

2 Production Status and Ecological Characteristics of Legume Crops in Zhejiang Province

2.1 Planting structure and regional distribution of legume crops in Zhejiang Province

Legume crops occupy an important but structurally differentiated position within Chinese cropping systems, and Zhejiang should be understood within this broader pattern. In China, pulses are commonly embedded in rotation, intercropping, and mixed-cropping systems, which gives legumes value not only as food crops but also as flexible components of diversified farmland use. The major food legume groups grown nationally include pea, faba bean, common bean, mung bean, adzuki bean, and cowpea, together with a wider set of locally distributed minor legumes, indicating that species choice is closely tied to local ecological and market conditions. For Zhejiang, this implies a planting structure in which soybean, mung bean, adzuki bean, cowpea, and vegetable-type legumes are more likely to coexist than to form a single dominant dry-grain system, especially under intensive land use and multiple-cropping conditions. At the national scale, soybean planting is also organized by agroecological zones, and the middle-lower Yangtze River double-cropping ecoregion is recognized as one of the major soybean production zones in China, which places Zhejiang within a wider south-eastern soybean adaptation belt (Mei et al., 2024).

From the perspective of spatial distribution, legume planting in Zhejiang is likely to show obvious regional heterogeneity because crop layout in China generally responds to both natural suitability and comparative economic return. Studies of crop planting structure in other Chinese regions show that spatial allocation is shaped by climate, geography, and population-related factors, and that optimizing crop distribution requires attention to county- or regional-scale differences rather than uniform provincial planning. Remote-sensing evidence from major grain regions further shows that higher-benefit crops tend to concentrate in locations with better accessibility and stronger production conditions, while less competitive crops contract or shift spatially when relative profitability declines (Liu and Wang, 2022). Applied to Zhejiang, this suggests that vegetable legumes and fresh-use beans are more likely to cluster in peri-urban plains and developed horticultural belts, whereas dry-grain legumes are more likely to persist in hilly areas, upland fields, or as rotation crops within smaller and more fragmented farming systems. In recent decades, reduced profits have caused decreases in the sowing area of some dry food legumes in China, while vegetable food legumes have expanded because of stronger market demand and shorter growth duration (Figure 1).

2.2 Agro-ecological characteristics

Zhejiang belongs to China's subtropical agricultural zone, and its agro-ecological background is generally characterized by abundant heat and rainfall occurring in the same season, a combination that strongly supports intensive cropping but also increases ecological sensitivity. Research on China's subtropical region shows that this broad zone has synchronous hydrothermal conditions and serves as one of the country's traditional agricultural cores (Chen et al., 2025). Comparable studies from humid subtropical production areas show annual precipitation concentrated in the April-October growing season and high overlap between peak temperature and rainfall. For legume crops in Zhejiang, such conditions are generally favorable for rapid biomass accumulation and multiple cropping, but they also mean that excess moisture, cloudy-rainy periods, and strong seasonal fluctuations can affect sowing dates, flowering, pod setting, and harvesting stability.

At the same time, Zhejiang's ecological suitability for crops is shaped not only by climate but also by topography and soils. A land ecological suitability analysis conducted specifically in Zhejiang selected annual mean temperature, accumulated temperature above 10 °C, extreme low temperature frequency, humidity, slope, aspect, altitude, soil type, and soil texture as key determinants of crop distribution, showing that provincial crop suitability depends on the joint action of climate, terrain, and edaphic factors. The same study demonstrated that GIS-based suitability zoning can effectively reproduce the current distribution of crops in Zhejiang, indicating strong spatial differentiation in ecological adaptation across the province. This is especially relevant for legumes because the province includes plains, river valleys, coastal zones, and hilly or mountainous land, so temperature resources, drainage conditions, and soil physical properties are unlikely to be uniform. In such a setting, differences in ecological niche among legume species are expected to translate directly into differences in regional yield level and yield stability.