

Connecting supermarkets and farms: the role of intermediaries in Walmart China's fresh produce supply chains

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Abstract

This paper identifies and describes the recent emergence of a new class of private sector intermediaries in fresh fruit and vegetable (FFV) supermarket supply chains in China. These intermediaries play key roles that determine the ways in which farm households participate in and the benefits they derive from new retail-led market opportunities associated with the supermarket sector's shift from FFV procurement through wholesale markets towards more direct contracting with farm communities. This paper provides a comprehensive description of 198 FFV supply chain intermediaries working with Walmart China in 2014, including their historical background, infrastructure investments, downstream marketing and upstream sourcing. We find that these actors play an increasingly critical role in the organization of land, labor and production through contracts. Our study provides critical insights for understanding both the trends in vertical coordination of China's developing agricultural sector and the pace of the country's agricultural modernization. Walmart is a leading international supermarket chain with a growing presence in China, and evidence suggests that their supply chain strategies are similar to other large supermarkets in the region. Results are also relevant to understanding current challenges in China related to food safety and quality, a top priority in recent years.

Key words: vertical integration, supply chains, small farmers, supermarkets, Walmart, agricultural development, China

Introduction

It is now well documented that supermarkets have become an important alternative to small shops and wet markets for consumers in the developing world and that supermarkets' sourcing and supply chain geography can have implications for small farmers' poverty and technology adoption (Weatherspoon and Reardon, 2003; Hernández et al., 2007; Neven et al., 2009; Barrett et al., 2012; Michelson, 2013). Although supermarkets are a relatively new phenomenon in China, their procurement strategies have evolved rapidly during their short tenure. As Chinese consumers' demand for high quality fresh produce increases and competition among modern retailers intensifies, supermarkets have sought to reduce their reliance on wholesale markets by shifting procurement of fresh fruits and vegetables (FFVs) towards more direct relationships with farmers

and farming communities. In addition to reducing costs by eliminating layers of intermediation, the shift to more direct procurement is motivated by supermarkets' desire to better control the quality, stability and safety of the fresh produce that they sell.

Successfully establishing direct sourcing relationships with farmers in China requires overcoming a series of context-specific barriers, including weak institutions as well as a fragmented and complex agrarian sector and limited cold chain and logistics infrastructure. A new sector of private intermediaries has emerged in recent years to aggregate production and reduce costs by connecting small farmers with supermarkets in China (Hu et al., 2004; Zhang and Donaldson, 2008), but as yet there has been no examination of these intermediaries and the roles they play in rapidly evolving procurement systems, land consolidation and agricultural

intensification. The aim of this paper is to provide more systematic evidence about the identity and roles of these key intermediaries in China.

This paper uses data collected from 198 intermediaries (which we call ‘vendors’) involved in Walmart China’s fresh produce supply chains to present the first systematic look at the role of emerging intermediaries in Chinese FFV retail value chains. Our primary focus is the relationship between private intermediaries and upstream farming communities, including the organization of land, labor and production through contracts. We provide a comprehensive description of emerging supply chain intermediaries, including their historical background, infrastructure investments, downstream marketing and upstream sourcing. Our analysis is one of the first in the literature on supermarkets in emerging markets to focus on supply chain intermediaries. Given the rapid pace of change in China’s agricultural economy, these emerging intermediaries will play a critical role in determining farm households’ participation in and benefits from supply chain transformation, the agrarian structure that emerges from this transformation and the degree to which modern retailers such as supermarkets can meet Chinese consumers’ growing quality and food safety demands.

Though Walmart is the focus of our study, the research is of broader interest for two primary reasons. First, Walmart is a sufficiently large and dynamic player in the market that it is important to understand its supply chain strategies—both because the volumes Walmart sources are large and growing and because Walmart is often an industry leader on the cutting edge of procurement strategies particularly in China, where local retailers follow and learn from Walmart sourcing (Cao and Pederzoli, 2013). In short, Walmart’s strategies today may provide insight into what we are likely to see from other large retailers in China in the coming years. Second, as we will discuss, the intermediaries that we study provide fresh produce not only to Walmart, but also to other national and international supermarkets operating in China. Walmart serves as an entry point to study these private intermediaries; but by understanding them we learn more broadly about China’s developing agri-food sector.

Given that a majority of the new private sector intermediaries operating in FFV sourcing had already been traders or brokers, to what extent are the actors and the operations we describe in this paper new or innovative in the Chinese marketplace? We argue that Walmart’s sourcing strategy in China—moving fresh produce procurement away from wholesale markets and instead relying more on contractual-based procurement with farm communities in order to both increase traceability and reduce costs—is indicative of broader trends in the sector (Gale and Hu, 2012). Supermarket efforts to remove layers of intermediation and obfuscation from the supply chain are motivated by pressures affecting retail grocery as a whole related to increasing traceability

and reducing costs. Moreover, the shift towards more direct contracting with farmers and farm communities is important because the absence of wholesale markets from these supply chains means that the contracting intermediary must provide additional services to the farm community in order to meet the supermarket’s transaction timing, scale and quality and variety specifications. These services range from technical assistance to investment in greenhouses to coordination of many small farmers in order to meet the volume and timing required to fulfill a purchase order. Note that such services are likely more important for certain crops than others, a point we discuss in the analysis.

The remainder of this paper proceeds as follows. The first section, FFV Supply Chains in China: Policy Background and Walmart, traces recent changes in agricultural policy related to the development of China’s FFV market and presents Walmart China’s evolving FFV procurement strategy. This policy background is useful for understanding the specific challenges facing retailers working to establish agricultural supply chains in China. The Data Collection Section describes our data collection methodology. The third section, Description of Vendors describes the key intermediaries connecting Walmart to farm communities and examines the relative importance of different downstream marketing channels. The section Vendor Upstream Sourcing describes the relative importance of procurement via stable relationships with farm communities versus other channels and examines the specific roles that vendors play in the organization of production, including land consolidation and the provision of agricultural services. The Conclusion summarizes our findings, discusses policy implications and suggests additional avenues for research.

FFV Supply Chains in China: Policy Background and Walmart

Policy background

China’s agricultural sector has undergone a series of dramatic changes since the 1949 Revolution. This section summarizes key changes relevant to the production and marketing of FFVs and provides context that is critical to understanding the challenges facing supermarkets working to establish FFV supply chains.

Initial reform period (1978–1995). Between 1978 and the early 1990s, the government began the transition from a centrally planned to a market-based agri-food system. In addition to moving away from collective agriculture by implementing the Household Responsibility System and granting individual use rights to land, the government also relaxed restrictions on the private retail sector. Direct sales of fresh produce to consumers by farmers and street hawkers, illegal under central planning, increased rapidly in small towns and secondary cities. Wet markets, which had been forbidden in large cities, were

allowed to re-open. These open air retail markets for food quickly multiplied and became the basis of China's modern fresh produce marketing system (Sicular, 1995; Hong, 2000). The government also eliminated restrictions on inter-regional trade of agricultural products (Sicular, 1988). The large distances associated with the new, inter-regional supply chains created the need for wholesale markets, which had been absent for over three decades. In 1984, the government established the first fresh produce wholesale market in Shouguang, Shandong. Wholesale markets grew rapidly in the next decade, with their total number quadrupling between 1986 and 1995 (Hu et al., 2004).

The government also took steps to address the prior neglect of the FFV sector by implementing a series of sector-specific policies to promote production. During the Planned Economy period the government had focused on ensuring a sufficient supply of basic grains and industrial crops like cotton. The fresh produce sector had languished; land area dedicated to commercial fresh fruit and especially vegetable production was small and limited to suburban communes close to cities (Zhou et al., 2007). As a result, fresh vegetable supply chains were highly localized at the beginning of the Initial Reform Period, with urban consumers connected to nearby communes growing fresh vegetables.

The 'Vegetable Basket Program' (*Cai Lan Zi Gong Cheng*), initiated in 1988, sought to expand and geographically consolidate vegetable production in order to supply the rapidly growing urban population. The central government's national land-use plan established five national commercial vegetable production areas (Walker, 1984). To carry out the Vegetable Basket Program in each region, the central government created the 'Mayor's Responsibility System' (*Shi Zhang Ze Ren Zhi*), which assigned responsibility to a deputy mayor for ensuring the provision of non-staple foods to urban residents. Local government implementation of this directive included direct investment in infrastructure, such as wet markets, and the provision of subsidies to increase farmers' incentives to plant vegetables. For example, to increase vegetable production the Guang Zhou government offered a subsidy per acre planted in vegetables, subsidized the price of fertilizers and pesticides and eliminated the grain production quota for vegetable farmers (Wang et al., 1990).

By the time supermarkets arrived in China in the early 1990s, the FFV retail sector consisted largely of wet markets and street hawkers who procured fresh produce from wholesale markets. Fresh produce supply chains in the traditional market system operated in the early 1990s much as they do today. Fresh produce moves through private markets, but the government still plays a significant role by setting regional production goals and implementing policies to help local officials achieve these goals.

Recent policy reforms (1995–Present). Since the late 1990s, the Chinese central government has prioritized

controlling food-driven price inflation and improving food safety. The government has implemented several recent policies to address challenges that are rooted in the high degree of fragmentation in production and marketing and the lack of coordination in supply chains.

First, since the late 1990s, the government has promoted the formation, registration and strengthening of farmer cooperatives in order to elevate farmer cooperatives into market players with increased bargaining power and greater capacity to coordinate production and marketing (Deng et al., 2010).

Second, starting in the mid-1990s, the Chinese government created the Dragon-Head Companies Program to promote agricultural industrialization and vertical coordination between agro-industrial enterprises and farming communities. In exchange for special tax status and access to subsidized loans, Dragon Head Companies are expected to promote modernization of the agricultural sector through investments in transportation and logistics firms as well as contracting initiatives involving small farmers (Dong and Jensen, 2007). The Dragon Head program now exists at the provincial and municipal levels and includes more than 60,000 firms (Zhang, 2012).

Third, in an effort to address rising food safety concerns, in 2000, the central government established a compulsory Pollution-free (*Wu Gong Hai*) standard that establishes maximum allowable levels of pesticide residues, antibiotics and heavy metals for fresh produce. The government also established two voluntary standards, Green Food (*Lu Se Shi Pin*) and Organic Food (*You Ji Shi Pin*), with more stringent requirements.

Finally, in 2008, the Ministries of Commerce and Agriculture jointly issued an 'Announcement to Initiate Direct Farm Pilot Programs' to encourage direct contracting between large retail buyers such as supermarkets and farm communities. The objectives of the Chinese government's Direct Farm Program are three-fold. First, involving modern international retailers is expected to lead to an injection of much needed investment and organizational know-how throughout the FFV supply chain. Additional efficiency gains and, ultimately, lower prices for consumers are expected by the circumvention of wholesale markets and a reduction in the number of intermediaries involved in the traditional procurement system. Finally, the improved on-farm and post-harvest technologies brought by large retailers accompanied by a reduction in the number of layers of intermediation are expected to increase the traceability and safety of food.

To support the expansion of the Direct Farm initiative, the government organizes trade forums and conferences to facilitate relationships between supermarkets and cooperatives; provides financial incentives for building cold chain storage and distribution centers; and provides technical and management training to supermarket personnel, cooperative representatives and individual

farmers. An increasing number of supermarkets in China have started Direct Farm programs, including small, locally-based supermarkets, large domestic supermarkets with national coverage and international supermarket chains, such as Carrefour, Walmart and Metro.

Walmart's evolving fresh procurement strategy in China

The data used in our analysis come from a case study of Walmart in China. While Walmart is just one among many international and domestic supermarkets operating in China, its experience provides insights into the challenges of establishing more direct, vertically coordinated fresh produce supply chains. As part of the reform process described above, China began to allow foreign retailers to do business inside its special economic zones in 1992. Walmart opened its first store in Shenzhen in 1996 and, after establishing a significant presence in the rapidly growing Southeast region, expanded to other Tier-1 cities on the Central and Northeast coast prior to moving to Tier-2 and Tier-3 cities in Central and Western China. By 2012, Walmart had established 358 stores across 21 provinces, with an 8.2% share of the Chinese supermarket industry (PRWEB, 2012). In August 2016, Walmart's share of China's grocery market was estimated to be 4.9%, and Walmart was the third largest grocer in China after Sun Art Group (a joint venture between Taiwan's RT-Mart and France's Groupe Auchan) with 7.7% and Vanguard Group (a Tesco merger), which holds 6.1% of the market. Walmart's recent growth has been strong, especially in Western China (Kantar World Panel, 2016).

Establishing supply chains that can compete with wet markets on price while at the same time meeting more stringent quality and safety standards has been an ongoing and dynamic process for Walmart. Like nearly all supermarkets in China, Walmart initially relied exclusively on wholesale markets to source fresh produce. Initially, Walmart purchasing officers directly acquired produce at local wholesale markets and, using contracted transportation, delivered it to nearby stores. Given the lack of own-transportation and storage infrastructure, Walmart gradually increased reliance on a large number of specialized and dedicated wholesalers (Hu *et al.*, 2004). By 2013, Walmart's domestically sourced fresh produce was supplied by several hundred highly heterogeneous firms. These firms, which Walmart terms 'vendors', ranged from small companies supplying a handful of products to a few stores within a single province to large, highly capitalized logistics companies supplying a wide range of products to stores across China.

In 2008, Walmart accepted the government's invitation to participate in the Direct Farm Program by creating its own pilot program. (We have found no information regarding whether and how Walmart may have been involved in the proposal for or the design of the Chinese

government's Direct Farm program. Walmart has an office of government relations in China and has worked closely with the central government on other initiatives (Gereffi and Ong, 2007). This pilot effort, which operated in parallel to its primary fresh produce procurement system, provided Walmart the opportunity to explore the feasibility of moving towards more direct sourcing relationships. Given that Walmart was a relative newcomer in China and lacked both the size and experience needed for direct vertical coordination, the retailer identified a number of its vendors to help establish the pilot Direct Farm program. While the vendors were quite heterogeneous in terms of size, the common feature they shared was that all had strong ongoing procurement relationships with local farm communities and cooperatives.

At its peak, Walmart's Direct Farm pilot counted on roughly 20 vendors who managed procurement relationships with a total of 54 farm bases. A farm base (*ji di*) is a general term used by the Chinese government to describe an area of coordinated farm production that provides fresh produce to a vertically coordinated value chain. Farm bases range in size from a subset of a single village's cultivable land to the combined land of multiple villages. For purposes of this paper, a farm base is defined by two criteria. First, the farm base has an identifiable and potentially traceable location, typically a village or contiguous group of villages. Secondly, the vendor participates in pre-planting planning of production on the farm base. Our emphasis is thus on the existence of a minimal amount of vertical coordination at this initial point in the value chain. As we will show, on some farm bases the vendor plays significant additional roles including the consolidation of the land constituting the farm base and the provision of inputs, technical assistance and fixed investment. This definition also encompasses a wide of range of possible land tenure and labor arrangements on farm bases; ranging from wage labor operations on land consolidated by vendors to conventional contract farming relationships between vendors and individual farmers in villages or cooperatives.

Walmart decided to discontinue the formal Direct Farm program at the end of 2012 for a number of reasons including the high cost of establishing stable contracting relationships with farm bases and a lack of consumer willingness to pay for a Direct Farm brand that promoted traceability and higher quality. As we will see, however, the Direct Farm pilot provided valuable experience that would be integrated into the next step in the evolution of their procurement system.

Beginning in 2013, in order to facilitate growth and expansion across new regions in China, Walmart made significant investment in and reorganization of its FFV procurement system. Most importantly for our analysis was the shift toward reliance on a smaller number of large vendors who can supply larger quantities and greater variety of fresh produce at more competitive

prices. Walmart's Direct Farm Program pilot experience proved important in the vendor consolidation process as it demonstrated that it was indeed feasible, although still challenging, to directly contract with farm bases via certain vendors. While Walmart anticipates relying primarily on wholesale markets in the short run, it expects to build on the Direct Farm experience and, in the medium and longer run, transition away from wholesale markets towards more direct and traceable procurement relationships with farm bases. By the end of the consolidation process, which occurred between mid-2013 and mid-2014, Walmart had reduced the total number of FFV vendors from several hundred to 80, of which 50 primarily supply vegetables and 30 primarily supply fruit. As described in the next section, these 80 vendors will be the primary focus of our analysis.

Data Collection

The analysis in this paper is part of an ongoing project to evaluate the impacts of Walmart's direct procurement relationships on farm households in China. The research, which is supported by a grant from the Walmart Foundation, is being carried out by a team from the University of California, Davis and the Center for Chinese Agricultural Policy. The results presented here represent the first step in the overall research project and take the form of an in-depth descriptive analysis of the FFV vendors who mediate the relationship between farm bases and Walmart.

Throughout 2013, the research team met extensively with members of Walmart's Fresh Produce team in Beijing and at Walmart headquarters in Shenzhen to understand the evolution and current structure of their FFV supply chain. The team also met with vendors and farmers on farm bases throughout the country.

Initial interviews with vendors and visits to vendor farm bases revealed that, in some cases, the vendors contracted by Walmart do not directly manage relationships with farm bases but instead rely on local agents—typically traders, brokers or cooperative managers—to manage the local procurement relationships. We call the 80 vendors that emerged from Walmart's vendor consolidation process and who are responsible for Walmart's FFV procurement 'primary vendors'. The local agents who are contracted by primary vendors are called 'secondary vendors'.

Between January and May in 2014, we conducted a phone survey with the owner and main produce procurement manager at 73 of Walmart's 80 primary vendors. Seven vendors chose not to complete the survey. Of these, 48 supply vegetables and 25 supply fruit to Walmart. Primary vendors were asked if they work with secondary vendors to manage farm bases and, if so, to provide the secondary vendor's contact information. We then contacted and conducted a similar phone survey

Table 1. Vendor characteristics.

	Primary vendor (73)	Secondary vendor (125)
Mean age of vendor (years)	8.5	5.7
% with prior experience as:		
Farmer	40	56
Agricultural trader/broker	75	57
Owner of agricultural input business	8	12
Owner of transportation business	26	17
% that are government cadre	6	6
% of owners that completed:		
Middle school	4	15
Regular/Vocational High School	30	51
College	66	34
% of vendors that are:		
Individual brokers	0	8
Cooperatives	5	61
Registered companies	95	31
% of vendors with Dragon-head classification at:		
City level	23	14
Province level	14	6
National level	3	2

with the secondary vendors. Use of secondary vendors is common in our sample: 81% (39/48) of vegetable vendors and 92% (23/25) of fruit vendors reported that they rely on at least one secondary vendor. We were able to survey 125 secondary vendors (62 vegetable and 63 fruit vendors), representing at least one secondary vendor for 73% of the primary vendors who reported using secondary vendors. Although the primary vendors for whom we do versus do not have information about secondary vendors are quite similar, we note that our sample may not be representative of the population of secondary vendors. Primary vendors for whom we lack secondary vendor information are not systematically different in terms of the characteristics in Table 1. Nor do we find systematic differences in downstream marketing patterns. However, annual sales for primary vendors for whom we have information on secondary vendors are nearly twice as large as those for whom we have no secondary vendor information though this difference is driven by the large sales of two particularly large primary vendors. Our total sample size is thus 198 vendors, 73 primary vendors who receive purchase orders directly from Walmart and 125 secondary vendors who manage local procurement relationships for the primary vendors but do not themselves have direct sales relationships with Walmart.

Figure 1 provides a stylized picture of the FFV supply chain in China and the position of the primary and secondary vendors. We describe the structure of data collected, with reference to this figure. We first asked basic

questions about the owners, size and structure of the vendor company. We then asked about their downstream relationships. Specifically, we asked the vendors about the crops they sell and the importance of Walmart as a buyer relative to other supermarkets and other marketing outlets. We then turned upstream to explore the relative importance of three primary procurement channels used by vendors: (1) wholesale markets, (2) spot market transactions with farm communities and (3) procurement by vendors through repeated contractual relationships with farm bases. The third channel is the focus of this paper. To describe this relationship, the survey asked about the land tenure and labor arrangements on farm bases and the services provided to farm bases by the vendors. Though we would have liked to have gathered information about margins along the supply chain, vendors and Walmart considered this information too sensitive and refused to answer questions related to prices paid and received.

Description of Vendors

Although intermediaries like Walmart's vendors appear to play a critical role in managing supermarkets' fresh produce supply chains, surprisingly little is known about who they are and the nature of their operations. This section begins to fill this gap.

Who are the vendors?

Table 1 provides descriptive statistics on the background and degree of formality of the vendors. The companies are relatively new, with an average of 8.5 years since registration or founding for primary vendors and just under six years for secondary vendors. The majority of companies began procurement after 2005.

Prior to starting the company, vendors had varying backgrounds in the agricultural sector. Not surprisingly, the majority of both primary and secondary vendors had prior experience as an agricultural trader or broker. Approximately half of vendors had direct experience in farming, while a smaller fraction had prior experience as owners of agricultural service companies such as input supply or logistics businesses. Vendors have a relatively high level of education with the levels of primary vendors somewhat higher than those of secondary vendors. About two-thirds of the primary vendor owners have college degrees or above, whereas half of the owners of secondary vendors have only a high school degree.

Table 1 also provides information on the institutional status and formality of the vendors' operations. All of Walmart's primary vendors are formal, registered entities, with 95% taking the form of a registered company and 5% as a cooperative. In contrast, only 31% of secondary vendors are registered companies. Most of the remaining secondary vendors identify as cooperatives, and a smaller

percentage as informal brokers. A non-trivial number of both primary and secondary vendors have achieved the Dragon-Head Company designation—a sign of support and, likely, some subsidization from the government. Primary vendors report a slightly higher rate of Dragon-Head Company status than secondary vendors. Twenty-three percent of primary vendors have attained at least city-level Dragon-Head Company status, which is the lowest among all administrative levels (city, province and national levels).

How big are vendors?

Table 2 presents information on the value of fresh produce sales in the year prior to the survey (2013). Average annual sales for all vendors (not reported in Table 2) was 97 million Yuan. To put this number in perspective, according to Hu *et al.* (2004), Sanlu Vegetable Co. Ltd, an early emerging specialized/dedicated vegetable wholesaler for supermarkets in China, had annual sales of about 33 million yuan in 2003.

Table 2 reveals significant size differences by vendor type. First, mean sales of primary vendors (198 million Yuan) are five times that of secondary vendors (39 million Yuan). This is not surprising as we would expect primary vendors, who directly supply large retail chains like Walmart, to have higher annual sales. Second, for both primary and secondary vendors, those who specialize in fruit are substantially larger than those specializing in vegetables. This is likely attributable to two factors. First, in China fruits continue to be more of a luxury good than vegetables and command higher prices. Second, the major fruits, including apples and pears, are significantly less perishable than most vegetables and thus permit larger operations via storage and inventory management.

Where are Vendors located and from where do they source produce?

As discussed in the section Data Collection, Walmart's vendor consolidation process sought to identify companies with the capacity to supply large quantities of diverse products consistently throughout the year. In our survey, we explored the extent of geographic diversification of procurement by vendors via farm bases. We find a large difference between the geographic scope of sourcing of primary versus secondary vendors. As expected, secondary vendors operate on a much more local scale, with only 6% sourcing from a farm base outside of the province of the vendor's headquarters. In contrast, half of the primary vendors source from farm bases located in outside provinces. A sharp distinction also exists between primary vendors specializing in vegetables versus fruit: 76% of fruit vendors but only 31% of vegetable vendors source from farm bases in outside provinces. This is likely explained by the higher perishability of fresh

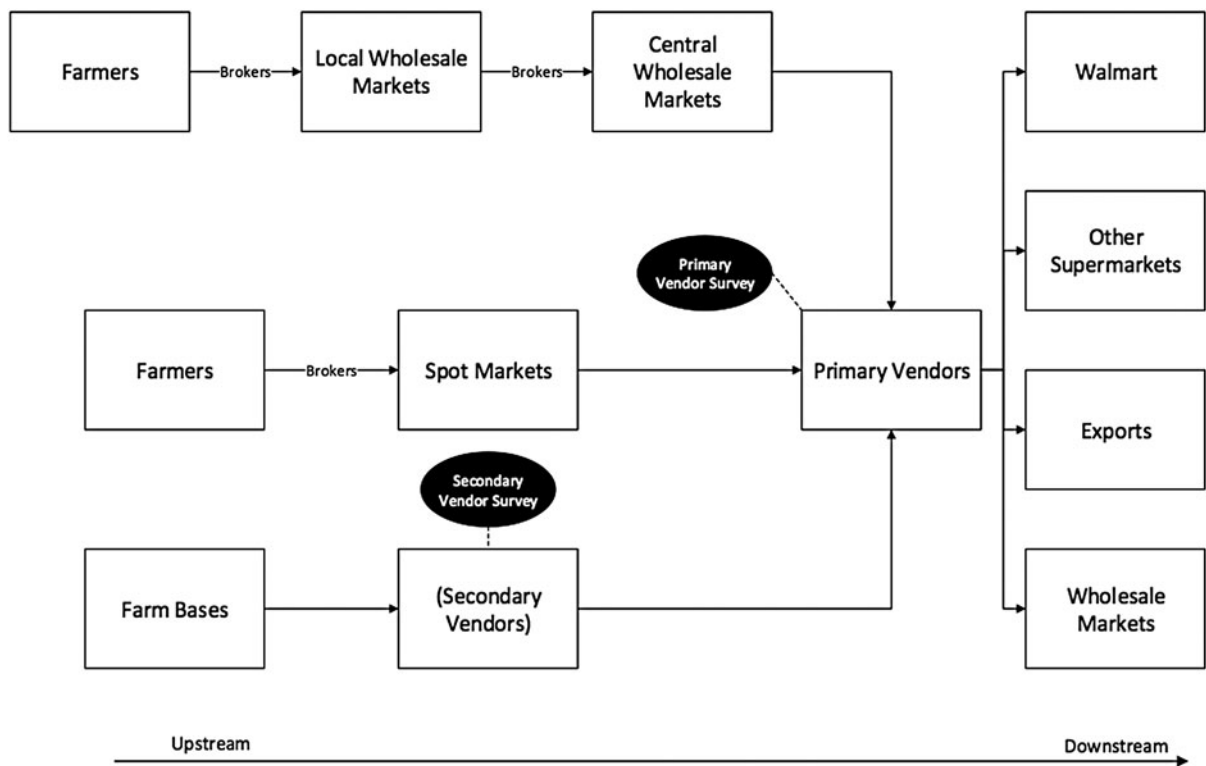


Figure 1. Supply chain of Walmart FFV Vendors.

vegetables, especially leafy greens, which limits the geographic range of sourcing.

How specialized are vendors by market outlet?

A key to understanding how primary and secondary vendors are involved in the broader transformation of China's agri-food sector is understanding how dedicated they are to the supermarket sector. Table 3 shows the relative importance of different marketing outlets for both primary and secondary vendors. Given that our sample of primary vendors comprises firms that supply to Walmart, it is not surprising that supermarkets are their most important client; 85% of primary vendors sold more to supermarkets than to other marketing channels. Among this 85%, supermarkets accounted for 76% of annual sales. Table 3 also shows that while these primary vendors are largely dedicated to supermarkets, they are less dedicated to Walmart and instead sell to a variety of retailers. In fact, Walmart was the most important outlet (in terms of sales value) for only 40% of primary vendors.

Wholesale markets represent a significantly less important source of demand for our sample of primary vendors. Only 16% identified wholesale markets as their most important outlet. On average, 56% of the sales of these vendors went to wholesale markets, suggesting that they are quite diversified across traditional and modern buyers. During interviews, many vendors mentioned

that they target supermarkets as their priority outlet and consider wholesale markets as a residual outlet for excess supply or supply that does not meet quality standards of supermarkets.

In contrast to primary vendors, supermarkets play a minimal role in demand for fresh produce from secondary vendors. Supermarkets were the most important source of demand for only 3% of the secondary vendors in the sample. Other vendors, and the Walmart primary vendors in particular, are the largest buyers for secondary vendors. Wholesale markets were the most important outlet for 25% of the secondary vendors.

The picture that emerges from Table 3 is that primary vendors for Walmart China are indeed dedicated to supermarkets as their main clients and play an indispensable intermediary role given evidence that their upstream suppliers—secondary vendors in our study—do not appear to circumvent them to directly supply supermarkets. Primary vendors are clearly providing Walmart and other supermarkets with services that secondary vendors cannot. We explore the types of services provided in the next section.

Vendor Upstream Sourcing

Having described the vendors and the relative importance of Walmart and other downstream outlets in the demand for the FFV they procure, we now turn to upstream relationships. We first explore the relative

Table 2. Annual sales value of primary and secondary vendors.

	Primary vendors			Secondary vendors		
	Vegetable (47)	Fruit (25)	All (72)	Vegetable (62)	Fruit (63)	All (125)
Mean sales value in the last 12 months (million yuan):	93 (20)	396 (176)	198 (64)	25 (7)	53 (19)	39 (10)
% of vendors with sales value of:						
Less than 10 million	13	0	8	66	63	65
10–50 million	49	28	42	24	17	21
50–100 million	15	24	18	5	11	8
More than 100 million	23	48	32	5	8	6

Notes: One primary vegetable vendor did not report a sales value. Standard errors are reported in parentheses.

Table 3. Downstream marketing patterns of vendors.

Market outlet:	Primary vendors		Secondary vendors	
	(73)		(125)	
	% that sell to the following as their most important market outlet	Conditional mean of % sales to market outlet	% that sell to the following as their most important market outlet	Conditional mean of % sales to market outlet
Supermarkets	85	76	3	44
Walmart	40	64	NA	NA
Vendors	NA	NA	76	74
Walmart primary vendors	NA	NA	61	65
Wholesale markets	16	56	25	60
Other	3	66	4	70

Notes: Market outlet ‘Other’ includes exporters, restaurants, government, institutions, and schools.

importance of contractual relationships with farm bases in vendors’ overall procurement. We then turn to the specific roles vendors play in the organization of and production on farm bases.

Vendor procurement channels

As described in the Policy Background and Walmart section, to promote greater food safety and reduce intermediation costs, the Chinese government recently encouraged retailers to establish more direct contracting and procurement relationships with farm communities. Although Walmart’s pilot effort to procure through its Direct Farm program yielded mixed results and was eventually suspended, the lessons from that experience were incorporated into their most recent vendor selection and consolidation process. Specifically, in their selection process Walmart placed significant weight on a vendor’s demonstrated experience and ability to contract directly with farm bases.

We now provide evidence of how this criterion has affected the origin of FFV procured in Walmart’s

supply chain. Specifically, we examine the following two questions. How important are farm bases in overall procurement for Walmart’s primary vendors? How direct are the relationships between Walmart and the individual farmers on these farm bases?

In terms of Fig. 1, the data collected in our phone survey allow us to assess the relative importance of contractual relationships with farm bases versus traditional wholesale and spot market transactions in the overall procurement of Walmart’s primary vendors. Vendors were asked what share of the value of FFV sold to Walmart in the previous year was procured through the three channels depicted in Fig. 1: wholesale markets, spot market transactions at farm-gate and contractual relationships with farm bases. We further differentiate the third (farm base) channel into a ‘Direct’ farm base channel if Walmart’s primary vendor directly managed the farm base relationship and an ‘Indirect’ farm base channel if the primary vendor sourced from at least one secondary vendor who, in turn, managed the farm base relationship. Note that given that Walmart used a vendor’s potential to manage farm base relationships as a selection criterion,

Table 4. Relative importance of procurement channels of primary vendors.

	% value sold to Walmart that was procured from:			
	Direct farm base	Indirect farm base	Spot market	Wholesale market
All (68)	27	50	9	14
Vegetable vendors(45)	29	37	15	19
Fruit vendors (23)	25	56	7	12

Notes: Direct Farm Bases indicates that produce was procured by the primary vendor from a farm base that they directly managed without the presence of a secondary vendor. Indirect Farm Base indicates that produces were procured by the primary vendor from a farm base managed by a secondary vendor. Five primary vendors did not report their relative importance of procurement channels.

vendors may have an incentive to overstate the relative importance of procurement through farm bases. Our figures should thus be taken as upper bounds.

Table 4 gives the relative importance of the four channels. Two interesting results stand out. First, farm bases appear to play an important role in Walmart's procurement of FFV. Averaging across all primary vendors, 77% (=27 + 50%) of produce sold to Walmart was sourced through contracting relationships with a farm base. Wholesale markets (14%) and spot transactions (9%) are much less important. The importance of farm bases was slightly higher for primary vendors specializing in fruit (81%) than those specializing in vegetables (66%).

Secondly, and less encouragingly, although farm bases account for the majority of fresh produce sold to Walmart, the relationships between farmers and Walmart are highly intermediated. Indeed 'Indirect' sourcing through farm bases is nearly twice as important as 'Direct' sourcing. The continued existence of multiple layers of intermediation between Walmart and farm-gate suggests that establishing traceability in fresh produce supply chains will continue to be a challenge in the near future.

Vendors as aggregators of land and labor

Incorporating farm households in modern supply chains for FFV in China presents a number of significant challenges. As described in the Policy Background and Walmart section, historical neglect of agriculture in general and of the FFV sector more specifically imply that logistics infrastructure development is poor, farmer experience growing FFVs is shallow, and farmer understanding of quality and safety standards required by international retailers such as Walmart is weak. The fragmented, small landholdings of rural households is perhaps the most daunting challenge as meeting purchase orders of the size, quality and timing sought by retailers requires aggregating and coordinating across large numbers of farmers.

As reported above, however, in spite of these challenges, the majority of the produce procured by Walmart's primary vendors was sourced through farm bases. This finding suggests that these scale and coordination challenges have, at least partially, been overcome by vendors

in Walmart's FFV supply chain. In this section, we examine the specific roles vendors are playing at the farm base level. We first examine the degree to which vendors directly consolidate land to achieve scale and describe the patterns of land tenure and labor relationships that are emerging when vendors carry out land consolidation. We then describe the role of vendors in providing services and investment to coordinate production and meet voluntary quality and safety standards.

A first reflection of the depth and nature of the vendor's participation in the production process is the organizational structure of the farm base. By organizational structure, in turn, we mean the control of property rights and the land tenure and labor relationships that structure production on the farm base. An important axis of differentiation across farm bases is whether local villagers maintain control of property rights over land or whether instead the land has been consolidated by and property rights have been transferred to the outside vendor. In general, we expect that when land has been consolidated, vertical coordination tends to be greater and the vendor exercises greater control over production.

In our survey, we first asked both primary and secondary vendors whether or not they worked with any farm bases. If so, we then asked about the organizational model of the farm base, the types of investments vendors made on and the services they provide to the farm base. We collected information on a total of 460 farm bases.

We observe four distinct organizational models among the farm bases from which Walmart's vendors source FFV. They are as follows:

- *Owner Operator Model:* Local villagers control the property rights over and operate the land, typically signing a marketing contract with the vendor. This organizational model resembles conventional out-grower or contract farming schemes.
- *Wage Worker Model:* The vendor acquires the property rights over the land and then operates the farm base using primarily hired labor. This is a vertically integrated farm base in which no contracting (beyond wage contracts) occurs between the vendor and farm households. Two additional types of heterogeneity exist across wage worker farm bases. First, the hired

Table 5. Distribution and size of farm bases by organizational model.

	Owner-operator model		Vendor controlled farm bases					
	% of farm bases	Mean area (Mu)	Wage worker model		Sub-leasing model		Mixed model	
			% of farm bases	Mean area (Mu)	% of farm bases	Mean area (Mu)	% of farm bases	Mean area (Mu)
Vegetable (<i>n</i> = 241)	10	4725 (2390)	49	1381 (341)	14	1193 (363)	27	2635 (755)
Fruit (<i>n</i> = 218)	18	2433 (607)	37	1956 (390)	26	2734 (486)	19	2102 (432)
All (<i>n</i> = 459)	14	3636 (1300)	43	1613 (258)	20	2152 (342)	23	2471 (540)

Notes: Standard errors are reported in parentheses. One farm base did not report the organizational model. Thirty-nine farm bases did not report the farm base area.

workers are typically either the local villagers from whom the vendor acquired property rights or migrants. In the latter case, the vendor typically provides housing in the form of worker dormitories. Secondly, incentive schemes for hired workers range from fixed wage per day or month, to piece rate and from individual-based incentive to team-based incentives.

- *Sub-Lease Model:* The vendor acquires the property rights over the land and then sub-leases the consolidated land to other farmers, often after making significant investment in the form of greenhouses, roads or electrification. Sub-lessees are typically required to grow specific crops for the vendor on part of the leased land. Interesting heterogeneity also exists within this organizational model. For example, on some farm bases leases take the form of fixed rental while on others they are sharecropping arrangements. The vendor may sub-lease back to the original village owner or instead may sub-lease to migrant farmers from other provinces.
- *Mixed Model:* The outside vendor acquires the property rights over the land and sub-divides the farm base into one area operated under the wage worker model and another area operated under the sub-lease model.

The process of land consolidation by private actors from outside the village is a sensitive and complicated issue in China and, though we were able to collect initial evidence on the topic, considerable work remains to understand how the process is taking place and how it relates to the modernizing agri-food sector. In order to provide additional insights into the land consolidation process, we conducted an in-depth survey with 20 farm bases managed by Walmart's primary vendors. Nearly all of these farm bases reported renting-in land through village leaders or cooperatives. Leases varied in length, from 1-year renewable leases to 10-year leases. We also found considerable variation in how land was being used prior to the establishment of the farm base. In some cases, the farm base was established on land that had already been consolidated by another company. In other cases, the farm base was established on land that

was reportedly left idle by the village collective. In yet other cases, the vendor worked with village leaders to coordinate the rental of individual farms of many villagers. Not surprisingly, the details of land consolidation were related to the degree of urbanization and off-farm opportunities in the area; as urbanization progresses in China, an increasing number of farmers eager to leave the countryside and search work for in urban areas are willing to return their land to the village or transfer the land to others to farm.

Table 5 presents the frequency of the four organizational models as well as mean area for the farm bases in the full sample. The first two columns refer to owner-operated farm bases, i.e., those in which the villagers maintain full control of property rights. The remaining columns refer to the three organizational models in which the vendor acquired property rights and consolidated the farm base's land. The rows compare farm bases primarily producing vegetable to those producing fruit.

The first result to note is the large scale of farm bases, indicating that significant aggregation is occurring to achieve scale. The mean area across all sample farm bases is 2184 mu (not reported in Table 5). To put this figure in perspective, the average farm size per rural household in China is approximately 9 mu (0.6 ha). The average farm base thus corresponds roughly to a village with 220 farmers. Across the three vendor controlled models, the mean farm base size is 1948 mu, which is just over half the size of the owner-operated farm bases. Although they are smaller, the mean size of 1948 mu implies that vendors are consolidating significant areas across large numbers of households.

Among vendor consolidated models, vegetable farm bases are roughly 25% smaller than fruit farm bases (1721 mu versus 2248 mu). In addition, while about half of the vegetable farm bases are less than 500 mu, only a quarter of the fruit bases are less than 500 mu. The prevalence of larger areas is much higher among fruit than vegetable farm bases: 28% of fruit farm bases and only 14% of vegetable farm bases are larger than 2000 mu. The smaller size of the vegetable farm bases relative to fruit farm bases may be explained by the higher labor

intensity of vegetable production, especially among leafy green vegetables, making labor supervision relatively more important in vegetable than fruit farms. These higher labor supervision costs, in turn, may limit the scale of production area. The fact that wage worker farm bases, where labor supervision requirements are likely greatest, have the smallest mean size (1613) is consistent with this hypothesis.

Table 5 also shows that land consolidation is the dominant strategy of vendors; 86% of all farm bases in our sample are vendor controlled while only 14% are owner-operated. Interestingly, this dominance holds for both vegetable and fruit farm bases. Since most of the fruit farm bases produce orchard crops, one might expect that these farm bases would be predominantly owner-operated due to the potential for moral hazard in the care and maintenance of trees. While a slightly larger fraction (18 versus 10%) of fruit farm bases are owner operated compared with vegetable farm bases, fruit bases are, just like vegetable bases, dominated by vendor-controlled models. One possible explanation is that vendors acquire long-term property rights and thus internalize the moral hazard problem.

Again, focusing on the vendor-controlled farm bases, the dominant organizational model for both fruit and vegetable farm bases is the wage worker model, which accounts for 43% of all farm bases in the sample. One way to think about differences across the three types of vendor-controlled organizational models is the tradeoff between the degree of control over production exerted by the vendor and labor supervision costs. Under the wage worker model, the vendor controls all aspects of production, from crop and variety choice, to farming practices and marketing channels. This control is costly, however, as hired labor requires significant supervision to reduce moral hazard. In contrast, under the sub-leasing model the vendor relinquishes some control over production—for example, renters or sharecroppers have some autonomy over choice of crop and are only required to sell a portion of output to the vendor. Labor supervision costs, however, are likely to be much lower as renters rely primarily on family labor to carry out production. The mixed model represents an interesting compromise. Several vendors using the mixed model stated that they prefer sub-leasing precisely because of the complexity and costs of hired labor, but they felt they needed to maintain a portion of the farm base under the wage labor model as a type of insurance policy; i.e., they did not want to run the risk that the renters would not provide production of sufficient quantity or quality that would jeopardize the vendor's ability to meet supermarket orders.

Services and voluntary certifications provided by vendors

An important component of vertical coordination along the FFV supply chain is the communication of

supermarkets' quality and safety standards to farmers and the provision of services that help farmers meet these standards. In this section, we explore the degree to which vendors play this coordination role by providing inputs and technical assistance to farm bases and acquiring voluntary certifications for food safety.

In the survey, we asked vendors whether they provided the following types of productive inputs to each farm base: (i) seeds, (ii) fertilizers, pesticides, herbicides or other agro-chemical inputs and (iii) technical assistance. We did not inquire about the payment form for these inputs (i.e., free, cash, or credit). Our in-depth discussions with vendors suggest, however, that most chemical inputs were provided on credit and the costs were deducted from the output delivered to the vendor. Technical assistance, in contrast, was typically provided at no cost to the farmers. In some cases, vendors hired agronomists or crop specialists to maintain a permanent presence on the farm base. In other cases, vendors do not maintain a permanent technical assistance presence but instead contract specialists from local universities or private agro-chemical companies or coordinate visits by government extension agents to run training workshops or to provide assistance when specific needs arise.

Table 6 shows the frequency of input provision by vendors on farm bases. Note that farm bases that interacted with both a primary and secondary vendor are classified as having received an input if at least one of the vendors provided it. The rows of Table 6 compare input provision by organizational model of the farm base. As expected, vendors are much more active in the provision of inputs on farm bases that they directly control than on the owner-operated farm bases. The largest difference is in the provision of seeds (75 versus 37%) and chemical inputs (76 versus 46%). The difference in the frequency of provision of technical assistance is smaller (85 versus 67%). Differences across the three types of vendor-controlled organizational models are less stark, although the frequency of input provision, as expected, is highest in the wage worker model. This pattern suggests that land consolidation is associated with a higher degree of control of the production process by vendors.

One way farm bases can convey information about the safety of their produce is through voluntary certification. As discussed previously, Green and Organic standards are certified by the Chinese government. Private standards such as Global Gap are increasingly required by global retailers operating in China.

Among sample vendors, 48% acquired Green certification, 27% acquired Organic certification and 32% reported a private certification. The frequencies are similar across vegetable and fruit vendors. Clearly these forms of voluntary certification are not yet a requirement for vendors procuring for international retailers such as Walmart. This may be explained by Chinese consumers' low willingness to pay a price premium for certified products (Zhang, 2012). We expect the prevalence of these

Table 6. Input provision by vendors

	% of Farm bases to which a vendor provides:		
	Seeds	Chemical inputs	Technical assistance
Vendor controlled farm bases (394)	75	76	85
Wage worker only model (197)	82	81	86
Sub-lease only model (91)	71	74	86
Mixed model (106)	64	70	82
Owner operated farm bases (63)	37	46	67

Note: Three farm bases did not report information about input provision.

forms of voluntary certifications to rise in the future as demand and interest rise among consumers.

Conclusions

Modern retailers, including supermarkets, face a difficult tradeoff in developing supply chains for FFV in China. Increased consumer demand for quality and especially for food safety has created pressure to move away from traditional wholesale markets and towards greater vertical coordination and direct sourcing relationships with farming communities. This move towards greater vertical coordination, however, faces a number of challenges specific to China. On one hand, the historical neglect of the FFV sector through the 1990s left a legacy of poor infrastructure, for example in transportation, processing and cold chain storage. On the other hand, the highly fragmented land tenure system in which average farm size is less than one ha creates significant transactions costs in aggregating production to meet retailers' purchase orders. Retailers such as Walmart have thus turned to an emerging class of intermediaries to overcome these challenges and coordinate upstream relationships with farm communities.

This paper exploits a unique data set to provide an in-depth description of these intermediaries and the specific roles they are playing in coordinating the FFV supply chain for a leading retailer, Walmart. We surveyed nearly all (73/80) of Walmart's 'primary vendors', the intermediaries that directly fulfill Walmart's FFV purchase orders, and a large subset (125) of the 'secondary' vendors, local intermediaries who frequently manage farm base relationships for the primary vendors.

Our survey results show that these emerging Chinese private market intermediaries are large, with average annual FFV sales of approximately 200 million Yuan and 40 million Yuan for primary and secondary vendors, respectively. Secondly, while these vendors are dedicated to supplying the supermarket sector, they do not supply exclusively to Walmart. We find that the majority of the FFV procured by Walmart is not coming from traditional wholesale channels but instead is sourced via contractual relationships and pre-planting

coordination with farm bases via these intermediaries. While bypassing wholesale markets reduces the number of layers of intermediation, Walmart's FFV supply chain is still far from 'direct' as Walmart's primary vendors often rely on an additional layer of local, secondary vendors to manage the relationship with the farm bases. This suggests that achieving full traceability, which is a key step in improving food safety, remains a challenge for the foreseeable future.

A novel contribution of this study is the documentation of four main organizational models on farm bases. Three of these models are characterized by land consolidation and acquisition of property rights by the vendor; the fourth is a more traditional owner-operated model similar to contract farming or out-grower schemes. Vendor-controlled models account for the vast majority (85%) of all farm bases from which the vendors are sourcing FFV. The prevalence of vendor controlled farm bases demonstrates the important role vendors play in coordinating production and achieving scale and the important role they are likely to play in the coming years.

The structure of land tenure and labor relationships that emerge in China will have important implications for small-holder incomes and thus also for rural poverty. Studying heterogeneity in the organization of land and production is interesting from the perspective of development economics because of the differences across models in incentives to and roles played by vendors and farmers. In particular, different models imply differences in: property right over land, bargaining power around technologies and crop varieties, responsibilities and ownership of capital investments and dissemination of new technical knowledge, and in risk sharing and incentives for effort. The types of technologies that will be adopted, the intensity of resource use, and the economic and environmental sustainability of the FFV supply chain will be determined, to a large degree, by the continued evolution of these organizational models and the participation of the key intermediaries analyzed in this paper.

Our research emphasizes the critical role being played by emerging intermediaries in China's rapidly evolving agri-food supply chains and in rural development more broadly. Our findings raise several important research questions for future study related to the use of different

organizational models by vendors in rural China. First, how can we explain the heterogeneity in organizational models across farm bases? On one hand, information asymmetries between crop growers and buyers and problems related to farm labor incentives may favor the use of an owner-operator model. On the other hand, if vendors have an advantage providing financial resources, management skills and knowledge of retail markets, then models that offer the vendor a higher degree of control, such as the sub-leasing or wage worker model, may be more efficient. Finally, risk sharing between growers and buyers will also likely influence the organizational model—suggesting that the model that emerges on a particular farm base is related to the seasonality and production characteristics of the crop portfolio. A second set of questions relates to the welfare implications of different organizational models for farmers and farm workers. Understanding the choice and effects of the organization of land and labor is critical as these supermarket supply chains grow, deepen and extend in rural China.

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