ELSEVIER
www.elsevier.com/locate/worlddev

World Development Vol. 37, No. 11, pp. 1773–1780, 2009

0305-750X/$ - see front matter

doi:10.1016/j.worlddev.2008.08.027

Producers, Processors, and Procurement Decisions: The Case of Vegetable Supply Chains in China

RANDY STRINGER
University of Adelaide, Adelaide, SA, Australia

NAIQUAN SANG
Nanjing University of Finance and Economics, China

and

ANDRÉ CROPPENSTEDT *
Food and Agriculture Organization of the United Nations, Rome, Italy

Summary. — This study examines how different supply chain characteristics impose different coordination costs on vegetable processors. The results provide a basis for understanding the relative importance of four alternative supply chain characteristics to vegetable processors: (1) the size of the producers' production base; (2) the distance between the producer and the processing plant; (3) the level of detail specified in the contract between processors and grower; and (4) whether the producer has food safety certification. Vegetable processors from Laiyang County, Shandong province, China's largest horticultural production and export region, provide the data underlying the following analysis. Conjoint analysis suggests that the vegetable processors consider the size of the production units as the most important supply chain characteristic influencing their choice of producers, followed by distance to producer, type of contract and food safety certification.

Key words — supply chains, vegetable markets, supermarkets, China

1. INTRODUCTION

China's agricultural sector and food economy continue to undergo rapid and fundamental structural changes. Growing urban populations, expanding *per capita* incomes, changing lifestyles, maturing agribusiness markets, and emerging mass media and communication systems are altering food consumption, production and distribution patterns. More than two decades of policy, market and institutional reforms contribute directly to these profound changes, resulting in an increasingly modernizing and globally integrated rural economy.

As domestic demand increases, trade opportunities grow and policy incentives shaping the agricultural sector become gradually less state controlled, food producers, processors, retailers and exporters face growing opportunities and increasing difficulties associated with managing their businesses. Privatization and restructuring associated with transition economies disrupt links all along food supply chains, resulting in widespread coordination problems, long payment delays for delivered products, access to timely and quality inputs and services, high search costs for potential buyers and sellers, missing credit markets, weak market access, and difficulties meeting rising production standards and related food safety requirements (Dries, Reardon, & Swinnen, 2004; Swinnen, 2004; White & Gorton, 2004).

China's farm structure presents export-oriented vegetable processors and supermarket procurement managers with additional coordination problems due to costs associated with contracting and collecting sufficiently large volumes of produce from numerous small producers, poor infrastructure and the distances between growers and processing plants and cities (Goldman, 2000; Hu, 2005; Hu, Reardon, Rozelle, Timmer, & Wang, 2004; Zhang, Fu, & Yang, 2005).

The minute size of plots is especially daunting. China has some 200 million farm households, producing on an average of 6 plots per household. The average size of a plot is about 0.1 hectare (ha) and the average land holding is about 0.65 ha. (OECD, 2005). Producers also face problems associated with a lack of bargaining power, payment delays, access to high quality seeds, price risks; parcel size and information on fertilizer and pesticide use and risks (Hu, 2005; Wei, Yanrong, & Gang, 2003; Yuman, Jinsong, Zhang, & Kamphuis, 2004).

In a recent review of how agrifood supply chains are resolving supply chain disruptions and weak market institutions in the transition economies of Europe and Central Asia, Swinnen (2004) finds that: (i) private contracts and related emerging vertical coordination practices are key initiatives (much more important and widespread in scope and complexity than in Western economies); (ii) producer assistance programs are an important component for many vegetable supply chains; and (iii) the search for quality is the major driver of supply chain coordination.

To date, most of the literature on the forces influencing how food supply chains in China are evolving focuses on its recent WTO membership, export competitiveness and trade performance (Chen, Chen, & Shi, 2003; Dong & Jensen, 2004; Huang, 2002; Kamphuis, Ravensbergen, & Zhang, 2003). Additional studies examine the supply chain impact of rapidly

* Final revision accepted: August 7, 2008.

expanding urban retail food markets, especially how supermarkets in their early expansion stages affect wholesale fruit and vegetable markets and distribution networks (Hu, 2005; Reardon & Timmer, 2005).

This study contributes to this growing literature by examining how different supply chain characteristics impose different coordination costs on vegetable processors. The analysis demonstrates the way processors trade off between coordination costs associated with these different characteristics when making procurement decisions. Vegetable processors and producer surveys from Laiyang County, Shandong province, China's largest horticultural production and export region, provide the data underlying the analysis. The aim is to better understand how supply chain actors are making decisions in a rapidly changing economy.

2. CHINA'S EVOLVING VEGETABLE SUPPLY CHAINS

In the past three decades, vegetable markets in China have evolved from short, linear supply chains controlled tightly by the state, to highly complex, increasingly diverse and progressively coordinated supply chains. Before the economic reforms of the late 1970s and early 1980s, vegetable supply chain were centrally planned and managed, "total procurement, total sale" supply chains (Ruben, Boselie, & Lu, 2007; Zhang, Qingguo, & Xu, 2004). Vegetables were produced on village communes with seeds and other non-labor inputs provided by the state. The collectives tended to produce single variety vegetables, delivering their assigned quotas to either state-controlled cooperatives or state-owned vegetable companies at fixed prices. The vegetable companies cleaned, sorted and packed the vegetables before sending them on to distribution centers. The distribution centers allocated the vegetable to state-owned retail shops where they were sold at subsidized prices.

Over a decade long period beginning in 1978, a series of economic reforms first replaced the collectives with individual household rights over land parcels. Next, reforms progressively eliminated quantity quotas and state procurement regulations on vegetables, removing price controls all along the supply chain and encouraging privately-owned wholesale markets, wet markets and retails shops.

During this transition period, vegetable supply chains included millions of very small scale vegetable producers growing mostly different vegetable varieties on their individual parcels. Growers began selling their vegetables directly to traders, processors, wholesale markets, cooperatives, retail shops and supermarkets. Negotiations along the chain tended to be limited to price and quantity (Zhang *et al.,* 2005). Wholesale vegetable markets became a dominant supply chain actor during this transition. From China's first ever market in 1984, wholesale markets expanded to more than 4,200 across the country by 1998 (Yuman *et al.,* 2004).

(a) *Adapting to rising domestic vegetable demand and export opportunities*

Since the mid 1990s, domestic demand and export opportunities have encouraged the rapid expansion of vegetable production and trade. Rising incomes and urban lifestyles lead to diet shifts away from staples and towards vegetables, fruits, livestock and dairy products, and fats and oils. The level of protein consumption *per capita* is higher in China than the world average, and just below the levels in Japan and the Republic of Korea.[2] Between 2000 and 2004, fruit and vegetable exports increased from US$ 3.6 billion to US$ 6.4 (FAOSTAT, 2006). China supplies around three quarters of the Republic of Korea's fresh vegetable imports, and its share of Japan's fresh vegetable imports increased from less than 10% in 1989–91 to 37% in 2002–04 (Huang & Gale, 2006).

The rapid growth in vegetable consumption, exports, production and trade resulted in new pressures along the supply chain. Land resources have been reallocated, reflecting both the growing demand for vegetables and China's comparative advantage in land scarce, labor-intensive activities. Between 1991 and 2003, the share of land allocated to fruit and vegetable production increased from 8% to 18%, with output quadrupling.

While data and related information on how export trade and domestic supermarkets affect vegetable supply channels is scarce, recent case studies and surveys are providing insights. One survey conducted in six counties of Zhejiang province in 2003 indicates that marketing channels for vegetables include direct sales to wholesale and retail markets (43% of total marketed production); sales to processors (18%); and sales to intermediate traders (16%) (OECD, 2005; Statistical Bureau of Zhejiang Province, 2004).

Other studies suggest that, like most transition economies, supermarket chains are becoming a dominant influence on the food retail markets. China has the fastest growing supermarket sector in the world today. In 2001, supermarkets accounted for 48% of Chinese urban food markets, up from 30% in 1999 (Reardon & Timmer, 2005). The first supermarket in China was established in 1990. By 2003, the number had increased to more than 74,000, with $75.5 billion in sales (Hu, 2005). These studies suggest that supermarkets are spreading beyond the largest cities, moving to smaller towns and to the poorer, more remote interior.

Many traditional wet markets are being closed or consolidated in China's larger cities. In part, authorities consider the wet markets unsanitary and, in part, they earn less tax revenue than more regulated supermarkets (Bean, 2005). Some large wholesale markets are adapting. For example, the Shou Guan Vegetables Wholesale Market in Shandong province now supplies vegetables to more than 20 provinces (OECD, 2005). The Jibu Vegetable Wholesale Market in Shenzhen services Southern provinces and some neighboring countries.

To date, most of the vegetable supply chain studies in China identify food safety as the major concern to both export-oriented processors and to domestic supermarkets (Chen, Shepherd, & da Silva, 2005; Dong & Jensen, 2004; Jonker, Ito, & Fujishima, 2005; Zhang *et al.,* 2005). Limited information exists on how vegetable producers choose among other cost related influences, including size of holding.

This study focuses on the link between vegetable processors and growers from Laiyang. Like other parts of Shandong, vegetable supply chains in Laiyang are heavily export oriented. Regional export data is not available, however, a case study of neighboring Anqiu City estimates that more than 50% of vegetable produced are exported, 30% are sold in domestic markets through local wholesalers and 20% are sold to local markets (Yuman *et al.,* 2004).

Export market buyers dictate the vegetable varieties, production practices and processing requirements. Shandong's processors export vegetables in all forms, including fresh, frozen, dried, juice, dehydrated, pickled, mashed and powered. The major export varieties include beetroot, ginger, onion, scallion, radishes, taro, yam, cucumber, eggplant spinach and lettuce. (Shields & Huang, 2004; Yuman *et al.*, 2004). The larger and more export-oriented processing companies tend to be either foreign owned or foreign–domestic joint