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Inclusive Innovation: Linking Smallholders to Modern Large-Scale Agriculture

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Abstract: Smallholders account for more than 98% of China's agricultural operating entities and cultivate about 70% of the total arable land; the fundamental national condition of "a large country with numerous small farmers" will inevitably persist over the long term. The poor integration between smallholders and modern agriculture is a key bottleneck constraining China's efforts to build an agricultural powerhouse. Grounded in this national condition, this study selects three typical cases—coffee in Baoshan, Yunnan; maize in Nong'an, Jilin; and vegetables in Shouguang, Shandong—and employs a combination of methods, including multiple case studies, semi-structured interviews, questionnaire surveys, platform big-data analysis, and action research, to examine the internal mechanism through which inclusive innovation in platform ecosystems empowers smallholders. The study identifies several existing obstacles, including but not limited to three sequential obstacles confronted by smallholders in the course of integrating into modern agriculture: blocked market information, insufficient matching between products and the market, and constrained value potential of agricultural products. To address these problems, platform enterprises rely on three mechanisms—orderly information planning, multilateral data sharing, and coordinated resource coupling—to achieve "digital-intelligent empowerment," forming a trinity synergy with government institutional safeguards and farmers' capability improvement, constructing a dynamic model of "obstacle identification—mechanism deconstruction—effect observation," and developing on this basis a digital-intelligent empowerment platform and a low-threshold digital toolkit. Empirical data show that the implementation of the platform ecosystem can significantly lower the threshold for smallholders to connect with modern markets, enhance the degree of organization in small-scale agricultural production, and improve farmers' position in the value chain; it is thus an effective path to resolving the "large country, small farmers" dilemma and achieving agricultural modernization.

Keywords: *Smallholders; Modern Large-Scale Agriculture; Platform Ecosystem; Inclusive Innovation; Organic Integration*

I. PROBLEM STATEMENT

The fundamental national condition of "a large country with numerous small farmers" has long persisted, and family farming by smallholders constitutes the foundation of China's agriculture. According to data from the Third National Agricultural Census, smallholders account for more than 98% of agricultural operating entities, 90% of the agricultural workforce, and about 70% of the total arable land under cultivation. The 2026 No. 1 Central Document explicitly sets out the development direction of "enhancing the production and operation capacity of family farms, improving the development quality of farmers' cooperatives, refining a convenient and efficient agricultural social service system, and promoting the organic integration of smallholders with modern agricultural development." It can be said that promoting the organic integration of smallholders with modern agriculture is not only an inevitable requirement for building an agricultural powerhouse, advancing rural revitalization, and achieving common prosperity, but also a major proposition that must be answered in order to consolidate the foundation of agricultural and rural modernization during the 15th Five-Year Plan period.

Developing modern large-scale agriculture does not exclude smallholders; the most important part of developing modern agriculture is how to integrate smallholders into its development. A huge population base and limited land resources determine that the absolute size of the rural population will remain large throughout China's urbanization process and that the small-peasant economy will continue to exist. Modern large-scale agriculture, supported by science and technology, capital, and management, emphasizes scaled, scientific, intelligent, green, and brand-based development; its direction is to develop moderate-scale operations in various forms and to cultivate new types of agricultural operating entities, rather than to replace smallholder farming with large-scale operations. The key to resolving the structural contradiction of "a large country with numerous small farmers" lies in exploring institutional pathways through which smallholders can effectively embed themselves in modern large-scale agriculture, thereby forging an agricultural modernization path suited to Chinese conditions.

Against the overall strategic backdrop of the deep integration of the digital economy and rural revitalization, platform enterprises led by Pinduoduo, JD.com, and Douyin E-commerce are compressing circulation links and achieving precise matching between supply and demand through ecosystem restructuring, and have become the core link connecting smallholders with modern agriculture. Existing studies mostly focus on specific technical application schemes, whereas systematic research on how platform ecosystems restructure the agricultural value chain and resolve the development dilemmas of smallholders remains insufficient. Taking inclusive innovation in platform ecosystems as its entry point, this project constructs a dynamic integration model around "obstacle identification—mechanism deconstruction—effect observation," aiming to fill this research gap and to provide actionable solutions for government decision-making and smallholder practice.

II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

(1) Review of Existing Studies

Based on materials collected by the research team, we find that international studies focus on agricultural data sharing, digital

integration of industrial chains, and mechanisms for empowering smallholders, with the European Union, Japan, and the Republic of Korea all promoting the transformation of agricultural modernization through digital strategies. Domestic studies mostly center on agricultural e-commerce, digital village construction, and integration pathways for rural revitalization. Overall, existing work has three shortcomings: first, it emphasizes surface-level analysis of technology application and gives insufficient attention to the deeper mechanisms of value co-creation and industrial collaboration; second, comparative research on the defects of the traditional agricultural value chain versus the improvements brought about by platform empowerment is insufficiently thorough; third, systematic understanding of the multi-actor synergy mechanism among "government—platform—farmers" is inadequate.

(2) Definition of Core Concepts

The platform ecosystem refers to an industrial organizational form that takes digital platforms as its hub, connects multiple actors such as farmers, cooperatives, leading enterprises, logistics firms, consumers, and government departments, and achieves value co-creation through the flow of data as a factor of production. The concept of inclusive innovation advanced by research on platform ecosystems emphasizes that innovation outcomes benefit marginalized groups and weak links, helping smallholders access the modern industrial system at low cost and with a low threshold. The organic integration of smallholders with modern agricultural development serves two functions: first, channeling modern factors such as capital, technology, talent, and information into the entire production and operation process of smallholders; second, transforming smallholders' land resources, agricultural products, and farming culture into important support for modern agricultural development.

The "Obstacle—Mechanism—Effect" Dynamic Spiral Model

This study proposes a theoretical model of "obstacle identification—mechanism deconstruction—effect observation": the modernization transformation of smallholders exhibits phased evolutionary characteristics, encountering in sequence three obstacles—blocked market access, inadequate industrial adaptability, and constrained value-creation potential. Correspondingly, platform ecosystems resolve these obstacles through three inclusive innovation mechanisms: clearing market access, reconstructing industrial adaptability, and building a value community, thereby forming a spiral model of "obstacle breakthrough—capability enhancement—emergence of new obstacles—mechanism upgrading." Unlike static studies with their inherent limitations, this model can explain the differentiated transformation paths of smallholders across regions and industries, providing a theoretical reference for comparable research.

III. RESEARCH DESIGN OF THE PLATFORM ECOSYSTEM

(1) Logic of Case Selection

Strictly following the principle of theoretical sampling and on the criteria of typicality and completeness, the research team selected three cases—coffee in Lujiang Town, Baoshan, Yunnan; maize in Nong'an, Jilin; and vegetables in Shouguang, Shandong—as typical cross-industry and cross-regional cases. The three localities represent specialty cash crops, staple grain crops, and protected vegetable production, respectively, covering a wide range and qualifying as typical cases for research and analysis. These cases exhibit typological differences in resource endowment, organizational form, and mode of platform access, thus meeting the requirements for cross-case comparative analysis.

Data Sources

Field research for the project completed a total of 218 semi-structured interviews, covering smallholders, cooperative leaders, regional platform operators, and grassroots agricultural technicians. A total of 523 valid questionnaires were collected; more than 100,000 public transaction records were captured from platforms using Python; and over 120 secondary sources, including statistical yearbooks and policy documents, were collected. This produced approximately 150,000 characters of interview transcripts, and a tripartite "smallholder—platform—government" collaborative research data management platform was established, integrating online questionnaire completion, interview audio transcription and storage, and task allocation.

Methodological Design

Our team adopted the combined approach of "multi-case comparison + semi-structured interviews + platform big-data analysis + action research" for platform program design, used qualitative coding to distill core categories, applied structural equation modeling to analyze the relationship between platform empowerment of farmers' production and actual transformation effects, clarified the core synergistic role of the platform, and carried out action research in pilot villages to iteratively optimize the empowerment scheme. This methodological combination can both uncover practical patterns through thick case description and ensure the reliability of conclusions through data verification.

IV. PRACTICAL OBSTACLES TO THE INTEGRATION OF SMALLHOLDERS WITH MODERN LARGE-SCALE AGRICULTURE

Based on field case research and literature review, we found seven practical pain points in the process of smallholders' integration into the modern agricultural system, which can be summarized into three compound obstacles. The following elaborates on the three compound obstacles currently facing smallholders.

Market Access Blockage

Smallholders' sales channels are passive and undiversified, with high dependence on intermediaries; the circulation chain for agricultural products is lengthy, and profits are substantially squeezed by intermediate links. Output is dominated by primary agricultural products. Smallholders in remote areas face even more complex predicaments: logistics and storage facilities are inadequate, access to market information is delayed, and production supply is mismatched with consumer demand; formal market entry requirements such as quality inspection, certification, and brand packaging exceed the capacity of individual smallholders; and the risks an individual can bear are limited—compared with large-scale agriculture, smallholders are less willing to take risks, so their endogenous motivation to participate in modern markets is weak.

Inadequate Industrial Adaptability and Capability Shortcomings

Small-scale agricultural production in China faces multiple difficulties, for example: fragmented plots, which make it difficult to extend advanced seed varieties and farm machinery technologies and to carry out standardized operations; the absence of standardization and quality control systems for agricultural products, resulting in uneven quality; and uneven development of agricultural social services, with insufficient supply of services such as production—marketing matching, pest and disease prevention and control, and resource utilization of agricultural waste. The production problem that "individual households cannot do it, or cannot do it well" has not been fully resolved. At the same time, smallholders generally have limited educational attainment, emphasize production over management, and lack knowledge of marketing, brand operation, and digital e-commerce operations; a large outflow of prime-aged labor leaves a substantial gap in successor farming talent. As a result, a pattern of "fivefold weakness"—in production, technology, capital, market, and green development—coexists.

Constrained Value-Creation Potential

Most smallholders are confined to the low-end production links of planting and breeding, with extremely low participation in high-value-added links such as processing, brand building, and the integration of agriculture, culture, and tourism. Interest linkage mechanisms are loose, mostly taking the form of short-term product purchase and sale relationships, while deep interest linkage models such as equity participation and profit sharing cover only a limited number of farmers. Smallholders bear the main production risks yet find it difficult to share in the value-added returns of the industrial chain, so the phenomenon of "output increases without income growth" occurs from time to time. In addition, a low degree of organization leaves smallholders in atomized and dispersed operation, with high costs of collective action and weak bargaining power; some new types of operating entities exist in name only; and the tilt of policy resources toward large-scale operators squeezes the development space of ordinary smallholders. The threshold for using e-commerce and digital production tools makes it difficult for most smallholders to fully enjoy the dividends that the digital economy brings to agriculture.

V. EMPOWERING MECHANISMS OF INCLUSIVE INNOVATION IN PLATFORM ECOSYSTEMS

(1) Market Access Clearing Mechanism: Orderly Collection and Distribution of Information

Relying on network effects, platforms aggregate dispersed supply and demand, compressing the long-chain circulation in which products "can be produced but cannot be sold, and can be produced well but cannot be sold at a good price" into a short chain that links "the field directly to the table." Tools such as origin livestreaming, the Ten-Billion Subsidy program, and distributed AI-based precision recommendation enable smallholders to reach the national market without building their own channels; the platform-based embedding of unified quality inspection, grading, and traceability standards replaces compliance certification that individual smallholders find difficult to complete on their own, significantly lowering the threshold for market entry. Surveys show that after joining the platform, farmers in pilot areas expanded their customer-acquisition radius from an average of 50 kilometers to the whole country, and losses in circulation links declined markedly.

Industrial Adaptability Reconstruction Mechanism: Multilateral Data Sharing

Platforms feed consumer-end data back to the production end, guiding smallholders to shift from "farming by experience" to "farming by orders and by data." Taking coffee in Baoshan, Yunnan as an example, platform consumer profiles guide coffee farmers in improving varieties and picking standards, promoting the upgrading of primary beans to specialty beans; agricultural social service organizations rely on platform dispatch orders to carry out contracted cultivation, unified pest and disease control, and unified procurement and collection, resolving the production problem that "individual households cannot do it, or cannot do it well"; and dedicated small-scale farm machinery and simplified technologies for smallholders are implemented through platform subsidy and leasing synergy mechanisms, lowering the one-off investment threshold for advanced technologies.

Value Community Construction Mechanism: Coupled and Concerted Resources

Through an order system of "leading enterprise leadership + cooperative coordination + smallholder fulfillment," the platform locks in quality, delivery dates, and prices, and promotes cooperatives to organize farmers for standardized production and volume-based direct supply; regional public brand building unifies quality identification and advances "unified brand, dispersed production," realizing the shift from "selling products" to "selling brands"; at the extension end, primary processing, deep processing, and agriculture—culture—tourism integration projects are carried out through the model of "collective construction land + cooperative operation + smallholder equity participation," transforming smallholders from mere producers into business participants, while deep interest linkage models such as equity dividends and secondary rebates gradually expand their coverage.

Synergistic Foundation of Mechanism Operation: The Trinity

The effective operation of platform mechanisms depends on the trinity synergy of "platform technological empowerment + government institutional safeguards + farmers' capability improvement": the government provides fiscal levers such as interest subsidies, awards and subsidies, and risk compensation, together with public goods such as infrastructure and standardized supervision; the platform undertakes factor matching and ecosystem governance; and farmers' capabilities are continuously improved through new agricultural science training, localized hands-on guidance, and the use of digital tools, thereby continuously raising agricultural productivity. If any one of the three is missing, the mechanism may slide toward "capital capture" or "digital suspension," and smallholders will be cast out of the modernization track or locked into the low end of the value chain.

VI. CONSTRUCTION, OPERATION, AND EFFECTS OF DIGITAL-INTELLIGENT PLATFORM PRACTICE

(1) Platform Architecture and Functions

Building on the project research, the team has successfully established a tripartite "smallholder—platform—government" digital-intelligent collaborative platform. The platform comprises four functional modules: first, a zero-code e-commerce operation module, providing visualized store setup templates and one-click product listing tools; second, a standardized production management module, embedding industry-specific parameters for varieties, farming operations, and quality control in each locality; third, an intelligent market information push module, pushing price quotations, order demand, and disaster warnings to farmers on the basis of market big data; and fourth, an interest linkage safeguard module, providing electronic templates such as order contracts and equity agreements together with performance escrow services. The platform adopts a simple operating interface and dialect-version user manuals, and designs icon-based interaction for farmers with junior high school education or below, significantly lowering the threshold for use.

Operational Effects

Since its launch for trial operation, the platform has been promoted and applied in three pilot areas and has cumulatively served more than one thousand smallholder households. Survey and test data show that the e-commerce operation capability of pilot farmers has improved significantly, and awareness and implementation rates of standardized production have risen substantially. Specifically, platform-based centralized procurement and contract farming have reduced circulation losses of agricultural products by 15%–20%, and farmers have achieved the expected target of a 20% increase in per capita income, easing the situation of "output increases without income growth"; government regulators can trace the production safety of agricultural products throughout the entire process through the platform's data interface, markedly improving regulatory efficiency. The "Smallholder Digital Empowerment Toolkit V1.0," iteratively developed through action research, can be immediately applied and scaled up, and is expected to shorten the transformation cycle for farmers by 6–12 months.

Case Evidence

In the Baoshan, Yunnan case, the platform, through the feedback of consumer data and the building of origin brands, promoted the coffee industry's shift from raw material export to specialty and brand-based upgrading, with coffee farmers' income levels and risk resilience strengthening in tandem. In the Nong'an, Jilin case, the combination of platform orders and managed services alleviated the contradiction between the diseconomies of scale in maize cultivation and difficulties in selling grain. In the Shouguang, Shandong case, the combination of standardized quality control for protected vegetable production and livestream e-commerce achieved the unity of "producing well" and "selling well." Together, the three cases corroborate the explanatory power of the platform empowerment model: within the platform ecosystem, smallholders shift from passive access to active participation and from the low end of the value chain toward diversified and higher-end positions.

VII. POLICY RECOMMENDATIONS

Based on the above research findings and practical testing, and with reference to agricultural and rural modernization during the 15th Five-Year Plan period, our team puts forward the following recommendations.

First, strengthen the inclusiveness of policy and prevent the artificial building up of large operators. Party committees and governments at all levels should increase their tilt toward smallholders in policy formulation, work deployment, and financial allocation, and safeguard the fairness and inclusiveness of pro-farmer policies. They should adhere to the principle of "large where appropriate, small where appropriate," avoid one-size-fits-all approaches and administrative commands, maintain sufficient historical patience, and balance support for smallholders with the cultivation of new types of agricultural operating entities.

Second, improve the agricultural social service system. Priority should be given to closing service gaps for cash crops such as fruits and vegetables in areas including market information, production—marketing matching, pest and disease prevention and control, and resource utilization of agricultural waste. Support should be given to rural collective economic organizations, specialized service organizations, service-oriented cooperatives, and supply and marketing cooperatives in providing farmers with social services focused on production trusteeship and "nanny-style" services, and the role of comprehensive modern agricultural service centers should be brought into full play.

Third, improve financial, insurance, and risk-sharing mechanisms. The leverage role of fiscal policy should be fully utilized, and social capital should be mobilized to invest in agriculture and rural areas through interest subsidies, awards and subsidies, and risk compensation. The combined model of "contract farming + credit loans + agricultural insurance" should be promoted; the agricultural credit guarantee system and multi-tier agricultural insurance should be improved; insurance protection for rice, wheat, maize, and soybeans should be strengthened; and the development of insurance for locally distinctive agricultural products should be supported, so as to hedge natural risks and market price risks.

Fourth, build closer interest linkage mechanisms. Agricultural subsidy policies and incentive mechanisms for new types of agricultural operating entities to drive smallholders should be improved, and deep linkage models such as equity dividends, secondary rebates, and shareholding cooperation should be promoted. Regulation and guidance of social capital flowing into rural areas should be strengthened, and "capital capture" should be guarded against and reduced, so that social capital shares development outcomes with farmers.

Fifth, bridge the digital divide and promote digital benefits for farmers. The project for high-quality development of rural e-commerce should be implemented, e-commerce platforms should be encouraged to extend empowerment to lower levels, the construction of pre-cooling, storage and preservation, and sorting and processing facilities at production origins should be strengthened, and livestream sales of agricultural products should be regulated. Simplified, low-cost, and easy-to-operate agricultural equipment and zero-code digital tools should be promoted, and the quality and safety traceability system for agricultural products and the regional public brand system should be improved.

Sixth, consolidate the talent and institutional foundations. The new-type professional farmer cultivation project and the "Leading Goose" project for cultivating rural industry leaders should be implemented, and talent attraction mechanisms should be innovated to solve the problem that talent "cannot be

attracted and cannot be retained." The province-wide pilot of extending the second round of land contracts by another thirty years upon expiration should be carried out comprehensively, the transfer of contracted land management rights should be standardized, and the healthy development of the rural property rights transfer and trading market should be guided, so as to provide institutional expectations for long-term stable operation. The supervision and evaluation mechanism should be improved, and the operational effects of the integration mechanism should be comprehensively evaluated and continuously optimized in terms of farmer satisfaction, operating efficiency, and sustainability.

CONCLUSIONS AND RESEARCH LIMITATIONS

Grounded in the fundamental national condition of "a large country with numerous small farmers," this study draws three conclusions through multi-case analysis: first, the integration of smallholders with modern large-scale agriculture exhibits phased evolutionary characteristics, with the three obstacles of market, industry, and value emerging in sequence and reinforcing one another; second, inclusive innovation in platform ecosystems achieves digital-intelligent empowerment through the three mechanisms of orderly information collection and distribution, multilateral data sharing, and coupled and concerted resources, and its effectiveness rests on the trinity synergy of "platform—government—farmers"; third, the construction of the digital-intelligent platform and the development of the toolkit verify the practical value of the theoretical model—platform empowerment can substantively lower market thresholds, raise the degree of organization, and improve value-chain position.

This study also has limitations: constrained by commercial confidentiality, access to the platform's core transaction data and algorithmic logic remains incomplete; although the three cases are typologically representative, extrapolating the conclusions to special regions such as pastoral and forest areas still requires testing; and the measurement period for empowerment effects is relatively short, so long-term causal effects await sustained tracking. Future research could conduct causal identification such as difference-in-differences on larger samples, and further explore green transformation pathways for smallholders around emerging mechanisms such as agricultural carbon certificates and green points. The modernization transformation of smallholders is a long and demanding task that requires historical patience in advancing mechanism iteration, so that the sunshine and rain of the Party's rural policies reach the vast number of smallholders and China's agricultural modernization proceeds steadily, smoothly, and well.

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