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Vegetable supply chain integration: the case of a trinity cooperative in China

CASE STUDY

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Abstract

China's vegetable supply chain faces challenges, such as the shortage of technologies for vegetable production, storage and preservation, imperfect rural finance services, and uncertainty in terms of vegetable production and sales. Companies and the Chinese government focus on food safety and security, as well as supply stability. The Meiyu Cooperative is a National Top 100 farmers' cooperative in China that addresses these concerns successfully. It has established 'a trinity cooperation mechanism' to coordinate and integrate vegetable production, supply and sale, and financial credit. The cooperative has successfully built close relationships with farmers and companies, thus achieving financial, social, and environment benefits. This cooperation mechanism represents an innovative model for integrating the vegetable supply chain and providing necessary services based on farmers' demands. This case study is addressed to senior undergraduate students and postgraduate students specialising in agricultural economics and can also be used for training administrators in food companies.

Keywords: trinity cooperative, vegetable supply chain, case study

JEL code: Q13

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A teaching note has been prepared for this case study. Interested instructors at educational institutions may request the teaching note by contacting the author or IFAMA.

1. Introduction

An important reason for farmers establishing a cooperative is access to services and other such benefits. According to the Chinese Farmer Professional Cooperative Law, services include purchasing agricultural materials, agricultural product sales, processing, transportation, and storage, as well as technology and information related to agricultural production and sales. Thus, the Chinese government is understandably concerned about how farmers gain access to services when organised as a cooperative. This paper uses Meiyu Cooperative as an example to illustrate how a cooperative provides services to help farmers achieve benefits through the trinity cooperation mechanism on vegetable production, supply and sale, and financial credit.

In the following sections, the general backgrounds of the vegetable supply chain in China and vegetable industry in China and Rui'an County are introduced. Then, the challenges of the vegetable supply chain in China are illustrated. Next, the case of Meiyu Cooperative's trinity integrating supply chain model is presented, along with a discussion on the potential benefits for supply chain management, as well as the economic, social, and environmental perspectives of Meiyu's trinity cooperation model. Finally, new challenges for Meiyu trinity cooperative are articulated.

2. Vegetable supply chain in China

Due to the high moisture content, easy deterioration, as well as being strongly influenced by the natural environment, it is difficult to preserve vegetables. As such, high standards are required for the vegetable supply chain to achieve high efficiency and low transaction costs.

The vegetable supply chain in China consists of input suppliers, vegetable farmers (producers), vegetable processing companies, vegetable distributors, vegetable retailers, and vegetable consumers (Figure 1). Suppliers are companies that produce seed products and other agricultural materials for vegetable farmers. Farmers in the vegetable chain produce and sell vegetables by choosing the most efficient agricultural machines and focusing on the best production skills. Vegetable processing companies process and manufacture vegetables into final products, such as green salads and vegetable cans, collaborating with vegetable farmers, which are placed upstream in the supply chain, to ensure a secure vegetable supply and with vegetable retailers, which are placed downstream in the supply chain, to establish brands and efficient marketing. Vegetable distributors manage vegetable transportation, guaranteeing the distribution of fresh vegetables from producers to customers. This transportation is usually carried out by logistics companies using professional cooling systems to keep vegetables fresh so that their value can be maintained.

Because of the intermediated links between vegetable farmers and consumers, the long transaction process leads to high transaction costs in areas such as transportation cost, fees from vegetable retailers, negotiation cost, and decay loss. Thus, to lower transaction costs and increase the efficiencies of production, supply, and sale, as well as promote vegetable security and safety, it is important to optimise the vegetable supply chain.

There are several types of vegetable supply chains in China. The first is 'farmers + company' (Figure 2, left-hand side), to which most small-scaled vegetable farmers belong to. Farmers in the vegetable industry in China with a production scale below 8.24 acres are defined as small-scaled vegetable farmers. They

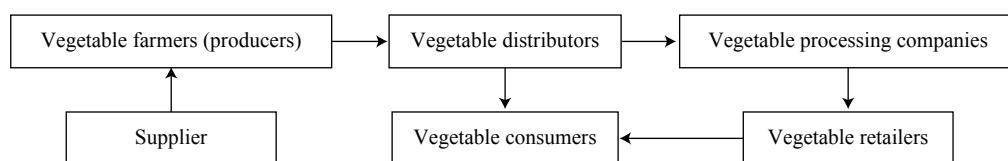


Figure 1. Typical vegetable supply chain in China.

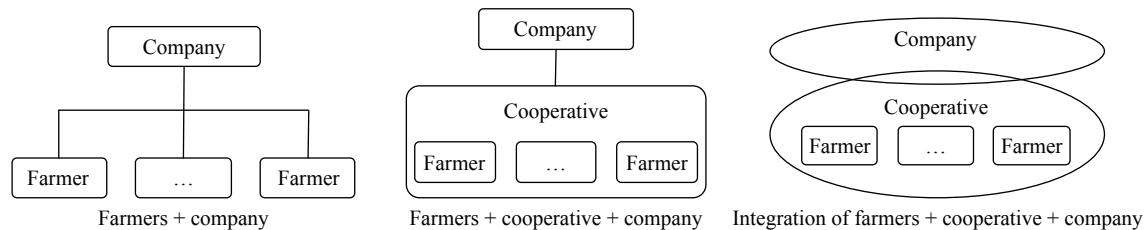


Figure 2. Three types of supply chains in the vegetable industry.

manage vegetable production, while various companies take charge of processing, manufacturing, and sales. The obligations for both companies and farmers are contract-based. This type of supply chain establishes a loose/transactional relationship between farmers and companies through contracts, which reduces transaction costs. For example, although companies provide technology assistance to farmers, such assistance is rather low level and limited to the production process. Specifically, it does not include pre-, during, and post-production processes, which can result in a low level of food security due to farmers' inability to negotiate vegetable prices with companies.

The second type of vegetable supply chain is 'farmers + cooperative + company' (Figure 2, center). This is a semi-tight supply chain type of the vegetable industry, which includes cooperatives as to increase the coordination between companies and farmers. Specifically, cooperatives have tight relationships with their member farmers by providing services for pre-, during, and post-production (e.g. agricultural materials procurement, medium or high-level technology support, and vegetable sales). However, this coordination among farmers, cooperatives, and companies is not sufficient. As a result, the distribution process system has not been established, as the information flow is not transparent among farmers, cooperatives, and companies.

Another type of supply chain is based on the 'integration of farmers + cooperative + company' (Figure 2, right-hand side). This is a tight supply chain type in the vegetable industry. The cooperative has a high-level of vertical coordination with both farmers and companies in the vegetable industry. Here, the cooperative and vegetable enterprises (e.g. a processor) are invested and support each other. The cooperative can provide a highly unified procurement of production and sales, as well as the highest extent of financial support and technical assistance, while imposing strict quality requirements. This tight coordination reduces transaction costs, which ultimately increases efficiency in the vegetable supply chain and facilitates food security and safety in the vegetable industry.

3. Vegetable Industry in China and Rui'an County

The vegetable industry has been found to strongly impact the agricultural development in China and also plays an important role in increasing farmer revenues in China. Shang and Zhang (2005) point out that the net profit from producing vegetables per one Chinese acre (approximately 0.16 acres) in heliogreenhouses is between USD 920 and USD 1,230, in large and medium greenhouses it is between USD 460 and USD 615, and between USD 150 and USD 450 in open-field production. Therefore, if farmers get more technological support in production, they can increase their revenues.

Additionally, the growth of the vegetable industry facilitates other industries' development such as seeds sales, chemical fertiliser manufacture, and food processing industries. According to the Food and Agricultural Organization (FAO) database, the planting area and annual yield for vegetables in China accounted for 43% and 49% of the global figures, respectively, both ranking first in 2018. Based on the FAO database, China's vegetable exports contributed 12% to the global vegetables exports in 2018. According to UN's Comtrade database, the value of vegetable exports in China grew 63% from 2009 to 2017, maintaining a trade surplus between 2009 and 2017 (Table 1).

Table 1. Chinese vegetable imports and exports in billion USD, 2009-2017. Source: UN Comtrade database, 2019.

Year	Export	Import	Export and import	Surplus
2009	4.27	1.27	5.54	3.00
2010	5.75	1.62	7.37	4.13
2011	6.65	2.35	9.00	4.30
2012	6.35	2.46	8.81	3.89
2013	6.75	3.15	9.90	3.60
2014	6.57	3.43	10.00	3.14
2015	6.84	3.64	10.48	3.20
2016	7.44	3.68	11.12	3.76
2017	6.96	3.14	10.10	3.82

Rui'an is a county of Wenzhou City, a port and industrial county in Zhejiang province, China. It is considered as a vegetable production base in Zhejiang province, which is located in the southeast of the country, supplying vegetables to other cities besides Zhejiang province, such as Shanghai, Wuhan, and Changzhou. According to data from the National Bureau of Statistics, the vegetable production volume of Rui'an county has been on the rise for the past 10 years. The county is thus well-known for its vegetables, such as tomatoes, cucumbers, and eggplants.

Vegetable production in Rui'an county represents well the vegetable production situation in China, which is still dominated by small-scale vegetable farmers. Recently, the Chinese government has raised funds through different agricultural programs, such as the 'modern agricultural industry development program', but these funding programs tend to rather encourage large-scale farmers by providing them with financial benefits. Therefore, it is not easy for small-scale vegetable farmers in Rui'an county to apply for funds to support vegetable production, supply, and sales.

4. Challenges for the vegetable supply chain in China

The challenges faced by the vegetable supply chain in China come from the disparities between small-scale farmers and the large market, for example, in terms of food safety and security in supply chains, farmers' challenges during the pre-, during, and post- production processes, as well as insufficient financial support for farmers. These challenges hinder farmers' access to services from cooperatives. The concerns regarding food security and safety are sources of stress for farmers, as well as the local government. Compared to large-scale vegetable producers, small-scale ones have limited abilities against risks such as market price fluctuations. How to increase farmers' earnings is still one of the most urgent problems for the local government. Meanwhile, it is difficult to ensure the quality of chemical fertilisers for farmers and thus guarantee vegetable safety. As such, both small-scale vegetable producers and the local government want to find an effective strategy to solve vegetable security and safety.

Another challenge is related to farmers' challenges in the pre-, during, and post-production processes. Most Chinese vegetable producers are organised as traditional families and small-scale farmers. In the pre-production process, they lack scientific cooperation and mutual trust in facilitating production technology for transportation and marketing (Luo *et al.*, 2017). Thus, farmers' benefits are easily transferred to big companies, which lowers their profits. In the pre-production process, the high cost of purchasing agricultural materials individually make it difficult to guarantee the quality of chemical fertilisers. During production, the lack of cooperation and information asymmetry among farmers increases the costs of inputs and also affects the quality of vegetables (Wiese and Toporowski, 2013). During post-production, small-scale farmers lack sales channels, such as supermarkets and wholesale markets. Additionally, vegetable production is strongly influenced by the weather and crops can easily decay if vegetable producers do not sell them in a timely

manner in the market. For example, according to statistical data from the Local Investigation Group in Luohe City, the purchase price for Chinese cabbage in Luohe, Henan Province was USD 0.62 per 500 grams and USD 1.26 in Shanghai's vegetable market in February 2018. The explanation resides in the fact that the price increases approximately 100% during the sales flow process. Therefore, it is easy to cause high transaction costs and losses (farmers' benefits decrease from the transaction of vegetables) during post-production.

A third challenge is the insufficient financing for vegetable production. Local governments and banks usually provide financial support for large-scale farmers. However, it is not easy for small-scale farmers to obtain financial support to expand production and sales, which definitely hinders the overall expansion of vegetable production, supply, and sales.

One of the most important reasons for the existence of these three challenges is the lack of coordination among production, supply and sale, and credit (Luo *et al.*, 2017; Muller *et al.*, 2012; Wang *et al.*, 2018). This insufficient coordination likely hinders vegetable industry's development, negatively influencing the growth of China's rural economy. In the following, this paper illustrates how Meiyu Cooperative uses a trinity cooperation model to resolve these challenges.

5. Meiyu Cooperative

5.1 Background of Meiyu Cooperative

Meiyu Cooperative, located in Rui'an County, is a leading vegetable cooperative. This cooperative is a national top 100 farmers' cooperative in China. As the largest perennial vegetable base in Wenzhou City, Meiyu Cooperative has had an annual output value of over USD 15,380,000 over a total area of more than 1,300 acres. Around 60% of vegetables produced in Meiyu Cooperative are supplied to Wenzhou City, while the remaining 40% are sold all over the country.

In 1991, several farmers started cooperating in the production and purchasing of agricultural materials, formally establishing Meiyu Cooperative in 2001. The registered capital for this cooperative was USD 159,000. Farmer members are distributed across 41 villages and 7 towns in Rui'an county. The membership of Meiyu Cooperative has increased from 94 in 1991 to 762 in 2018. Mr. Huang, Zeqiang was the first chairman of the cooperative, contributing significantly to its development. The cooperative owns many vegetable brands, including Qianglv (Strongly Green), Lvyinxiang (Green Impression), and 'Meiyu.' Meiyu Cooperative established a website (www.myschzs.com) to provide information such as cultivating skills and marketing activities to support farmers. Compared with professional vegetable companies (e.g. Chinese Vegetable Group Co. Ltd. in Shandong Province), Meiyu Cooperative, being comprised of small-scale farmers, does not have the advantage of producing vegetables on a large scale.

In terms of cooperative governance, Meiyu Cooperative established a member committee and a board of directors. Decision making is based on the 'one member one vote' principle, which promotes members' participation in the democratic decision-making process. Mr. Huang Zeqiang, the first chairman of the cooperative describes its role as follows: 'Meiyu Cooperative serves as a bridge between farmers and companies. It assists farmers with services to make more profits from vegetable production and also supports farmers to better sell vegetables.' Meiyu Cooperative does not aim to make profits from its members but instead links vegetable farmers, companies, and consumers.

According to Mr. Lei Dafeng, the current chairman of the cooperative, Meiyu Cooperative has seven staff members responsible for managing cooperative members, collecting vegetable industry information, offering vegetable production training, connecting vegetable experts from institutions, and managing affairs from the Supply Agency, Wanke Company, and Credit Agency. Particularly, these staff members link farmers to sale platforms such as internet whole-sale markets, companies, communities, supermarkets, and others.

Once the cooperative started establishing production cooperation, it became an example for the cooperatives in Zhejiang province. In particular, it focused on supply cooperation in supply chains since 2006 and subsequently considered cooperation in vegetable sales and credit coordination (ultimately expanded to finance). Eventually, Meiyu Cooperative has shaped itself based on a trinity cooperation in production, supply, sale, and financial credit for supply chain integration. Table 2 shows the key development stages of Meiyu Cooperative.

The trinity cooperation mechanism of Meiyu Cooperative has a significant impact on the local economy and social development in terms of supply chain integration (Figure 3). Through production, supply and sale, and financial credit cooperation, Meiyu Cooperative has coordinated and collaborated with different sectors to upgrade the efficiency of the supply chain and develop the agricultural cooperative. In the next five years starting from 2019, Meiyu will further integrate its supply chain to achieve sustainable competitive advantage. The next section details the trinity cooperation model of Meiyu Cooperative and shows how this model helps Meiyu Cooperative achieve sustainable development.

Table 2. Development stages of Meiyu Cooperative.

Period	Business development milestone
1991-2003	<ul style="list-style-type: none"> Started as several farmers cooperating in production and purchasing production materials. Expanded into vegetable production and officially established the cooperative to sell fresh vegetable in Wenzhou metropolitan area. Established vegetable brand Qianglv and won the Certificate for National Pollution-Free Agricultural Products. Developed production cooperation in vegetable supply chain.
2004-2008	<ul style="list-style-type: none"> Founded the Vegetable Technology Service Center and Agricultural Residue Testing Center to expand production cooperation. Established the Supply Agency to support unified sourcing to facilitate supply cooperation. Introduced new vegetable seed varieties from Israel. Invested more in technology support production and started to invest for supply and sale. Established Farmers' Credit Guarantee Company to provide financial support to members.
2009-2011	<ul style="list-style-type: none"> Established the Agricultural Origin Trading Market. Built 13 points of sales at wholesale vegetable markets in Changzhou, Hangzhou, and Shanghai cities. Established the Agricultural Materials Warehouse and Vegetables Acquisition Point. Founded Wenzhou Wanke Company to expand sale cooperation. Built Huimin Rural Mutual Funds Union.
2011-2018	<ul style="list-style-type: none"> Founded a credit cooperation union. Started to provide financial support to members who were affected by natural disasters. Then, financially assisted members during the seasonal shortages of agricultural materials. Finally, it has taken advantage of capital to support agricultural development, proving farmers cooperation to obtain financial credit. Integrated the vegetable chain in terms of production, supply and sale, and financial credit.

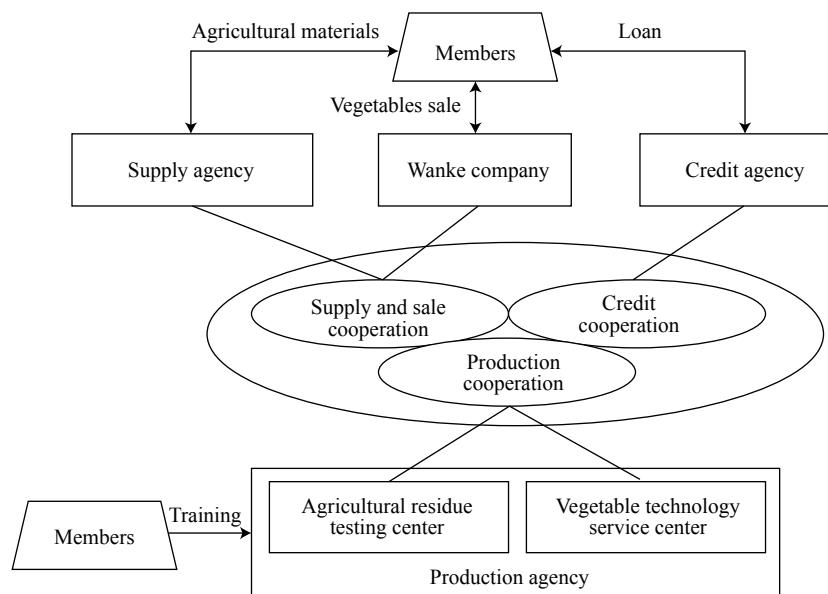


Figure 3. Meiyu's Trinity supply chain model.

5.2 Trinity cooperation model of Meiyu Cooperative

The Chinese government is always concerned with the agricultural economy and rural development. China's first Central Document of 2017 pointed out that the main disparity in agriculture was based on the insufficient total quantity and structural contradictions, especially in the supply sector. To promote structural reform in agricultural supply, China should actively develop moderate scale operations through standardised farmer cooperatives, particularly trinity comprehensive cooperation such as the Trinity Federation of Farmer' Cooperative Economic Organization and Trinity Cooperatives.

The Trinity Federation of Farmers' Cooperative Economic Organization reforms traditional supply and sale cooperatives based on a macro view. It is governed by the local government and includes four level trinity organisation (province, city, county, and town). For example, the Mayu Federation of Farmers' Cooperative Economic Organization from Rui'an county is a town-level trinity organisation administered by the town government, which established the 'agricultural material platform' to provide more than 2,000 agricultural materials to increase supply cooperation between agricultural material companies and farmers. Meanwhile, the town government utilises 'electronic commerce platform + stores' to promote sale cooperation between sale platforms and farmers. Moreover, it is tasked to two rural banks and an agricultural credit guarantee company with improving credit cooperation between farmers and credit organisations, while also integrating production cooperative, supply and sale cooperative, and credit union through government control.

From the micro perspective, a trinity cooperative integrates supply chains with production, supply and sale, and financial credit cooperation through members' autonomy. In this paper, Meiyu's trinity cooperative model is the second type of trinity cooperation (Figure 3). Compared with the typical vegetable supply chain in a traditional cooperative (Figure 1) and from the perspective of supply chain management, farmers volunteered to establish the Agricultural Residue Testing Center and Vegetable Technology Service Center for production cooperation under this model. Meanwhile, farmers in this cooperative volunteered to establish the Supply Agency through supply cooperation to integrate external suppliers and Wanke Company through sale cooperation to involve external customers. Additionally, members volunteered to create the Credit Agency through credit cooperation to integrate financial institutes.

By directly allowing farmers to understand the demands, Meiyu Cooperative provides a basket of services to farmers from a supply chain management perspective. Specifically, during pre-production, this cooperative provides farmers with materials on agricultural supply. During production, Meiyu Cooperative offers production management services such as technology, cultivation technique, and harvest services. It also provides services post-production (e.g. product purchasing, product sale, and product processing services).

■ *Production cooperation*

Meiyu Cooperative established the Vegetable Technology Service Center and Agricultural Residue Testing Center to support farmers in production cooperation. This center provided new technologies to farmers, which significantly lowered costs. For instance, to assist production, Meiyu Cooperative advocated galvanised steel pipe technology for establishing greenhouses, as well as new greenhouse standardised production technologies and industrialised skills for seedling production. To date, it has founded four greenhouse vegetable demonstration bases, namely Disanjia, Panyang, Yutou, and Jiujia. Another example relates to the introduction of new planting technologies, such as hydroponic production, by the Vegetable Technology Service Center, which increased production efficiency. On the other hand, the Agricultural Residue Testing Center promoted the efficient use of fertilisers and pesticides, along with the quality control of vegetable production.

Besides technology development in production cooperation, the farmers in Meiyu Cooperative also cooperated in consolidating the production of new species of vegetables. For instance, this cooperative introduced new tomato varieties, such as the FA-189 from Israel, from 2004 to 2005. Due to the technological advancement and centralised production, Meiyu Cooperative significantly increased its productivity and created many well-known high-quality fresh vegetable brands such as Qianglv and Lvyinxiang. Thus, the vegetables from Meiyu Cooperative are strongly competitive in the vegetable market. Moreover, through the large scale vegetable production, Meiyu Cooperative could negotiate better prices in the vegetable market. In other words, this production cooperative provides a way for local farmers to increase production scale, access resources, as well as achieve a better market position to sell vegetables by negotiating with large businesses. Furthermore, Meiyu Cooperative provided assistance in terms of agricultural product supply before production and offered wholesale service after production.

■ *Supply and sale cooperation*

Individual farmers lack bargaining power and cannot guarantee the quality of agricultural resources. As a solution to this problem, through supply cooperation, Meiyu Cooperative established the Supply Agency to support unified sourcing. For instance, the agency signed contracts with Wuzhou Fertilizer Group to purchase over 1000 different agricultural fertilisers and then farmers uniformly purchased agricultural materials such as seeds, fertilisers, and raw materials from the Supply Agency. Meanwhile, Meiyu Cooperative helped purchase agricultural materials at a reasonable price, thus reducing purchasing cost and ensuring the quality of raw materials through this large supply scale.

As a socially vulnerable group in the vegetable market, it was not easy for individual farmers to expand their distribution channels and sell their agricultural products at reasonable prices. Through sale cooperation under Meiyu Cooperative from 2009, farmers launched Wanke Company to expand distribution channels and increase bargaining power in the vegetable market. Meiyu Cooperative negotiated market prices with supermarkets, schools, and wholesale markets through contracts. For instance, by integrating downstream consumers, Meiyu Cooperative has created tight relationships with many restaurants catering for middle schools (e.g. Wenzhou Middle School), colleges (e.g. Wenzhou Career and Technology College), companies (e.g. Kangnai and Yiming), supermarkets (e.g. Nanda and Renben), and government agencies (e.g. Wenzhou City Administration Center). Additionally, it established 13 points of sale at wholesale vegetable markets all over China. The cooperative has not only stabilised its vegetable supply quantity but also ensured vegetable consumers' access to vegetables. Most recently, in 2018, it started supplying fresh vegetables to the 35th

Chinese Scientists' Expedition to Antarctica. Moreover, many companies, such as Huafeng Group Enterprise, placed orders with Meiyu to purchase fresh vegetables in advance.

■ *Credit cooperation*

As mentioned in the previous section, compared to big agricultural companies, it is not easy for small-scale farmers to obtain financial support from banks and local governments due to their low credit capabilities. Therefore, Meiyu Cooperative established the Credit Agency to provide public financial services to farmers rather than for profit. The agency conducted credit cooperation through three strategies: internal mutual financial support, external financial assistance, and internal mutual insurance support. This credit cooperation illustrates how farmers, cooperative, and financial institutions can coordinate in the financial supply chain.

Internal mutual financial support: together with two other cooperatives, Meiyu Cooperative established the Huimin Rural Mutual Fund Union, which provided financial services to members in the pre-, during, and post-production processes. The registered capital was USD 769,200 and the voluntary shareholders were 694 members from these three cooperatives. According to the principle 'run by the local farmers, governed by the local farmers and benefitting the local farmers,' members of the three cooperatives can enter and exit the Huimin Rural Mutual Fund Union voluntarily but individual shares cannot exceed 10%. The capital source are mainly the registered capital and members' deposits, along with USD 769,200 credit from Rui'an Rural Commercial Bank. This Mutual Fund Union effectively integrates the three cooperatives' idle capital and realises capital allocation among three cooperatives based on different funding demands for the different seasons. Therefore, it increases capital efficiency.

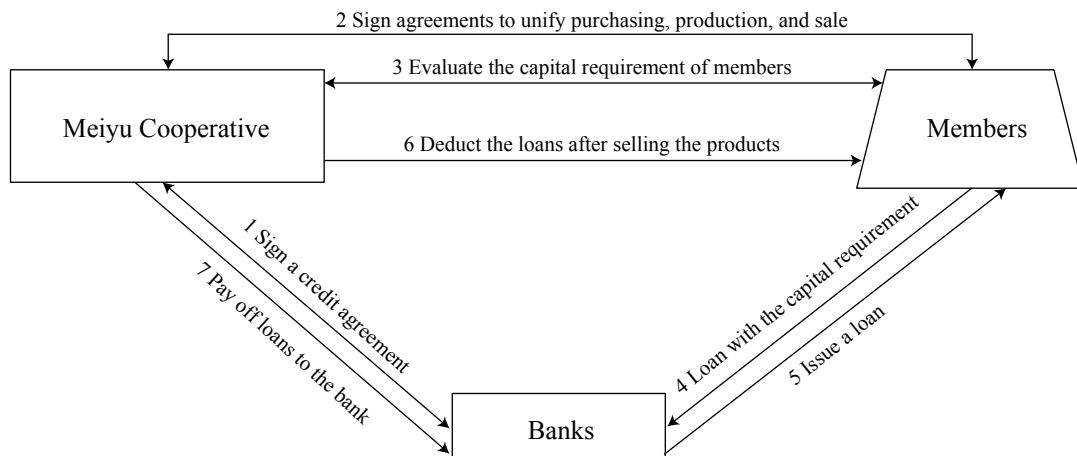
The Mutual Fund Union also provides financial services, including deposits, loans, and settlement to members. The values of loans range from USD 769 to USD 76,900 and the types of loans consist of mortgages, mutual guarantee loans, and credit loans. The interest rate is aligned to the one in rural cooperative financial institutions and members participate in the distribution of profits. Depositors share the distribution of 35% of the total profits according to their outstanding deposits, while lenders share the distribution of 15% of the total profits based on their loan values. Thus, the loan rate is lower than the one in rural cooperative financial institutions. Huimin Rural Mutual Fund Union has three investigators, one in each of the three cooperatives, which have expertise in lenders' management and credit status. Compared to banks, it is more efficient and convenient to provide financial support to members in this way. For instance, this mutual fund union can approve loans up to USD 30,800 to members in half a day if all necessary documents are available.

■ *External financial assistance*

Meiyu Cooperative signed a credit agreement of USD 1,153,800 with Rui'an Rural Commercial Bank, subsequently distributing the funds according to members' actual needs. Specifically, 500 members guaranteed by the Meiyu Cooperative have already received funds of USD 5,384,600 from Rui'an Commercial Rural Bank. Meanwhile, members can use Wechat (a type of social media in China) to loan and return loans at any time according to the financial policy of 'benefit farmers through internet loan to' for convenience.

For example, if farmers lack capital to purchase agricultural materials, Meiyu Cooperative would sign an agreement with them, which provides capital credit documents guaranteeing loans and credit sale service from the bank for purchasing agricultural materials. Additionally, this agreement offers advance payments from the bank for purchasing agricultural products. Meiyu Cooperative collects agricultural products at certain prices and settles both the capital and interest of financing services during harvest season in seven steps (Figure 4).

First, Meiyu Cooperative signs three agreements for purchasing, production, and sales with members. Second, the cooperative signs individual agreements with farmers for unified purchasing, production, and sales to better understand members' characteristics through production, supply, and sales cooperation. Third, if



farmers need loans in the purchasing or production process, the cooperative would allocate value and issue

Figure 4. Loan process for members under the cooperative's external financial assistance.

documents of capital demand according to production scale and capital demand. Fourth, farmers can obtain loans from the credit granting bank based on the capital demand documents issued by Meiyu Cooperative. Fifth, farmers purchase agricultural materials from Meiyu Cooperative according to requirements and deliver finished products to the cooperative for sales according to the production standards of the cooperative. Sixth, Meiyu Cooperative sells farmers' products and deducts the loaned sums for payment to the bank. Finally, Meiyu Cooperative withdraws farmers' loan contracts.

■ Internal mutual insurance supports

Together with 21 other cooperatives, Meiyu Cooperative established Rui'an Xingmin Rural Insurance Mutual Aid Association in October, 2015 as the second insurance mutual aid association in China approved by the National Banking and Insurance Regulatory Commission. The registered and operating capital are USD 153,800 and USD 769,200, respectively. The association was registered as a collective enterprise in Mayu Town, Rui'an City and its business scope consisted of providing insurance for normal agricultural products, agricultural product freights, and farmers small loans guarantee, as well as for operating bank deposits and bonds and other insurances approved by the National Banking and Insurance Regulatory Commission. It was the first rural insurance mutual aid association that focused on agricultural insurance to serve the *trinity* construction of rural areas in China.

Regarding the organisational structure, the Rui'an Xingmin Rural Insurance Mutual Aid Association was made up of 22 professional cooperatives and two individuals, its members covering the entire town of Mayu in Wenzhou City. This rural insurance mutual aid association established a board of directors, a board of supervisors, a department of business management, and a department of comprehensive management, including five directors, five supervisors, and 13 staff members, managers, and part-time executives (all having obtained qualifications from the National Banking and Insurance Regulatory Commission).

The insured farmers would be guaranteed by two mechanisms by the rural insurance cooperatives. The first one is an economical compensation mechanism. Once farmers registered loss, they could obtain a rapid settlement of claims to facilitate agricultural production. The second one is a financing mechanism: members could increase their credit value of financing through insurance, which allows banks to provide higher loans. For instance, for the production of greenhouse tomatoes during winter while focusing on preventing natural disasters, Meiyu Cooperative could cover a production of greenhouse tomatoes of approximately 75 acres, with the highest insurance premium for one Chinese acre (approximately 0.16 acres) being USD 185. In other words, if these 75 acres of greenhouse tomatoes were damaged by freezing, the highest insurance claim for one Chinese acre (approximately 0.16 acres) would be as high as USD 185.

Rui'an Xingmin Rural Insurance Mutual Aid Association has successfully filed two batches of seven types of insurance with the Bank and Insurance Regulatory Bureau in Zhejiang. This rural insurance mutual aid association has gained a premium income of USD 32,300 from providing insurance value of USD 864,100. Furthermore, it has settled claims of USD 14,600, covering 710 farmers. For planting, the insurance premium income was USD 25,700 from providing insurance value of USD 366,100. It has also guaranteed farmland of approximately 327 acres, covering 691 farmers.

Credit cooperation changes the traditional rural credit operation of individual credit investigations and financial supervision. Through credit cooperation, Meiyu Cooperative members, the cooperative, companies, and consumers coordinate with each other. Credit cooperation also supports different sectors in the financial supply chain system. Particularly, it reduces financial difficulties for small-scale farmers and enhances the efficiency and competitiveness of the credit supply chain. As a result, farmers, cooperatives, companies, and consumers establish stable supply and sale relationships. Meiyu Cooperative easily controls farmers cash flows and logistics, as well as lowers the financial risks from farmers' loans.

6. Benefits of the trinity cooperation mechanism

This trinity cooperation mechanism does not only develop supply chain management, but also provides benefits to the rural economy, social life, and environment.

6.1 Benefits for supply chain management from the trinity cooperation mechanism

The trinity cooperation mechanism has expanded the opportunities for supply chain integration (i.e. internal integration with farmers and external integration with suppliers and customers). Specifically, this trinity cooperation mechanism has brought benefits to supply chain management, namely cooperation in production, supply, sale, and credit (Table 3).

Table 3. Differences in supply chain management before and after implementing the trinity cooperation model.

	Before trinity model	After trinity model
Whole supply chain	<ul style="list-style-type: none"> • Lack of opportunities • Lack of information sharing • Loose relationship 	<ul style="list-style-type: none"> • Expand opportunities • Promote information sharing • Tight relationship between farmers
Production	<ul style="list-style-type: none"> • Lacking unified production criterion to produce • Lacking uniform pesticide quality • Traditional production without new varieties and seeds • Low efficiency 	<ul style="list-style-type: none"> • Establish unified production criteria • Uniform pesticide quality • Promote science and technology innovation in production with new varieties and seeds • Higher quality and upgraded production efficiency
Supply and sale	<ul style="list-style-type: none"> • Lacking a unified agricultural material purchasing • Lacking a unified sales channel to sell vegetables 	<ul style="list-style-type: none"> • Founded the Agricultural Material Company to purchasing agricultural materials and pesticides • Established Wanke Company to create sales channels to further expand market and sell vegetables
Credit	<ul style="list-style-type: none"> • Lacking capital exchange • Not easy to borrow money from local banks to expand production, supply, and sales 	<ul style="list-style-type: none"> • Increase mutual benefits (e.g. farmers who save money through the Credit Agency increase profits and farmers who lack capital obtain financial support) • Promote credit of scale development

The cooperation mechanism has expanded the opportunities for integrating supply chains by establishing a tight relationship with each supply chain partner to facilitate the coordination of supply chain activities and organisational integration with farmers, cooperatives, financial institutions, suppliers, and customers. Additionally, its organisational structure improved communication, information sharing, and joint decision making across supply chain partners in the vegetable industry. Farmers in this organisational cooperative seek business effectiveness and efficiency through close relationships with supply chain partners.

Production cooperation developed a production of scale based on unified production criteria and uniform agricultural materials. It also helped in choosing new varieties and seeds. Production cooperation has promoted innovation in vegetable production, such as promoting new skills to produce tomatoes; that is, it enhanced efficiency.

Supply cooperation in Meiyu Cooperative relied on establishing the Agricultural Material Company to purchase agricultural materials and pesticides. For sales cooperation, Meiyu Cooperative established Wanke Company to develop sales channels to expand the market. This supply and sale cooperation reduced transaction costs and significantly improved logistics and information flows in the vegetable supply chain and strengthened Meiyu cooperative's power to negotiate with companies on issues such as market prices.

Meiyu Cooperative provided funding and insurance services to resolve funding shortages and security issues for farmers. This credit cooperation between farmers increased mutual financial support. Specifically, farmers who saved money through the Credit Agency increased their profits and those who lacked capital easily obtained capital support. Credit cooperation guaranteed abundant funds through mutual insurance for adopting modern technologies, new machines, equipment, research program, and development activities to enhance cooperative development.

6.2 Benefits by the trinity cooperation mechanism in terms of the economy, society, and environment

This model has also created benefits for the rural economy, society, and environment (Table 4). Since the central and local governments have made efforts to increase farmers' earnings in rural China, it is crucial to advocate the trinity cooperation mechanism in rural areas by using the case of the Meiyu Cooperative.

Table 4. Differences in economy, society, and environment before and after the trinity cooperation model.

	Before trinity model	After trinity model
Economy	<ul style="list-style-type: none"> Revenue: USD 460 (lower than annual per capital GDP of USD 500 in Rui'an County) Members: 94 Capital in Credit Agency: USD 769,200 	<ul style="list-style-type: none"> Revenue: USD 11,000 (higher than annual per capital GDP of USD 10,000 in Rui'an County) Members: 762 Capital in Credit Agency: increased by 231% to approximately USD 2,549,700
Social	<ul style="list-style-type: none"> Low quality of vegetables Consumers did not know about vegetable products from Meiyu Cooperative Lacked talents Loose relationship between farmers 	<ul style="list-style-type: none"> Social impact on surrounding villages Vegetable quality guaranteed Well-known brands increased consumer demand Attract talents Facilitate degree of knowledge transfer from Meiyu Cooperative to local farmers Tight relationship between farmers
Environmental	<ul style="list-style-type: none"> Used pesticides and normal vegetables Cannot guarantee safety of vegetables 	<ul style="list-style-type: none"> Less use of pesticide/antibiotics Guaranteed green vegetable Increase safety of vegetables

Economically, this mechanism helped farmers tackle low earnings. Additionally, this trinity mechanism resulted in profit increases due to the growing number of members and better capital flows. Specifically, the farmers' annual revenue increased from USD 450 in 1991 (lower than the average annual per capita GDP of USD 500 in Rui'an County) to USD 11,000 in 2017 (higher than average annual per capita GDP of USD 10,000 in Rui'an County). The number of members in Meiyu Cooperative has increased from 94 to 762 between 1991 and 2018. The capita of the Credit Agency increased by 231% from USD 769,200 to USD 2,549,700.

Meiyu Cooperative not only increased members' revenues, but also supported the revenue growth of farmers from surrounding villages, creating social impact through the trinity cooperation mechanism. This mechanism allowed the vegetable industry to become transparent, guaranteeing the quality of vegetables. It also helped create high quality brands of vegetables such as Qianglv and Lvyinxiang, which obtained many national qualifications such as 'national pollution-free agricultural product qualification' and 'national green food qualification'. The mechanism promoted customer reputation and safety of vegetables by developing and attracting skilled members to the vegetable supply chain. For instance, the third chairman, Mr. Lei, an agricultural college graduate, was attracted to this cooperative and contributed significantly to its development through his professional agricultural knowledge and skills. Moreover, the trinity cooperation mechanism facilitated the knowledge transfer from the cooperative to local farmers. For instance, farmers learned advanced skills from invited experts from universities and professional organisations.

Environmentally, the Meiyu Cooperative improved environmental sustainability through the reduction of environmental pollution. It also advocated the reduced use of pesticides/antibiotics in the vegetable supply chain and facilitated triple bottom line performance. Therefore, this trinity model improved food safety in the vegetable supply chain.

7. New challenges for Meiyu Cooperative

There are some new challenges for Meiyu Cooperative at the time of writing this case. First, this cooperative lacks talents for further development. Specifically, although the cooperative has already lowered transaction costs through production cooperation and sale and supply cooperation, the talent shortage creates high management costs. For example, the monthly wage for a clerk at the Supply Agency is USD 870, much higher than the average monthly payment in Rui'an county for a similar position (USD 435-580). Additionally, there is a high cost for hiring the three staff members working at the Credit Agency. Thus, attracting more talents is a big concern for this cooperative.

Another challenge lies in the unbalanced development of the trinity cooperation mechanism. Meiyu Cooperative developed production cooperation adequately. For instance, production cooperation has facilitated vegetable productivity and helped create popular vegetable brands, which makes this cooperative a leading cooperative in the vegetable industry. However, regarding sales, Meiyu Cooperative's sale channels are still insufficient during the vegetable harvest season. For example, the tomato harvest season has a satisfactory result for vegetable farmers in this cooperative in terms of quantities but also creates pressures because previous market channels have not been enough for the abundant tomato harvest. Moreover, the tomato market price is lower due to the large supply from other producer competitors. Therefore, Meiyu Cooperative should consider strategies for expanding its sale channels. Regarding the financial chain, although Meiyu Cooperative has established a credit cooperation union, its capital is not adequate for all members. As such, this small credit cooperation union needs more financial support from the local government and banks. Additionally, the cost to maintain this union is too high due to its limited labor force (i.e. three workers). Although this union did not encounter security issues, eventually Meiyu cooperative needs to take security problems into consideration.

8 Discussion questions for readers

1. From the supply chain management perspective, explain what a trinity cooperative is and how the trinity cooperation model helped Meiyu Cooperative manage the vegetable supply chain.
2. Explain how the trinity cooperative integrates the agri-food supply chain and what is the difference between trinity cooperatives and traditional firms in supply chain integration.
3. Discuss supply chain finance management through the Credit Agency of Meiyu Cooperative.
4. What should Meiyu Cooperative do to resolve the new challenges it faces?
5. Discuss further options for Meiyu Cooperative to improve the vegetable supply chain.

Supplementary material

Supplementary material can be found online at <https://doi.org/10.22434/IFAMR2019.0023>.

Table S1. List of interviewees used in the case study.

Table S2. Three chairmen of Meiyu Cooperative.

Financial performance of the Credit Agency in 2018.

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