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Dilemmas and Promotion Pathways of Patent Commercialization in Agricultural Universities

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Abstract: *Agricultural universities are important forces in agricultural science and technology innovation and patent output. Currently, the number of patents granted to agricultural universities in China continues to grow, yet the commercialization rate of these patents remains persistently low. A large number of research outcomes stay in laboratories, failing to contribute effectively to industrial development. This paper systematically examines the structural dilemmas facing patent commercialization in agricultural universities: the misalignment between research orientation and industrial demand leads to inadequate quality of patent supply; weak intellectual property protection and insufficient professional services undermine the market value of patents; the lack of pilot-scale testing and the special characteristics of agricultural technologies raise the threshold for industrialization; and management systems and incentive mechanisms fail to motivate researchers to engage in commercialization. These four factors are interlinked and mutually reinforcing. On this basis, the paper proposes four corresponding promotion pathways: improving quality at the source, strengthening protection, smoothing market channels, and reforming institutional incentives. The aim is to provide references for breaking the bottlenecks in patent commercialization and promoting the practical application of agricultural research outcomes.*

Keywords: *Agricultural universities; patent commercialization; industry-university-research collaboration*

1. Introduction

Patents are the industrial carriers of innovative outcomes and typical representatives of new quality productive forces. Universities occupy a pivotal position in the innovation system, connecting knowledge production, talent cultivation, and technology application, and serving as an important channel for the industrialization of scientific and technological achievements. Agricultural universities focus on key agricultural fields such as bio-breeding, smart agriculture, green plant protection, facility cultivation, and ecological restoration, continuously generating a large number of original and applied patented technologies. They are an important source of China's agricultural science and technology self-reliance.

In October 2023, the General Office of the State Council issued the Special Action Plan for Patent Commercialization and Application (2023–2025), requiring that by the end of 2025, all universities and research institutions should have covered their untransformed effective patents. In March 2026, the Ministry of Education issued the Notice on Implementing the University Patent Commercialization Tackling Action, requiring universities to establish pre-application evaluation mechanisms for patents, shifting the focus from quantity to quality and commercialization orientation.

However, the difficulty and slowness of agricultural patent commercialization have long existed. According to the 2025 China Patent Survey Report released by the China National Intellectual Property Administration, the industrialization rate of invention patents in Chinese universities is only 10.1%, while that of enterprises reaches 54.0%, a huge gap[1]. The shortfall is even more pronounced in the agricultural and forestry fields; for example, the commercialization rate of invention patents in forestry is merely 8.74%[2]. This paper, grounded in the specific characteristics of the agricultural industry and the operational mechanisms of university research, systematically analyzes the multiple dilemmas faced by agricultural universities in patent commercialization and explores pathways suited to the agricultural sector.

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2. Realistic Dilemmas in Patent Commercialization of Agricultural Universities

2.1 Misalignment between Research Orientation and Industrial Demand

Currently, agricultural universities widely suffer from a disconnect between research activities and industrial needs. Researchers often file patents merely to meet internal assessment criteria, lacking market awareness. Many patents suffer from technological homogeneity, vague application scenarios, and insufficient practical value, making them inherently unsuitable for industrialization[3]. The prevailing tendency to emphasize patent applications over commercialization exacerbates this structural deviation from the outset.

Furthermore, there is a deep conflict between the inherent nature of agricultural research and current patent examination standards. Agricultural research is predominantly basic or applied basic research; outcomes such as breeding improvements and cultivation techniques require years of field trials and multi-regional validation, with maturation cycles far longer than those of general engineering patents. Current examination rules demand completeness of technical disclosure and reproducibility, making it difficult for most stage-specific agricultural achievements to meet the grant criteria. From January to July 2025, the number of invention patents granted to Chinese universities dropped by 28.01% year-on-year, with agricultural universities hit especially hard. While the stricter examination is intended to improve quality, it also screens out many intermediate outcomes, leading to a severe shortage of high-quality, readily commercializable patents at the source.

2.2 Weak Intellectual Property Protection and Insufficient Professional Services

Patent protection provides the legal foundation for market recognition and directly affects commercial value. Agricultural universities face dual constraints in this regard.

First, the quality of patent drafting is generally low. Agricultural patents often involve special requirements such as biological material deposits, field trial data, and variety specificity descriptions. The professional background of patent agents and its match with the technical field largely determine the clarity of claim hierarchy, reasonable scope of protection, and legal stability of the patent. However, the number of registered patent agents with agronomy or biology backgrounds is extremely limited nationwide, and their distribution is geographically unbalanced. Agents without relevant backgrounds find it difficult to produce high-quality patents for agricultural technologies.

Second, intellectual property infringement in agriculture is inexpensive and costly to enforce. Technologies like new plant varieties and breeding methods are easily replicated, while evidence collection and litigation are complex and time-consuming, further weakening the market exclusivity of patents. Weak protection not only reduces the assessed market value of patents but also dampens enterprises' willingness to participate in commercialization.

2.3 Weak Pilot-Scale Testing and High Industrialization Threshold

A clear gap exists in the pilot-scale testing and maturation stage. Pilot testing is a critical transition step from laboratory research to industrialization, serving to remedy technical defects, optimize process parameters, and adapt to production scenarios. However, agricultural universities generally lack systematic pilot platforms and experimental bases. Most research achievements have only been validated at the laboratory level, without large-scale pilot tests or field adaptation trials, so their technological maturity falls short of enterprise standards for large-scale application[4]. At the same time, pilot testing in agriculture is costly, time-consuming, and risky; small and medium-sized agricultural enterprises are weak in risk tolerance and limited in capital, making it difficult for them to bear the costs of technology maturation alone.

Moreover, agricultural technologies are highly scenario-dependent and have long validation cycles. Agricultural production is strongly constrained by natural factors such as climate, soil, hydrology, and regional germplasm conditions. Technologies that perform well under laboratory conditions may exhibit instability or poor adaptability when scaled up to field conditions, requiring repeated validation across seasons and regions. New varieties typically take a long time from authorization to market promotion, with high uncertainty. The difficulties researchers face in obtaining reasonable market valuations for their hard-earned results reflect the fragility of the agricultural patent commercialization chain from lab to field.

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2.4 Structural Deficiencies in Management and Incentive Mechanisms

The failure of management systems and incentive mechanisms to effectively motivate researchers to engage in commercialization is a deeper-rooted cause, governing the functioning of other links and determining researchers' intrinsic drive.

In terms of ownership and benefit distribution, agricultural universities' service inventions belong to state-owned assets, and processes such as equity investment and licensing involve multiple-department approvals, with ambiguous ownership boundaries and unclear revenue distribution. Researchers lack stable expectations of personal gains after commercialization, leading to a prevalent mindset of "dare not, do not want to" transfer.

In terms of evaluation, current promotion and performance reviews still hinge on numbers of papers, grants, and patent grants. As some scholars have noted, simply linking patent counts to evaluation indicators while excluding actual commercialization performance from routine assessment makes researchers' behavioural choices contrary to the goal of technology transfe[r][5]. For researchers, investing time in commercialization yields little credit in promotion or performance evaluation; rationally, they focus on more readily quantifiable outputs such as papers and projects.

In terms of service teams, technology transfer staff in universities are mostly administrative part-timers, with a serious shortage of full-time technology managers. Existing personnel generally lack professional capabilities in agricultural industry operations, patent valuation, and business negotiation. In some agricultural universities, each technology manager oversees more than 60 patents on average, yet their work is limited to basic documentation and information recording. Technology managers are a new profession arising from the demand for commercialization, whose core duties include mining, cultivating, incubating, maturing, evaluating, promoting, and trading research outcomes[6]. In reality, this professional team, which should serve as the hub of commercialization, is still in its infancy in agricultural universities, and both its size and capacity are insufficient to meet actual needs.

These four dilemmas are not isolated but form a chain of causal transmission: deviation of research from industrial demand leads to patents lacking market value; low drafting quality undermines protection effectiveness; absence of pilot testing blocks the path to maturity; and management deficiencies suppress participation at every stage. They reinforce each other, constituting a systemic barrier to patent commercialization in agricultural universities.

3. Promotion Pathways for Patent Commercialization in Agricultural Universities

Targeting the multiple constraints of low source quality, weak protection, blocked market channels, and insufficient institutional incentives, this paper proposes systematic pathways from four dimensions.

3.1 Source Control: Guiding Research with Industrial Demand

Adhere to the principles of demand orientation and priority for commercialization, improving patent quality throughout the entire chain from research topic selection, patent portfolio planning, to technology maturation. First, establish a pre-application evaluation system, abandoning the utilitarian practice of applying merely for the sake of obtaining a grant. The system evaluate pending patents for technical maturity, market fit, and industrialization potential, and curb low-quality outputs. Second, guide researchers to focus on urgent agricultural problems and industrial upgrading needs, laying out patents in areas such as smart planting, green and low-carbon technologies, ecological management, and improved variety breeding, to enhance industrial relevance. Third, strengthen pilot-scale support by leveraging university experimental stations, key laboratories, and industry-university collaboration platforms to conduct multi-region, multi-cycle field trials and technology demonstration, bridging the missing link from small-scale to large-scale production.

3.2 System Improvement: Strengthening Agricultural Intellectual Property Protection

Given the specificity of agricultural IP, build a multi-layered protection system. First, enhance coordinated protection for new plant varieties, agricultural biotechnology patents, and other special IP types, forming a protection portfolio covering patents, variety rights, and trade secrets. Second, ensure that patent agents engaged for agricultural work have matching technical backgrounds, as mismatch often leads to deficient claim scopes and legal flaws. Third, reinforce the leading role of universities as

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patent holders, reversing the tendency of administrative management to weaken the exercise of private rights.

3.3 Channel Opening: Promoting Precise Supply-Demand Matching and Field Application

Focus on the end-use nature of agricultural patents by opening both supply-demand matching and industrialization application channels. First, rely on the national IP operation platform system to establish precise matchmaking mechanisms. During the special action period, 1.349 million stored patents from over 2,700 universities and research institutions were inventoried nationwide, identifying 680,000 promising invention patents and precisely matching them with 460,000 enterprises[1]. Agricultural universities should fully utilise this platform for regular patent screening and enterprise needs matching. Second, innovate commercialization models by actively promoting mechanisms such as "pay after use," open licensing, and portfolio transfer, lowering the threshold for small and medium-sized agricultural enterprises. The open licensing provisions newly added to the current Patent Law offer a market-oriented path for agricultural patents. Third, leverage market players as key connectors, drawing on mature models of equity participation and joint research with leading agricultural companies, encouraging research teams to go to enterprises and fields, forming a four-party integration of government, universities, enterprises, and farmers.

3.4 Institutional Reform: Stimulating Researchers' Commercialization Motivation

Deepen the reform of service invention ownership. Agricultural universities *shall c*larify ownership, simplify approval procedures for transfer, licensing, and equity investment, and optimise revenue-sharing ratios to adequately protect researchers' legitimate interests. The Ministry of Education has explicitly required universities to gradually abolish rewards for patent grants and increase rewards for commercialization, guiding the shift from application-oriented to implementation-oriented patent work. Agricultural universities should actively implement this policy direction so that researchers dare and are willing to commercialise.

Establish a differentiated evaluation system for researchers. Agricultural universities shall establish a differentiated evaluation system for researchers. For those engaged in applied research and technology development, they shall reduce the weight of papers and grants, and focus on quantifiable indicators such as contract values, actual funds received, and industrial spillover effects. They shall move away from the simple counting of patents and establish separate evaluation criteria for basic and applied research.

Build a professional technology manager team. Agricultural universities shall refrain from merely selecting internal administrative staff; they shall recruit professionals from leading agricultural enterprises who understand both markets and industry. Technology managers are responsible for mining, incubation, maturation, evaluation, promotion, and transaction of research outcomes. Agricultural universities should train versatile talents who understand agricultural technology, market operations, legal compliance, and policy implementation.

Establish an integrity management and accountability mechanism. Article 20 of the current Patent Law introduces the principle of good faith in patent applications and rights exercise. Agricultural universities should implement integrity commitment management for inventor attribution and ranking, and adopt a system of primary responsibility and ex-post accountability for the truthfulness of substantive technical content, ensuring that commercialization is built on genuinely innovative foundations.

4. Conclusion

To overcome the challenges in patent commercialization at agricultural universities, it is essential to emphasize both problem-oriented and demand-driven approaches. By recognizing the unique characteristics of the agricultural industry, we must enhance the market readiness of patents from the outset, stimulate internal momentum through institutional reforms, remove barriers through specialized services, and strengthen the innovation ecosystem through close collaboration among industry, academia, and research. This comprehensive strategy aims to establish a virtuous cycle of innovation—where research responds to real needs, patents are of high quality, commercialization channels are accessible, and implementation delivers tangible benefits. It will help more agriculture-related patents move beyond laboratories and into fields, effectively leveraging high-level agricultural scientific and

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technological innovation to drive high-quality agricultural development and support the comprehensive revitalization of rural areas.

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