Challenges and Strategies of Implementing Agricultural Electronic Licenses in China

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Posted Date: 14 June 2024

doi: 10.20944/preprints202405.1980.v2

Keywords: agricultural electronic licenses; government services; application and interconnection; policy and regulation

Article

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Abstract: In the process of expanding the application of electronic licenses in the Chinese agricultural sector, challenges such as inconsistent information standards, poor interoperability, significant data barriers, and lack of regulatory basis are encountered. By examining online information and practical data of agricultural electronic licenses in the 31 provincial-level administrative units in mainland China, variations in the reasons for promoting the expanded application of electronic licenses in different regions were identified. It is believed that strategies should be proposed around key factors such as government capacity, economic development, social needs, and intergovernmental relations. Suggestions include enhancing the intensity of information aggregation, diversifying the management entities, advancing the intelligence of underlying technology, and improving the completeness of legal rules. New conceptual proposals, such as constructing a database for agricultural information collection, establishing a multi-entity management authorization mechanism, implementing intelligent applications of electronic licenses at the grassroots level, and developing specialized legal rules, require further validation.

Keywords: agricultural electronic licenses; government services; application and interconnection; policy and regulation

1. Introduction

The General Office of the State Council of China issued the "Opinions on Accelerating the Expansion of Electronic Licenses Application and Nationwide Interconnection," which comprehensively deployed measures regarding the "expansion of electronic license application areas," "promotion of nationwide interconnection and mutual recognition of electronic licenses," and "comprehensive enhancement of the support capabilities for electronic licenses application," striving to achieve the goal of "data traveling more, and people traveling less [1]." Given the report of the 20th National Congress of the Communist Party of China emphasizing the "most arduous and challenging task remains in the rural areas for the comprehensive construction of a socialist modernized country." Against the backdrop of the deepening implementation of "Internet Plus Government Services," there is an urgent need for targeted research findings from the academic community on addressing prominent issues in the agricultural field practice related to electronic license standardization deficiencies, incomplete information interoperability mechanisms, inadequate shared service systems, and limited application scenarios. However, existing research outcomes are relatively scarce, with current literature primarily focusing on issues in electronic license archive management [2], the necessity of electronic licenses in promoting government informatization [3], exploration of electronic license digitization practices in land planning [4], solutions for shared and verifiable electronic licenses [5], and the technical applications of blockchain in electronic licenses sharing [6]. While these studies provide a foundational basis, theoretical achievements focusing on the current status of electronic licenses application in key areas and combining systematic data analysis with feasible technological solutions are yet to emerge. Therefore, by utilizing agricultural data and information as a reference point, a typological analysis of the basic situation of electronic licenses application in the 31 provincial-level administrative units in mainland China can be conducted. This approach can help identify common factors, root problems, and correspondingly design strategic

 doi:10.20944/preprints202405.1980.v2

solutions, effectively addressing the urgent need to promote the expanded application of electronic licenses in China.

2. Current Status of Agricultural Electronic Licenses Application in China

2.1. Digitalization of Agricultural Administrative Service Delivery

In June 2018, the General Office of the State Council issued a notice on the implementation plan for further deepening the "Internet Plus Government Services" to promote the reform of "One Network, One Gateway, One Time" government services. It proposed to accelerate the construction of a three-tier interconnected online government service platform system at the national, provincial, and municipal levels to promote the realization of "one-time login, access to all services." In May 2019, the central government website went online to integrate online service functions from all regions across the country, serving as the "National Government Service Platform," the central hub for government services nationwide. Following the launch of this platform, government departments at all levels from the central government to provincial, municipal, and county levels gradually opened online service items on the platform or migrated existing online service platforms to it [7]. The issuance and use of various electronic licensing matters in relevant fields should be integrated on this platform in accordance with unified standards and regulations. Therefore, the online service items of provincial agricultural departments on the "National Government Service Platform" not only directly reflect the application capability level of data, including electronic licensing, but also provide authoritative, objective, and comparable data.

To access specific data, one can navigate to the "National Government Service Platform," select the "Local Government Service Window," choose the province (autonomous region, municipality directly under the central government), select the municipal level administrative division name below, click on "Individual Services/Legal Entity Services," and under "Search for service items by department," select "Agriculture and Rural Areas." Then, under "Service Items," choose the checkbox "Display only items that can be processed online" to view the number of actual online service items related to agriculture in that province and the specific service item names. By following this process, data and information on the actual online processing of rural affairs in all provinces nationwide can be obtained (as of June 1, 2024).

Table 1. Electronic processing of provincial-level agricultural government services.

province (autonomous region, municipality directly under the central government)	number of personal online transactions	number of corporate online transactions	total
Beijing Municipality	9	14	23
Tianjin Municipality	59	95	154
Hebei Province	19	38	57
Shanxi Province	26	56	82
Inner Mongolia Autonomous Region	16	46	62
Liaoning Province	42	59	101
Jilin Province	31	42	73
Heilongjiang Province	22	35	57
Shanghai Municipality	22	45	67
Jiangsu Province	64	86	150
Zhejiang Province	19	35	54
Anhui Province	30	54	84
Fujian Province	20	32	52
Jiangxi Province	38	87	125
Shandong Province	13	20	33
Henan Province	32	57	89
Hubei Province	28	55	83
Hunan Province	32	52	84

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Guangdong Province	13	45	58
Guangxi Zhuang Autonomous Region	42	70	112
Hainan Province	22	46	68
Chongqing Municipality	23	39	62
Sichuan Province	24	50	74
Guizhou Province	24	50	74
Yunnan Province	12	23	35
Tibet Autonomous Region	68	73	141
Shaanxi Province	42	56	98
Gansu Province	21	31	52
Qinghai Province	6	18	24
Ningxia Hui Autonomous Region	25	29	54
Xinjiang Uygur Autonomous Region	29	43	72

Based on the data presented in the table above, a preliminary analysis comparing the integration and sharing of information between the agricultural sectors of various provinces and the National Public Service Platform leads to the following conclusions:

There are significant disparities in the electronic governance services related to agriculture, including the application and sharing capabilities of electronic licenses and certifications. The overall pattern indicates that the eastern regions, particularly the southern coastal areas and the northeast, followed by the central regions, exhibit stronger capabilities than the western regions.

The autonomous regions and municipalities directly under the Central Government demonstrate notably superior online governmental service capabilities in agriculture compared to the general provinces. Within the same region, neighboring areas tend to have a strong influence on each other's public service capabilities, generally displaying similar and high levels of service.

Provinces with fewer agricultural governance services conducted online also tend to have a considerable portion of their other tasks on the National Public Service Platform not fully integrated, with data interoperability and recognition still unachieved. In some provinces, less than 40% of the tasks that could be handled online on the National Public Service Platform are among those already integrated into the platform.

Although the number of agricultural-related online transactions processed through the National Public Service Platform does not directly correspond to the application and sharing of electronic licenses and certifications in each locality, it is possible to observe, at a macro level, the fundamental pattern of data interoperability, mutual recognition, and trust in the agricultural sector across various provinces, autonomous regions, and municipalities directly under the Central Government.

2.2. Institutionalization of Agricultural Electronic Licensing Regulations

To ensure a further understanding and refinement of the issuance and application of electronic licenses in agriculture, in addition to the hardware construction for agricultural data informatization, local governments have conducted information retrieval on their normative documents in accordance with the spirit of policies such as "Opinions on Accelerating the Expansion of Electronic Licenses Application and National Interconnection" and "Opinions of the Ministry of Agriculture and Rural Affairs on Further Deepening the Reform of 'Delegating Power, Strengthening Regulation, and Improving Services'". This process allows for an examination at the institutional design level of the issuance and application of electronic licenses in the agricultural sector in various regions, thereby evaluating the actual application and sharing levels.

 doi:10.20944/preprints202405.1980.v2

Table 2. Analysis of provincial electronic license policies and regulations.

province (autonomous region, municipality directly under the central government)	name of the policy or regulation	implementation time
Beijing Municipality	No directly related electronic license documents or unavailable at present	unavailable
Tianjin Municipality	Interim Measures for the Management of Electronic Licenses in Tianjin Municipality	2019.2.19
Hebei Province	Measures for Accelerating the Expansion of Electronic Licenses Application Areas and Promoting Nationwide Interconnection	2022.5.28
Shanxi Province	Implementation Measures (Trial) for Electronic License Management on Shanxi Province Integrated Online Government Service Platform	2022.4.22
Inner Mongolia Autonomous Region	Notice from the Inner Mongolia Autonomous Region Government Service Bureau on Accelerating the Standardization and Expansion of Electronic License Application Areas	2022.5
Liaoning Province	Task List for Accelerating the Expansion of Electronic License Application Areas and Interconnection	2022.4.6
Jilin Province	Implementation Plan for Accelerating the Expansion of Electronic License Application Areas and Interconnection in Jilin Province	2022.7
Heilongjiang Province	Implementation Plan for Accelerating the Application of Electronic Licenses in Heilongjiang Province	2021.11
Shanghai Municipality	Shanghai Municipality Electronic License Management Measures	2022.7.1
Jiangsu Province	Notice on Accelerating the Application of Electronic Licenses	2020.11.2
Zhejiang Province	Regulations in Zhejiang Province to Ensure the "Maximum One Visit" Reform	2019.1.1
Anhui Province	No directly related electronic license or undisclosed documents available at present	unavailable
Fujian Province	Implementation Plan for Fujian Province to Accelerate the Expansion of Electronic Licenses Application Areas and Cross-Regional Interconnection	2022.5.30
Jiangxi Province	(1)Work Plan for the Construction of Electronic License System in Jiangxi Province	2017.11.17
	(2)Work Plan of Jiangxi Provincial Department of Agriculture and Rural Affairs on Further Deepening the Reform of "Delegating Power, Enhancing Regulation, and Improving Services" in Agriculture and Rural Areas to Optimize the Business Environment	2022.7.19
Shandong Province	(1)Implementation Plan for Deepening Data Empowerment to Build a "Province without Certificates"	2022.5.27
	(2)Work Norms for the Construction and Application of Electronic Licenses in Shandong Province (Trial)	2022.7.13
Henan Province	Interim Measures for the Management of Electronic Licenses in Henan Province	2018.8.31
Hubei Province	Interim Measures for the Management of Electronic Licenses in Hubei Province	2019.3.1

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Hunan Province	No directly related electronic license or undisclosed documents available at present	unavailable
Guangdong Province	Interim Regulations on the Administration of Government Electronic Licenses in Guangdong Province	unavailable
Guangxi Zhuang Autonomous Region	(1)Notice from the Leading Group for the Construction of Digital Guangxi of the Guangxi Zhuang Autonomous Region on Issuing the Implementation Plan for Accelerating the Expansion of Electronic Licenses Application and Interconnection in Guangxi	2020.9.7
	(2)Draft for Solicitation of Comments on the Interim Measures for the Management of Electronic Licenses in the Guangxi Zhuang Autonomous Region	2022.10.12
Hainan Province	Implementation Measures for the Management of Electronic Licenses Application on the Integrated Government Service Platform in Hainan Province	2020.9.1
Chongqing Municipality	Work Plan for the Optimization and Enhancement of the Integrated Government Service Platform "YuKuaiBan" in the City in 2022	2022.5.9
Sichuan Province	Interim Measures for the Management of Electronic Licenses on the Integrated Government Service Platform in Sichuan Province	2022.4.8
Guizhou Province	Notice from the Provincial Big Data Bureau and 14 Other Departments on the Comprehensive Promotion of the Application of the Fourth Batch of Electronic Licenses in Government Services	2022.7.28
Yunnan Province	15 Measures to Accelerate the Expansion of Application Fields and Cross regional Mutual Recognition of Electronic Certificates and Licenses	2022.7.9
Tibet Autonomous Region	Implementation Plan for Accelerating the Standardization, Formalization, and Expanded Mutual Recognition of Electronic Licenses	2022.6.20
Shaanxi Province	Interim Measures for the Management of Government Electronic Licenses in Shaanxi Province(Trial)	2022.8.25
Gansu Province	Notice from the General Office of the People's Government of Gansu Province on Accelerating the Expansion of Electronic Licenses Application and Interconnection	2022.4.22
Qinghai Province	Interim Measures for the Management of Electronic Licenses in Qinghai Province	2021.9.22
Ningxia Hui Autonomous Region	No directly related electronic license or undisclosed documents available at present	unavailable
Xinjiang Uygur Autonomous Region	Implementation Plan for Advancing the Expansion of Electronic Licenses Application and Nationwide Interconnection Reform	2022.9.16

Through big data retrieval and comparison, as of now, Beijing, Anhui, Hunan, and Ningxia have not yet formulated or disclosed specialized electronic license policy regulations. The remaining 27 provinces and municipalities have all issued and implemented policy documents directly related to the management or application of electronic licenses, presenting the following main characteristics after analysis:

The majority of the policy documents issued by provincial governments are still at the level of the fundamental principles stated in the "Opinions on Accelerating the Expansion of Electronic Licenses Application and National Interconnection." Ten provincial governments have released specialized electronic license documents that use the expression of "promoting the expansion of

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electronic licenses application and national interconnection." These documents largely retain the content of the State Council General Office's "Opinions on Accelerating the Expansion of Electronic Licenses Application and National Interconnection," with only a few provinces making adjustments based on local realities through task lists, specific measures, and other forms.

The effectiveness of the specialized electronic license policy documents issued by local authorities is generally low, mainly being "notices," "plans," or "interim measures." Except for Shanghai, which has enacted the "Shanghai Electronic License Management Measures," the electronic license-related policies of most provincial governments have a relatively low level of authority. Prior to the State Council General Office's issuance of the "Opinions on Accelerating the Expansion of Electronic Licenses Application and National Interconnection" on January 20, 2022, the normative electronic license documents introduced by local governments were mostly "interim" or "trial," indicating that local electronic licenses are still primarily in the exploration and experimentation phase in terms of expanding application and mutual recognition, with a considerable gap from comprehensive and deepened promotion of electronic license implementation.

Some provinces have made beneficial attempts by combining existing e-government service systems and clarifying the key tasks of electronic license-related normative documents. Examples include Zhejiang's "Regulations on Guaranteeing the 'One Visit at Most' Reform in Zhejiang Province," Shandong's "Implementation Plan to Deepen Data Empowerment and Build a 'Province without Licenses'," and Chongqing's "2022 'Yukuaiban' City-wide Integrated Government Service Platform Optimization and Enhancement Work Plan." While these documents may not explicitly mention "electronic licenses" in their titles, they are based on the State Council General Office's "Opinions on Accelerating the Expansion of Electronic Licenses Application and National Interconnection." The content of these documents revolves around electronic licenses or convenient online government services, effectively implementing the spirit of central policy documents and focusing on local government resources, which is commendable.

2.3. Exemplification of Agricultural Electronic License Application Practice

To provide a more scientific and comprehensive reflection of the current status of agricultural electronic licenses, it is necessary to combine the specific practices of agricultural and rural departments below the provincial level. Emphasis should be placed on provinces and regions where the application and sharing levels of agricultural electronic licenses are relatively low to prevent research conclusions from being superficial or biased. By conducting searches, surveys, and comparisons of publicly available electronic license application achievements in various levels of agricultural fields at the local level, the following exemplary cases have been compiled:

Gansu Province achieved online verification of electronic business licenses in 2020. When handling operations such as pesticide sales permits, pesticide advertising reviews, refined organic fertilizer registration approvals, shoreline aquaculture licenses, approval of hunting national second-level protected aquatic wildlife, issuance of permits for artificial breeding of national first-level protected aquatic wildlife, issuance of permits for major crop hybrid seeds and their parent seed production, and qualification accreditation of crop seed quality inspection institutions, paper or electronic business licenses are no longer provided [8].

Guangxi Zhuang Autonomous Region has completed the construction of an electronic license aggregation system, enabling the import, conversion, verification, updating, and connection to the regional shared exchange platform of basic data for electronic licenses in the system, thereby achieving initial data updating iterations. The agricultural electronic license aggregation system has claimed 52 types of licenses, collected nearly 950,000 structured data entries, effectively ensuring the timeliness and completeness of aggregated licenses [9].

In Liaoning Province, agricultural enterprise staff no longer need to physically submit materials at government hall windows to receive paper approvals. Results can now be directly generated as electronic approval documents for home download and use. Currently, the province has taken the lead in developing and applying electronic licenses for eight newly added provincial-level administrative services, such as "Rewarding individuals who violate the 'Liaoning Province

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Livestock and Poultry Slaughter Management Regulations'," in accordance with the "Liaoning Province Government Service Project Catalog (2020 Edition)." This has streamlined processes such as "standardizing data management, real-time incremental generation, and automatic printing," facilitating online downloads and eliminating the need for in-person visits [10].

Shanghai achieved basic management of fishing vessels through integrated online services between departments and cities in 2019. The city's agricultural service management system has been established, with 36 administrative licensing matters fully integrated and data-linked with the city's online service system, enabling seamless sharing and application. Four fisheries-related matters, including fishing license approvals, fishing gear tool index approvals, fishing vessel registration, and practicing veterinarian qualification accreditation, have achieved departmental and city-level integration. Future focus areas include integration between the acceptance and processing ends of the online service platform, real-time access to departmental electronic license data, and seamless coordination of steps such as single sign-on, online application, form submission, review and approval, and electronic license issuance [11].

Shandong Province and Shenzhen City, as the first pilot locations for paperless issuance of animal quarantine licenses in the country, successfully verified the reliability of paperless issuance of animal quarantine licenses and related electronic license systems in 2022. They have fully transitioned to using electronic licenses for animal quarantine licenses in their respective regions, eliminating the need for paper animal quarantine licenses for the slaughtering and sale of qualified livestock and poultry products. Relevant enterprises have also digitized their meat quality inspection licenses simultaneously [12].

Summarizing the above practical examples of agricultural electronic license application and sharing at the local level can further clarify the progress differences across regions in promoting the expansion and mutual recognition of electronic licenses:

Provinces and municipalities with relatively underdeveloped economies have limited and narrow application of electronic licenses. While the relevant departments are investing limited human, material, and financial resources in promoting electronic licenses, slow progress and limited outcomes can be understandable. Higher-level departments should provide assistance based on local realities to help provinces and municipalities with less developed economies align with the overall national momentum of electronic license application and sharing.

Currently, the key task for all regions nationwide in advancing agricultural electronic licenses application remains the completion of data collection and integration work. Accelerating the expansion and mutual recognition of electronic licenses in agriculture is contingent upon the comprehensive digitization of existing data and the full coverage of online issuance of incremental licenses. Due to differences in local governance capabilities, economic development levels, and agricultural conditions, progress in agricultural data collection varies across regions. In provinces and municipalities with limited personnel, financial resources, weak technical capabilities, and poor archive materials, local departments are still striving to digitize paper licenses and promptly collect and upload them, indicating a certain gap from achieving comprehensive application and mutual recognition in various fields nationwide.

Provinces and municipalities undertaking pilot tasks and with strong e-government capabilities have achieved comprehensive electronic licenses application in specific areas. For instance, Shanghai, Shenzhen, and Shandong have achieved full coverage of electronic licenses in fisheries management, inspection and quarantine, providing valuable experiences for the gradual.

3. Principal Issues Impeding the Application of Agricultural Electronic Licenses

By systematically reviewing the application of local electronic licenses, integrating the application of electronic license-related government service data in various agricultural areas, the design of policy standards, and specific practical measures, common factors influencing the expansion of electronic licenses are extracted to further clarify the issues and challenges. Through analysis, it is believed that government capacity, economic development, social demands, and

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intergovernmental relations are key factors currently determining the progress of electronic license expansion and mutual recognition processes [13].

Government capacity factor: The government's "Internet + government service" capability is closely related to its own basic capability. The stronger the basic capability of the local government, the stronger its "Internet + government service" capability, including the application of electronic licenses. Government capacity generally needs to examine indicators such as the scale of government agencies, the soundness of local regulations, the transparency of policies and regulations, government law enforcement capability, government efficiency, public satisfaction with the government, social security and public satisfaction, and the level of e-government.

Economic development factor: The implementation of electronic license systems in various provinces and municipalities inevitably requires the input of human, material, and technological resources, and these resources ultimately require the support of economic and financial resources. Therefore, the expansion of the application of electronic licenses and the interconnection will be affected by the economic development factor, and the stronger the economic development, the more likely it is to enhance the actual application capability. From the two relatively authoritative indicators of per capita GDP and the scale of finance and finance in each province and municipality, the economically better-off eastern coastal areas generally have a higher degree of application than the western inland areas; the electronic license systems of autonomous regions and municipalities are generally more sound than those of ordinary provinces.

Social demand factor: The application capability of agricultural electronic licenses is also driven by social demand. The stronger the social demand, the greater the pressure on the relevant government departments, and the more urgent the need to provide electronic and convenient online agricultural government services. In the agricultural and rural areas, the four indicators of industry scale, population scale, network penetration rate, and agricultural service expenditure are the key factors reflecting the social demand for the application of electronic licenses by relevant departments: the larger the scale of the agricultural industry in the region, the more it can promote the local relevant departments to realize the application of electronic licenses and enrich the application scenarios. The larger the population, the greater the demand for online services such as electronic licenses; the higher the network penetration rate, which reflects the ratio of the Internet and smart mobile devices to the total population in the region; the agricultural service expenditure can reflect the social service supply capacity of the relevant government departments, and also reflect the strong demand of agricultural enterprises and the masses for agricultural government services.

Inter-governmental relations factor: Under China's political system, the behavior of a specific government is not only affected by its own and its jurisdiction factors, but also by the behavior of other governments. This influence is mainly manifested in two aspects: One is the vertical influence due to administrative management relations, where the instructions or demonstrations of the higher-level government will have a direct impact on the lower-level government; the other is the positive competitive effect between the behaviors of adjacent governments [14]. In the application of agricultural electronic licenses, the administrative departments of autonomous regions and municipalities are generally more mature in their electronic license application systems due to their closer ties with the central government. In addition, there is a strong driving effect between the business departments of neighboring regions within the same region, and their capabilities in applying agricultural electronic licenses are basically similar and at a relatively high level.

In summary, to further promote the development of electronic license application in the agricultural sector in the future, the following four key problems need to be focused on:

3.1. The Expansive Volume of Agricultural Licenses as a Barrier to Digitalization

The number of approved license documents will inevitably expand rapidly as the application of electronic licenses is expanded, as there are approval results for all approval matters. Meanwhile, the accumulated agricultural electronic license data is difficult to collect and process due to the inconsistent data and information format standards between the central and local governments, among various departments within the same level, and between different departments [15]. For

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example, when the staff from the Regulation Division, Market and Informatization Division, Government Service Window, and relevant business departments of the Guizhou Provincial Department of Agriculture and Rural Affairs, as well as the staff responsible for the data team of the Guizhou Provincial Data Management Bureau and the Provincial Government Service Center, communicated and exchanged views on promoting the electronic application of administrative approvals such as fishery, agricultural machinery, animal husbandry and veterinary medicine, and fertilizer registration, it was found that there are 10 agricultural government business systems (the National Plant Quarantine Informatization Management System, the China Agricultural Pesticide Digital Supervision Management Platform, the Veterinary Health Integrated Information Platform, the National Inland Fishing Vessel Management System, the Phase I Application Management System of the Golden Agriculture Project, the China Fishery Crew Management System, the China Fishery Management and Command System, the China Seed Industry Big Data Platform, and the Seed Production and Operation License Management System), involving 30 major government service items; and there are 4 provincial-level business systems (the Guizhou Province Electronic Certification Information Management System for Animals and Animal Products, the Guizhou Province Agricultural Machinery Safety Supervision Information Management System, the Guizhou Agricultural Pesticide Digital Supervision Management Platform, and the Guizhou Province Agricultural Machinery Purchase Subsidy Management System), involving 8 major government service items. It is clear that the task of collecting and integrating the electronic license data information within the existing multiple agricultural systems will be a rather onerous and arduous one [16].

3.2. Reduced Data Interoperability Due to Excessive Authorizing Entities

Agricultural electronic licenses typically require approval and issuance by multiple government agencies or authorizing entities, resulting in a diverse governance structure that includes the local agricultural and rural audit department, the higher-level agricultural and rural review department, and even collaborative departments outside the agricultural and rural system. This directly leads to a proliferation of approval business information systems for individual licenses, with a nationally developed electronic licensing platform by higher authorities, platform systems independently developed by some provincial and municipal governments, and online service platforms established separately by central and local government service agencies. Achieving electronic licensing of approval results requires active cooperation from each governance entity and their respective information systems, open sharing of electronic licensing metadata, and unified format standards to facilitate feedback of approval results from online platforms to relevant approval processes. Additionally, as conditional information, it is used to control the automatic flow of collaborative approval processes. Promoting the compatibility of access portals and collaborative approval mechanisms on government service platforms by relevant departments will enhance the operational effectiveness of expanding the application and mutual recognition of electronic licenses [17].

3.3. The Burden and Digital Barriers of Frontline Work

Over the years, the approval results of agricultural-related licenses have mostly been unified paper documents, and agricultural enterprises and the general public are accustomed to using physical licenses. The comprehensive implementation of electronic licenses, while not posing overly high technological barriers, faces challenges in practice, especially at the grassroots level, such as incomplete retention of paper licenses, insufficient frontline manpower, and weak willingness for online processing. Therefore, the primary obstacle to the implementation of the system ultimately remains a "human" issue.

On one hand, frontline workers generally face the phenomenon of "fewer people, more tasks," compounded by the continuous expansion of new business formats represented by the digital economy into the segmented markets of agriculture and rural areas. The emergence of new problems and situations further strains the already stretched administrative capacity when dealing with the heavy workload of digitizing paper licenses for electronic archiving and uploading. On the other

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hand, the application process for agricultural electronic licenses often involves direct interaction with the general public. While mobile internet has been widely adopted in rural areas, residents, especially older farmers, face a natural "digital divide" in using smartphones. Long-standing habits of handling affairs make grassroots individuals more inclined towards offline and paper-based processes when dealing with agricultural licenses. A blanket implementation of electronic licenses can easily leave technologically inexperienced households feeling lost and generate resistance and frustration.

Therefore, from a holistic perspective, advancing the expanded use and mutual recognition of electronic licenses requires a systematic and in-depth understanding of the frontline realities, unified thinking, and alignment with the people's needs. Through more intelligent and user-centric institutional design and technological means, the true goal is to achieve greater data mobility, reduce the physical burden on the public, and ease the workload of staff [18].

3.4. Lack of Specialized Legal Regulations for Agricultural Electronic Licenses

Electronic licenses are a new phenomenon in the realm of "Internet + government services." Existing institutional coordination rules, as well as archive management systems and standard regulations, fail to meet the new requirements of electronic license management in terms of functional authorization, legal validity, license interoperability, and personal privacy [19]. Therefore, there is a need to expedite the revision of institutional organizational plans, archive management systems, and standard regulations that are not conducive to the expanded use and mutual recognition of electronic licenses, refine work standards, establish a new standard system, and address the problem of incompatible institutional mechanisms and regulatory rules [20].

Hence, relevant departments should take the lead in formulating basic and specialized regulations for the implementation of electronic licenses in agriculture to prevent doubts in different regions regarding the implementation of electronic licenses and cross-regional recognition of electronic licenses. They should lead the establishment of national pilot projects for electronic licenses application and mutual trust, provide solid legal and regulatory basis for issuing lists of electronic license application scenarios, formulating supporting rules for electronic license interoperability, clarifying mechanisms for handling cross-regional disputes related to electronic licenses, and establishing complementary online and offline systems for electronic licenses. This comprehensive approach will elevate the legal level of the electronic license system, foster a conducive institutional environment, and enhance the rule of law in the electronic license system.

4. Strategies for Expanding the Application of Agricultural Electronic Licenses

Currently, the main construction of the agricultural domain government service platform has been preliminarily completed in China, as illustrated in Figure 1.

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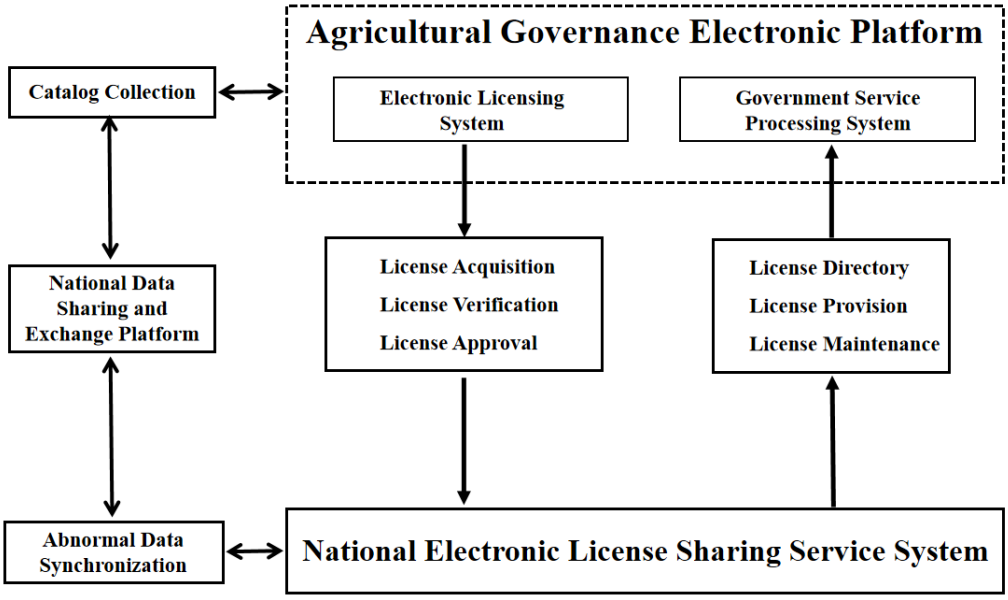

Figure 1. Information docking process for agricultural electronic license.

Specifically, the agricultural electronic license sub-system pushes data information to the front-end database. The national data sharing and exchange platform extracts license data information from the front-end database and sends it to the resource sharing service center front-end database. The resource sharing service center regularly fetches license directory information from the front-end database and saves it to the data aggregation area. The national electronic license sharing service system periodically reads license data information from the data aggregation area of the resource sharing service center, conducts a series of validations, saves standardized license data to the core data area, and writes back non-standard abnormal data to the exception information table in the front-end database. The resource sharing service center periodically reads abnormal data from the license front-end database and saves it to the resource sharing service center front-end database. The national data sharing and exchange platform reads abnormal data from the resource sharing service center front-end database and sends it to the agricultural electronic license system front-end database for periodic reading of abnormal data, makes necessary modifications, and re-reports qualified data [21].

However, in terms of expanding the application and mutual recognition of electronic licenses, there is still potential space for business integration, data integration, and technological integration in the construction of the electronic license sub-system. It is necessary to proactively address the challenges of a large number of agricultural licenses, lack of uniform electronic standards, numerous authorization and governance entities affecting data interoperability, lagging digitization of grassroots paper licenses leading to a digital divide, and the absence of specialized regulatory basis for agricultural electronic licenses. By gradually improving the electronic license system across levels, regions, systems, departments, and businesses through the technical roadmap depicted in Figure 2, the aim is to achieve collaborative application and mutual recognition.

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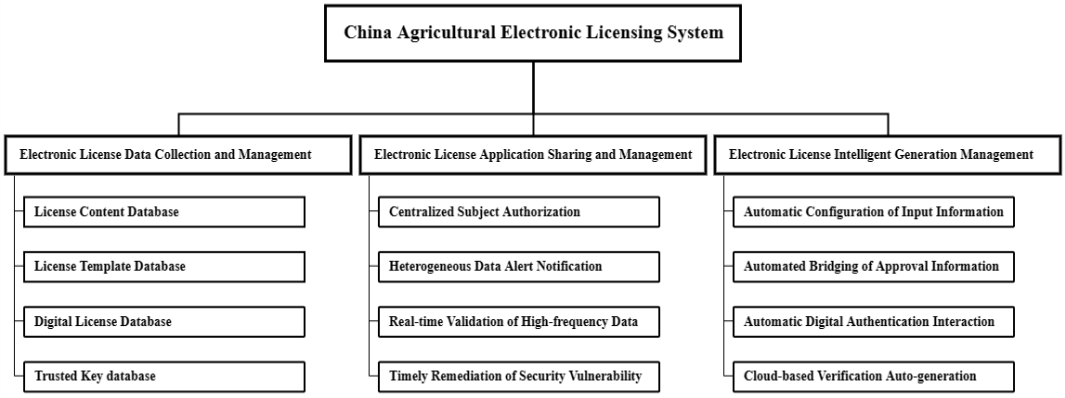

Figure 2. Information docking process for agricultural electronic license.

4.1. Accelerating the Development of Agricultural Electronic License Information Collection Database

To address the challenges posed by the large number of agricultural licenses and the lack of uniform electronic standards, it is recommended to strictly adhere to the process of electronic license generation and storage. Electronic licenses should be generated and stored in real-time according to a standardized format, focusing on the construction and enhancement of the license content, license templates, digital certificates, and trust key databases.

The license content database, facilitated by the establishment of provincial or municipal data exchange platforms and routing configurations, involves transmitting the packaged information of newly generated electronic licenses from various electronic license generation subsystems to the relevant department's electronic license content database. The license template database aims to standardize the format of the original issuance information across different regions, integrating, validating, and cleansing data using universally accepted license templates before submitting them in a standardized template format for storage. The digital certificate database emphasizes the verification and sealing of data sent from various departments, utilizing blockchain timestamp technology to electronically sign and authenticate electronic licenses at different levels after departmental review, ensuring the authenticity, validity, and uniqueness of the electronic licenses [22]. The trust key database assigns a unified number to electronic license information, encrypts data such as information, revocation lists, and electronic signatures into an electronic license information package, and attaches a unique data key for the agricultural electronic license system to facilitate storage verification and mutual recognition during transmission [23].

4.2. Enhancing Diversified Management of Agricultural Electronic License Application and Sharing

From the perspective of governance entities, strict governance and diversified coordination of electronic licenses application and sharing can effectively address the challenges posed by numerous authorization and governance entities affecting data interoperability. Specifically, it is recommended to focus on the following four aspects:

Unified Subject Authorization: Relevant departments of the State Council should lead the nationwide adjustment of authorization for agricultural electronic licenses usage to unify the overall task division of the national electronic license and service system. Based on the provision of electronic licenses and government services at the provincial and municipal levels, hierarchical and cross-level authorizations should be established [24]. Initially, electronic license information generated by various municipalities should be transmitted to the province in real-time or periodically to establish a unified provincial electronic license database. This database should provide government services such as license inquiries, comparisons, and verifications for the entire province. Furthermore, on the agricultural government service platform, collaborative approvals for inter-provincial and inter-municipal matters should be opened up, enabling secure transmission and credible authentication of approval results between provinces and municipalities. Lastly, relevant departments should

 doi:10.20944/preprints202405.1980.v2

comprehensively collect and manage the issuance, usage, and changes of electronic licenses nationwide.

Heterogeneous Data Alerting: A data structure comparison and expiration judgment function should be set up within the electronic license system to alert discrepancies in data structure uniformity and expired electronic license data. Once abnormal data structures are detected, approvers or applicants should be promptly notified for real-time modifications, extensions, or replacement of licenses. Real-time notifications should be issued for the cancellation of electronic licenses due to data anomalies, informing relevant departments and individuals of the specific reasons for the license invalidation.

Real-time Correction of High-frequency Data: The electronic license system should incorporate a high-frequency information data verification and correction module. By sharing the agricultural electronic license database, data should be compared, verified, and authenticated using digital certificates or electronic signatures to identify the authenticity of licenses. This process assists technical staff in relevant departments to promptly identify and address high-frequency instances of license fraud.

Timely Security Vulnerability Remediation: Establishing an electronic license security maintenance mechanism is crucial. Real-time security vulnerability checks should be conducted on electronic licenses issued by provincial and municipal departments, with regular maintenance updates. Focus should be on conducting security evaluations on the issuance time, application regions, overall quantities, and abnormal trends of electronic licenses. Real-time generation of system security inspection reports should be prioritized to mitigate system breakdowns and data breaches resulting from multi-departmental and cross-regional collaborative operations.

4.3. Upgrading the Intelligence of Agricultural Electronic License Work at the Grassroots Level

Given the lag in the digitization of paper licenses at the grassroots level and the existence of digital barriers, it is imperative to enhance the intelligence level of electronic license generation to alleviate the pressure on frontline workers and facilitate the use of smart devices by agricultural businesses and the public with limited technical proficiency. This should include the following aspects:

Automatic Information Input Configuration: Integrate input, license styles (templates), electronic stamps, and digital authentication modules in the electronic license system, embedding them with scanner and printer interfaces. Enable scanning, input, text recognition, content correction of licenses held by external personnel, and exchange them to the electronic license content database or publish them as proof of transaction results. Simplify operations to obtain maximum information, starting from the data input source to reduce the workload of workers.

Automatic Approval Information Bridging: Enhance the bridging function modules of electronic license systems of various departments at all levels, automatically linking and pushing approval information from front-end approval systems to the corresponding functional departments. Automatically provide a verification code generated from the license content information to achieve mutual recognition, trust, and interoperability across multiple departments and levels.

Automatic Digital Authentication Interaction: Establish a data exchange front-end node module to send packaged license content and template information through the data exchange platform to the electronic license database while connecting with the digital certificate system to issue digital certificates for designated licenses [25].

Cloud-based Verification Auto-generation: Improve cloud-based transaction technology to generate accessible transaction items from packaged license information, push them to relevant department data centers, and include them in the cloud resource directory. Additionally, enhance the extraction and comparison verification functions for the information of these transaction items to ensure the security and reliability of cloud data.

4.4. Developing Specialized Regulations for the Expansion of Agricultural Electronic Licenses Application

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Given the current absence of specific regulations governing the implementation of agricultural electronic licenses, it is recommended to promptly introduce specialized regulations that can guide the nationwide promotion of electronic license expansion and mutual recognition. Currently, the strict adherence to legal procedures in advancing any government initiative is crucial. This requirement serves as a significant indicator of the modernization and legal governance capabilities of relevant departments.

Furthermore, an analysis of the institutional design of electronic licenses application in various regions clearly indicates that the lack of authoritative, guiding, and specialized legal norms for electronic license implementation at the national level has led to inconsistencies in ideological understanding and varying levels of importance placed on implementing policies related to the expansion and mutual recognition of electronic licenses. This has resulted in uneven levels of promotion and application of agricultural electronic licenses nationwide.

Therefore, it is essential to expedite the introduction of specialized regulations for electronic license implementation to break the habitual reliance of agricultural enterprises and the public on paper licenses. By establishing a comprehensive legal foundation, these regulations can facilitate the nationwide expansion and mutual recognition of electronic licenses from top-down, providing clarity, authority, and accountability for departments at all levels, especially frontline workers. It is recommended to draft the "Implementation Measures for Electronic License on Agricultural and Rural Government Service Platforms" (draft expert opinion) promptly based on the current status of government service platform construction in the agricultural sector and the practical realities of electronic licenses application in various regions. This initiative aims to promote the application of electronic licenses in more fields and achieve nationwide interconnection, mutual recognition, and trust.

5. Summary

Promoting the development of a regulatory framework for electronic licenses is crucial to achieve cross-level, cross-regional, and cross-departmental sharing, mutual recognition, and trust. This initiative holds significant practical significance in facilitating daily administrative management and post-inspection, streamlining material application processes for enterprises and the general public, accurately verifying and confirming the identities of service applicants, and timely conducting data analysis and decision-making by the Chinese government.This paper focuses on the current challenges in the expansion of agricultural electronic licenses in China, including information standards, interoperability, data barriers, and regulatory foundations. By examining the objective realities of agricultural electronic licenses application in provinces, autonomous regions, and municipalities nationwide, the paper proposes a comprehensive set of strategic solutions centered around four key factors: government capabilities, economic development, social demands, and intergovernmental relations. These solutions encompass the design of an agricultural information collection database, a multi-party management sharing mechanism, intelligent applications of electronic licenses at the grassroots level, and specialized legal rules, aiming to enhance the efficiency of government services, improve the satisfaction of the public, and contribute to the modernization of China's governance system.

Author Contributions: Conceptualization, methodology, data curation, writing—original draft preparation, funding acquisition, Q.C.; supervision,project administration, B.C.; writing—review and editing, Q.C. and B.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by National Social Science Foundation of China (grant number 21CFX045).

Data Availability Statement: Data are contained within the article.

Conflicts of Interest: The authors declare no conflicts of interest.

 doi:10.20944/preprints202405.1980.v2

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