

between tea plants and their environment, including the development of simulation models to predict climate impacts and guide breeding programs. Furthermore, integrating biodiversity and ecosystem-based approaches can enhance the resilience of tea plantations to climate change, thereby preserving genetic diversity (Chowdhury et al., 2021).

### **3.2 Habitat loss and agricultural expansion**

The expansion of agricultural land for tea cultivation has led to significant habitat loss and fragmentation, posing a threat to tea plant genetic diversity. The conversion of natural habitats into tea plantations reduces biodiversity and disrupts ecological processes, which are vital for maintaining genetic variation within tea populations (Dai, 2021). This habitat loss is particularly concerning in regions where tea cultivation overlaps with the habitats of endangered species, such as the Asian elephant in southwestern China, highlighting the need for careful land-use planning and conservation efforts.

To address these challenges, it is crucial to adopt agroecological practices that promote biodiversity within tea plantations. This includes incorporating native shade trees, maintaining habitat diversity, and implementing organic farming practices that reduce the environmental impact of tea cultivation (Hajiboland, 2017). By creating a mosaic of landscapes that support both tea production and biodiversity, it is possible to mitigate the negative effects of agricultural expansion on genetic diversity.

### **3.3 Overexploitation and monoculture practices**

Overexploitation and monoculture practices in tea cultivation can lead to a reduction in genetic diversity, making tea plants more susceptible to pests, diseases, and environmental changes. Monoculture systems often rely on a limited number of high-yielding cultivars, which reduces the genetic pool and increases vulnerability to biotic and abiotic stressors. This lack of genetic diversity can result in significant economic losses due to crop failures and decreased resilience to changing environmental conditions (Pandey et al., 2021).

To counteract the effects of monoculture, it is essential to promote the cultivation of diverse tea varieties and implement integrated pest management strategies that reduce reliance on chemical inputs (Pandey et al., 2021). Encouraging the use of traditional and indigenous tea varieties can also help preserve genetic diversity and enhance the resilience of tea plantations. By fostering a diverse genetic base, tea cultivation can become more sustainable and better equipped to withstand future challenges posed by climate change and other environmental stressors.

## **4 Conservation Strategies for Tea Plant Genetic Resources**

### **4.1 In situ conservation approaches**

In situ conservation involves preserving tea plant genetic resources within their natural habitats, ensuring that the plants continue to evolve and adapt to environmental changes. This strategy is crucial for maintaining the ecological interactions and evolutionary processes that sustain genetic diversity. In situ conservation can be implemented through the establishment of protected areas, such as national parks and reserves, where tea plants and their ecosystems are safeguarded from anthropogenic threats like deforestation and land conversion (Wyse et al., 2018). This approach not only helps in preserving the genetic diversity of tea plants but also supports the conservation of associated biodiversity, which is essential for ecosystem stability.

Moreover, in situ conservation is often complemented by community involvement, where local communities are engaged in the management and protection of natural habitats. This participatory approach ensures that conservation efforts are sustainable and culturally appropriate, as local knowledge and practices are integrated into conservation strategies. By involving communities, conservation programs can also address socio-economic challenges, providing alternative livelihoods that reduce pressure on natural resources (Wyse et al., 2018).

### **4.2 Ex situ conservation in seed banks and gene banks**

Ex situ conservation is a vital strategy for preserving tea plant genetic resources outside their natural habitats. This method involves the collection and storage of seeds, tissues, or other plant materials in seed banks and gene banks,