

# Unearthing botanical bounty

In its 10-year history, **SHANGHAI CHENSHAN BOTANICAL GARDEN** has already made a big contribution to biodiversity research, plant conservation and sustainable urban development.

As the world's population and bioeconomy expand, the protection of existing habitats and species is a major challenge for sustainable development. Shanghai Chenshan Botanical Garden (Chenshan), along with its research arm, Shanghai Chenshan Plant Science Research Center, the Chinese Academy of Sciences, are committed to the ecologically-managed conservation of plants in East China and to find new sustainable solutions. "We want our research and horticulture to bring lasting benefits to humanity," said Yonghong Hu, head of the organization.

Chenshan was launched in 2010, supported by Shanghai's municipal government, the Chinese Academy of Sciences, and the State Forestry Administration. The location was an inspired choice in the planning of suburbs west of Shanghai. Named after a beauty spot in the Yangtze River Delta, Chenshan was once part of a patchwork of smallholdings and saline fishponds around an old quarry. Now this 207-hectare botanical garden has emerged with giant glasshouses, lakes, walkways and dramatic quarry cliffs, all encircled by a wide raised bank created to provide good soils for the multitude

of plants enjoyed by a million visitors each year.

## Science

Beyond the floral displays, the laboratory, herbarium and education facilities underpin the threefold mission: to conserve indigenous plants in East China, to discover sustainable uses, and to share the team's passion with the public. "We aim to align our work with national strategies, including the Belt and Road Initiative, serve Shanghai's needs for ecologically sustainable development, and actively support progress in the Yangtze River Delta," said Hu, whose vision is for a world-class centre for plant science and horticultural training, with popular public programmes.

The 80-strong research team works in three main areas in collaboration with provincial and national institutions: supporting conservation strategies, discovering sustainable plant routes to medicinal uses, and finding scientific methods to develop and cultivate plants for Shanghai's local climate.

## Conservation

The pressures of urbanization in East China make plant conservation an urgent priority,



but the scale of progress demands a systematic approach starting with sound ecological surveys and protocols based on well managed priorities. Chenshan has been designated as a National Conservation Centre, and has identified new approaches for protecting endangered indigenous plants by studying their physiology properties and genetic mechanisms, and by devising suitable cultivation technologies. It has also formulated reproducible standards and guidelines for nationwide adoption.

## Collections and Bioinformatics

Building a rich collection of plant species is fundamental to research, particularly for functional genomics. Chenshan researchers have collected 15,871 plant species belonging to 1,782 genera of 253 families from around the world. Plants significant to East China's biodiversity such as ferns, beech, orchids and *Salvia*

species are key subjects for conservation and sustainable use. A germplasm resource bank has been created as part of China's national network of germplasm banks.

The public displays showcase plants from Europe, Africa, Australia and America. The native plant conservation zone contains species native to East China. The garden is building a significant collection of bamboos, and is breeding new cultivars of magnolia, rose, and hydrangea to beautify the urban landscape of Shanghai and the neighbouring city of Ningbo.

Chenshan has built a comprehensive collection management system and created a cloud-based bioinformatics database, the iBiodiversity platform. This incorporates detailed specimen entries from seed data, field notes and other useful information. An app, 'Gardener Note', has also been developed to efficiently process plant specimens. With the

digital management system, the garden's rich plant specimen data and encyclopaedic information are available online for scientists and the public.

## Sustainable use

Based on studies of plant genomics and metabolic pathways, Chenshan has produced notable discoveries in plants with culinary and medicinal values. Known for their medicinal, aromatic and horticultural appeal, plants in the Lamiaceae family (e.g. mints and sages) are under the spotlight.

An example is *Salvia miltiorrhiza*, also known as red sage, whose roots are highly valued in traditional Chinese medicine for their therapeutic effects on heart and liver diseases. Transcriptome mining has revealed biosynthetic routes to terpenes, a class of organic compounds usually found in the essential oils of plants. The work reveals mechanisms in red sage that yield medicinal products. In

another Lamiaceae study, researchers have decoded the genetic keys to the biosynthesis of a potential anti-cancer compound in Chinese skullcap (*Scutellaria baicalensis*). Other genomics studies are looking at metabolic regulation in the bindweed and peony families that influence the synthesis of medically active compounds; similar projects are exploring the functional food values in sweet potato.

## Public education and engagement

For the public Chenshan is primarily an attractive place to spend leisure time. The plant collections, displayed in 26 thematic zones, provide seasonally changing beauty and interest. A programme of cultural and horticultural events, ranging from flower shows to concerts, continues to build awareness and attract visitors. Public education, informally, and through course activities, aims to promote the intrinsic value of plants in all our

lives. Opportunities are taken to build a deeper understanding of biodiversity and horticulture — the garden organizes more than 100 popular science events every year, attracting nearly 50,000 participants. Its summer camp has engaged more than 4,000 primary and middle school students, and received excellent feedback.

## Global ambitions

Chenshan has established partnerships with more than 20 internationally renowned botanical gardens and institutions, including Kew Gardens and the John Innes Centre in the UK, the University of California, Davis, and Morton Arboretum in the USA. Exchange activities have been organized with more than 500 domestic and international institutions. It also represents China on international bodies, including Botanic Gardens Conservation International (BGCI) and the International Association of Botanic Gardens (IABG).

## SPEARHEADING GROWTH FOR FUTURE GENERATIONS

Shanghai Chenshan Botanical Garden has:

- Published **64** monographs, and **757** papers, including **306** SCI papers
- Obtained **24** patents and **33** software copyrights
- Organized more than **30** academic symposiums
- Bred **27** new plant varieties

Together with other Asian IABG members, Chenshan enhances collaboration among Belt and Road Initiative countries by organizing a series of IABG training programmes for more than 60 professionals from 20 Asian countries, sharing the experience of managing and developing a botanical garden.

Aiming to become a world-renowned centre of botanic and horticultural excellence, Chenshan is building a training curriculum to welcome international students. The development plan aims to nurture botanists and horticulturalists. "Using plant science to meet societal needs is so important," said Hu, "We hope the progress we've made in 10 years will encourage botanists and conservationists worldwide." ■

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