Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 2510-2521
Article History: Received: 10 April 2022 Revised: 18 May 2022 Accepted: 30 June 2022 Publication: 25 July 2022

Study on the Stability of Mixed Alliance in Fresh Produce Supply Chain from the Perspective of Psychological Fit

Wen Liang[1], Miaojing Ying[2], Yaning Miao[2], Lijie Zhao[2], Biwen Zhang[2]
[1] Department of Economics and Management, Lanzhou Institute of Technology, Lanzhou, Gansu,730050, China
[2]Department of Economics and Management, Lanzhou University of Technology, Lanzhou, Gansu,730050, China

Abstract:

Background: In the process of market circulation of fresh agricultural products, information asymmetry between production and marketing often leads to low psychological fit of fresh agricultural supply chain parties, and the problem of instability with the supply chain is intensified. The key to solve this problem is to establish fresh agricultural supply chain alliance, and the stability of fresh agricultural supply chain alliance directly maps the survival competitiveness of the alliance. Contractual coordination has been applied to the study of improving the psychological fit of members and maintaining the stability of hybrid alliances in fresh produce supply chains. Subjects and Methods: this paper focuses on fresh produce supply chain alliances, constructs longitudinal and cross-sectional alliance models, and uses system dynamics to realize model simulations under formal contracts to explore the psychological fit of alliance partners' profit changes, deviations of alliance partners' behaviors from the expected goals of the alliance, and satisfaction of alliance partners, so as to determine which contract can improve the psychological fit of the alliance and achieve hybrid alliance stability. Results: under the perspective of alliance members' profits, the optimal preference of suppliers and mid- and high-end sellers is a revenue sharing-quality differentiation combination contract, while the optimal preference of mid- and low-end sellers is a revenue sharing contract; the psychological fit of members is optimal under the combination contract, and the coordination effect of revenue sharing contract on increasing alliance members' satisfaction with the alliance is better than that of quality differentiation contract under a single contract, while the coordination effect on alliance expectation fulfillment effect is reversed. The combination contract has the strongest coordination effect on enhancing the stability of mixed supply chain alliances, followed by the quality differentiation contract and finally the revenue sharing contract. Conclusions: under the mixed alliance model of "supplier + mid- to high-end seller + mid- to low-end seller", the combination contract is most helpful to improve the stability of the alliance; Based on the design of contract parameters in this paper, the combination contract is more attractive to suppliers and mid- and high-end sellers, while the mid- and low-end sellers are more concerned about the revenue sharing contract; The operation of the mixed alliance of fresh produce supply chain achieves the active matching between the quality of fresh produce at different levels and the demand of consumers. The following aspects of this paper are still worthy of further research in follow-up: first, quantify the contribution of each member of the alliance in the alliance collaboration to realize the change of benefit sharing mechanism, so as to monitor the change of fresh produce supply chain alliance stability. Second, consider the change of alliance stability when comparing alliances under the impact of external environment. Finally, consider comparing the impact on fresh agricultural products supply chain alliance stability after amending and optimizing the formal contract and the relationship contract.

Keywords: *System Dynamics (SD), psychological fit, stability of supply chain hybrid alliance, contract coordination.*

Acknowledgements: *Supported by a project grant from Natural Science Foundation of Gansu Province Science and Technology Program (Grand No. 20JR10RA277).*

Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 2510-2521
Article History: Received: 10 April 2022 Revised: 18 May 2022 Accepted: 30 June 2022 Publication: 25 July 2022

I. INTRODUCTION

In the process of market circulation of fresh agricultural produce, the asymmetry of information between production and marketing often leads to low efficiency and high risk in the fresh agricultural supply chain, which makes the supply chain management more difficult. In view of this, the key to solve the problem is to build a fresh agricultural products supply chain alliance to ensure the cooperation of all parties in the supply chain. The stability of fresh produce supply chain alliance directly maps the survival competitiveness of the alliance, which is the necessary guarantee to maintain a high matching degree between fresh produce supply and consumers' multi-level expected demand[1].Therefore, how to guarantee the stability of fresh produce supply chain alliances is a key issue that needs to be addressed by relevant research.

At present, the related studies on alliance stability mainly focus on the exploration of alliance stability influencing factors, multi-method alliance stability measurement and contractual coordination alliance stability analysis. Hao et al. (2019) and Yuan et al. (2020) combined game theory and differential equation calculations to verify that the probability of information sharing is positively related to the stability of supply chain alliance collaboration[2-3]. Li et al. (2018) demonstrated through a game-theoretic approach that alliances tend to be farsightedly stable regardless of who was in the dominant alliance, and that large alliances maight be structured to be farsightedly stable with retailer alliances when the intensity of competition was weak[4]. An et al. (2019) and Zheng et al. (2019) integrated DEA and Shapley value methods to achieve resource sharing and benefit allocation in a three-stage supply chain system and coordinated closed-loop supply chain equity[5-6]. Zhou (2017) achieved a fair distribution of benefits among supply chain alliance members by improving the Shapley value so as to maintain the stability of agricultural supply chain alliances[7]. Liu et al. (2013) found that: from the perspective of farmers, alliance performance is positively related to alliance stability, alliance quality promotes alliance performance, and different powers have different effects on alliance quality[8].Qing (2016) and Xing et al. (2017) took the self-regulating ability of the coalition system itself as the starting point to tap and utilize the simulation function of system dynamics to achieve the stabilization of the coalition cooperation state[9-10]. Jiang (2019) explored the most stable structural model among supply chain alliance members in terms of performance[11]. Sui (2017) demonstrated a mutually reinforcing relationship between alliance performance and alliance relationship stability[12].Wang et al. (2019) demonstrated that quality and safety relationship commitment, partner characteristics are all positively related to the stability of supply chain partnerships[13]. Gang et al. (2015) and Kozicka (2019) separately tested that trust and satisfaction have a positive effect on the cooperative relationship and efficiency among supply chain members[14-15]. Liu et al. (2013) Considered that in addition to the influence of hard mechanisms of profit on supply chain cooperation, soft mechanisms, psychological expectations, and supply chain members' perceptions of objective natural conditions also influence the cooperation and stability of the supply chain[16].Lee et al. (2021) examined the relationship between psychological safety and operational performance in the context of supply chain partners, and the study demonstrated a significant positive relationship between psychological safety and operational performance[17].

In summary, scholars' research on multiple breadth of supply chain alliances has coalesced into rich research results, but there is still room for research on the dynamic change mechanism of fresh produce alliance stability and the portrayal of dynamic characteristics of alliance members. Based on this, this paper constructs a longitudinal and transversal alliance model from fresh agricultural produce supply chain

Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 2510-2521
Article History: Received: 10 April 2022 Revised: 18 May 2022 Accepted: 30 June 2022 Publication: 25 July 2022

alliance, and uses system dynamics to realize model simulation under formal contract, in order to explore the profit change of alliance partners, deviation of alliance partner's behavior from the expected goal of the alliance, and satisfaction of alliance partners, in order to determine which contract has the highest alliance stability, so as to provide theoretical guidance for solving the realistic fresh agricultural produce quality and consumer demand In order to provide theoretical guidance for solving the problem of matching the quality of fresh produce with consumer demand in reality.

II. CONSTRUCTION OF A HYBRID ALLIANCE STABILITY MODEL FOR FRESH PRODUCE SUPPLY CHAIN BASED ON SYSTEM DYNAMICS

1. Hybrid alliance model construction for hierarchical fresh produce supply chain

The management and coordination control of each member in the operation of fresh agricultural produce supply chain alliance is to meet the common alliance goal. In this paper, the vertical alliance + horizontal alliance model of fresh agricultural products supply chain is constructed by ""supplier + middle and high-end seller + middle and low-end seller"", that is, several independent farmers and production bases form a horizontal alliance1 and transport fresh agricultural products to a horizontal alliance2 formed by several suppliers, and the suppliers complete the quality differentiation of fresh agricultural products according to the vertical alliance agreement, and then transport them to the alliance of sellers with different market positions until they are delivered to consumers with different demands, as shown in Figure 1.

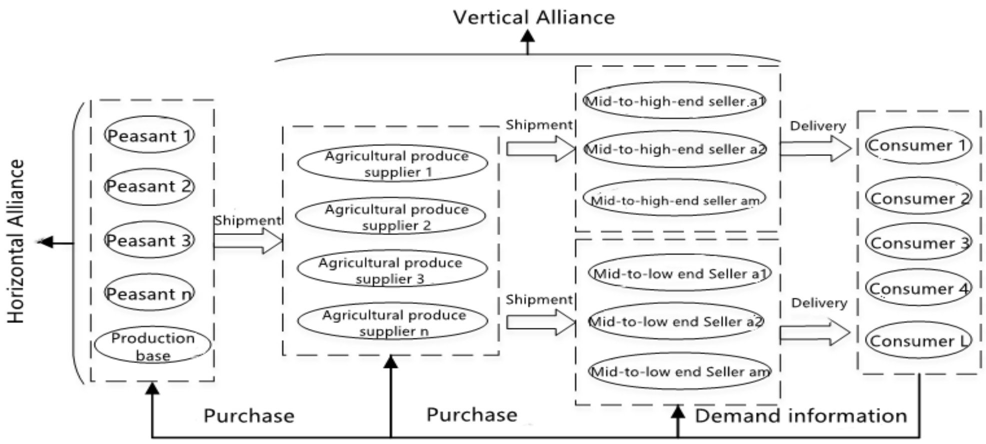


Figure 1 Hierarchical fresh produce supply chain hybrid alliance model

2. Analysis of contractual coordination mechanism of mixed alliance in fresh produce supply chain

Alliance member status, inter-member interest relationship and formal contract connotation together determine the structure and function of fresh agricultural produce supply chain alliance. The analysis of contractual coordination mechanism can effectively sort out the relationship among alliance members (where FS-suppliers, FR1-middle and high-end sellers, FR2-middle and low-end sellers) and provide the theoretical basis for the stability of fresh agricultural products supply chain alliance. (1) Revenue sharing contract coordination mechanism

Suppliers commit to when sellers are committed to product freshness control and sales service control, that is, they can purchase high, medium, and low quality fresh produce at wholesale prices a, b and c. FR1 sells high and medium quality fresh produce at x and y1 prices in the middle and high end markets, and FR2 sells medium and low quality fresh produce at y2 and z prices in the middle and low end markets. FR1 needs to return FR1 sales revenue FR1 is required to return the revenue from FR1 sales to the supplier; FR2 is required to return the revenue from FR2 sales to the supplier. Suppliers and sellers both comply with the revenue sharing contract to pay and get back, thus promoting fairer alliance distribution to enhance the stability of fresh produce supply chain alliance.

- Quality differentiated reward and punishment contract coordination mechanism

In order to ensure the rights and interests of alliance members, FS needs to carry out quality stratification screening of fresh produce. FR1 and FR2 can monitor the quality of FS's quality differentiation level, and when the quality of fresh produce FR1 is lower than that of FR2, FR1 and FR2 will both share the *FS sales revenue penalty compensated by FS. When FS sells to FR1 and FR2 fresh agricultural products with high, medium and low quality differentiation, FS gets the reward revenue *(FR1 sales revenue + FR2 sales revenue), and the seller monitors the supplier's quality differentiation level, and maintains the alliance order according to the contract with parallel rewards and penalties to ensure the stability of fresh agricultural products supply chain alliance.

- Combined contract coordination mechanism

FS and FR1 and FR2 implement revenue sharing contract, quality differentiation reward and punishment contract at the same time, that is, FS supplies fresh agricultural produce required by FR1 and FR2 at agreed low price, and FR1 and FR2 give revenue sharing compensation at the same time; FS completes quality differentiation of fresh agricultural products at high, medium and low end according to the contract input quality differentiation cost, and FR1 and FR2 implement contract rewards and penalties after acceptance inspection. The contract will be rewarded and penalized for breach of contract. The combined contract combines the advantages of two types of contracts and guarantees the stability of fresh produce supply chain alliance in multiple dimensions.

3. Fresh produce supply chain mixed alliance cause-effect loop analysis.

The self-regulation of fresh produce supply chain alliance is mainly realized through a series of feedback effects. When the behavior of one of the alliance members changes, it will inevitably lead to corresponding changes in the behavior of other alliance members, and such changes will in turn affect the behavior of the member who initially changed through inventory deviation adjustment, freshness preservation effort level control, sales service effort control, quality differentiation level, etc., so that their status or related elements are weakened or strengthened, and this process is called feedback.

Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 2510-2521
Article History: Received: 10 April 2022 Revised: 18 May 2022 Accepted: 30 June 2022 Publication: 25 July 2022

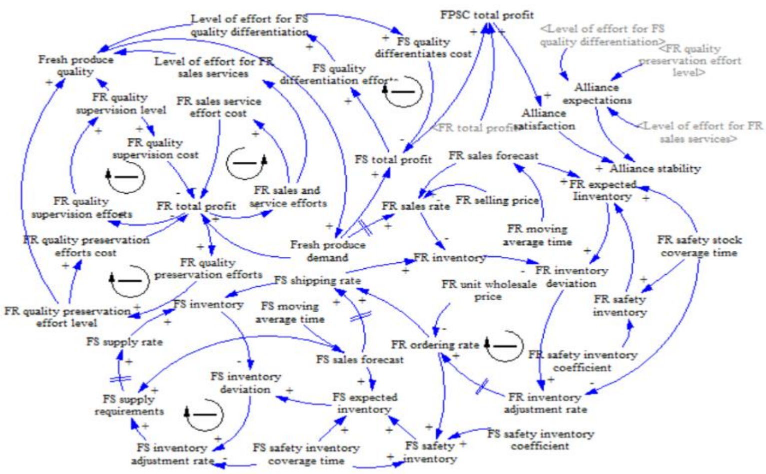


Figure 2 Fresh produce supply chain hybrid alliance cause-effect loop

By combining system dynamics thought and causal loop analysis method, a causal loop diagram that responds to the feedback mechanism of fresh produce supply chain alliance operation and the feedback mechanism among alliance subjects and structures is established, as shown in Figure 2.

①FS inventory → FS inventory deviation - → FS inventory adjustment rate + → FS supply demand + → FS supply rate + → FS inventory +.

②FR inventory → FR inventory deviation - → FR inventory adjustment rate + → FR order rate + → FS shipment rate + → FR inventory +.

③ FR total profit → FR quality preservation effort + → FR quality preservation effort level + → FE quality preservation effort cost + → FE profit -.

④FR profit → FR sales service effort + → FR sales service cost + → FR total profit -.

⑤ FR total profit → FR quality assurance effort + → FR quality assurance effort level + → FR quality assurance cost + → FR total profit -.

⑥ FS total profit → FS quality distinction effort + → FS quality distinction effort level + → FS quality distinction cost + → FS total profit -.

4. Construction of hybrid alliance stability model for fresh produce supply chain

- Inventory flow mapping

Through contractual coordination mechanism analysis, the complex dynamic process of fresh produce supply chain system is simulated from the system perspective by combining quantitative and qualitative analysis. According to the nature of the factors influencing the fresh produce supply chain alliance system, the contract-related variables such as FS quality differentiation reward and punishment amount, FS revenue sharing amount, FR1 revenue sharing cost and FR2 revenue sharing cost are incorporated into the model to obtain the fresh produce supply chain alliance stock flow diagram, as shown in Figure 3.

Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 2510-2521
Article History: Received: 10 April 2022 Revised: 18 May 2022 Accepted: 30 June 2022 Publication: 25 July 2022

- Model equation design

The functional equation is constructed to quantify the interrelationship between the influencing factors. Combining the original variable types and influence relationships of the fresh produce supply chain alliance and referring to relevant research literature (Li et al. 2020； Jiang. 2019),the functional equation is constructed by setting the variables under the formal contract, and the specific equation is constructed as follows.

State variable equation design

FE total profit = INTGE(FS revenue increase rate - FS cost increase rate + FS quality distinction incentive amount + FS revenue sharing amount + FS quality distinction penalty amount,0).

FR1 total profit = (FR1 revenue increase rate - FR1 cost increase rate + FS quality distinction compensation FR1,0).

FS inventory=INTEG(FS supply rate - FS1 shipment rate - FS2 shipment rate,0).

FR1 inventory = INTEG(FS1 shipment rate - FR1 sales rate,0).

- Rate variable equation design

FS supply rate=DELAY1(FS supply demand, FS supply delay).

FS1 shipment rate=DELAY1(FR1 order rate, FS1 shipment delay).

FR1 sales rate = DELAY1 (mid- to high-end fresh produce market demand, FR1 sales delay).

FS revenue increase rate = FS supply revenue.   FR1 revenue increase rate = FR1 sales revenue.

FS cost increase rate = FS inventory cost + FS transportation cost + FS purchasing cost + FS quality differentiation cost + FS quality differentiation cost.

FR1 cost increase rate = FR1 preservation effort costs + FR1 inventory costs + FR1 sales effort costs + FR1 ordering costs + FR1 transportation costs + FR1 quality monitoring costs + FR1 revenue sharing expenses + FR1 quality inspection expenses.

- Partial auxiliary variable equation design

FS revenue sharing = α*FR1 sales revenue + β*FR2 sales revenue.

FR1 revenue sharing expenses = α*FR1 sales revenue.

FR1 quality inspection expenses = ε*FR1 sales revenue.

FS quality differentiation incentive amount = IF THEN ELSE(FS quality differentiation level >= 0.6,IF THEN ELSE(FS quality differentiation level >0.7,ε*(FR1 sales revenue + FR2 sales revenue), 0), -ε*(FR1 sales revenue + FR2 sales revenue)).

FS quality distinction penalty = IF THEN ELSE(FS quality distinction level >= 0.6,IF THEN ELSE(FS quality distinction level >0.7,-γ*FS supply revenue,0),γ*FS supply revenue).

FS quality distinction compensation FR1 = FS quality distinction compensation FR2 = FS quality distinction penalty amount/2.

Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 2510-2521
Article History: Received: 10 April 2022 Revised: 18 May 2022 Accepted: 30 June 2022 Publication: 25 July 2022

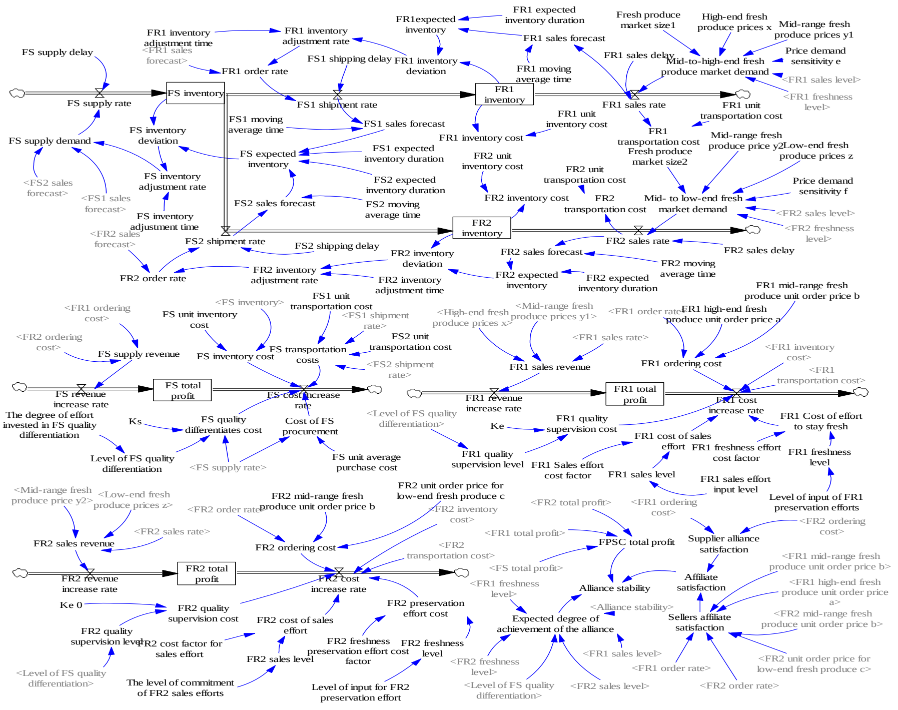


Figure 3 Fresh produce supply chain mixed alliance stock flow chart

- Partial constant setting

Table 1 Main constants setting

Variables	Variables Meaning	Value
FS transportation cost per unit	Unit transportation cost of fresh produce suppliers	3
FS unit inventory cost	Fresh produce supplier unit inventory cost	2
FS average cost per unit purchase	Fresh produce supplier unit purchase cost	20
FS1, FS2 moving average time	Moving average time of FR1 and FR2 sales of fresh produce suppliers	1.5,2
FS1, FS2 shipment delay	Fresh produce supplier 1, supplier 2 shipment delay time	1,1
FR1, FR2 preservation cost factor	Fresh produce vendor unit preservation effort cost factor	6,4
FR1, FR2 cost of sales effort factor	Fresh produce vendor unit sales effort cost factor	6,4
FR1, FR2 expected inventory duration	Fresh produce seller's expected inventory duration	2,2
FR1, FR2 inventory adjustment time	Fresh produce seller's inventory adjustment time	2,3
FR1, FR2 unit inventory cost	Fresh produce seller's unit inventory cost	1.5,1
FR1 selling price of high and mid-end fresh produce	FR1 Fresh produce selling price	65,52
FR2 mid- and low-end fresh produce selling price	FR2 fresh produce selling price	50,40
FR1 price demand sensitivity e	Coefficient of influence of market price on FR 1 demand	0.56
FR2 price demand sensitivity f	Coefficient of influence of market price on FR 2 demand	0.77

Constants are the key link to assist in simulating the operation of the fresh produce supply chain alliance simulation. Referring to the 2020 China Fresh Produce Supply Chain Research Report - Mangosteen product related data set parameters and implement quantization, through several runs of correction, the final model through the system dynamics consistency test, the test of validity, sensitivity test, unit test, extreme value test, determine the constants as shown in Table 1.

- Programming parameters

On the basis of the original no-contract model, the revenue sharing contract and quality differentiation

Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 2510-2521
Article History: Received: 10 April 2022 Revised: 18 May 2022 Accepted: 30 June 2022 Publication: 25 July 2022

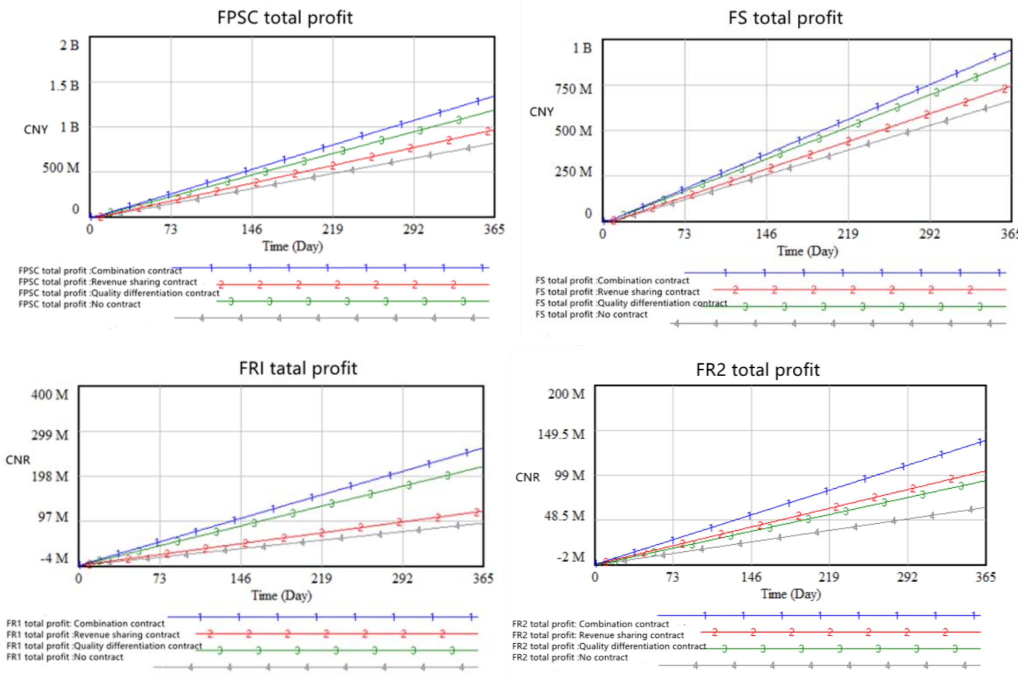
contract are added to form the "no-contract", "revenue sharing contract", "quality differentiation contract", and "combination contract" scenarios in turn. The "combination contract" scheme is used to examine the dynamic changes of the stability of fresh produce supply chain alliance under the coordination of single contract or combination contract. The specific parameters of the schemes are shown in Table 2.

Table 2 Contractual coordination of fresh produce supply chain hybrid alliance scheme

Parameters	**α**	**β**	**γ**	**ε**	**FS quality distinction level**	**FS quality differentiation coefficient**	**FR1,FR2 quality supervision coefficients Ke、Ke0**	**FR1, FR2 freshness preservation efforts input**	**FR1 , FR2 sales service input**	**Order unit price for high-end produce a**	**Order unit price for mid-range produce b**	**Order unit price for low-end produce c**
No Covenants	0	0	0	0	0.61~0.71	70	10	0.5	0.5	50	39	30
Revenue Sharing Contract	0.11	0.11	0	0	0.61~0.71	70	10	0.7	0.7	40	29	20
Quality differentiation contract	0	0	0.26	0.26	0.71~0.81	100	15	0.5	0.5	50	39	30
Combination Contracts	0.11	0.11	0.26	0.26	0.71~0.81	100	15	0.7	0.7	40	29	20

III. SIMULATION ANALYSIS OF FRESH PRODUCE SUPPLY CHAIN ALLIANCE STABILITY CONTRACT COORDINATION

Vensim PLE software was used to simulate the four contract scenarios. The results of the changes in profit levels of suppliers, mid- and high-end sellers, and mid- and low-end sellers, changes in overall profits of fresh produce supply chain alliance, alliance expectation realization, alliance member satisfaction, and alliance stability changes were obtained in turn, as shown in Figure 4(a-g).



Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 2510-2521
Article History: Received: 10 April 2022 Revised: 18 May 2022 Accepted: 30 June 2022 Publication: 25 July 2022

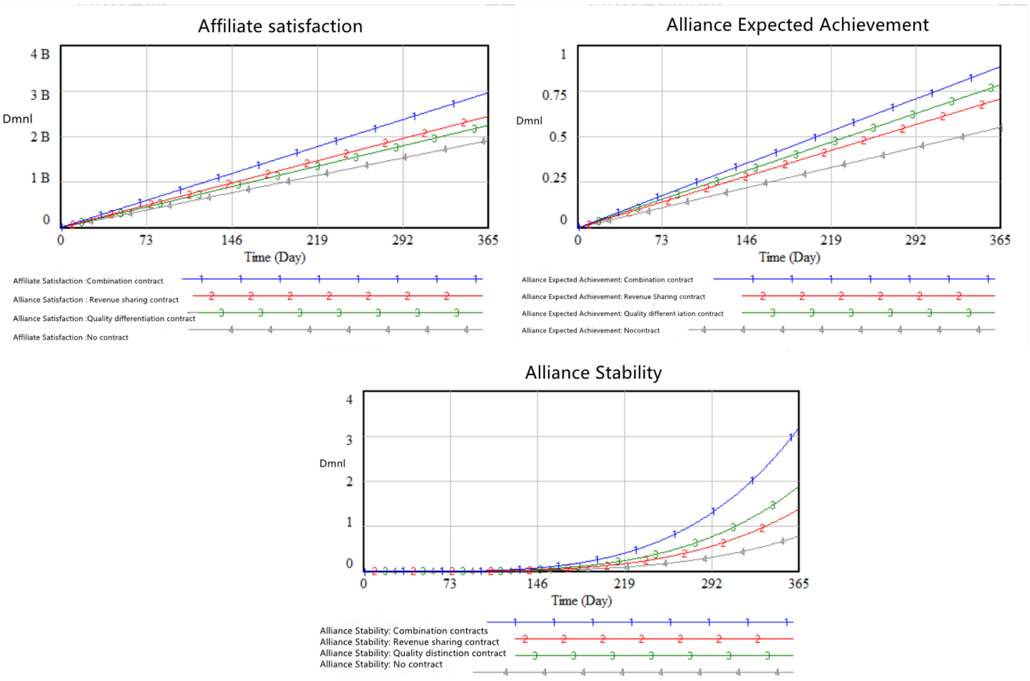


Figure 4 Atlas of simulation results of fresh produce supply chain alliance (a-g)

1. Total profit of the alliance

The total profit of fresh produce supply chain alliance is the total profit of each member, and the purpose of alliance is to maximize the profit of all members so as to occupy a higher market power. The results show that the total profit under the revenue sharing contract, quality differentiation contract and combination contract has increased by 18.2%, 44.6% and 63.8% respectively by the 365th day of simulation. The combination contract satisfies the needs of all members of the supply chain alliance, in which sellers get low wholesale prices from suppliers through the revenue sharing contract, and suppliers get rebates from sellers by improving the quality differentiation of fresh produce under the quality differentiation contract, which positively motivates alliance members to work together to gain higher profits.

2. Total profit of suppliers

Suppliers are an important link between fresh produce production and sales. As of day 365 of the simulation, the total profit of suppliers under the combination contract, quality differentiation contract and revenue sharing contract increased by 12.1%, 31.3% and 42.1%, respectively, compared with that without the contract. The combination contract combines the advantages of quality differentiation contract and revenue sharing contract, ensuring that suppliers are reasonably rewarded and monitored by sellers after implementing quality differentiation of fresh produce, and that suppliers are reasonably rewarded by sellers while reducing wholesale prices, effectively improving the quality differentiation of fresh produce and ensuring revenue sharing between both parties, so that suppliers can finally gain higher profits.

3. Total profit of sellers

- Total profit of mid- to high-end sellers

Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 2510-2521
Article History: Received: 10 April 2022 Revised: 18 May 2022 Accepted: 30 June 2022 Publication: 25 July 2022

Different contracts coordinate the degree of quality differentiation and revenue sharing mechanism for fresh produce, resulting in different rates of increase in total profits of mid- to high-end sellers. As of the end of the simulation period, with the addition of the revenue sharing contract, the quality differentiation contract, and the combination contract, the total profit of mid- to high-end sellers increased by 1.29, 2.26, and 2.81 times, respectively, compared with the profit without the contract. The combination contract satisfies both the demand for high quality supply and low cost control of fresh produce for the mid- and high-end sellers, and the coordination effect is the best; when the single contract is in effect, the consumer demand of the mid- and high-end sellers has a higher demand for fresh produce quality compared with the price factor, so the consumer demand reverses the preference of the mid- and high-end sellers for the quality differentiation contract, followed by the revenue sharing contract.

- Total profit of mid- and low-end sellers

The trend of total profit growth of the middle and low-end sellers under different contracts is roughly the same as that of the middle and high-end. The results show that, by the end of the simulation cycle, the addition of quality differentiation contract, combination contract, and revenue-sharing contract contributed to 1.47, 1.65, and 2.19 times higher total profits of the mid- and low-end sellers, respectively, than those of the no-contract scenario, and the combination contract had the best coordination effect; the contract preferences of the mid- and low-end sellers differed from those of the mid- and high-end sellers when a single contract was in effect, and the profits of the mid- and low-end sellers were lower than those of the revenue-sharing contract under the quality differentiation contract scenario. The profit of the middle and low-end sellers is lower than that of the revenue-sharing contract, and the revenue-sharing contract can better meet the real demand of the middle and low-end sellers for consumers who value lower prices for the same quality of fresh produce, thus the demand of the middle and low-end consumers drives the preference of the corresponding sellers for the revenue-sharing contract, followed by the quality differentiation contract.

4. Alliance satisfaction

Alliance satisfaction includes the comprehensive evaluation of supplier alliance and seller alliance on the fairness of benefit distribution during the execution of revenue sharing and quality differentiation contracts. The simulation results show that the total satisfaction of the alliance members with the alliance cooperation increases in any order, and by the end of the simulation cycle, the alliance satisfaction increases by 17.3%, 27.7% and 54.8% than that of the no-contract solution under the coordination of the quality differentiation contract, revenue sharing contract and combination contract. The combination contract solution not only satisfies the sellers' requirements of quality differentiated sales and price reduction based on order quantity, but also ensures that the suppliers can receive rebates from the sellers based on the price reduction while implementing price reduction in wholesale, which has the best effect on the satisfaction of all members of the alliance, followed by the revenue sharing contract and finally the quality differentiated contract.

5. Alliance expectation realization degree

The simulation results show that by the end of the simulation cycle, the expected realization of the alliance under the revenue sharing contract, the quality differentiation contract, and the combination contract

Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 2510-2521
Article History: Received: 10 April 2022 Revised: 18 May 2022 Accepted: 30 June 2022 Publication: 25 July 2022

are 0.70, 0.78, and 0.88, which is 28.3%, 42.2%, and 60.4% higher than that of the no-contract scenario. The prescriptive nature of the alliance contract takes the restraining behavior as the starting point, which not only stimulates the suppliers to independently improve the quality differentiation level, but also drives the mid- and low-end sellers to continuously improve the preservation level and sales level, and finally realizes that the actual input level of alliance members is higher than the expected value.

6. Alliance stability

By the end of the simulation cycle, the inclusion of covenants has greatly improved alliance stability, with 4.1 times, 2.4 times, and 1.77 times increase in alliance stability under the combination covenant, quality differentiation covenant, and revenue sharing covenant scenarios, respectively. In the first 87 days of the simulation of the four scenarios, the alliance stability of fresh produce supply chain changed slightly; the alliance stability under the combination contract, quality differentiation contract, and revenue sharing contract scenarios started to accelerate on day 104, 119, and 126, respectively, and achieved the stability that required 365 days to maintain under the no-contract scenario in only 257, 297, and 309 days, respectively. It can be seen that the combination contract is the fastest and most effective in improving alliance stability, followed by the quality differentiation contract, and finally the revenue sharing contract. From the perspective of mid- to high-end and low-end sellers, the high quality and low procurement cost of fresh agricultural products are satisfied at the same time, and the sellers are more willing to maintain the stability of the alliance because they have both quality and price advantages in the process of consumer selection; the suppliers implement wholesale concessions and differentiate the quality of fresh agricultural products, and receive compensation from the sellers at the same time, so the production and marketing links of fresh agricultural products are more smoothly connected, and the suppliers are more willing to maintain the alliance. In short, the needs of multiple subjects in the alliance at different levels are met, and all members are more willing to maintain the operation of the alliance and comply with the alliance contractual agreement, thus achieving the overall stability of the alliance.

IV. CONCLUSIONS AND OUTLOOK

In this paper, we study the characteristics of fresh produce supply chain alliance, clarify the logical relationship and construct a cause-effect linkage diagram, establish a fresh produce supply chain alliance stability model, incorporate revenue sharing contract and quality differentiation contract, and realize model simulation with the help of Vensim PLE software to compare and analyze the influence of each contract scheme on fresh produce supply chain alliance stability. ① Under the mixed alliance model of "supplier + mid- to high-end seller + mid- to low-end seller", the combination contract is most helpful to improve the stability of the alliance. ②. Based on the design of contract parameters in this paper, the combination contract is more attractive to suppliers and mid- and high-end sellers, while the mid- and low-end sellers are more concerned about the revenue sharing contract. ③The operation of the mixed alliance of fresh produce supply chain achieves the active matching between the quality of fresh produce at different levels and the demand of consumers.

Considering the complex and volatile nature of the market, the following aspects of mixed alliance stability of fresh agricultural products supply chain are still worthy of further research in follow-up. ① Quantify the contribution degree of each member of the alliance in the alliance collaboration to realize the change of benefit distribution mechanism, so as to monitor the change of fresh agricultural products supply chain alliance stability. ② Consider the alliance under the impact of external environment to compare the change of alliance stability. ③ Consider comparing the impact on fresh agricultural products supply chain alliance stability after amending and optimizing the formal contract and the relationship contract.

REFERENCES

[1] Li L. Y., Nie L. L., Fu Q.(2020) Differential Analysis of Consumers' Willingness to Buy Fresh Produce from Community E-Commerce in Different Categories--Empirical Evidence Based on 578 Consumers in Nanchang. Journal of Agricultural and Forestry Economics and Management ,19,457-463.

[2] C. Hao, Q. Du, Y. Huang, L. Shao & Y. Yan. (2019) Evolutionary Game Analysis on Knowledge-Sharing Behavior in the Construction Supply Chain. Sustainability, 11.

[3] Hy, A.; Yb, A.; Hcf, A.; Al, B.(2020) Stability Analysis of Supply Chain in Evolutionary Game Based on Stability Theory of Nonlinear Differential Equation .Alexandria Engineering,59,2331-2337.

[4] Li, C.W., Zhou, Y.M., Guo, J.S., et al.(2018) A Study of Retailer Alliance Cooperation and Stability Under Quantity Competition in Two-Tier Supply Chains. Systems Management, 27,791-792.

[5] An, Q.; Wen, Y.; Ding, T.; Li, Y.(2019) Resource Sharing and Payoff Allocation In A Three-Stage System: Integrating Network DEA With The Shapley Value Method. Omega ,85,16-25.

[6] Zheng, X. X.; Li, D. F.; Liu, Z.; Jia, F.; Sheu, J. B.(2019) Coordinating a Closed-Loop Supply Chain with Fairness Concerns through Variable-Weighted Shapley Values. Transportation Research Part E Logistics and Transportation Review, 126,227-253.

[7] Zhou, Y. F.(2017) Benefit Distribution Mechanism of Agricultural Supply Chain Based on Improved Shapley Value Model. Statistics and Decision Making, 23,52-54.

[8] Liu Q, Qiu Y, School B, et al. (2013). Research on the Influence of Fresh Agricultural Supply Chain Stability on the Performance of Supply Chain. Science-Technology and Management,2022, 01-17.

[9] Qing Xuemei.(2016) Research On the Construction of Contractual Strategic Alliance Ecosystem and Its Stability [D]. Chongqing University

[10] Xing Hailong,Gao Changyuan,Zhang Shuchen.(2017) Construction and Simulation Study on The Stability Model of Big Data Alliance Based on System Dynamics. Journal of Intelligence,36,159-165.

[11] Jiang Hao.(2019) Research on the Optimal Model of Farmers' Union Performance from the Perspective of Agricultural Product Supply Chain. Business and Economic Research, 7,109-112.

[12] Sui B. W. (2017) The Impact of Relationship Stability on the Alliance Performance of Cross-border Agricultural Products Supply Chain-An Empirical Analysis Based on Guangxi-ASEAN .China circulation economy, 31,65-75.

[13] Wang Lei,Li Cuixia,Wang Zemin. (2019) The Impact of Partner Characteristics on the Stability of Cooperative Relationships in Dairy Supply Chains-an Empirical Study Based on Quality and Safety Perspective.Agricultural Technology Economics, 7,104-114.

[14] Qu, W. G.; Yang, Z. (2015) The Effect of Uncertainty Avoidance and Social Trust on Supply Chain Collaboration. Journal of Business Research ,68,911–918.

[15] Kozicka, K.; Kot, S.; Riana, I. G.(2019) The Efficiency of Cooperation between the Participants in the Supply Chain in the Tourism-Related Branch of Industry in Relation to Client Satisfaction. Sustainability , 11.

[16] Liu, Q.; Qiu, Y.; (2013.)School, B.; University, N. Research on the Influence of Fresh Agricultural Supply Chain Stability on the Performance of Supply Chain. Science-Technology and Management

[17] Lee, B. W.; Nittala, L.; Jacobs, M. A.; Yu, W.(2021) Impact of Psychological Safety on Supply Chain Operational Performance. International Journal of Production Research,0, 1–20.