4.3 Reduction of production costs and grain losses

The economic value of mechanization should not be measured only by lower labor input per hectare. In many rice regions, the larger gain comes from replacing uncertain, fragmented, or delayed operations with reliable service. Smallholders often cannot justify separate investment in nurseries, transplanting machinery, dryers, storage, and processing facilities. Service centers lower that barrier by spreading fixed costs across a larger service area. This is one reason agricultural socialized services matter so much in Chinese smallholder systems. They do not eliminate smallholders; they lower the cost of connecting them to modern agriculture (Zeng et al., 2025; Liao et al., 2025).

Loss reduction is equally important. Qu et al. (2021) showed that rice losses accumulate across the harvest process, including reaping, threshing, winnowing, transportation, and storage transfer. In a service-center context, grain loss is reduced not only because machines are faster, but because operations are organized in sequence. Prompt harvesting followed by immediate drying is far more effective than improving either link alone.

Mashan's emergency harvest case illustrates this clearly. The center did not merely send harvesters into the field; it paired harvest rescue with large-scale drying. That combination matters, especially under typhoon conditions, when wet grain can deteriorate rapidly after harvest. The center's expansion from 10,000 tons to 18,000 tons of annual drying capacity also suggests that the operators understood postharvest loss reduction as a core public and economic function, not as a secondary activity. In applied terms, this is one of the strongest arguments for full-process rather than partial mechanization: effective systems reduce both visible labor costs and less visible losses.

4.4 Promotion of green agricultural development and resource utilization efficiency

Green agricultural development is often discussed in broad policy language, but at farm scale it usually depends on a few concrete conditions: reducing unnecessary input use, improving operational precision, lowering waste, avoiding weather-related loss, and organizing production in ways that use land, labor, and machinery more efficiently. In rice systems, agricultural socialized services have been shown to encourage greener behavior among smallholders, while broader work on grain systems in China suggests that mechanization can support improved grain production capacity and resource-use efficiency when it is combined with organized services and coordinated operations (Liu and Li, 2023; Shi et al., 2023).

There is also emerging agronomic evidence that some mechanized rice cultivation systems can align productivity with environmental goals. A recent field study from the Taihu Lake region found that rotary tillage plus mechanical transplanting produced higher and more stable rice productivity while maintaining lower methane emissions and lower yield-scaled global warming potential than plowing plus mechanical transplanting. The exact agronomic conditions of that experiment differ from those at Mashan, but the broader implication is important: mechanization and greener outcomes are not inherently contradictory. The outcome depends on how tillage, planting, timing, and management are combined.

In Mashan, the green effect of full-process mechanization appears through organization. Centralized seedling production avoids repeated household-level preparation. Mechanized transplanting improves timeliness. Technical service encourages more standardized field management. Professionalized plant protection makes it easier to target inputs. Combine harvesting and centralized drying reduce avoidable loss of grain already produced. Storage and processing prevent further postharvest waste and create a traceable pathway to market. Green development in this sense is not a separate project added after mechanization. It emerges when mechanization is used to raise the efficiency of the whole chain and to reduce wasted labor, wasted grain, and wasted operations.

5 Case Analysis of Mechanization Application in Mashan Agricultural Service Center

Before discussing the individual cases, one limitation should be stated clearly. The four cases below are based mainly on two internal project briefs supplied with the manuscript materials and on field photographs (Table 2). These are operational management materials rather than independently audited datasets. They are therefore used here as descriptive case evidence, not as a statistical basis for causal inference. Their value lies in showing how the center works in practice.