

云南特色资源 植物及利用

YUNNAN CHARACTERISTIC
RESOURCES
PLANTS AND UTILIZATION



李伟 李旦 沈立新/主编



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Preface

Since ancient times, plant resources have been used to support human existence and development, and the collection and utilization of plant resources have played a key role in promoting human civilization and economic development. Ancient humans collected wild plants as important food sources, and used dry wood materials as an important energy source. In addition to feeding on wild plants, ancient humans gradually expanded the scope of the use of wild plants. They began to plant a variety of wild plants for cultivation purpose (i.e., the domestication of wild plants), which led to the origins of agricultural practices. Actually, we could find some early records of crop or fruit cultivation, processing and utilization practice from several ancient Chinese books, such as “The Book of Songs” and “Rites of the Zhou”. For instance, peaches are often mentioned in early Chinese Literature, and mounting archaeological evidence suggests that peaches are indigenous to China. Meanwhile, genetic evidence has shown that rice, soybean, buckwheat and many other crops also originated in China. As the world enters into modern civilization, the utilization of plant resources has also stepped into a new phase thanks to rapid advances in science and technology. For instance, studies on chemical composition and structure of natural components derived from plants, or research on sequencing specific genes of favorable traits in plants have greatly increased the effectiveness and applicability of research on the use of plant resources. With the world’s population continue to grow, accompanied by social, cultural and economic development, the demand for plant resources will surely increase. Since the process of selection, development and utilization of new resources derived from plants is essential for maintaining the survival and development of human society, regardless whether the specific temporal frame refers to the past, the present or the future, the utilization of plant resources should always



play an irreplaceable and important role in influencing the course of human civilization, as well as all aspects of social, cultural and economic development.

Since the start of the 21st century, the boom in biological industry across the globe has been propelled by rapid development of modern science and technology, with plant-based resources representing the solid material foundation for the development of the entire biological industry. Nowadays, rising biological industry, in parallel with the information industry, has profoundly influenced global economy and national competitiveness. Many researchers even predict that in the middle of the 21st century, the biology-based economy would exceed the information-based economy for the first time. Therefore, it is not surprising that every country in the world is actively looking for valuable plant resources in order to gain competitive advantages in terms of developing new food, medicine, energy products, industrial materials and so on. For example, the United States and many developed European countries have put an emphasis on basic and applied research involving the understanding and utilization of a wide spectrum of natural plant resources. To serve this purpose, they organize multi-disciplinary research teams using cross-industry approaches, and also expend huge amounts of human and capital resources. Also, they send well-trained researchers to Asia, Africa, South America and other regions with high levels of wild resources to conduct work on resource survey and collections.

China is one of twenty megadiverse countries in the world for its high species diversity. China covers a vast territory with highly diverse ecosystems, which begets an extremely rich level of plant resources. For example, the number of higher plants in China ranks third in the world. Forest cover in China accounts for 20.36% of the total land area, while the stock volume of forest plantations may be the largest in the world. China is also one of eight centers of origin for crop plants, with nearly 10,000 species of crops, including their wild relatives. Among them are 528 genera and 1,339 species of main cultivated plants, half of which originated in China. Actually, China is the place of origin of many important crops such as rice and soybean. Also, it represents an important center of origin and distribution of wild and cultivated fruit trees.

China has extremely rich plant resources in the world, and Yunnan province has the highest level of plant resources in China. Therefore, Yunnan province is an epitome of China's rich plant diversity. Yunnan province is located in the core area of

eastern Himalayan and northern Myanmar region, known as one of the world's biodiversity hot spots. Yunnan has very old geological history. Since the Tertiary Period, the Indian plate has crashed with the Eurasian plate, which brought rich African plant species from the South Hemisphere. The upheaval of the Himalayas and the forming of the Hengduan Mountains have led to the retreat of the Tethys, but some Tethyan plant species still survived these regions. Moreover, Yunnan province has a number of old and complicated East Asian plant species originally and regionally developed, and some tropical Indo-Malayan plant species spread along the rivers to Yunnan. During the Quaternary Period, more North Temperate plant species migrated to Yunnan province due to the glacial influence. It is the unique geological history that has enriched the diverse and complex plant species in Yunnan province. Yunnan province has the reputation of "The kingdom of wild plants", "The kingdom of wild animals", and "The gene pool of biological resources". Based on a recent statistics, 1,658 species of bryophytes, 1,325 species of pteridophytes, 116 species of gymnosperms, and 15,241 species of angiosperms are found in Yunnan province. This high level of plant diversity is really amazing (e.g., angiosperm species found in Yunnan account for 50% of total angiosperms in China), especially when we consider the fact that Yunnan province only covers 4% of China's total land area. The high richness of plant resources in Yunnan province is also reflected by diverse germplasm resources. More than 1,000 agricultural plants are cultivated in Yunnan province. Also, a wide range of their wild relatives, such as wild tea, wild rice and wild kiwifruit, could be found across Yunnan province. In particular, Yunnan has the largest and the best-preserved ancient tea gardens, and thus has been widely recognized as the birthplace of tea plant. Another notable characteristic of Yunnan's plant resources lies in their uniqueness. A variety of seed plants belonging to 243 genera are endemic to China, among which 180 genera are endemic to Yunnan, accounting for 74.1% of China's total endemic seed plants. Although most endemic species are limited to some specific regions of Yunnan province, a notable feature of specialist species with a narrow niche breadth, and their population sizes are usually small, the level of species richness is pretty high. For example, Xishuangbanna is known to have more than 150 endemic seed plant species, and the northwest region of Yunnan is known to have more than 900 endemic seed plant species. In addition, a large number of unique plant species belonging to monotypic family, monotypic genera or monotypic genus



could be found in Yunnan, which is with high research and conservation value.

Due to different precipitation and temperature conditions, the natural distribution patterns of plant resources tend to display significant regional differences. Therefore, different geographical environment, including a variety of factors such as latitude, longitude, climate, temperature, precipitation and soil nutrients, could directly or indirectly affect the quality of plant resources that live in specific areas or regions. Yunnan province is characterized by its unique highland monsoon climate, without the obvious alternation of the four seasons. Yunnan has a broad spectrum of climate types, including north tropical, south subtropical, middle subtropical, north subtropical, warm temperate, cold temperate, alpine tundra temperate, alpine desert temperate and so on. In addition, the mountainous areas are usually characterized by vertical climate zones, and such unique climate phenomenon is often described as “one mountain with four different seasons, and different climatic conditions within very few miles”. Meanwhile, the geological features of Yunnan province are characterized by high mountains, deep gorges and meandering rivers. Also, large scale of horizontal zones and vertical zones are staggered distributed, and areas with favorable climatic conditions for plant growth are bountiful. Therefore, unique physical conditions and climates in Yunnan have provided distinctive and optimal conditions for plant growth, survival, evolution and diversification. Furthermore, during the process of long-term evolution, many plant resources in Yunnan have developed their unique quality. For example, *Panax notoginseng*, which it is most commonly referred to in English as notoginseng, has a superior quality when it is produced in Wenshan, Yunnan. Another plant species, *Rhizoma gastrodiae*, has supreme quality when it is produced in Zhaotong, Yunnan. Clearly, both display a high level of effective constituents when produced in Yunnan compared to the same kinds if grow in other places.

Yunnan province is not only famous for these two high-quality medicinal plants, but also well-known for its diverse plant resources. For example, more than 2,500 wild plant species are recorded in Yunnan province, which have great ornamental value. The diversified and rich flower resources in Yunnan are valuable treasures bestowed upon us by nature, which have great potentials of utilization and commercialization. Eight genera of famous flowering plants of Yunnan include the genus of *Camel-*

lia, *Rhododendron*, *Primula*, *Gentiana*, *Orchid*, *Magnolia*, *Lilium* and *Mecnopsis*. In particular, some flowering plants of the genus *Camellia* in Yunnan are world famous. For instance, *Camellia reticulate*, a rare ornamental evergreen tree endemic to Yunnan, is famous for its large, showy and colorful flowers. Flowering plants of the genus *Rhododendron* in Yunnan are also well known for their diverse floral colors and morphologies. With the rapid economic development, the fresh flower market will undoubtedly become an important trading activity and the economic backbone for the development of Yunnan. It is worth noting here that although many precious and rare wild flowers find their distinct niches in Yunnan, they have attracted little attention so far, and we are still oblivious to their ecological and economic values.

Yunnan is one of the places in the world with the most abundant resources of wild edible mushrooms. In China, there are 938 kinds of edible mushrooms, and over 800 varieties can be found in Yunnan. Also, Yunnan owns various kinds of wild fruits and vegetables, which are not only rich in nutrition, but also pesticide-free or fertilizer-free. Around 75 genera and 1,250 species of bamboo are known to exist throughout the world. Five hundred species in 40 genera are recorded in China, of which 250 species in 29 genera grow naturally in Yunnan. They are used for multiple purposes, such as the construction material, fiber, food (edible shoots), utensils, music instruments, as well as ornamental plants. Yunnan has the largest ethnic minority population in China. These ethnic minorities have accumulated their rich knowledge and experience in terms of the use of plant resources through their long development history, which provides valuable information reference when China and the rest of the world is working hard to search and develop new products from plant resources.

In order to develop and implement a green economy strategy, and to effectively and scientifically utilize abundant plant resources in Yunnan, Yunnan government has issued the “Colorful Yunnan Conservation Action Plan (2007)”, “Lijiang Declaration (2008)”, “Tengchong Programme (2010)”, “Xishuangbanna Agreement (2012)”, “Yunnan Biodiversity Conservation Strategy and Action Plan (2012–2030)” and several other decision profiles, and has repeatedly emphasized the importance of sustainable use of diverse plant resources found in Yunnan. Meanwhile, Yunnan government has promulgated the “Biological Industry Development Plan in Yunnan”, “Opinions of Yunnan Government on Accelerating the Development of Biological Industry”,

“The Implementation and Promoting of the Development of Biological Industry Plan in Yunnan” and other documents, which reemphasizes the importance of biological industry development in Yunnan. Yunnan government has also started to develop its Big Biological Industry Development Action Plan (2014–2025), with the aim of making Yunnan as a center of biological resources, biotechnology research and product export in the world. Meanwhile, more than 60 preferential policies and measures for the development of biological industry, which cover the aspects of financial support, taxation reduction, land use, as well as talent introduction and recruitment, have been developed to support the development of biological industry in Yunnan.

As China’s highest academic institution, the Chinese Academy of Sciences has two research institutes and three botanic gardens that are specialized in plant research, among which one research institute (the Kunming Institute of Botany) and one botanic garden (Xishuangbanna Tropical Botanical Garden) is located in Yunnan. At present, there are 206 scientific research institutes in Yunnan that are related to the development and utilization of plant resources. For example, Kunming National Biological Industrial Base in Kunming, Yunnan had 670 enterprises by 2014, including the Yunnan Baiyao (Group) Co, Kunming Pharmaceutical Corp, Walvax Biotechnology Co, Kunming Dihon Pharmaceutical Co, Yunnan Sunpa Image Transmission Technology Co, and Yunnan Oriental Bioengineering, with 75 of the enterprises in production. The Kunming National Biological Industrial Base has been working with universities and institutions such as the Chinese Academy of Sciences (CAS) Kunming branch, the Chinese Academy of Medical Sciences Institute of Medical Biology, the CAS Kunming Institute of Botany and Kunming Institute of Zoology, the Yunnan Institute of Materia Medica, Kunming University of Science and Technology, Kunming Medical University, and Yunnan Agricultural University, all of which have provided a solid foundation in terms of scientific and technological support for the base.

Although Yunnan province is endowed with very rich plant resources, our capacity to protect these valuable resources and to utilize them in a sustainable way is still weak. On the one hand, the unsustainable use and over exploitation of natural resources could lead to the local extinction of many endemic and threatened plant species, and the losses of these species would further cause damage to certain ecosystem

functions and services. On the other hand, inefficient utilization of plant resources is a common phenomenon in Yunnan. For example, the sale of raw or crude products instead of refined or finished products is not only a waste of precious resources, but also significantly reduces marketing competitiveness. Therefore, it is time for us to think an essential question—how to protect precious plant resources found in Yunnan, and use them in an efficient and sustainable way?

The aim of the present work, of course, is not to address this serious question, because such big topic goes beyond our scope. However, we strive to collect information about some precious plant resources found in Yunnan with high values, and possibly, with high marketability potential, and thus provide some necessary basis for scientific research and possible advices on resource development planning in the future. Since Yunnan has extremely rich plant richness, our work could not cover every kind of plant species. Instead, our study objectives refer to the vascular plants (i.e., ferns, gymnosperms and angiosperms). Although green algae, bryophytes and other types of plants are not included in our study, it does not mean that their values are not important when compared to vascular plants. However, because the basic information about these plants is extremely lacking, we have to exclude them from the present work. Similarly, Yunnan has very diverse and abundant resources of wild edible mushrooms. However, since five kingdom classification system divides species into five kingdoms, namely, Animalia, Plantae, Fungi, Protista and Monera, with Plantae and Fungi explicitly separated, this is the main reason why fungi species are not included in the present work either. Also, because some plant species endemic to Yunnan are with limited geographical distribution or population size, they are often listed as national or provincial key protected wild plants. Regarding such species, we should not focus on exploring their monetary values. Instead, the priority of current work is to protect them in a strict and effective manner.

According to different criteria, plant resources could be categorized differently. For instance, in accordance with the statue conditions, plant species could be divided into resources of mosses, ferns, shrubs and vines, trees, and herbs. According to the forms of their existence in nature, plant species could be divided into vegetation, species or germplasm resource. However, it is widely accepted that plant resources could be classified according to their functional uses. For example, the book “Chi-



na's economic plants" developed by CAS classified plants as fiber, oil, starch, tannic, aromatic and medicinal plants. When we classify plant resources found in Yunnan according to their functional use, we follow a principle that the emphasis should be put on plant resources in Yunnan with significant functional and economic values. For the present work, plant resources of Yunnan are classified as five major categories, including medicinal plant resources, edible plant resources, ornamental plant resources, timber and non-timber plant resources, as well as plant resources for the production of aromatics, bioenergy, and some basic chemical raw materials. For each category, subcategories are created if needed. For example, the category of edible plant resources is further divided into some subcategories, such as wild edible vegetable resources, wild edible fruit resources, wild plant resources used for producing functional and healthy food, wild edible spice plant resources, and wild edible pigment plant resources.

With the classification of five major categories of plant resources, we then collect the information of relevant plant species belonging to each category, including their Latin name, common name, current conditions (e.g., distribution, abundance, the extent of utilization), and the major use. For us, this is a huge work that requires a lot of time and effort. Eventually, we have established a species list, with 300–500 species for each major category of plant resources. We have also consulted with many experts with great expertise and experience in the protection and utilization of plant resources. We ask them to check the list of plant resources we have made, and to make sure that all important plant resource species have been included in the list. If not, we will add more species as suggested. In order to collect more information, our project members also carried out field surveys and personal interviews across Yunnan province. For example, we interviewed many researchers, business executives, and local government officials from the Department of Forestry, Agriculture, and Industry Development Office. Also, we conducted surveys on local farmer markets. In sum, through desk research, expert interviews and field surveys, we have improved the quality of collected information, and obtained some new understanding regarding the protection and utilization of many plant resources in Yunnan. It is our hope that our work could help provide some necessary basis for scientific research on plant resources and possible advices regarding their development planning in Yunnan province.



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1

云南省植物资源概述

1.1 云南生物多样性资源简介

云南地处我国西南边陲，与缅甸、老挝、越南接壤，国境线长4060千米，国土面积39.4万平方千米。境内高山峡谷相间，山川湖泊纵横，植被类型复杂。在低纬度高海拔地理条件和季风环流因素的综合影响下，云南的气候具有四季温差小、干湿季分明、气候垂直变化显著的低纬山原季风气候特点，垂直气候带特征突出，气候类型多样。云南不光有着丰富的土壤资源，而且全境内土壤垂直分布明显，并伴有水平与垂直地带交错分布的现象。云南特殊的地理位置和复杂的自然环境，为各种生物的起源、演化和繁衍提供了适宜的生境，孕育了极为丰富的生物资源，是我国17个生物多样性关键地区和全球34个物种最丰富的热点地区之一，生物多样性的丰富程度傲居全国之首，备受国内外的高度关注。如亚洲象、印度野牛、绿孔雀等多种珍稀野生动物在我国仅分布于云南。同时，云南境内还生活着大批孑遗种、特有种和稀有种，成为许多重要物种类群起源、分化及分布的关键地区之一。

云南的生物多样性特点首先体现在其丰富程度上。就生态系统类型