

to grain-yield variation. This pattern has been observed in soybean multi-location trials, where grain yield ranged from 979.8 to 3645 kg·ha⁻¹ and significant differences were detected among genotypes, environments, and GEI. Comparable results were reported for common bean, where AMMI analysis confirmed that grain yield changed significantly across environments and supported the identification of both broadly adapted and specifically adapted genotypes (Daemo, 2024).

Agro-ecological Zoning and Multi-environment Trial Sites for Legume Yield Stability Evaluation in Zhejiang Province, China

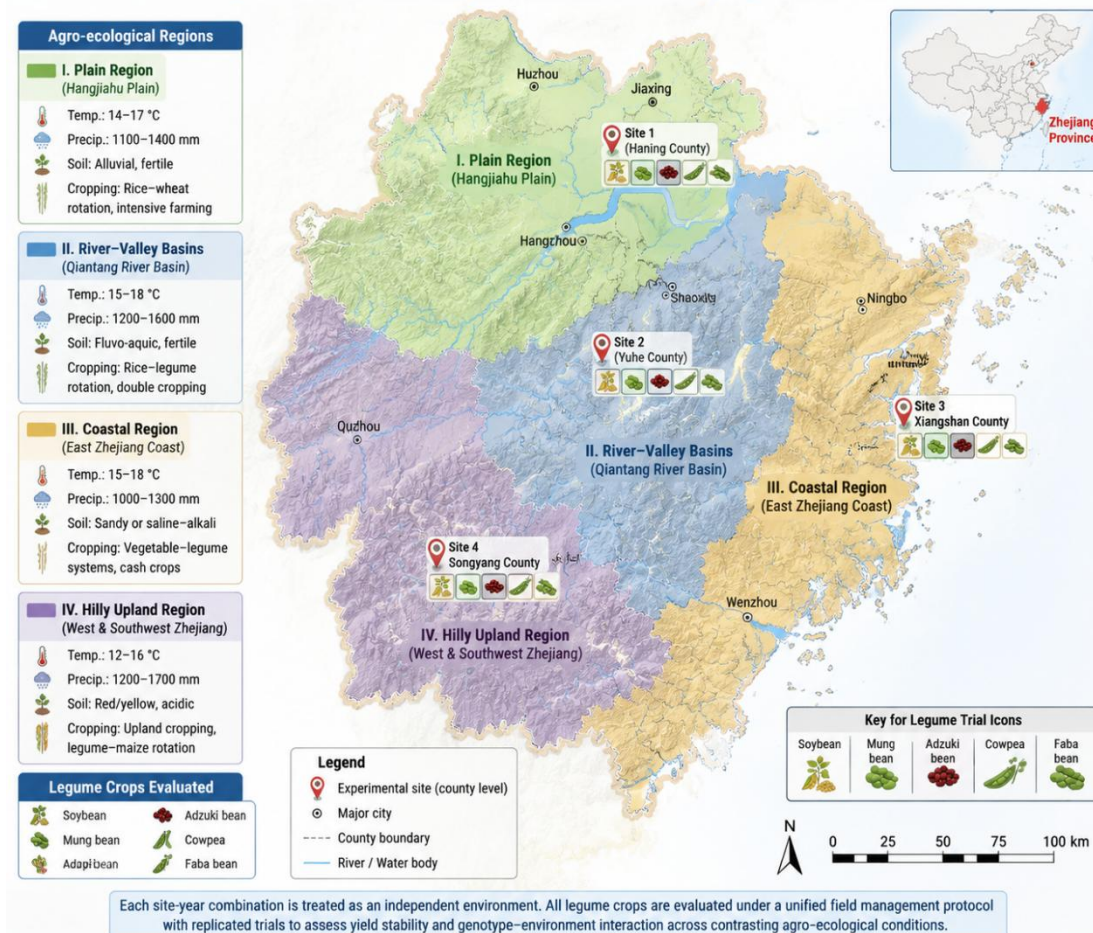


Figure 3 Agro-ecological zoning and representative multi-environment trial locations for evaluating legume yield stability across Zhejiang Province, China. The map highlights contrasting production environments including plains, river valleys, coastal zones, and hilly uplands

A second likely pattern is that some legume crops or varieties will be broadly adaptable across Zhejiang, while others will perform best only in certain ecological zones. In faba bean, GGE biplot analysis identified genotypes with low GEI and broad adaptability, showing that materials less affected by environmental fluctuation are more reliable across diverse sites (Wondaferew et al., 2024). In southern China pea trials, the tested environments were partitioned into two mega-environments, and some genotypes were stable across many sites while others showed clear specific adaptability to particular environments. For Zhejiang, this implies that soybean or mung bean may perform more steadily across multiple regions, whereas adzuki bean, cowpea, or pea may express stronger ecological specialization depending on thermal and moisture conditions.

7.3 Implications and optimization

The main implication of the Zhejiang case study is that production recommendations should be based on region-specific matching of crop type and ecological setting, rather than on a single provincial ranking of legume crops. Work from other Chinese ecological regions shows that the best-performing legume mixtures differed among locations, and the recommended crop combinations were therefore region-specific rather than universal