The contingency effects of agriculture industrialization on the relationship between collaboration practices and sustainable performance

by

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Table of Abbreviations

CMB	Common Method Bias
CMP	Collaboration Management Practice
CMV	Common Method Variance
CNT	Collaborative Network Theory
CP	Collaboration Practices
CR	Composite Reliability
CT	Contingency Theory
EcoP	Economic Performance
EFA	Exploratory factor analysis
EMS	Environment Management System
EnvP	Environmental performance
DETR	Department of the Environment, Transport and the Regions
DSC	Demand Side Collaboration
FAO	Food and Agriculture Organization of United Nations
FSD	Farmer Supermarket Docking
GSCP	Green Supply Chain Practice
HRA	Hierarchical Regression Analysis
KMO	Kaiser-Meyer-Olkin
MEcoP	Moderating Economic Performance
MEnvP	Moderating Environmental Performance
MSocP	Moderating Social Performance
NDRC	National Development and Reform Commission
NRLO	National Council for Agricultural Research
OECD	Organisation for Economic Cooperation and Development
PCA	Principle Component Analysis
RMSEA	Root Mean Square Error of Approximation
RoHS	Restriction of Hazardous Substances
SCC	Supply Chain Collaboration
SCM	Supply Chain Management
ScoP	Social Performance
SCP	Supply Chain Practices
SP	Sustainable Performance
SPSS	Statistical Product and Service Solutions
SSC	Supply Side Collaboration
SSCM	Sustainable Supply Chain Management
SSCP	Sustainable Supply Chain Practice
TBL	Triple Bottom Line
TCE	Transaction Cost Economics
VIF	Variance Inflation Factor
WCED	World Commission on Environment and Development
WTO	World Trade Organization
3N	Three Sustainable Issues
3P	Pollution Prevention Pays

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Abstract

Given the fast growing development of China's agro-food industry in recent decades, a sustainable performance issue has been brought up in the research agenda. The aim of this research is to investigate how collaborative supply chain management practices might affect sustainable performance, especially in the business environment of a much advanced agriculture industrialization in China.

An extensive literature review has been carried out to lay down a sound theoretical foundation for the further research development needed to achieve the research objective. The exploration and synthesizing of the prior literature on the topic have also led to the identification of research gaps. More importantly, the literature review has led to the development of key research hypotheses, upon which a conceptual framework is developed to advance current understanding of the issues.

To test the hypotheses and the model, a predominantly empirically based abductive methodological approach has been adopted. By designing the specifically targeted survey questionnaires and carrying out field research work in China, sufficient first-hand data have been collected and processed. In particular, the hierarchical regression modelling techniques are used to test the moderating effect of the environmental factor—agriculture industrialization on the relationship between collaborative practices and sustainable performances. The tests and analysis results show that 16 out of 18 hypotheses are supported with significant statistical significance, and the overall conceptual model has thus been validated methodologically.

Significant research findings have been drawn from the analysis results.

First, the relationship is contingent to exogenous factors, and hence it is not a static or fixed relation. Second, the factor of agricultural industrialization does exert moderating power over the relationship from collaborative practices to sustainable performance. Third, collaborative practices are generally positively associated with economic, social and environmental performance, except for demand-side collaboration, which is negatively associated with economic performance in the Chinese agriculture context. Fourth, farmer-supermarket docking as one of the unique collaborative practices in China's agro-food industry is more effective at improving sustainable performance under high degree of agriculture industrialization.

This research claims a theoretical contribution by advancing conceptual understanding about improving sustainable performance through collaborative practices by factoring in the exogenous level of agriculture industrialization in China. This research also provides empirically proven guidance for managers and practitioners to differentiate the effects of collaboration management practices under different levels of agriculture industrialization. A real-world case study has been introduced to support the arguments.

Keywords: collaboration, supply chain practice, sustainability, contingency effect, agriculture industrialization, sustainable performance

Chapter 1: Introduction

1.1 Defining the research area

Over the last decade, the Chinese agricultural business sector has attracted increasing attention from practitioners and academics alike for its critical contribution to the cross-industry global campaign on sustainable development. Initiatives from related global organizations, national governmental bodies, and international institutions (Ansari and Kant, 2017) have been launched to cultivate and promote a much more sustainable business eco-system across all business sectors (Pagell and Wu, 2009). Amid all that have been envisaged so far, the initiatives of implementing green supply chain practices in China's agro-food business sector appears to be distinctively prominent and highly visible to the international world (Esfahbodi, Zhang and Watson, 2016). However, those initiatives have also turned out to be increasingly the focal issues for government policy-makers, business practitioners, and academic researchers. As is evident from recent literature, researchers who devoted their study from the theoretical lenses have found that the in-depth studies of such an issue could exert profound influence on the study of the overall sustainable performance of agro-food supply chains around the world (Beske, Johnson and Schaltegger, 2015; Reefke and Sundaram, 2017). There is little doubt that achieving agro-food supply chain's sustainable performance has already become one of the top agendas for both business practitioner and academic researcher alike (Zailani et al., 2012).

As an ultimate intended consequence, sustainable performance may be driven by many managerial initiatives, including a range of purposefully designed and tested best practices aimed at improving sustainability for agro-food supply chains. Those practices are defined as ‘green supply chain practices’ (Kim and Chai, 2017). Growing literature evidence suggests that the most recognised managerial practices in achieving any form of green supply chain status and its long-term sustainable performance have been predominantly supply chain-wide collaborative practices (Blome, Paulraj and Schuetz, 2014). Notwithstanding that a supply chain’s sustainable performance, in theory, could be associated with a series of complicated factors. The most noticeable factor is 'collaborative practices' (Mathiassen, 2002) in supply chain-wide collaborations and integrations to achieve more sustainable or greener agro-food supply chains (Dania, Xing and Amer, 2016). Mirhedayatian, Azadi and Saen (2014), Nyaga, Whipple and Lynch (2010), Gimenez and Tachizawa (2012) all claimed that collaborative practices in the context of supply chain-wide collaboration has and will certainly exert a positive and apparently dominant impact on improving supply chains’ sustainable performance as an intended consequences (Beske and Seuring, 2014; Nyaga and Whipple, 2011).

However, no matter how widely this notion has been supported in the main stream literature, simplistically adopting an ‘apparent’ relationship between the two constructs from collaborative practices to sustainable performance could be naïve, if not flawed. This leads to a critical research problem of what exactly is the relationship between the two and how reliable the relationship is as a conceptual model, which is clearly the issue concerned by the business practitioners as well as the researchers within the relevant community. Therefore, in this research, a fundamental hypothesis is proposed as that collaborative practice may not always lead to or result in better sustainable performance, and certainly not always at an anticipated effectiveness level. Sousa and Voss's (2008) research may offer some conceptual support to this hypothesis. They suggested that when the value of a best practice, such as collaboration management practices, is supported by empirical evidence, research should shift from the justification of its value to understanding the contextual conditions under which it is effective. Sousa and Voss indicated their suspicion that the contextual conditions under which the effect was presumed could have played a major influencing or moderating role to the level of effectiveness of the casual effect. Such contextual conditions can be any major factors in the business environment.

Among many environmental factors in China's agriculture industry sector, 'agriculture industrialization' has been identified by many extant literatures as one of the most influential developing agendas in China (Pagell and Wu, 2009). It appears to be well supported that China's agriculture development has been showcased by continuous and fast-paced industrialisation over the last two decades (Deng et al., 2008). Taking 'industrialization' as an exemplary environmental factor in China's agricultural industry sector is indisputably significant and relevant for the study. Thus, the author chose to identify the research area within the scope of examining the relationship between collaborative management practices and sustainable performance under the backdrop of the progressive industrialization that has been taking place in the Chinese agriculture sector.

1.2 Literature foundation

In fact, the identified research area has sound literature basis that could directly support the research motivation, further clarify research gaps, and lead to a clearer research objective.

The concept of sustainability was initially proposed in 1987 by The Brundtland commission (World Commission on Environment and Development, WCED, 1987) and covers all aspects of sustainability. It is also known as one of the most economic and political definitions (Hulshof, 1992). WCED (1987) concluded that sustainability enhances both current and future potential to meet human needs and aspirations through exploitation of resources, direction of investments, orientation of technological development and institutional change. This path-breaking concept conclusively highlights four key research trends: exploiting and allocating natural resources efficiently; investment in sustainable projects; technology integration to enhance sustainability; and sustainable regulation making. As a continuously evolving concept, various research projects have been conducted from a sustainable development perspective, for instance, supply chain resilience (Berkes, Folke and Colding, 2000), sustainable performance measurement (Taticchi, Tonelli and Pasqualino, 2013), sustainable economic performance (Daly and Cobb, 1989), ecological food print (Rees and Wackernagel, 1994), sustainability of the value chain (Vurro, Russo and Costanzo, 2014) and welfare maximization (Pearce and Turner, 1990).

In recent years, sustainable developments have become essential to fresh agro-food supply chain management. Like other supply chains, the perishable fresh agro-food supply chain involves flow and transformation of goods to satisfy customer demand (Christopher, 2005). However, food quality, safety and weather variations differentiate fresh agro-food supply chain from other supply chains (Salin, 1998). Apart from this, the perishable nature of the products and demand fluctuations increase the complexity of the agriculture supply chain. According to Boehlje (1999), with the market structure shifting from small-scaled independent firms to tightly aligned industrial firms, now is the right time to adopt the concept of sustainable supply chain management in fresh agro-food industry. Supply chain collaboration (SCC) as one of the key mechanism of sustainable supply chain management has attracted many research attention in recent years (Beske and Seuring, 2014). The research around SCC mainly contributes to its definition, measurements, dimensions and impact on performances. This research examines the most often adopted collaboration management practices in the Chinese agriculture industry. Using the most commonly adopted practices can provide useful knowledge and contributions to the current Chinese agriculture industry. Managers can appreciate at a more in-depth level knowledge how specific collaborative management practices might contribute to a firm's sustainable performance, especially under different levels of agriculture industrialization. Collaboration management practices will be reviewed through literature and validated with agriculture enterprises in China. After theoretical and reality confirmation, the most often adopted collaboration management practices are supply side collaboration, demand side collaboration and farmer-supermarket docking. Supply side collaboration and demand side collaboration is known as two main dimensions of supply chain collaboration (Giovanni and Vinzi, 2014). Farmer supermarket docking is an innovative collaboration management practice often adopted in agriculture industry, such as in Japan, America and China (Zhang and Xu, 2010). However, the adoption behaviour various due to the structure and system difference between countries. It was initially proposed by Chinese government to remove the middle tiers in the agriculture supply chain, which eventually reduces waste and creates benefits for farmers and end customers.

Many researchers point out that collaboration between firms improves supply chain performance (Zhu and Sarkis, 2007). However, the complexity of the Chinese agriculture supply chain increased in the past years after China joined the WTO and rapid developing environment, especially the developing agenda of agriculture industrialization. Within this environmental complexity, the traditional understanding that collaboration improves supply chain performance needs to be rethought.

As Carter and Rogers (2008) stated that sustainable supply chain management (SSCM) is ‘‘the strategic and transparent integration to achieve firm's social, environmental and economic goals simultaneously.'' This definition highlights the importance of balancing the three components of development which is crucial for ensure the quality of human life (OECD, 1997; DETR, 1999). However, intensive debates regarding the conflicting objectives of economic growth, social performance and environment performance are ongoing at international levels (Vasileiou and Morris, 2006). Glover et al. (2014) argued that until today, adopting sustainable practices will reduce overall profits by inducing extra costs, which is one of the dominant logics in the industry. Consequently, the adoption rate for sustainable practices is excessively low in developing countries (Zhou, Helen and Liang, 2011).

However, it is also evident in the literature that not everyone agrees about the general positive impact of collaborative practices on sustainable performance. While many studies do find a positive relationship between supply chain collaboration and certain sustainable performances (Nyaga and Whipple, 2011; Beske and Seuring, 2014; Huq et al., 2016; Gimenez and Sierra, 2013; Iyer, 2011), others find that a positive relationship may not always delivered and could be moderated by other factors, such as firm size (Cao and Zhang, 2011), internationalization (Macchion et al., 2017) and absorptive capacity (Giovanni and Vinzi, 2014). A few studies even found negative associations between supply chain collaboration and certain sustainable performances (Kim and Rhee, 2012). In addition, some research concluded a non-significant relationship between supply chain collaboration and sustainable performance (Mitra and Datta, 2014; Kim and

Rhee, 2012; Nakano, 2009; Vachon and Klassen, 2008). Such inconsistency in the literature surely represents an interesting research agenda in its own right.

It is also worth noting that several studies in the past have adopted the contingency theory to explain the reason for the inconsistency in research results. Contingency theory suggests that there is no single optimal design and leadership style of an organization, but rather that it is contingent upon various internal and external influential factors (Fiedler, 1971; Lawrence and Lorsch, 1967; Donaldson, 2001). Hence, contingency theory suggests that the contribution of supply chain collaboration to a firm's sustainable performance is subject to the impact of external environmental factors such as political uncertainty, developing agenda, market risks, and cultural factors (Donaldson, 2001). There is little consensus and understanding about the moderating effect of external factors on the relationship, especially in the agriculture industry in China. There is also an apparent scarcity of literatures explaining why in some circumstances external factors have no significant impact on SCC-SP relationships, whereas in others, external factors can exert a significant impact.

1.3 Aim of the study

Given the research problems and the identified scope, this study aims at extending the concurrent worldwide research on how the long-term sustainable agro-food supply chain's performance can be achieved, especially in China's current dynamic business environment. The study aims at challenging the conventional wisdom of collaboration-performance logic that is prominent in the literature (Ramanathan, Gunasekaran and Subramanian, 2011) by creating a theoretically verifiable and practically implementable framework that models the above identified key constructs: collaborative practices, sustainable performance, and agriculture industrialization. The unit of analysis is the selected agro-food supply chain in the northern part of China. The research objective of this study can therefore be stated as:

- to investigate the relationship between the collaborative practices and sustainable performance of an agro-food supply chain under the influencing effects of the rapidly advancing agricultural industrialization as envisaged in China today.

Under the main objective, it might be helpful to clarify some cascaded sub-objectives of the study:

1. to investigate the recent development and obstacles to the 'green' supply chain campaign in China;
2. to examine the factors and their roles in the managerial endeavour towards more sustainable performance for agro-food supply chains;
3. to observe and analyse the development and challenges of agricultural industry in China in the recent two decades;
4. to critically review the related literature and establish the theoretical foundations for development of the hypotheses;
5. to develop a reflective constructs-based structural equation model that conceptualizes all proposed hypotheses; and

6. to empirically test the hypotheses and consequently advance the conceptual understanding of the moderating effect of industrialization and solidify any theoretical contributions.

A number of research questions have also been developed to clarify the direction of study and support attainment of the main research objectives stated above. The research questions are arranged in four areas.

- **Collaborative practices**

RQ1.1 What are the most widely adopted supply chain collaborative practices in Chinese agro-food supply chains?

- **Sustainable performance**

RQ2.1 What are the key measurement dimensions for the construct of sustainable performance in the literature?

RQ2.2 How does each measure contribute to the overall sustainable performance?

- **Direct relationships**

RQ3.1 What is the relationship between collaborative practice and sustainable performance?

RQ3.2 Would the relationship be positive and remain stable regardless?

- **Exogenous factor**

RQ4.1 What is the most influential exogenous factor in the recent Chinese agriculture research agenda?

RQ4.2 How much moderating power may it exert onto collaboration-performance relationship?

1.4 Outline of research approaches

This study adopts a contingency theory (Bacher, 2007)-based explorative research approach to rigorously reveal the potential influencing or moderating effect of an environmental factor. It is not difficult to extrapolate the application of contingency theory to this research problem by recognizing that there is no best way of managing sustainable performances, including through well-established collaborative practices. It is highly likely that effectiveness in achieving sustainable performance may vary depending on the influence of some environmental factors. Therefore, first, the research approach is designed to start with first investigating the direct relationship between the adopted collaborative practices in the Chinese agriculture industry and their measurable sustainable performance. These will be largely literature review-based exercises, whereby some hypotheses can be developed. Second, based on the literature review, the key environment factor that the effectiveness of the sustainable performance management is likely to be contingent (dependent) upon will be identified. Third, the study hypotheses a conceptual framework whereby the external environmental factor—the level of agricultural industrialization can be constructed as the moderating factor. The final step is to empirically test the hypothesized model using a hierarchical regression method, which includes survey instrument design and data collection.

1.5 Structure of the thesis

The thesis structure may be best illustrated by the flow chart shown in figure 1.

- Chapter 1 provides an overview of the research. Research problems are identified, leading to the motivation of the study. Research objectives and research questions are stated explicitly, followed by a brief description of the methodological approaches.
- Chapter 2 introduces the background of the Chinese agriculture industry along with resistance and challenges facing the business sector on its journey towards a more sustainable and 'greener' agro-food supply chain. The key constructs are defined in chapter 3.
- Chapter 3 critically reviews the literature and establishes a sound theoretical foundation as to what has been achieved so far in terms of the identified research problems. The literature review further identifies the research gaps, which becomes helpful in subsequent hypotheses development. A series of hypotheses will be developed, upon which an overall theoretical framework that captures all proposed hypotheses is finalized.
- Chapter 4 starts with research philosophy, then, the research design and the justification of the chosen research methodologies. Followed by questionnaire design, data collection, and data validation using confirmatory factor analysis. This chapter also introduces the main method for hypotheses testing—hierarchical regressing analysis.

- Chapter 5 presents the result of the direct relationship between collaboration practice and sustainable performance, as well as the moderating effect of agriculture industrialization. The results are presented in a structure that follows the themes of the hypotheses to facilitate clarity. Hypotheses are classified into three groups that correspond to the impact on environmental performance, social performance and economic performance, respectively.
- Chapter 6 discusses the research findings by explaining how they are used to answer some of the research questions and supports the attainment of research objectives; relevant literatures has been closely engaged to provide needed rigor.
- Chapter 7 draws the key conclusions, highlighting their main theoretical and practical implications, with some extended discussion on limitation and recommendations for future research.

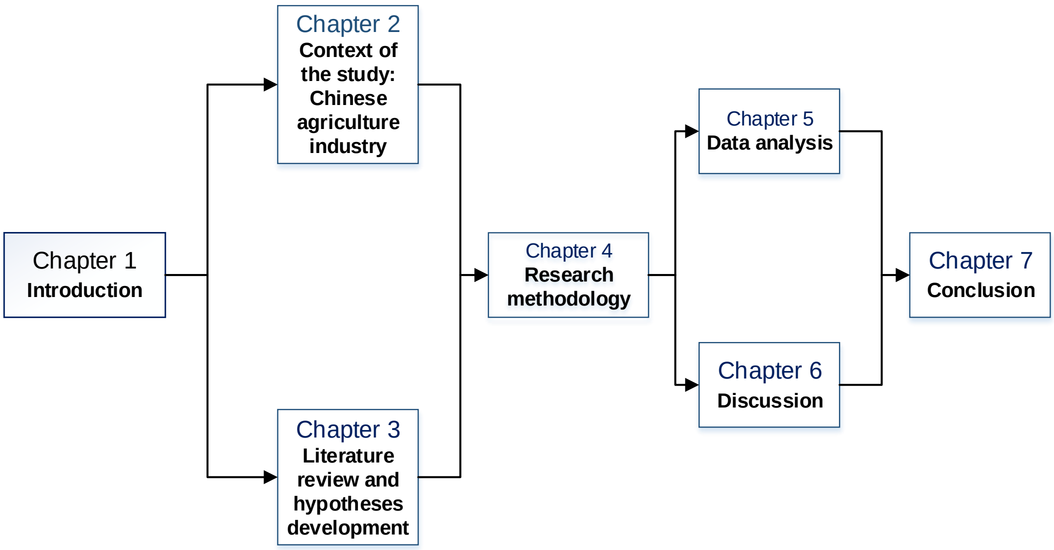

Figure 1: Flow chart of thesis structure

Chapter 2 Context of the Study: Chinese Agriculture Industry

This chapter describes the context of the study, which is the Chinese agriculture supply chain. The key aim of this chapter is to lays a foundation for development of research hypotheses and subsequently the development of the conceptual framework that captures the inter-connections between collaborative practices, sustainable performance and the level of industrialization. By introducing the characteristics of Chinese agriculture supply chains as they are currently operating, the arguments presented in the later chapters will be more rigorous and make better senses. This chapter also describes the development and some common structures of the Chinese agriculture supply chains along with the challenges they faced in the development process.

2.1 Significance of agriculture supply chain

Agriculture supply chain management is currently emerging as one of the top research agendas in China. The subject has been repetitively discussed in the country's top government documents (Tisdell, 2009). One reason is that supply chain management has already become a critical factor in a company's competitive advantage (Cao and Zhang, 2011). However, research on agriculture supply chain management is still in its infancy. This study investigates the moderating effect of agriculture industrialization on the relationship between collaborative practices and sustainable performance in Chinese agriculture supply chains. There are several reasons for investigating such relationships in Chinese agriculture supply chains.

- Increasing awareness in the agriculture industry has caused enterprises to expand their focus on sustainability of organizations (Zhu and Sarkis 2007, Lai et al. 2010a, Zailani et al. 2012). To date, numerous researches suggests that degradation of natural resources, environmental pollution, potential health and food safety risks are threatening human life (Zailani et al. 2012). Consequently, firms are starting to seriously consider the environmental impact of their decisions. Adding to the rapid growth of the world's population and energy exhaustion, firms are starting to realize that present-day supply chains are inadequate and must be re-configured (Carter and Jennings, 2002). Additionally, increasing institutional and social pressures from media and non-governmental organizations have pushed companies to pay more attention to the sustainability aspect of the agriculture industry (Sarkis, 2001).
- As the third largest country in the world in terms of national territorial area, China contributes more than half of the world's vegetable production, more than five times that of the world’s second largest vegetable producer, India, and sixteen times that of the world’s third largest producer, the United States (FAO, 1989). According to Food and Agriculture Organization of United Nations (FAO, 2011), vegetable production increased from 356.8 million tons to 573.9 million tons in 12 years, a tremendous growth of 60.8%. It is not difficult to imagine the

resources and environmental burden created by such rapid growth. Consequently, how well China's agricultural sector develops and how sustainably it evolves will have an enormous impact on the global economy and environment.

- The Chinese agriculture industry has experienced reformation and industrialization in the past two decades (Babu et al., 2015). Agriculture industrialization integrates the link between production, processing and marketing processes that improve the overall efficiency of the agriculture supply chain by adopting modern technology and expanding the scale of operation (Babu et al., 2015). However, along with the rapid development of agriculture industrialization, sustainability issues of environmental pollution, resource degradation, food poisoning accidents, demand fluctuation, and price fluctuation (Prandl-Zika, 2008) have caused scholars and practitioners to rethink how agriculture industrialization may influence supply chain operations.
- Prior studies have investigated the moderating/mediating effect of exogenous factors on the collaboration practice (CP) and sustainable performance (SP) relationship. Nevertheless, most studies have focused on manufacturing industries (Nakano, 2009; Vachon and Klassen, 2008; Nyaga, Whipple and Lynch, 2010). Agriculture is one of the most important sectors in China from both an economic and a social perspective, since food is essential to daily life. Therefore, an industry-focused study could provide better understanding in the operation management domain.

- Another major challenges in the Chinese agriculture supply chain are food waste and safety issues (FAO, 1989; Zhou, Helen and Liang, 2011). The high wastage rate and safety accidents that happened in the past decades reflected the inefficiency of that agriculture supply chain management process (Zhou et al., 2011). It is argued that inappropriate supply chain collaboration could cause information lags and misallocation of resources that result in poor sustainable performance (Cao and Zhang, 2011). Hence, it could be beneficial to examine how collaboration practices contribute to firms' sustainable performance in Chinese agriculture contexts.

To conclude, the theory-related and context-related gaps on the CP-SP relationships are illustrated. Therefore, this study adds a new perspective to the current debate about the CP-SP relationship by looking into the Chinese agriculture industry. Also, focusing on a single market will ensure high internal validity.

2.2 Chinese agriculture industry

As a great ideological scholar (Mao, 1957) once said, agriculture production is the priority and foundation of economic development. Considering China's current agriculture situation, the need for solving the so-called 'three rural issues' that specifically defined in Chinese agriculture contexts, also known as the three sustainable issues, gradually has become a primary task in China's sustainable development (China agenda 21, 1994). Wen officially raised the concept of 'three rural issues' in 1996.

Soon afterwards, it became a theoretical term used in official decision-making. In China, the three rural issues are the most acute and fundamental long-term sustainable developing factors in the current business environment (Chen, 2007). They are agriculture issues, countryside issues and farmer issues, echoing the government's witticism that the ‘countryside is the cradle of the Chinese nation, agriculture is the foundation of the economy, and farmers are the oxygen of our life. Without them, a country cannot be built’ (China agenda 21, 1994). This strong awareness of sustainable agro-food development has been transferred into action. Several statistical reports generated by the National Development and Reform Commission (Gunders, 2012) show a rapid increase in government investment in the agriculture sustainable issues, increasing from 214.4 billion Chinese yuan to 1228 billion yuan in 10 years (2003 to 2013). Total growth of 473% confirmed convincingly the determination of the Chinese government to build a sustainable agriculture supply chain.

2.2.1 Market introduction

Published statistics show strong growth over the past 10 years in the Chinese fruits and vegetables market, which is expected to continue growing at a steady rate over the next five years (Carter, Zhong and Zhu, 2012). As reported by the National Statistic of Peoples Republic of China (2015), the total value of agriculture output grew from 2.15 trillion Chinese yuan in 2006 to 5.76 trillion yuan by 2015. Total growth of 167.9% indicates a strong and stable developing trend in the agriculture industry (as shown in Figure 2).

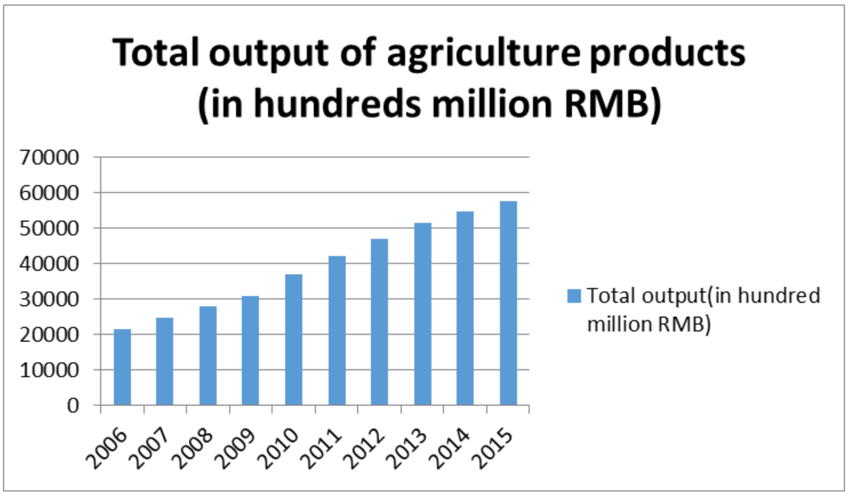

Figure 2: Total output of agriculture products (2006-2015)

In addition, Figure 3 shows a stable and positive growth trend for vegetable and fruit production in China from 2006 to 2015, measured in 10,000 tons. The total production of vegetables increased from 53953.8 to 78526, whereas the total production of fruits increased from 17101 to 27375 in this period. The total growth rates for vegetable and fruit production are 45.5% and 60%, respectively. The statistical evidence further indicates a positive and stable developing trend of agriculture production.

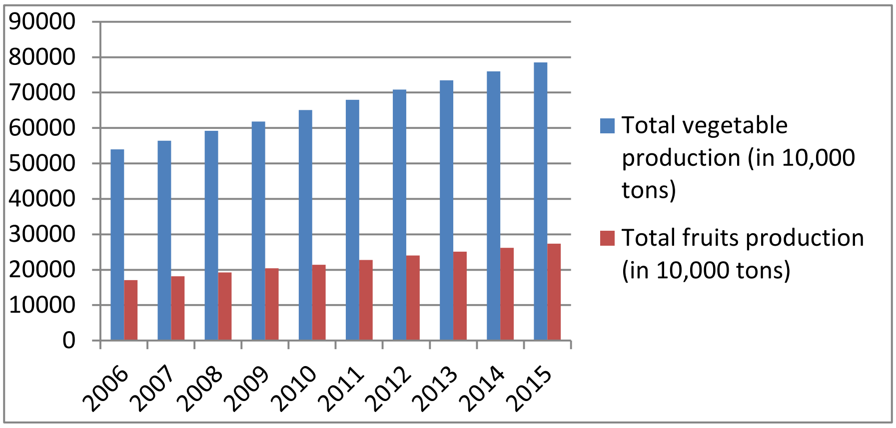

Figure 3: Total vegetable and fruit production (2006-2015)

In the Asian fruit and vegetables market, China accounts for 76% of the total market value, followed by India, Japan, South Korea and the rest of

Asia-Pacific (Figure 4). Consequently, creating a sustainable agriculture supply chain is a pressing issue for future development in China.

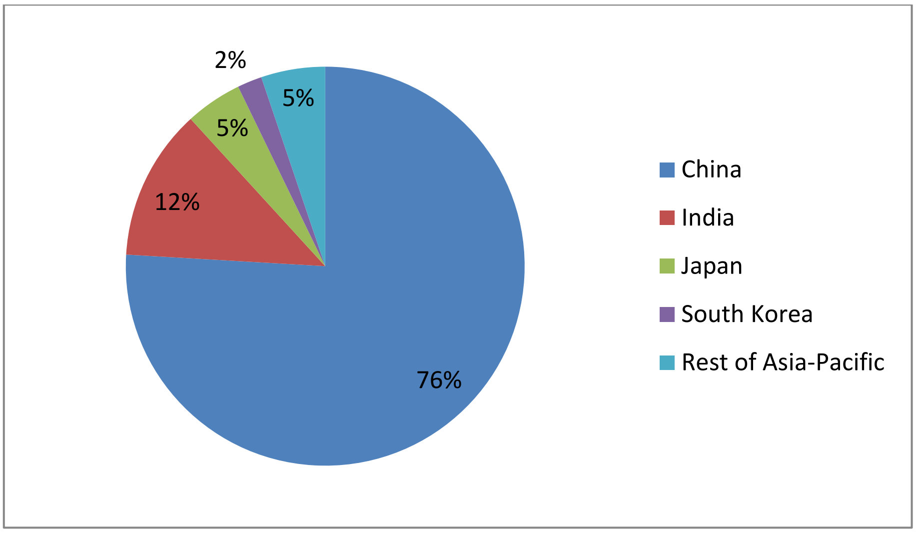

Figure 4: China's fruit and vegetable market geography segmentation: $ billion, 2011

2.2.2 Agriculture supply chain management in China

Agriculture is one of the most significant economic sectors of China (Huang and Xu, 2002). The Chinese government has played a significant role in creating a sustainable agriculture supply chain. In the past, many studies have focused on the technology side of agriculture rather than the management side (Hu et al., 2007). However, recently, researchers' attention has shifted to the management side of creating a sustainable agriculture supply chain. Growing evidence identifies supply chain collaboration as the most recognized managerial practice in achieving long-term sustainable development (Beske and Seuring, 2014). In terms of collaboration in the agriculture supply chain, there are some studies at the macro-level. For instance, Saengadsapaviriya (2011) developed a framework to measure effective factors of collaborative supply chain and supply chain performance between countries in the Association of South

East Asian Nations (ASEAN). Horvath (2001) studied the role of collaboration on improving the operational efficiency of the supply chain. Nevertheless, as suggested by Matopoulos et al. (2007), researches on supply chain collaboration are at a macro-level. This research takes a micro-view of sustainable performance and investigates the impact of widely adopted collaboration practices on three dimensions of sustainable performance.

In recent years, the concept of supply chain management has been introduced to the agriculture industry. Compared with other supply chains, the fresh agriculture supply chain is unique due to the perishable nature of the products, low stability, safety and product freshness (Yu and Nagurney, 2013). Due to the unique nature of agricultural products, optimizing a sustainable supply chain model becomes an important research agenda (Amaeshi et al., 2008). After years of integration in agriculture supply chain structure, two supply chain models have emerged from the market environment: leading enterprise supply chain model and farmer-supermarket direct purchase model.

- Leading enterprise supply chain models in China

Since 2006, the continuous development in agriculture industrialization has made significant progress in Hainan province. In 2010, there were more than 157 agriculture leading enterprises and 3485 agriculture cooperatives/associations (Wang, 2003). Agriculture leading enterprises act as the bond of the supply chain, not only joining the farmer during the production process, but also helping farmers distribute the products to customers. According to the Department of Agriculture in Hainan province, about 30% of the products are distributed via this channel. Yongqing is a national-level agriculture leading enterprise that connected 110,000 farmers and built 94 agriculture associations. By integrating farmers' production information and providing them with free technical services, the company built a network with wholesale markets in more than 60 provinces. Yongqing is also taking care of the distribution process by arranging transportation. In 2010, its sales revenue reached 1230 million yuan and successfully captured 9.14% of the total revenue in Hefei province.

The agriculture leading enterprise model can integrate upstream and downstream supply chain processes, which in turn creates a closer relationship between supply chain members. Therefore, supply chain uncertainty is reduced by the stabilized distribution channel and better food safety control. Meanwhile, strong technical support from the leading enterprises helps farmers build a standardized production system and effectively reduces production cost and food safety issues. Figure 5 illustrates the supply chain structure of agriculture leading enterprises model that includes farmers, agriculture association/co-operative, agriculture leading enterprises, wholesale market and distributor. Agriculture leading enterprise acts as the centre of the supply chain that links the agriculture association with wholesale markets or supermarkets.

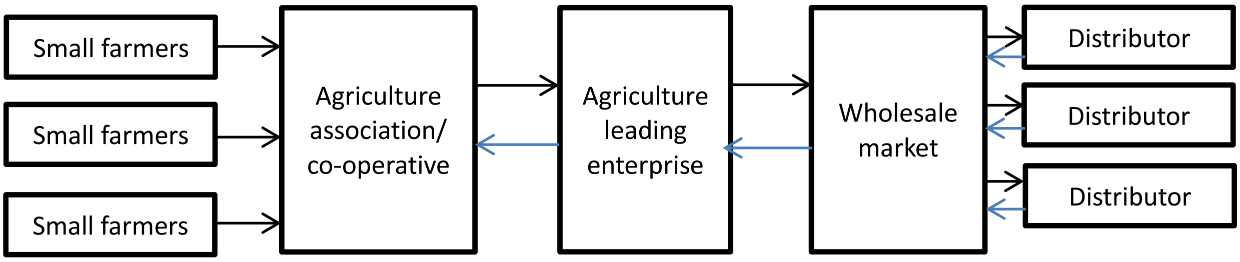

Figure 5: Agriculture leading enterprise model (black arrow indicates product distribution and blue arrow indicates information distribution)

- Farmer-supermarket direct purchase model

Following agriculture industrialization and rapid development of agriculture associations, the farmer-supermarket direct purchase model started taking shape. This time, the supermarket distribution centre acts as the bond of the supply chain. Supermarkets collaborate with agriculture co-operatives/associations formed by farmers during the production and procurement process. The agriculture co-operatives/association or supermarket arranges for the transportation service to deliver the product to the supermarket's distribution centre. Then, vegetables or fruits are processed and dispatched to different stores. In 2010, Carrefour procured more than 4148 tons of fresh agro-products directly from agriculture co-operatives/associations (Zhu and Geng, 2016). Directly collaborating with more than 6450 peasant household and 32050 farmers, Carrefour distributes agro-products to more than 180 stores in more than 40 cities. During the collaboration, Carrefour set product quality standards and food safety requirements for farmers and rewarded farmers who followed the standard with a higher purchase price (10% higher than market price).

The farmer-supermarket direct purchase model effectively reduces the middle tiers in the supply chain process, which in turn reduces transaction costs and improves competitive advantage. This supply chain structure enables a close collaboration between farmers and supermarkets. Liu (2014) strongly believed that collaboration could reduce supply chain uncertainty and enhance the traceability for food safety. Furthermore, supermarkets can use advertisement that includes the traceable product information to gain customers' trust. Supermarkets can make and execute procurement standards and quality testing protocols according to consumers' demands. This not only satisfies consumers' safety and quality requirements, but also promotes a standardized supply chain process. Figure 6 illustrates the supply chain structure of a farmer-supermarket direct purchase model that includes farmers, agriculture associations/co-operatives and supermarkets. Farmer supermarket direct purchase model acts as the centre of the supply chain that links the agriculture co-operatives/associations with supermarkets.

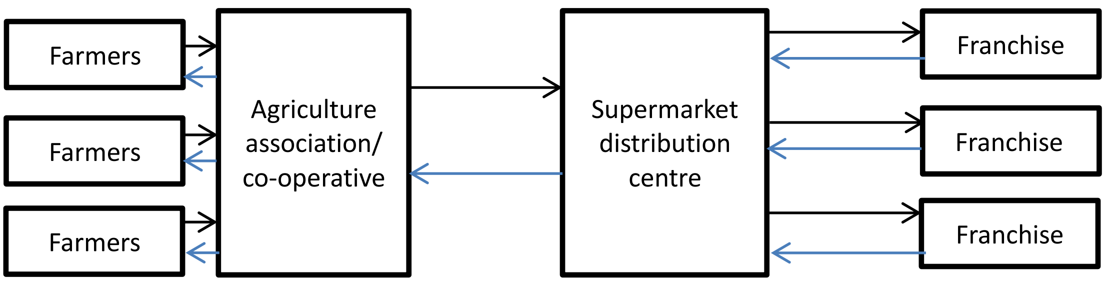

Figure 6: Farmer-supermarket direct purchase model (black arrow indicates product distribution and blue arrow indicates information distribution)

Although an agriculture supply chain can be categorized into different stages, they are highly interrelated. Therefore, collaboration between supply chain partners is critical to the overall supply chain performance.

Research done by Chen et al. (2017) indicates that research about supply chain collaboration for the purpose of sustainability is gaining growing attention in the research and business field. Therefore, collaboration between supply chain partners is a critical research agenda.

2.3 Supply chain collaboration in agriculture

Collaborative partnerships have a strong impact on the success of the agriculture supply chain (Giovanni and Vinzi, 2014). Generally speaking, there are two types of supply chain collaboration: horizontal collaborations and vertical collaborations (Barratt, 2004). Horizontal collaboration occurs between firms that are on the same level of the supply chain, for instance, between agriculture associations and agriculture co-operatives. It is commonly recognized that companies in the same sector that offer similar products treat each other as rivals. However, companies can collaborate to increase their bargaining power with a common supplier; hence, better deals could be made due to economies of scale (Mentzer et al., 2001).

Vertical collaboration is commonly adopted in supply chain management. It refers to the collaboration between firms and upper tier suppliers (upstream collaboration) and lower tier customers (downstream collaboration) (Barratt, 2004). Upstream collaboration refers to collaboration with the suppliers that provide sufficient materials for production. In the agriculture industry, agriculture leading enterprises may collaborate with farmers. An ordering plan or contract may be developed between the leading enterprises and farmers. Downstream collaboration refers to the collaboration with customers such as supermarkets, wholesalers or end customers (Blome, Paulraj and Schuetz, 2013). Through collaboration, the company could improve demand forecasting and knowledge of customers' preferences (Blome, Paulraj and Schuetz, 2014).

2.4 Challenges in the Chinese agriculture supply chain

To address the necessity of the research in sustainable supply chain, and to investigate the recent development and obstacles to the green supply chain campaign, this section reviews the main sustainable challenges in the literature. In the late 1970s, China carried out rural reformation that started with encouraging collaboration between small farmers and then went on to the development of leading enterprises and reconfiguring supply chain structure, finally achieving agriculture industrialization (Harvie, 1999; Zhang and Brummer, 2011). According to the Annual Statistics of Chinese Agro-Industry, the gross output from 1979 to 1989 increased by 188%. Along with the rapid development in agro-industry, new problems and challenges start to arise. After China joined the World Trade Organization (WTO), the Chinese agriculture supply chain faced a new historical stage with both internationalization and marketization challenges (Yin, 2002). China Agenda 21, one of the most authoritative government documents, outlined the nation's six biggest sustainability challenges: natural resources and food waste, rapidly growing demand, the deteriorating environment and pollution, soil degradation, food safety issues and agriculture industrialization (China Agenda 21, 2013). To obtain a broader understanding of the challenges, an exploratory search is conducted to collate sustainable challenges reported in the relevant literature. The search deploys the research papers published in peer-reviewed, high-impact journals written in both Chinese and English. The key search terms related to the concepts of ‘sustainable challenge’ or ‘environmental challenge’ are used to capture relevant articles. This search is applied to the titles, abstracts and keywords of journal articles in online databases, such as ProQuest, Emerald, and ScienceDirect. By performing the search and excluding duplicated results, a total 37 papers on sustainable challenge are identified. However, after screening on the abstracts, only 23 articles are admitted as the final samples for the review and analysis. The sustainable challenges are summarized for each article.

1) The first challenge stems from the unique market character: small farmer household scale and large market scale. Recent developments in agricultural land reformation created a decentralized farming system, which increased the difficulty for farmers and government to manage the supply chain operations. Statistics shows that the average agricultural acreage was about 9.00 acres per family by 2012, which amounts to 2.28 acres per person (Yearbook, 2012). According to Yan (2010), small farmer households are facing critical challenges of higher prime and transaction costs, severe market risks and lags in information sharing, which are especially obvious in the agriculture supply chain due to seasonal production, unstable output and the perishable nature of the products. Furthermore, the Chinese Ministry of Agriculture (2012) reports a large fluctuation in commodity prices due to unsound regulations and information lags. The underlying psychological and economical behaviour is not complicated. Farmers wish to make more money by growing valuable

products; hence, prices will drop when supply exceeds demand. In the following year, a death spiral ensues when all farmers are growing another valuable product (Wan and Luo, 2007). Since 2010, the price of fresh agriculture products has experienced abnormal fluctuations that have brought many challenges to small farmers, such as unstable income (Zhou et al., 2012).

2) The second challenge arises from the ambiguity of the trade-off between profitability and food safety. Globally, soil pollution by chemical mendicants has raised many concerns about sustainable development and human health issues. Cadmium has been identified as the main pollutant in the soil that is toxic and persistent in nature (Satarug et al., 2003). Cadmium from the soil may be assimilated by vegetables and rice, causing direct public health issues (Franz et al., 2008). Du (2005) claimed that nearly 20% of agricultural soils are contaminated by heavy metals, of which cadmium accounts for the most. Taking a micro-viewpoint of the situation, 90% of rice is grown in Asia, whereas 20% of the soil is contaminated (Kyuma, 2004). In addition, land desertification and intensive farming are problems created by the craving for higher productivity in industrialized countries. People only focus on immediate profits rather than considering long-term conditions, such as soil fertility and condition (Kesavan and Swaminathan, 2008). Kesavan and Swaminathan (2008) point out that no effective actions were taken to control soil degradation, water exhaustion and chemical disposal. As a result of the negligence, productivity has started to decline in most developing countries.

3) Given the severe challenge of reduced productivity, the fast-growing

population merely creates more burdens on the environment and natural resources (Kesavan and Swaminathan, 2008). Land, water, forests, oceans and atmosphere are inevitable victims of economic development (Kesavan and Swaminathan, 2008). The human population on the planet increased from 5.2 billion to 6.6 billion in 18 years (1990 to 1998), as had use of resources. The United Nations expects that the population will rise to 7.9 billion in 2025 (Nations, 2002), and a large part of the growth will occur in China, India and Africa. High population growth not only accelerated the depletion of natural resources, but also creates unabsorbed wastes and pollution. Wackernagel et al. (2002) have pointed out that human demand has exceeded the resources regeneration rate since 1980. Brown and Kane (1995) also asserted that the imbalance between growing demands and resource scarcity will be a potential challenge in sustainable development.

4) Moreover, much of the current empirical research focuses on food safety issues, especially in China. A few recent studies have considered the excessive use of chemicals in fertilizers, which is threatening human health and soil health. Zhou, Helen and Liang (2011) found that farmers rely heavily on agricultural chemicals such as pesticides and fungicides, which can cause food poisoning and other illnesses. In addition, food safety problems have attracted attention in recent years after many tragedies: melamine events, poison beans, fake organic food and poison bean sprouts (Jin and Li, 2009). In light of these tragedies, food safety awareness and demands for healthier food are heightened.

5) Among all the issues, food waste is one of the most severe challenges

that are likely to ruin farmers' efforts. Rosegrant and Cline (2003) suggested that about one-third of agriculture products are wasted or lost during production, postharvest, handling, storage, processing, packaging and consumption, which amounts to an estimated 1.3 billion tons annually across the world. This will be a severe challenge in 2030, due to the booming world population and increased demand. In developing countries, 40% of the total waste comes from the early stage of pre-harvest and possessing due to inadequate infrastructure of the supply chain, whereas 40% of the waste comes from the latter stages of retail and consumption in developed countries (Bond, M. et al, 2013).

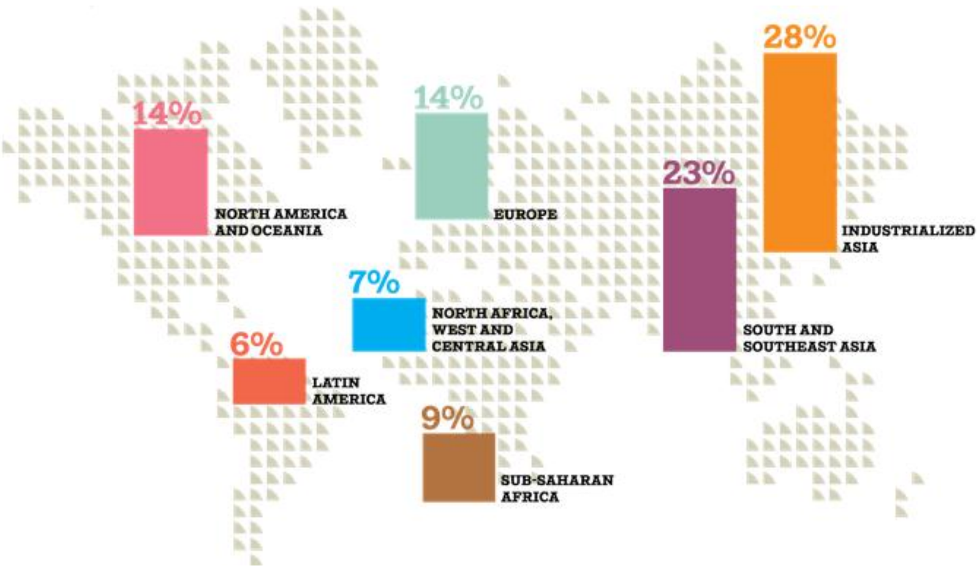

Figure 7: Total share of global food loss and waste in 2009

Figure 7 shows that South Asia, Southeast Asia and industrialized Asia have the highest loss rate, nearly double that of North America and Europe. Losses of fruits and vegetables are the highest due to their perishable nature (FAO, 1989). Parfitt, Barthel and Macnaughton (2010) discovered that the average loss rate in developing countries is about 50%, which means nearly half of the fruits and vegetables produced by hard-working farmers are lost or wasted in the supply chain. Not only are the labour resources wasted, but 1.4 billion people still live in poverty and do not have enough food. Liu (2014) emphasizes that food waste is an acute challenge in China, which needs to use only 6% of the world's total water resources and 9% of the arable land to feed 21% of the world's population.

In essence, the future of mankind depends on sustainable development of the supply chain. Consequently, these challenges and pressures are pushing governments and firms to seriously consider the economic, social and environmental impact when they are making policies or doing business (Zailani et al., 2012).

6) Finally, agriculture industrialization has evidently become another severe challenge facing China's sustainable development. Agriculture industrialization was defined in 1995 in three steps: 1) implementing regional arrangements for leading products; 2) integration and collaboration between farmers, agriculture associations and wholesalers; and 3) becoming a market-oriented supply chain that enhances overall economic effectiveness (Niu, 2006). The Chinese government implemented a series of policies and practices to advance the development of agriculture industrialization. For instance, it has created wholesale market systems, supported agriculture associations, provided training to agriculture leading enterprises, ensured the legal status of agriculture associations/co-operatives, and optimized regional distribution of agriculture products (Chen and Tan, 2003). During decades of practices and experience, the fresh agriculture supply chain has changed

significantly (China Agriculture Q4 report, 2013). Close strategic alliances and collaborations are formed after modernization and industrialization (Amsden, 1992).

Along with the development in agriculture, many sustainability issues have been raised such as water pollution, degradation of natural resources, air pollution, climate change, and loss of soil quality (Keeney and Kemp, 2002). From the social perspective, agriculture industrialization (AI) also created inequality between peasants and large agro-firms. Gliessman (2007) expressed his concerns about the long-term sustainable development of the agro-industry, pointing out that the benefit of increased productivity has been misunderstood by ignoring the degradation of natural resources agriculture industrialization caused.

Therefore, it is necessary for government and supply chain managers to re-evaluate the impact of AI on supply chain operations.

2.5 Summary

This chapter started by discussing the importance of the Chinese agriculture supply chain. It argued that the agriculture supply chain is a critical sector of China’s economy. Descriptive statistics shows steady and positive growth in production and total output in the last 10 years. This chapter also introduced the unique supply chain structure and sustainability challenges in the Chinese agriculture industry. It was suggested that agriculture industrialization has evidently become a severe challenge to China’s sustainability development.

To overcome the identified sustainability challenges, it was argued that companies should adopt appropriate collaboration management practices when facing different degrees of agriculture industrialization. To conclude, agriculture as a key sector in China has been a core developing agenda in the past decades. However, supply chain management research in the Chinese agriculture industry is very limited. Hence, there is a need for researchers to investigate and analyse the agriculture supply chain management in the context of China.

Having laid the foundation of agriculture supply chain in this chapter, the next chapter will review the literature to investigate the relationship between supply chain collaboration and sustainable performance.

Chapter 3: Literature review

3.1 Introduction

Over the last decade, it has been recognized that competition between firms has been shifted to the supply chain level (Christopher, 2011; Simatupang and Sridharan, 2002). The supply chain's performance and competitiveness can no longer be attributed only to any single supply chain members within the supply chain, but also more significantly to the dynamic interactions and collaborations within the supply chain (Cao and Zhang, 2011). Therefore, it becomes convincing that supply chain collaboration, which has been identified as one of the governance mechanisms, plays a critical role in improving sustainable performance and creating competitive advantage (Gimenez and Sierra, 2013; Cao and Zhang, 2011). Many researchers believe that supply chain collaboration is positively associated with the supply chain's overall performance, which includes economic, environmental, and social performance (Mirhedayatian et al., 2014; Nyaga, Whipple and Lynch, 2010; Gimenez and Tachizawa, 2012; Beske and Seuring, 2014; Nyaga and Whipple, 2011). On the other hand, some studies found some insignificant or even negative relationships between collaboration practices and performance (Giovanni and Vinzi, 2014; Gimenez and Sierra, 2013; Kim and Rhee, 2012; Nakano, 2009; Vachon and Klassen, 2008). This apparent inconsistency in regards to the relationship between the collaborative practices and performance in general has been a debating area for some time. To address the problem in this research, it becomes necessary and fundamental to investigate such inconsistency in the literature and if necessary to extend the investigation to a wider scope of the knowledge.

This chapter reviews the key terms in the literature and provides rationale understanding of how those conceptual terms have been developed. More importantly, the chapter also reviews the literature in regards to the key constructs used in the theoretical framework for this research, including sustainable performance, agriculture industrialization and collaboration practices. Finally, the chapter presents the detailed development of all hypotheses involved in the study.

The following research questions will be discussed.

1) What is the relationship between collaboration practice (CP) and sustainable performance (SP)?
2) Is there any environmental factor that may moderate the CP-SP relationship?
3) To what extent and how will environmental factors moderate the CP-SP relationship?

To answer the first research question, this chapter reviews the literature specifically in the area of supply chain collaboration and sustainable performance to investigate the most commonly adopted collaboration practices, especially in the Chinese agricultural sector, and the common measurement dimensions of sustainable performance. Most importantly, the review will shed light on how collaboration management practices affect the three dimensions of sustainable performance.

The second and third research questions investigate the moderating effect of supply chain environmental factors on collaboration practice (CP) -sustainable performance (SP) relationships. The conflicts of some of the findings in the literatures will be discussed in depth, some of which are achieved by make use supply chain operations management theories and contingency theory. The literature review also directly leads to the development of hypotheses that address the research gaps in the literature.

3.2 Supply chain collaboration

Supply chain collaboration is a continuously growing concept that has several seemingly different definitions (Mentzer et al., 2001; Sriram et al., 1992). It is commonly believed that supply chain collaboration could bring tremendous benefits to a business (McLaren, Head and Yuan, 2002). There are many types of collaboration, including information sharing, collaborative decision-making and incentive alignment (Cao and Zhang, 2011; Holweg and Pil, 2008). Many studies suggest that collaboration with supply chain partners can reduce total costs and waste, improve the supply chain’s operational efficiency, and eventually achieve better performance (Prajogo and Olhager, 2012; Aksin and Masini, 2008).

This section reviews the literature from two perspectives.

- What are the definitions, benefits and costs of collaboration?
- What are the often-adopted collaborative management practices in the agriculture industry?

3.2.1 Definition of supply chain collaboration

Supply chain collaboration (SCC) as one of the key strategic supply chain management approaches has existed for nearly two decades. Its academic definition varies from author to author but without much serious controversy (Gimenez and Sierra, 2013; Mentzer et al., 2001; Sriram et al., 1992). One of the most widely recognized definitions of SCC was suggested by Simatupang and Sridharan (2002), which states 'two or more independent companies work jointly to plan and execute supply chain operations with greater success than when acting in isolation'. This definition has been adopted in this research.

3.2.2 Benefits and costs of collaboration

The potential benefits and advantages of supply chain collaboration have been widely studied and reported across many literatures. Many researchers suggest that SSC is positively associated with performance. However, some argued that SCC also increased ownership costs and transaction costs (McLaren et al., 2002). The benefits and costs of SCC can vary in different environments and are influenced by many environmental factors. Such as geographical dispersion, a firm's location, different industrial characters, company culture could also affect the outcomes and needs of collaboration management practices (Bragg et al., 2011). Therefore, investigating the impact of supply chain collaboration on performance in agriculture industry can provide better understanding to the Chinese agriculture context. The benefits and advantages are summarized below.

- Improving operational performance

Wilding (2006) argued that by collaboratively working together with other supply chain members, firms could multiple the outcomes of the efforts of working alone. By adopting supply chain collaboration practices, firms can achieve a better responsiveness level and service level than they can alone (Holweg et al., 2005).

- Improving service quality

Accurate and timely information sharing is often the direct result of SCC in a supply chain, which could significantly improve a firm's service quality performance (Mentzer et al., 2001). Another benefit of SCC is the reduction of the supply chain costs, including inter-firm transactional costs and inventory and production costs (McLaren, Head and Yuan, 2002).

- Improving logistics performance

Many studies have found that better supply chain collaboration can improve a firm's performance (Nyaga et al., 2010), especially logistics activities performances whereby the logistics service providers are the collaborative partners of the supply chain (Ha et al., 2011). Furthermore, many studies show that the successful outcome of current collaboration could result in more collaboration activities (Ramanathan and Gunasekaran, 2014).

- Risk mitigation

Another benefit of supply chain collaboration is being more able to combat the uncertainty and risk mitigation in the operational dimension of supply chain management. SCC has been claimed to make the supply chain more resilient. For example, SCC can effectively reduce rationing in the supply chain, also known as the main cause of the bullwhip effect (Lee et al., 2014). Close collaboration could effectively prevent bullwhip effects, reduce inventory levels, better utilize logistics, and mitigate operational risks (Holweg et al., 2005).

Despite the alluring potential benefits of SCC, adequate implementation of SCC does cost the supply chain in a number of different ways.

- Direct costs

Direct and indirect costs are associated with achieving a higher level of supply chain collaboration (McLaren et al., 2002). For instance, Internet and communication software has been considered as a direct cost of interacting operational systems and information sharing along the supply chain (Burgess, Prakash and Rana, 2006).

- Indirect costs

On the other hand, indirect costs such as labour and opportunity costs are associated with supply chain collaboration (McLaren et al., 2002).

To summarize, many studies find a positive impact of supply chain collaboration on a firm’s performance (Nyaga et al., 2010). However, some researchers have argued that SCC also increased ownership costs and transaction costs (McLaren et al., 2002).

Thus, it appears that the benefits and costs of SCC can vary in different environments and are influenced by many environmental factors. Some factors such as geographical dispersion, a firm’s location, and different industrial characters could also affect the outcomes and needs of collaboration management practices (Bragg et al., 2011). Furthermore, strategic management and company culture affect implementation of collaborative management practices (Akintoye et al., 2000). According to Holweg et al. (2005), SCC should be designed and implemented in accordance with various factors such as 'the geographical dispersion, the demand pattern, and the product characteristics'.

Although there are many different views and potential research agendas about the role of supply chain collaboration, this study focuses on the impacts of supply chain collaboration on sustainable performance.

3.2.3 Collaboration practices

Different types of collaboration practices in supply chain management can be classified from different perspectives, such as upstream and downstream collaboration (Frohlich and Westbrook, 2001) and internal and external collaboration (Stank, Keller and Closs, 2001). In addition to exploring the dimensional issues of supply chain collaboration as some literatures have done, this study chose to focus on recently emerged and commonly adopted collaboration practices in the Chinese agriculture industry to advance knowledge for the benefit of farmers and agriculture enterprises in China. The author follows two steps when investigating and identifying often-adopted collaborative practices in China. First, extensive literature on collaboration practices will be reviewed and summarized. Second, the results will be compared and validated by using 27 real-world observations collected from the Department of Agriculture in Hefei Province in China.

The Department of Agriculture has provided 103 secondary case data through its official website, which lists the supply chain practices adopted in the past 10 years by agriculture related enterprises. After filtering the collaboration practices, the data suggests that 27 firms have adopted at least one collaborative practice.

The sampling strategy follows the same approach as selecting articles for sustainable challenges in section 2.4. The search deploys the research papers published in peer-reviewed, high-impact journals written in both Chinese and English. The key search terms related to the concepts of ‘collaboration’ and ‘sustainable/green/environment performance’ is used to capture relevant articles. This search is applied to the titles, abstracts and keywords of journal articles in online databases, such as ProQuest, Emerald, and ScienceDirect. By performing the search and excluding duplicated results, a total of 137 papers are identified. However, after screening on the abstracts, only 40 journal articles investigate the relationship between collaboration and supply chain performance. Reviewing the results from 40 relevant peer-reviewed journal articles (as illustrated in Table 1) revealed that 23.7% (9) of them examine the supply side collaboration; 12.5% (5) focus on the demand side collaboration; and 37.5% (15) of the articles address both supply side collaboration and demand side collaboration. Overall, 21% (8) of the articles consider supply chain collaboration at an aggregate level. Three articles (7.9%) conceptualize supply chain collaboration as a three-dimensional model: supply side collaboration, demand side collaboration and internal collaboration. To summarize, more than 80% (32) of the studies investigate the supply side collaboration and demand side collaboration.

Table 1 defines the commonly adopted collaboration practices as:

- supply side collaboration: work jointly with suppliers to plan and execute supply chain operations;
- demand side collaboration: work jointly with customers to plan and execute supply chain operations;
- internal collaboration: work jointly within the company to plan and execute supply chain operations; and
- aggregate: consider supply chain collaboration one single construct.

Author	Year	Journal	Supply side	Demand side	Internal collaboration	Aggregate
Sheu, Yen and Chae	2006	International Journal of Operations and Production Management		√		
Thron, Nagy and Wassan	2007	International Journal of Logistics Management		√		
Lee, Kwon and Severance	2007	Supply chain Management: An International Journal	√	√	√	
Stephan Vachon, Robert D. Klassen	2008	International Journal of Production Economics	√	√		
Mikihisa Nakano	2009	International Journal of Physical Distribution & Logistics Management	√	√	√	
Eve D. Rosenzweig	2009	Journal of Operations Management		√		
Gilbert N. Nyaga et. Al	2010	Journal of Operations Management				√
Cecilia Soler, Kerstin Bergstrom and Helena Shanahan	2010	Business Strategy and the Environment				√
Ogan M. Yigitbasioglu	2010	International Journal of Physical Distribution and Logistics Management	√	√		
Gilbert N. Nyaga and Judith M. Whipple	2011	Journal of Business Logistics	√	√		
Iyer	2011	Journal of Business and Industrial Marketing		√		
Cao and Zhang	2011	Journal of Operational Management				√
Jinsoo Kim and Jongtae Rhee	2012	International Journal of Production Research	√	√		

Kenneth et al.	2012	Industrial Management & Data Systems	√	√		
Cristina Gimenez and Elcio M. Tachizawa	2012	Supply Chain Management: An International Journal	√			
Cristina Gimenez, Vicenta Sierra, Juan Rodon	2012	International Journal of Production Economics				√
Suhaiza Zailani et al.	2012	International Journal of Production Economics		√		
Kim and Rhee	2012	International Journal of Production Research	√			
Giovanni and Vinzi	2012	International Journal of Production Economics	√	√		
Oguz Morali and Cory Searcy	2013	Journal of Business Ethics	√	√		
Christina Gimenez and Vicenta Sierra	2013	Journal of Business Ethics	√			
Chen, Sohal and Prajogo	2013	International Journal of Production Research	√	√	√	
Pietro De Giovanni and Vincenzo Esposito Vinzi	2014	Transportation Research Part D	√	√		
Seyed Mostafa Mirhedayatian et.al	2014	International Journal of Production Economics	√			
Subrata Mitra and Partha Priya Datta	2014	International Journal of Production Research	√			
Arijit Bhattacharya et al.	2014	Production Planning & Control		√		
Philip Beske and Stefan Seuring	2014	Supply Chain Management: An International Journal				√
Constantin Blome, Antony Paulraj and Kai Schuetz	2014	International Journal of Operations & Production Management	√	√		

Nix and Zacharia	2014	The International Journal of Logistics Management			√
Giovanni and Vinzi	2014	Transportation Research Part D	√		
Yang	2014	International Journal of Production Economics	√		
Wu, Chuang and Hsu	2014	International Journal of Production Economics	√	√	
Hartley, Brodke and Wheeler	2014	Operational Management Research		√	
Elcio M. Tachizawa and Cristina Gimenez and Vicenta Sierra	2015	International Journal of Operations and Production Management	√		
Frank Wiengarten and Annachiara Longoni	2015	Supply Chain Management: An International Journal	√	√	
Jabbour et al.	2015	Transportation Research Part E		√	
Chen and Wu	2015	International Journal of Physical Distribution & Logistics Management	√	√	
Fahian Anisul Huq et al.	2016	Journal of Operations Management			√
Olga chkanikova	2016	Business Strategy and the Environment	√		
Macchion et al.	2017	Production Planning and Control			√

Table 1: supply chain collaboration dimensions

An early study by Sarkis (1999) suggests that most of the sustainable supply chain collaboration practices have mainly focused on the supply side. However, Klassen and Vachon (2003) argued that the focus should be shifted from considering only the supply side to the totality of the supply chain, for instance, upstream and downstream. In the past decades, encouragingly, the research studies that empirically test the impact of collaboration on a firm's performance often have considered both supply side and demand side collaboration (Giovanni and Vinzi, 2014; Wiengarten and Longoni, 2015; Morali and Searcy, 2013; Kim and Rhee, 2012; Green et al., 2012). Giovanni and Vinzi (2014) argued that collaborative practices can be directed either upstream with suppliers or downstream towards customers. As Table 1 shows, supply side collaboration and demand side collaboration are two of the most commonly and often-adopted external collaboration practices. However, the results may need to be further confirmed under the research contexts since there are limited studies of the Chinese agro-food industry.

3.2.4 Validation using secondary data from China's agro-food department

To extend the research into the Chinese fresh agro-food contexts and make the research outcome specifically relevant to China's agro-food industry, the author has invested significant resources and effort to specifically investigate the widely adopted supply chain collaboration practices in the southern part of China. The Department of Agriculture has provided 103 secondary case data through its official website, which lists the supply chain practices adopted in the past 10 years by agriculture related enterprises (Table 2). The data suggest that 27 firms adopted at least one collaborative practice. Among those firms, 13 adopted supply side collaboration, 6 adopted demand side collaboration and 19 adopted farmer-supermarket-docking (FSD), which is a unique and innovative collaboration practice recently introduced by the Chinese government. Only 2 out 103 firms adopted all three collaboration practices, indicating that adoption of collaboration practice is still in its infancy.

Case	Type of business	SSC	DSC	FSD
Hefei 1	Agriculture co-operative/association			√
Hefei 2	Agriculture co-operative/association	√		√
Hefei 3	Agro-food related enterprise		√	
Hefei 4	Agriculture co-operative/association			√
Hefei 5	Agriculture co-operative/association	√		
Hefei 6	Agriculture leading enterprises			√
Hefei 7	Agriculture leading enterprises	√	√	√
Hefei 8	Agriculture co-operative/association	√		√
Hefei 9	Agriculture leading enterprises	√		
Hefei 10	Agro-food related enterprise			√
Hefei 11	Agriculture co-operative/association			√
Hefei 12	Agriculture leading enterprises			√
Hefei 13	Agriculture co-operative/association			√
Hefei 14	Agriculture leading enterprises		√	√
Hefei 15	Agriculture leading enterprises	√	√	√
Hefei 16	Agriculture co-operative/association			
Hefei 17	Agro-food related enterprise	√		√
Hefei 18	Agriculture co-operative/association	√		
Hefei 19	Agriculture co-operative/association			√
Hefei 20	Agriculture leading enterprises	√		
Hefei 21	Agro-food related enterprise			√
Hefei 22	Agriculture leading enterprises	√		
Hefei 23	Agriculture co-operative/association	√		
Hefei 24	Agro-food related enterprise	√	√	√
Hefei 25	Agriculture leading enterprises		√	√
Hefei 26	Agriculture co-operative/association	√		√
Hefei 27	Agro-food related enterprise			√

Table 2: Summary of adopted collaboration practices in Hefei province

By investigating the widely adopted collaboration practices identified from literature and real-world case data about the Chinese agro-food industry, this research aims to make the result relevant to a particular real-world scenario to differentiate its findings from the general findings in the literature. This study categorizes the collaborative practices into three widely adopted collaboration practices in the Chinese agro-industry: supply side collaboration, demand side collaboration and farmer-supermarket docking.

3.3 Sustainable performance

This section reviews the literature from the following two perspectives.

- The concept and development of sustainability
- The dimensions of sustainable performance

3.3.1 Concept of sustainability

For the last decade, great effort has been devoted to the study of sustainable development across many industrial sectors. Research on sustainable agricultural development has become a popular topic in developed countries (Smith, 2008). However, to the author's best knowledge, very few publications are available in the extant literatures that actually address agriculture collaboration practices and how they may influence sustainability outcomes in China. To explore sustainable performances, a thorough discussion of the concept of sustainability would be helpful to the subsequent research.

One of the first sustainability concepts was proposed in 1987 by the Brundtland Commission (World Commission on Environment and

Development (WCED), 1987), which covers all aspects of sustainability and posits one well-established definition from economic and political perspectives (Dovers, 1989). It not only highlights the importance of sustainability, but also suggests four ways of achieving it. WCED (1987) defined sustainability as enhancing both current and future potential to meet human needs and aspirations by exploitation of resources, the direction of investments, the orientation of technological development and institutional change. This concept of sustainability is usefully extended by the Food and Agriculture Organization of United Nations (FAO) with a link to the agriculture industry. A growing body of literature explores FAO's definition of sustainable development, which identifies conserving land, water, plant and animal genetic resources by environmentally non-degrading, technically viable and socially acceptable methods as the main factors of sustainable development (Smith, 2008).

Douglass (1984) proposed a narrower definition that focused on agriculture industry. He distinguishes food sufficiency, stewardship and community as the three main approaches in sustainable development. First, food sufficiency as a prime goal of agriculture gradually becomes a severe challenge in the 21st century due to natural resources exhaustion. Eventually, food production will fail to meet the growing demand. Second, a stewardship approach, also known as an ecological approach, means the maintenance of productivity of the renewable resources for long-term development. Finally, a community approach, known as the social approach, argues that the relationship between humans and nature should be based on respect. Gips (1988) expanded on Douglass' three main approaches, suggesting that ecologically sound, environmentally viable, socially just and humanity are the key factors of sustainability. A distinct integration between Douglass' and Gips' definitions is that Gips emphasizes the importance of human dignity and cultural protection in sustainable development. In addition, United Nation Global (1990) defined sustainability as 'the management of environmental, social and economic impacts, and the encouragement of good governance practices, throughout the lifecycles of goods and services'.

From these definitions, one may be able to draw a broad but renewed understanding of what exactly sustainability means. Most researchers believe that economically viable, socially acceptable and environmentally sound are the three key attributive dimensions of sustainability. Subsequent publications have consolidated these definitions by framing them as the so called 'triple-bottom-line model' (Høgevold et al., 2015). Accordingly, the author intends to use the economic, social and environmental performance as the triple-bottom-line benchmarks for discussing and testing the relationships between collaboration practices and sustainable outcomes. Table 3 summarizes the sustainable performance dimensions used in recent research. In all, more than 20% of the studies conceptualize sustainable performance through the three dimensions: economic, social and environmental performance. More than 70% of the papers included at least one of the three measurements.

Author	Year	Sustainable performance measure
Sheu, Yen and Chae	2006	Performance at an aggregate level
Thron, Nagy and Wassan	2007	Performance at an aggregate level
Lee, Kwon and Severance	2007	Cost-containment performance and reliability performance
Stephan Vachon, Robert D. Klassen	2008	Cost, quality, delivery, flexibility, environment
Mikihisa Nakano	2009	Logistic & production performance
Eve D. Rosenzweig	2009	Operation performance and business performance
Gilbert N. Nyaga et. Al	2010	Performance as one construct
Cecilia Soler, Kerstin Bergstrom and Helena Shanahan	2010	Economic and environmental performance
Ogan M. Yigitbasioglu	2010	Performance of resource usage, output and flexibility
Gilbert N. Nyaga and Judith M. Whipple	2011	Operational performance
Iyer	2011	Operational performance
Cao and Zhang	2011	Performance at an aggregate level
Jinsoo Kim and Jongtae Rhee	2012	Finance performance & Non finance performance
Kenneth W. Green, Je et al.	2012	Environmental & organizational performance
Cristina Gimenez and Elcio M. Tachizawa	2012	Economic, social and environmental performance
Cristina Gimenez, Vicenta Sierra, Juan Rodon	2012	Economic, social and environmental performance
Suhaiza Zailani et al.	2012	Economic, social, environmental performance, Operational performance
Kim and Rhee	2012	Finance performance and nonfinancial performance
Giovanni and Vinzi	2012	Environmental and economic performance
Oguz Morali and Cory Searcy	2013	Economic, social and environmental performance
Christina Gimenez and Vicenta Sierra	2013	Environmental performance
Chen, Sohal and Prajogo	2013	Supply chain performance in general
Pietro De Giovanni and Vincenzo Esposito Vinzi	2014	Cost, quality, delivery, flexibility and environmental
Seyed Mostafa Mirhedayatian et.al	2014	Environmental and economic performance
Subrata Mitra and Partha Priya Datta	2014	Economic performance
Arijit Bhattacharya et al.	2014	Environmental, economic, operation performance
Philip Beske and Stefan Seuring	2014	Economic, social and environmental performance
Constantin Blome, Antony Paulraj and Kai Schuetz	2014	Sustainability performance at an aggregate level
Nix and Zacharia	2014	Operational performance and relational performance

Giovanni and Vinzi	2014	Environmental performance and economic performance
Yang	2014	Performance at an aggregate level
Wu, Chuang and Hsu	2014	Finance performance and nonfinancial performance
Hartley, Brodke and Wheeler	2014	Operation performance
Elcio M. Tachizawa and Cristina Gimenez and Vicenta Sierra	2015	Environmental performance
Frank Wiengarten and Annachiara Longoni	2015	Cost, social, environment performance, quality, flexibility & delivery
Ana Beatriz Lopes de Sousa Jabbour et al.	2015	Environmental performance
Yenming J.Chen et al.	2015	Economic and environmental performance
Fahian Anisul Huq et al.	2016	Social performance
Olga chkanikova	2016	Environmental performance
Macchion et al.	2017	Innovation performance

Table 3: Dimensions of sustainable performance

Having identified the heterogeneous measures of sustainability discussed in the literatures (Table 3), there emerged a call for more commonly agreed upon but fewer dimensions of sustainability. A well-recognized model in sustainable management research developed by Elkington (1997) argued that the diverse dimensions of sustainable performance can be collapsed into three dimensions: social, environmental and economical, also known as the triple bottom line. This research uses this model to measure sustainable performance.

3.3.2 Triple bottom line

In fact, the early research by WCED and FAO may have paved the way for the development of Elkington's three bottom line model. Elkington successfully articulated the philosophical terms into an accessible language for corporations and shareholders (Henriques and Richardson, 2013). Elkington (1997) clearly and convincingly placed the triple-bottom-line as a major research topic onto the globally campaigned research agenda, positing that the majority of the leading agricultural enterprises worldwide are using it as a management tool. The triple-bottom-line model describes three key components that can enhance organizational sustainability by enhancing their environmental, social and economic performances (Carter and Rogers, 2008).

The model argues that focusing on monetary returns from social and environmental performance is the best way of achieving sustainability. Knowing that there is a win-win relationship between the three dimensions, firms have started to adopt sustainable practices and management tools to improve their economic, social and environmental performances (Carter and Rogers 2008). Seuring and Muller (2008) pointed out that with a thorough understanding of the win-win situation, studies on the same topic assert different opinions, arguing about various tensions between the three aspects of triple bottom line. However, most researchers agree with the win-win relationship between the three dimensions.

3.4 Relationship between collaboration practices and sustainable performance

3.4.1 Collaborative practices (CP) and sustainable performance (SP)

Sustainable agriculture is a broad topic that has been studied by researchers from all over the world in the past 10 years (Beske et al., 2013). One prominent research field is about adopting and implementing some proven sustainable collaboration practices to achieve desired sustainable performances. Both theoretical formulation and practical implementations of CP and SP have developed rapidly during the recent years (Seuring and Muller, 2008; Carter and Easton, 2011). Essentially, sustainable collaboration allows companies to work jointly to implement corporate responsible managerial practices that promote their long-term financial performance while achieving positive environmental and social goals. Halldorsson, Kotzab and Skjott-larsen (2009) pointed out that one possible driver for such corporate action is the changes of market requirements and public complaints up and down the fresh agro-food products supply chains. Growing concerns include environmental protection, natural eco-system's sustainability, social responsibility, community impact, long-term economic performance, and food and beverage safety (China Agenda 21, 1994). In responding to those concerns, proactive initiatives and actions were launched across agricultural supply chains in different regions, much of which were understood to be the collaborative practices.

The early research in this area was first introduced by Pullman, Maloni and Dillard (2010), which explains the impact of environmental and social sustainable practices on the natural environment, product quality, market, and cost performance within the wine industry. According to Pullman, Maloni and Dillard (2010), a positive correlation between the two constructive factors of supply chain collaborative practices and quality performance. A conceptual link between the two constructs has thus been clearly presented to the wider research community and was recognized as a key research agenda in the area. This study joins those of many researchers in this field and attempts to contribute from a specific perspective. However, the concurrent literature review shows that the theory, after 8 years, still remains largely at a generalized conceptual level, only providing limited support and explanation to many empirical researches carried out. Furthermore, Melnyk, Sroufe and Calantone (2003) explored the importance and impact of an environmental management system (EMS) on a firm’s overall performance. Melnyk, Sroufe and Calantone's (2003) results suggest that EMS can bring real benefits to companies’ overall performance, including cost reduction, quality improvement, waste reduction, and efficiency improvement. In addition, the study stressed the need for further investigation into the relationships between collaborative practices and sustainable performance (Melnyk, Sroufe and Calantone, 2003), which is also a key research objective that the author aims to achieve.

Based on the foregoing works carried out by Zhu and Sarkis (2004), who also evaluated the impact of green supply chain practices on sustainable performance, with a focus on environmental and economic performance. Specifically, the study found a convincing win-win relationship between supply chain practices, environmental and economic performance in China. Zhu and Sarkis (2004) emphatically suggest that sustainable supply chain practice is a new concept and new phenomenon in China’s agricultural industry sector, and its adoption rate is still relatively low. The low adoption rates are partially caused by the underdeveloped agriculture infrastructure, the increasingly competitive market environment (Niu, 2006), lack of funding and low educational levels (China Agenda 21, 1994). Moreover, because China is still a developing country with an agriculture-dominated economy, the majority of the big Chinese agricultural enterprises consider economic performance their top priority, and environmental and social impact must give way to economic development. Furthermore, many small farmers tend to have very limited knowledge about the environmental and social implications of their activities and limited funds for adopting any sustainable practices that larger organizations can afford. As evidenced in a few studies exploring the relationship between supply chain practices and sustainable performance, Zhu and Sarkis (2004) compared the different characteristics among four countries and suggested that the strength of the relationships varies in individual countries (Zhu and Sarkis, 2004). Hence, further investigation into the Chinese agriculture industry may shed new light into the research field.

Later on, Guo and Marinova (2011) found that a discernible increase in environmental awareness in the general public in China due to regulation, market competition and market pressures. However, the increased environmental awareness has not translated into sustainable practice adoption, perhaps due to lack of effective management strategies, implementation tools and adequate know-how. Another possible explanation of the low adoption rate could be the ambiguous economic performance outcomes of adopting the practices. Thus, any further research to identify and analyse the impact of supply chain practice on economic performance could contribute to improving the adoption rate of sustainable supply chain practices.

Another critically related area to review is agro-food safety in China. Over the last decade, food safety issues and how the government exercise control over those issues has attracted great attention from the Chinese population and the global media due to the increase in clinical cases of serious diseases caused directly by pesticide residues and food chemicals introduced into the agro-food supply chains (Zhou, Helen and Liang, 2011). Extending Zhu et al. (2004)'s research in sustainable practice adoption, Zhou, Helen and Liang (2011) designed a comprehensive framework that identifies the key influential factors of adopting sustainable supply chain practices, which are firm size, expected premium, export market, brand image, e-commerce, staff training and traceability. An apparent difference between Zhou, Helen and Liang's (2011) and Zhu et al.'s (2004) studies lies in the different practical implications of their conceptual frameworks. The former study posits policy implications and adoption standard model for Chinese vegetable supply chains, whereas the latter study only provides a conceptual framework at the general management level. As far as the food safety issue in China is concerned, the practice and achievement in Zhejiang province, one of the largest agro-food exporting provinces in China, is the most noticeable and can be recommended for other provinces to follow. Reports show they face the most rigorous safety regulations and checks, so that the adoption behaviour and the magnitude of adoption practices tend to be higher than in most other parts of China.

From the food waste reduction perspective, Kaipia, Popovska and Loikkanen (2013) have demonstrated that information sharing can facilitate sustainable performance in reducing food waste throughout the supply chain. An interesting idea raised by Kaipia, Popovska and Loikkanen (2013) is that supply chain structural configuration appears to be essential for long-term sustainable development. What is more, China's government initiative Agenda-21 (1994) also specifically points out that supply chain collaboration can significantly enhance the sustainability of China's agro-food supply chain.

3.4.2 Literature evidence and its categorization

This section summarizes the literature evidence from a statistical proportions and distribution perspective. Such evidence could further strengthen the theoretical foundations discussed in the earlier sections. Out of the 40 selected and reviewed articles that identified in section 3.2.4, 62.5% (25) clearly identified a positive effect of CP on SP (Table 4), whereas 20% (8) established a non-significant relationship between them. Another 10% (4) found a negative impact of CP on SP.

Among the 25 papers that identified a positive effect of CP on SP:

- three papers argued that the relationship is mainly positive, but it is moderated by an external factor. One paper suggests that absorptive capacity moderates the collaboration-performance relationship (Giovanni and Vinzi, 2014). The other papers suggest the level of environmental munificence and firm size also moderate the relationship (Rosenzweig, 2009; Cao and Zhang, 2011);
- thirteen papers identified a positive relationship between collaboration and one of the dimensions of sustainable performance. Tachizawa, Gimenez and Sierra (2015) believe that supply side collaboration is positively associated with

environmental performance, whereas Wiengarten and Longoni (2015) found that demand side collaboration is positively associated with social performance; and

- nine papers argued that the relationship between CP and SP is positive in any and all cases regardless of the underlying research constraint and assumptions (Gimenez and Sierra, 2013; Gimmenez, Sierra and Rodon, 2012; Beske and Seuring, 2014).

Among the 12 papers that found a negative or non-significant relationship between CP and SP:

- three papers found that supply side and demand side collaboration (SSC and DSC) do not have significant impact on sustainable performance (Nakano, 2009; Nyaga et al., 2010; Vachon and Klassen. 2008). Vachon and Klassen (2008) differentiated the impact of SSC and DSC on sustainable performance and found that the relationship is not always significant in a supplier driven market environment;
- one paper concluded that SCC has a significant effect on performance, but without further clarifying the degree of the effectiveness;
- four papers argued that the relationship between CP and SP is not significant, regardless of positive or negative effect (Giovanni and Vinzi, 2014; Mitra and Datta, 2014; Kim and Rhee, 2012; Nakano, 2009; Vachon and Klassen, 2008; Blome, Paulraj and Schuetz, 2014). Giovanni and Vinzi (2014) concluded that SSC is only positively associated with economic performance, but has

no significant impact on environmental performance; and

- four papers argued that the relationship between CP and SP is even somewhat negative (Gimenez and Sierra, 2013; Chen and Wu, 2015; Chkanikova, 2016). Kim and Rhee (2012) argued that collaboration through activation of support (support from the supplier or the buyer) is negatively associated with economic performance due to the increased cost burdens to the supporting party.

To summarize, contrary to most researchers' believe, there is actually no clear consensus on the relationship between CP and SP in general. Several papers argued that the inconsistency might be caused by the impact of exogenous factors. Therefore, further research is needed to achieve better understanding of managing collaboration practices in agro-industry for sustainable performance.

Year	Author	Positive relationship	Negative relationship	Not significant
2006	Sheu, Yen and Chae	√		
2007	Thron, Nagy and Wassan	√		
2007	Lee, Kwon and Severance	√		
2008	Stephan Vachon, Robert D. Klassen			√
2009	Mikihisa Nakano	√		√
2009	Eve D. Rosenzweig	√		
2010	Gilbert N. Nyaga et. Al	√		
2010	Cecilia Soler, Kerstin Bergstrom and Helena Shanahan			
2010	Ogan M. Yigitbasioglu	√		
2011	Gilbert N. Nyaga and Judith M. Whipple	√		
2011	Iyer	√		
2011	Cao and Zhang	√		
2012	Jinsoo Kim and Jongtae Rhee	√		√
2012	Kenneth W. Green, Je et al.	√		
2012	Cristina Gimenez and Elcio M. Tachizawa	√		
2012	Cristina Gimenez, Vicenta Sierra, Juan Rodon	√		
2012	Suhaiza Zailani et al.	√		
2012	Kim and Rhee	√	√	
2012	Giovanni and Vinzi	√		
2013	Oguz Morali and Cory Searcy			

2013	Christina Gimenez and Vicenta Sierra	√		
2013	Chen, Sohal and Prajogo	√	√	
2014	Pietro De Giovanni and Vincenzo Esposito Vinzi	√		√
2014	Seyed Mostafa Mirhedayatian et.al	√		
2014	Subrata Mitra and Partha Priya Datta			√
2014	Arijit Bhattacharya et al.			
2014	Philip Beske and Stefan Seuring	√		
2014	Constantin Blome, Antony Paulraj and Kai Schuetz			√
2014	Nix and Zacharia	√		
2014	Giovanni and Vinzi	√		√
2014	Yang			√
2014	Wu, Chuang and Hsu	√		
2014	Hartley, Brodke and Wheeler	√		
2015	Elcio M. Tachizawa and Cristina Gimenez and Vicenta Sierra	√		
2015	Frank Wiengarten and Annachiara Longoni	√		
2015	Ana Beatriz Lopes de Sousa Jabbour et al.			
2015	Yenming J.Chen et al.	√	√	
2016	Fahian Anisul Huq et al.	√		
2016	Olga chkanikova	√	√	
2017	Macchion et al.	√		

Table 4: Relationships between supply chain collaboration and sustainable performance

3.5 Hypotheses development

Based on the literature review, this section critically addresses the identified research gaps, including the validity of the relationship between the CP and SP; contingency factor of the relationship; and the underlying reasons for the inconsistency in the literature, leading to the development of several hypotheses. In doing so, this research employs several established theories to make the argument and hypotheses development more rigorous. The relevant theories or theoretical tools often seen in the literature of supply chain collaboration research have already supported research advancement immensely. They are Transaction Cost Economics (TCE), Collaborative Network Theory (CNT), and Contingency Theory (CT) (Chicksand et al., 2012). The selection of theories and theoretical supports has been inspired by several reviewed articles that presented cases of proper application in the field of SCM research (Burgess et al., 2006; Richey et al., 2010；Chicksand et al., 2012; Soni and Kodali, 2012). While many other theories have been applied to SCM research, these three theories appear to be immediately beneficial due to their repeated adoption in explaining the effect of supply chain collaboration (Chicksand et al., 2012). The backgrounds of the three theories and their application to this research are also presented.

3.5.1 Background of the chosen theories

- **Transaction Cost Economics (TCE)**

Transaction Cost Economics was initially proposed by Coase (1937) and further developed by Williamson (1971). Transaction costs are the expenses generated by identifying product prices, negotiating and implementing exchanges (Williamson, 1975). Moreover, TCE has been applied in supply chain management research mainly to understand an organization’s behaviour under implementation of supply chain collaboration (Wilding and Humphries, 2006) as well as the impact of supply chain collaboration on the supply chain’s performance (Nyaga et al., 2010). TCE suggests that companies could achieve better performance by selecting the appropriate collaboration mechanisms according to the transaction activities (William, 2008). Collaboration, as one sustainable mechanism, can reduce transaction costs, including opportunism cost, monitoring activities costs, and uncertainty costs, through the development of relational capital (Croom, 2001). There will be costs associated with achieving a high level of collaboration, including information and communication, technology, effort, and uncertainty arising from the collaborative partners (Hobbs, 1996). Nevertheless, firm still prefer to collaborate since they believe greater benefits can be achieved through inventory reduction, transport cost reduction and better customer satisfaction levels (Demil and Lecocq, 2006). Furthermore, Sriram et al. (1992) point out that high transaction costs even increase the willingness to collaborate to reduce such costs in the future.

In general, TCE underpins why firms choose different types of collaboration to fit their businesses. It reveals the trade-off of supply chain collaboration that a higher level of supply chain collaboration may also come with a higher level of transaction cost and consequent risks. Nevertheless, most applications of the theory tend to support an overall positive correlation between collaboration and performance.

- **Collaborative Network Theory**

Collaborative Network Theory (CNT) is the foundation of the reciprocal effect in inter-firm relationships (Oliver, 1990). Therefore, interactions between firms and supply chain partners become more convincingly important due to the rigorous backing of the theory (Hakansson and Ford, 2002). Halldorsson et al. (2007) argued that an effective relationship between supply chain partners could better utilise the resources owned by the firms, which in turn creates better performance compared to the situation of only a single firm. This resource combination is called supply chain collaboration (Cao and Zhang, 2011). CNT suggests that the value of resources can be significantly enhanced by combining them, which underlines unequivocally the importance of creating an effective supply chain relationships/network with the partners (Halldorsson et al., 2007).

However, the contribution of CNT to the inter-firm relationships may depend on the ‘personal chemistry’ between supply chain partners. For instance, well-known factors such as trust levels, degree of communication, mutual understanding, and cultural difference could influence the level of contribution of collaboration on supply chain performance (Halldorsson et al., 2007). In this research, CNT was deployed to explain the efficacy of the supply chain collaboration as a result of collaborative network that leads to a firm's improved performance. Furthermore, CNT may introduce associated exogenous factors that can moderate the relationship between CP and SP to a certain degree.

- **Contingency theory**

Contingency theory (CT), as mentioned in Chapter 1, provides a pivotal theoretical foundation for the conceptual model that this research develops. CT can offer further powerful explanations for the inconsistency of research results in the field of CP-SP relationships. Generally, CT recognises that there is no universally and perpetually correct way to manage the supply chain (Flynn, Huo and Zhao, 2010), and any meaningful models or concepts developed are contingent on one or more factors and to various of degrees. Hence, quite logically, any effective supply chain management strategy should fit the environment it operates in. In other words, CT suggests that the contribution of supply chain collaboration to sustainable performance is contingent on the external environment it operates in, which also lends support to CNT.

3.5.2 Selection of exogenous factor—Agriculture industrialization (AI)

Several obvious and yet significant exogenous factors can be easily identified in the Chinese agro-food industry context, such as government policy, development agenda, investment and environmental uncertainty (Niu, 2002).

The selection of AI has been largely influenced by the current development agenda in the Chinese agriculture industry, and it must be a dominant factor, a directly relevant factor, and a newly emerged and dynamic factor if it is to serve the research objective of this study. Chinese government documents discuss AI as a key agenda. It is very representative: represent Chinese government policy, fast growing economy, and technology development. In order not to lose the research significance, this research focused only on the moderating effect of agriculture industrialization. No other moderating factors have been suggested by the existing literatures in the field. There is no evidence to suggest that any other moderating factors, even if they are in existence, will have any more significant influence or relevance than that of AI.

Taking into consideration these criteria and based on the real-world circumstances in China's agro-food industry discussed in Chapter 2 and some of the reviewed literature, 'agricultural industrialization' (AI) is identified as a key and representative external factor that is hypothesized to have influence or moderating power to the on-going relationships between CP and SP. The AI factor measures the level of agricultural industrialization in China, and thus it is independent from any firm's management strategy. Also, it is currently playing an important role in reshaping China's agricultural industry.

AI is one of the critical factors already researched across many disciplines such as economics, agriculture and globalization. AI is a process and is defined by Yin (2002) to have four development stages. The first stage is to integrate all supply chain partners into a complete agriculture system. The second stage is to integrate farming with food processing, resulting in what is called the farmer and supermarket integration. The third stage is the enhancement of processing capability and development of competitive advantage. The final stage is to create a continuously and sustainable developing mechanism. As far as the author knows, AI as an exogenous factor has been widely studied, but not as a moderator of the CP-SP relationship in supply chain management contexts. As the most recent development agenda in Chinese agro-food industry, AI has been considered a key factor for almost all agriculture related research. Many studies have also stressed their interest in understanding the impact of agriculture industrialization on supply chain performances (Gliessman, 2007).

3.5.3 The proposed theoretical framework

In this section, the key theoretical constructs are defined; followed by the hypotheses development based on the literature reviews; then a theoretical framework is constructed to capture all the constructs and their inter-relationships. The test of the framework’s validity is presented in Chapter 4 on methodologies.

3.5.4 Collaboration practices (CP)

Many studies have emphasised the important role of upholding strong inter-organizational collaborations, including those with customers and suppliers to improve the firms’ performance (Vachon and Klassen, 2006; Drake and Schlachter, 2008; Hollos et al., 2012; Gimenez and Sierra, 2013; Morali and Searcy, 2013). Some recent research has focused on investigating supply side and demand side collaboration (Blome, Paulraj and Schuetz, 2014). One of the real world case observations was made by Paulraj, Jayaraman and Blome (2014) to investigate the widely adopted CP in the agriculture industry. The results not only spur some interesting extended discussions about the literature, but also showcase some innovative and proven collaboration practices (such as farmer-supermarket docking) that have been widely adopted recently. Hu and Zhang (2010) suggested that farmer-supermarket docking is direct collaboration between farmers (supply side) and supermarkets (demand side), which can enhance agriculture sustainable performance. Current findings on collaborative practices form the basis on which the categorization of collaborative practices in the Chinese agro-food industry is defined. Three commonly adopted collaboration practices in the Chinese agriculture industry thus have been defined: supply side collaboration, demand side collaboration and farmer-supermarket docking. These collaborative practices are representative of many other practices, and the subsequent research findings will have more direct implications in practice.

In this research, supply side collaboration (SSC) is defined as the cooperation between a responding firm and relevant suppliers to achieve sustainability objective providing materials, equipment, services, feedback and requirements to suppliers (Carter et al. 2000; Rao and Holt 2005; Vachon and Klassen 2006; Hoejmose and Afrien-Kirby 2012; Zailani et al. 2012; Zhu, Sarkis and Kai, 2012). Similarly, demand side collaboration (DSC) involves cooperation between firms and customers to achieve sustainability goals (Vachon and Klassen, 2006 and 2008). Moreover, farmer-supermarket docking (FSD) is a joint collaboration between suppliers (agriculture co-operatives and associations) and supermarkets, which could enhance the sustainable performance by eliminating middle tier suppliers (Hu, Yang and Zhang, 2009).

3.5.5 Relationship between collaboration practices (CP) and sustainable performance (SP)

To explore the CP-SP relationship, a hypothesized model has been proposed for each collaboration practices since the author intends to distinguish the impacts of different collaborative practices under the influencing environmental factor of agriculture industrialization (AI). First of all, the relationships between CP and the three dimensions of sustainable performance are examined as the direct effects, without taking into consideration of the moderating effect of AI.

To model the direct impact of CP in its three dimensions of SSC, DSC and

FSD on SP, the author draws upon existing knowledge from the sustainable supply chain management (SSCM) literature. Supply-side and demand-side collaboration are arguably the basis of collaboration practices that enable cooperation between a responding firm and suppliers, as well as cooperation between buying firms and customers to achieve sustainability goals. As the SSCM literature (Giovanni and Vinzi, 2014) suggests, supply-side and demand-side collaborations provide formal or informal mechanisms that promote trust among participating parties, reduce operational waste and mitigate shared risks, and hence lead to increased profitability and improved environmental performance (Dyer, Cho and Chu, 1998; Chen and Paulraj 2004). Simatupang and Sridharan (2005) argued that supply chain collaboration enables the sharing of information, thus enhancing the adaptability of response and diminishing the bullwhip effect. By reducing the bullwhip effect, supply chain inefficiencies and waste can be reduced through better demand forecasting and inventory management, which in turn improve the overall sustainable performance (Karadzic et al., 2014).

Based on the CNT introduced in section 3.5.1, collaboration between supply chain partners could better utilise the firms' resources, which in turn creates better performance compared to a single firm (Hakansson and Ford, 2002). Furthermore, collaboration could enable suppliers and customers to not only share valuable information and promote problem-solving capability and supply chain agility, but also to share common views and beliefs on policies, behaviours and goals (Cao and Zhang, 2011), which could also enable better understanding of customers’ preferences, product demand and food safety standards or requirements (Turkulainen and Ketokivi, 2012). These can have a positive impact on environmental and economic performance by minimizing resource waste, management effort, and supply chain costs (Azevedo, Carvalho and Machado, 2011). Social performance can also be enhanced through better monitoring systems for food safety (Pullman, Maloni and Carter, 2009).

It is therefore reasonably convincing that collaborations with the demand side and supply side are positively associated with firms' economic, social and environmental performance through better information exchange, knowledge sharing, less misunderstanding, and participation in sustainability programs.

Farmer-supermarket docking is a new form of external collaboration among supply chain members that is unique to Chinese agro-food supply chains. Xiong and Xiao (2011) argued that the traditional agriculture supply chain include dealers, distributors, retailers and other middle links, which often leads to severe circulation loss, information lag and high transaction costs (Hu, Yang and Zhang, 2009). To solve these problems, the Chinese Ministry of Commerce and the Ministry of Agriculture Department promotes the demand-supply direct collaboration, also known as 'farmer-supermarket docking', in the agro-food industry to strengthen the link between production and marketing (Tang and Lan, 2015). Direct collaboration between agriculture cooperative/associations and supermarkets often reduces the circulation link, lowers procurement costs, stabilizes costs and price, stimulates rural consumption, and solves the contradiction between ‘difficult to sell agro-products’ and ‘difficult to buy agro-products’ (Yu and Nagurney, 2013). It is one of the innovative agro-food supply chain structural reconfigurations successfully experimented in China. Furthermore, Xu (2010) carried out a comparative analysis of several fresh agro-products and suggested that farmer-supermarket docking is one of the most effective ways to enhance sustainability performance by improving the quality and safety of agro-products. Based on the TCE introduced in section 3.5.1, companies could achieve better performance by selecting the appropriate collaboration mechanisms according to the transaction activities (William, 2008). Therefore, it is also reasonable to believe that FSD is positively associated with sustainable performance since it reduced transaction costs by eliminating the middle tiers of the supply chain. In the same vein, FSD has a positive impact on social performance since it stabilizes the costs and prices of agriculture products and stimulates rural consumption, which is badly needed for the rural areas in China. Moreover, environmental and economic performance can also be enhanced as a result of lower procurement costs, transaction costs and resource waste (Tang and Lan, 2015).

All these factual and literature-based arguments suggest the following hypotheses.

Hypothesis 1. Supply-side collaboration (a), demand-side collaboration (b) and farmer-supermarket docking (c) are positively associated with environmental performance.

Hypothesis 2. Supply-side collaboration (a), demand-side collaboration (b) and farmer-supermarket docking (c) are positively associated with social performance.

Hypothesis 3. Supply-side collaboration (a), demand-side collaboration (b) and farmer-supermarket docking (c) are positively associated with economic performance.

3.5.6 Agriculture industrialization in China

Tweeten (1997), an agriculture economist, summarised the development of agriculture industrialization (AI) in 5 key ways: 1) larger operation scale; 2) substitution of capital and technology for labour; 3) increased unit productivity; 4) stabilised food prices; and 5) vertical integration with processors and distributors. It is widely recognised that AI has provided a cheaper and abundant food supply for the Chinese population (Tang and Lan, 2015). However, environmentalists have harshly criticised AI as a promoted policy because of the resulting problems of 'water pollution, degradation of natural resources, air pollution, climate change, and loss of soil quality'—and the list goes on (Keeney and Kemp, 2002). From the social perspective, AI also created inequality between peasants and large agro-firms. Gliessman (2007) expressed his concerns about the continuing development of AI from the perspective of the long-term sustainable development of the agro-industry. He pointed out that the benefit of 'increased productivity' has been misunderstood because it ignores the degradation of natural resources caused by AI.

In short, the contribution of AI to sustainable development remains unexplored. Nevertheless, the research questions examine how AI, as a prominent factor in Chinese agro-food industry sector, will impact CP-SP relationship.

3.5.7 The contingency effect of AI

Agriculture industrialization as a part of the wider industrialization process can be defined as ‘a process in which changes of a series of strategic production functions are taking place’ (Zheng and Cheng, 2005). In this study, AI is considered a moderating factor for CP-SP relationships. The main focus is the strength, direction, and magnitude of that moderating power rather than the form of the moderation effect. The author initially investigates the impact of AI on the CP-SP relationship individually at the sub-dimension level (Figure 8) rather than the joint effect of AI on SP outcomes. Boehlje et al. (2011) argued that the outcome of agriculture industrialization can be categorized from six perspectives: 1) increased quality, safety and product traceability; 2) high adoption rates of information exchange and innovative technology; 3) enhanced business practices implementation; 4) increased use of leasing and other outsourcing strategies; 5) wider adoption of contracting, strategic alliance and effective collaboration; and 6) reduced supply chain complexity and variability.

Based on contingency theory, Germain et al. (2008) suggested that supply chain process variability moderates the relationship between supply chain practice and economic performance inversely. Hence, economic performance can be strengthened when the supply chain process variability decreases. Boehlje (1996) suggested that reducing supply chain complexity and variability is one of the key outcomes of AI. Therefore, a high degree of AI could have a positive impact on CP-economic performance relationships.

To explain the moderating effects of AI, the author takes a theoretical approach by integrated the contingency theory with the concept of ‘institutional pressure’ (Yang, 2017). There are three institutional pressures that may influence organisational competitive alignment: normative, coercive and mimetic pressures (Sarkis, Zhu and Lai, 2011). Coercive pressure is a critical external factor that drives sustainable supply chain practices (Sarkis, Zhu and Lai, 2011). Coercive pressure is defined as both formal and informal pressures on organizations by other organizations, such as buyers, government agencies, and regulatory norms. In recent decades, the Chinese government has carried out a radical industrialization process and created regulations and policies to support the development of AI. The government not only implemented regulations to support AI's development, but also introduced subsidies and tax exemptions for the leading enterprises in the field. As a result, AI has inadvertently created coercive pressures on organizations (Zheng and Cheng, 2005). Zhu and Sarkis (2007) concluded that coercive pressure positively moderates organizations’ environmental performance, especially when these pressures drive the implementation of green supply chain practices. Thus, AI acting as a type of coercive pressure could positively moderate an organization’s environmental performance. Nevertheless, Robertson and Swinton (2005) asserted that AI may not achieve the anticipated long-term sustainability, since the productivity and standards of food safety may not be sustainable due to the consequent deterioration of the natural environment or even the social environment. Thus, this research argues that due to the trade-off between economic and environmental outcomes, a high degree of AI weakens the contribution from collaboration practices to environmental performance.

According to relevant research literatures in production research, buyer-supplier trust can significantly strengthen the impact of collaboration practices on social performance (Gualandris and Kalchschmidt, 2016). AI promotes wider adoption of third-party sub-contracting, strategic alliances and many other effective collaborative practices that enhance the trust level between buyer and supplier. Hence, a high degree of AI could strengthen the impact of collaboration practices on social performance. On the other hand, Tang and Lan (2015) argued that buyer-supplier trust will not be fully established in the Chinese agro-industry due to the bargaining power of suppliers, inequality of market positions, and lack of contract law. Thus, the positive moderation effect of AI in the Chinese agriculture industry might not be so significant.

Based on these arguments, the author proposes the following hypotheses.

Hypothesis 4. Under a high degree of AI, the association between supply side collaboration (a), demand-side collaboration (b), farmer-supermarket docking (c) and environmental performance will be weakened.

Hypothesis 5. Under a high degree of AI, the association between supply side collaboration (a), demand-side collaboration (b), farmer-supermarket docking (c) and social performance will be weakened.

Hypothesis 6. Under a high degree of AI, the association between supply side collaboration (a), demand-side collaboration (b), farmer-supermarket docking (c) and economic performance will be strengthened.

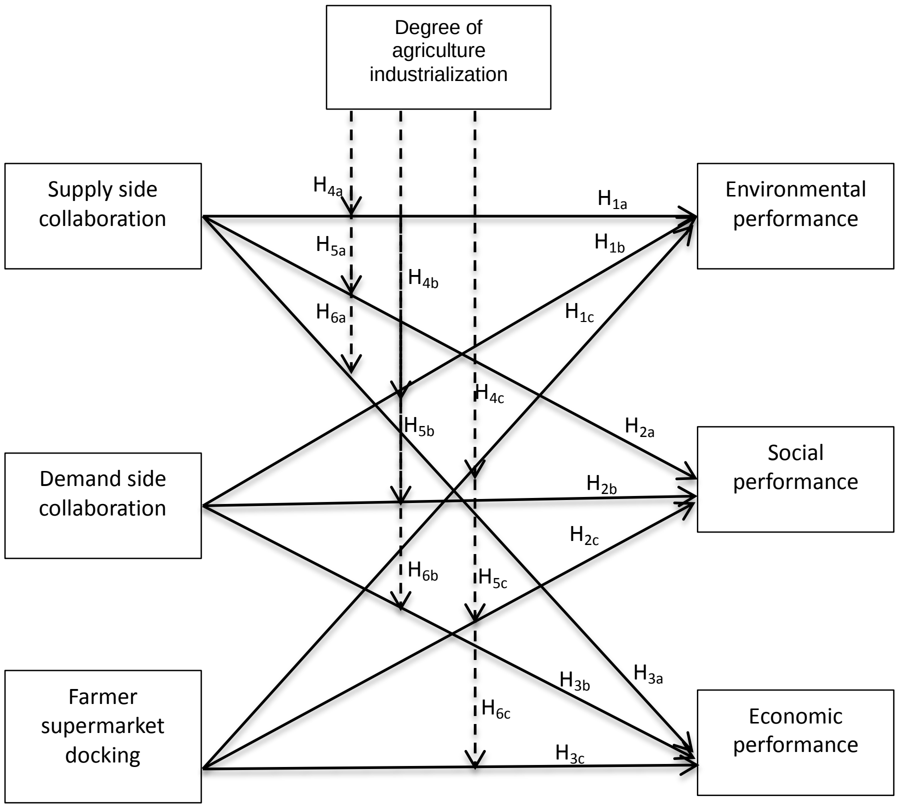

Figure 8: Proposed theoretical framework

Figure 8 illustrates the theoretical framework that includes the six top-level proposed hypotheses (18 hypotheses all together) of three collaboration practices on sustainable performance under the moderating effect of agriculture industrialization.

3.6 Summary

Chapter 3 reviewed and discussed the literature and provided definitions of the key constructs (CP, SP, and AI). The literature review helped identify the most relevant dimensions of sustainable performance using the triple-bottom-line concept. Furthermore, the literature reviews are combined with real-world observations to establish the most widely adopted collaboration practices in the Chinese agriculture industry. The literature on the relationship between supply chain collaboration and sustainable performance is emphatically explored. Contingency theory has been applied to explain the inconsistent findings in the literature about the moderating effects of external environmental factors.

To investigate the relationship between CP and SP, relevant theories in collaboration management have been explored, including Transaction Cost Economics, Collaborative Network Theory and Contingency Theory. CNT suggests that collaboration is positively associated with the performance of firms, whereas TCE suggests that the increasing costs and managerial effort may eventually exceed the benefit gained from collaboration. Contingency theory explains the inconsistency. Based on contingency theory and the research introduced in Chapter 2, this chapter also introduced the selection of the exogenous factor agriculture industrialization. By synthesizing the literature findings and developing the related theoretical arguments, a theoretical framework (Figure 8) comprised of six top-level research hypotheses (18 hypotheses all together) has been established.

Chapter 4: Methodology

4.1 Introduction

This chapter presents an overview of the research design and the chosen methodological approaches believed to be the most effective for the research objectives. Justification of selecting particular research methodologies such as hierarchical regression modelling has also been thoroughly discussed to maintain a good standard of methodological rigor. Taking the stance of ‘critical realism’ (Wass and Wells, 1994) as a general research philosophy, the proposed theoretical framework discussed in the previous chapter is derived initially from the literature review and relevant theory synthesizing, but it must be properly verified by real-world observations. Such ‘critical realism’ philosophy, however, often involves empirical studies in which real-world observation and its resultant data are collected through survey instruments. Then the proposed model will be empirically tested with an appropriate statistical or mathematical tool such as Regression Model using the data collected from a questionnaire. This research generally follows the critical realism approach, which also deploys several empirical study methodologies that operationalize the philosophical approach. Such a general research approach design is not new. In fact, it has been quite widely adopted in the concurrent literatures, such as the initiative design (Golicic and Davis, 2012), in which the findings in literature were used to develop the framework, and the collected data support the main quantitative methods which in turn test the framework.

Furthermore, this chapter provides details on the development of the measurements for each construct, the design of the questionnaire and data collection processes. All data used in the study have been properly screened and tested for reliability and validity before they were analysed. Finally, this chapter introduced the analysis technique used to test the hypotheses—regression analysis.

4.2 Research philosophy

A widely agreed-upon and adopted research methodology for social science including management science can be explained as a three-layer approach model (see Figure 9). The model is adapted from Saunders et al. (2011), who believe that a philosophical approach is the foundation of the research strategy which in turn affects data collction and its subsequent analysis techniques. In the context of this research, Saunders et al.'s model addresses the three methodological questions.

- What philosophical assumption underpin this research?
- What is the design of the research?
- What are the data collection and analysis techniques of the research?

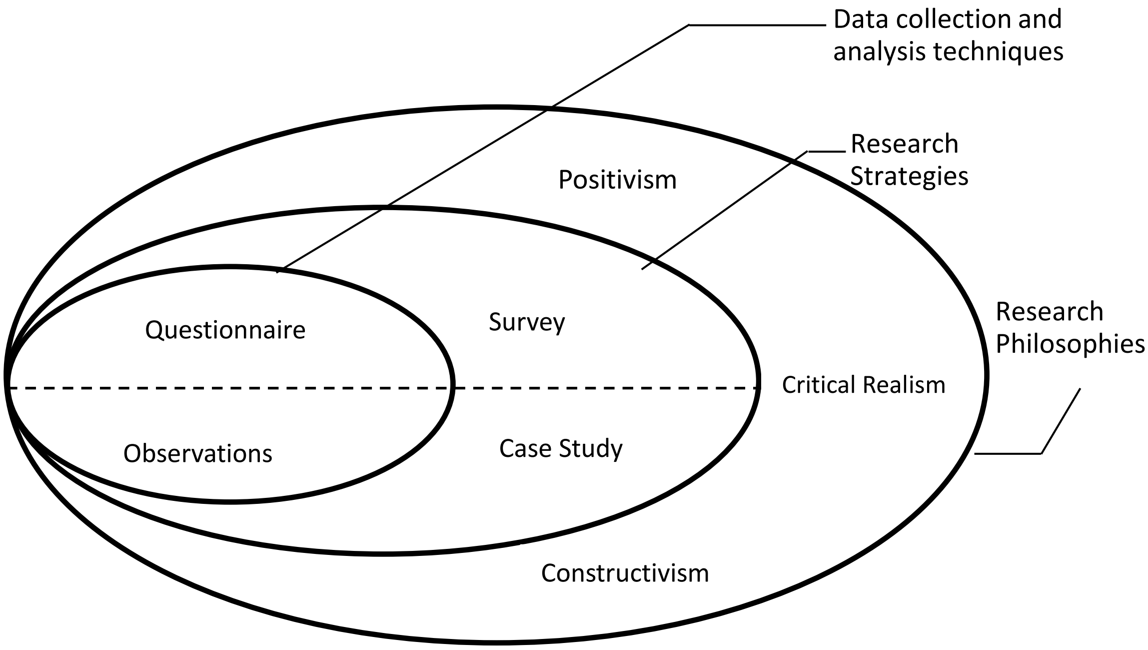

Figure 9: Research methodology three-layer approach, adapted from Saunders et al. (2011)

4.2.1 Philosophical approaches

In accordance with the three-layer approach, Saunders et al. (2011) clarify the connections between philosophical approach, research strategy, data collection technique and analysis approach. Positivism and constructivism are two well-known schools of thought in the philosophy of scientific research, in which each approach makes different assumptions about the nature of reality and the concerns between the knower and what is knowable. Each school of thought will be discussed according to the following questions.

1) Ontological question: what is the nature of reality and the knowable?
2) Epistemological question: what is the relationship between the knowable and the knower?
3) Methodological question: what techniques will be used to seek out

knowledge?

First, positivists believe that an objective reality can be obtained due to the invariant natural laws, which is known as the realist ontology (Guba, 1990). The primary premise that a positivist works on is that the researcher can fully understand the truth through objective and independent research. Consequently, the research process includes no personal opinions, which is known as an objectivist epistemology (Denzin and Lincoln, 2011). Methodologically, positivists usually use sampling techniques and rigorous measurement to establish general rules that are suitable for the majority, which undoubtedly is the only way of getting to the truth. On the other hand, the constructivists believe that no objective truth can be obtained and reality only exists in one's mind. Research findings include continuous interactions between the knowable and the knower, which is known as subjectivist epistemology. Contrary to positivism, constructivists firmly believe it is impossible for the knower to keep personal thoughts out of the research process. Thus, they try to minimize misconception, interpret various researchers' subjective opinions, and finally to draw a consensus result. In a word, constructivists tend to use observation techniques and interviews to create a non-generalizable result.

According to Bowersox (1969), logistics studies have been dominated by positivist research approaches since the 1950s. Moreover, recent study suggests that a positivist approach is commonly adopted in the field of supply chain management (Burgess et al., 2006). However, positivism and constructivism are two extreme approaches in research philosophy. This research will use a middle ground approach that includes more diversified methodologies such as critical realism. Also known as post-positivism, critical realism to some extent integrates the idea of positivism and constructivism (Wass and Wells, 1994). The assumptions that differentiate critical realism from positivism and constructivism are that they believe truth is out there but can never be fully understood due to the unavoidable subjective consciousness of researchers. As Figure 9 shows, critical realism includes context analysis while applying objective quantitative analysis. To answer the research questions, this study carries out the context analysis from the literature and case studies, which addresses the first two questions. The rigorous quantitative analysis, on the other hand, addresses the final two research questions proposed in Chapter 1. Therefore, critical realism is perhaps a more suitable philosophical approach for this research. Methodologically, a critical realist usually uses multiple research techniques to reduce subjectivity (Wass and Wells, 1994). The chosen philosophical approach as the first layer therefore paves the way for the next layer, which is about selecting the appropriate research strategies.

This research adopts multiple methods to triangulate research findings (Boyer and Swink, 2008). The main reason for this is to avoid any possible weakness and disadvantage of any single method (Mangan et al., 2004; Carter and Roger, 2008). By using both qualitative and quantitative methods, the result can be cross-validated (Batenburg, 2007) to ensure its validity. As far as the third layer is concerned, the main research methods are considered to be predominantly empirical survey, combining qualitative methods such as real-world observation to provide depth to the research.

4.2.2 Research strategy

Edmondson and McManus (2007) suggest that the overall research strategy should seek a methodological fit. In another words, prior research, research questions, research design and theoretical contribution should remain coherent with each other.

As far as this research subject is concerned, the prior published research appears to fall into the intersection between the well-established literature on the relationship between supply chain collaboration and sustainable performance and the less consolidated literature on the moderating effect of the relationship, in particular on the Chinese agriculture industry. Therefore, given the gaps and contradictions related to the relationship between collaboration practices and sustainable performance highlighted in Chapter 3, prior research can be perhaps considered to be still in its infancy.

In fact, the research questions set out in Chapter 1 are designed to advance the relevant theories beyond the infancy stage. In particular, the questions are targeted towards ‘understanding how exogenous factor impacts on the relationship between supply chain collaboration and sustainable performance’ in the Chinese agriculture industry. The research questions aim at investigating the contingency effect of the most influential exogenous factor in the recent Chinese agriculture research agenda.

Bearing in mind that the primary aim of this research is to examine the relationships of key conceptual factors or constructs rather than to design measurements for the theoretical constructs, each construct can only be considered valid when it is supported by the measurement indicators according to the basic theories of structural equation modelling (SEM). The measurements used in this research are adapted from many past studies. Specifically, after reviewing the literature, real-world observations in the form of a second-hand case study are gathered. The questionnaires are designed to fit the purpose of real-world observation while making good use of prior research in which those required measurement indicators are already well established. Duplication of discussion of the validity of each adopted measurement has thus been avoided. After the questionnaires were designed, they were sent to a small number of supply chain experts to be validated and endorsed.

4.2.3 Research questions

Building on the evidence from the literature review, the field research carries out the actual data collection for the measurements with consideration of some control variables to be discussed in detail later. From the research methodological perspective, this research addresses the following critical questions in the context of the Chinese agriculture industry in recent years.

- RQ1 What are the most widely adopted supply chain collaborative practices in Chinese agro-food supply chains?

- RQ2.1 What are the key measurement dimensions for the construct of sustainable performance in the literature?
- RQ2.2 How does each measures contribute to overall sustainable performance?
- RQ3.1 What is the relationship between collaborative practice and sustainable performance?
- RQ3.2 Would the relationship be positive and remain stable regardless?
- RQ4.1 What is the most influential exogenous factor in the recent Chinese agriculture research agenda?
- RQ4.2 How much moderating power can this external factor exert onto the collaboration-performance relationship?

The four research questions are designed to progressively achieve the research objective. The first two research questions examine background knowledge on the theoretical constructs. RQ1 looks at the most widely adopted supply chain collaborative practices in Chinese agro-food supply chains, which will be addressed by reviewing the literature and conducting real-world observations. RQ2 looks at the key measurement dimensions for the construct of sustainable performance in the literature, which will lead to discussion of how each dimension of sustainable performance might contribute to overall sustainable performance. RQ1 and RQ2 serve as the fundamental knowledge questions that will lead to further theoretical framework building and testing.

RQ3 looks at the relationship between CP and SP, which can be addressed partially through an intensive literature review. As has already been observed in Chapter 3, there are some significant inconsistency and research gaps in the literature, which will lead to the idea of contingency effect.

Finally, RQ4 seeks to identify the most influential exogenous factor in the recent Chinese agriculture research agenda, which will lead to the central investigation on the moderating power it may exert on collaboration performance. This will in turn explain the underlying reasons for the inconsistency of research findings in the literature.

4.2.4 Research approach

Inductive and deductive approaches are often used in supply chain research (Saunders, 2011). The inductive approach is to oberve, collect data and develop a theory or model after analysing the results (Hepp et al., 2007). On the other hand, the deductive approach is to build or infer a new model according to existing knowledge or theory and then to collect relevant data to verify the model (Saunders, 2011). This research follows an abductive approach developed from the framework proposed by Mentzer and Kahn (1995), which has some combined benefits of both inductive and deductive approaches. Figure 10 illustrates the abductive reasoning approach.

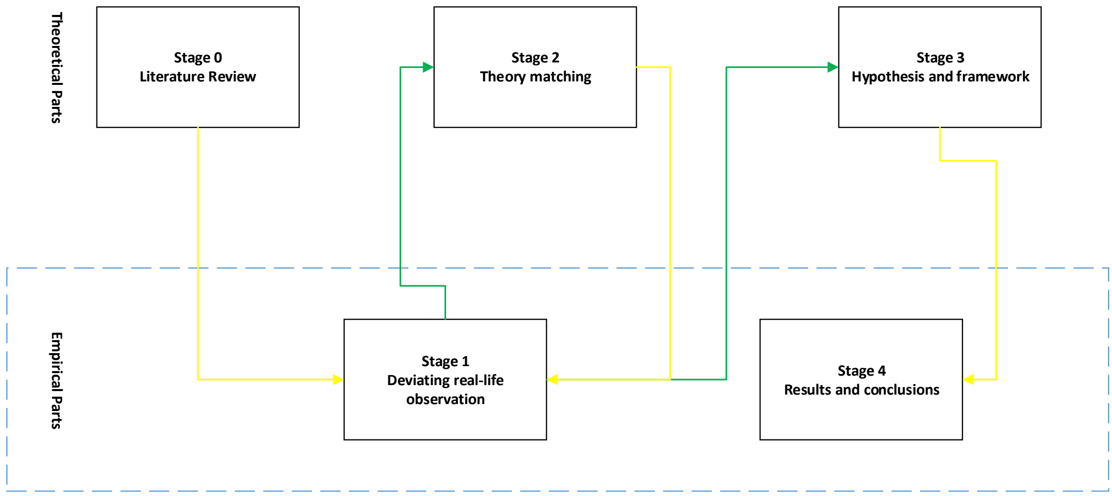

Figure 10: Process of abductive reasoning approach (Kovacs and Spens, 2005) Key: Yellow arrows indicate inductive approach, green arrows indicate deductive approach

The abductive approach is mainly used to examine the relationship between the connected constructs in a conceptual framework using both inductive and deductive approaches. Figure 10 shows the five main stages.

- To begin with idea generation, the literature is reviewed as a theoretical foundation.
- Real-world observations are made to provide justifications for the theoretical framework, including constructs and measurements.
- Real-world observations are matched with theoretical knowledge.
- Theoretical framework and constructs measurements are established.
- The proposed hypothesis is examined with appropriate methods, and the research outcome is discussed.

4.3 Research design

To empirically test the hypotheses, this study adopts a well-established quantitative approach in collecting, validating and analysing the survey data. This section starts by justifying how each construct is measured and how the data are collected and analysed. Then, a justification of selecting the appropriate data analysing method is presented. Given the importance and rapid development of the Chinese agriculture industry, the unit of analysis for this research is Chinese agriculture enterprises, including some leading agricultural enterprises and agricultural associations/co-operatives. As the third largest country in national territorial area, China contributes more than half the world's vegetable production. Therefore, how well China's agricultural sector develops and how sustainable it becomes will have an enormous impact on the global economy as well as the global environment. In addition, the Chinese agriculture industry has implemented intensive collaborative practices between supply chain members as a key strategic change in its supply chain management. The research outcomes anticipated from this study will hopefully provide positive managerial implications to policy-makers and practitioners. To reduce potential results bias, this research focuses on a single industry in China since different industries with different management strategies and organizational behaviour patterns could confound the research issues unnecessarily. Prior research reported in the literature has also concluded that by focusing on a single industry can reduce bias (Lockstroem et al., 2010).

In regards to the respondent groups from which the empirical data are to be collected, this research has identified 137 Agriculture related firms which the survey will be sent. Table 5 illustrates some examples of the selected firms.

合肥市新世野枣业专业互助社	Hefei Xinshiye Jujube Professional Association
肥东徽贡枣莳植专业互助社	Feidongwei Jujube Professional Association
肥东县撮镇雪花藕专业互助社	Feidongxian Cuozhen Snow lotus root Professional Association
合肥浩源生果专业互助社	Hefei Haoyuan Crud Fruit Professional Association
肥东运达蔬菜专业互助社	Feidong Yunda Vegetable Professional Association
肥东县柯岗蔬菜专业互助社	Feidongxian Kegang Vegetable Professional Association
肥东县古龙红薯农夷易近专业互助社	Feidongxian Gulong Sweet Potato Professional Association
肥东县世华生态农业专业互助社	Feidongxian Shihua Eco Agriculture professional Association
安徽长风农牧科技有限公司	Anhui Changfeng technology agriculture Ltd
合肥顶绿食品股份有限公司	Heifei Dinglu Food Co.Ltd.
肥东县徽之皇蔬菜专业互助社	Feidongxian Weizhihuang Vegetable Professional Association
肥东县金色年夜地蔬菜专业互助社	Feidongxian Jinsenianyedi Vegetable Professional Association
安徽东宝食品有限公司	Anhui Dongbao Food Ltd
安徽鸿汇食品集团有限公司	Anhui Honghui Food Ltd
安徽青松食品有限公司	Anhui Qingsong Food Ltd
安徽隆平高科种业有限公司	Anhui Longping High-tech industry Ltd.
合肥徽香缘绿色食品有限公司	Hefei Weixiangyuan Green Food Ltd
安徽大世界果品有限责任公司	Anhui Dashijie Fruit Ltd

Table 5 : Selected Chinese agriculture-related enterprises

They are all from the same agro-food industry category and are the leading companies in both industrialization and supply chain management practices. The author initially approached the Department of Agriculture in Hefei Province and obtained contact lists of agriculture related firms. The selected companies have made great efforts to develop modern agriculture and built a standardized agricultural product management service system from production to marketing channels, as well as to improve peasants' welfare. The selection criteria of the responding firms are:

1) Responding firms need to have adopted at least one collaboration practice in the past 5 years.

2) Responding firms need to be in the fresh agriculture industry, such as fruits and vegetables, since different livestock supply chains would have different natures.
3) The responding firms need to have been established for at least 5 years.

Following the concept of Podsakoff et al. (2003), the respondents could choose to keep personal information anonymous to avoid the 'common rater' effect, which means the respondents tend to provide consistent or desirable answers. The key respondents targeted by this research are middle level managers. Using mid-level managers as the key respondents is highly recommended by Zhu, Sarkis and Lai (2008), who suggest that mid-level managers are involved in daily management and decision-making processes and hence have better understanding of supply chain management issues. For instance, they tend to have more insightful knowledge about recently introduced supply chain integrative practices and performance. Similarly, Bowen et al. (2001) point out that middle-level managers tend to have a positive attitude towards environmental issues due to their adequate involvement and sufficient exposure to sustainability-related legislation, regulation and social issues. The subsequent data collection and analysis are discussed in section 4.6.

4.4 Methodologies in the literature

A summary of what has been applied in similar researches could provide some justification for the choice of research methodologies. The aim of this section is to review the often-adopted research methodologies in investigating the relationships in supply chain management domain and provide support to the selection of research methodologies. The research design is also influenced by and based on the methodological applications in the research field from the literature.

Among the 40 journal articles reviewed (see Table 6), the majority used factor analysis (57.5%). All the papers that used factor analysis adopted a Likert-type scale for measuring the constructs. About 20% of the papers implemented a combination of factor analysis and regression analysis, and 22.5% used a qualitative research approach (interview, simulation or case study). Thus, factor analysis and regression analysis are two of the most widely adopted methodological tools for examining relationships between constructs.

Author	Year	Research methodology	Sample size
Sheu, Yen and Chae	2006	Case study	Five pairs of suppliers and retailers
Thron, Nagy and Wassan	2007	Discrete-event simulation	N/A
Lee, Kwon and Severance	2007	Multivariate regression models	122
Stephan Vachon, Robert D. Klassen	2008	Structural equation modelling	84
Mikihisa Nakano	2009	Structural equation modelling	65
Eve D. Rosenzweig	2009	Regression analysis	86
Gilbert N. Nyaga et. Al	2010	Structural equation modelling	370 buyer, 255 supplier
Cecilia Soler, Kerstin Bergstrom and Helena Shanahan	2010	Interview	15
Ogan M. Yigitbasioglu	2010	Structural equation modelling	221
Gilbert N. Nyaga and Judith M. Whipple	2011	Structural equation modelling and regression analysis	435
Iyer	2011	Linear regression analysis	152
Cao and Zhang	2011	Structural equation modelling	211
Jinsoo Kim and Jongtae Rhee	2012	Structural equation modelling	249
Kenneth W. Green, Je et al.	2012	Structural equation modelling	159
Cristina Gimenez and Elcio M. Tachizawa	2012	A structured literature review	N/A
Cristina Gimenez, Vicenta Sierra, Juan Rodon	2012	Structural equation modelling and regression analysis	519
Suhaiza Zailani et al.	2012	Structural equation modelling	400
Kim and Rhee	2012	Structural equation modelling	249
Giovanni and Vinzi	2012	Structural equation modelling	138
Oguz Morali and Cory Searcy	2013	Case studies and interview	100 case and 18 interview
Christina Gimenez and Vicenta Sierra	2013	Structural equation modelling	109-Germany; 79-spain
Chen, Sohal and Prajogo	2013	Structural equation modelling	203
Pietro De Giovanni and Vincenzo Esposito Vinzi	2014	Confirmatory factor analysis and regression analysis	120
Seyed Mostafa Mirhedayatian et.al	2014	HSBM(network slack based measure) and case study	10

Subrata Mitra and Partha Priya Datta	2014	Structural equation modelling	81
Arijit Bhattacharya et al.	2014	ANP	N/A
Philip Beske and Stefan Seuring	2014	Comparison analysis	N/A
Constantin Blome, Antony Paulraj and Kai Schuetz	2014	Structural equation modelling and regression analysis	259
Nix and Zacharia	2014	CFA, structured interview and survey	473
Giovanni and Vinzi	2014	Structural equation modelling	178
Yang	2014	Path analysis	137
Wu, Chuang and Hsu	2014	Structural equation modelling	177
Hartley, Brodke and Wheeler	2014	Path analysis	126
Elcio M. Tachizawa and Cristina Gimenez and Vicenta Sierra	2015	Structural equation modelling and regression analysis	143
Frank Wiengarten and Annachiara Longoni	2015	Factor analysis	90
Ana Beatriz Lopes de Sousa Jabbour et al.	2015	Structural equation modelling	95
Yenming J.Chen et al.	2015	Regression analysis	205
Fahian Anisul Huq et al.	2016	Case studies	N/A
Olga chkanikova	2016	Case studies and interviews	N/A
Macchion et al.	2017	Confirmatory factor analysis and hierarchical regression analysis	125

Table 6: Research methodology in collaboration management research

Table 7 further illustrates the research context for the reviewed articles. The majority of the studies were conducted in the manufacturing industry (55%), and only 7.5% of them investigated the food industry. Among those, most of the researches into the food industry appear to have used mainly the qualitative research methodology, such as interview and case studies. Therefore, those studies in the agriculture industry tend to remain at the qualitative level. It would be more informative, however, if further research could show some empirically tested results to support the theories using quantitative research methods.

Author	Year	Industry/Location/Respondents
Sheu, Yen and Chae	2006	Taiwan
Thron, Nagy and Wassan	2007	Medium size food manufacturer
Lee, Kwon and Severance	2007	U.S
Stephan Vachon, Robert D. Klassen	2008	North American manufacturing industry
Mikihisa Nakano	2009	Japanese manufacturing industry
Eve D. Rosenzweig	2009	50 US Manufacturers
Gilbert N. Nyaga et. Al	2010	Manufacturing & service industries in US
Cecilia Soler, Kerstin Bergstrom and Helena Shanahan	2010	Purchasing managers in food industry
Ogan M. Yigitbasioglu	2010	119 Finnish and 102 Swedish firms
Gilbert N. Nyaga and Judith M. Whipple	2011	Procumbent managers
Iyer	2011	Manufacturing industry
Cao and Zhang	2011	U.S Manufacturing industry
Jinsoo Kim and Jongtae Rhee	2012	Korea
Kenneth W. Green, Je et al.	2012	Manufacturing industry
Cristina Gimenez and Elcio M. Tachizawa	2012	N/A
Cristina Gimenez, Vicenta Sierra, Juan Rodon	2012	Assembly industry
Suhaiza Zailani et al.	2012	Manufacturing in Malaysia
Kim and Rhee	2012	Korea
Giovanni and Vinzi	2012	Italian firms
Oguz Morali and Cory Searcy	2013	Eight industry sectors including energy, financial, food, forestry, manufacturing, metals-mining, telecom, and transportation.
Christina Gimenez and Vicenta Sierra	2013	Purchasing managers in Germany and Spain
Chen, Sohal and Prajogo	2013	Manufacturing industry in Australia
Pietro De Giovanni and Vincenzo Esposito Vinzi	2014	North America package printing industry
Seyed Mostafa Mirhedayatian et.al	2014	Soft drinks manufacturing industry
Subrata Mitra and Partha Priya Datta	2014	Indian manufacturing industry
Arijit Bhattacharya et al.	2014	Manufacturing industry

Philip Beske and Stefan Seuring	2014	General
Constantin Blome, Antony Paulraj and Kai Schuetz	2014	European manufacturing firm
Nix and Zacharia	2014	Supply chain managers
Giovanni and Vinzi	2014	Italian
Yang	2014	Manufacturing industry in Shanghai
Wu, Chuang and Hsu	2014	Manufacturing industry in Taiwan
Hartley, Brodke and Wheeler	2014	Operation managers
Elcio M. Tachizawa and Cristina Gimenez and Vicenta Sierra	2015	Spanish purchasing and supply managers
Frank Wiengarten and Annachiara Longoni	2015	Assembly manufacturing production & operation managers
Ana Beatriz Lopes de Sousa Jabbour et al.	2015	Brazilian firm with IOS14001
Yenming J.Chen et al.	2015	EEE related industries in Taiwan
Fahian Anisul Huq et al.	2016	Bangladesh exporting industry
Olga chkanikova	2016	Food industry in Sweden
Macchion et al.	2017	Italian fashion industry

Table 7: Research context

4.5 Measures and questionnaire design

This research adopts a quantitative approach by collecting survey data from the Chinese agriculture industry. The measurements were designed in three steps. First, the measurements of the key constructs (SSC, DSC, FSD, AI, EcoP, ScoP and EnvP) were developed based on the existing knowledge from literature. Since this research investigates relationships rather than contributing to the measurement terms, the author adopts the already established measurements from literature and modifies them when necessary. Then the measurements are pre-tested through interviews with companies’ managers in agriculture enterprises to discuss and validate each measurement before the piloting test. Therefore, the measurements from existing literatures are validated using interviews before sending to the final respondents. Table 8 shows the measurement items for each construct.

Construct	Observable factors
Supply side sustainability collaboration	SSC1 - We cooperate with our suppliers to achieve sustainability objectives
	SSC2 - We provide our suppliers with sustainability requirements for their process
	SSC3 - We collaborate with our suppliers to provide products and/or services that support our sustainability goals
	SSC4 - We develop a mutual understanding of responsibilities regarding sustainability performance with our suppliers
	SSC5 - We conduct joint planning to anticipate and resolve sustainability-related problems with our suppliers
	SSC6 - We periodically provide suppliers with feedback about their sustainability performance
Farmer supermarket docking	FSD1 - Farmers directly cooperate with supermarket to reduce transaction costs
	FSD2 - Farmers directly cooperate with supermarket to improve information exchange.
	FSD3 - Farmers directly cooperate with supermarket to improve farmers income/welfare
	FSD4 - Farmers directly cooperate with supermarket to stabilize fresh agro-food price
	FSD5 – Farmers directly cooperate with supermarket to ensure food safety.
Supply side collaboration	SSC1 - We cooperate with our customers to achieve sustainability objectives
	SSC2 - We cooperate with our customers to improve their sustainability initiatives
	SSC3 - We collaborate with our customers to provide products and/or services that support our sustainability goals
	SSC4 - We develop a mutual understanding of responsibilities regarding sustainability performance with our customers
	SSC5 - We correct joint planning to anticipate and resolve sustainability-related problems with our customers
Agriculture industrialization	AI1 - The percent of farms in a county organized as corporations
	AI2 - Farm size in acres in a county
	AI3 - The percent of farmers in the county having more than 50000 Chinese Yuan in sales
	AI4 - Percent of farmers with full time hired labour
	AI5 - Cost of hired labour per farm
	AI6 - Value of contract labour per farm
	AI7 - Cost of fertilizers per farm
	AI8 - Costs of other chemicals per farm
Social performance	SOC1 - Increase of management commitment
	SOC2 - Increase of customer satisfaction
	SOC3 - Increase of employee development
Economic performance	ECO1 - Decrease of cost for materials purchasing
	ECO2 - Decrease of cost for energy consumption
	ECO3 - Decrease of fee for waste treatment

	ECO4 - Decrease of fee for waste discharge ECO5 - Decrease of fine for environmental accidents ECO6 - Increase of investment ECO7 - Increase of operational cost ECO8 - Increase of training cost ECO9 - Increase of costs of purchasing
Environmental performance	ENV1 - Reduction of air emission ENV2 - Reduction of waste water ENV3 - Reduction of solid wastes ENV4 - Decrease of consumption for hazardous/harmful/toxic materials ENV5 - Decrease of frequency of environmental accidents ENV6 - Improve an enterprises' environmental situation

Table 8: Measurements for each construct

The measurement of sustainable performance was adopted from Zhu and Sarkis (2007), Carter and Rogers (2008), Gunasekaran and Spalanzani (2012), Pochampally et al. (2009) and Dues et al. (2013). Furthermore, the measures of supply side collaboration and demand side collaboration were adopted from the study by Blome, Paulraj and Schuetz (2014). Farmer-supermarket docking (FSD) is a widely applied collaborative practice in the current Chinese agriculture industry. As a result, the measurement for FSD is adapted mainly from studies focusing on the Chinese agriculture industry (Zhang and Xu, 2010; Zhang and An, 2010; Bartenstein, 2010). Agriculture industrialization is conceptualized as a composite measure of industrialization level based on the scale developed by Bartenstein (2010). A five-point Likert scale was used for all the constructs. A higher value indicates a higher level of collaboration and higher degree of agriculture industrialization or a better performance. For economic performance, this research takes both positive and negative performance into consideration (Zhu and Sarkis, 2007). To ensure consistency, the scale for negative performance is reversed, so that 1 indicates high performance and 5 indicates low performance. In total, 7 constructs with 42 observable measurement factors are captured in the model.

4.6 Data collection

The second step is pre-testing the questionnaire. This research adopted a random sampling strategy. Simple random sampling is a type of probability sampling techniques. With the random sampling, there is an equal change of selecting each unit from the population being studied. The author contacted the Department of Agriculture in An’hui province for the contact lists. There are in total of 685 contacts obtained from 137 agriculture related enterprises. The sampling population are mid-level managers in agriculture related enterprises in An’hui province. Including managers from different positions (such as, logistic manager, operation manager, purchasing manager) in a company can provide a comprehensive view to the matter. The sample for this research was identified from the Ministry of Agriculture in An’hui province. A contact list of 137 leading agriculture enterprises and agriculture associations/cooperatives in China was established. The author randomly contacted 12 companies, and 6 of them agreed to help in the questionnaire validation process. The author held several telephone meetings with companies’ managers to discuss and validate the survey questions and measurements. Some modifications and improvements were made mainly in terms of the clarity of language to help respondents better understand the questions. Furthermore, two managers suggested including firm’s collaboration portfolio as a control variable since it could impact a firm’s overall performance. Thus, the author included the collaboration portfolio as a control variable.

The survey was initially designed in English and then translated into Chinese by two experts in Chinese operation research. After this, the questionnaire was translated back into English by two more operation management researchers. The translated Chinese version was compared with the original English version to ensure conceptual equivalence (King, 2011). Then, as suggested by Hensley (1999), the revised questionnaire was pilot-tested with a small scale survey (35 respondents) to ensure that the indicators (measurements) were clear and relevant to real-world practices in the Chinese agriculture industry. The questionnaire has been further improved based on the feedback from the pilot test.

Finally, the survey questionnaire was sent to everyone in the contact list from the selected 137 agriculture companies. The author followed Frohlich's (2001) suggestion to improve the response rate by contacting all the responding firms before sending out the questionnaire. The questionnaire was designed in a WeChat application (a widely used communication application in China) that can be answered using either a computer or a mobile phone. This allows the questionnaire to be easily distributed and answered. Furthermore, 685 questionnaires were sent. Twenty-seven returned questionnaires were discarded due to incomplete responses, so 134 usable responses were collected. A response rate of 19.6% is considered reasonable in operational management research (Malhortra and Grover, 1998). A profile of respondent's statistics is included in table 9. No further statistical analysis will be performed since the number of respondents from the same company are not sufficient enough.

Profile of respondents	%of respondents
Gender	
Male	62.3%
Female	37.7%
Education level	
Primary school or less	12.7%
Junior high school	19.4%
Graduated high school	28.4%
Graduated college	23.9%
Bechelor's degree	11.9%
Post graudate degree	3.7%
Position within company	
Company director	3.0%
Production manager	12.3%
Marketing manager	16.5%
Operation manager	22.1%
Purchasing manager	8.0%
Logistic and supply chain manager	37.6%
Employee age group	
>=25	3.0%
26-35	17.2%
36-45	26.9%
46-55	34.3%
56-65	11.9%
>65	6.7%

Table 9: Respondents profile

4.7 Control Variables

Several firm-level control variables were introduced to ensure that the testing of the model is not significantly biased by factors that were not constructed into the model. Methodologically, however, such bias is quite commonplace and will typically result in omitted variable bias (OVB) (Clarke, 2005). This research adopted Li, Poppo and Zhou (2008)' study by considering industry effects, firm age, and firm size as the main control variables, plus, the collaboration portfolio size as mentioned earlier. They are briefly defined below and summarized in Table 9.

- First, industry effects (IE) are widely recognized as predictors of firm-level variables in the literature (Dess, Ireland, and Hitt, 1990). To control industry effects, this research only focused on the Chinese agriculture industry. The selected respondents are all from the agriculture industry.
- Firm age (FA) can be an influencing factor for the firm's competitive advantage and dynamic capabilities (Zahra, Ireland and Hitt, 2000). This research uses the number of years the firm has been in operation since its establishment as a control variable. The author classifies firm age into 5 categories ranging from 1 for firms established less than 5 years prior to 5 for firms that are more than 50 years old (Capron and Mitchell, 2009).
- Firm size (FS) is another influencing factor for the firm's competitive advantage. Large companies tend to have a lower cost of capital and lower risk (Chang and Thomas, 1989). Furthermore, large firms tend to have better access to resources, which creates dynamic capabilities. This research used the number of full-time employees as a control variable. The author classifies firm size into 5 categories ranging from 1 for firms that have less than 20 employees to 5 for firms that have more than 500 employees (Capron and Mitchell, 2009).
- Collaboration Portfolio. According to Powell et al. (1996), a firm's

collaborations and alliances activities have recognizable impact on its performance outcomes. Firms with large collaboration portfolios tend to have an institutionalized management strategy. This research uses the number of current alliances to measure the collaboration portfolio size. The author classified firm size into 5 categories ranging from 1 for firms that have less than 5 alliances to 5 for firms that have more than 50 alliances (Jiang, Tao and Santoro, 2010).

- Dummy Variables. Because the survey respondents work at both agriculture leading enterprises and at agriculture associations/cooperatives. Therefore, the author adopted Mithas, Ramasubbu and Sambamurthy (2011)'s approach by using dummy variables to record the difference (1= agriculture leading enterprises, 0= agriculture associations/cooperatives).

As shown in Table 9, majority of the selected firms are small and medium sized agriculture associations/co-operatives between 5 to 10 years old, with a low collaboration portfolio.

Descriptive Information	**%of respondents**
Firm Age	
0-5 years	3.0%
5-10 years	66.4%
10-25 years	24.6%
25-50 years	3.7%
More than 50 years	2.2%
Agriculture sector	
Agriculture leading enterprises	14.9%
Agriculture association/cooperative	85.1%
Collaboration portfolio	
0-5 alliances	56.7%
5-10 alliances	38.1%
10-25 alliances	3.0%

25-50 alliances	0%
More than 50 alliances	2.2%
Number of employees	
<20 employees	0%
20-100 employees	59.7%
100-250 employees	27.6%
>250 employees	12.6%

Table 10: Descriptive statistics of respondents

4.8 Measurement validation and reliability

4.8.1 Reliability test

As discussed in section 4.5, the questionnaire contains a total of 42 observable measurement factors that form the initial measurement model (see Table 8).

Most of the measures usually reflect not only the theoretical meaning of the construct, but also measurement error (Bagozzi et al., 1991). Such error could be a critical problem in measuring constructs (Hair Jr et al., 2010). Therefore, it is necessary to examine the validity of each construct before testing the hypotheses (Bagozzi et al., 1991).

According to Bagozzi and Yi (2012), construct validity is the extent to which indicators of a construct measure what they are purported to measure. Thus, the validity of each construct is tested to make sure it is measured correctly before conducting further analysis. This research used Cronbach's alpha to measure internal consistency between the factors (Cronbach, 1951). A high level of Cronbach's alpha indicates the relationship between measurements and constructs is significant, whereas a low level indicates that the measuring items are unable to capture the constructs. As recommended by Hair (2010), alpha value greater than 0.6 is good enough for conducting research in social science. Therefore, to test composite reliability and total reliability, Cronbach's alpha has been applied to the 7 individual constructs and the whole model. As Table 10 shows, the Cronbach's alpha value for each construct was 0.804 for SSC, 0.739 for DSC, 0.811 for FSD, 0.881 for AI, 0.825 for SOC, 0.914 for ECO and 0.858 for ENV. Satisfactorily, the values are all above the acceptable value of 0.7.

1. Supply side sustainability collaboration	**Cronbach's alpha**
We cooperate with our suppliers to achieve sustainability objectives	0.804
We provide our suppliers with sustainability requirements for their process	
We collaborate with our suppliers to provide products and/or services that support our sustainability goals	
We develop a mutual understanding of responsibilities regarding sustainability performance with our suppliers	
We conduct joint planning to anticipate and resolve sustainability-related problems with our suppliers	
We periodically provide suppliers with feedback about their sustainability performance	
2. Farmer supermarket docking	
Farmers directly cooperate with supermarket to lower transaction costs	0.811
Farmers directly cooperate with supermarket to improve information exchange.	
Farmers directly cooperate with supermarket to improve farmers income/welfare	
Farmers directly cooperate with supermarket to stabilize fresh agro-food price	
Farmers directly cooperate with supermarket to ensure food safety	
3. Demand side sustainability collaboration	0.739
We cooperate with our customers to achieve sustainability objectives	
We cooperate with our customers to improve their sustainability initiatives	
We collaborate with our customers to provide products and/or services that support our sustainability goals	
We develop a mutual understanding of responsibilities regarding sustainability performance with our customers	
We correct joint planning to anticipate and resolve sustainability-related problems with our customers	
4. Agriculture industrialization	
The percent of farms in a county organized as corporations	0.881
Farm size in acres in a county	
The percent of farmers in the county having more than 50000 Chinese Yuan in sales	
Percent of farmers with full time hired labour	

Cost of hired labour per farm	
Value of contract labour per farm	
Cost of fertilizers per farm	
Costs of other chemicals per farm	
5. Social performance	
Increase of management commitment	0.825
Increase of customer satisfaction	
Increase of employee development	
6. Economic performance	
Decrease of cost for materials purchasing	0.914
Decrease of cost for energy consumption	
Decrease of fee for waste treatment	
Decrease of fee for waste discharge	
Decrease of fine for environmental accidents	
Increase of investment	
Increase of operational cost	
Increase of training cost	
Increase of costs of purchasing	
7. Environmental performance	
Reduction of air emission	0.858
Reduction of waste water	
Reduction of solid wastes	
Decrease of consumption for hazardous/harmful/toxic materials	
Decrease of frequency of environmental accidents	
Improve an enterprises' environmental situation	

Table 11: Cronbach's alpha for each construct

Furthermore, the Cronbach's alpha factor for the whole model has been tested as 0.68, which is arguably acceptable in management research (Tavakol and Dennick, 2011; Hair, 2010). Hence, the composite reliability and total reliability are acceptable.

4.8.2 Exploratory factor analysis

The method of exploratory factor analysis (EFA) is often used to identify the observable factors that measure a specific construct. Hence, the measurements that are correlated and distinct from each other can be classified into a construct. This process is to avoid the effect of collinearity

(Cudeck. 2000). Using EFA, the items are grouped and then compared with the proposed measurement model 1. Based on the initial model shown in Table 10, a total number of 42 measurements are tested.

First, Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were used to test the discriminant validity (Dziuban and Shirkey, 1974). The null hypothesis is that the correlation matrix is not an identity matrix. The test reported a KMO measure of 0.776, showing strong evidence to reject the null hypothesis and accept the alternative hypothesis. Bartlett's test of sphericity shows a Chi-square value of 3246.618, p<0.000. To conclude, both test results suggest the model is suitable for factor analysis.

Then, the principle factor analysis was used on the 42 measurements to determine their factor loading. Promax rotation is used since it is not reasonable to assume the factors are uncorrelated. (Jolliffe, 2005). Factor loadings falling into the range of more than 0.5 under the corresponding constructs and below 0.5 on other constructs are considered reliable (Brown, 2015). Furthermore, the constructs are only extracted with eigenvalues larger than 1. Table 11 illustrates the item loadings after the Promax rotation. The factor loadings on the right constructs are marked in bold, whereas incorrect loadings are marked in red.

Item loadings	**ECO**	**AI**	**ENV**	**SSC**	**FSD**	**DSC**	**SOC**	**OTHER**
ENV1	0.11	-0.12	**0.64**	0.14	0.07	0.02	0.22	-0.05
ENV2	-0.03	-0.18	**0.78**	0.1	0.02	-0.01	0.06	0.05
ENV3	0.07	-0.31	**0.66**	0.02	0.13	0.16	0.04	-0.02
ENV4	-0.02	-0.15	**0.75**	0.14	0.01	0.08	0.11	0.04
ENV5	-0.02	-0.17	**0.71**	0.1	0.15	0.07	0.26	-0.01
ENV6	-0.16	-0.11	**0.69**	0.01	0.29	0.07	0.18	-0.12
SOC1	-0.16	-0.17	0.28	-0.15	0.09	0.06	**0.7**	-0.14
SOC2	-0.1	-0.16	0.39	0.18	0.07	0.08	**0.86**	0.01
SOC3	-0.02	-0.16	0.31	0.18	0.07	0.04	**0.71**	0.17
ECO1	**0.67**	-0.04	-0.01	-0.07	0.21	-0.05	-0.15	-0.29

ECO2	**0.75**	0.01	0.01	0.03	0.14	-0.15	0.24	-0.04
ECO3	**0.72**	0.04	-0.02	0.01	0.02	-0.22	-0.12	0.14
ECO4	**0.76**	-0.01	0.13	-0.01	0.03	-0.02	-0.23	0.1
ECO5	**0.77**	0.08	-0.11	0.12	0.15	-0.07	-0.02	-0.16
ECO6	**0.75**	0.17	0.07	-0.02	-0.06	-0.21	0.05	-0.22
ECO7	**0.76**	0.12	-0.05	0.08	-0.01	-0.09	0.03	0.09
ECO8	**0.76**	0.01	-0.09	0.07	0.15	-0.1	0.02	0.12
ECO9	**0.83**	0.05	-0.06	0.04	0.03	-0.1	0.05	-0.16
AI1	0.05	**0.69**	0.01	-0.17	-0.14	-0.04	-0.27	-0.04
AI2	-0.01	**0.71**	-0.26	-0.06	-0.06	-0.02	-0.03	-0.3
AI3	0.03	**0.7**	-0.29	0.13	0.17	0.04	-0.06	0.21
AI4	-0.03	**0.74**	-0.09	-0.15	-0.14	-0.1	-0.1	-0.19
AI5	0.03	**0.72**	-0.11	-0.09	-0.2	-0.05	0.02	0.23
AI6	0.18	**0.73**	-0.08	-0.03	0.22	-0.02	-0.21	0.08
AI7	0.3	**0.73**	-0.12	-0.02	-0.17	-0.07	0.09	-0.01
AI8	0.05	**0.66**	-0.1	-0.25	0.03	0.18	-0.02	-0.04
SSC1	0.07	-0.13	0.18	**0.74**	-0.13	-0.05	-0.03	0.12
SSC2	-0.07	-0.12	-0.01	**0.78**	-0.09	0.12	0.03	-0.07
SSC3	0.09	-0.04	0.21	**0.84**	0.08	0.03	0.02	0.01
SSC4	-0.04	-0.31	0.2	**0.65**	0.18	0.06	-0.01	-0.25
SSC5	-0.01	-0.66	0.23	**0.09**	0.07	0.06	0.06	-0.01
SSC6	0.17	-0.09	0.18	**0.78**	-0.08	-0.01	0.02	-0.07
DSC1	-0.26	-0.16	0.21	-0.19	-0.3	**0.54**	0.02	0.13
DSC2	-0.27	-0.02	0.14	0.03	-0.08	**0.83**	0.22	-0.04
DSC3	-0.28	-0.03	0.06	0.17	-0.15	**0.63**	0.08	0.08
DSC4	-0.34	-0.01	-0.07	-0.19	-0.06	**0.15**	0.12	**0.6**
DSC5	-0.18	0.02	0.04	0.03	-0.13	**0.77**	0.08	0.02
FSD1	0.18	-0.04	0.03	-0.15	**0.64**	-0.26	0.15	-0.01
FSD2	0.05	-0.35	0.27	-0.06	**0.52**	-0.33	0.06	-0.06
FSD3	0.09	-0.11	0.16	-0.02	**0.78**	-0.18	-0.05	-0.02
FSD4	0.15	-0.08	0.12	0.07	**0.82**	0.03	0.07	-0.1
FSD5	0.21	-0.24	0.35	-0.07	**0.57**	-0.11	0.09	0.27

Table 12: Factor loadings after Promax rotation

With the benchmark value of 0.5, item SSC5 has been removed from the measurement model due to the low factor loadings (<0.5) of its constructs. Item DSC4 is also removed due to its loading on an un-corresponding construct. After removing SSC5 and DSC4, another principal factor analysis was carried out to check the final measurement model including the remaining 40 items. The result is shown in Table 13.

Item loadings	ECO	AI	ENV	SSC	FSD	DSC	SOC
ENV1	0.11	-0.12	**0.64**	0.15	0.07	0.01	0.23
ENV2	-0.04	-0.16	**0.78**	0.1	0.03	-0.01	0.07
ENV3	0.07	-0.33	**0.66**	0.02	0.13	0.16	0.05
ENV4	-0.02	-0.15	**0.75**	0.15	0.01	0.08	0.12
ENV5	-0.02	-0.15	**0.71**	0.11	0.16	0.07	0.27
ENV6	-0.15	-0.11	**0.68**	0.02	0.3	0.07	0.19
SOC1	-0.15	-0.16	0.27	-0.14	0.1	0.05	**0.71**
SOC2	-0.11	-0.15	0.38	0.17	0.07	0.08	**0.87**
SOC3	-0.03	-0.15	0.31	0.16	0.06	0.05	**0.71**
ECO1	**0.69**	-0.03	-0.02	-0.04	0.22	-0.05	-0.15
ECO2	**0.75**	0.02	0.01	0.03	0.14	-0.15	0.23
ECO3	**0.71**	0.03	-0.02	-0.01	0.01	-0.21	-0.12
ECO4	**0.75**	-0.01	0.14	-0.01	0.02	-0.01	-0.23
ECO5	**0.78**	0.08	-0.11	0.13	0.15	-0.07	-0.02
ECO6	**0.76**	0.04	0.07	-0.01	-0.05	-0.21	0.06
ECO7	**0.76**	0.12	-0.05	0.07	-0.02	-0.08	0.03
ECO8	**0.75**	0.02	-0.09	0.05	0.13	-0.08	0.01
ECO9	**0.84**	0.05	-0.06	0.05	0.04	-0.1	0.05
AI1	0.05	**0.69**	0.11	-0.18	-0.14	-0.04	-0.27
AI2	0.01	**0.72**	-0.27	-0.05	-0.04	-0.03	-0.03
AI3	0.02	**0.7**	-0.29	0.11	0.16	0.05	-0.07
AI4	-0.02	**0.75**	-0.09	-0.14	-0.13	-0.11	-0.1
AI5	0.02	**0.73**	-0.11	-0.11	-0.21	-0.04	0.02
AI6	0.18	**0.74**	-0.08	-0.04	0.21	-0.01	-0.21
AI7	-0.01	**0.73**	-0.13	-0.03	-0.16	-0.07	0.09
AI8	0.06	**0.66**	-0.1	-0.25	0.03	0.18	-0.03
SSC1	0.07	-0.12	0.18	**0.74**	-0.14	-0.05	-0.03
SSC2	-0.07	-0.1	-0.02	**0.78**	-0.08	0.12	0.03
SSC3	0.09	-0.04	0.16	**0.83**	0.07	0.03	0.02
SSC4	-0.03	-0.31	0.2	**0.67**	0.18	0.05	0.04
SSC6	0.17	-0.07	0.18	**0.78**	-0.07	-0.01	0.02
DSC1	-0.27	-0.17	0.21	-0.2	-0.31	**0.55**	0.03
DSC2	-0.28	0.22	0.13	0.04	-0.07	**0.83**	0.02
DSC3	-0.29	-0.04	0.06	0.16	-0.16	**0.63**	0.08
DSC5	-0.18	0.01	0.04	0.03	-0.13	**0.76**	0.08
FSD1	0.18	-0.04	0.02	-0.15	**0.64**	-0.26	0.15
FSD2	0.05	-0.34	0.27	-0.05	**0.52**	-0.34	0.06
FSD3	0.1	-0.11	0.16	-0.01	**0.78**	-0.18	-0.05
FSD4	0.15	-0.07	0.11	0.08	**0.82**	0.03	0.08
FSD5	0.19	-0.24	0.35	-0.08	**0.55**	-0.1	0.09

Table 13: Final measurement model with Promax rotation

After the principle component analysis with Promax rotation, 7 constructs have been extracted. As Table 14 shows, the total variance explained is larger than the 60% cut-off value (63.1%), indicating good reliability (Jolliffe, 2002).

Total Variance Explained—Initial Eigenvalues			
Construct	Total	% of Variance	Cumulative%
1	7.83	19.58	19.58
2	6.71	16.77	36.35
3	3.30	8.26	44.61
4	2.61	6.53	51.14
5	2.02	5.05	56.20
6	1.46	3.64	59.84
7	1.30	3.26	63.10

Table 14: Total variance explained

The correlation matrix of the study's construct with corresponding mean and S.D value, in table 15 shows that the proposed model meets this condition.

Item	**Mean**	**S.D**	**Loading**
ENV1	3.39	0.66	0.64
ENV2	3.31	0.54	0.78
ENV3	3.28	0.55	0.66
ENV4	3.6	0.64	0.75
ENV5	3.45	0.61	0.71
ENV6	3.54	0.6	0.68
Soc1	3.31	0.71	0.71
Soc2	3.62	0.67	0.87
Soc3	3.48	0.59	0.71
Eco1	3.33	0.63	0.69
Eco2	3.8	0.68	0.75
Eco3	3.49	0.72	0.71
Eco4	4.07	0.66	0.75
Eco5	3.95	0.68	0.78
Eco6	4.01	0.64	0.76
Eco7	3.8	0.65	0.76
Eco8	2.89	0.67	0.75
Eco9	4.03	0.69	0.84
AI1	2.78	0.67	0.69
AI2	3.86	0.73	0.72
AI3	4.12	0.65	0.7
AI4	3.89	0.59	0.75

AI5	4.11	0.7	0.73
AI6	4.06	0.68	0.74
AI7	3.9	0.67	0.73
AI8	2.91	0.55	0.66
SSC1	2.89	0.57	0.74
SSC2	3.82	0.78	0.78
SSC3	3.44	0.58	0.83
SSC4	4.11	0.57	0.67
SSC6	3.12	0.61	0.78
DSC1	2.77	0.72	0.55
DSC2	2.86	0.59	0.83
DSC3	3.05	0.62	0.63
DSC5	3.19	0.64	0.76
FSD1	3.23	0.71	0.64
FSD2	3.48	0.72	0.52
FSD3	3.69	0.63	0.78
FSD4	4.32	0.75	0.82
FSD5	3.48	0.62	0.55

Table 15: Total Variance Explained

4.8.3 Common method bias

Common method variance (CMV) is ‘a potential problem in behavioural research if the same person is providing data on both predictor and criterion variables in the same measurement context, can have a serious effect on empirical results’ (Podsakoff and Organ, 1986). To avoid CMV, the selected respondents need to be prequalified (working position and years of experience) to ensure they have sufficient knowledge and background. The respondents were notified that all the responses will be kept anonymous. Finally, the author performed Harman’s one-factor test using exploratory factor analysis by extracting a single factor from all the indicators and revealed that no single factor explained more than 30% of the total variance in the variables (total variance explained: 19.58%). Hence, common method bias is unlikely in this research.

4.9 Analysis method

The hypotheses can be classified into three groups. The first group examines the direct relationship between three collaboration practices and economic performance under the influence of the moderating effects of AI. The second group examines the direct relationship between the three collaboration practices and environmental performance. The third group examines the direct and moderating impact on social performance.

The literature on modelling methodological tools for relationships between those key constructs reports that structural equation modelling (SEM) and regression analysis (RA) are two well recognized analysis methods. Both methods allow researchers to examine the direct relationships between the theoretical constructs (Klem, 2000). Hierarchical regression analysis (HRA) is widely used in management research (Rutter and Gatsonis, 2001). Not only can it be used to identify direct and indirect correlations, but it also can enable the researcher to identify the most suitable model by comparing all hypothesized relationships. Statistical significance is examined by the t-test method. A p-value less than 0.1 indicate a significant relationship. The adjusted R-squared in HRA, as an indicator of the goodness of fit, will be compared between different models. Higher adjusted R-square means that the model can better explain the data sample. Therefore, the most suitable model should have the highest adjusted R-square value. This research will adopt the regression analysis to test the direct relationships and the relationships under the moderating effect of AI.

Hypotheses 1 to 3 proposed a direct relationship between collaboration practices and economic performance, social performance and environmental performance. The regression fit models can be specified as:

Economic Performance ($EcoP_i$) = α_1 + V_1 firm size+ V_2 collaboration portfolio + V_3 number of employees + V_4 unit of analysis + β_1 agriculture industrialization + β_2 supply side collaboration + β_3 demand side collaboration + β_4 farmer-supermarket docking + ε_1

Environmental Performance ($EnvP_i$) = α_2 + V_5 firm size+ V_6 collaboration portfolio + V_7 number of employees + V_8 unit of analysis + $\beta_5 AI_i$ + $\beta_6 SSC_i$+ $\beta_7 DSC_i$ + $\beta_8 FSD_i$ + ε_2

Social Performance ($SocP_i$) = α_3+ V_9 firm size+ V_{10} collaboration portfolio + V_{11} number of employees + V_{12} unit of analysis + $\beta_9 AI_i$ + $\beta_{10} SSC_i$+ $\beta_{11} DSC_i$ + $\beta_{12} FSD_i$ + ε_3

where $\alpha_{1,}$ $\alpha_{2,}$ α_3 are the intercepts, V_1 to V_{12} are the coefficients for control variables, and β_1 to β_{12} are the regression coefficients for AI_i, SSC_i, DSC_i and FSD_i. A significant coefficient of β_2, β_3, β_4, $\beta_{6,}$ β_7, β_8, β_{10}, β_{11} and β_{12} would indicate the presence of a correlation, suggesting that collaboration practices have an effect on sustainable performance. More specifically, a positive coefficient suggests that CP is positively associated with sustainable performance, whereas a negative coefficient indicates that CP is negatively associated with sustainable performance.

Hypotheses 4 to 6 proposed a moderating effect of AI on the relationship between CP and economic performance, social performance and environmental performance. Advanced from the regression analysis, the hierarchical regression analysis (HRA) is a stepwise-model. Using the direct relationship as the null model, HRA will allow the analysis process to add in the moderating factor of AI as the alternative model. Finally, the moderation effect exists if the alternative model has better goodness of fit and is more significant than the null model. The fit model can be specified as:

Moderating Economic Performance ($MEcoP_i$) $=\alpha_1 + V_1$ firm size+ V_2 collaboration portfolio + V_3 number of employees + V_4 unit of analysis + β_1 agriculture industrialization + β_2 supply side collaboration + β_3 demand side collaboration + β_4 farmer-supermarket docking $+\lambda_1$ demand side collaboration $*$ agriculture industrialization + λ_2 supply side collaboration $*$ agriculture industrialization $+\lambda_3$ farmer-supermarket docking $*$ agriculture industrialization $+\varepsilon_4$

Moderating Environmental Performance ($MEnvP_i$) $=\alpha_2 + V_5$ firm size+ V_6 collaboration portfolio + V_7 number of employees + V_8 unit of analysis + $\beta_5 AI_i + \beta_6 SSC_i + \beta_7 DSC_i + \beta_8 FSD_i + \lambda_4 DSC_i AI_i + \lambda_5 SSC_i AI_i + \lambda_6 FSD_i AI_i + \varepsilon_5$

Moderating Social Performance ($MSocP_i$) $=\alpha_3 + V_9$ firm size+ V_{10} collaboration portfolio + V_{11} number of employees + V_{12} unit of analysis + $\beta_9 AI_i + \beta_{10} SSC_i + \beta_{11} DSC_i + \beta_{12} FSD_i + \lambda_7 DSC_i AI_i + \lambda_8 SSC_i AI_i + \lambda_9 FSD_i AI_i + \varepsilon_6$

where $\boldsymbol{\alpha_1}$, $\boldsymbol{\alpha_2}$, $\boldsymbol{\alpha_3}$ are the intercepts, V_1 to V_{12} are the coefficients for the control variables, and $\boldsymbol{\lambda_1}$ to $\boldsymbol{\lambda_9}$ are the regression coefficients for $SSC_i AI_i$, $DSC_i AI_i$ and $FSD_i AI_i$. A significant coefficient would indicate the presence of the moderating effect, suggesting that agriculture industrialization is moderating the CP-SP relationships. More specifically, a positive coefficient suggests that under a higher degree of agriculture industrialization, the relationship between CP and SP will be strengthened, whereas a negative coefficient indicates that under a higher degree of agriculture industrialization, the relationship between CP and SP will be weakened.

4.10 Summary

The research philosophies, research design, approach and analysis methods were introduced. This research took a critical realistic stance because it examines a rich context of analysis while applying the objective quantitative analysis methods. It follows an abductive reasoning approach that includes using of both inductive and deductive approaches. Based on the research approach, the survey questionnaire was designed and the survey process was reported. The collected data were tested for validity and reliability before the analysis was performed. Finally, the selection of analysing method was also presented. The hierarchical regression analysis for testing the direct relationships and the moderating effect has been explained.

Chapter 5: Analysis and Results

5.1 Chapter introduction

The hierarchical regression analysis presented in the research methodology chapter has been used to test the hypotheses. The result of the analysis will be presented, and further discussion of the results will follow in the next chapter. The direct relationship between collaboration practice (CP) and sustainable performance (SP) is tested using linear regression analysis, and the moderating effect of AI is tested using hierarchical regression analysis (HRA). To perform the analysis, the author used a recent version of SPSS, which is a credible and widely available statistical software package.

The results are presented in a structure that follows the themes of the hypotheses to facilitate clarity. Hypotheses are classified into three groups that correspond to the impact on environmental performance, social performance and economic performance, respectively.

5.2 Collaboration practice and environmental performance relationships

To test both the direct and moderated relationships between CP and environmental performance, a procedure outlined by Jaccard and Turrisi (2003) was followed. First, in the case of multi-dimensional constructs, the measuring items were averaged for all constructs. Then, to reduce the potential problem of multicollinearity, the independent and moderating variables were mean-centred (Aiken and West, 1991). The values of variance inflation factors (VIF) for each constructs are within the range from

1 to 5, thus showing no sign of multicollinearity (Hair et al., 1998).

Table 16-18 is a well-established hierarchical regression model. It has been used by many peer reviewed journal articles in the past (Graham, 2018; Ding et al., 2015; Glenn Richey et al., 2009;). The following discussions are developed by adopting the existing multiple regression process. Table 15 illustrates the regression result for the relationship between CP and environmental performance, which contains three models. Model 1 is the baseline mode that contains only control variables. The p-value for each control variable shown in the bracket is bigger than 0.1, indicating that all the control variables have no significant impact on environmental performance. Model 2 examines the direct effects of supply side collaboration (SSC), demand side collaboration (DSC), farmer-supermarket docking (FSD) and agriculture industrialization. The coefficients for SSC, DSC and FSD are positive and significant. The results suggest that all three collaboration practices are positively associated with environmental performance. Model 3 adds the three interaction items of agriculture industrialization with collaboration practices. The adjusted R^2 value can be compared between models 2 and 3. Higher adjusted R^2 values indicate that one model represents the data better than the other model. Table 16 reveals that model 3 has a higher adjusted R^2 value (increased from 0.320 to 0.423). This means that the predictive power of the regression analysis has been increased after adding the interactions section, which indicates that the moderation effects do exist to a significant level.

The coefficients for the interaction terms DSC*AI, SSC*AI and FSD*AI are significant but negative, which indicates that under a high degree of agriculture industrialization, the effect of DSC, SSC and FSD on EnvP will be weakened. Variance inflation factors were checked among the independent variables, revealing the highest VIF to be 1.885. This suggests no sign of multicollinearity (Hair et al., 1998).

Hypothesis 1 (contains three sub-hypotheses) was tested with model 2 because this model displays the direct effect of CP on environmental performance. The result confirms positively the hypothesized relationship between three collaboration practices and environmental performance (H_{1a}, H_{1b} and H_{1c}). Hypothesis 4 (H_{4a},H_{4b},H_{4c}) was tested with model 3 because this model includes the interactive terms. Comparing the adjusted R^2, model 3 is superior to model 2. Therefore, one can confidently conclude the moderating effect of AI to the relationships does exist to a non-trivial degree. Furthermore, the coefficients for the interaction terms are significantly negative. This appears to support the work of Davis and Langham (1995), who suggests that under a high degree of agriculture industrialization, the effectiveness of collaboration practice will be weakened.

Variables	Coefficient	Model 1	Model 2	Model 3
Intercept	α	3.005***	2.909***	2.894***
(P-value)		0	0	0
Controls				
Firm Age	V1	0.114(0.294)	0.114(0.221)	0.101(0.250)
Collaboration Portfolio	V2	-0.165(0.551)	-0.049(0.560)	-0.077(0.340)
Number of Employees	V3	0.061(0.551)	-0.010(0.907)	-0.018(0.818)
Unit of Analysis	V4	-0.086(0.687)	-0.193(0.286)	-0.177(0.288)
Predictors				
Agriculture Industrialization	β1		-0.257***	-0.393***
Supply Side Collaboration	β2		0.186**	0.192**

Demand Side Collaboration	β3		0.345***	0.148*
Farmer-supermarket Docking	β4		0.469***	0.241**
Moderating effects				
DSC x AI	λ1			-0.328***
SSC x AI	λ2			-0.396***
FSD x AI	λ3			-0.157**
R-squared		0.037	0.361	0.471
Adjusted R-squared		0.007	0.32	0.423
F value		0.026	7.294**	12.18***

* P⩽0.1, ** P⩽0.05, *** P⩽0.01

Table 16: Regression results—Environmental performance

5.3 Collaboration practices and social performance relationships

Table 17 provides the regression result for the relationship between CP and social performance. Model 1 shows the effects of the control variables only. The p-value for each control variable is higher than 0.1 (p value is shown in the bracket); hence, none of the control variables has any significant impact on social performance. Model 2 examines the direct effects of SSC, DSC, FSD and AI. The coefficient for DSC and FSD is positive and significant. The results suggest that demand side collaboration and farmer-supermarket docking are positively associated with social performance. Nevertheless, the p-value for the coefficient of supply side collaboration is higher than 0.1, which indicates an insignificant relationship between SSC and social performance. Model 3 adds the three interaction items. Comparing models 2 and 3, the adjusted R-squared value increased from 0.152 to 0.206. Hence, the predictive power of the regression analysis increased after adding the interaction items. The coefficients for the interaction terms are significant but negative. Therefore, the impact of SSC, DSC and FSD on social performance is weakened under a high level of agriculture industrialization.

Hypotheses 2 (H_{2a}, H_{2b}, H_{2c}) is assessed using model 2 according to the procedure outlined by Jaccard (2003). Hypothesis 2 suggested that the three collaboration practices can enhance a firm's social performance. Model 2 confirmed the positive relationship between DSC, FSD and social performance (H_{2b} and H_{2c}). Hypothesis 5 was tested with model 3 because this model displays the moderation effect of AI. The results provide support for the negative moderation effect of AI on SSC-SocP, DSC-ScoP and FSD-SocP relationships (H_{5a}, H_{5b} and H_{5c}).

Variables	Coefficient	Model 1	Model 2	Model 3
Intercept	α	3.576***	3.421***	3.254***
(P-value)		0	0	0
Controls				
Firm Age	V5	-0.016(0.890)	0.018(0.867)	0.012(0.911)
Collaboration Portfolio	V6	-0.157(0.138)	-0.075(0.450)	-0.038(0.702)
Number of Employees	V7	-0.087(0.416)	-0.149(0.136)	-0.135(0.164)
Unit of Analysis	V8	0.211(0.352)	0.163(0.442)	0.186(0.365)
Predictors				
Agriculture Industrialization	β5		-0.263***	-0.288***
Supply side Collaboration	β6		-0.003	-0.058
Demand side Collaboration	β7		0.313***	0.185**
Farmer-supermarket Docking	β8		0.308**	0.233*
Moderating effects				
DSC x AI	λ4			-0.427***
SSC x AI	λ5			-0.43**
FSD x AI	λ6			-0.265**
R-squared		0.027	0.203	0.271
Adjusted R-squared		-0.003	0.152	0.206
F value		0.872	6.018***	10.355***

* P⩽0.1, ** P⩽0.05, *** P⩽0.01

Table 17: Regression results—Social performance

5.4 Collaboration practices and economic performance relationships

Finally, table 18 provides the regression result for the relationship between CP and economic performance. Model 1 is the baseline modal that contains only the control variables. The p-value for each control variables is larger than 0.1, indicating that none of the control variables has a significant impact on economic performance. Model 2 examines the direct effects of supply side collaboration, demand side collaboration, farmer-supermarket docking and agriculture industrialization. The coefficients for SSC and FSD are positive and significant. The results suggest that SSC and FSD are positively associated with economic performance. Nevertheless, the coefficient for DSC is significant but negative, which rejects the initial hypotheses. Model 3 adds the three interaction items of agriculture industrialization with collaboration practices. Comparing models 2 and 3, the adjusted R-squared increased from 0.213 to 0.298. Hence, the predictive power of the regression analysis apparently has been increased after adding the interaction items. The coefficients for the three interaction terms are significant and positive, which indicates that under a high degree of agriculture industrialization, the effect of SSC, DSC and FSD on EcoP will be strengthened, providing further evidence to the initial hypotheses.

Hypothesis 3 postulates that SSC, DSC and FSD have positive impact on economic performance. The results provide support to hypotheses H_{3a} and H_{3c}, whereas H_{3b} has been rejected. Hypotheses 6 was examined with model 3 because this model includes the interaction terms (DSC x AI, SSC x AI, FSD x AI). The results provide empirical support for the moderation effect of AI on SSC-SocP (H_{6a}), DSC-SocP (H_{6b}) and FSD-SocP (H_{6c}) relationships with satisfactory statistical significances.

Variables	Coefficient	Model 1	Model 2	Model 3
Intercept	α	3.335***	3.468***	3.762***
(P-value)		0	0	0
Controls				
Firm Age	V9	0.160(0.164)	0.058(0.574)	-0.017(0.863)
Collaboration Portfolio	V10	-0.013(0.904)	0.026(0.782)	0.013(0.885)
Number of Employees	V11	-0.029(0.788)	0.017(0.854)	0.014(0.873)
Unit of Analysis	V12	-0.162(0.471)	-0.238(0.238)	-0.187(0.329)
Predictors				
Agriculture Industrialization	β9		0.153*	0.203**
Supply side Collaboration	β10		0.19*	0.314**
Demand side Collaboration	β11		-0.476***	-0.359***
Farmer-supermarket Docking	β12		0.241**	0.420**
Moderating effects				
DSC x AI	λ7			0.253**
SSC x AI	λ8			0.56**
FSD x AI	λ9			0.536***
R-squared		0.02	0.261	0.356
Adjusted R-squared		-0.011	0.213	0.298
F value		0.391	5.687**	7.124**

* P⩽0.1, ** P⩽0.05, *** P⩽0.01

Table 18: Regression results—Economic performance

The hierarchical regression results of each hypothesis are summarised in Table 19. The results marked as 'Supported' indicates the result supports the initial hypotheses, while 'not significant' indicates the relationship is not significant, and 'rejected' indicates that the regression result rejects the initial hypothesis.

Results of Hierarchical regression analysis	
Hypotheses	**Results**
H1a. Supply side collaboration→ Environmental performance	Supported
H1b. Demand side collaboration→ Environmental performance	Supported
H1c. Farmer supermarket docking→ Environmental performance	Supported
H2a. Supply side collaboration →Social Performance	Not significant
H2b. Demand side collaboration →Social Performance	Supported
H2c. Farmer supermarket docking →Social Performance	Supported
H3a. Supply side collaboration →Economic performance	Supported
H3b. Demand side collaboration →Economic performance	Rejected
H3c. Farmer supermarket docking →Economic performance	Supported
H4a. Supply side collaboration× Agriculture industrialization →Environmental performance	Supported
H4b. Demand side collaboration× Agriculture industrialization →Environmental performance	Supported
H4c. Farmer supermarket docking × Agriculture industrialization →Environmental performance	Supported
H5a. Supply side collaboration× Agriculture industrialization→ Social Performance	Supported
H5b. Demand side collaboration× Agriculture industrialization→ Social Performance	Supported
H5c. Farmer supermarket docking × Agriculture industrialization→ Social Performance	Supported
H6a. Supply side collaboration× Agriculture industrialization→ Economic performance	Supported
H6b. Demand side collaboration× Agriculture industrialization→ Economic performance	Supported
H6c. Farmer supermarket docking × Agriculture industrialization→ Economic performance	Supported

Table 19: Results of 18 sub-hypotheses

5.5 Chapter summary

The 6 top-level hypothesis groups (18 hypotheses all together) developed to form the theoretical model have all been empirically tested by HRA. The results are summarized in Table 18. In sum, 16 out of 18 hypotheses have been supported in the regression analysis with strong statistical evidence (H_1, H_{2b} and $_{2c}$, H_{3a} and $_{3c}$, $H_{4,}$ H_5 and H_6). The two hypothesized relationships that are not convincingly supported are the negative relationship between DSC and economic performance (H_{3b}) and the insignificant relationship between SSC and social performance (H_{2a}). Nevertheless, the test result as a whole has positively endorsed the moderating effects of AI on the relationship from CP to SP. Thus, the conceptual model, as depicted in Figure 8, has been largely validated.

Chapter 6: Discussion

This chapter extends the discussion of the research results and findings. The discussion is not following the sequence of the hypotheses developed in Chapter 4, but according to the types of collaboration practices. Hence, all the relationship between each collaboration practice and sustainable performance will be discussed. A real-world case study is presented at the end of the chapter.

6.1 Regression Analysis (H1-H3)

The regression analysis results on the relationships between collaboration practices and sustainable performance (H1-H3) appear to be largely consistent with prior studies (Tachizawa, Gimenez and Sierra, 2015; Mirhedayatian et al., 2014; Nyaga and Whipple, 2011; Gimenez, Sierra and Rodon, 2012). Given that the critical importance and valuable contribution of collaboration practices to the development of sustainable supply chain have been widely discussed and largely proven in the literature, these results do not merely repeat the prior findings; they further justify and solidify the practical value and conceptual notion of the three CP dimensions that are specifically related to the agriculture industry in a developing country such as China. The results offer further evidence of the positive managerial impact of demand side collaboration, supply side collaboration and farmer-supermarket docking on the three dimensions of sustainable performance. Previous studies, however, may have demonstrated the positive impacts of collaboration management practices on a firm's performance mostly within manufacturing industries (Zhu and

Sarkis, 2012), which can be regarded as a one-dimensional performance measurement. The hypothesis testing results of this study extends the scope to the three dimensions of sustainable performance. These results reinforce the need to adopt the learned best practices of collaborative practices in agro-industry to enhance firms' economic, social and environmental performance.

6.2 Discussion of CP-SP relationship

6.2.1 Supply side collaboration and sustainable performance

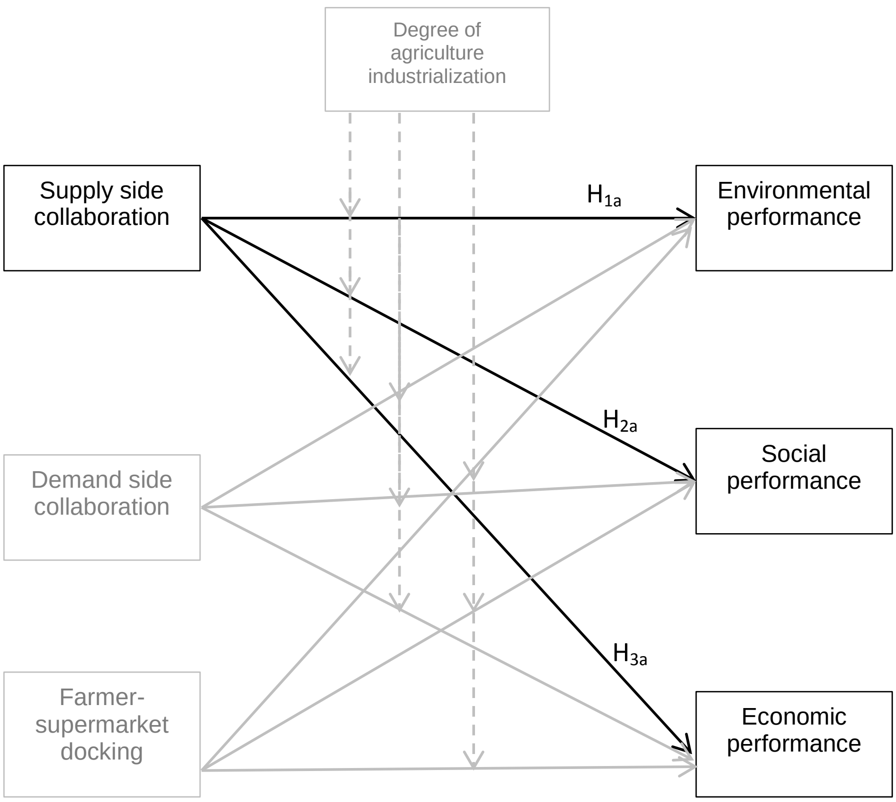

Figure 11: Relationship between SSC and sustainable performance (constructs highlighted in black indicate the discussion of the hypotheses)

The test results on the relationship between supply side collaboration and sustainable performance appear to have supported the initial hypotheses and are largely consistent with prior research (Mirhedayatian et al., 2014;

Gimenez and Tachizawa, 2012; Huq et al., 2016; Gimenez and Sierra, 2013). In terms of the critical importance and practical business value of supply side collaboration, the results demonstrate positive impacts of supply side collaboration on economic and environmental performance that adds further evidence to existing collaboration network theory. From the agriculture enterprises point of view, collaborating with the supply side, such as small farmers or local agriculture cooperatives/associations, could improve information sharing and build trust and Guanxi, which in turn can improve environmental and economic performance.

Nevertheless, the result suggests that the association between supply side collaboration and social performance is not significant. The author suspects two potential reasons for this result. First, collaborative network theory suggests that the positive effect of collaboration practice on sustainable performance is contingent on ‘personal chemistry’, such as exogenous environmental factors (Halldorsson et al., 2007). Therefore, the relationship between supply side collaboration and social performance could be moderated by many exogenous factors that eventually lead to a non-significant correlation. The second potential reason is suggested by Drake and Schlachter (2008), who believe that the association between supply side collaboration and social performance is contingent on the form of collaboration. They identified two types of collaboration: sustainable collaboration and dictatorial collaboration (Drake and Schlachter, 2008). Sustainable collaboration aims at achieving a win-win relationship with supply chain members through investments of time and resources that benefit the entire supply chain. In a sustainable collaborative relationship, firms would not take advantage of each other to maximise short-term gains. An example of the sustainable collaboration would be that of Toyota and Honda. Both companies understand their suppliers' operations, and they use their own resources to help supply chain partners meet their sustainability goals. Honda sent an engineer to help its supplier, Atlantic Tool, improve its factory operations. This action obviously brought benefits to Atlantic Tool, but Honda also realized its gains from better quality control and on-time delivery.

On the contrary, dictatorial collaboration happens naturally when the supply side or demand side has more power. An example of dictatorial collaboration in the UK food industry is Tesco and a few other large grocery stores. The UK grocery industry is highly consolidated, with 75 distribution centres supplying over 50% of the grocery stores (Drake and Schlachter, 2008). Large retailers such as Tesco have an enormous degree of power over their suppliers. Robson and Rawnsley (2001) point out that retailers were doing everything they could to minimise their costs. Sometimes, if they are forced, vendors use inferior ingredients and processes to maintain some degree of profitability (Drake and Schlachter, 2008). Hence, social issues such as nutrition and food safety become severe problems.

The Chinese agriculture industry is driven by the buyers, which means buyers have more power than suppliers. Therefore, when collaborating with the supply side, dictatorial collaboration tends to prevail. To maximise profits, supermarkets will bargain lower food prices and force farmers to use excessive chemical pesticides, which will reduce the quality of the food supply as a whole. In short, in a buyer-driven market environment, collaborating with the supply side may not always improve a firm's social performance.

6.2.2 Demand side collaboration and sustainable performance

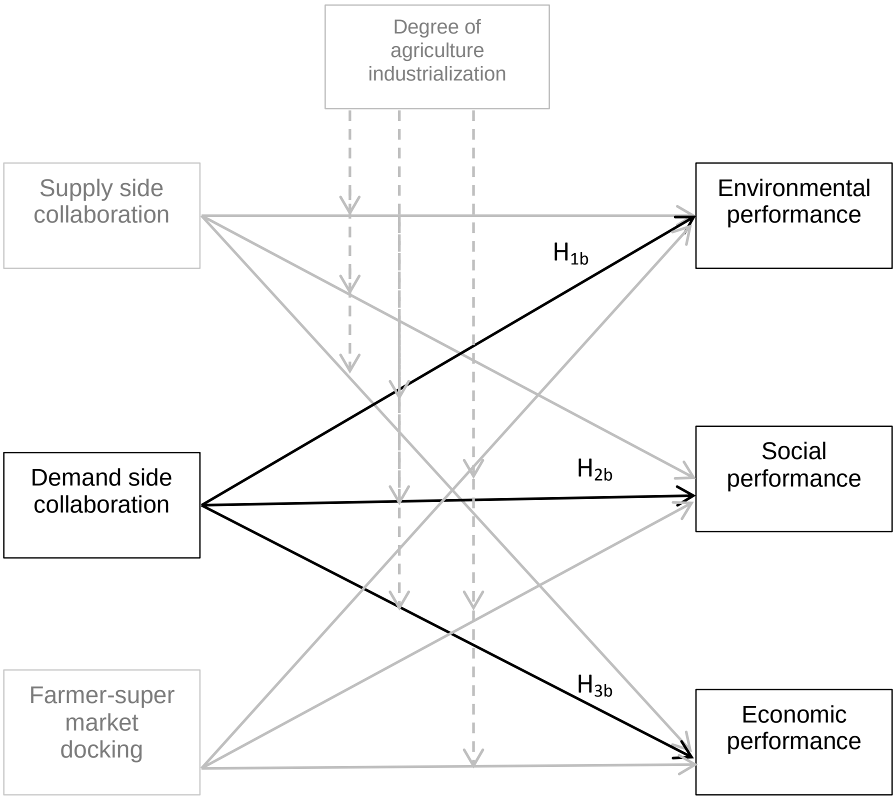

Figure 12: Relationship between DSC and sustainable performance

In terms of demand side collaboration (DSC), the findings suggest that DSC could have a positive impact on social and environmental performance. Even though the results largely support the collaborative network theory, one of the hypotheses has been rejected. The initial hypothesis theorized that DSC has a positive impact on economic performance. The findings indicate that DSC is negatively associated with economic performance. To gain an in-depth understanding of this counter-intuitive result, the author conducted further interviews with two of China's agriculture industry managers to identify contextually embedded explanations. The interviewees suggest that the negative impact on economic performance can be partially caused by the bargaining power difference between suppliers and buyers, which may lead to one-sided dominance whereby the economic performance of the supply chain may be compromised, or it may be caused by market competiveness whereby a collaborative approach towards the customer may not be always most effective. Several studies suggest that due to the competitive market environment and customers' (as the demand side) preferences towards the appearance of agro-products, farmers thus have an increased tendency to use more farm chemicals and to improve the appearance of the products, which consequently reduces the supply chain's environmental sustainability performance. Apparently, any not carefully thought-through ideas driven by customers' demands or based on an unbalanced relationship with customers could result in the negative impact of DSC on the economic performance of the supply chain. Under the unbalanced relationship and unregulated market environment, trust becomes another critical issue between suppliers and customers. Kwon and Suh (2004) suggest that lack of trust among supply chain partners often results in inefficient and ineffective performance. Therefore, lack of trust between farmers and customers could be one of the reasons for the negative economic performance.

6.2.3 Farmer-supermarket docking and sustainable performance

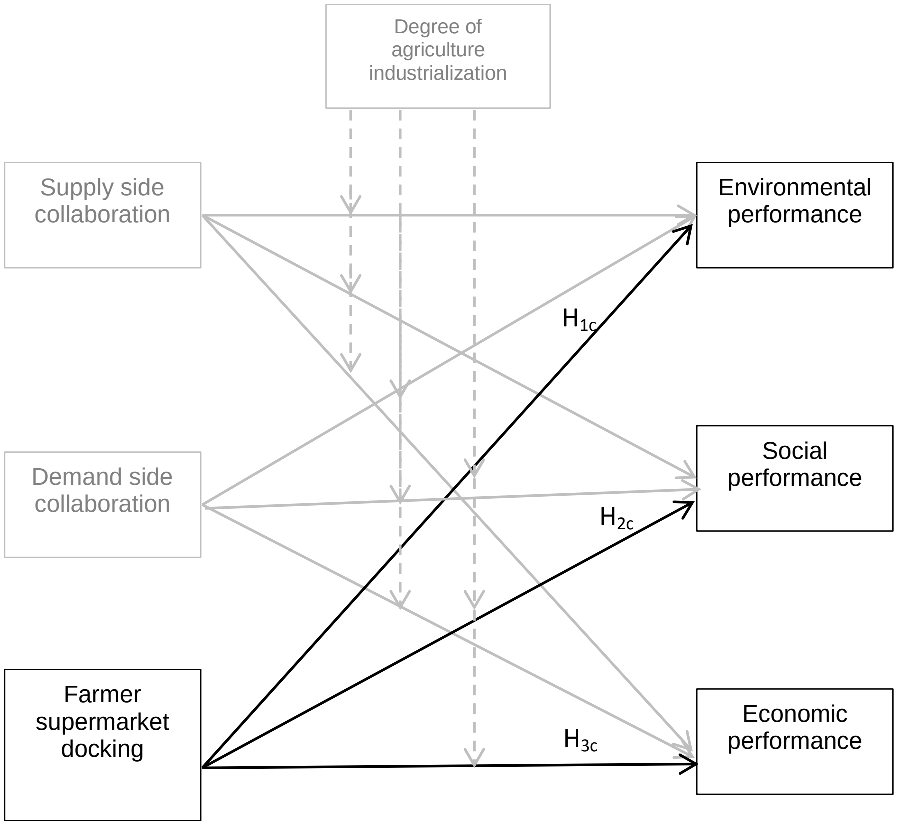

Figure 13: Relationship between FSD and sustainable performance

The results of the FSD-SP relationships support the initial hypotheses and are largely consistent with prior research (Zhang and Xu, 2010; Zhang and An， 2010；Li et al., 2011; Ji, Wang and Yan, 2013). Although the value of farmer-supermarket docking has been proven by many prior researches, the results further justify the value of FSD to the sustainable development in an emerging country such as China. The research finding offers an empirical support for the purported impacts of FSD on three dimensions of sustainable performance. Direct collaboration between agriculture cooperatives/associations and supermarkets often reduces circulation links, lower procurement costs, stabilize costs and prices, stimulate rural consumption, and solve the contradiction between 'difficult to sell agro-products' and 'difficult to buy agro-products'. Hence, the success cases of FSD in China are the living proof of the positive impact of supply side collaboration on economic, social and environmental performance.

6.3 Discussion of moderation effect of AI (H_4-H_6)

The main objective of this research is to investigate the moderating effect of AI on CP-SP relationships. Top-level hypotheses 4-6 have been proposed to test the moderating effect of AI with each supply chain collaboration practice.

Although the importance of CP has been widely recognized, the literature still lacks a theory-based explanation of the effectiveness of CP on sustainable performances, which may vary under the influence of certain external factors, and more specifically, under a major emerging environmental factor in China—agriculture industrialisation (AI). There is also a research gap identified in previous literature as to why in some instances, AI exhibits a positive influence on the CP-sustainable performance relationship, but in other instances, a CP-sustainable performance relationship has been weakened under the influence of AI. The hypotheses testing results show that it comes down to the existence and influence of the exogenous factor AI. Thus, the result verifies to a significant degree that moderating effects of AI do exist, and the model depicting the moderation effect has been empirically proven.

6.3.1 Supply side collaboration and sustainable performance under AI

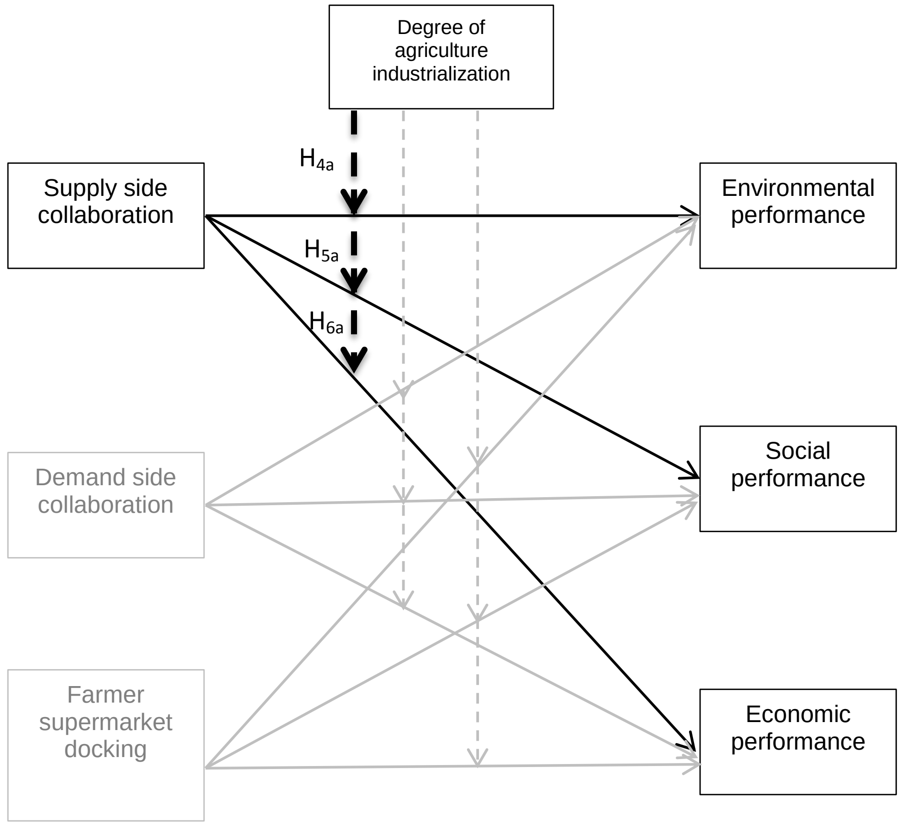

Figure 14: Moderation effect of AI on SSC-SP relationship

Based on the literature synthesis, the author initially hypothesised that under a high degree of AI, the impact of supply side collaboration (SSC) on environmental and social performance will be weakened, while SSC-economic performance relationships will be strengthened. Such a proposition can never be entirely convincing unless an empirically tested result supports it. Indeed, these hypotheses were tested using hierarchical regression analysis and were based on first-hand collected real-world empirical data. The result further confirmed the moderating effect of AI on SSC-economic performance (EcoP), DSC-EcoP and FSD-EcoP relationships. The test result shows that the moderating effects of AI on SSC-ScoP and SSC-EnvP is significant and negative, whereas the moderating effect of AI on SSC-EcoP is significant and positive.

The result is consistent with past findings that suggest suppliers who developed a close collaboration within a highly industrialized market would lead to higher switching costs and risk exposure (Ghoshal and Moran, 1996; Zhao et al., 2013). Gualandris and Kalchschmidt (2016) state that AI promotes wider adoption of contracting, strategic alliance and effective collaboration that enhance the trust level between buyer and supplier, which in turn improves a firm's social performance. However, Tang and Lan (2015) suggest that buyer-supplier trust cannot be fully established in the Chinese agro-industry due to unequal bargaining power and lack of contract law. Therefore, this could be the reason for the negative moderation effect on the SSC-ScoP relationship.

In addition, the results indicate that AI positively moderates the relationship between SSC and economic performance. According to Germain et al. (2008), supply chain process variability moderates the relationship between supply chain collaboration and economic performance inversely. A key outcome of AI is reducing supply chain complexity and variability. Thus, the result supports Germain et al. (2008)'s study, suggesting that under a high degree of industrialization (low supply chain complexity and variability), supply chain collaboration is positively associated with economic performance. To summarize, a high degree of agriculture industrialization weakens SSC-environmental performance (EcoP) and SSC-SocP relationships, but strengthen the SSC-EcoP relationship.

6.3.2 Demand side collaboration—sustainable performance under AI

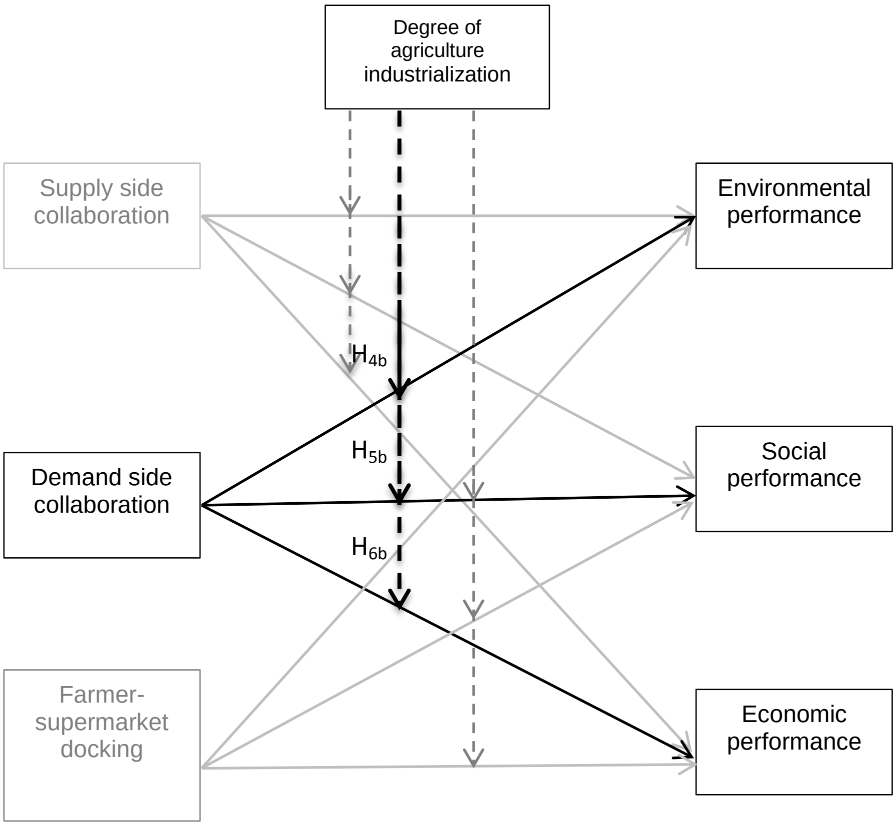

Figure 15: Moderation effect of AI on DSC-SP relationship

Although the value of demand side collaboration (DSC) has been recognized, the literature lacks a theory explaining why in some instances, DSC has non-significant or even negative impact on sustainable performance, but in other instances, DSC could strengthen sustainable performance. The empirical results appear consistent with the initial hypotheses, indicating that a high degree of agriculture industrialization can strengthen the impact of demand side collaboration on economic performance and weaken the impact on social and environmental performances. These results are also supported by the empirical evidences from a number of Chinese agriculture studies (Zhang and An, 2010; Chen and Yang, 2012).

6.3.3 Farmer-supermarket docking—sustainable performance under AI

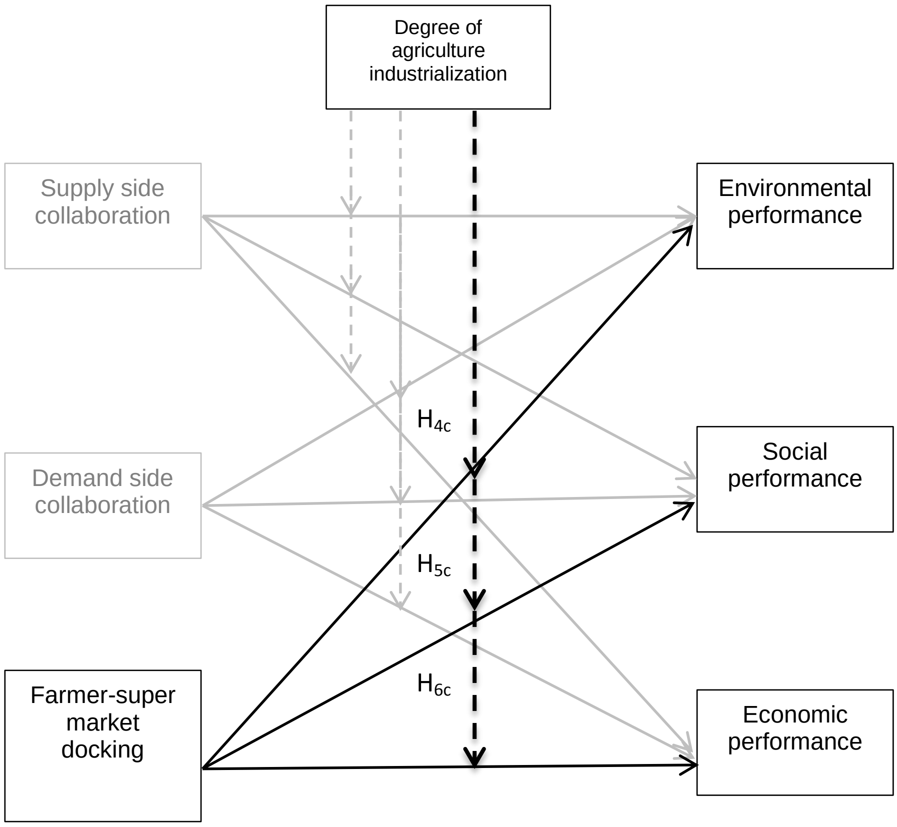

Figure 16: Moderation effect of AI on FSD-SP relationship

The results further confirm the theoretical premise that suggests that a high degree of agriculture industrialization can strengthen the impact of farmer-supermarket docking on economic performance and weaken the impact on social and environmental performances. These results are also supported by empirical evidence from several Chinese agriculture studies (Zhang and Xu, 2010; Zhang and An， 2010； Li et al., 2011; Ji, Wang and Yan, 2013). One notable point is that the strength of the moderation effect of AI on the EnvP and ScoP is weaker than that of SSC and DSC, which suggests that under a high degree of AI, FSD is less affected and could achieve better performance than SSC and DSC.

To summarize, all the empirical data based regression analysis results show predominantly clear statistical support for the theoretical framework. Only Hypothesis 3b was statistically rejected with a negative but significant impact on economic performance. Furthermore, Hypothesis 2b was not statistically supported by the survey data ($p>0.1$). It is also evident that most of the results were consistent with the general arguments in the supply chain collaboration research. However, the insignificant correlations should not be interpreted as a negative impact on sustainable performance because the insignificant relationship is only a direct impact without taking consideration of other indirect impacts such as trust level, commitment and market risks.

6.4 Case study

The case study aims at further verifying the developed theoretical framework by using the relevant facts and information gathered from 27 real-world organizations in the northern part of China. The selected firms are comprised of leading agriculture enterprises and cooperatives/associations. All the firms are located in Hefei (city in An'hui province) in China. Fruits and vegetables are their major products. For instance, Hefei 5 is an agriculture cooperative that produces sweet potatoes, Hefei 26 is a leading agriculture enterprise focused on producing sustainable vegetables. Most of the companies are SME that have an average of 50 employees.

The author contacted the key personnel in the 27 agriculture enterprises that reportedly had adopted at least one collaborative practice in the past

10 years. A verification/survey questionnaire was sent through WeChat to test whether the proposed framework is supported by the real-world cases (see the appendix B for the questionnaire). The questionnaire includes two sections. The first section takes the measurement of AI level for companies, which is mostly adopted from the established literature. Then the companies are categorized into two groups, high AI and low AI, in order to carry out further comparison analysis. The second section contains the sustainable performance outcomes after adopting the collaboration practices. As mentioned in Chapter 3, since the companies adopt different collaboration practices, they may have left some questions blank if it is not applicable. The questionnaire was answered by mid-tier managers who had worked at the company for more than 10 years.

The results will be structured into three tables and used for a comparison analysis. Each table presents the comparison of sustainable performances under high and low degree of agriculture industrialization for three collaboration practices (SSC, DSC, and FSD). The first column for each table is case number which indicates the number and name of the responding firms. The second column represents the sustainable performance outcomes (EcoP-economic performance, SocP-social performance, EnvP-environmental performance). Each table contains two parts; the top part illustrates the performance outcome under low degree of agriculture industrialization whereas the bottom part illustrates the performance outcome under high degree of agriculture industrialization. The analysis is to compare the first and second part to see if there is a difference in sustainable performance outcome under different degree of agriculture industrialization. As shown in Appendix B, firstly, the selected firms will be classified by the degree of agriculture industrialization (low or high) according to the questionnaire results. The measurement design for the construct AI is the same as the main questionnaire (1 indicate low degree of AI whereas 5 indicate a high degree of AI). For the convenience of the comparison, the degree of AI that is greater than 2.5 is categorised as high and less than 2.5 is categorised as low. Then, the sustainable performance outcomes are designed using Five-point Likert scale (0=negative performance outcome; 1=not significant; 2=a little bit of improvement; 3=to some degree; 4=relatively significant improvement; 5=significant improvement).

Table 20 shows the sustainable performance outcome (EcoP, SocP, EnvP) after collaborating with the supply side under both low and high degree of agriculture industrialization. The average performance levels for EcoP and EnvP are higher than 3.0, indicating that supply side collaboration is positively associated with economic and environmental performance. However, the social outcome after adopting SSC is not significant. The author compared the first and second part of the table to examine moderating effect of agriculture industrialization. As Table 19 shows, under a low degree of AI, the social and environmental performance after adopting SSC is strengthened (average social performance increased from 0.8 to 1.2 under low degree of AI, whereas the average environmental performance increased from 3.1 to 3.8 under a low degree of AI). Under a high degree of AI, the economic performance after adopting SSC is strengthened (average economic performance increased from 3.2 to 3.7 under high degree of AI), which provides further support to the research findings.

	Supply side collaboration			
Case no.	**Low degree of AI**	**EcoP**	**SocP**	**EnvP**
Hefei2	Feidongwei Jujube Professional Association	3	1	4
Hefei5	Feidongxian Mahuxiang Xiaotao Potato Professional Cooperation	5	2	3
Hefei7	Hefei Haoyuan Crud Fruit Professional Association	4	0	5
Hefei15	Anhui Changfeng technology agriculture Ltd	2	1	4
Hefei20	Hefei Jinlu Food Ltd	2	2	3
	Average	3.2	1.2	3.8
Case no.	**High degree of AI**	**EcoP**	**SocP**	**EnvP**
Hefei8	Feidongxian Jinsenianyedi Vegetable Professional Association	4	1	4
Hefei9	Feidongxian Hengxine Dible Fungi Professional Association	2	0	2
Hefei16	AnhuiHuayi Agriculture technology Development Ltd	3	1	2
Hefei17	Hanhui Honghui Food Ltd	4	0	4
Hefei18	Hefei Weishihuang Food Ltd	5	2	2
Hefei22	Anhui Tongtai Food Ltd	3	1	4
Hefei23	Anhui Quanyin High-tech industry Co. Ltd.	3	1	3
Hefei24	Anhui Longping High-tech industry Ltd.	4	0	3
Hefei26	Hefei Weixiangyuan Green Food Ltd	3	1	4
	Average	3.7	0.8	3.1

Table 20: Case results of SCC—Sustainable performance

Table 21 shows the sustainable performance outcome (EcoP, SocP, EnvP) after collaborating with the demand side. The social and environmental performance outcomes are all greater than 3, indicating that demand side collaboration is positively associated with social and environmental performance. Nevertheless, the result suggests that demand side collaboration is negatively associated with economic performance, which further supports the survey results.

As for the moderating effects, environmental and social performance after adopting DSC is strengthened under a low degree of AI (4.7 and 3.3 for a low degree of AI, 3.1 and 3 for a high degree of AI). On the opposite side, economic performance after adopting DSC is slightly strengthened under a high degree of AI (0.3 for a low degree of AI, 0.5 for a high degree of AI). However, the impact is not significant. The results are generally consistent with the proposed framework.

	Demand side collaboration			
Case no.	**Low degree of AI**	**EcoP**	**SocP**	**EnvP**
Hefei3	Hefei Qinglongchang Jujube Professional Association	0	4	5
Hefei7	Hefei Haoyuan Crud Fruit Professional Association	1	5	4
Hefei15	Anhui Changfeng technology agriculture Ltd	0	5	4
	Average	0.3	4.7	4.3
Case no.	**High degree of AI**	**EcoP**	**SocP**	**EnvP**
Hefei14	Anhui Dongbao Food Ltd	0	2	3
Hefei24	Anhui Longping High-tech industry Ltd.	1	4	3
	Average	0.5	3.1	3

Table 21: Case results of DSC—Sustainable performance

Table 22 shows the sustainable performance outcome (EcoP, SocP, EnvP) after adopting farmer-supermarket docking. All performances are greater than 3, indicating that farmer-supermarket docking is positively associated with economic, social and environmental performance. Furthermore, the results also further confirmed the survey findings that discussed in section 6.3.3. The case study shows that under a high degree of AI, the social and environmental performance after adopting FSD is weakened (average social performance decreased from 4 to 3.7 under high degree of AI, whereas the average environmental performance increased from 4.1 to 4.4 under a low degree of AI). Under a high degree of AI, the economic performance after adopting FSD is strengthened (average economic performance increased from 3.3 to 4.5 under high degree of AI). The results reinforce the argument that the strength of the negative moderation effect of AI on EnvP and ScoP is weaker than that of SSC and DSC, which suggests that under a high degree of AI, FSD could benefit SSC and DSC. Overall, the above analyses based on the case studies have provided useful evidence and support for the proposed framework.

	Farmer supermarket docking			
Case no.	**Low degree of AI**	**EcoP**	**SocP**	**EnvP**
Hefei1	Hefei Xinshiye Jujube Professional Association	2	4	5
Hefei2	Feidongwei Jujube Professional Association	3	3	4
Hefei6	Feidongxian Cuozhen Snow lotus root Professional Association	3	3	5
Hefei7	Hefei Haoyuan Crud Fruit Professional Association	4	4	5
Hefei10	Feidong Yunda Vegetable Professional Association	3	3	5
Hefei11	Feidongxian Kegang Vegetable Professional Association	3	4	4
Hefei12	Feidongxian Gulong Sweet Potato Professional Association	3	5	5
Hefei13	Feidongxian Shihua Eco Agriculture professional Association	4	5	2
Hefei15	Anhui Changfeng technology agriculture Ltd	5	4	5
Hefei21	Heifei Dinglu Food Co.Ltd.	3	5	4
	Average	3.3	4	4.4
Case no.	**High degree of AI**	**EcoP**	**SocP**	**EnvP**
Hefei4	Feidongxian Weizhihuang Vegetable Professional Association	4	5	4
Hefei8	Feidongxian Jinsenianyedi Vegetable Professional Association	5	4	4
Hefei14	Anhui Dongbao Food Ltd	4	3	5

Hefei17	Anhui Honghui Food Ltd	4	4	4
Hefei19	Anhui Qingsong Food Ltd	5	3	4
Hefei24	Anhui Longping High-tech industry Ltd.	4	3	3
Hefei26	Hefei Weixiangyuan Green Food Ltd	5	4	4
Hefei27	Anhui Dashijie Fruit Ltd	5	4	5
	Average	4.5	3.7	4.1

Table 22: Case results of FSD—Sustainable performance

6.5 Summary

The above results and exploratory discussion have revealed some helpful insights as to how the exogenous factor moderates the relationship between supply chain collaboration and sustainable performance. Both positive and negative moderating effects of the AI factor on the specific dimension of the CP-SP relationships have better explained contingency nature of the relationships. In regards to the managerial guidance for real-world business practices, the results have clearly pointed to more adoption of the farmer-supermarket docking when the business environment is highly industrialized. On the other hand, the results shows that the SSC and DSC could bring more benefits to the business under a low degree of AI.

Chapter 7 Conclusion

7.1 General Conclusion

This study can be concluded from a number of perspectives. However, ultimately, the author wishes to conclude that the main research objective defined in Chapter 1 section 1.3 has been achieved in full. The main objective is “to investigate the relationship between the collaborative practices and the sustainable performance of an agro-food supply chain under the influencing effects of the fast advancing agricultural industrialization as envisaged in China today.” Accordingly, these conclusive remarks can be made.

1. The relationship between collaborative practice and sustainable performance in the context of achieving a green supply chain for the China’s agro-food industry sector is not a foregone conclusion in that the level of effectiveness of such effect could be influenced by external factors.
2. The investigation into the development of China’s agricultural industry has shown some convincing evidence that phenomenal growth and substantive industrialization have taken place there. It has been conclusively recognized that as far as China’s agricultural sector is concerned, increasingly strengthened industrialization is the most prominent environmental factor to take into consideration.
3. The specifically developed conceptual framework shown in Figure 8 has been largely tested positive in regards to the hypothesized moderating effect of the agriculture

industrialization on collaboration-sustainability relationship. This finding extends existing understanding in the literature and contributed to the development of theoretical models within related research subjects.

7.2 Theoretical contribution

The findings of this research extend the application of contingency theory into the area of supply chain collaboration and agro-food industry sustainability, suggesting that the contribution of supply chain collaboration to a firm’s sustainable performance is subject to the impact of external environmental factors such as political uncertainty, developing agenda, market risks, and cultural factors (Donaldson, 2001). As a result, a better conceptual understanding at the theoretical level regarding to a number of contentious issues have been achieved, which includes the understanding on the supply chain collaborative practices, ‘triple-bottom-line’ based sustainable performances, and agricultural industrialization, has been achieved.

Furthermore, Chinese agriculture industry is undergoing significant changes in the past 20 years. With the market structure and agriculture system changing, a rapid growth in industrialization process has been witnessed, as along with some severe sustainable challenges. This research provides the most recent knowledge and renewed analysis to the supply chain collaboration in the sustainable development domain. A specific theoretical model has been developed to conceptualize the collaboration practices and sustainable performance using multidimensional constructs. Thus it provides a renewed understanding on the CP-sustainable performance relationships. This study has been largely based on empirical evidences to construct the idea that supply chain collaborations are associated with the high-level sustainable performance, as well as the moderating effect of agriculture industrialization on the relationship. The analyses conducted herein support the posited hypothesis. At the centre piece of this research lies in a comprehensive theoretical model that explains the contingency effect of AI on the three types of CP. This research, thus, helps to further reveal and clarify the theoretical relationships among CP, AI and SP.

7.3 Practical Implications

In terms of the contributions and implications to practices, this research directly supports and facilitates frontline agricultural supply chain managers by highlighting the importance of understanding the practical influence of agricultural industrialization and the impact it may bring. The findings also present important implications for managerial practice by explaining that collaboration practices and agriculture industrialization interact with each other to affect firms' sustainable performance. First, the findings suggest that firms should consider adopting farmer-supermarket docking when the business environment is highly industrialized. Second, the results show that the SSC and DSC could bring more benefits to the business under a low degree of AI.

Managers can appreciate at a more in-depth level knowledge how the three specific collaborative management practices might contribute to a firm's sustainable performance, especially under different degrees of agriculture industrialization. By differentiating the demand side collaboration, supply side collaboration and farmer-supermarket docking, managers can now formulate their business development strategies based on knowing that under a high degree of AI, the strategies and practices of farmer-supermarket docking can achieve better sustainable performance. Managers thus will have better control over allocating investment resources for the collaborating practices under the different degrees of AI.

7.4 Limitations and future research

7.4.1 Data

Collecting data from a single sector (fresh agriculture industry) in one country provides better internal validity, however, the generalizability of the results may be limited (Bryman and Bell, 2011). Future research could collect data from other agriculture industries, such as forestry, graziery and fishery. A comparison analysis on the moderating effect of AI between different agriculture industries would provide further evidence to the research findings.

7.4.2 Methodology

Even though this thesis applied quantitative survey methods and a qualitative case study to capture the relationships between CP, SP and AI, but it was observed only at one particular time. Hence, the dynamic impacts of SCC on the proposed outcomes could be limited in the results of this research.

7.4.3 Longitudinal examination

The effects of supply chain collaborations are dynamic in nature, which could have a multiplicative impact over time. Therefore, a longitudinal study using the hypotheses in this research would likely shed new light on the dynamics of relationships between supply chain collaboration and sustainable performance.

7.4.4 Measurement of theoretical constructs

Future research could focus on developing the measurement of theoretical constructs in the agriculture industry. The majority of the measurements of the theoretical constructs used in this research are adopted from some generalized models already established in the literature. However, it could be beneficial to develop an industry-specific measurement for future studies.

Recognizing the rapid development of agriculture industrialization in China, it would be beneficial to understand the interaction mechanisms of many factors involved.

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Appendix A

Questionnaire 1

Section A: Respondents background

1. What is your position in the company?	Please tick one
Company owners	_____
Operations managers	_____
Supply chain managers	_____
Leaders of Agriculture Cooperatives	_____
Experienced farmers	_____
Others ____________ (please put down your position)	_____

2. How many employees are there in your companies/cooperatives/association/business?	Please tick one
>700	_____
351-250	_____
201-250	_____
101-200	_____
51-100	_____
<50	_____

3. What type of business are you in?	Please tick one
Agriculture leading enterprises	_____
Agriculture Association/Cooperative	_____
Others__________(Please put down your business type)	_____

Section B: Collaboration management practices measurements

Please consider the following statement, to which degree do you agree in your situation? (Please circle one) 1- not at all, 2-a little bit, 3-to some degree, 4-relatively significant, 5-significantly. A higher value indicates a higher level of collaboration.

	1. Supply side sustainability collaboration	Not at all				Significant
1)	We cooperate with our suppliers to achieve sustainability objectives	1	2	3	4	5
2)	We provide our suppliers with sustainability requirements for their process	1	2	3	4	5
3)	We collaborate with our suppliers to provide products and/or services that support our sustainability goals	1	2	3	4	5
4)	We develop a mutual understanding of responsibilities regarding sustainability performance with our suppliers	1	2	3	4	5
5)	We conduct joint planning to anticipate and resolve sustainability-related problems with our suppliers	1	2	3	4	5
6)	We periodically provide suppliers with feedback about their sustainability performance	1	2	3	4	5

	2. Farmer supermarket docking	Not at all				Significant
7)	Farmers directly cooperate with supermarket to lower transaction costs	1	2	3	4	5
8)	Farmers directly cooperate with supermarket to improve information exchange.	1	2	3	4	5
9)	Farmers directly cooperate with supermarket to improve farmers income/welfare	1	2	3	4	5
10)	Farmers directly cooperate with supermarket to stabilize fresh agro-food price	1	2	3	4	5
11)	Farmers directly cooperate with supermarket to ensure food safety	1	2	3	4	5

	3. Demand side sustainability collaboration	Not at all				Significant
12)	We cooperate with our customers to achieve sustainability objectives	1	2	3	4	5
13)	We cooperate with our customers to improve their sustainability initiatives	1	2	3	4	5
14)	We collaborate with our customers to provide products and/or services that support our sustainability goals	1	2	3	4	5
15)	We develop a mutual understanding of responsibilities regarding sustainability performance with our customers	1	2	3	4	5
16)	We correct joint planning to anticipate and resolve sustainability-related problems with our customers	1	2	3	4	5

Section C: Agriculture industrialization measurements

Please consider the following statement, to what extent do you believe in your situation? (Please circle one) 1- Low, 2-below average, 3-moderate, 4-above average, 5-high. A higher value indicates a higher level of agriculture industrialization.

	4. Agriculture industrialization	Low				High
17)	The percent of farms in a county organized as corporations	1	2	3	4	5
18)	Farm size in acres in a county	1	2	3	4	5
19)	The percent of farmers in the county having more than 50000 Chinese Yuan in sales	1	2	3	4	5
20)	Percent of farmers with full time hired labour	1	2	3	4	5
21)	Cost of hired labour per farm	1	2	3	4	5
22)	Value of contract labour per farm	1	2	3	4	5
23)	Cost of fertilizers per farm	1	2	3	4	5
24)	Costs of other chemicals per farm	1	2	3	4	5

Section D: Sustainable performance measurement

Please consider the following statement, how does your company perform change after adopting collaboration management practices? (Please circle one) 1- not at all, 2-a little bit, 3-to some degree, 4-relatively significant, 5-significant. A higher value indicates a higher level of performance.

	5. Social performance	Not at all				Significant
25)	Increase of management commitment	1	2	3	4	5
26)	Increase of customer satisfaction	1	2	3	4	5
27)	Increase of employee development	1	2	3	4	5

	6. Economic performance	Not at all				Significant
28)	Decrease of cost for materials purchasing	1	2	3	4	5
29)	Decrease of cost for energy consumption	1	2	3	4	5
30)	Decrease of fee for waste treatment	1	2	3	4	5
31)	Decrease of fee for waste discharge	1	2	3	4	5
32)	Decrease of fine for environmental accidents	1	2	3	4	5
33)	Increase of investment	5	4	3	2	1
34)	Increase of operational cost	5	4	3	2	1
35)	Increase of training cost	5	4	3	2	1
36)	Increase of costs of purchasing	5	4	3	2	1

	7. Environmental performance	Not at all				Significant
37)	Reduction of air emission	1	2	3	4	5
38)	Reduction of waste water	1	2	3	4	5
39)	Reduction of solid wastes	1	2	3	4	5
40)	Decrease of consumption for hazardous/harmful/toxic materials	1	2	3	4	5
41)	Decrease of frequency of environmental accidents	1	2	3	4	5
42)	Improve an enterprises' environmental situation	1	2	3	4	5

Appendix B

Questionnaire 2

Section A:

Please consider the following statement, to what extent do you believe in your situation? (Please circle one) 1- Low, 2-below average, 3-moderate, 4-above average, 5-high. A higher value indicates a higher level of agriculture industrialization.

	4. Agriculture industrialization	**Low**				**High**
17)	The percent of farms in a county organized as corporations	1	2	3	4	5
18)	Farm size in acres in a county	1	2	3	4	5
19)	The percent of farmers in the county having more than 50000 Chinese Yuan in sales	1	2	3	4	5
20)	Percent of farmers with full time hired labour	1	2	3	4	5
21)	Cost of hired labour per farm	1	2	3	4	5
22)	Value of contract labour per farm	1	2	3	4	5
23)	Cost of fertilizers per farm	1	2	3	4	5
24)	Costs of other chemicals per farm	1	2	3	4	5

Section B:

1) Please consider the following statement, how does your company perform change after collaborating with the supply side? (Please circle one) 0-Negative performance outcome, 1- not significant, 2-a little bit improvement, 3-to some degree, 4-relatively significant improvement, 5-significant improvement.

	0-Negative performance	**1-Not significant**	**2-a little bit improvement**	**3-to some degree**	**4-relatively significant improvement**	**5-significant improvement**
Economic Performance	0	1	2	3	4	5
Social Performance	0	1	2	3	4	5

Environmental Performance	0	1	2	3	4	5

2) Please consider the following statement, how does your company perform change after collaborating with the demand side? (Please circle one) 0-Negative performance outcome, 1- not significant, 2-a little bit improvement, 3-to some degree, 4-relatively significant improvement, 5-significant improvement.

	0-Negative performance	**1-Not significant**	**2-a little bit improvement**	**3-to some degree**	**4-relatively significant improvement**	**5-significant improvement**
Economic Performance	0	1	2	3	4	5
Social Performance	0	1	2	3	4	5
Environmental Performance	0	1	2	3	4	5

3) Please consider the following statement, how does your company perform change after adopting farmer supermarket docking? (Please circle one) 0-Negative performance outcome, 1- not significant, 2-a little bit improvement, 3-to some degree, 4-relatively significant improvement, 5-significant improvement.

	0-Negative performance	**1-Not significant**	**2-a little bit improvement**	**3-to some degree**	**4-relatively significant improvement**	**5-significant improvement**
Economic Performance	0	1	2	3	4	5
Social Performance	0	1	2	3	4	5
Environmental Performance	0	1	2	3	4	5

Appendix C

Questionnaire 1 Chinese version

Section A: 调查者背景

1. 您在公司什么职位	请选一项
公司老板 Company owners	_____
运营经理 Operations managers	_____
供应链经理 Supply chain managers	_____
农业合作社领导 Leaders of Agriculture Cooperatives	_____
有经验的农民 Experienced farmers	_____
其他 Others ____________ (请写下您的职位)please put down your position)	_____

2. 您所在的公司有多少员工？How many employees are there in your companies/cooperatives/association/business?	请选一项
>700	_____
351-250	_____
201-250	_____
101-200	_____
51-100	_____
<50	_____

3. 您所在的是什么类型的公司？What type of business are you in?	Please tick one
农业龙头企业 Agriculture leading enterprises	_____
农业合作社 Agriculture Association/Cooperative	_____
其他 Others__________(请您写下公司种类 Please put down your business type)	_____

Section B: 合作管理的实际测量 Collaboration management practices measurements

请您考虑以下问卷，按同意程度打（请划圈）1- 一点不同意，2- 一点点 3- 一定程度上， 4- 比较同意， 5- 很同意。同意度越高说明合作度越高。

Please consider the following statement, to which degree do you agree in your situation? (Please circle one) 1- not at all, 2-a little bit, 3-to some degree, 4-relatively significant, 5-significantly. A higher value indicates a higher level of collaboration.

	1. 供应方面可持续性合作 Supply side sustainability collaboration	一点都不 Not at all				很同意 Significant
1)	我们和供应商合作达成可持续性目标 We cooperate with our suppliers to achieve sustainability objectives	1	2	3	4	5
2)	我们可以给供应商提供可持续性解决方案 We provide our suppliers with sustainability requirements for their process	1	2	3	4	5
3)	我们和供应商合作提供可达成可持续目标的商品和服务 We collaborate with our suppliers to provide products and/or services that support our sustainability goals	1	2	3	4	5
4)	我们和供应商达成分担可持续性表现的共识 We develop a mutual understanding of responsibilities regarding sustainability performance with our suppliers	1	2	3	4	5
5)	我们进行联合计划，以预测和解决与供应商可持续性相关的问题 We conduct joint planning to anticipate and resolve sustainability-related problems with our suppliers	1	2	3	4	5
6)	我们定期向供应商提供关于其可持续性表现的反馈 We periodically provide suppliers with feedback about their sustainability performance	1	2	3	4	5

	2. 农民超市对接 Farmer supermarket docking	一点都不 Not at all				很同意 Significant
7)	农民直接与超市合作，降低交易成本 Farmers directly cooperate with supermarket to lower transaction costs	1	2	3	4	5
8)	农民直接与超市合作，改善信息交流。Farmers directly cooperate with supermarket to improve information exchange.	1	2	3	4	5
9)	农民直接与超市合作，提高农民收入/福利 Farmers directly cooperate with supermarket to improve farmers income/welfare	1	2	3	4	5

10)	农民直接与超市合作，稳定新鲜的农产品价格 Farmers directly cooperate with supermarket to stabilize fresh agro-food price	1	2	3	4	5
11)	农民直接与超市合作，确保食品安全 Farmers directly cooperate with supermarket to ensure food safety	1	2	3	4	5

	3. 需求方可持续协作 Demand side sustainability collaboration	一点都不 Not at all				很同意 Significant
12)	我们与客户合作实现可持续性目标 We cooperate with our customers to achieve sustainability objectives	1	2	3	4	5
13)	我们与客户合作改善其可持续发展举措 We cooperate with our customers to improve their sustainability initiatives	1	2	3	4	5
14)	我们与客户合作提供支持我们可持续发展目标的产品和/或服务 We collaborate with our customers to provide products and/or services that support our sustainability goals	1	2	3	4	5
15)	我们与客户就可持续发展绩效相互理解责任 We develop a mutual understanding of responsibilities regarding sustainability performance with our customers	1	2	3	4	5
16)	我们纠正联合计划，以期与客户预测和解决与可持续性相关的问题 We correct joint planning to anticipate and resolve sustainability-related problems with our customers	1	2	3	4	5

Section C: 农业产业化测量 Agriculture industrialization measurements

请考虑下面的陈述，您相信到什么程度？（请划圈）1-低，2-低于平均值，3-中度，4-高于平均值，5 高。 价值越高，农业工业化水平越高。Please consider the following statement, to what extent do you believe in your situation? (Please circle one) 1- Low, 2-below average, 3-moderate, 4-above average, 5-high. A higher value indicates a higher level of agriculture industrialization.

	4. 农业产业化 Agriculture industrialization	低 Low				高 High
17)	一个县里农场为组织的百分比 The percent of farms in a county organized as corporations	1	2	3	4	5
18)	以亩为单位在一个县的农场面积 Farm size in acres in a county	1	2	3	4	5
19)	全县农民的收入超过 5 万元人民币的比例 The percent of farmers in the county having more than 50000 Chinese Yuan in sales	1	2	3	4	5
20)	全职雇佣农民的百分比 Percent of farmers with full	1	2	3	4	5

	time hired labour					
21)	每个农场雇佣劳动力的成本 Cost of hired labour per farm	1	2	3	4	5
22)	每个农场的合同工价值 Value of contract labour per farm	1	2	3	4	5
23)	每个农场的肥料成本 Cost of fertilizers per farm	1	2	3	4	5
24)	每个农场其他化学品的成本 Costs of other chemicals per farm	1	2	3	4	5

Section D: 可持续绩效评估 Sustainable performance measurement

请考虑以下声明，在采用协作管理实践之后，贵公司如何执行更改？（请划圈）1-完全没有，2 - 有点，3 - 有一定程度，4 - 相对有意义，5 有意义。较高的值表示较高的性能水平。Please consider the following statement, how does your company perform change after adopting collaboration management practices? (Please circle one) 1- not at all, 2-a little bit, 3-to some degree, 4-relatively significant, 5-significant. A higher value indicates a higher level of performance.

	5. 社会表现 Social performance	一点都不 Not at all				很同意 Significant
25)	增加管理承诺 Increase of management commitment	1	2	3	4	5
26)	提高客户满意度 Increase of customer satisfaction	1	2	3	4	5
27)	增加员工发展 of employee development	1	2	3	4	5

	6. 经济表现 Economic performance	一点都不 Not at all				很明显 Significant
28)	降低材料采购成本 Decrease of cost for materials purchasing	1	2	3	4	5
29)	降低能耗成本 Decrease of cost for energy consumption	1	2	3	4	5
30)	减少废物处理的费用 Decrease of fee for waste treatment	1	2	3	4	5
31)	减少废物排放费 Decrease of fee for waste discharge	1	2	3	4	5
32)	减少环境事故的罚款 Decrease of fine for environmental accidents	1	2	3	4	5
33)	增加投资 Increase of investment	5	4	3	2	1
34)	运营成本增加 Increase of operational cost	5	4	3	2	1

35)	增加培训成本 Increase of training cost	5	4	3	2	1
36)	增加采购成本 Increase of costs of purchasing	5	4	3	2	1

	7. 环保性能 Environmental performance	一点都不 Not at all				很明显 Significant
37)	减少空气排放 Reduction of air emission	1	2	3	4	5
38)	减少废水 Reduction of waste water	1	2	3	4	5
39)	减少固体废物 Reduction of solid wastes	1	2	3	4	5
40)	减少有害/有毒物质的消耗 Decrease of consumption for hazardous/harmful/toxic materials	1	2	3	4	5
41)	减少环境事故的频率 Decrease of frequency of environmental accidents	1	2	3	4	5
42)	改善企业的环境状况 Improve an enterprises' environmental situation	1	2	3	4	5

Appendix D

Questionnaire 2 Chinese version

Section A:

请考虑下面的陈述，你相信到什么程度？ （请划圈）1-低，2-低于平均值，3-中度，4-高于平均值，5 高。 价值越高，农业工业化水平越高。Please consider the following statement, to what extent do you believe in your situation? (Please circle one) 1- Low, 2-below average, 3-moderate, 4-above average, 5-high. A higher value indicates a higher level of agriculture industrialization.

	4. 农业产业化 Agriculture industrialization	**低 Low**				**高 High**
17)	一个县里农场为组织的百分比 The percent of farms in a county organized as corporations	1	2	3	4	5
18)	以亩为单位在一个县的农场面积 Farm size in acres in a county	1	2	3	4	5
19)	全县农民的收入超过 5 万元人民币的比例 The percent of farmers in the county having more than 50000 Chinese Yuan in sales	1	2	3	4	5
20)	全职雇佣农民的百分比 Percent of farmers with full time hired labour	1	2	3	4	5
21)	每个农场雇佣劳动力的成本 Cost of hired labour per farm	1	2	3	4	5
22)	每个农场的合同工价值 Value of contract labour per farm	1	2	3	4	5
23)	每个农场的肥料成本 Cost of fertilizers per farm	1	2	3	4	5
24)	每个农场其他化学品的成本 Costs of other chemicals per farm	1	2	3	4	5

Section B:

1) 请考虑以下声明，贵公司在与供应商合作后如何进行变更？ （请划圈）0-否定的表现结果，1-不显着，2-略微改善，3-一定程度，4-相对显着改善，5 显着改善。Please consider the following statement, how does your company perform change after collaborating with the supply side? (Please circle one) 0-Negative performance outcome, 1- not significant, 2-a little bit improvement, 3-to some degree, 4-relatively significant improvement, 5-significant improvement.

	0-负面表现 Negative performance	**1-不明显 Not significant**	**2-一点改善 a little bit improvement**	**3-在一定程度上 to some degree**	**4-相对显著的改善 relatively significant improvement**	**5-显著的改善 significant improvement**
经济表现 Economic Performance	0	1	2	3	4	5
社会表现 Social Performance	0	1	2	3	4	5
环境表现 Environmental Performance	0	1	2	3	4	5

2) 请考虑以下声明，贵公司在与需方合作后如何进行变更？ （请划圈）0-否定的表现结果，1-不显着，2-略微改善，3-一定程度，4-相对显着改善，5 显着改善。Please consider the following statement, how does your company perform change after collaborating with the demand side? (Please circle one) 0-Negative performance outcome, 1- not significant, 2-a little bit improvement, 3-to some degree, 4-relatively significant improvement, 5-significant improvement.

	0-负面表现 Negative performance	**1-不明显 Not significant**	**2-一点改善 a little bit improvement**	**3-在一定程度上 to some degree**	**4-相对显著的改善 relatively significant improvement**	**5-显著的改善 significant improvement**
经济表现 **Economic Performance**	0	1	2	3	4	5
社会表现 **Social Performance**	0	1	2	3	4	5
环境表现 **Environmental Performance**	0	1	2	3	4	5

3) 请考虑以下说法，贵公司采纳农民超市对接后如何进行变更？（请划圈）0-否定的表现结果，1-不显着，2-略微改善，3-一定程度，4-相对显着改善，5 显着改善。Please consider the following statement, how does your company perform change after adopting farmer supermarket docking? (Please circle one) 0-Negative performance outcome, 1- not significant, 2-a little bit improvement, 3-to some degree, 4-relatively significant improvement, 5-significant improvement.

	0-负面表现 Negative performance	**1-不明显 Not significant**	**2-一点改善 a little bit improvement**	**3-在一定程度上 to some degree**	**4-相对显著的改善 relatively significant improvement**	**5-显著的改善 significant improvement**
经济表现 **Economic Performance**	0	1	2	3	4	5
社会表现 **Social Performance**	0	1	2	3	4	5
环境表现 **Environmental Performance**	0	1	2	3	4	5