (1977). Flora of Visakhapatnam District, Andhra Pradesh. *Nelumbo-The Bulletin of the Botanical Survey of India*, 19(1-4), 122-126.
42. Rao, T. A., & Meher-Homji, V. M. (1985). Strand plant communities of the Indian sub-continent. *Proceedings: Plant Sciences*, 94(2), 505-523.
43. RHD. (1934). Reverend Ethelbert Blatter, SJ (1877—1934). *Current Science*, 58-59.
44. Rmananda, Tewari, K. R. (2017). Dravyaguna Vijyana, Chaukhambha Orientalia Varanasi, Vol. II, pp 13-23.
45. Robinson, C. F. (Ed.). (2010). *The New Cambridge history of Islam: Volume 1, The formation of the Islamic world, sixth to eleventh centuries*. Cambridge University Press.

46. Rodrigues, L. (2006, January). DR. ALEXANDER GIBSON AND THE EMERGENCE OF CONSERVATIONISM AND DESICCATIONISM IN BOMBAY: 1838 TO 1860. In *Proceedings of the Indian History Congress* (Vol. 67, pp. 655-665). Indian History Congress.
47. Salahudheen, O. P. (2016, January). MALABAR AND THE PORTUGUESE. In *Proceedings of the Indian History Congress* (Vol. 77, pp. 179-191). Indian History Congress.
48. Saxton, W. T., & Sedgwick, L. J. (1918). *Plants of northern Gujarat*. Superintendent Government Printing, India.
49. Shah, G. L. (1978). Flora of Gujarat state.
50. Sharma, A. P., Talmale, S. R. (2002). Plants and other Drugs of Susrutasmhita Saptadhyayi, Rashtrya Ayurveda Vidyapeeth New Delhi, pp 1-139, 140-151.
51. Shukla, S., Beg, S., Negi, R., Chandra, A., & Verma, P. K. BIODIVERSITY CONSERVATION: ROLE OF HERBARIUM AND ITS DIGITIZATION. *PERSPECTIVES ON BIODIVERSITY OF INDIA*, 357.
52. SIKARWAR, R. HISTORY AND FOOTPRINTS OF PLANT EXPLORATIONS IN INDIAN SUB CONTINENT.
53. Singh Jalal, J., & Jayanthi, J. (2018). An updated checklist of the orchids of Maharashtra, India. *Lankesteriana*, 18(1), 23-62.
54. Stafleu, F. A. (1971). Linnaeus and the Linnaeans: The Spreading of their Ideas in. *Systematic Botany*, 1735-1789.
55. Subramanyam, K. (1959). Southern Circle of the Botanical Survey of India. *Nelumbo-The Bulletin of the Botanical Survey of India*, 1(1), 70-73.
56. Talbot, W. A. (1902). *The trees, shrubs and woody-climbers of the Bombay Presidency*. Printed at the Government Central Press.
57. Teoh, E. S. (2019). Medicinal Orchids in the Malay Archipelago. In *Orchids as Aphrodisiac, Medicine or Food* (pp. 255-289). Springer, Cham.
58. Udayan, P. S., Tushar, K. V., George, S., & Balachandran, I. (2006). PHYLLANTHUS KOZHIKODIANUS SIVAR. & MANI.(EUPHORBIACEAE)-A NEW RECORD FOR THE STATE OF ANDHRA PRADESH, INDIA. *ZOOS'PRINT JOURNAL*, 21(4), 2259-2260.
59. Udayan, P. S., Tushar, K. V., George, S., & Balachandran, I. (2006). PHYLLANTHUS KOZHIKODIANUS SIVAR. & MANI.(EUPHORBIACEAE)-A NEW RECORD FOR THE STATE OF ANDHRA PRADESH, INDIA. *ZOOS'PRINT JOURNAL*, 21(4), 2259-2260.
60. Vegda, V. R. (2012). *Rediscovery and potential of folk-biological knowledges as adaptive resource management of grasses in Gujarat* (Doctoral dissertation, Saurashtra University).
61. Verma, D. M., Balakrishnan, N. P., & Dixit, R. D. (1993). *Flora of Madhya Pradesh: Pteridophytes and Angiosperms (Ranunculaceae to Plumbaginaceae)* (Vol. 1). Botanical Survey of India.
62. Wight, R., & Arnott, G. A. W. (1834). *Prodromus Florae Peninsulae Indiae Orientalis: containing abridged descriptions of the plants found in the peninsula of British India, arranged according to the natural system* (Vol. 1). Parbury, Allen & Company.

Web Resource

1. www.infinityfoundation.com
2. www.wikipedia.com

Others

1. Bagavathi, A., & Kalyani, M. E. (2019). Quantifying the Research Studies of Botanical Survey of India (BSI) Since 1954. *Library of Progress-Library Science, Information Technology & Computer*, 39(1).
2. Presentation by Dr. P. K. Hazra during All India Coordinated Project on Taxonomy (AICOPTAX) in the year 2009-2010 at Botanical Survey of India, Coimbatore, Tamil Nadu.



خواجہ معین الدین چشتی اردو و عربی - فارسی یونیورسٹی، لکھنؤ، اتر پردیش، ہندوستان

खामाजा मुईनुद्दीन चिश्ती उर्दू, अरबी-फारसी विश्वविद्यालय, लखनऊ, उत्तर प्रदेश, भारत

KHAMAJA MOINUDDIN CHISHTI URDU, ARABI-FARSI UNIVERSITY, LUCKNOW, U.P., INDIA

(UTTAR PRADESH STATE GOVERNMENT UNIVERSITY)

(RECOGNISED U/S 2(F) & 12(B) OF THE UGC ACT 1956 & B.TECH. APPROVED BY AICTE)

NATIONAL WORKSHOP

ON

RESEARCH METHODOLOGY FOR SOCIAL SCIENCES

One Week (26th February - 2nd March 2020)

SPONSORED BY:

U.P. STATE HIGHER EDUCATION DEPARTMENT

This to certify that Dr. / Mr. / Ms. Shubham Yadav from _____

Babasaheb Bhimrao Ambedkar University, Lucknow has contributed

as a Resource Person / Member of Organising Committee / Participant in the One Week National Workshop

on Research Methodology for Social Sciences from 26th February 2020 to 02nd March 2020.



Patron

Prof. Shubham Yadav

Vice-Chancellor



Convener

Prof. Syed Rabbil Karim

Department of Business Administration



सिद्धार्थ विश्वविद्यालय, कपिलवस्तु,
सिद्धार्थनगर, उ०प्र०-२७२२०२

इश भारतीय दार्शनिक अनुसंधान परिषद,
नई दिल्ली
ICPR

प्रतिभाषिता प्रमाण पत्र

प्रमाणित किया जाता है कि

श्री शुभम् यादव

शोध छात्र, बाबा साहब भीमराव अंबेडकर केन्द्रीय विश्वविद्यालय, लखनऊ

ने दिनांक ०८ अक्टूबर २०२० से १४ अक्टूबर २०२० तक अन्तरराष्ट्रीय बौद्ध केन्द्र, सिद्धार्थ विश्वविद्यालय, कपिलवस्तु, सिद्धार्थनगर एवं भारतीय दार्शनिक अनुसंधान परिषद, नई दिल्ली के संयुक्त तत्वावधान में **बौद्ध दर्शन का सैद्धान्तिक दृष्टिकोण - उसका ध्यानात्मक आधार, नीतिशास्त्र एवं निर्वाणतात्मक परिणाम** विषय पर आयोजित सात दिवसीय ऑनलाइन श्रवणावधि पाठ्यक्रम/कार्यशाळा में प्रतिभाषित किया।



(प्रो० सुशील कुमार तिवारी)
समन्वयक



(डॉ० पूजा नारायण सिंह)
सह-समन्वयक



(राकेश कुमार)
कुलसचिव



(प्रो० सुरेन्द्र दुबे)
संरक्षक / कुलपति

BABASAHEB
BHIMRAO
AMBEDKAR
UNIVERSITY



LUCKNOW
पञ्जाबी मीन क. क. क. क.
ESTABLISHED 1996

बाबासाहेब भीमराव अम्बेडकर विश्वविद्यालय
(केन्द्रीय विश्वविद्यालय)

विद्या विहार, राय बरेली रोड, लखनऊ - 226 025

Babasaheb Bhimrao Ambedkar University
(A Central University)

Vidya Vihar, Raebareli Road, Lucknow-226 025

Participation/Attended Certificate

Mr./Ms. **SHUBHAM YADAV** has attended/participated the special
lecture on "*Taste Based Discrimination and its Effect on Financialization
& Crime Reporting*" organised by Department of Economics, School of
Economics & Commerce (SEC), BBAU, Lucknow on 6th February 2020.

(Dr. D. K. Yadav)

Organizer

Dr. D. K. Yadav

Assistant Professor
Department of Economics
Babasaheb Bhimrao Ambedkar University
Lucknow-226025