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An Intelligent Bookkeeping and Tax Filing Model for Farming Households Based on AI and Accounting Rules

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Abstract

With the advancement of digital village construction, farm households are increasingly operating online but commonly face practical difficulties such as disordered bookkeeping and cumbersome tax filing. Conventional enterprise-level fiscal and tax software, however, cannot accommodate the scenarios of farm households. To address this gap, this study integrates accounting principles, agriculture-related tax policies, and AI technologies such as optical character recognition (OCR) and natural language processing (NLP) to construct a lightweight, highly compliant prototype for intelligent bookkeeping and tax filing by farm households, and implements it on a WeChat mini-program platform. Retrospective simulation tests using historical operating data from 217 farm households show that the prototype significantly improves bookkeeping standardization rates and tax filing accuracy while effectively reducing fiscal and tax compliance risks. The standardized operating data it generates also provide a foundation for building a digital credit system for farm households. This study offers a reference for digital village construction and agriculture-related inclusive fiscal and tax services.

Keywords: Digital Village Construction; Farm Households; Intelligent Bookkeeping; Tax Filing; WeChat Mini-Program; Fiscal and Tax Compliance

1. Introduction

At the theoretical level, data from the Ministry of Commerce show that in 2022, national rural online retail sales reached 2.17 trillion yuan, with online retail sales of agricultural products exceeding 530 billion yuan. Digital agriculture has become an important engine for rural revitalization. Amid the rapid growth of rural e-commerce, however, the fiscal and tax management capacity of farm households lags far behind, with prominent problems including missing invoices, confusion between income and costs, unfamiliarity with tax filing procedures, and failure to claim available preferences (Chen, 2023; Wang, 2025). general-purpose financial software is complex to

operate,and difficult for data integration,making it poorly suited to farm household scenarios (Ma, 2025; Xie, 2025; Chen, 2026). There is a notable gap in lightweight intelligent fiscal and tax tools.

The theoretical significance lies in the fact that existing research on fiscal and tax intelligence concentrates mostly on the enterprise side,while lightweight models for individual farm households remain scarce (Sreedevi, 2026). This paper integrates accounting practices, agriculture-related tax law, and AI technology to construct a framework for an intelligent fiscal and tax model for farm households, along with a linkage mechanism of "fiscal and tax compliance—credit evaluation—financing matching," thereby enriching the cross-disciplinary research system (Zheng, 2026).

In terms of practical significance, the model uses a WeChat mini-program as its carrier, requiring no download and fitting the habits of farm households. It lowers the accounting threshold through AI automation and simplifies fiscal and tax operations. Contract risk warnings and filing guidance help avoid tax-related and transaction dispute risks. Standardized data form a digital credit file, opening a channel between farm households and credit products, alleviating financing difficulties, and providing digital tool support for grassroots departments to implement preferential agricultural policies.

1.1. Current Status at Home and Abroad

From the perspective of international research, large-scale agricultural operators in Europe and the United States typically employ full-time or part-time financial personnel. Agriculture-related intelligent fiscal and tax products mainly target large family farms and, relying on a well-developed agricultural credit system, achieve linkage between fiscal and tax management and credit services. Research on agricultural e-commerce in Southeast Asia focuses on logistics optimization in agricultural product supply chains, while AI model research on simple fiscal and tax services for individual farm households is relatively scarce. Overall, although foreign intelligent bookkeeping technology is relatively mature, its operating entity scale, tax systems, and rural digital infrastructure differ considerably from the scattered farm household scenario in China, making direct localization and reuse impossible (Hasan, 2022).

In terms of domestic research, Chinese scholars have conducted extensive studies on the interpretation of agriculture-related tax preferential policies, the development dilemmas of rural e-commerce, and the development of enterprise intelligent fiscal and tax systems. However, existing intelligent fiscal and tax research concentrates on the enterprise side. Integrated model research that connects accounting, agriculture-related tax law, AI recognition, and digital credit for individual e-commerce farm households remains insufficient.

In summary, scholars at home and abroad have accumulated relatively rich findings in areas such as enterprise fiscal and tax intelligence and rural e-commerce development, yet research targeting the specific scenario of small-scale, scattered rural e-commerce operators lacking professional fiscal and tax personnel in China remains weak. This research gap concerning intelligent fiscal and tax services for individual e-commerce households is precisely the direction this paper seeks to explore and fill.

1.2. Research Content and Innovation Points

This paper first identifies the core fiscal and tax pain points of online-operating farm households through field interviews and questionnaire surveys. It then analyzes the business processes of online transactions of agricultural products by farm households and, combining the Accounting Standards for Small Business Enterprises with agriculture-related tax preferential policies, builds a simplified accounting rule base tailored to farm households. Next, it integrates AI technologies such as OCR invoice recognition and NLP contract text parsing to design three core sub-models: intelligent bookkeeping, tax calculation, and contract risk warning. Finally, it completes model development and retrospective simulation verification on the "Nongshui Dun" mini-program to test the model's practicality and accuracy, and builds a supporting digital credit evaluation system for farm households based on standardized operating data.

Based on the above analysis, the innovation points of this paper are mainly as follows. First, taking accounting rules and tax provisions as the underlying core and integrating AI technologies such as OCR and NLP, it breaks through the previous technical path in which fiscal and tax systems served only enterprises. Second, it constructs a full-chain closed-loop model of "bookkeeping—invoices—tax filing—risk control—credit," realizing the popularization of professional fiscal and tax capabilities and filling the gap in lightweight fiscal and tax tools for individual farm households. Third, through standardized operating data, it builds a digital credit evaluation system for farm households and explores the linkage mechanism of "fiscal and tax compliance—credit evaluation—inclusive finance."

2. Analysis of Core Fiscal and Tax Pain Points of Farm Households and Model Adaptation Needs

2.1. Core Fiscal and Tax Pain Points in Online Operations of Farm Households

(1) Insufficient credit and financing difficulties. The proportion of formal credit demand among farm households is as high as 92.1%, but the mean formal credit scale per household is 415,500 yuan, with a standard deviation as high as 1,949,100 yuan. The actual formal credit obtained is low and extremely unevenly distributed, making credit constraints prominent. This pain point stems from the lack of standardized financial data for farm households, which prevents financial institutions from assessing their repayment capacity, thereby blocking financing channels (Zhao, 2023; Chongqing, 2026).

(2) Most rural e-commerce entities do not employ full-time financial personnel and have incomplete account books; traditional manual bookkeeping cannot adapt to multi-platform business needs, resulting in distorted accounting. This pain point prevents the operating results of farm households from being truthfully reflected, directly affecting cost control and operating decisions(Liu & Hou, 2023; Zhang, 2024; Zhong'an Online, 2025).

(3) Tax filing difficulties and loss of policy benefits. Research finds that about 40% of farmers' professional cooperatives still do not keep accounts. Among those without accounts, most either file zero returns or file arbitrarily during tax declaration, and some cooperatives have not filed taxes

for years. This pain point exposes farm households to risks of late tax payment fees and fines, and prevents them from enjoying agriculture-related tax preferences, causing direct economic losses (Tang, 2023; Fang, 2025).

(4) Contract risks are hidden and difficult to prevent. According to statistics, more than 95% of farm households lack sufficient understanding of contents such as "price protection clauses," "force majeure exemptions," and "compensation limits." When price protection services are not selected, the actual compensation amount usually does not exceed three times the freight, and the compensation obtained is less than 20% of the actual loss. E-commerce contract clauses are complex, and risks such as payment collection and compensation are difficult to identify in advance. This pain point places farm households in a weak position in e-commerce transaction disputes, makes receivables difficult to safeguard, and directly threatens their cash flow (Muping District People's Court, 2025).

2.2. Adaptation Needs of the Intelligent Fiscal and Tax Model

Based on the above pain points, the model needs to meet the following core adaptation needs:

First, lightweight operation needs: the interface should be extremely simple, adopt step-by-step guided operations, support automatic entry through invoice photographing and one-click synchronization of transaction flows, enabling farm households with zero accounting background to use it independently(Li & Yao,2026). Second, agriculture-specific accounting rule needs: it should incorporate accounting subjects for self-produced, circulated, and processed agricultural products, and embed automatic calculation logic for agriculture-related value-added tax and business income tax reductions and exemptions(Gao & Li,2023). Third, multi-scenario AI recognition needs: use OCR to recognize purchase invoices, express waybills, and bank receipts and automatically classify income and expenses; use NLP to parse electronic purchase and sales contracts, extract key clauses, and mark risks. Fourth, credit data accumulation needs: automatically aggregate standardized bookkeeping, compliant tax filing, and contract performance data to form a digital credit file that can be accessed by financial institutions after authorization by farm households.

3. Architecture Design of the Fiscal and Tax Model for Farm Households Based on AI and Accounting Rules

The model adopts a four-layer architecture of "perception layer—rule layer—intelligence layer—application layer," taking simplified accounting rules adapted to the operating characteristics of farm households as the underlying core and AI technology as the tool to address the practical pain point of insufficient fiscal and tax professional capacity among farm households (Cheng, Huang, Wang, 2024), as shown in Figure 1.

At the perception layer, multi-source data collection is responsible for providing the basis for subsequent accounting processing, including farm households photographing and uploading invoices, voice entry of income and expenses, authorized synchronization of order flows from e-commerce platforms, and WeChat Pay and bank transaction records.

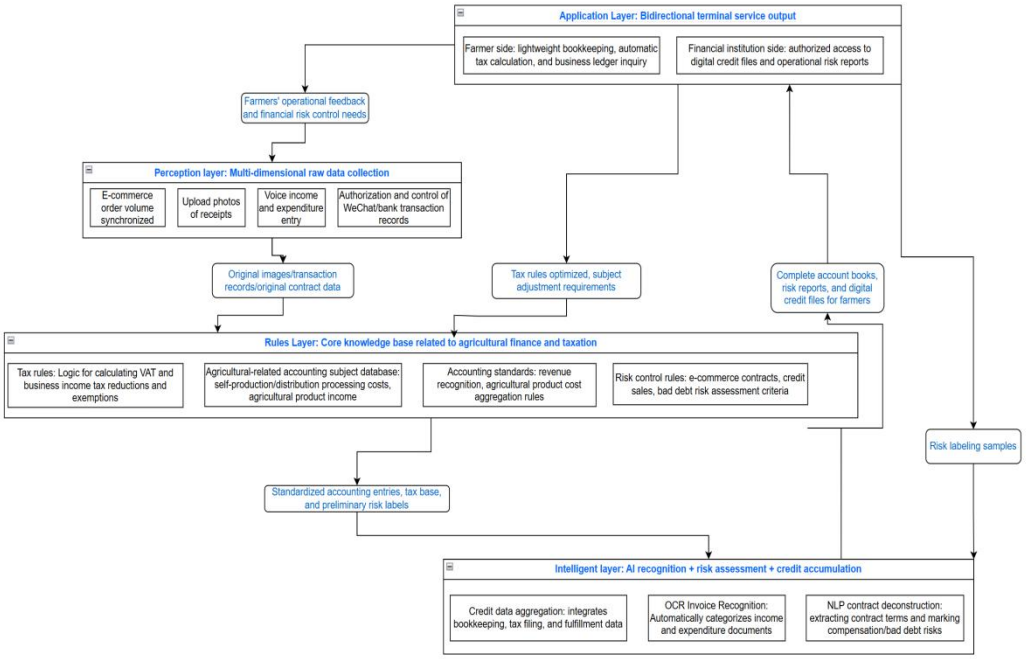


Figure 1. Overall Four-Layer Architecture of the Intelligent Bookkeeping and Tax Filing Model for Farm Households

At the rule layer, a simplified accounting subject library for farm households is built in (agricultural product sales revenue, seedling costs, logistics expenses, packaging consumables, etc.), along with revenue recognition criteria, cost aggregation methods, agriculture-related value-added tax and income tax reduction and exemption rules, and contract risk determination rules. Based on the characteristics of farm households being "small in scale and simple in business," the Accounting Standards for Small Business Enterprises are adapted in practice:

Subject simplification: enterprise-applicable subjects such as deferred income are removed, and only cash, accounts receivable, agricultural product sales revenue, and agricultural production costs (with secondary subjects such as seedlings and logistics) are retained, reducing the accounting threshold.

Revenue simplification: because spot transactions have short payment collection cycles, the actual settlement flow of e-commerce platforms is used as the basis for revenue recognition, simplifying contract and cash flow recognition conditions.

Cost simplification: direct costs such as seedlings, labor, and logistics are recognized in profit or loss for the current period in a lump sum when actually incurred, without cross-period allocation.

Tax law consolidation: rules for tax exemption of self-produced agricultural products, the small-scale taxpayer exemption threshold, and business income reduction and exemption are built in, transforming policy provisions into automatic calculation logic.

At the intelligence layer, cloud-based AI interfaces such as OCR and NLP are invoked to complete invoice information extraction, intelligent matching of business keywords to simplified accounting subjects (subject recognition accuracy $\geq 92\%$), contract semantic parsing, abnormal transaction detection, and automatic calculation of credit indicators.

At the application layer, the WeChat mini-program front end contains five functional modules: intelligent bookkeeping, invoice management, contract risk control, intelligent tax filing, and digital credit. It transforms accounting rules into visualized operating ledgers, filing guidance, risk prompts, and credit files, realizing concise output of complex accounting logic.

3.1. Core Sub-Model Design Functions and Highlights

In the design of the AI intelligent bookkeeping sub-model, the following core functions are highlighted. First, data collection allows farm households to conveniently photograph invoices and bind e-commerce stores to synchronize order flows; OCR recognition extracts amounts, transaction dates, and business types. Second, accounting rule matching is carried out. For example, a dedicated first-level subject for farm households is preset—agricultural production costs (with logistics expenses, seedling costs, and packaging consumables under it)—and a separate agricultural product sales revenue subject is preset. AI recognition of business keywords automatically matches the corresponding subjects. Third, automatic accounting can summarize income and costs by period, automatically calculate operating profit, generate a simple ledger, and distinguish tax-exempt income from taxable income.

In addition, an intelligent invoice management sub-model is designed, whose process runs through photographing and uploading → automatic recognition → classified archiving → export for reference. It helps solve the problems of missing, lost, and incorrect invoices for farm households and supports automatic classification and storage of purchase invoices, express waybills, and bank receipts.

For the agriculture-related tax calculation and guidance sub-model, a corresponding preferential rule library is designed, including policy determination conditions such as VAT exemption for small-scale taxpayers, VAT exemption for self-produced agricultural products, and agricultural reductions and exemptions for individual business income. Automatic calculation extracts ledger data from bookkeeping to automatically match available tax preferences and calculate tax payable and tax reductions and exemptions. Finally, filing guidance provides step-by-step illustrated guidance for the electronic tax bureau filing process and automatically generates copyable filing data, reducing the difficulty of filing operations.

At the level of reducing overall risk, the designed NLP contract risk warning sub-model can perform text parsing. For example, when farm households upload electronic purchase and sales contracts, NLP extracts core fields such as payment deadlines, compensation liability, acceptance standards, and breach clauses. At the same time, risk rule determination is carried out, with preset risk labels such as overdue payment collection, unfair after-sales clauses, and imbalance of rights and responsibilities. After matching, risk points are highlighted and marked, plain-language risk interpretations are output, and compliant and simple negotiation and modification suggestions are provided for high-risk clauses.

3.2. Supporting Model for Digital Credit Evaluation of Farm Households

Based on intelligent bookkeeping and contract performance records, evaluation indicators are established across three dimensions: operational stability, contractual compliance, and operational scale. These dimensions correspond to the duration of continuous bookkeeping and monthly

revenue volatility, dispute-free contract records and on-time tax filing records, as well as average annual revenue and the completeness of standardized cost deductions.

Specifically:

Operational Stability (Weight: 30%): Comprehensively calculated based on the duration of continuous bookkeeping (assigned scores of 10-30 points for 1-6 months respectively) and monthly revenue volatility (smaller fluctuations yield higher scores).

Contractual Compliance (Weight: 40%): Comprehensively evaluated based on dispute-free contract records (full marks for no disputes, with points deducted based on the number of disputes) and on-time tax filing records.

Operational Scale (Weight: 30%): Scores are assigned based on the level of average annual revenue and the completeness of standardized cost deductions. This serves as the basis for the model.

The model calculates a comprehensive credit score based on the above three indicators and automatically generates a digital credit file for farm households. This score serves as a reference for agriculture-related credit granting, and farm households may authorize financial institutions to access it directly.

4. Technical Implementation and Simulation Verification of the Model

This part aims to verify the application effect of the model in the fiscal and tax scenario of farm households through technical implementation and simulation testing. The specific technical scheme and test design are as follows.

The technical implementation scheme adopts the idea of "light front end, heavy cloud API" to reduce development costs and avoid the high investment of independently training AI models. First, the front end is developed using the native framework of WeChat mini-programs, with an extremely simple interactive page, which helps adapt to the operating habits of middle-aged and older farm households. Second, AI services are used by connecting to mature APIs such as Alibaba Cloud OCR invoice recognition and Tencent Cloud NLP text analysis, with unified encapsulation of interfaces connected to the rule engine; the cost per call is about 0.01–0.05 yuan, which makes it possible to cover more than a thousand uses during the project period. Finally, desensitized operating data of farm households are stored on a back-end cloud server (field-level encryption, no storage of personally identifiable information), and a logic database of accounting and tax rules is built to realize automatic data flow and calculation.

4.1. Simulation Verification Design

This part conducts retrospective simulation based on historical six-month operating data from 217 farm households in five e-commerce villages in Beijing, Hebei, and Shanxi. The sample screening criterion was that local farm households had fixed online stores and were engaged in agricultural product e-commerce. In the experiment, the above data were input into the traditional manual tax filing mode (control group) and the AI fiscal and tax model of this paper (experimental group) for comparative testing. It should be noted that this study is a laboratory simulation, not a

real pilot use by farm households. The model performs field-level encryption on user operating data, strictly complies with relevant laws and regulations on personal information protection, and does not disclose sensitive operating information of farm households.

4.2. Result Comparison

Based on the above simulation-based empirical observations, the project team compiled the following comparison data, as shown in Table 1.

Table 1. Comparison of Key Fiscal and Tax Indicators Between the Control Group and the Experimental Group

Indicator	Control Group	Experimental Group	Increase/Decrease
Bookkeeping standardization rate/%	28.7	98.2	+69.5
Tax filing accuracy rate/%	35.3	95.7	+60.4
Invoice completeness rate/%	32.1	94.3	+62.2
Time per bookkeeping entry/min	4.2	0.9	-78.6
Compliance risk occurrence rate/%	41.2	15.7	-61.9
Awareness rate of tax preferences/%	27.6	89.4	+61.8

Note: Data come from the project team's simulation test results.

The simulation results show that the model significantly improves accounting quality and efficiency. The bookkeeping standardization rate and tax filing accuracy rate of the experimental group increased substantially, and the time per bookkeeping entry dropped to less than one minute, verifying the effectiveness of AI automatic matching in compensating for the insufficient accounting capacity of farm households. The compliance risk occurrence rate dropped significantly, indicating that the risk warning mechanism is effective. It should be pointed out that in the simulation scenario, digital credit files of eight farm households were generated according to the credit evaluation rules of this model, and their indicators met the reference conditions for agriculture-related credit granting; real credit implementation still requires system docking and business process confirmation by financial institutions. In addition, the above improvements stem from the fact that the simulation test was based on a historically structured dataset. In real scenarios, blurred invoices will reduce AI recognition performance, corresponding to the limitations mentioned above; this study has not yet connected to official interfaces and is still some distance from large-scale commercialization.

5. Application Limitations and Optimization Directions of the Model

Existing limitations include limited AI recognition accuracy, where the clarity of invoice photographs, handwriting, and dialect speech diversity all affect recognition accuracy, with a small number of errors; insufficient rule coverage, with inadequate coverage of tax details for specialty cash crops and non-standard cooperative operation models, and some local preferential policies not having been updated in time; and high costs for age-friendly promotion, as middle-aged and older

farm households have weak digital operation ability, rely on manual assistance, and require high offline training and promotion costs. In addition, data silos have not yet been broken. The digital credit file currently serves only as auxiliary credit material and has not established an official direct data connection with tax and banking systems, so one-click filing or credit granting is not possible. At the same time, accounting scope and definitions have limitations: household and business expenditures of farm households are mixed, and the model defaults to including the full amount as costs, which easily leads to artificially low profits; allocation rules need to be introduced later. It should be particularly emphasized that this study is a conceptual prototype verification, not a mature online commercial product.

In terms of subsequent optimization directions, data iteration should be carried out to enhance recognition, including expanding local dialect speech samples, handwritten invoice images, and specialty agricultural product transaction data, continuously improving AI recognition accuracy; the rule library should be dynamically updated by establishing a dynamic update mechanism for local agriculture-related preferential policies, covering non-standard cooperation models and special details for specialty cash crops; at the same time, age-friendly interaction and collaborative promotion should be carried out by optimizing the mini-program interface (large fonts, voice guidance, illustrated tutorials) and working with village officials and agricultural cooperatives to conduct batch training and lower the threshold for use(Rural "three-capital" management,2025).

6. Conclusion and Outlook

6.1. Research Conclusion

Aiming at the fiscal and tax pain points in online operations of farm households, this paper constructs a lightweight prototype model integrating accounting rules and AI technology, and verifies its effectiveness in improving accounting quality and reducing compliance risks through simulation based on historical data from 217 households. It should be objectively pointed out that this model is only a proof of concept, has not yet connected to official tax and banking interfaces, and is still some distance from large-scale commercial application.

6.2. Future Outlook

Policy coordination: jointly promote the mutual recognition of agriculture-related electronic vouchers and credit data with tax departments, agriculture and rural affairs departments, and financial institutions, and build a digital governance ecosystem of multi-party collaboration among government, banks, farmers, and enterprises. Credit assetization: incorporate the digital credit files of farm households into local inclusive finance infrastructure, and form a closed loop of “compliance—credit—financing” at the institutional level. Standardized promotion: distill the core logic of the model into local standards and replicate them to agricultural product e-commerce villages and towns nationwide, improving the effectiveness of rural inclusive services.

Author Contributions:

Conceptualization, X.Z. and X.P.; methodology, X.Z.; software, X.P.; validation, X.Z., W.M. and A.Y.; formal analysis, A.Y.; investigation, W.M.; data curation, X.P.; writing—original draft preparation, W.M. and A.Y.; writing—review and editing, X.Z.; visualization, X.P.; supervision, X.Z.; project administration, X.P.,All authors have read and agreed to the published version of the manuscript.

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The data presented in this study are available on request from the corresponding author due to privacy, confidentiality, and ethical restrictions regarding the raw farm household operating data. The simulation dataset and aggregated results are available upon reasonable request.

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Conflict of Interest:

The authors declare no conflict of interest.

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