BOTANIC GARDEN PROFILE Brindaban Botanic Garden, Hetauda, Bagmati Province, Nepal

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Abstract

Brindaban Botanic Garden (BBG) was established in 2019 BS (1962 CE) as a medicinal herbal farm under the Department of Plant Resources. The Garden is managed by the Government of Nepal and is located at an altitude of 400 m in the tropical zone of the Churiya range of Central Nepal, Hetauda-13. It was reduced to 30 ha from 96 ha in 2050 BS (1993 CE), and has evolved substantially since its inception as a location for the mass cultivation of economically important aromatic plants. It is now a diverse botanic garden, engaging in ecotourism, research, education and plant conservation. BBG has living collections of 508 plant species that support its activities. It has ten themed sections, an information display centre and a phytochemistry laboratory, and it runs active conservation programmes for three threatened species. In recent years, BBG has strengthened its role in plant research by carrying out varietal development of *Mentha arvensis* and fern propagation. The Garden's growing popularity and projected growth in visitor numbers from several districts of Nepal satisfy its objectives of providing a green space in an increasingly urbanised society and delivering science-based information about plants. This article provides a brief history of the Garden, an overview of its operations and a description of the layout of its different sections.

Introduction

The history of the establishment of botanic gardens in Nepal dates back to the mid-2010s to mid-2020s BS (1960s CE), after the late King Mahendra visited the Royal Botanic Garden Edinburgh (RBGE) (Hughes & Lamichhane, 2017) and was impressed by what he saw. Altogether, 12 botanic gardens are spread over Nepal's ecological regions, covering some 794.7 ha. They are managed under the Department of Plant Resources (DPR) and the Ministry of Forests and Environment run by the Government of Nepal (Lamichhane & Rai, 2021).

Brindaban Botanic Garden (BBG) was established in the year 2019 BS (1962 CE) and is one of the oldest of these 12 botanic gardens. It was founded under the DPR as a medicinal herbal farm that covered an area of 96 ha. Aromatic plants including *Cymbopogon citratus*, *Cymbopogon winterianus* and *Cymbopogon martinii* were cultivated and harvested for the extraction of essential oils. Later, in the year 2050 BS (1993 CE), the herbal farm areas were reduced to 30 ha and the remaining 66 ha were allocated for residential settlement to replace housing affected by severe floods.

The herbal farm continued to function until the year 2056 BS (1999 CE), when the

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DOI 10.24823/Sibbaldia.2026.3669

farm was given the name Brindaban Botanic Garden. Since then, it has functioned as a botanic garden, engaging in ecotourism, research, education and plant conservation.

Location and climate

BBG is located 4 km from the city of Hetauda in Makwanpur district. Its elevation is 400 m above sea level. The Garden is surrounded by a river on its eastern and northern sides, and to the west there is forest containing *Shorea robusta*, which is the typical vegetation of the low-lying regions of Nepal, known as the Terai. On the southern side of the Garden is the residential neighbourhood that was established following the severe floods of 2050 BS (1993 CE). The climatic conditions are categorised as mild and moderate with dry winters. The mean yearly temperature is 21.6 °C, with winter lows of 7.2 °C and summer highs of 35 °C. Annual precipitation is approximately 2,100 mm, most of which falls in July.

Staffing

BBG is a unit within the Plant Research Centre, Makwanpur, managed by the DPR. There are 25 members of staff in all, including the senior scientific officer, a garden chief, two supervising scientific officers, and a chemist and botanist. In addition, two staff members are assigned to administrative and accounting work, and seven act as assistants for various aspects of research and garden work. The remaining employees are a security guard and daily waged workers who assist in horticultural tasks. The Garden also provides workplace training for students in agriculture and forestry; research interns are taken on every year and receive training in horticulture and oil extraction.

Garden facilities and layout

BBG has a range of buildings to accommodate its main functions, and the landscape is divided into themed areas to demonstrate to visitors the ecological and cultural importance of plants (Fig. 1).



Fig. 1 View of the round garden at the entrance to Brindaban Botanic Garden. Photo: Chandrakala Thakur.

DOI 10.24823/Sibbaldia.2026.3669

At the entrance to the Garden, there is a main building that includes the office of the senior staff. The Information Centre and Museum are located in the centre of the Garden in a building that holds herbarium specimens and plant samples to demonstrate the work of the Garden to visitors. There are also four shelters distributed around the Garden to provide visitors with a place to rest and to offer protection from heavy rain or strong sun in the summer months (Fig. 2).

Nursery

Every year the Garden produces more than one lakh (100,000) seedlings of medicinal and ornamental (both annual and perennial) plants. These plants are produced from both seed and cuttings in the nurseries and polytunnel. The Garden also has three structures with solid roofs and open sides that provide protection for plants that have recently been propagated and potted up.



Fig. 2 The shelter for visitors to rest and relax. Photo: Chandrakala Thakur.

The medicinal plants are later distributed to farmers who are involved in the cultivation of such plants, whereas the ornamental plant seedlings are used within the Garden for its displays. When excess plants are available, they are distributed free to visitors.

Ceremonial Plantation Plot

The Ceremonial Plantation Plot extends over approximately 0.5 ha allocated for the plantation of tree species to commemorate special events (Fig. 3). Members of the public can purchase from a selection of native species and plant their chosen species to celebrate events significant to them. The first planting was carried out by Raghu Ram Parajuli, the former Chief Officer of the Plant Research Centre, who planted a specimen of *Santalum album* L. on his birthday. This initiative helps to generate income for BBG and attracts local families and other visitors to the Garden. This celebration of events also serves to make people aware of the importance of plants in human survival and for the protection of our environment. A total of 224 plantings have been made on the plot.

Thematic gardens

There are 12 thematic sections established within BBG. Of these, the most popular and attractive to visitors are the Maze Garden, the Hedge Garden, the Foliage Garden, the Bougainvillea Garden, the Rock Garden, the lawns and the Hibiscus Garden.

The Bougainvillea Garden was established in 2078 BS (2021 CE). It is one of the major attractions for visitors to BBG. Here 48 varieties of *Bougainvillea spectabilis* and *Bougainvillea glabra* have been planted, each supported by a cement pole. There are almost always some varieties in bloom, making the area very popular for taking videos to post on social media (Fig. 4).

DOI 10.24823/Sibbaldia.2026.3669



Fig. 3 The Ceremonial Plantation Plot provides a space for commemorating people and special events. Photo: Chandrakala Thakur.

The Maze Garden is a unique feature of BBG. The design was initially made using *Hibiscus rosa-sinensis* varieties, but due to the grazing from local deer these were replaced by *Justicia gendarussa* plants in 2080 BS (2023 CE). The plants in this plot are flourishing and enhance the maze's aesthetic appeal. This garden is a favourite among visitors, particularly with children and young adults. The maze provides a place to lose oneself and enjoy being surrounded by plants (Fig. 5).

The Rock Garden has approximately 50 xerophytic plant species and is a big attraction due to the diversity of plant forms exhibited and their contrast with native Nepali vegetation. This garden has hard landscaping features of boulders, stones, sand and pebbles to illustrate the arid conditions of the native habitats of many of these species and to support their healthy cultivation in BBG's monsoonal climate (Figs 6 & 7). Most of the plants are exotic and include *Agave americana*, *Opuntia microdasys*, *Opuntia polyacantha*, *Opuntia monacantha*, *Euphorbia tirucalli*, *Mammillaria vetula*, *Cleistocactus tupizensis* and *Cereus repandus*. The native species *Euphorbia royleana* is also cultivated in this section; this species is listed in CITES due to the demand for all parts of the plant for medicinal uses.

A significant and appealing aspect of BBG is the grassed areas, or lawns (Fig. 8). Particularly during the rainy season, these make the Garden even more attractive. Aside from the thematic gardens and the many grassed areas, the Garden is a serene and peaceful place, and these qualities add to its appeal for visitors.

DOI 10.24823/Sibbaldia.2026.3669



Fig. 4 The Bougainvillea Garden is one of the most visited and popular sections of Brindaban Botanic Garden. Photo: Chandrakala Thakur.



Fig. 5 The recently established Maze Garden planted with *Justicia gendarussa* is a popular area, particularly with children. Photo: Chandrakala Thakur.

DOI 10.24823/Sibbaldia.2026.3669



Fig. 6 The Rock Garden housing living collections of cacti and succulents. Photo: Chandrakala Thakur.



Fig. 7 Potting up cacti and succulents for the xerophytic living collection. Photo: Rup Narayan Chaudhary.

DOI 10.24823/Sibbaldia.2026.3669



Fig. 8 The lush green vegetation of Brindaban Botanic Garden. Photo: Chandrakala Thakur.

Garden activities

Living collections

BBG cultivates 508 species within the Garden. Most are grown in pots and then planted out once they outgrow them. Of the 508 species, 343 have been brought to the Garden and planted out, while the other 165 species were already growing in the Garden as part of their natural distribution. As the Garden itself is situated in the subtropical zone, most of the plants are adapted to subtropical conditions. Because of the Garden's history as a herbal farm, many medicinally important plants are cultivated. The Garden has retained its focus on this group of plants because there is a continuing need for their cultivation. Examples of species with medicinal value that are cultivated at BBG are *Rauvolfia serpentina*, *Asparagus racemosus*, *Santalum album*, *Tinospora cordifolia*, *Phyllanthus emblica*, *Aegle marmelos* and *Sapindus mukorossi*. BBG also carries out research into medicinal plants, with a recent focus on *Mentha arvensis*.

Conservation

A total of 41 species that are on the IUCN Red List of threatened species are cultivated at the Garden. Among them, a few species naturally occur in the vegetation zone of BBG. These include *Cycas pectinata* (VU), *Cyathea spinulosa* (EN), *Pterocarpus marsupium* (NT), *Rauvolfia serpentina* (NT), *Dioscorea deltoidei* (DD) and *Pterocarpus santalinus* (EN). These are the most threatened species being cultivated at BBG. The Garden also cultivates two plants endemic to Nepal, namely *Dendrobium moschatum* and *Begonia leptoptera*.

Information Display Centre

The Information Display Centre of BBG houses approximately 2,500 herbarium specimens and 1,300 museum specimens (Fig. 9). The museum specimens are mainly leaves, stems, flowers, seeds and roots of medicinal plants preserved in dry form. Parajuli *et al.* (2021) recorded 199 species of plants preserved in the museum. Each museum specimen has a label with its name (local and scientific)

DOI 10.24823/Sibbaldia.2026.3669



Fig. 9 The Information Display Centre. Local people and visitors gather information about the herbs and preserved medicinal plant specimens. Photo: Khem Raj Thapa Magar.

and information about how the parts can be used medicinally. The museum is very popular with visitors who have an interest in medicinal plants. The herbarium specimens are used by students for documentation and identification.

Phytochemistry laboratory

The Garden has a small phytochemistry laboratory, which was established in the year 2056 BS (1999 CE) and provides a facility for the extraction of oil from aromatic plants. A chemist is assigned to supervise and monitor its overall functioning. So far, almost 120 samples from aromatic plants have been extracted. Extraction is carried out to test the oil content of the various medicinal and aromatic plants. These extracted oil samples are kept in sample bottles as a reference collection.

Research and development

The Garden plays an equally important role in the field of research and development. Research efforts are focused on *Mentha arvensis* and *Gnetum montanum*, along with the edible and ornamental fern species *C. spinulosa*, *Diplazium esculentum*, *Dryopteris cochleata* and *Nephrolepis cordifolia*.

M. arvensis varieties are among the most important medicinal and aromatic plants, and they are widely distributed and cultivated throughout Nepal. They are used for flavouring food, for cosmetics, and for pharmaceutical purposes, and, as such, they are economically important sources of essential oils. Additionally, mint possesses pesticidal qualities that make it useful for treating certain bacterial and fungal plant diseases (Budhathoki *et al.*, 2020).

Research has been carried out at BBG since 2078 BS (2021 CE) with the aim of producing the best varieties of *M. arvensis* for their yield of menthol. Identification of high-menthol-yielding genotypes is the ultimate objective of this research programme. Initial research was conducted using 14 genotypes of the species. After years of evaluation and selection, three promising genotypes have been developed through the selection process.

In situ conservation of *G. montanum* has been active since 2079 BS (2022 CE). *G. montanum* is categorised as LC in the IUCN Red List (Baloch, 2011). However, the assessment noted that the species is declining globally, and it is not abundant in Nepal. Because it is collected for its medicinal qualities, it is listed in CITES Appendix III. The species was recorded at Thingan, Bakaiya rural municipality, in Makwanpur district in 2076 BS (2019 CE). After the first encounter by BBG staff,

DOI 10.24823/Sibbaldia.2026.3669

several field trips were carried out in search of the species. It was successfully reported from four more locations in Makwanpur district during 2078 BS (2021 CE) and 2079 BS (2022 CE). The number of individuals in these populations was low: three were recorded at one location, and the other sites had only one or two. Local people were unaware of the plant's rarity, and so a conservation programme to increase numbers in these populations was initiated. Seeds were collected from the Bakaiya rural municipality. Germination tests and seed sowing were carried out at BBG in 2079 BS (2022 CE). Almost 80% of the seeds germinated, and the seedlings were grown on. After a year, seedlings from seeds of each population were planted in their respective wild locations. A total of 150 seedlings of *G. montanum* have augmented the existing populations to protect the plants from grazing and cutting.

Fern propagation programme

Following horticultural training at RBGE in 2076 BS (2019 CE), the corresponding author Chandrakala Thakur embarked on the first successful fern propagation programme in DPR botanic gardens (Hughes *et al*., 2023). *Tectaria coadunata* spores were sown in the protected environment of the phytochemistry laboratory at BBG. These germinated successfully, with the formation of gametophytes and then the development of sporophytes both recorded (Thakur *et al*., 2022). The sporophytes of *C. spinulosa*, *D. esculentum*, *D. cochleata*, *N. cordifolia*, *Pteris biaurita, T. coadunata*, *Thelypteris ornata* and *Thelypteris procera* are now in cultivation at BBG (Figs 10–12).

Four species – *P. biaurita*, *T. coadunata*, *T. ornata* and *T. procera* – are now planted out in the Fern Garden. Young plants of



Fig. 10 The fern propagation laboratory. Photo: Subita Shrestha.

C. spinulosa have been distributed to three DPR botanic gardens: Dhakeri Botanical Garden at Banke, Devariya Botanic Garden at Kailali and the Urban Garden Development at Kathmandu. The transferred plants have become well established in their respective gardens and have attained a healthy stature.

Eight species of fern are propagated at BBG. Among them are four edible species of economic value, namely *D. esculentum*, *T. coadunata*, *D. cochleata* and *N. cordifolia*. Their tender leaves and stolons are sold in markets for their delicious taste, and they also have nutritional and medicinal benefits (Manandhar, 2002). It has been found that *D. esculentum* is a widely traded species in Nepal and has high market demand (Fraser-Jenkins & Kandel, 2019). *C. spinulosa* is a CITES-listed species which is in demand for its ornamental qualities. Therefore, the fern propagation programme is not only

DOI 10.24823/Sibbaldia.2026.3669



Fig. 11 Fern cultivation and knowledge exchange with horticultural staff of the Royal Botanic Garden Edinburgh. Photo: Pratigya Sharma.

important for progressing understanding of fern cultivation techniques and widening awareness of fern cultivation in Nepal, but it also reduces pressure on wild populations of these species. The sale of ferns raised at BBG to farmers interested in mass cultivation for cutting generates revenue for the Garden as well as providing a livelihood for farmers without the exploitation of wild plants.

There are plans to expand research at BBG to address the cultivation of other ornamental fern species that are in high demand for the floriculture industry. Expansion of research activities will be carried out for *C. spinulosa* and *N. cordifolia*, and for the edible species *D. esculentum* and *T. coadunata*. There are also plans to work on ornamental species that can be used in vertical gardening. Expansion of the fern cultivation programme could increase the use of ferns in landscaping and contribute significantly to strengthening conservation efforts.

Visitors

The Garden collects revenue from entrance fees and has other revenue streams arising from Nepal's Forest Rule 2079 BS (2022 CE), a regulation made under the Forest Act 2076 BS (2019 CE). The number of visitors to the Garden has grown in recent years. In the fiscal years 2079–2080 BS (2022–2023 CE) and 2080–2081 BS (2023–2024 CE), total visitor numbers were 10,211 and 27,227 respectively, while in 2081–2082 BS (2024–2025 CE), 26,795 people visited the Garden. In the following fiscal year,

DOI 10.24823/Sibbaldia.2026.3669



Fig. 12 Students gathering information about the plants of *Cyathea spinulosa* at Brindaban Botanic Garden. Photo: Chandrakala Thakur.

the Garden received 31,699 visitors. The majority of these visitors are students, who comprise approximately 62% of the total (Figs 12 & 13). The National Botanic Garden of Nepal visitor numbers have similarly grown in recent years to nearly 300,000 visits annually, indicating the potential for botanic gardens to attract visitors (Hughes & Lamichhane, 2017). Many people come to take photographs, record videos and create social media content.

Students from a variety of academic programmes, including pharmacology, forestry and botany degree courses, as well as elementary school students come to BBG to learn about plants and their significance. While at the Garden they are told about the living plants and about conservation and research programmes. Garden staff help with the processes of introduction and orientation.

Conclusions

After almost 63 years of existence, BBG is still evolving. In common with many institutions, it has gone through a number of transitions to improve and modernise its activities. The Garden has become one of the most popular tourist destinations in the city of Hetauda: people from various parts of the region visit it, as do students from all over Nepal. The thematic gardens, demonstration plots and research programmes provide a wide range of information to the visiting public and professional visitors. It has also become an attractive place to relax and walk. The Garden has some unique features in the context of Nepalese botanic gardens, having developed

DOI 10.24823/Sibbaldia.2026.3669



Fig. 13 Students on an educational visit to the Garden to enhance their knowledge about plants and botanic gardens. Photo: Milan Tamang.

themed areas such as the Maze Garden and pursued up-to-date techniques in fern propagation. Moreover, it is always looking for more innovative ways to generate revenue and appeal to visitors, and expects to make an important contribution to ecotourism for many years to come.

Acknowledgments

We are grateful to the BBG team for their valuable support and dedication to the management and maintenance of the Garden. We would also like to extend our special thanks to Kate Hughes, Horticultural Projects Manager at RBGE, for her constructive comments and thoughtful contributions during the process of writing and reviewing the manuscript.

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DOI 10.24823/Sibbaldia.2026.3669