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Integrating the Cross-Border Industrial Chain: An Exploring of Key Configuration of Agricultural Investment in Lancang-Mekong River Region

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Abstract: The demand for agriculture finance and investment for sustainable agriculture development has long been a concern for many years. However, the insufficient integration of the agricultural technology innovation chain and technology transfer impedes the enhancement of collaborative innovation capability in evolving total factor productivity. This paper utilizes Chinese agricultural companies' investment in the Lancang-Mekong River region as an example to scrutinize key configuration factors fostering the integration of technical collaboration within agricultural industry chains. The results indicated that Chinese agricultural companies can be classified into two categories based on their approach to technical collaboration. The first category is strength-oriented, and companies in this category have the capability to transform technological investments, yielding relatively high returns. They also have optimistic expectations regarding favorable policies in the host country. This category accounts for about one-third of the companies studied. The second category is potential-oriented, in which firms possess the potential for technological investment transformation, with lower investment returns. They require effective contextual management and tax incentives from the host country to thrive. The impact of foreign direct investment decision-making diminishes, introducing new imperatives for the current host country's market environment and the management of FDI enterprises in the host country. This study makes contributions to advance the exploration of technology's impact on agricultural companies' cross-border investment, stipulating new requirements for the transformative development of regional foreign direct investment, particularly for private enterprises.

Keywords: agricultural industrial chain; foreign direct investment; technical integration; fsQCA

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1. Introduction

The demand for agriculture finance and investment that empowers the agriculture industry development for sustainable agriculture and agri-food value chains has been a concern for many years [1]. At least USD 80 billion in annual investments are expected to meet the projected 70% increase in food demand by 2050 [1]. Since the 1950s—especially over the past 60 years—China has implemented three major development stages to aid developing countries: foreign aid, mutual-benefit cooperation, and foreign investment [2]. Here, the Belt and Road Initiative (BRI) has a positive impact on China's overseas investment through technical efficiency, human capital, and institutional transition [3–5].

In particular, agricultural cooperation and investment has become both an end to and a means of China's diplomacy, which helps maintain the food security of the target countries and promote the overseas interests of Chinese enterprises [6]. Meanwhile, the COVID-19 pandemic has prompted the Chinese government to place more emphasis on ensuring a safe agricultural supply chain.

China's private-led agricultural outward investment faces challenges in technology transfer and upgrading, necessitating technological innovation and exploration to drive reverse spillover and industrial advancement. In 2020, China's total stock of foreign agricultural investment amounted to USD 30.2 billion, with a total of 1010 agricultural enterprises established overseas. Planting agriculture accounted for the highest stock of foreign investment, representing 59.38% of the total, with 90% of the investment coming from private enterprises, which drives China's agricultural overseas investments [7]. However, private enterprises also face difficulties in overseas agricultural investments, such as small investment scales and lacking awareness of risk management [8,9]; the challenges come from the difficulties in implementing agricultural technology transfer to the host countries, and the need to upgrade and reconstruct China's agricultural industry value chain [10]. Hereafter, China is still in the early stage of overseas investment and requires the support of core technologies. By leveraging advanced technology spillover, it can achieve reverse technology spillover and promote industrial structure upgrading [8,11].

Transnational agricultural enterprises must balance innovative industrial adjustments with the challenges of integrating technology and information for the development of the industrial chain. Science & Technology Innovation (STI) could not only increase farmers' incomes and reduce food prices but could also provide more employment opportunities, change food consumption patterns, and promote changes in the agricultural production structure and industrial upgrading [12–15]. Here, modern transnational agricultural enterprises continuously adjust their industrial chains to adapt to innovation, especially the upgrading of the agricultural product market space and the agricultural factor structure [16,17]. The supply chain will go through changes by technology transfer, such as real-time visibility throughout the entirety of the supply chain, and continuous collaboration between the stages of the chain, among other significant changes [18]. However, the weak integration of the agricultural technology innovation chain and the technology transfer restrict the enhancement of the collaborative innovation capability in the evolution of productivity [19–21]. The trans-national agricultural enterprises build industry chains, and it is not only necessary to rely on the linkage between upstream and downstream sectors of the industry chain and the internal construction of each link but also to have the support and linkage of the innovation chain in terms of information, technology, and other aspects. To realize the work on both the "industry chain" and the "innovation chain", it is essential to understand the key factors that configure both, which serve as the basis for this research opportunity.

Therefore, this study investigates the construction process of the industrial chain of 109 Yunnan agricultural enterprises engaged in foreign investment, accounting for 64.5% of Yunnan's agricultural enterprises engaged in foreign investment, according to the statistics of *Yunnan Agricultural Yearbook* (2021), and 25.8% of China's agricultural investment enterprises in ASEAN [7]. It utilizes fsQCA to analyze the configurational characteristics of agricultural technical collaboration enterprises, distinguishing the differences and objectives of different configurational integrative developments. The aim is to support sustainable agriculture and agri-food value chains by providing services to agricultural enterprises engaged in foreign investment. There are two contributions to the study. This study makes dual contributions by addressing critical gaps in existing research. First, it develops a comprehensive analytical framework to overcome the limitations of current

agricultural industry chain theories, particularly in cross-border contexts. By systematically identifying multidimensional collaborative factors influencing transnational agricultural investment—rather than isolating single factors—it addresses the cognitive gap in understanding cross-border linkage mechanisms [22,23]. Second, it proposes an innovative configuration-based mechanism for agricultural investment, tackling scenario sensitivity through differentiated models [24,25]; meanwhile, it contributes to sustainable agriculture and industrial chains by deducing key factors, dependencies, and strategic directions that enhance sustainability. It identifies distinct enterprise groups based on their investment profiles and evaluates their impact on sustainable agriculture, providing actionable insights for policymakers and stakeholders to align investments with sustainability goals.

The remainder of the paper is organized as follows. Section 2 presents the literature and hypotheses developed to answer the research questions of this study. Section 3 describes the research methodology and data used in the empirical analysis. The empirical results and findings are presented and discussed in Section 4, followed by Section 5 to conclude the study.

2. Literature Review

2.1. The Value Chain and International Division of Labor Theoretical Support

The value chain framework was introduced by Porter (1985) [26] and it breaks down business activities into design, production, sales, and auxiliary links. The theory of international division of labor has also evolved into intra-product division of labor [27]. With technological advancements and the deepening of global trade liberalization, the intra-product international division of labor has progressed rapidly. The existence of within-product specialization is important for understanding the impact of globalization on firms and workers, the evolution of total factor productivity, and the likelihood of long-run income convergence [28]. Here, Foreign Direct Investment (FDI) is one of the two ways of shifting production processes to overseas subsidiaries or affiliates while retaining high value-added stages within the domestic parent company in the intra-product division of labor. Moreover, Grossman and Rossi-Hansberg (2008) [20] put forth a theory on the global production process, which highlights the division of labor through different countries providing value-added services for various stages of the global value chain. When the cost of trading tasks decreases, it can lead to shared benefits for all domestic factors, including technology. Countries with sufficiently different endowments specialize in unique goods, resulting in a higher degree of production division and technological content. This differentiation allows developing countries to distinguish their products from similar ones and avoid direct competition [19].

2.2. Expanding the International Market for Agricultural Products Requires Agricultural Enterprises to Improve Their Industrial Links

Modern transnational agricultural companies adjust their industrial chains to adapt to innovation and expand coordination and cooperation, which facilitates the optimization and upgrading of agricultural product market space and the agricultural factor structure [16,17]. The essence of expanding the agricultural industry chain lies in improving the extension of each link toward high-end development, whether in terms of depth or breadth. This results in the construction of three agricultural industry chain models: production sector extension, processing sector advancement, and service sector leadership [29]. Currently, China's agricultural industry is at the bottom of the industrial value chain, with spatial separation in the agricultural industry chain, significant gaps between upstream and downstream sectors, and a lack of necessary industrial links. However, as the agricultural industry chain gradually upgrades, it is shifting towards the processing and service sectors,

such as circulation, from the production sector. Therefore, improving the industrial links of the agricultural industry chain will serve as the strategic engine for the development of modern agriculture [30].

2.3. The Development of Cross-Border Agricultural Industry Chains Requires Innovation Management Mechanisms

As the global economy and regional integration deepen, the international division of labor has evolved from product specialization to global production. Today's agrarian economies are bypassing the manufacturing sector and directly developing their agriculture and services sectors through participation in global agricultural value chains [31]. To integrate into global industry chains, China's cross-border agricultural trade and cooperation must transform and upgrade. Currently, Chinese multinational enterprises have prominent resource-oriented characteristics, and Southeast Asia is the region where Chinese agricultural enterprises have the most foreign investments [32,33]. Enhancing the cooperative management system of agricultural industry chains can effectively increase farmers' willingness to join cross-border agricultural enterprises [34]. However, agricultural cross-border cooperation that seeks complementary resources often faces higher political risks than other types of cross-border cooperation, necessitating innovative management mechanisms for cross-border agricultural enterprises [35].

2.4. The Development and Integration of Agricultural Industry Chains and Innovation Chains Require Technological Support

According to Zhu (2012) [36] and Huang and Ding (2018) [37], institutional innovation, technological advancement, market reform, and agricultural investment are the four main driving forces for agricultural development in China. Science, technology, and innovation (STI) not only increase farmers' incomes but also provide more employment opportunities and promote changes in agricultural production structure and industrial upgrading [12,13,15]. Liu Z et al. (2022) [3] found a clear coupling relationship between the agricultural industry chain and the technological chain. The main factor restricting the enhancement of the collaborative innovation capability of the agricultural science and technology innovation system is the weak integration of the agricultural technology innovation chain and the industry chain [21]. Developing countries consider science and technology as drivers of economic growth, and agricultural research and innovation support are expected to play a significant role in this process [38–40].

Overall, to establish industry chains for cross-border agricultural enterprises, it is important to not only connect the upstream and downstream sectors of the industry chain and work on the development of each link internally but also have access to support and linkage from the innovation chain in terms of information, technology, and other aspects. This becomes even more crucial for new entrants in the industry who face significant challenges in their attempts to surpass competitors through developmental innovation or establishing new businesses. Therefore, cross-border agricultural enterprises need to understand the key factors that configure both the "industry chain" and the "innovation chain" to succeed in this field. This research opportunity is based on identifying these key factors. According to the literature review, our research hypothesis is as follows:

Hypothesis H1. *Technical collaboration is the core condition for the differentiation of agricultural enterprises' foreign investments, and the configurational effectiveness depends on distinct complementary conditions.*

Hypothesis H2. *The interaction between policy and market cooperation in the configuration positively regulates the integrated development of the industrial chain of agricultural foreign investment enterprises.*

3. Materials and Methodology

3.1. Empirical Analysis Strategies

This article builds on the theoretical framework by integrating the Eclectic Theory of International Production (OLI) with the TOE framework. OLI was first systematically introduced by British economist John H. Dunning in 1977 and has been further developed in subsequent research. It primarily aims to explain the motives behind multinational corporations' foreign investments. According to Dunning (1988) [41], there are three key advantages that multinational corporations possess in international investment: Ownership Advantage (O) refers to the unique competitive advantages of an enterprise, such as technology and management; Location Advantage (L) pertains to the appeal of a host country's resources, market potential, and policies; Internalization Advantage (I) highlights the benefits of mitigating market imperfections through the internalization of cross-border transactions. Additionally, Tornatzky and Fleischer (1990) [42] integrated variables from three dimensions: Technology (T), Organization (O), and Environment (E), to form the TOE framework while studying the factors influencing technological innovation in enterprises. This framework is widely applied to explain factors affecting technology adoption and innovation diffusion. The dimensions are as follows: Technological dimension includes technical characteristics, resource costs, and collaborative efforts; organizational dimension encompasses organizational resources, structure, culture, and strategic objectives; environmental dimension covers industry competition, policies and regulations, and the market environment. Through a systematic analysis of the TOE framework, the driving factors and obstacles to technology implementation can be comprehensively identified, providing a structured basis for decision-making. Hence, this study constructs the following theoretical framework (Figure 1).

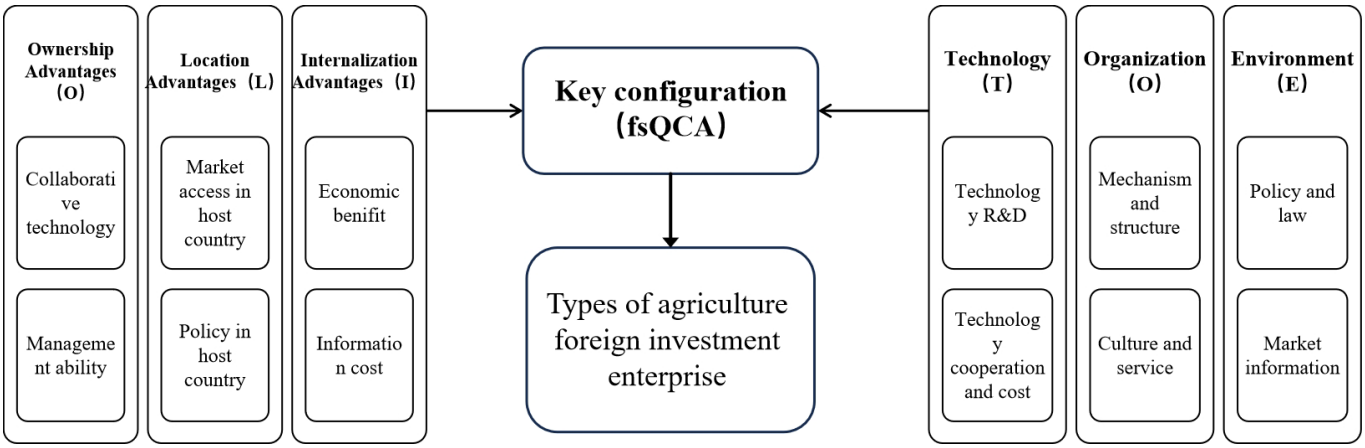

Figure 1. The framework for key configuration in the integrated development of industrial chain.

Traditional econometric models assume factor independence, examining only linear and unidirectional causality, thus failing to capture interdependent and synergistic relationships among multiple variables. In contrast, QCA employs Boolean logic to analyze factor configurations, enabling exploration of concurrent causality and identifying multiple causal paths through set-theoretic relationships [43,44]. Its application in management research has expanded, including agricultural management [25,45,46]. Depending on data type, fsQCA adopts a holistic perspective, comparing cases to uncover causal relationships

between conditional combinations and outcomes, making it particularly suited for analyzing synergistic effects and distinguishing core from auxiliary conditions [47,48]. Given that this study involves both continuous and multivalued data, fsQCA is selected as the analytical method. This study aims to investigate the variables that influence agricultural foreign investment using a theoretical framework. We will employ the fsQCA method to effectively address the question, "Which configurations of variables can lead to the desired outcomes?" This analysis will focus on how these variables work together to enhance technological innovation cooperation and will identify the configurations and core conditions that facilitate the integrated development of the industrial chain.

3.2. Survey Context

The mountainous area of Yunnan accounts for 94% of the population, with 25 border counties under its jurisdiction and 11 national open ports, 16 ethnic groups living across borders, and 4 major international rivers extending across borders. It borders 32 counties and districts in the three countries of Myanmar, Laos, and Vietnam, covering an area of nearly 20 million ha of land and involving a cross-border population of over 10 million [49]. As an important land passage from China to South and Southeast Asia, Yunnan's cross-border mountainous areas have been in a cross-border form since ancient times, including economic and trade exchanges, cultural exchanges, and agricultural production. They are influenced both by abroad and domestic resources and markets and are not only important cross-border open areas but also important cross-border mountainous areas in Yunnan and even in China. According to the data of Yunnan Agricultural Yearbook 2021, as of the end of 2019, 153 agriculture enterprises in Yunnan Province had overseas investment, and 176 agricultural enterprises established overseas branches through investment, ranking 1st in the country. From the perspective of investment regions and country distribution, there are 69 in Laos and 83 in Myanmar, an increase of 1.24 times compared to 2015; the cumulative investment in foreign agriculture reached 1.415 billion US dollars, accounting for the 6th place in the country. Among them, the cumulative investment in Laos and Myanmar accounted for 44.9% and 53.2%, respectively. Yunnan's foreign agricultural investment mainly focused on poppy alternative cultivation projects, mainly in northern Laos and northern Myanmar, and mainly invested in the production of food crops, cash crops, livestock products, and fertilizers.

In this context, Yunnan Province, as China's window and gateway to South and Southeast Asia, which borders Lao, Myanmar, and Vietnam, has developed a new pattern of open agricultural development over the past forty years of reform and opening up. The export trade volume of agricultural products has continued to grow and has remained at the top in the western region for consecutive years, making it the province's largest export commodity. Yunnan Province also ranks first in the number of agricultural enterprises established through foreign investment in China, and its competitiveness in foreign agricultural investment continues to strengthen, with increasingly frequent international agricultural cooperation and exchanges [50]. In March 2019, with the approval of the State Council, the National Development and Reform Commission of China issued national documents. This policy fully leverages Yunnan Province's locational advantages in the new pattern of comprehensive opening-up and the Belt and Road Initiative promotes mutually beneficial cooperation between Yunnan Province and neighboring countries and further emphasizes the role of enterprises in cooperation in the field of planting agriculture [51]. Yunnan Province has successively introduced provincial documents as well and proposed fully leveraging the role of enterprises as innovation subjects [52]. Therefore, as the implementers and innovators in the new pattern, how can agricultural enterprises simultaneously construct cross-border characteristic agricultural industry chains and achieve

technology integration development with foreign technical collaboration as the mainstay, thus connecting and serving both domestic and international markets?

3.3. Survey Design

This research was conducted by the Yunnan Alternative Planting Development Industry Association, using a semi-structured questionnaire survey on 109 agricultural investment enterprises in Northern Laos and Myanmar in 2021. These enterprises represent around 64.5% of Yunnan's agricultural outward investment enterprises. The survey covered four main sections: (1) Basic information on overseas investment of agriculture enterprises, including the nature of enterprise ownership, structure and methods of outward investment, establishment time and capital assets, types and main planting conditions of investment crops, sources, and advantages of outward investment information; (2) Enterprise management system, they are internal management system refers to having clear departmental functions and management structures, such as personnel department, finance department, production department, audit department, etc., and conducting standardized investment and performance evaluation; employee training system refers to the professional skills of employees, such as enterprise culture training, rubber cutting professional technology, certification training, etc.; external publicity refers to the creation of enterprise image, such as unified operation of bilingual official website or APP, enterprise logo and publicity, social media cooperation, etc.; cultural construction refers to enterprise public welfare and cultural activities, such as building primary schools, clinics, employee team building, and caring for local communities. (3) Enterprise social welfare, involved in infrastructure, which refers to providing employees with a safe and comfortable working and living environment, enhancing their sense of belonging and efficiency, such as production environment, living facilities, accommodation security, etc.; medical ad education refers to ensuring the health of employees, supporting their career development and family needs, such as basic medical benefits, educational advancement, etc.; (4) evaluation of investment environment policies, involving the selection of support policies and recognition of difficulties for both domestic and investing countries.

This survey design focuses on multiple topic selection with implicit classification information, making it easy to fully utilize its multi-directional features and measure the classification information contained in each indicator through a frequency table.

Based on statistics gathered from surveyed enterprises, it was found that around 85% of Yunnan's agricultural outward investment comes from private enterprises. The regions with the most intensive investment distribution are northern Laos and Myanmar. Joint ventures and direct investment in production and construction are the primary investment methods used. The investment fields are divided into 84% in the planting industry, 12% in forestry, and 4% in the aquaculture industry. Investment returns are mainly from sugarcane (44%), rubber (37%), grain (11%), and bananas (7%). Over 57% of enterprises are experiencing a transition in their planting structures with new crops, such as coffee, beans, and Chinese herbal medicine, due to technical collaboration.

From the early 1990s to 2000, the cumulative growth rate of agricultural outward investment and technical collaboration among surveyed enterprises, as well as the proportion of agricultural outward investment to total assets, maintained synchronous and stable growth. From 2000 to 2010, the cumulative growth rate of agricultural outward investment and technical collaboration enterprises experienced a significant increase, but the proportion of agricultural outward investment in total assets fluctuated significantly. During the decade from 2010 to 2020, the cumulative growth rate of agricultural outward investment and technical collaboration enterprises showed a slight increase, and the pro-

portion of agricultural outward investment in total assets rebounded to the base period level but slightly decreased (Figure 2).

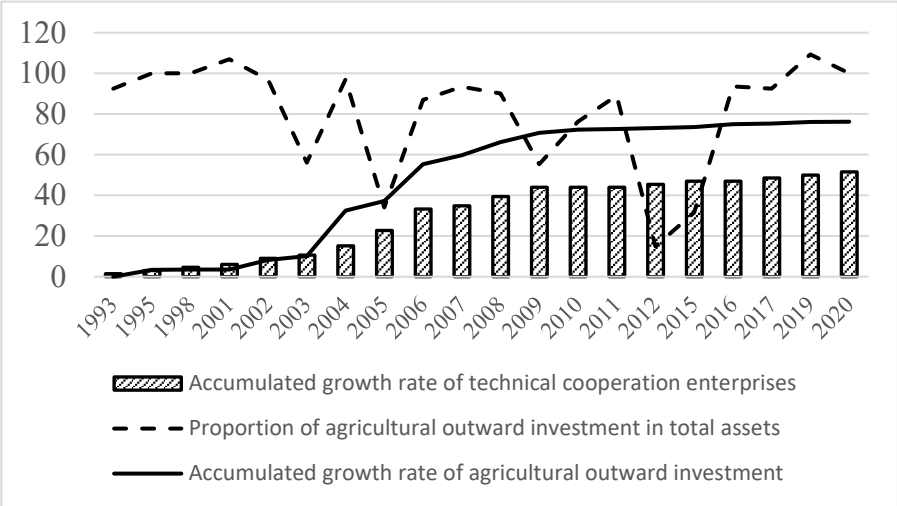

Figure 2. Changes in the cumulative growth rate of agricultural outward investment and technical collaboration among surveyed enterprises (%). Note: Since new enterprises carry out agricultural outward investment every year, this study uses the base period investment data of each enterprise as the newly added funds for the year and observes the trend of outward investment changes using cumulative growth rates. "n" years cumulative growth rate= [(cumulative value of the previous n years/total sample value)] × 100%.

The main body of cross-border agricultural outward investment borders private small enterprises and local companies, with small investment scale, weak financing ability, and low risk resistance [53,54]. The extensive development model has become the main obstacle to the sustainable development of alternative planting enterprises [55]. Although the change in the proportion of agricultural outward investment to total assets lacks sustainability, from 2006 to 2010, as the peak period for agricultural outward investment enterprises to settle in, 21.7% of surveyed enterprises began to expand their investment links from the production end to the middle and lower reaches of processing, warehousing, and sales. The cumulative growth rate of agricultural outward investment is still continuous and stable, while the cumulative growth rate of technical collaboration enterprises experienced synchronous growth in the initial decade since 2003, it has not been able to maintain the same frequency of increase as the cumulative growth rate of agricultural outward investment. It can be said that the integration and development of agricultural technical collaboration as the main force of the technology chain lacks momentum or strength.

3.4. Data and Variables

Based on a literature review and research experience, this study selected conditional variables related to the research topic while considering heterogeneity. An offline survey was conducted, yielding 109 valid questionnaires collected anonymously and voluntarily. The survey team communicated the purpose of the study at the beginning of the questionnaire and through direct communication; however, some questions may have involved sensitive topics, such as investment funds, and the team cannot guarantee that the surveyed companies fully understood or accurately completed the questionnaires, which may have led to some missing or logically inconsistent data. Therefore, considering the quantity and quality of the indicator data required for this study, the team ultimately selected 66 survey samples. Additionally, fuzzy set Qualitative Comparative Analysis (fsQCA) is appropriate for small to medium-sized samples, typically ranging from 10 to 50 cases [56]. This method

identifies multiple concurrent causal paths using set theory and Boolean algebra, rather than relying on traditional statistical methods that require larger sample sizes. Thus, the data collected meets the sample requirements for this research method.

The Ministry of Agriculture and Rural Affairs has reported that out of the 115 leading agricultural enterprises in China, only 16 are full industry chain enterprises. Most private enterprises are still in the planting and initial processing stages. To measure the degree of construction of the agricultural industry chain, this study uses a set of six multiple choice questions. These questions are related to the establishment of a sole proprietorship or joint venture farm, the establishment of a primary processing factory for agricultural products, self-operated sales of agricultural products, and the construction of an agricultural comprehensive park or technical collaboration. The study also aims to understand the changes in the external cooperation methods of agricultural enterprises. The construction of comprehensive agricultural parks or technical collaboration is proposed as an integrated development indicator for the technology chain. The survey reveals that 57.9% of agricultural enterprises engage in technical collaboration, and there is significant variability in this result. Additionally, according to the market-oriented index system developed by Wang et al. (2019) [57], five key dimensions are included: the government-market relationship, non-state-owned economic development, product market development, factor market development, and the role of market intermediary organizations and the legal environment. Furthermore, when enterprises pursue overseas investments, changes in their internal requirements and external environment inevitably lead to innovations in areas such as organizational management, knowledge management, and information technology, etc., [5,9,10,21]. Thirdly, according to the statistical absolute standard empirical threshold established by Cohen (1988) [58], heterogeneity is categorized as follows: low heterogeneity SD < 0.5 mean; medium heterogeneity 0.5 mean $\leq$ SD $\leq$ mean; and high heterogeneity SD > mean. As shown in Table 1, all indicators display medium to high levels of heterogeneity, except for Foreign Direct Investment (FDI). A further clarification is that when constructing the indicator system, it is also essential to consider the importance of each indicator. The proportion of investment flows to total assets as FDI is a crucial metric for assessing the quality and structure of outward investment. A higher proportion indicates a stronger investor control and long-term involvement in the target project, leading to a more significant impact on the economy of the host country. Therefore, based on this, this study aims to establish an indicator system with six dimensions: the strength of Foreign Direct Investment (FDI), economic benefits (EB), investment in information sources (IS), language context management (LCM), Chinese policy support (CPS), and foreign policy support (FPS) (Table 1) which are described as follows:

The strength of Foreign Direct Investment (FDI) refers to the amount of foreign investment by enterprises, which is an important indicator reflecting the strength of their foreign investment. Private enterprises invest relatively smaller amounts overseas, but their investment methods, business operations, and scale are more flexible. This makes up for the weaker areas of foreign agricultural investment by state-owned enterprises. As a result, the flow and stock proportion of private enterprises continues to increase [59]. Many enterprises are involved in this survey, and there are significant differences in their financial strength and investment entry times. Therefore, we measure the investment strength of different enterprises by examining the investment flow in the year of entry, its proportion to the total asset value of the enterprise and normalizing it.

Economic benefit (EB) is crucial for the survival and growth of businesses. It is the fundamental starting point for all economic activities and the core vitality of enterprises. However, the level of economic benefits cannot be determined merely by the increase or decrease in profits, as production costs must also be taken into account. This survey lacks a

detailed analysis of enterprise cost and profit, and it is difficult to use flow over a period as the sole quantitative indicator for enterprise profit analysis. Therefore, the proportion of annual revenue to total assets is measured and normalized to compare the economic benefits of each enterprise's outward investment.

Table 1. The variables of investment mechanism: Measure descriptives of sample enterprises by fsQCA.

Variables	Measure Descriptives					
	Definition	**Type ****	**Mean**	**SD**	**Max**	**Min**
ATC * (Agro-enterprise Technical Collaboration)	No = 0; Yes = 1	A	0.27	0.35	0.50	0.00
FDI (Foreign Direct Investment)	Proportion of investment flows to total assets %	C	0.80	0.32	1.00	0.55
EB (Economic Benefits)	Annual income to total assets %	C	0.99	1.07	1.79	0.28
IS (Information Source)	Options percentage of government information source %	B	0.36	0.47	1.00	0.33
LCM (Language Context Management)	Option percentage of management in local language %	B	0.35	0.18	0.50	0.25
CPS (Chinese Policy Support)	Option percentage of tax reduction policy by China %	B	0.29	0.18	0.50	0.25
FPS (Foreign Policy Support)	Option percentage of tax reduction policy by host country %	B	0.34	0.35	1.00	0.50

* Means outcome variable, while the others are conditional variables. ** A. binary value data; B. multi-valued data; C. continuous data.

The investment of Information Source (IS): Information has become a crucial production factor for companies, alongside human resources, material resources, capital, and technology. For Chinese enterprises, it has become a "sharp tool" for cross-border development. To make informed business decisions, companies need timely, accurate, and credible information sources. Our survey found that 71.7% of companies obtained information primarily through industry associations, investment fairs, and market transactions. The remaining 28.3% of companies relied on government official websites. However, to improve government information sources, it is recommended that businesses increase their reliance on them.

The Language Context Management (LCM) in investment countries was found that there were no significant differences in employee agricultural skills, management skills, laws and regulations, cultural exchange training, as well as internal construction such as internal rules and regulations, personnel management, production plans, and bulletin development among enterprises, as a result of questionnaire statistics. However, there was strong heterogeneity in the use of investment country language to publish bulletins, establish websites, and communicate with media. Only 35.3% of the companies surveyed were able to use the language of the investing country for contextual management. This indicates that there is still a gap in the external management of integrating into the investing country. Therefore, this variable is mainly based on the proportion of language management in each enterprise.

Chinese Policy Support (CPS) refers to different forms of support provided by the government to businesses, such as direct subsidies, project subsidies, tax exemptions, simplified functional department processes, and loan exemptions. Tax exemptions account for 31.6% of the total support provided, and they are ranked second in terms of satisfaction

level on the Likert scale. Therefore, this variable is mainly based on the proportion of China's tax reduction policies.

The Foreign Policy Support (FPS) question evaluates the support provided by a country's government to foreign investors. This support includes various indicators such as land lease incentives, water and electricity cost incentives, tax exemptions, and availability of financial services. Among them, tax reductions and exemptions account for 31.6% of the total, and on the five-point satisfaction Likert scale, this indicator reveals the second scale of relatively satisfied. Hence, this factor depends on the percentage of tax reduction policies offered to foreign investors.

4. Results

4.1. Data Calibration and Necessary Conditions

Following the QCA research standards, calibration is a crucial step in transforming raw data into fuzzy set affiliation degrees that range from 0 to 1. The calibration thresholds set at this stage have a direct impact on the reliability of the analysis results. This study utilized the calibration standards proposed by Fiss (2011) [60], which defined the 75%, 40%, and 15% percentiles of each indicator as the thresholds for fully affiliated, intersection, and not affiliated, respectively. As a result, this study calibrated the means of data from the six dimensions, along with clearly defined threshold criteria. Then, the calibration results will be used as the data for the fsQCA analysis (Table 2). They are currently a single indicator and need to enter fsQCA configuration analysis to determine the configuration relationship.

Table 2. The calibration of variables of the invested enterprise.

Variables		Calibration		
		Fully Affiliated	Intersection	Not Affiliated
outcome variable	ATC	0.5	0	0
conditional variables	FDI	1	0.84	0.39
	EB	1.26	0.56	0.23
	IS	0.5	0.33	0.14
	LCM	0.5	0.33	0.25
	CPS	0.33	0.25	0
	FPS	0.5	0	0

Next, a necessity test is conducted on the outcome variables and conditional variables to verify whether each condition is necessary for the integration and development of the industrial and technological chains of agricultural outward investment enterprises. This helps identify the condition configuration that has the highest degree of explanation for the enterprises surveyed. Table 3 displays the necessity analysis results of six antecedent conditions for agricultural enterprise technology investment. The only condition with a consistency value greater than 0.9 is high foreign party tax reduction policies (FPS) in non-agricultural technical collaboration, but the lack of sufficient coverage is only 0.3571. The consistency of other individual conditions is lower than 0.9, indicating that no condition constitutes a necessary condition for agricultural enterprise technology investment. Therefore, it is necessary to examine the impact of condition configuration on agricultural enterprise technology investment.

Table 3. Analysis of necessary conditions.

Conditions Tested	ATC		~atc	
	Consistency	Coverage	Consistency	Coverage
FDI	0.6354	0.7570	0.8023	0.3614
~fdi	0.4640	0.8612	0.4605	0.3233
EB	0.5888	0.7516	0.7675	0.3705
~eb	0.5068	0.8522	0.4854	0.3086
IS	0.5665	0.8196	0.7974	0.4363
~is	0.6104	0.8885	0.6703	0.3690
LCM	0.6060	0.7957	0.8277	0.4110
~lcm	0.5515	0.8943	0.5886	0.3610
CPS	0.6960	0.7817	0.8426	0.3579
~cps	0.4283	0.8780	0.4859	0.3767
FPS	0.8609	0.8131	1.0000	0.3571
~fps	0.3193	1.0000	0.4765	0.5644

Note: Uppercase letters indicate the presence of the condition, and lowercase letters indicate the absence conversely.

4.2. Conditional Configuration Analysis

The fsQCA minimization program generates three results based on different simplified assumptions: complex solution, intermediate solution, and parsimonious solution. Ragin (2008) [61] argues that the intermediate solution strikes a balance between complexity and parsimony, making it better than the other two solutions. In this solution, large circles represent core conditions that exist in both intermediate and parsimonious solutions, while small circles represent marginal conditions that exist only in intermediate solutions. This paper selected six conditions that have no clear theoretical expectation on the technical collaboration relationship with overseas agricultural investment enterprises. Therefore, in the configuration standardization analysis, no directional presupposition or judgment is made for each condition in the counterfactual analysis. The complex solution and the intermediate solution are consistent with each other [62,63]. Although this configuration accounts for only 55.82% of the result cases, it demonstrates a very high level of consistency (0.9716). This indicates that the current configuration has a strong consistency of solutions, with an extremely high degree of explanation; however, further investigation into additional, unexplored configuration paths is necessary. Meanwhile, each configuration has been arranged from left to right according to the degree of consistency, and it is found that there is a lack of clear core existence conditions, which confirms the need for further analysis of the differences in investment condition combinations.

Table 4 shows 6 configurations below:

Configuration 1 (fdi × EB × is × LCM × FPS) suggests that agricultural enterprises invest relatively less overseas and rely more on domestic government sources for information. However, when the proportion of enterprise income is high, and the investment country offers language management and high tax relief benefits, agricultural enterprises tend to enhance the integration of the technology chain, mainly by focusing on technical collaboration. Enterprises that have good investment returns and are well integrated with the investment country's environment have the potential for technological transformation in investment methods. In this case, around 14.3% of enterprises can be explained, or such enterprises account for approximately 14.3%.

Configuration 2 (fdi × EB × IS × lcm × FPS) indicates that agricultural businesses have a relatively low investment in foreign countries and may struggle with language barriers. However, when these businesses generate high profits, they tend to rely more on information sources from their home country's government. Additionally, if the investment country offers tax reductions and welfare benefits, agricultural businesses may be more likely to integrate technology chains through technical collaboration. Policy-oriented enter-

prises, which rely on policy support for technological cooperation, constitute approximately 13.18% of enterprises in this scenario.

Configuration 3 (FDI × EB × IS × LCM × cps × FPS) suggests that agricultural businesses tend to have a higher percentage of overseas investment, corporate income, and government information sources. These businesses are capable of managing the language environment of the investment country and can enjoy higher tax reduction benefits. Agricultural enterprises mainly focus on technical collaboration to enhance the integration of technology chains, but do not require higher tax reduction support from their own countries. These enterprises are primarily focused on overseas business and have the lowest coverage rate of 8.7% among the six configurations. They are typically large agricultural outward investment enterprises.

Configuration 4 (eb × LCM × CPS × FPS) specifies that agricultural enterprises will primarily focus on technical collaboration to enhance the integration of the technology chain. This is true when the proportion of corporate profits is low, the investment country's language management is in place, and both the domestic and investment country's tax exemptions and benefits are high. Potential enterprises that have contextual management and external advantages require support from domestic and foreign preferential policies to innovate technical collaboration. These enterprises should mostly be flexible private enterprises with foreign trade characteristics. The coverage rate of such enterprises is 26.92%.

Configuration 5 (fdi × eb × is × CPS × FPS) shows both the domestic and investment countries offer higher tax exemptions and benefits. However, agricultural enterprises have a low proportion of overseas investment and corporate profits, and the domestic government has access to a low proportion of information sources. The agricultural enterprises will still focus on enhancing their technology chains through technical collaboration, despite the challenges. The investment volume is small and lacks government support, with tax reduction being the main source of profit margin. It is urgent to expand the profit margin through technical collaboration.

Configuration 6 (is × LCM × CPS × FPS) indicates that both domestic and investment countries have high tax exemptions and benefits, and a contextual management system in place. Even though the amount of information sourced from the domestic government is relatively low, agricultural enterprises will still improve the integration of technology chains, mainly through technical collaboration. This configuration is like Configuration 2 but has the highest coverage rate at 29.96%.

Table 4. The configurations of ATC enterprises.

Configurations	ATC Strength-Oriented			ATC Potential-Oriented		
	C1	C2	C3	C4	C5	C6
FDI	⊗	⊗	•		⊗	
EB	•	•	•	⊗	⊗	
IS	⊗	•	•		⊗	⊗
LCM	•	⊗	•	•		•
CPS			⊗	•	•	•
FPS	•	•	•	•	•	•
raw coverage	0.1430	0.1318	0.0875	0.2692	0.1547	0.2996
unique coverage	0.0157	0.0633	0.0340	0.0837	0.0459	0.0668
consistency	0.9985	0.9984	0.9952	0.9855	0.9750	0.9522
solution coverage	0.5582					
solution consistency	0.9716					

Note: According to the fsQCA convention for interpreting configurations, a large-size • or ⊗ represents core existence or non-existence condition, while a small-size • or ⊗ indicates marginal existence or non-existence condition. However, the current configuration results reveal that only marginal existence conditions are present (small size •). Meanwhile, a marginal non-existence condition (small size ⊗) is only observed in the LCM component of Configuration C2, the blank means the condition existed or not.

4.3. Robustness Test

Finally, it is important to test the robustness of the results obtained from QCA analysis. This can be achieved by adjusting the consistency threshold and frequency threshold. In this paper, the frequency threshold was set to 1 and the consistency threshold was set to a value of 0.80, which means that at least 80% of the cases were retained and the PRI value was not lower than 0.5. The analysis produced the results mentioned above. To increase the robustness of the analysis, the consistency threshold was set to a stricter value of 0.85, while the frequency threshold remained the same. This stricter threshold did not affect the overall consistency and coverage of the solution. For an even more stringent threshold test, the consistency of the overall solution was improved to 0.90, and the results remained consistent. This shows that the conclusions of the paper are robust. However, specific values will not be listed here, as the results remained unchanged.

5. Conclusions and Discussion

5.1. Main Conclusions

The OLI theory posits that when an enterprise possesses Ownership (O), Location (L), and Internalization (I) advantages, it is more likely to engage in foreign direct investment. If it has only Ownership (O) and Location (L) advantages without the Internalization (I) advantage, it may opt for export trade instead. Although all the enterprises examined in this study are engaged in foreign direct investment, they do not necessarily exhibit all three advantages. In this context, the core elements of configurations C1, C2, and C3 are relatively strong and exhibit fewer non-existence conditions. This strength is likely to enhance technology cooperation as the primary drivers in foreign investment. Conversely, configurations C4, C5, and C6 have more non-existence conditions, which positions them as both potential candidates for foreign investment or turn into export trade. Thus, the six configurations of agricultural foreign investment enterprises in the Lancang-Mekong region can be categorized into two distinct types.

The first type is technology investment transformation and strength-oriented. Configurations 1, 2, and 3 have relatively high investment benefits and hopeful expectations for favorable policies in the host country. The difference lies in the presence of external investment strength and government information sources as marginal or core conditions. The lack of contextual management is a difference in the presence or absence of marginal conditions, specifically in policy support and subtle variations in overseas management construction. This can be summarized as companies possessing the strength for technological investment transformation, accounting for approximately 1/3 in this case.

The second type is technology investment transformation and potential-oriented. Configurations 4, 5, and 6 exhibit lower investment benefits but require contextual management and tax incentives in the host country. Additionally, other conditions have significant origins. Technical collaboration for the integration development of the technological chain can be observed in these three types of configurations. These companies have relatively weaker capital strength but more flexible management construction. This can be summarized as companies with the potential for technological investment transformation, constituting approximately 2/3 in this case.

Secondly, the OLI theory emphasizes that ownership advantages (O) are essential for internalizing advantages (I). The effectiveness of ownership advantages (O) relies on the location advantages (L) of the host country. Specifically, technology and management are critical components of foreign investment, and their application in the host country depends on the market and policy conditions present there. Therefore, this article explores how to enhance ownership advantage (O) to facilitate technological cooperation and achieve the transformation and upgrading of foreign investment. From the perspective of

various existence conditions, the Foreign Policy Support (FPS), also referred to as location advantages (L), indeed constitutes a core condition for these two types of enterprises. Meanwhile, Economic Benefits (EB) are contributory conditions for strength-oriented enterprises, whereas Chinese Policy Support (CPS) contributes to potential-oriented enterprises. Conversely, Foreign Direct Investment (FDI) and Chinese Policy Support (CPS) are either non-core or unobserved in strength-oriented configurations, while Foreign Direct Investment (FDI), Economic Benefits (EB), and Information Source (IS) play a marginal role in potential-oriented configurations. These findings conclude that foreign-invested agricultural enterprises should prioritize familiar with host-country policies, strengthen their overseas management practices, and accelerate their integration into foreign markets to leverage bilateral opportunities for profit expansion in industrial chains. Similarly, potential investors will not only understand themselves with host-country regulations but will also master domestic foreign-investment policies to enhance their strategic positioning.

5.2. Highlights and Contributions

Our study highlighted the crucial role of policy and technology support in cross-border agricultural enterprises in the Lancang-Mekong River region, making several significant contributions. Firstly, our results reveal the existence of two distinct types of agricultural enterprises. The first type is characterized as strength-oriented, with a small number of enterprises but with high investment efficiency. These enterprises would greatly benefit from policy innovations aimed at further enhancing their investment efficiency. On the other hand, the second type is potential-oriented, comprising a larger number of enterprises with lower investment efficiency. These enterprises would benefit from technological support to extend the investment industry chain, ultimately improving overall investment efficiency.

Secondly, our study contributes to a deeper comprehension of the prerequisites for cross-border agricultural investment. It highlights the indispensable requirement for policy support from both bilateral governments and emphasizes the significance of integrating into the investment environment of the host country. Enterprises encounter risks related to language and cultural differences during the investment process in addition to the challenges posed by market volatility. Addressing these risks calls for collaborative efforts between enterprises and governments, wherein innovative policies and applicable technologies are synergistically employed to mitigate the challenges.

5.3. Discussion and Limitations

This study positions the theoretical construction of the agricultural enterprise industrial chain in the Lancang-Mekong region, emphasizing the crucial configurational differences in foreign direct investment under the enhancement of technical collaboration. The research findings support the development approach of promoting international division of labor within global production, i.e., the overseas production investment [27]. However, it is noteworthy that under technical collaboration, foreign direct investment diverges into different configurations, giving rise to distinct types of corporate investments, which support hypothesis 1. This study not only advances the exploration of technology's impact on corporate configurations [15,64], but also sets forth new requirements for the transformational development of foreign direct investment, particularly for private enterprises. Furthermore, while analyzing the various key elements of configurational factors, the study observes that under the influence of technical collaboration, the tax reduction policy by the host country is a necessary condition across all key configurations. Countries with high institutional risks may compel companies to rely more on internalization. The institutional environment of the host country can influence decisions regarding foreign investment and the costs of obtaining information [65]. The economic strength's impact on

the decision-making of foreign direct investment declines, presenting new demands on the current host country's market environment [33,66]. The preferential policies and market environment also confirm hypothesis 2. Furthermore, this study also indicates that market failure in the host country can, to some extent, act as a driving force for enhancing outward foreign direct investment and establishing information channels [67].

Therefore, this study proposes that, firstly, strength-oriented agricultural enterprises are beneficial for integrating the two markets and resources. Such enterprises need to further participate in the global industrial division of labor. In addition to strengthening their industrial chains and management, they require improvements or expansions in host countries' preferential policies to facilitate the transformation and upgrading of their technological investments. Hence, they could be upgraded once the policies could be optimized, such as technology diplomacy to gain recognition and investment incentives from host countries, thereby facilitating the transformation and upgrading of such enterprises and creating a demonstrative leadership effect. Secondly, the potential-oriented agricultural enterprises with less significant and stable investment returns, although they possess some market foundation and flexibility in long-term foreign investment activities, their strength is relatively weak, and the demands for internal and external support, such as market development and policy backing, are evident. Therefore, these enterprises require technical collaboration to overcome investment bottlenecks and expand profit margins. The technical collaboration platforms are needed urgently for internal support and empowerment.

Meanwhile, this study is not free of limitations. The configurations generated by fsQCA have inherent limitations, including the inability to handle continuous variables and the possibility of containing contradictory sets. Furthermore, the representative examples of cross-border investment in the Lancang-Mekong region exclusively focus on China's Yunnan province, Laos, and Myanmar. In future research, it would be valuable to gather more comprehensive information on cross-border investment from other provinces in China. This would enable the construction of more generalization and representative conclusions regarding the establishment of cross-border agricultural industrial chains in the Lancang-Mekong region.

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