ISSN: 1813-4890

E-commerce Participation, Information Acquisition, and Behavioral Transformation among Grape Growers: Evidence from Yingkou City, Liaoning Province

Jinning Wang

Graduate University of Mongolia, Ulaanbaatar 999097, Mongolia

Abstract

This study examines how e-commerce participation is associated with the production and operational behavior of grape growers in Yingkou City, Liaoning Province. Building on the Theory of Planned Behavior and incorporating information asymmetry and risk-perception perspectives, the article constructs an analytical framework linking e-commerce participation with three behavioral outcomes: standardized production behavior, diversified marketing behavior, and green technology adoption. The empirical analysis is based on 386 valid questionnaires collected from major grape-producing townships in Yingkou. Multiple regression, bootstrap mediation tests, and hierarchical regression models were used to examine direct, mediating, and moderating relationships. The results show that e-commerce participation is positively associated with all three behavioral outcomes, with the strongest coefficient observed for diversified marketing behavior (0.465), followed by standardized production behavior (0.428) and green technology adoption (0.412). Information acquisition capability is a strong positive mediator, accounting for about one-third of the total effect, while risk perception plays a significant negative mediation role, indicating that greater participation reduces subjective uncertainty and thereby facilitates behavioral improvement. The heterogeneity analysis further shows that age weakens the behavioral effect of e-commerce participation, whereas planting scale and household human capital strengthen it. These findings suggest that the value of rural e-commerce lies not merely in online sales, but in its capacity to reshape production organization, market connection, and technology choice. The article concludes with implications for digital-rural governance, platform service design, and targeted capacity-building for different types of growers.

Keywords

Rural e-commerce, grape growers, information acquisition capability, risk perception, behavioral transformation.

1. Introduction

1.1. Research background and problem

The rapid expansion of the digital economy has changed the way agricultural products are produced, marketed, and evaluated. In rural China, e-commerce is no longer simply an additional sales outlet; it increasingly acts as an organizational mechanism that connects production, circulation, and consumption. For fresh products such as grapes, this shift is especially consequential because product quality, visual presentation, packaging, timeliness, and consumer feedback are all highly visible in online transactions. Under these conditions, e-commerce participation may influence not only where farmers sell, but also how they produce, how they manage quality, and how they respond to market signals.

ISSN: 1813-4890

Yingkou City in Liaoning Province provides an appropriate case for examining this issue. As an important grape-producing area in northern China, Yingkou combines a stable production base with increasing exposure to platform-based selling, livestream promotion, and community marketing. Yet growers do not benefit from digitalization in the same way. Even within the same production area, they differ markedly in participation depth, information-processing ability, resource endowment, and post-harvest organization. These differences raise an important empirical question: does e-commerce participation translate into substantive behavioral transformation, or does it merely add an online transaction channel without changing underlying production and operational logic?

Existing studies have identified positive associations between e-commerce and income growth, market access, or entrepreneurial activity, but three gaps remain. First, relatively less attention has been paid to specialty fruit growers, whose products are perishable, quality-sensitive, and strongly affected by reputation mechanisms. Second, many studies focus on single outcomes, whereas standardized production, marketing diversification, and green technology adoption should be understood as related dimensions of operational adjustment. Third, research still needs clearer evidence on the mechanisms and boundary conditions through which e-commerce participation affects farmers' decisions. This article addresses these gaps by integrating direct effects, mediation paths, and heterogeneous conditions within a unified empirical framework.

1.2. Research hypotheses

Drawing on the Theory of Planned Behavior, this study treats e-commerce participation as more than a technical choice. It alters growers' expected benefits, perceived control, and behavioral willingness by exposing them to platform rules, quality standards, consumer evaluation, and richer market information. Information asymmetry theory further suggests that platform participation reduces search and matching costs and improves access to timely market and technical information. At the same time, a risk-perception perspective highlights that digital participation may change how growers evaluate quality, price, logistics, and after-sales uncertainty.

On this basis, four testable expectations are proposed. First, e-commerce participation is expected to be positively associated with standardized production behavior, diversified marketing behavior, and green technology adoption. Second, information acquisition capability is expected to mediate these relationships positively. Third, risk perception is expected to mediate them negatively because higher participation should lower subjective uncertainty and thus facilitate behavioral improvement. Fourth, the behavioral effect of e-commerce participation should be heterogeneous: the effect is expected to be weaker for older household heads and stronger for growers with larger planting scales and richer household human capital.

2. Theoretical framework and research design

2.1. Analytical framework

Figure 1 summarizes the analytical framework. E-commerce participation influences three behavioral outcomes directly and also indirectly through two mechanism variables. Information acquisition capability captures the resource-empowerment channel: by improving access to prices, quality standards, logistics arrangements, consumer preferences, and technical information, platforms enhance growers' ability to adjust production and marketing decisions. Risk perception captures the uncertainty channel: greater familiarity with platform rules, transaction procedures, and market feedback can lower perceived operational risk and encourage more active behavioral choices.

ISSN: 1813-4890

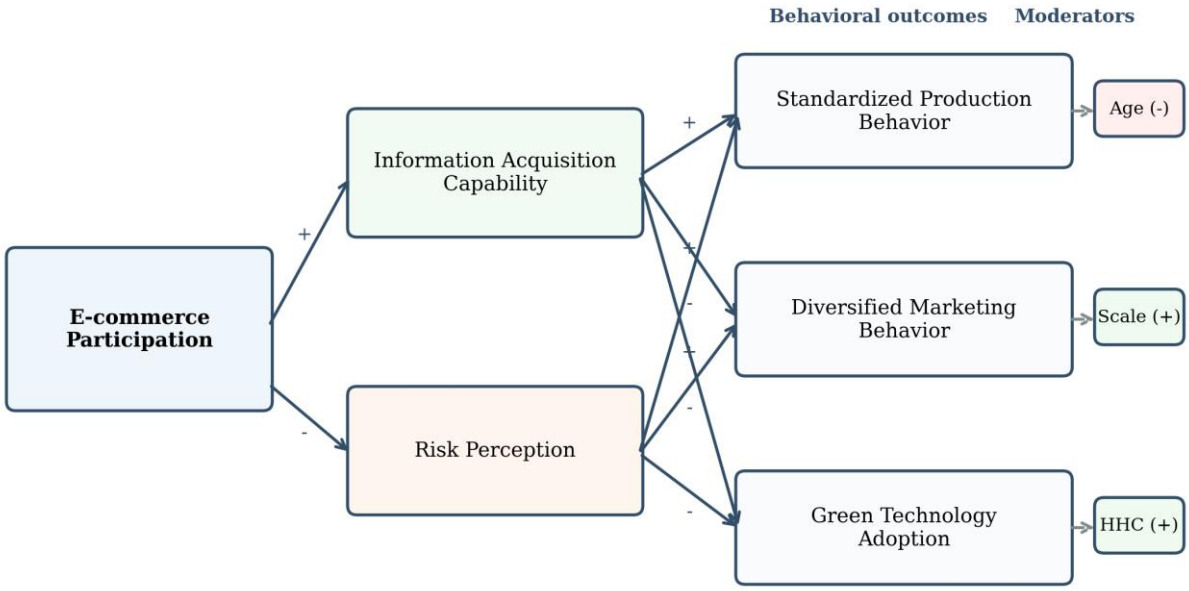

Figure 1. Analytical framework of e-commerce participation and grape growers' behavioral transformation.
Note: HHC = household human capital. Dashed arrows indicate heterogeneity conditions affecting the strength of the e-commerce effect.

2.2. Data source and sample

The empirical analysis is based on fieldwork conducted in the major grape-producing areas of Yingkou City, including Xutun Town and Bangshibao Town in Gaizhou City and Zhoujia Town and Tangchi Town in Dashiqiao City. Offline surveys were used as the main mode of data collection and were supplemented by online follow-up where necessary. Through face-to-face interviews, questionnaire completion, and key-item verification, the study obtained 386 valid questionnaires, with an effective response rate of 92.3%.

Table 1 shows that the sample includes both traditional and digitally active growers. Men account for 80.8% of household heads, while 54.4% are older than 50. Medium-scale planting households dominate the sample (49.0%), and 52.1% of the surveyed households participate in e-commerce. This structure is suitable for examining not only average relationships, but also variation across age, scale, and capability conditions.

Table 1. Descriptive statistics of the sample profile.

Characteristic Dimension	Category	Frequency (n)	Percentage (%)
Gender of household head	Male	312	80.8
Gender of household head	Female	74	19.2
Age of household head	Younger and middle-aged (<=50)	176	45.6
Age of household	Middle-aged and older (>50)	210	54.4

ISSN: 1813-4890

head			
Education level of household head	Primary school or below	68	17.6
Education level of household head	Junior secondary school	185	47.9
Education level of household head	Senior secondary / technical secondary or above	133	34.5
Planting experience (years)	<=5 years (new entrants)	52	13.5
Planting experience (years)	6-10 years	128	33.2
Planting experience (years)	11-20 years	156	40.4
Planting experience (years)	>20 years	49	12.9
Planting scale	Small scale (<=5 mu)	142	36.8
Planting scale	Medium scale (5-20 mu)	189	49.0
Planting scale	Large scale (>20 mu)	55	14.2
Degree of organization	Member of a cooperative	163	42.2
Degree of organization	Not a cooperative member	223	57.8
Farm household e-commerce participation	Participates in e-commerce	199	52.1
Farm household e-commerce participation	Does not participate in e-commerce	187	47.9
Regional level of e-commerce development	Low-level areas	105	27.2
Regional level of e-commerce development	Medium-level areas	198	51.3
Regional level of e-commerce development	High-level areas	83	21.5

Note: 1 mu ≈ 0.067 hectares.

ISSN: 1813-4890

2.3. Variables and methods

The core explanatory variable is the e-commerce participation index, measured through three observed dimensions: whether grapes are sold through e-commerce channels, the share of e-commerce sales in total sales, and the frequency or proficiency of e-commerce use. The dependent variables are standardized production behavior, diversified marketing behavior, and green technology adoption. The main mediators are information acquisition capability and risk perception, while household head age, planting scale, and household human capital are introduced as moderators.

The scale quality is satisfactory. Cronbach's alpha ranges from 0.824 to 0.883 and composite reliability from 0.853 to 0.905. Confirmatory factor analysis also indicates acceptable fit (chi-square/df = 2.365, GFI = 0.902, CFI = 0.923, IFI = 0.925, RMSEA = 0.058). After descriptive and correlation analysis, the study uses multiple regression to estimate direct effects, bootstrap tests to identify mediation effects, and hierarchical regression to test moderation effects. Because the data are cross-sectional, the results should be interpreted primarily as structured empirical associations rather than definitive long-run causal effects.

3. Empirical results and analysis

3.1. Direct effects of e-commerce participation

Table 2 reports the core effect estimates. After controlling for gender, age, education, years of planting experience, cooperative membership, and the regional level of e-commerce development, e-commerce participation remains positively associated with all three behavioral outcomes. The coefficient is 0.428 for standardized production behavior, 0.465 for diversified marketing behavior, and 0.412 for green technology adoption. The largest coefficient appears in diversified marketing, which is consistent with the idea that digital participation first changes farmers' market connection and channel organization, and then feeds back into production and technology choices.

Several control variables are also noteworthy. Household head age is negatively related to all three outcomes, whereas education, planting experience, cooperative membership, and the regional level of e-commerce development are positively related to behavioral improvement. These patterns suggest that the behavioral value of e-commerce participation is embedded in a broader local capability and organizational environment.

Table 2. Summary of direct and mediated effects of e-commerce participation.

Note: ECP = e-commerce participation; IAC = information acquisition capability; RP = risk perception. RP is coded in the positive direction, so negative indirect coefficients indicate that higher e-commerce participation lowers perceived risk and thereby promotes behavioral improvement.

Outcome	Direct effect of ECP	Indirect effect via IAC	Share via IAC (%)	Indirect effect via RP	Share via RP (%)
Standardized production behavior	0.428***	0.215***	33.3	-0.138***	21.4
Diversified marketing behavior	0.465***	0.232***	33.5	-0.150***	21.7
Green technology adoption	0.412***	0.208***	33.5	-0.136***	21.9

ISSN: 1813-4890

3.2. Dual mediation of information acquisition capability and risk perception

The mediation results reveal two distinct but complementary channels. Information acquisition capability is a strong positive mediator. Across the three outcomes, the indirect effects range from 0.208 to 0.232, and the mediated share is roughly one-third of the total effect. This indicates that a substantial part of the behavioral value of e-commerce lies in better access to prices, demand signals, technical information, and platform rules. For growers of fresh products, such information can quickly translate into quality grading, product presentation, packaging decisions, and more informed technology choices.

Risk perception also matters, but in a different way. The indirect coefficients through risk perception are negative, ranging from -0.136 to -0.150. Because higher values on the risk-perception scale represent stronger perceived risk, these coefficients mean that deeper platform participation tends to reduce subjective uncertainty. Once growers become more familiar with transaction procedures, reviews, logistics norms, and customer feedback, they are more willing to diversify channels, adopt green practices, and standardize production. Compared with the information channel, the risk channel is weaker in magnitude, but it is far from marginal.

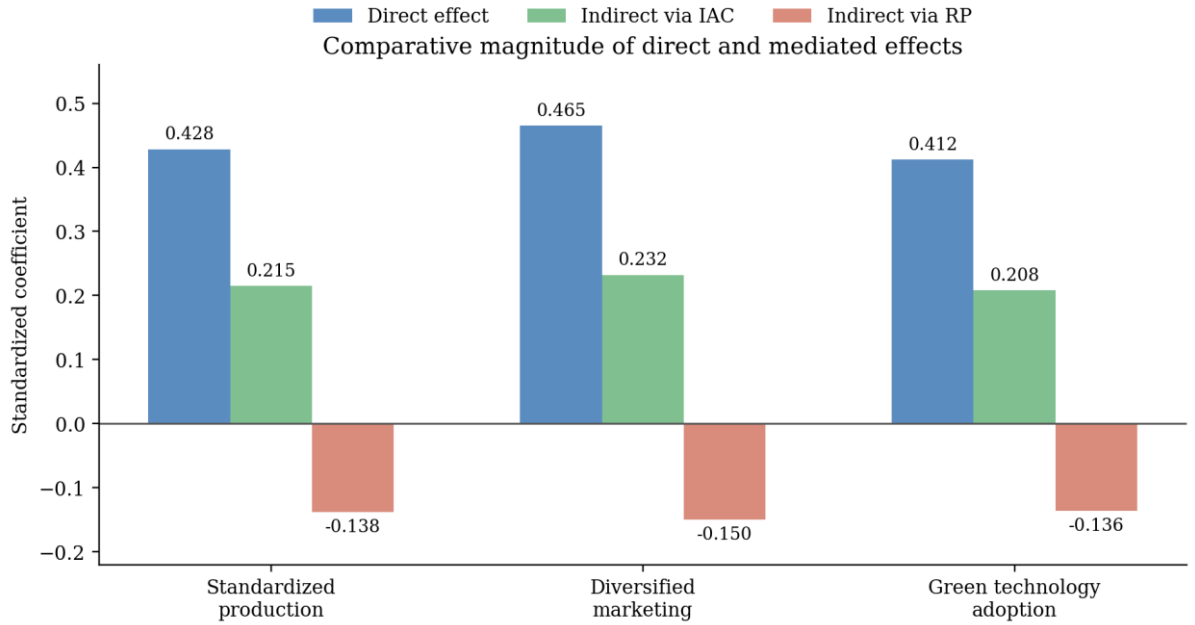

Figure 2. Comparative magnitude of direct and mediated effects across the three behavioral outcomes.

Note: The RP bars are negative because higher scores indicate stronger perceived risk; the estimates therefore capture a risk-reduction mechanism.

3.3. Heterogeneous moderation effects

The hierarchical regression models show that the effect of e-commerce participation is not evenly distributed across farmer groups. Age weakens the behavioral effect: the interaction terms between e-commerce participation and household head age are significantly negative for all three outcomes. By contrast, planting scale and household human capital strengthen the effect, and all corresponding interaction terms are significantly positive.

Substantively, these results mean that younger and middle-aged growers are more able to absorb platform rules and external information, larger-scale operators are better positioned to convert digital exposure into organization and complementary investment, and households with stronger human capital can respond more efficiently to digital opportunities. Thus, the same degree of platform participation yields different behavioral payoffs depending on capability foundations.

ISSN: 1813-4890

Table 3. Interaction coefficients of the heterogeneous moderation models.

Outcome	Age interaction	Planting scale interaction	Household human capital interaction
Standardized production behavior	-0.156**	0.172***	0.189***
Diversified marketing behavior	-0.163**	0.185***	0.201***
Green technology adoption	-0.151**	0.168***	0.182***

4. Discussion

The findings point to a broader understanding of rural e-commerce. In the Yingkou grape industry, e-commerce participation is associated with more than online sales. It is linked to a reorganization of production, marketing, and technology. This is especially visible in the relatively large coefficient for diversified marketing behavior, which suggests that digital participation immediately expands channel choice and direct market connection. Once this market-facing shift occurs, growers also face stronger incentives to stabilize quality, improve grading and packaging, and adopt greener production practices that are more compatible with transparent platform environments.

The mediation evidence further clarifies why these associations emerge. Information acquisition capability is the more powerful pathway, which implies that the central function of e-commerce in this context is informational before it is purely transactional. Platforms lower the cost of seeing the market, understanding quality requirements, and learning from peer and customer feedback. Risk perception remains important because many growers approach digital markets with concerns about returns, logistics losses, reputational risk, and unstable rules. Participation appears to soften these concerns by making the digital environment more familiar and manageable.

The moderation results also carry a clear governance implication. Digital transformation is not automatically inclusive. Older growers, smaller operators, and households with weaker human capital convert e-commerce exposure into behavioral improvement less effectively. Therefore, policies that focus only on infrastructure or platform access are unlikely to be sufficient. The effectiveness of rural e-commerce depends on the coupling of access, capability, and organization.

5. Conclusion and policy implications

This article provides a condensed empirical analysis of how e-commerce participation is associated with the operational transformation of grape growers in Yingkou City. Using 386 valid questionnaires and a framework that combines direct effects, dual mediation, and heterogeneity analysis, the study reaches three main conclusions. First, e-commerce participation is positively associated with standardized production behavior, diversified marketing behavior, and green technology adoption. Second, information acquisition capability and risk perception together constitute a dual mechanism, with the information channel stronger than the risk channel. Third, the behavioral effect of e-commerce is significantly conditioned by age, planting scale, and household human capital.

Several implications follow. Local governments should move beyond generalized digital-rural slogans and provide differentiated training, especially for older growers and households with

weaker capability foundations. Platform enterprises should strengthen origin-based services in quality standards, cold-chain coordination, and rule interpretation so that growers face lower trial-and-error costs. At the industry level, support for cooperative organization, branding, and green technology extension can help translate market-facing digital participation into sustained production-side upgrading.

At the same time, the study has limitations. It is based on cross-sectional data from one grape-producing region and therefore cannot fully capture long-term causal dynamics or interregional variation. Future research can extend the design through panel data, comparative regional samples, or platform-specific analysis. Even so, the evidence reported here shows clearly that the significance of e-commerce in specialty agriculture lies in its capacity to reshape behavioral logic, not merely to add another channel for selling fruit.

References

[1] Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179-211.

[2] Fafchamps, M., & Minten, B. (2012). Information, prices, and farmers' market participation. American Journal of Agricultural Economics, 94(3), 714-730.

[3] Guo, H., Li, X., & Ma, W. (2021). The impact of e-commerce adoption on farmers' income: An empirical analysis based on survey data from Chinese farmers. Management World, 37(5), 123-135.

[4] He, Y., Ji, C., & Yi, X. (2023). E-commerce, information asymmetry, and farmers' quality control behavior. Food Policy, 115, 102456.

[5] Li, X., Guo, H., Jin, S., Ma, W., & Zeng, Y. (2021). Do farmers gain internet dividends from e-commerce adoption? Evidence from China. Food Policy, 101, 102135.

[6] Li, X., & Zeng, Y. (2024). The impact of rural e-commerce participation on farmers' green production behavior: The mediating effects of information acquisition and risk perception. Chinese Rural Economy, 2, 89-106.

[7] Liu, Q., & Yang, W. (2023). The impact of e-commerce participation on farmers' standardized production behavior: Evidence from grape growers. Journal of Agrotechnical Economics, 9, 78-91.

[8] Ma, W., & Abdulai, A. (2023). The impact of e-commerce on farmers' market participation and income: Evidence from China. Agricultural Economics, 54(3), 456-470.

[9] Tao, J., Liu, Y., & Huang, J. (2022). The impact and mechanism of e-commerce on rural agriculture: Evidence from China. Journal of Rural Studies, 95, 112-121.

[10] Wang, J., & Liu, J. (2022). An analysis of factors influencing grape growers' e-commerce participation behavior. Issues of Forestry Economics, 5, 521-528.

[11] Zhang, H., & Zhou, Z. (2022). The application of the theory of planned behavior in farmers' behavior research. Issues in Agricultural Economy, 9, 112-121.

[12] Zhou, L., & Liu, J. (2023). The moderating effect of household human capital on farmers' e-commerce participation. Issues in Agricultural Economy, 10, 98-109.

[13] Zhou, Y., & Hu, L. (2022). The mechanism of e-commerce platforms in agricultural product quality and safety governance. Issues in Agricultural Economy, 7, 45-56.