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Discussion on the Operational Model of Modern Agricultural Service Centers in Socialized Rice Production Services

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Abstract Modern agricultural service centers are becoming increasingly important in China's rice sector because they help solve a practical problem that many rural regions now face: rice production still matters, but the traditional household-based way of organizing it is under growing pressure from labor transfer, aging farm populations, fragmented land, tighter operation windows, and rising quality requirements. Focusing on Mashan Agricultural Service Center in Shangyu District, Zhejiang Province, this paper discusses how a modern agricultural service center operates in socialized rice production services and why such a model matters for contemporary agricultural modernization. The study combines policy documents, recent academic literature, and descriptive case materials from Mashan, including project briefs and field-based operational records. Rather than treating the center as a simple site for machinery storage, the paper analyzes it as a regional service platform that links centralized seedling cultivation, machinery dispatch, full-process trusteeship, drying and postharvest handling, technical guidance, and market-oriented branding. The results suggest that the practical value of a modern agricultural service center lies in organizational coordination. Its core contribution is to connect small-scale farmers with standardized, timely, and professionally managed production services without requiring every household to independently invest in costly facilities and equipment. The Mashan case shows that such centers can improve production efficiency, reduce labor burdens and transaction costs, strengthen emergency response under typhoon and harvest pressure, support greener and more standardized production, and create a foundation for regional rice brands. At the same time, their operation still faces constraints, including high capital intensity, shortages of skilled technical personnel, uneven service uptake across different farmer groups, limited digital management capacity, and growing climate risks. The paper argues that future development should focus on stronger regional coordination, useful digital tools, systematic talent training, deeper integration of postharvest and branding functions, and more explicit emergency-service design. In this sense, the modern agricultural service center is not just a service facility. It is an institutional bridge between smallholder farming and a more resilient, efficient, and quality-oriented rice production system.

Keywords Modern agricultural service center; Socialized agricultural services; Rice production; operational model; Zhejiang Province

1 Introduction

China's rice production is changing in a way that is both familiar and easy to underestimate. Rice remains a strategic staple crop, but the conditions under which it is produced are no longer the same as those that shaped the traditional household farming model. Rural labor has continued to move into non-farm sectors, the average age of those remaining in agriculture has risen, production costs have gone up, and farmers often manage multiple scattered plots rather than one unified operational unit. At the same time, public policy has become more demanding rather than less demanding: local agriculture is now expected not only to keep grain output stable, but also to become more efficient, greener, more standardized, and more responsive to market quality preferences (Tang et al., 2022). In rice farming, where missing a transplanting or harvesting window can have immediate consequences, these structural shifts have made the organization of services almost as important as the organization of land.

This is the context in which agricultural socialized services have expanded. In the Chinese setting, these services usually refer to specialized production services supplied by cooperatives, service organizations, agricultural enterprises, or village-level operating entities to farm households that still retain land rights and production interests. Recent studies have shown that such services can improve technical efficiency, encourage sustainable practices, raise land productivity, and help smallholders remain connected to modern production systems without being forced into a single large-farm model (Huan et al., 2022; Yang and Li, 2022; Cai et al., 2024). In other words, the key issue is no longer simply whether agriculture will mechanize, but how access to mechanization, agronomic guidance, drying, storage, and postharvest handling can be organized in a way that works for a landscape still dominated by small and medium-scale producers.

Zhejiang Province offers a particularly useful setting for discussing this problem. It is economically developed, highly urbanized, and agriculturally under strong pressure to modernize through quality and organization rather than through simple land expansion. Yet Zhejiang has also moved quickly to build modern agricultural service centers as regional infrastructure for socialized production services. Provincial policy now explicitly encourages service centers to provide integrated support such as full-process mechanized operation, centralized seedling raising, drying, storage, processing, training, and emergency services, while local districts like Shangyu have paired these broader goals with concrete support measures for rice machine transplanting, grain security, and high-quality rice development. This makes Zhejiang a good place to examine not only whether service centers exist, but how they actually function.

Although the literature on mechanization services and agricultural socialized services has grown rapidly, much of it still emphasizes outcomes such as yield, technical efficiency, fertilizer reduction, or machinery use. Those studies are valuable. They show that services matter. Yet they often say less about the concrete operational model of the service center itself: how functions are bundled, how teams are organized, how seedling, harvesting, drying, and training are coordinated, and how a center works as a regional institution rather than as a single business unit.

This study takes Mashan Agricultural Service Center in Shangyu District, Zhejiang Province, as a case to explore the operational model of modern agricultural service centers in socialized rice production services. By combining policy documents, recent academic literature, and practical case materials, the study examines the main service functions, organizational structure, and operational mechanisms of the center. Particular attention is given to how different service links, including seedling cultivation, machinery operation, grain drying, technical guidance, and postharvest management, are integrated into a coordinated service system. The purpose of this study is to summarize the practical experience of modern agricultural service centers, evaluate their role in improving rice production efficiency and supporting agricultural modernization, and identify the main challenges affecting their sustainable development. It is expected that the findings will provide useful references for the improvement of agricultural socialized service systems and the future development of modern rice production in China.

2 Development Background of Modern Agricultural Service Centers in Rice Production

2.1 Transformation of traditional rice production modes

Traditional rice production in China was historically built on household labor, manual coordination, and highly localized experience. That model worked under conditions where rural households had relatively abundant family labor, local production rhythms were strongly village-based, and the gap between production and postharvest treatment was much smaller than it is today. But the present situation is different. Rice still provides an essential foundation for food security, yet the typical household now faces much tighter constraints in labor availability, operation timing, and cost control (Tang et al., 2022).

Three changes stand out. The first is labor restructuring. Rural labor migration has reduced the number of people available for time-sensitive field work, and those who remain are, on average, older than before. Studies from Chinese grain-producing regions show that aging and labor transfer now directly shape technology demand, production organization, and outsourcing behavior in farm operations (Shen et al., 2024; Li et al., 2023). The second change is fragmentation. Even where total household-managed land is not extremely small, it may be split into multiple plots with different road access, irrigation conditions, and operational convenience. This makes coordinated fieldwork more expensive and reduces the efficiency of household-level machinery ownership. Recent analysis from Jiangsu suggests that both land-scale and service-scale operations matter, and that their interaction can significantly reduce per-unit machinery costs in rice production (Fu and Yang, 2025). The third change is quality pressure. Rice production is no longer judged only by whether grain is harvested. It is increasingly judged by whether the product can meet expectations for stable quality, safe postharvest handling, and recognizable market identity (Tang et al., 2022).

This transformation has made the traditional "each household manages every step for itself" pattern less workable. Timing is especially important in rice. Seedling preparation, transplanting, pest control, harvesting, and drying all have narrow operational windows. Once labor becomes scarce and plots remain scattered, households face higher coordination costs even before actual field work begins. It is one thing to own land; it is another to ensure that all necessary services arrive on time, in sequence, and at an acceptable quality level. That distinction explains why the transformation of rice production is not only about scaling up land, but also about reorganizing services.

2.2 Demand for socialized agricultural services in rice farming

The demand for socialized agricultural services in rice farming has grown because these services solve problems that individual households increasingly struggle to solve alone. At its core, socialized service is a way of making modern production inputs and operations available without requiring every farmer to own every machine, dryer, nursery system, diagnostic skill, and postharvest facility. In a fragmented and labor-constrained environment, that is not a marginal convenience. It is often the only realistic path to timely and standardized production.

Recent evidence makes this quite clear. Agricultural socialized services have been shown to improve the technical efficiency of smallholder rice producers, especially where farmers face production bottlenecks in machinery access and management quality (Cai et al., 2024). Other studies show that socialized services can encourage the adoption of sustainable agricultural practices, reduce fertilizer input, promote land protection, and increase land productivity when service supply matches the production needs of farmers (Huan et al., 2022; Cheng et al., 2022; Yang and Li, 2022). The logic is straightforward. When production services become specialized, providers can invest in better equipment, accumulate operational experience, and spread fixed costs across a larger service area. Farmers, in turn, can buy access to capability rather than capability itself.

In rice farming, this demand is particularly strong because production stages are tightly connected. Delays in seedling supply affect transplanting; poor field management affects pest pressure and uniformity; slow harvesting increases losses; and inadequate drying can damage the value of grain already produced. It is therefore misleading to think of rice service demand as being limited to one or two isolated operations. A farmer may begin by demanding harvesting service, but what actually matters is often a chain: seedling, transplanting, spraying, harvesting, drying, and sometimes even marketing. Once this chain perspective is adopted, the value of a coordinated service system becomes obvious.

Another reason demand has increased is the changing economics of fixed investment. High-quality dryers, transplanting equipment, nursery facilities, storage systems, and repair capacity are expensive. Their value depends on scale, but many households cannot justify such investment on their own land area. This is exactly why service-platform models are expanding. They pool demand, reduce duplication, and turn capital-intensive technology into shared regional infrastructure. In that sense, socialized services do not simply help farmers save labor. They reduce the threshold for entry into modern agriculture.

2.3 Policy support for modern agricultural service centers in Zhejiang Province

Zhejiang Province has actively formalized this service logic through policy. In 2024, the provincial government issued opinions on accelerating the construction of modern agricultural service centers, making clear that these centers should serve as important platforms for full-process agricultural services, including mechanized operation, centralized seedling raising, postharvest drying, storage, processing, technical guidance, and training. The policy direction is important because it does not treat service centers as isolated infrastructure projects. It treats them as nodes in a regional agricultural service network.

The Zhejiang policy framework is especially notable for two reasons. First, it emphasizes service proximity and regional coverage. The idea of a local service radius is crucial in rice production because time-sensitive operations lose value if machinery, seedlings, or drying capacity arrive too late. Second, the policy ties service center construction to broader goals of agricultural modernization, green development, emergency capacity, and digital management. This means the service center is expected to do more than dispatch machines. It is expected to act as a local platform for coordinated agricultural support.

Shangyu District reflects this provincial direction at the district level. The district's 2024 early-rice machine-transplanting subsidy scheme explicitly aimed to raise machine-transplanting rates, stabilize grain production, and strengthen production capacity through targeted support for transplanting operations. Meanwhile, Shangyu's 2024 development statistics continued to frame grain production, high-standard farmland, and agricultural modernization as strategic tasks rather than residual rural issues. Zhejiang's 2024 notice on leading agricultural varieties and major promoted technologies likewise signals that modernization in the province is expected to combine better varieties, better organization, and better service support.

For rice production specifically, this policy environment matters because it legitimizes service integration. It allows a service center to combine nursery work, machinery operation, drying, and technical assistance within one operational system instead of treating each as a separate administrative line. That is one reason why Zhejiang is a particularly useful province for examining how modern agricultural service centers function in practice.

2.4 Relationship between agricultural service centers and agricultural modernization

Agricultural service centers are closely tied to agricultural modernization because they provide a way to modernize production without assuming that all producers will become large-scale owner-operators. This is an important institutional point. In many Chinese regions, modernization is not happening through the disappearance of smallholders. It is happening through new arrangements that allow smallholders, cooperatives, and service organizations to operate together within a more professional and standardized system (Li et al., 2024; Zeng et al., 2025).

From a production perspective, service centers support modernization in at least four ways. First, they improve continuity across production stages. Modern agriculture depends not only on advanced inputs, but on correct sequencing. A service center can connect pre-production, in-season management, and postharvest handling more reliably than a set of disconnected providers. Second, service centers make technology more accessible. Farmers who cannot afford their own dryers or nursery systems can still benefit from them through service purchase. Third, service centers reduce coordination failures. A field may not need more theory; it may simply need seedling delivery, machinery dispatch, and drying capacity to arrive in the right order. Fourth, service centers make aggregation possible. By bringing together enough service demand, they make investment in equipment, training, and postharvest infrastructure more economically reasonable.

Modernization also has an organizational side that is sometimes overlooked. A service center does not only modernize the field. It modernizes routines: booking, scheduling, team management, maintenance, training, storage, quality records, and in some cases digital traceability. This is why the institution itself deserves attention. Mechanization without organization can remain partial and unreliable. Organization is what turns individual technologies into a functioning production system.

3 Organizational Structure and Operational Functions of Mashan Agricultural Service Center

3.1 Basic construction and functional layout of the service center

According to the case materials supplied with the manuscript, Mashan Agricultural Service Center is located in Mashan Village, Shangyu District, and is operated by the Shaoxing Shangyu Mashan Grain Specialized Cooperative. The center occupies 6.73 mu and was designed as a working service platform rather than as a symbolic demonstration building. The reported original construction included a 2,400 m² drying center, a 1,888 m² seedling cultivation center, and a 200 m² machinery shed, with total project investment exceeding RMB 6 million. The internal layout also included repair rooms, storage rooms, dryers, processing areas, and training or meeting space (Figure 1).

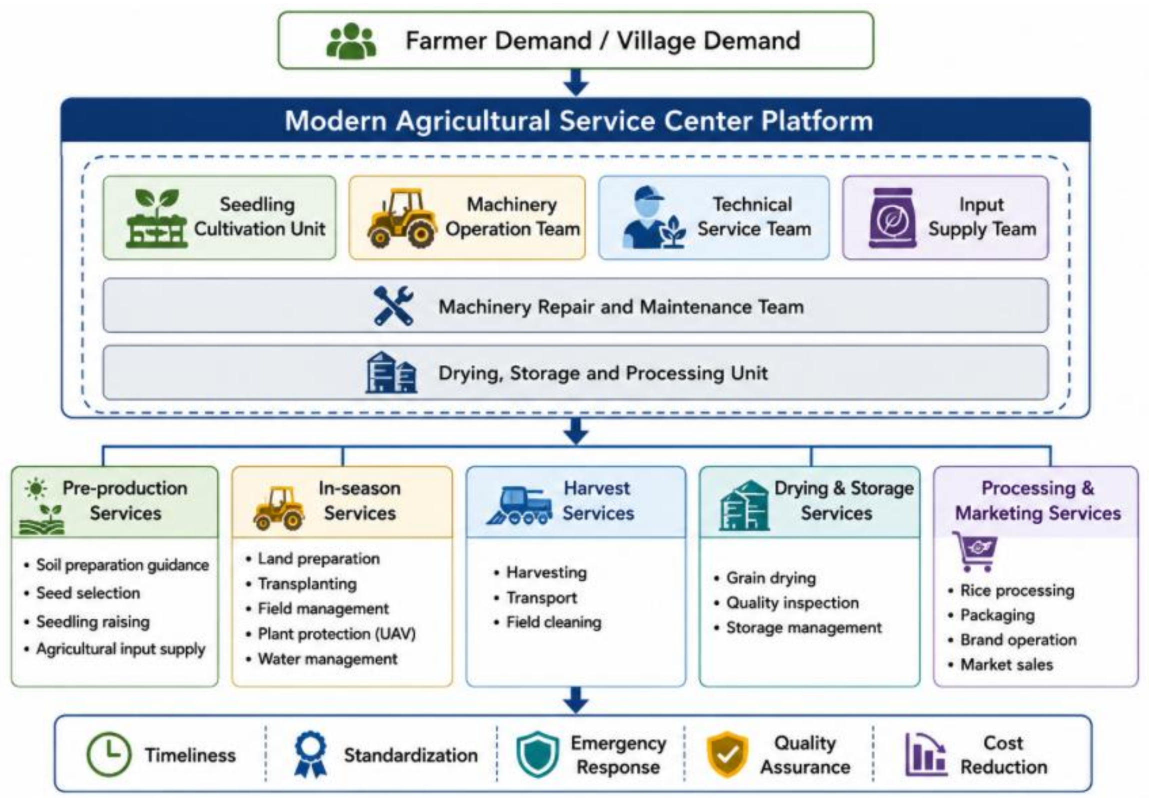

Figure 1 Operational framework of the modern agricultural service center in socialized rice production

What is striking here is the functional logic of the layout. The center does not simply place a few farm machines under one roof. Its facilities correspond to key bottlenecks in rice production: seedlings before planting, machinery during operations, drying after harvest, and training and support around the whole chain. That kind of layout matters because service efficiency depends on adjacency between functions. The seedling center supports transplanting. The dryers support harvesting. The storage and processing spaces support marketization. The repair area supports service continuity. In short, the building layout is an operational design, not just a construction plan.

The materials also indicate that the center later expanded its built area by an additional 805 m², adding eight more dryers, a 750-ton indoor metal granary, a 50-ton rice processing line, and additional support space. This later expansion is revealing. It suggests that postharvest service became more central over time, which is typical of service centers moving from basic operation assistance toward more integrated grain-chain functions.

3.2 Organizational management structure and service teams

Mashan's organizational design is just as important as its buildings. The supplied materials state that the center has seven fixed workers, around 100 sets of agricultural machinery and equipment, machinery assets valued at about RMB 8 million, and a 100% licensing rate among machinery operators. On paper, seven fixed workers may not sound like a large number, but the relevant issue is not headcount alone. It is how the center organizes specialized teams and supports seasonal mobilization.

The case materials describe four primary service teams already in operation: a mechanized operation team, an agricultural input delivery team, a technical service team, and a machinery repair team. This arrangement reflects a practical division of labor. The operation team focuses on field work; the technical team supports agronomic decisions and training; the repair team protects service continuity; and the input-delivery team reduces farmer-side coordination burdens. That is a significant shift away from the older model in which a machine operator might be expected to solve any and all problems alone.

This type of team structure is one of the clearest operational features of modern agricultural service centers. It shows that a service center is neither identical to a machinery cooperative nor reducible to a warehouse. It is an organization that combines tasks with people. In rice farming, this matters because field service quality depends not only on whether the machine arrives, but whether diagnosis, scheduling, repair, and postharvest support are connected to the machine's arrival.

3.3 Agricultural machinery and supporting facilities

Machinery is naturally central to the center's operation, but the case materials suggest that Mashan's core strength lies in the relationship between machinery and supporting facilities. The center reportedly holds around 100 sets of agricultural machinery and equipment, and the later facility expansion significantly increased drying, storage, and processing capacity. This combination is important because many discussions of mechanization still focus too narrowly on field machines while underestimating postharvest infrastructure.

For rice production, drying is not optional support. It is part of the service chain. Harvesting capacity without drying capacity only shifts the bottleneck downstream. The same is true for seedling cultivation. Transplanting service is much easier to standardize when tray seedlings are centrally prepared and delivered in a coordinated manner. The center's facility bundle therefore supports a "field-to-postharvest" model rather than a single-link operation model.

The machinery-support relationship also changes how capital is used. When dryers, seedling facilities, and storage are attached to machinery service, the whole investment becomes more productive because each function reinforces the value of the others. A harvester becomes more useful when it can deliver grain straight into a regional drying system. A seedling center becomes more useful when it supports machine transplanting across a wider service area. This is precisely the kind of asset coordination that distinguishes a modern service center from a loose network of separate providers.

3.4 Main operational functions in rice production services

The internal project briefs describe Mashan's service structure as a "1+8" model centered on full-process mechanized operation and supported by drying and processing, centralized seedling cultivation, technical services, agricultural input delivery, machinery maintenance, agricultural study and training, product marketing, and storage and preservation. The wording itself is useful because it makes clear that the center is not built around one machine type or one contractual relationship. It is built around coordinated services.

The main functions can be grouped into three layers. The first layer is direct production service: seedling raising, transplanting, field operation, harvesting, drying. The second layer is support service: repair, input delivery, technical guidance, training. The third layer is value-extension service: storage, simple processing, local branding, and marketing. This layered structure matches the way modern rice production actually works. Farmers need one set of services to get grain grown, another set to get it managed well, and a third set to protect or increase its value after harvest.

The materials also indicate that Mashan serves both a core nearby service area and a wider regional production area across seven towns and streets, with "nanny-style" services for around 5,000 mu nearby and more than 50,000 mu-times of full-process mechanized services annually across a broader area. This layered service radius is one of the center's most important operational traits. It suggests that the center combines intensive local support with wider regional dispatch, rather than choosing one scale at the expense of the other.

4 Main Operational Models of Socialized Rice Production Services

Before discussing the five main operational models, it is useful to state a general principle (Table 1). The service models of a modern agricultural service center are not separate in practice. They overlap. Centralized seedling raising feeds transplanting. Machinery scheduling affects trusteeship quality. Drying affects the value of harvest rescue. Training influences the quality of field management and the willingness of farmers to buy services. Still, for analytical clarity, the operational models can be discussed one by one.

Table 1 Main operational models of socialized rice production services

Operational model	Core content	Main organizational carrier	Main practical value
Centralized seedling cultivation service model	Unified nursery preparation, tray seedling production, delivery to farmers or service teams	Seedling center+technical team	Improves seedling uniformity, supports machine transplanting, reduces household nursery burden
Full-process trusteeship service model for rice production	Bundled services from pre-production to postharvest, partly or fully entrusted by farmers	Service center+cooperative+specialized operation teams	Reduces coordination costs and timing failures across stages
Agricultural machinery scheduling and cross-regional operation model	Seasonal dispatch of machinery across villages and towns, including emergency tasks	Operation team+repair team+service booking	Raises machinery utilization and supports timely peak-season operations
Grain drying and postharvest service model	Centralized drying, temporary storage, grain processing and preservation	Drying center+storage+processing line	Reduces postharvest loss and supports quality retention and branding
Technical guidance and farmer training service model	Agronomic advice, pest diagnosis, training, production guidance	Technical team+training space+external experts	Improves service quality, green production, and farmer trust in standardized management

4.1 Centralized seedling cultivation service model

Centralized seedling cultivation is one of the clearest examples of how service organization can change the economics of rice production (Figure 2). In household-based production, raising seedlings is not only laborious; it is also highly variable. Timing, tray preparation, seed quality, temperature, and management consistency all affect later field performance. Once labor becomes scarce and machine transplanting becomes more common, this stage turns into a serious coordination problem. Centralized seedling services address that problem by moving the work into a specialized facility.

Recent research on machinery rice transplanting and centralized rice seedling cultivation in China argues that these systems do more than save labor. They improve the efficiency of seedling supply, raise the space-use efficiency of nursery land, and even create a “seedling field saving” effect that can release time and land resources under crop rotation systems (Ruan et al., 2025). That finding is conceptually important because it shows that a service center can affect production before the crop even enters the main field.

Mashan’s materials are consistent with that logic. The center reportedly supplies more than 200,000 trays of early- and late-rice seedlings per year and provides associated technical guidance to nearby farmers. In practical terms, such a model does three things. It standardizes the starting point of the crop. It reduces household-level technical unevenness. And it makes machine transplanting much easier to coordinate. When many households receive seedlings from the same center, later operations can be scheduled with much greater confidence.

There is also a subtle institutional effect here. Seedling service often serves as the first point of deeper farmer-center cooperation. A household that begins by purchasing seedlings may later purchase transplanting, harvesting, drying, or even partial trusteeship. In that sense, centralized seedling supply is not a minor entry service. It can be the organizational gateway into the wider service system.

4.2 Full-process trusteeship service model for rice production

The full-process trusteeship service model is perhaps the most important modern form of socialized rice production service. Under this model, farmers do not surrender land rights, but they rely on the service center or related provider to complete part or all of the production chain. The crucial point is not whether every farmer purchases every link. It is that a bundled service option exists, and that the burden of cross-stage coordination shifts away from the household.

Figure 2 Postharvest service process flow in modern agricultural service centers (Photoed by Xinfeng Ren)

This matters because transaction costs in agriculture are often hidden. Farmers do not only “pay for operations.” They spend time finding operators, matching timing, arranging inputs, watching weather, securing drying space, and handling breakdowns. When these transactions are fragmented, production risk remains high even if one or two operations are mechanized. Full-process trusteeship reduces these coordination costs by organizing production as a service package rather than a scattered set of purchases (Li et al., 2024).

The literature supports this interpretation. Agricultural socialized services have been shown to improve rice producers’ technical efficiency not only through machinery access, but through systemic support at different production links (Cai et al., 2024). Studies on grain production behavior also show that socialized service adoption can promote grain cultivation by improving machinery use, encouraging more connected land operation, and increasing the operational attractiveness of grain production for households that might otherwise shift away from it (Li et al., 2024).

Mashan’s “1+8” system fits this trusteeship logic well. Even if not every farmer purchases the entire package, the center is clearly structured to make that possible. The practical value of the model lies in continuity. It reduces the chance that a farmer will solve one production bottleneck only to get stuck at the next. In rice farming, where delays compound quickly, that continuity is one of the strongest arguments for the service-center model.

4.3 Agricultural machinery scheduling and cross-regional operation model

Machinery scheduling is often treated as an administrative detail, but in real rice production it is one of the decisive elements of service performance. The usefulness of machinery depends not only on ownership, but on where it can go, when it can get there, how quickly it can be maintained, and whether dispatch can respond to narrow crop windows and bad weather. A modern service center therefore operates as a scheduling hub as much as a machinery owner.

This is especially true in regions like eastern China, where production calendars are dense, weather volatility can compress operation windows, and service demand peaks sharply. Cross-regional operation helps solve a classic utilization problem. A machine that is underused in one village but urgently needed in another becomes much more valuable when it can be moved efficiently across the service area. Research on machinery-based services and land productivity in China suggests that such services can significantly improve land productivity, but with different effects depending on crop conditions, scale, and local context (Yang and Li, 2022).

The policy environment in Shangyu also points in this direction. The district’s 2024 early-rice machine-transplanting subsidy scheme relied on an administrative mechanism designed around actual machine operations, implying that service performance is increasingly tied to measurable operation capacity rather than informal local arrangements. Even where detailed real-time scheduling data are not publicly available, the institutional direction is clear: machine service is becoming more formalized, more trackable, and more closely integrated with district-level grain goals.

In the Mashan case, the existence of specialized mechanized operation teams and a multi-town service radius suggests that cross-regional machinery dispatch is already part of the center's operating model. This is not only an efficiency question. It is also a resilience question. When a center can move harvesting or drying support quickly across several towns, it functions as a regional buffer against timing shocks.

4.4 Grain drying and postharvest service model

Postharvest service is where many service-center models prove their real maturity. It is relatively easy to advertise mechanized harvesting. It is much harder to build an integrated system that can handle wet grain, unstable weather, drying queues, storage, and simple processing in a region with many small producers. That is why drying and postharvest service deserve special attention.

Rice quality is highly sensitive after harvest. Grain harvested at the right time can still lose value through delayed or improper drying. Review work on rice harvest losses shows that losses occur across the wider harvest process rather than at cutting alone, and that postharvest handling remains a major source of avoidable loss (Qu et al., 2021). From a wider sustainability perspective, this is a serious issue. Once land, fertilizer, water, labor, and energy have already been used to produce the crop, postharvest avoidable loss becomes a direct efficiency and environmental problem.

The service-center model addresses this by centralizing drying. A center can invest in dedicated dryers, create more stable drying routines, reduce dependence on household sun-drying, and offer grain safety and quality conditions that small farmers cannot easily achieve individually. The broader literature on rice greenhouse gas mitigation also indirectly supports this focus by reminding us that sustainable rice systems are not only about emissions in the field; they are also about reducing waste and improving total system efficiency (Qian et al., 2023).

Mashan's later expansion fits this model closely. The addition of eight dryers, greater single-batch drying capacity, a metal granary, and a processing line suggests that the center evolved from a primarily operations-based unit into a more complete postharvest service platform. This is a major operational shift because it means the center can connect rescue harvesting to stable postharvest management and then to value-added rice products.

4.5 Technical guidance and farmer training service model

Technical guidance is often treated as a soft or secondary function compared with machinery and drying, but in practice it is one of the most important ways a service center increases the quality and credibility of its services. Farmers do not only need a machine operator. They need advice about timing, seedling quality, pest risk, field management, drying decisions, and sometimes market expectations. If the center lacks a technical layer, it risks becoming a basic contractor rather than a modern agricultural service institution.

This issue has become even more important as digital and green production goals have expanded. Research on digital agricultural technology services in Sichuan shows that such services can increase farmers' willingness to adopt digital production technologies by expanding information channels, improving cognitive understanding, and increasing technology accessibility (Gong et al., 2024). At the same time, studies on sustainable agricultural practice adoption among Chinese smallholders suggest that socialized services can help farmers enter more sustainable production pathways when those services reduce knowledge barriers and improve access to practical support (Huan et al., 2022).

The logic applies directly to rice service centers. Training and expert guidance help in at least three ways. They reduce farmer uncertainty about service quality. They improve the agronomic quality of the operations themselves. And they help align service-center goals with green and standardized production aims. Technical guidance is therefore not separate from the operational model. It is part of how the model builds trust and effectiveness.

In the Mashan case, the internal materials note regular training sessions and field guidance activities, especially during periods of frequent pest occurrence. This suggests that the center's service model already combines machinery with agronomy, which is precisely what a modern operational platform should do.

5 Practical Effects of Modern Agricultural Service Centers in Rice Production

5.1 Improvement of rice production efficiency

The first and most visible practical effect of a modern agricultural service center is improved production efficiency. But efficiency should be understood broadly. It includes labor saving, of course, but it also includes timeliness, continuity across operations, and reduced coordination risk. A well-functioning service center makes it easier to complete production steps within the correct agronomic window and with fewer gaps between stages.

This broader understanding is supported by existing literature. Agricultural socialized services have been found to improve technical efficiency among smallholder rice producers, partly because they replace irregular household arrangements with more standardized and professional support (Cai et al., 2024). Other studies show that mechanization and machinery-based services improve land productivity and production efficiency when machinery access is timely and well matched to field conditions (Yang and Li, 2022; Liu and Li, 2023).

Mashan's organizational structure helps explain why. The center combines centralized seedling supply, dedicated operation teams, drying capacity, machinery repair, technical guidance, and regional dispatch. Each of these reduces a different form of production friction. The result is not only faster operations, but a more stable production chain. A farmer no longer has to negotiate each link separately at peak season. That reduction in coordination failure is a genuine efficiency gain, even if it does not always appear directly in yield statistics.

5.2 Reduction of labor pressure and farming costs

The second major effect is the reduction of labor pressure and farming costs, especially for households facing labor outflow or aging. In current rural China, the question is often not whether labor is expensive, but whether sufficient labor is available at the right moment. Socialized services turn this structural challenge into an organizational problem that can be handled collectively rather than privately.

Several studies are helpful here. Research on aging agricultural labor force and outsourced pest-control services in rice areas of Fujian shows that outsourcing has become an important response to the aging of the agricultural labor force and can influence input use behavior in greener directions (Shen et al., 2024). Work on labor migration and fertilizer use among smallholders further suggests that socialized services can mediate or offset some of the production difficulties created by labor transfer (Li et al., 2023). In practice, a service center lowers the demand for family labor not by replacing the farmer entirely, but by taking over the most time-sensitive, equipment-sensitive, or physically demanding parts of production.

This also affects costs in a deeper way. A household that would otherwise need to purchase or maintain expensive machines, temporary drying arrangements, or separate labor contracts instead buys service when needed. This reduces fixed-cost pressure and allows smallholders to access scale advantages through the service system. For households that still want to remain in grain production but do not want to bear the full capital and management burden, this is one of the strongest benefits of the service-center model.

5.3 Enhancement of disaster prevention and emergency response capacity

The value of a service center becomes especially visible when weather no longer cooperates. Under typhoon threats, heavy rain, or compressed harvest windows, the difference between ordinary service provision and real emergency capacity becomes obvious. A center with machines, drying space, operators, and coordination ability can protect grain already grown. One without postharvest linkage may only move the risk from field to yard.

This is important because climatic risk to rice production is increasing. Recent climate projections for China's rice regions suggest that extreme climate challenges, especially heat stress and some forms of wet-period risk, are likely to intensify (Chen et al., 2025). At the same time, the practical literature on rice harvest losses shows that loss control depends heavily on timing and postharvest handling, both of which become more difficult under abnormal weather (Qu et al., 2021).

Mashan’s emergency harvesting case illustrates what a modern service center can contribute under such stress. According to the supplied materials, when the “double rush” period overlapped with typhoon weather, the center organized more than 20 harvester operations, completed emergency early-rice harvesting on more than 12,000 mu, and then dried more than 14,000 tons of grain. Even without experimental comparison, this is persuasive case evidence. It shows that the center’s real strength in emergencies is not the harvester alone, but the combination of harvesting and drying in one coordinated system.

5.4 Promotion of standardized and green rice production

Modern agricultural service centers also make standardized and greener rice production more realistic (Figure 3). This does not happen automatically. Machines can be used badly as well as well. But when operations are bundled with technical support, scheduling discipline, and postharvest facilities, the service-center model can reduce some of the variability and waste that come from uncoordinated household production.

Recent studies provide several angles on this. Agricultural socialized services in south China have been found to encourage greener production behavior, particularly in fertilizer-use decisions among smallholder rice farmers (Shi et al., 2023). Socialized services of agricultural green production have also been shown to reduce fertilizer input in rice systems, especially when combined with stronger information and social support (Yang et al., 2022). Meanwhile, rice-focused studies of greenhouse gas mitigation remind us that more sustainable systems depend on management choices across water, organic inputs, tillage, and crop handling rather than on a single technical fix (Qian et al., 2023).

At the operational level, Mashan’s model supports standardization in several ways. Centralized seedling cultivation reduces uneven crop establishment. Organized machinery service improves timing. Technical guidance strengthens field management. Centralized drying reduces postharvest instability and household-level weather exposure. If greener plant protection tools are adopted, professionally managed application can also reduce operator exposure and improve targeting relative to improvised field practice. Evidence from UAV-based herbicide application in direct-seeded rice suggests that modern spray systems can provide effective control while reducing labor burden and lowering carrier volume when used under appropriate conditions (Paul et al., 2024). The lesson is not that every center should rush toward any fashionable machine, but that professionalized service can make precision and greener input use more achievable.

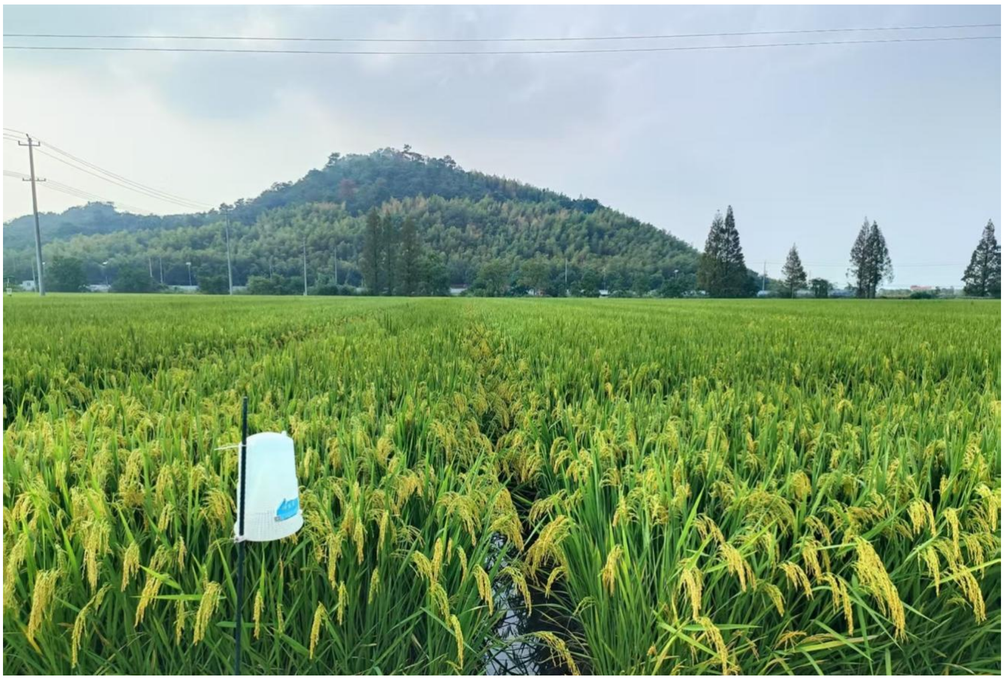

Figure 3 Standardized high-quality rice production field under agricultural service center management
Note: Unified field management supports standardized and green rice production (Photoed by Xinfeng Ren)

5.5 Promotion of regional rice brand development

One of the more interesting effects of the modern service center model is that it can help connect production services with local branding. This matters particularly in developed provinces, where agricultural competitiveness increasingly depends on quality recognition, traceability, and regional identity rather than on bulk volume alone. Rice branding is not separate from production organization. It depends on it.

Mashan's case is revealing here. The supplied materials report that the center's registered "Xinfeng" rice brand won the Silver Award in the 2024 "Zhejiang Good Rice" competition (Figure 4). On its own, this is not a scientific production indicator. But in an applied production study, it is meaningful because it shows that service capacity, processing, and branding can be linked. A center that can raise seedlings, coordinate operations, dry grain, store it safely, and process it locally has a much stronger basis for stable branded production than a provider limited to one field-operation link.

This is where modern agricultural service centers begin to resemble local industry-chain hubs rather than narrow service contractors. Their role expands from "helping farmers finish work" to "helping local rice become a differentiated product." That shift is especially important in places like Zhejiang, where agriculture must increasingly earn value through reliability, quality, and regional reputation.

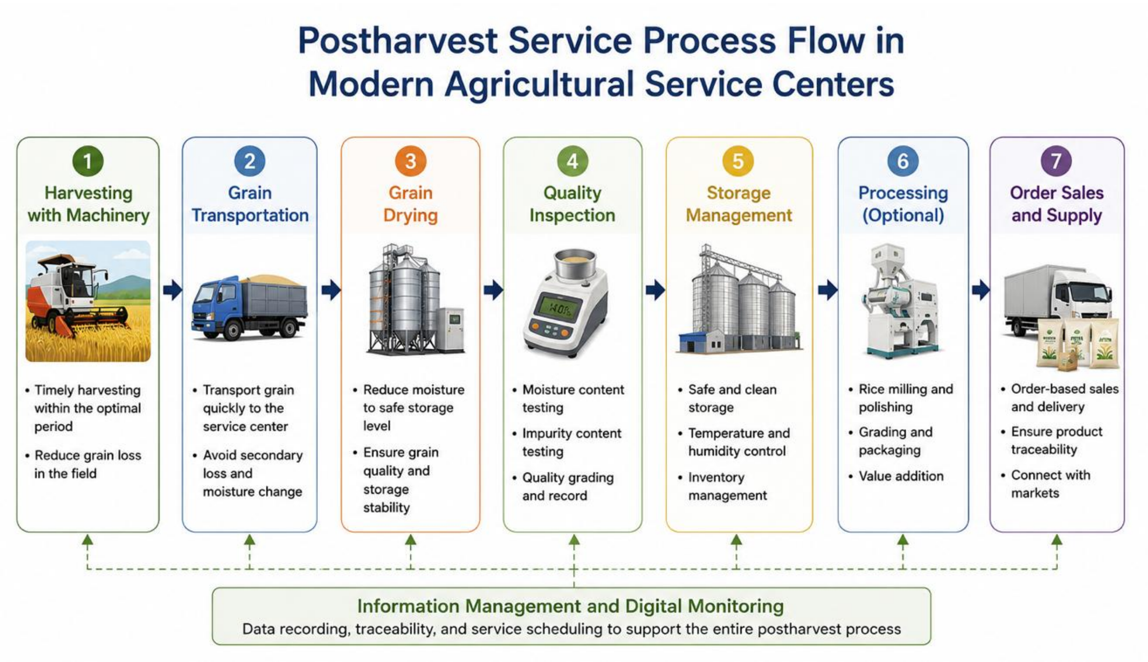

Figure 4 Postharvest service process flow in modern agricultural service centers

6 Case Analysis of Socialized Agricultural Services in Mashan Agricultural Service Center

Before discussing the individual cases, one methodological limitation should be stated clearly. The following four cases are based mainly on two internal project briefs supplied with the manuscript materials and related field descriptions. These are operational management materials rather than independently audited datasets. They are therefore used here as descriptive evidence of how the center functions in practice, not as a basis for strict causal inference.

6.1 Case of centralized seedling supply for surrounding farmers

The centralized seedling supply case captures the center's role at the earliest and often most fragile stage of rice production. Mashan's seedling cultivation center reportedly supplies more than 200,000 trays of standardized early- and late-rice seedlings each year for nearby farmers and service-linked operations. This volume suggests that seedling cultivation is not a small side activity. It is one of the center's core gateways into the local rice production system.

The practical value of the case lies in standardization. Seedling uniformity influences transplanting quality, later crop establishment, and management stability through the growing season. When seedlings are centrally produced, households no longer need to prepare nursery materials separately, and the timing of seedling availability becomes easier to match with machine transplanting. The project materials also note that technical guidance linked to the center reportedly improved seedling establishment rates for surrounding farmers by around 20%, which reinforces the point that the service is not merely material supply. It combines service products with agronomic support.

This case shows why service centers matter even before field operations begin. In many discussions of modernization, attention goes first to transplanting or harvesting machines. But in practice, the service quality of later links often depends on whether the earliest link was standardized well enough to support them.

6.2 Case of emergency agricultural machinery dispatch during typhoon season

The emergency dispatch case is perhaps the strongest demonstration of Mashan's regional role. According to the project materials, during the overlap of the "double rush" period and typhoon weather, the center mobilized more than 20 harvester operations, completed emergency harvesting of early rice on more than 12,000 mu, and then carried out more than 14,000 tons of drying afterward. These figures show not only operational scale, but operational sequencing.

Analytically, the key point is that harvest rescue and drying rescue occurred together. A harvester without drying support would only provide partial relief. Wet grain rescued from a field can still deteriorate rapidly if postharvest treatment is delayed. The Mashan case therefore illustrates a central feature of the modern service-center model: emergency response depends on linking field capacity with postharvest capacity.

This case also has a wider social meaning. In abnormal weather, the center functions partly like a quasi-public rural infrastructure node. It helps farmers reduce losses that individual households would struggle to prevent on their own. In a climate context where extreme events may become more frequent or more disruptive, this kind of regional protective role may become one of the most important justifications for service-center investment.

6.3 Case of grain drying and storage service expansion

Mashan's drying expansion case shows how a service center evolves beyond basic machinery support. According to the project materials, the center added eight dryers, increased single-batch drying capacity to 400 tons, raised annual drying capacity from 10,000 tons to 18,000 tons, and added a 750-ton indoor metal grain warehouse as well as a 50-ton rice processing line.

This is important because it marks the difference between partial mechanization and integrated service. A center that can harvest but not dry remains incomplete in a rice production setting. The Mashan expansion suggests that the operators recognized this and chose to strengthen the postharvest part of the chain. The expansion also helps explain how the center could respond to emergency harvest demand during bad weather. Without larger drying and storage capacity, emergency dispatch would have had much less value.

From a development perspective, this case suggests a typical upgrading path for rural service centers. They may begin around machinery operation, but long-term effectiveness pushes them toward postharvest control, storage, and processing. In rice systems, where quality and loss control matter greatly after harvest, this transition is logical and necessary.

6.4 Case of rice brand-oriented operation and market expansion

The final case extends the analysis from production support to market development. The internal materials state that Mashan promoted the "Xinfeng" rice brand through standardized production management, processing, and local marketing, and that the brand won the Silver Award in the 2024 "Zhejiang Good Rice" competition.

The significance of this case lies in what it reveals about the center's operational horizon. The modern agricultural service center is not confined to completing field tasks. It can also help stabilize the conditions needed for quality differentiation in the market. Brand-oriented operation depends on more than advertising. It requires some consistency in production, handling, storage, and output. A center with seedling supply, machinery service, drying, processing, and storage is better positioned to support that consistency than a service provider limited to a single operation link.

This case also suggests a broader development path in eastern China. In higher-income regions, the future of rice production may depend less on low-cost volume and more on the ability to combine service efficiency with local brand value. Mashan's brand case therefore shows a shift from service as production assistance to service as production-plus-market support.

7 Current Problems in the Operation of Agricultural Service Centers

7.1 High operational and equipment maintenance costs

One of the clearest challenges for modern agricultural service centers is the heavy capital and maintenance burden of integrated service provision. Mashan's own case illustrates the point well. Project investment exceeded RMB 6 million; machinery assets were reported at about RMB 8 million; and the center operates drying, nursery, storage, processing, and service-support spaces together. This is precisely why such centers are effective, but it is also why they are financially demanding.

The pressure continues after construction. Equipment depreciation, electricity for drying, fuel, repairs, spare parts, storage management, operator certification, and facility upgrades all create ongoing costs. Research on mechanization and production efficiency confirms that machinery can improve output and efficiency, but it also shows that capital intensity remains a serious barrier where scale or service volume is insufficient to absorb fixed costs (Liu and Li, 2023; Ruan et al., 2025). In practice, service centers succeed only when utilization is high enough and fees, subsidies, or linked business functions together support long-term sustainability.

This means that service centers are vulnerable to underuse. A modern center may look impressive, but if service demand becomes unstable or if newer technologies rapidly raise upgrading pressure, the center can face financial stress. Capital investment is therefore not just a construction issue. It is a continuing operational issue.

7.2 Insufficient professional and technical personnel

Another major problem is the shortage of multi-skilled technical personnel. Mashan's seven fixed workers and specialized teams show organizational capacity, but they also hint at how much is expected from a relatively small technical core. Modern service centers need more than tractor or harvester drivers. They need people who understand scheduling, machinery maintenance, drying control, field conditions, agronomy, safety, records, and increasingly digital tools.

This challenge appears repeatedly in the recent literature. Digital agricultural technology services can only function well when users and service providers have adequate literacy, training, and confidence (Gong et al., 2024). The broader review literature on agricultural socialized services also points out that access and delivery problems often stem not only from equipment shortages, but from measurement problems, coordination gaps, and service-quality inconsistency (Zeng et al., 2025). Technical personnel are therefore not simply labor inputs; they are part of the service model's credibility and adaptability.

In rural areas, attracting and retaining such personnel is not easy. Young people may prefer urban sectors, while older experienced operators may have limited capacity to shift into digital management or more formalized service systems. The more a center expands toward quality-oriented and smart-service functions, the more serious this human-resource constraint becomes.

7.3 Difficulties in coordinating services across different farmer groups

Although service centers are often promoted as bridges between smallholders and modern agriculture, farmers are not identical service users. They differ in plot conditions, road access, irrigation convenience, income expectations, quality preferences, willingness to pay, labor availability, and openness to standardized management. This heterogeneity creates a coordination challenge for service centers.

Research from Jiangsu indicates that the benefits of service-scale and land-scale coordination are real, but they also depend on governance conditions and local operating context (Fu and Yang, 2025). Studies from Jiangxi further show that the benefits of agricultural socialized services vary across farmer type, fragmentation level, region, and digital ability (Liao et al., 2025). That means a service package that works well for one village or household group may be less suitable elsewhere.

For Mashan, which serves both a core nearby area and a wider multi-township region, this problem is very relevant. Intensive "nanny-style" service near the center is easier to deliver than the same depth of service at the outer edge of the service radius. Some households may only want harvesting; others may want bundled operations; still others may care mainly about drying. Coordinating these different needs without overcomplicating management is a difficult but central task.

7.4 Limited digital management capacity in rural areas

Digital management is increasingly important, but many service centers still operate with relatively traditional management routines. This creates a gap between the complexity of the service chain and the tools available to manage it. A center must handle operation orders, machine schedules, seedling supply, drying queues, repair records, service billing, quality tracking, and sometimes subsidy-related reporting. Without stronger digital management, coordination becomes more difficult as service scale grows.

The recent literature on digital agricultural technology services shows that information channels, technology cognition, and practical accessibility strongly affect technology adoption and service effectiveness (Gong et al., 2024). Yet rural digitalization is uneven. Some farmers adapt quickly to online ordering or digital traceability; others do not. Some service staff can maintain digital records well; others remain more comfortable with phone calls and handwritten lists. As a result, digital capacity often develops more slowly than physical infrastructure.

For centers like Mashan, this is an operational constraint rather than a fashionable concern. Limited digital capacity can increase scheduling errors, reduce traceability, weaken service evaluation, and make regional coordination during peak periods more difficult than it needs to be. The problem is not the absence of advanced artificial intelligence. It is often the absence of stable, usable basic digital management.

7.5 Increasing risks from extreme weather and climate change

The final major problem is the increasing influence of extreme weather and climate change. Rice production is strongly exposed to heat stress, extreme rainfall, typhoons, and unstable harvesting periods. Modern service centers improve resilience, but they do not remove exposure. In fact, severe weather can test the limits of even a well-equipped center by creating simultaneous spikes in harvesting demand, drying demand, and temporary storage demand.

Recent climate research focused on Chinese rice production regions points toward intensifying extreme climate challenges under future scenarios, especially in relation to heat stress and changing risk patterns across growth stages (Chen et al., 2025). Broader review work on greenhouse gas and climate interactions in rice agriculture also reminds us that climate change is not only a long-term background issue; it is becoming a direct operational concern for rice systems (Qian et al., 2023).

Mashan's emergency harvest case shows strong response capacity, but it also reveals how dependent regional rice security can become on rapid coordinated intervention. This means future service-center design must treat resilience as a normal design goal, not as an occasional extra function.

8 Optimization Strategies and Future Development Directions

8.1 Improving regional agricultural service coordination mechanisms

The first improvement direction is stronger regional coordination. A service center is most effective when it is embedded in a stable service network rather than operating as an isolated provider reacting case by case. For Mashan, this means moving further toward a layered regional model: highly intensive nearby service, scheduled support across surrounding towns, and a clearly organized emergency-response layer for abnormal weather and compressed harvest periods.

This strategy is consistent with Zhejiang's policy emphasis on regional service networks and local service circles (People's Government of Zhejiang Province, 2024). It is also supported by the literature showing that agricultural socialized services work best when they improve operational continuity and reduce the fragmentation of production management (Cai et al., 2024; Li et al., 2024). In practical terms, coordination can be improved through seasonal service agreements with villages, more formal booking systems before peak seasons, better integration with local grain-production plans, and clearer emergency command arrangements for typhoon or heavy-rain periods.

The key is to strengthen the center's role as a regional operating hub. If service demand, machinery dispatch, drying needs, and emergency response are better synchronized at the area level, both farmers and the center gain predictability.

8.2 Promoting digital and smart agricultural service platforms

The second direction is digitalization, but it should be practical rather than decorative. Not every service center needs highly advanced artificial intelligence systems immediately. What many centers need first are reliable digital tools for booking, scheduling, queue management, records, and traceability. These are the digital foundations on which more advanced functions can later be built.

Research on digital agricultural services indicates that such services can raise farmers' willingness to engage with new production technologies by expanding information access and improving technology understanding (Gong et al., 2024). For a service center, digitalization should begin with management pain points: operation orders, machine dispatch, farmer service histories, drying-batch monitoring, storage records, and product traceability. Once those basic layers are stable, more sophisticated functions such as predictive scheduling, weather-linked reminders, or data-assisted quality control can be added.

Mashan is well suited to this direction because its service functions are already diverse. The more activities a center integrates, the more valuable ordinary digital order in management becomes. A modest but well-designed digital platform can improve both service quality and internal efficiency far more than a poorly used "smart" system with weak operational relevance.

8.3 Strengthening agricultural talent training and technical guidance

The third priority is talent development. Infrastructure and machinery can expand quickly; human capacity often cannot. For that reason, centers like Mashan would benefit from a more systematic training structure that distinguishes between different types of personnel: machine operators, repair technicians, dryer operators, agronomic field assistants, digital record managers, and future management staff.

This direction is strongly supported by both practice and research. Digital and green production services depend heavily on human capacity to translate tools into usable service. Studies on sustainable practice adoption and digital production willingness both underline the importance of training and technical assistance in reducing barriers to adoption (Huan et al., 2022; Gong et al., 2024). For a service center, training is also internally valuable because it improves standardization and reduces avoidable operational mistakes.

A useful model would be tiered training. Basic training should focus on safety, standard operating routines, and maintenance. Intermediate training should focus on agronomy-linked service quality and postharvest control. Advanced training should prepare younger staff and team leaders for coordination, digital management, and emergency organization. In the long run, talent may become the main difference between average service centers and exceptional ones.

8.4 Expanding integrated rice industry chains and brand development

The fourth direction is deeper integration of the rice industry chain. Mashan has already moved beyond field services into drying, storage, processing, and branding. That path should be further strengthened because it increases the center's economic resilience and makes better use of postharvest infrastructure.

The logic is strong. If a service center only earns from field operations, its income may remain highly seasonal and vulnerable to competition. If it can also support value retention and local branding, it gains a second source of relevance. Recent research on grain cultivation and food security in China shows that rice production now has to be understood not only as a matter of output, but also of quality structure and stable supply conditions (Tang et al., 2022). A center that can connect standardized production with recognizable local rice products is better positioned for the future than one that remains only an operation contractor.

For Mashan, this means continuing to strengthen the chain from seedling to market: standardized seedling supply, coordinated operations, quality-conscious drying, safe storage, simple processing, local branding, and more stable market channels. The "Xinfeng" rice case suggests that this path is already realistic.

8.5 Enhancing emergency agricultural service capacity under climate risks

Finally, future development should place more explicit emphasis on emergency service capacity under climate risk. The emergency harvesting case shows that Mashan already has a useful base, but climate pressure is likely to persist and perhaps intensify. That means resilience should be formalized rather than treated as an occasional success story.

Several practical steps follow from this. Seasonal emergency plans should be prepared before peak harvest. Machinery, dryers, fuel, and temporary storage arrangements should have reserve capacity. Coordination with township governments, village planners, and possibly agricultural insurance mechanisms should be strengthened. Weather information should be integrated more directly into early service planning. Training for emergency dispatch should be treated as part of ordinary center capability.

The real lesson of recent rice climate research is not just that risks are increasing, but that adaptation must be organized (Chen et al., 2025). Modern agricultural service centers are well placed to become that organizing mechanism at the regional level.

9 Conclusion

This study examined the operational model of modern agricultural service centers in socialized rice production services through the case of Mashan Agricultural Service Center in Shangyu District, Zhejiang Province. The main argument is that the value of such centers lies less in the possession of machinery itself than in the organization of coordinated services. A modern agricultural service center works as a regional platform that links seedling raising, machinery operation, drying, storage, technical guidance, training, and sometimes branding into a connected production-support system.

The discussion shows that Mashan's operational model has several defining features. It combines physical infrastructure with specialized teams rather than treating mechanization as mere equipment ownership. It operates through layered service radii, with both nearby intensive support and broader regional outreach. It pays serious attention to postharvest functions, which are often the true dividing line between partial and integrated service. And it increasingly connects production service with value-extension functions such as processing and branding.

The practical significance of this model is equally clear. Modern agricultural service centers can improve production efficiency, reduce labor pressure and coordination costs, strengthen emergency response under weather shock, support greener and more standardized rice production, and make it easier for smallholder-based production systems to remain linked with modern agricultural development. In developed provinces such as Zhejiang, where agriculture must often compete through quality, organization, and service rather than through simple expansion of scale, these functions are especially important.

At the same time, the Mashan case also shows that this model is not without pressure. Capital costs remain high. Skilled technical staff are hard to build and keep. Farmers are heterogeneous in demand and capacity. Digital management is still uneven. Climate risk is rising. These are not temporary inconveniences; they are structural issues that will shape whether service centers continue to function well over time.

For that reason, the future direction of modern agricultural service centers should emphasize stronger regional coordination, practical digital management, systematic talent training, wider integration of postharvest and branding functions, and more formalized emergency-service preparation. If these directions are pursued steadily, modern agricultural service centers can become one of the most realistic institutional paths for supporting a rice sector that is efficient, resilient, quality-oriented, and still compatible with the continued presence of large numbers of small-scale farmers.

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