

### 5.3 Applications of genomic editing for enhanced conservation

Genomic editing technologies, such as CRISPR-Cas9, TALENs, and zinc-finger nucleases, offer promising applications for the conservation of tea plant genetic resources. These tools enable precise modifications of the plant genome, allowing for the enhancement of desirable traits such as disease resistance and stress tolerance (Niazian, 2019). By targeting specific genes, genomic editing can help develop tea plant varieties that are better adapted to changing environmental conditions and have improved agronomic traits.

Moreover, genomic editing can be used to manipulate secondary metabolite pathways, potentially leading to the production of tea plants with enhanced flavors or health benefits (Niazian, 2019). This approach not only aids in conservation but also adds value to the tea industry by creating novel plant varieties with unique characteristics. As these technologies continue to advance, they hold significant potential for improving the conservation and utilization of tea plant genetic resources.

## 6 Case Study: Preserving Indigenous Tea Varieties in Yunnan, China

### 6.1 Background and significance of yunnan tea varieties

Yunnan Province is recognized as a pivotal region for the origin and diversity of tea plants, particularly *Camellia sinensis* var. *assamica*. This region is home to a rich array of tea germplasm resources, which are crucial for maintaining genetic diversity and supporting tea research and breeding programs. The genetic diversity found in Yunnan's tea varieties is not only significant for the local economy but also for global tea cultivation, as it provides a genetic reservoir that can be utilized for developing new cultivars with desirable traits such as disease resistance and improved flavor profiles (Lu et al., 2021; Pang et al., 2021). The ancient tea populations in Yunnan have been cultivated for centuries, contributing to the cultural and agricultural heritage of the region.

The genetic makeup of Yunnan tea varieties is characterized by high levels of diversity, which is essential for the adaptability and resilience of tea plants to changing environmental conditions. This diversity is reflected in the wide range of phenotypic traits observed among the tea plants, including variations in leaf size, shape, and chemical composition (Lei et al., 2022; Jiang et al., 2023). The preservation of these indigenous tea varieties is vital for sustaining the biodiversity of the region and for the continued development of the tea industry both locally and internationally (Long et al., 2003).

### 6.2 Conservation efforts by local communities and research institutes

Efforts to conserve the indigenous tea varieties in Yunnan involve both in situ and ex situ strategies. In situ conservation focuses on protecting the natural habitats of wild tea populations and maintaining traditional agroecosystems where native species and varieties are cultivated (Long et al., 2003). This approach is complemented by ex situ conservation methods, such as the establishment of germplasm banks and living collections, which serve as repositories for genetic material that can be used in future breeding and research efforts (Lu et al., 2021; Pang et al., 2021).

Local communities play a crucial role in these conservation efforts by preserving traditional knowledge and practices related to tea cultivation. This indigenous knowledge is invaluable for maintaining the genetic diversity of tea plants and for ensuring the sustainable use of these resources. Bai et al. (2024) first used Maxent to screen the regions where traditional germplasm resources are located and then constructed layers of the socio-economics factors included farmers' livelihoods, local knowledge, and traditional culture, respectively, to further obtain the potential areas. Research institutes in Yunnan have also been actively involved in documenting and evaluating the genetic diversity of tea germplasm, which aids in identifying superior and rare germplasm for conservation and utilization. Collaborative efforts between local communities and research institutions are essential for the successful preservation of Yunnan's tea heritage.

### 6.3 Lessons learned and recommendations

The preservation of indigenous tea varieties in Yunnan has highlighted the importance of integrating traditional knowledge with modern scientific approaches. One of the key lessons learned is the need for a comprehensive strategy that combines both in situ and ex situ conservation methods to effectively safeguard genetic resources