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Research on the Benefit Linkage Mechanism for Smallholder Farmers' Participation in Agricultural E-Commerce

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Abstract: Under the strategy of developing rural e-commerce, agricultural product e-commerce has become an important channel for smallholders to connect with large markets. However, the share of benefits that smallholders obtain in the e-commerce value chain has not increased in step with the expansion of transaction scale, and the construction of benefit linkage mechanisms lags behind. Following the logic of "model induction–dilemma diagnosis–countermeasures and suggestions–prospects," this paper sorts out four types of benefit linkage models and diagnoses the practical dilemmas from five dimensions. The results show that the linkage between smallholders and e-commerce operators is still dominated by loose forms, and the lack of bargaining power makes value-added returns concentrate in platforms, anchors, and circulation links. Accordingly, policy suggestions are proposed, including promoting the transition from loose to close linkage, establishing a distribution system of guaranteed returns plus dividends plus secondary rebates, strengthening contract governance, consolidating cooperative organizations, improving smallholders' capabilities, and optimizing external support.

Keywords: Smallholders; Agricultural product e-commerce; Benefit linkage mechanism; Benefit distribution; Organization

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1. Introduction

The third national agricultural census shows that smallholder farmers account for the majority of agricultural business entities, and household operation remains the dominant organizational form. Driven by the Digital Commerce Empowering Agriculture strategy and digital village construction, agricultural e-commerce has extended into rural areas and become an important tool for resolving the contradiction between "small-scale production" and "large markets." Existing studies have confirmed its positive effects: based on a difference-in-differences analysis of Taobao villages, Gao *et al.* found a significant income-increasing effect [1]; based on the Comprehensive Survey of Rural Revitalization, Luo *et al.* showed that e-commerce operation raises income

through the channels of information access, cost reduction, and increased financial support [2]; and Zhang *et al.* found that rural e-commerce promotes local employment of rural labor [3].

However, the expansion of transaction scale does not necessarily bring about benefit sharing. Zeng *et al.* pointed out that livestream e-commerce has driven the upward circulation of agricultural products to shift from long chains to short chains, from single channels to multiple channels, and from sole creation to multi-party co-creation [4], yet 'co-creation' is not equivalent to 'co-sharing'. Some literature has discussed the income-increasing, employment, and entrepreneurship effects quite thoroughly [5,6], but lacks a systematic typological induction and mechanism analysis of the core issue of benefit distribution. In practice, smallholder farmers mostly enter the value chain as raw-material suppliers, with weak bargaining power and low organization, so that value-added returns accrue to platforms, livestream anchors, MCN agencies, and circulation links. Based on empirical evidence from four provinces (Yunnan, Guizhou, Shaanxi, and Gansu), Xiong and Nie found that farmers in poverty-alleviated areas integrate as producers and face constraints in both bargaining and value capture [7]; based on 655 observations from Shaanxi, Cai *et al.* showed that the 'empowerment' effect of e-commerce integration highly depends on farmers' endogenous capabilities [8]; and based on CRRS data, Qiu *et al.* confirmed that cooperatives significantly promote farmers' e-commerce operation by supplying socialized services and enhancing digital capability [9], which indirectly indicates that organization is the key. Lei also noted that multiple blockages remain in the upward circulation of agricultural products and the dredging mechanism is not yet sound [10].

This paper focuses on the benefit linkage mechanism for smallholder farmers' participation in agricultural e-commerce. Following the main line of "model induction–dilemma diagnosis–countermeasures and suggestions–prospects," it first induces four typical models and compares their differences; then diagnoses the practical dilemmas from five aspects; puts forward corresponding countermeasures and suggestions; and finally summarizes and looks ahead to future research.

2. Induction of the benefit linkage models for smallholder farmers' participation in agricultural e-commerce

The common linkage modes in practice can be summarized into the following four types:

2.1. Market buyout model: Loose linkage based on one-time transactions

This is the most primitive and widest-coverage linkage mode. E-commerce enterprises or agents go to villages and households to purchase in one transaction at a uniform price, with no long-term contract and prices subject to market fluctuations. This model has the lowest transaction cost and the highest degree of farmer freedom, yet smallholder farmers cannot share the value-added returns from grading and packaging, brand marketing, and terminal retail, nor do they bear market risk beyond their responsibility; their income depends on the purchase market, and the room for income growth is limited.

2.2. Order-purchase model: Semi-close linkage based on contractual constraints

The order-purchase model adopts an 'e-commerce enterprise + cooperative + smallholder farmer' structure, in which the enterprise or cooperative signs contracts with farmers specifying varieties, quality, quantity, and guaranteed minimum prices, and provides advance payment for seedlings, technology, and production materials. Compared with market buyout, orders stabilize production and sales expectations through contracts, allowing

farmers to share part of the value added from standardization and scale. Through game-theoretic analysis, Pu *et al.* showed that after joining a cooperative, farmers are more willing to expand scale, and the lower the cooperative's management cost and the higher the farmer's risk aversion, the more they prefer the 'e-commerce + cooperative + farmer' pattern [11]. However, its stability highly depends on the binding force of the contract; when market prices deviate substantially from the order price, either party may default.

2.3. Share-cooperation model: Close linkage based on property-rights embedding

The share-cooperation model converts land management rights, capital, agricultural machinery, or products into shares in cooperatives, village collective economic organizations, or alliances, forming a composite distribution of "guaranteed return + dividend by shares," with some adding a secondary rebate based on transaction volume. Farmers shift from raw-material suppliers to participants in the industry chain and can share the value added from processing, circulation, and branding, making the linkage the closest; however, it requires high risk tolerance, governance capacity, and financial transparency, and the institutional design is more complex.

2.4. Service-driven model: Factor linkage based on division-of-labor participation

The service-driven model does not require farmers to engage directly in e-commerce; instead, cooperatives or service organizations provide specialized services such as agency operation, sorting, cold-chain, and livestreaming, so that farmers integrate into the value chain as producers or factor providers and earn part-time income from nearby wage work. Xiong and Nie found empirically that farmers in poverty-alleviated areas integrate as producers and increase income through two paths—expanding sales volume and raising prices [7]. This model is the most inclusive for farmers with weaker capabilities. See **Table 1**.

Table 1. Comparison of benefit linkage models for smallholder farmers' participation in agricultural e-commerce

Model type	Linkage bond	Benefit distribution mode	Risk sharing	Linkage tightness
Market Buyout Model	Spot transaction, price subject to market	One-time purchase price, no value-added sharing	Risks borne mainly by farmers	Loose
Order-Purchase Model	Purchase-sales contract, guaranteed minimum price	Guaranteed price + limited quality premium	Enterprise bears part of market risk	Semi-close
Share-Cooperation Model	Property-rights shares, joint investment	Guaranteed return + dividend by shares + secondary rebate	Shared operational risk	Close
Service-Driven Model	Socialized services, labor participation	Product income + wage/ part-time income	Service organization bears operational risk	Moderate

3. Practical dilemmas of the benefit linkage mechanism for smallholder farmers' participation in agricultural e-commerce

3.1. Imbalance in benefit distribution: Lack of bargaining power and an 'inverted pyramid' pattern

Smallholder farmers are scattered and lack organizational support, placing them in a weak position in price bargaining with platforms, anchors, MCN agencies, and e-commerce operators. A study comparing farmer data from Zhejiang and Shandong provinces found that although e-commerce significantly raises prices, marketing costs also rise simultaneously [12]. In livestreaming scenarios, channel revenue must sequentially deduct platform commissions, anchor commissions, and traffic and logistics fees, with the remainder flowing to the production

end, forming an inverted pyramid of "farmers taking the small share while the middle takes the large share" [4]. The imbalance in distribution traps farmers in the predicament of "selling more but earning less," leaving them without the endogenous motivation to improve quality and raise standards, and thereby depriving industrial upgrading of its micro-foundation.

3.2. Insufficient contract stability: Short-term tendency and opportunistic behavior

The longer the production cycle of agricultural products and the greater the price volatility, the more cooperation relies on oral or simple short-term contracts that lack clear grading standards, price-adjustment mechanisms, and liability for breach. When market prices exceed the order price, farmers resell to the higher-priced party; when prices are lower, enterprises downgrade and depress prices and delay settlement to shift losses. Under livestream e-commerce, the contradiction between instant sales and lagging production is amplified, and mismatches between order volume and supply occur frequently [4]. The softening of contractual constraints makes it difficult for contract farming to play its role in stabilizing expectations.

3.3. Virtualization of organizational carriers: 'Hollow' cooperatives and insufficient driving capacity

Cooperatives should have been the core carrier linking smallholder farmers with the e-commerce market, yet in reality some cooperatives suffer from 'hollowing out' problems such as non-standard registration, non-transparent finances, and unimplemented surplus distribution, making it difficult to truly organize smallholder farmers for standardized production and unified sales. The empirical study by Qiu *et al.* shows that the effect of cooperative participation mainly comes from the supply of agricultural socialized services and the improvement of farmers' digital capability, and that production-and-marketing service cooperatives play a more prominent role [9]; this also reflects the functional absence of many ordinary cooperatives in supplying e-commerce services. The model analysis by Pu *et al.* also shows that excessively high cooperative management costs weaken farmers' willingness to join, making organizational linkage hard to establish [11]. Once the carrier is virtualized, smallholder farmers can neither form collective bargaining capacity nor absorb external support resources.

3.4. Factor and capability constraints: Shortfalls in standardization, branding and digital skills

E-commerce demands far higher consistency of specifications, stability of supply, and traceability than traditional wholesale, yet smallholder farmers commonly suffer from scattered production, weak grading and sorting capacity, and insufficient cold-chain facilities. Xiong and Nie showed empirically that farmers in poverty-alleviated areas integrate as producers and face constraints in both bargaining and value capture [7]. At the same time, digital skills such as livestream operation, store decoration, and data analysis are scarce, and e-commerce talents with both digital capability and market networks are rare in rural areas; Cai *et al.*'s research on smallholder farmers' integration into the e-commerce value chain warns that farmers' endogenous capability is the key to whether they can truly benefit [8]; and Li *et al.* reminded that digital village construction suffers from the misunderstandings of emphasizing hardware over operation and platforms over subjects, so that investments easily become idle facilities [13]. Capability shortfalls mean that even when farmers enter e-commerce channels, they are easily locked into low-value-added raw-material supply.

3.5. Absence of risk-sharing mechanism: Volatility risks shifted to the production end

Corresponding to the imbalance in benefit distribution is the asymmetry in risk sharing. Once quality disputes, logistics losses, or consumer returns occur with agricultural products, the risk often ultimately falls on smallholder farmers through contract clauses or price depression; when prices fall and channels become unsalable, enterprises can reduce purchase volumes to avoid losses. Yi *et al.* found an inverted U-shaped relationship between farmers' e-commerce participation and income: beyond a certain threshold, the marginal effect of e-commerce on income begins to decline, while digital finance helps mitigate this decline [14]. This shows that channel expansion alone cannot automatically solve the problems of risk sharing and sustainable income.

4. Countermeasures and suggestions for improving the benefit linkage mechanism for smallholder farmers' participation in agricultural e-commerce

4.1. Promoting by category: Guiding the linkage modes from loose to close

It is not advisable to impose share cooperation on all smallholder farmers in a 'one-size-fits-all' manner. Classification should be based on scale of operation, product characteristics, and farmers' willingness: for elderly farmers with scattered production and weaker capability, priority should be given to service-driven linkage to secure their basic income and part-time opportunities; for farmers with a certain scale and standardization foundation, the order-purchase model should be used to stabilize production and sales expectations; and for regions with better industrial foundations and more complete organizations, the share-cooperation linkage should be advanced steadily. The research by Pu *et al.* on the selection conditions of two supply-chain models also suggests that the cooperative's organizational management cost and the farmer's risk preference jointly determine the feasibility of a certain linkage mode; only by promoting by category can the mode and endowment be effectively matched [11].

4.2. Improving distribution: Establishing the system of 'guaranteed return + dividend by shares + secondary rebate'

Benefit distribution is the key link of the benefit linkage mechanism. The composite distribution mode of 'guaranteed-price purchase + secondary rebate by transaction volume (amount) + dividend by shares' can be promoted, enabling smallholder farmers to obtain relatively stable production income while also sharing the value-added returns from processing, circulation and branding. At the same time, the cost and revenue accounting of the e-commerce supply chain should be more transparent; information such as platform commission ratios, traffic fees, and logistics costs should be disclosed to participating farmers, and the introduction of third-party evaluation and public disclosure systems can also be explored. The research by Fang *et al.* on e-commerce development promoting rural common prosperity also shows that whether the distribution system is complete and well-coordinated is an important prerequisite for the e-commerce dividend to truly benefit farmers [15].

4.3. Strengthening contract governance: Standardizing contract texts and improving credit constraints

It is recommended that the agriculture and rural affairs and market regulation departments jointly formulate and promote model contracts for agricultural e-commerce orders, clarifying grading standards, price formation and

adjustment, settlement cycles, and breach and dispute resolution. Two-way credit files for entities and farmers should be established simultaneously, with malicious breach of contract included in the discredit list and linked to support and credit granting; insurance institutions should be encouraged to develop performance, price-index, and quality-liability insurance to disperse performance risks and reduce contract costs through market-based means.

4.4. Substantiating organizational carriers: Standardizing cooperatives and developing industrial alliances

Cooperative standardization should be advanced, 'shell cooperatives' cleaned up, and financial disclosure and surplus return by transaction volume implemented, so that cooperatives become unified production and sales platforms. On this basis, 'leading enterprise + cooperative + family farm + smallholder farmer' alliances should be developed to incorporate farmers into stable supply chains through division of labor and cooperation, and drive villages through income-spillover effects [16]. Cooperatives should also reduce management costs and expand services such as agency operation, sorting, and cold-chain to enhance stickiness [9,11].

4.5. Remedying capability shortfalls: Digital training, standardized production and regional public brands

First, carry out classified digital-skills training: popularize e-commerce and standardization knowledge among ordinary farmers, and focus on cultivating livestream operation, store, and data-analysis capabilities among promising youth, so as to nurture local talent. Second, strengthen origin standardization by supporting grading and sorting, pre-cooling, and packaging lines to make supply more stable and consistent. Third, leverage regional public brands and traceability systems to bring scattered farmers into a unified brand and replace low-price competition with brand premiums [4].

4.6. Optimizing external support: Cold-chain logistics, platform rules, and policy incentives

The high logistics cost of agricultural products' upward circulation is a practical difficulty. County-level cold-chain and joint-distribution systems should be built faster, integrating passenger transport, postal and commercial circulation resources to open up the 'first kilometer' of upward circulation. Deng also pointed out that the lagging rural logistics network is the primary obstacle to e-commerce penetration and requires coordinated planning and sustained investment [17]. At the same time, platform rules should be made transparent and algorithms fair, the 'assisting farmers' label should be regulated, low-price involution and false marketing should be governed, and the farmer-end experience should be improved [18]. In terms of policy, special funds can be set up to subsidize positive-externality links such as logistics, branding, and talent, and the number of farmers driven, and the tightness of linkage should be used as the basis for support evaluation; supporting digital finance can mitigate the declining income effect [14].

5. Prospects

In summary, based on the induction of four types of benefit linkage models for smallholder farmers' participation in agricultural e-commerce, this paper analyzes the practical difficulties in the operation of the mechanism from five angles—benefit distribution, contract stability, organizational carriers, capability endowment and risk sharing—and accordingly proposes a package of countermeasures: promoting the linkage

modes from loose to close by category, improving the 'guaranteed return + dividend by shares + secondary rebate' distribution mechanism, strengthening contract governance and credit constraints, substantiating organizational carriers such as cooperatives, remedying factor and capability shortfalls, and optimizing external support such as cold-chain logistics and platform rules. Overall, the key to moving smallholder farmers from 'passive involvement' to 'active embedding' in the e-commerce value chain lies in using property rights and contracts as bonds to truly retain the value-added returns of the industry chain at the production end. This requires not only a stable and predictable community of shared interests between e-commerce entities and smallholder farmers, but also the joint support of government policy guidance, platform rule optimization, and financial service coordination.

Future research can start from the following aspects: first, using tracking survey data and quasi-natural experiment methods to measure the income-increasing effects of different linkage models and examine their differences across regions and scales of operation; second, introducing analytical tools such as cooperative game theory to quantify the marginal contributions of various entities in the e-commerce supply chain, so as to provide more specific reference ranges for the design of benefit distribution institutions; and third, paying attention to the impact of new business forms such as livestream e-commerce, instant retail and intelligent recommendation on smallholder farmers' bargaining power and interest patterns, while following up on new issues such as platform algorithm governance and data-factor benefit distribution, so as to promote the mutual integration of contract theory, value-chain governance theory and digital-economy policy research.

Disclosure statement

The authors declare no conflict of interest.

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