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E-commerce in agri-food sector: a systematic literature review

REVIEW ARTICLE

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Abstract

This paper aims to synthesize findings in the Agri-food E-commerce (AE) field through a systematic literature review and propose a number of future research directions based on the gaps identified from the review. There has been a general increase in the number of publications, indicating that AE research has elicited more and more interest from scholars in different countries and across multiple disciplines. We have identified a number of themes and made sense of them by developing an integrated conceptual model, which consists of two parts: one for AE adoption at a firm level and one for AE development at a regional level. Furthermore, we recommend that more emphasis should be put on the regional development modes of AE and their impact in the developing world, as the practice is evolving rapidly in some developing countries such as China.

Keywords: agriculture, food, e-commerce, smallholder market access, China.

JEL code: M31, Q13, Q18, R11

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1. Introduction

There has been much evidence that e-commerce offers an important opportunity for cost reduction and demand enhancement. Although the characteristics of some agri-food products present a few challenges for those wishing to market products through e-commerce, there is still much optimism about the potential success of e-commerce in agriculture (Leroux *et al.*, 2001). The high level of fragmentation in the food supply chain reinforces the expectation for Agri-food E-commerce (AE) (Montealegre *et al.*, 2007). The provision of food builds on a vertical chain of subsequent production, service and trading processes that span from the production of agricultural inputs to the delivery of final food products to consumers. AE means introducing e-strategy into the interaction and trading activities between participants in the food sector and changing the configuration and relationships at various stages and linkages of the food supply chain (Fritz *et al.*, 2004; Giustiniano and Fratocchi, 2002).

In the developing world, smallholders in agriculture are considered disadvantaged in the agri-food supply chain and income growth poses a common and critical issue for policymakers (Wiggins *et al.*, 2010). It is important for smallholders to successfully gain access to the market; however, they face many difficulties in this area. Due to their small scale, unit transaction costs are high in almost all transactions (Poulton *et al.*, 2010). The pervasive imperfections of markets in the developing countries, such as lack of information on prices and technologies, lack of connections to established market actors, distortions or absence of input and output markets, and credit constraints, often make it very difficult for smallholders to take advantage of market opportunities (Markelova *et al.*, 2009). To help smallholders address the inefficiencies and barriers to market access, two main approaches have been put forward. The first concerns taking collective action by establishing farmer organizations such as agricultural cooperatives (Hazell *et al.*, 2010; Markelova *et al.*, 2009). Acting collectively, smallholders may be in a better position to bargain with buyers and intermediaries, reduce the procurement cost of inputs, and obtain more market information and policy support. The second approach is to promote contract arrangements between smallholders and agribusiness firms (Abebe *et al.*, 2013; Guo and Jolly, 2008; Key and Runsten, 1999). In contract farming, smallholders arrange their production and sell the primary products to processing or distribution firms at a prior agreed price according to the signed contract.

In recent years, more and more smallholders in developing countries such as China have begun to sell agri-products directly to consumers via online shops in a third party trade platform. It is increasingly clear that e-commerce has become a new and effective way of helping smallholders to gain access to the market. By adopting e-commerce, smallholders can sell most of their products at a higher price than before because of the elimination of the price squeeze from intermediaries and the marketing constraints of information asymmetry (Zeng *et al.*, 2016). China's practice presents some new and exciting issues for AE research.

Noticeably, there are some authors who have just reviewed a small number of articles related to AE in the literature review section of their empirical works (Batte and Ernst, 2007; De Koster, 2002; Liu *et al.*, 2011; Machfud and Kartiwi, 2013; Zapata *et al.*, 2013). We have only found one literature review paper on this topic but it focuses on e-business models in the agri-food supply chain, which is narrow in scope, and it is dated (Van der Vorst *et al.*, 2002). However, to the best of our knowledge, no systematic literature review comprehensively examining AE has been carried out to date. With the fast development of AE practice, the aim of the paper is therefore to identify the key themes in this field and shed light on future research directions.

2. Research method

A systematic literature review method, considered as a necessary step in structuring a research field and forming an integral part of any research conducted (Easterby-Smith *et al.*, 2010), is adopted. Compared to a traditional narrative method of reviewing literature, a systematic review employs a more transparent paper-selection process, which enhances rigor and thoroughness, and reduces the effects of researcher bias (Tranfield *et al.*, 2003). Fink (2005) also argues that a systematic literature review is a systematic and reproducible design for

identifying and evaluating an existing body of scholarly works. To increase the reliability of the research, the systematic literature review process of going through the literature search, the selection of studies, data extraction, and thematic synthesis, were independently carried out by two of the researchers/co-authors, who then compared notes and reached agreement on the selection and coding of papers (identifying themes) to increase inter-coder reliability (Durlau *et al.*, 2007). Since there is no systematic knowledge system for AE, we didn't have any prior framework to guide this coding process. Rather, we allowed the themes to emerge from the papers reviewed. To develop the conceptual model, due to the limited studies of AE, we used some case examples from industry reports (e.g. Ali Research) and other secondary sources (e.g. Internet news coverage) to complement the findings of the literature review.

The literature analyzed here comprises peer-reviewed English language papers published in academic journals and conference proceedings. Given the small numbers, books and book chapters in this field were excluded from the review. In terms of data collection, Scopus database (www.scopus.com), regarded as the largest database with respect to peer-reviewed literature and international publishers, was used. It also delivers the most comprehensive overview of the world's research outputs in the field of science, technology, medicine, art & humanities, and social sciences. Two search strings of e-commerce and agri-food related keywords were first identified. The keywords related to e-commerce include: 'e-commerce' OR 'e-business' OR 'e-market* (e-markets, e-marketing and e-marketplace)' OR 'electronic commerce' OR 'electronic business' OR 'electronic market*'. And the relevant keywords for agri-food sector are: 'agri* (agriculture, agricultural, agribusiness and agri-food)' OR 'farm* (farming and farmer)' OR 'agro* (agro-based and agro-food)' OR 'food'. By combining the two search strings, there were 24 combinations input in the 'Article Title, Abstract, Keywords' domains of Scopus. We selected the subject areas of 'Economics, Econometrics and Finance'; 'Business, Management and Accounting'; 'Social Sciences'; 'Decision Sciences' at Scopus. Initially, 310 hits were obtained, including 129 journal articles and 181 conference papers.

A first-round selection was made based on titles and abstracts in order to decide whether or not the full paper should be read for further analysis. We tried to be comprehensive in the selection so only two overarching exclusion criteria were applied. First, papers not directly related to AE, or papers discussing food and non-food e-commerce at the same time but putting more emphasis on the latter, were excluded. Second, any technical articles on topics such as leveraging radio frequency identification technology and convergent mobile technologies were excluded. As a result, 80 papers remained after the initial selection round.

Then the second-round selection was made by screening the full text of the articles and assessing their quality. Papers not written in English or translated by poor-quality translation software or just mentioning AE in a descriptive way, were also excluded from the review. Finally, 64 papers, including 41 journal articles and 23 conference papers, remained for review.

3. Descriptive analysis

Descriptive details of the papers identified were extracted and analyzed according to the distribution of publication across the period, countries and areas, the quality of journals, and research methodologies (Supplementary Table S1).

3.1 Distribution of publications by year of publication

As shown in Figure 1, the time period of the publications is between January 2000 and December 2015. This starting point (2000) represents the beginning of the e-business century. We can see that the number of publications increased over time, reaching a peak in 2011 with 8 papers. The general trend in journal articles then stabilized. Most conference papers were presented after 2008.

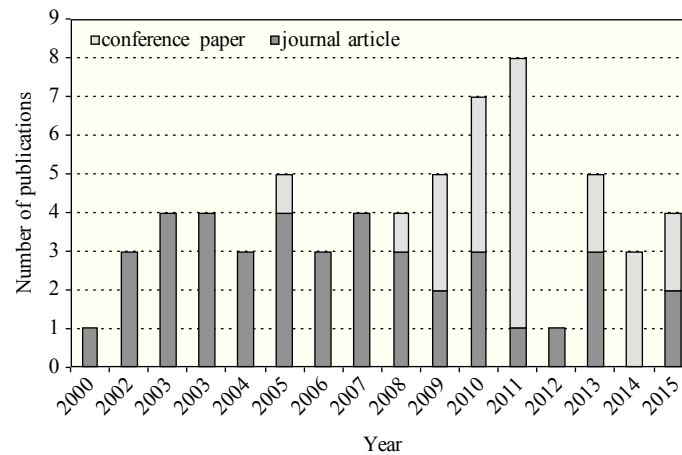


Figure 1. Distribution of publications per year.

3.2 Distribution of publications across countries

As shown in Figure 2, there appears to be some predominance from China (around 33% of the 64 selected papers and most of them are conference papers). USA is ranked second with 12 contributions (19%) and all are journal articles. Contributions were made mainly by the developed countries but we saw some from the new industrialized countries, i.e. South Korea and Taiwan. China, Brazil and Malaysia are the only three contributing countries from the developing world.

3.3 Distribution of publications by journals

The 41 journal articles identified were classified, according to the journals in which they are published, under six disciplines (Table 1). ‘Agricultural Economics and Agribusiness and Management’ contributed the most (14 papers; 34%) to this topic. ‘Information Management and Electronic Commerce’ and ‘Operation and Supply Chain Management’ are both the second largest disciplines contributing nine articles (22%). Three articles were published by ‘Marketing’ journals; two papers published in the ‘Tourism Management’ journals and four papers in other disciplines (i.e. Sector Studies, Entrepreneurship and Technology Management), showing that the topic is cross-disciplinary in nature.

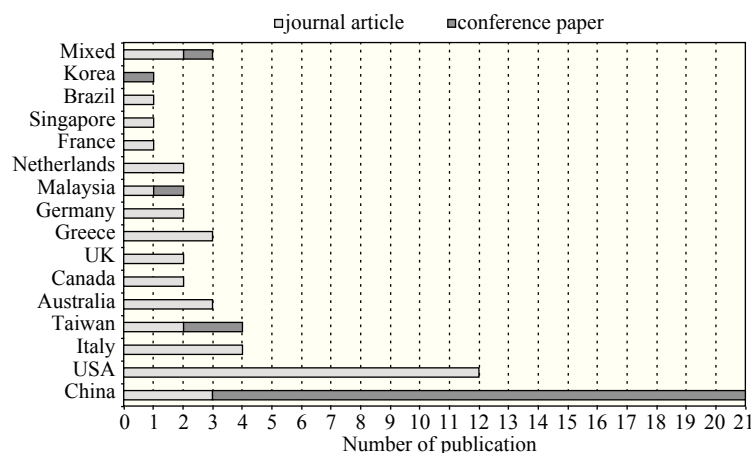


Figure 2. Distribution of publications across countries.

Table 1. Distribution by disciplines and journals.

Area/journal	No. of articles	SNIP ¹ 2014	SSCI ² 2015
A – Agricultural Economics, Agribusiness and Management	14		
Agribusiness	1	0.834	X
Agricultural and Resource Economics Review	1	0.572	
American Journal of Agricultural Economics	3	1.194	X
International Food and Agribusiness Management Review	4	1.021	
Journal of Agricultural and Resource Economics	1	0.801	X
Journal of Food Products Marketing	2	0.419	
Journal of International Food & Agribusiness Marketing	1	0.591	
Review of Agricultural Economics	1	1.134	
B – Information Management and Electronic Commerce	9		
International Journal of Business Information Systems	2	0.628	
International Journal of Electronic Commerce	1	1.738	X
International Journal of Information Science and Management	1	0.085	
International Journal of Security and Its Applications	1	0.980	
Information and Management	1	2.087	X
Journal of Digital Information Management	1	0.296	
Journal of Global Information Technology Management	1	0.259	X
Journal of Global Information Management	1	0.715	X
C – Operation and Supply Chain Management	9		
Annals of Operation Research	1	1.124	
International Journal of Business Performance Management	1	0.260	
International Journal of Engineering Business Management	1	0.722	
International Journal of Logistics: Research and Applications	1	0.858	
International Journal of Physical Distribution and Logistics Management	1	1.509	X
Supply Chain Management	2	1.842	X
Journal on Chain and Network Science	1	0.368	
The International Review of Retail, Distribution and Consumer Research	1	0.600	
D – Marketing	3		
Industrial Marketing Management	1	1.579	X
Journal of Business and Industrial Marketing	1	0.911	
Journal of Interactive Marketing	1	2.185	X
E – Tourism Management	2		
International Journal of Tourism Research	1	1.560	X
Journal of Vacation Marketing	1	0.959	
F – Others (Sector Studies, Entrepreneurship and Technology Management)	4		
British Food Journal	1	0.690	
Environment and Planning A	1	1.277	X
International Journal of Entrepreneurship and Innovation Management	1	0.543	
Technology in Society	1	0.601	

¹ SNIP = Source Normalized Impact per Paper, provided by Scopus. The larger value means the higher quality. Value ≥ 1 means that the journal is on or above average for its field and vice versa.

² SSCI = Social Science Citation Index.

3.4 Distribution according to the quality of journals

In order to identify the quality of these journals, the value of Source Normalized Impact per Paper (SNIP) indicator in 2014 and whether the journal is covered by Thomson Reuters' Social Science Citation Index (SSCI) in the 2015 version are presented in Table 1. In terms of SNIP indicator, only twelve journals have a numerical value larger than one (accounting for about 36% of the journals) and the mean value of all is 0.938. Journals with an impact factor of 1 or above are considered good quality in social science, so the overall quality of the journals is not high. On the other hand, only thirteen journals (less than 40% of the journals) are included in the list of SSCI.

3.5 Distribution according to the research methodologies

The articles identified were coded according to their research methodologies into five categories as suggested by Seuring and Müller (2008). Figure 3 presents the results. The survey appears to be the prevalent research method employed with 30 papers (almost half of the papers identified). 21 papers are of a rather theoretical or conceptual nature. The third most popular methodology is the case study with eight contributions. There are also four representations demonstrating new ideas by mathematical modelling. Only one selected paper is devoted to AE research via a literature review (Van der Vorst *et al.*, 2002). For the survey-based studies, the sample size is not large on the whole, and for the conceptual-based studies, the theoretical foundation is often missing (Supplementary Table S1).

4. Thematic findings

The main themes identified from the review are presented in this section and include factors affecting the firm-level adoption of AE, the firm-level adoption of AE, the firm-level performances of AE, factors affecting the regional development of AE, the regional development modes of AE, and the regional development impacts of AE.

4.1 Factors affecting the firm-level adoption of agri-food e-commerce

The factors affecting the adoption of AE by the agribusiness firms identified are one of the major themes in existing research (Table 2). The influencing factors are broadly classified as internal and external dimensions. Many internal factors related to a firm's characteristics such as leader traits and business patterns are indicated as salient (Henderson *et al.*, 2004, 2005; Janom and Zakaria, 2010; Kalaitzandonakes *et al.*, 2003; Machfud and Kartiwi, 2013; Molla *et al.*, 2010; Ng, 2005). Molla *et al.* (2010) highlight the fact that technology competence, financial commitment, perceived environmental e-readiness and organizational size are

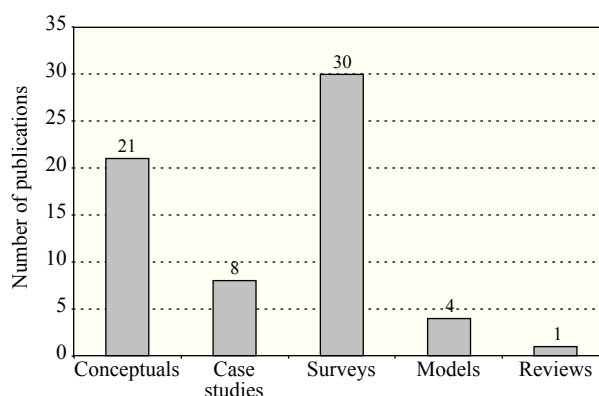


Figure 3. Research methodologies applied.

Table 2. Factors affecting the Agri-food E-commerce (AE) adoption and the AE development.

Groups	Internal factors	External factors
Adoption by agribusiness firms	Technology competence Financial commitment Perceived environment e-readiness Firm size Personal traits Perceived benefits Follow-up services Resources availability Target market segment Market scope Nature of products or services Organization structure and culture Types of business strategy	Traction trust and control in supply networks Strategic partners' influence Competitions Market trends Industrial contexts Government
Overall development of AE	Sales channels Service quality Cognition and quality of peasants E-commerce talents Branding and standardization Industry structure Product complexity High-touch nature of transactions Network effects Competition among e-market	Logistics costs Customs fees Technological changes Accessing international market Accessing rural areas Consumers' switch rate Urbanization rate

influential factors that directly affect e-business use. Technology context referring to firm's investment and accumulation of e-enabling technologies (e.g. handling transaction security and confidentiality) is identified as an important factor by some authors (Janom and Zakaria, 2010; Kalaitzandonakes *et al.*, 2003; Ng, 2005). As for the organizational size, Molla *et al.* (2010) find that the smaller the size of a horticulture firm, the greater the extent of e-business use; however, Henderson *et al.* (2005) provide an opposite result, reporting that Internet strategies are more likely to be adopted by larger firms with a global scope. This mixed result shows that firm size has complex effects on adoption and may be a regulated or mediating variable rather than an independent variable. The factor of personal traits for small and medium agribusiness firms, such as educational level, entrepreneurial characteristics, business experience, feeling and attitude to e-commerce, is also proposed (Janom and Zakaria, 2010; Machfud and Kartiwi, 2013). Generally, perceived benefits can provide incentives for firms' e-commerce adoption. For example, Henderson *et al.* (2004) disclose that firms perceiving greater logistics and inventory management gains are more engaged in e-commerce activities. But the lack of follow-up services (product returns) is the biggest barrier to e-commerce as perceived by agricultural producers in Midwestern US (Kalaitzandonakes *et al.*, 2003).

Through case analysis of Australian agribusiness firms, Ng (2005) develops a preliminary model for the selection of Business to Business e-business, including internal influencing factors such as resources availability, target market segment and market scope, nature of products or services, organizational structure and culture and types of business strategy and external influencing factors such as strategic partners' influence, competitions and market trends.

E-commerce provides support for vertical coordination processes in food supply networks. However, with e-business there is a need to build on the communication of safeguards for trust and control to influence the transaction decision as a prerequisite for e-business adoption in food networks (Fritz and Canavari, 2008).

O’Keeffe (2001) proposes that those firms in the perishable food industries who have already traveled some way down the partnership route will find such Business to Business e-commerce opportunities much more attainable than those who have not. Other external factors e.g. industrial contexts (regulatory environment, market structure, supporting industries) are also mentioned by authors such as Hsiao (2007) and Janom and Zakaria (2010).

4.2 The firm-level adoption of agri-food e-commerce

■ The firm-level strategies/models of agri-food e-commerce

There are five typical e-commerce models commonly adopted nowadays: Business to Business (B2B, a model that facilitates the transaction between businesses); Business to Customer (B2C, a model that facilitates businesses selling directly to customers); Customer to Customer (C2C, innovative ways to allow customers to interact with each other); Customer to Business (C2B, a model that facilitates customers offering products or services to businesses or that enables customers to name their own prices for a specific product or service); and Online to Offline (O2O, a model that draws potential customers from online channels to physical stores) (Zhang and Ma, 2015). A few scholars have made comparative analysis of these models in the agri-food sector and evaluated their developing trends (Chou, 2011; Gui and He, 2011; Huang *et al.*, 2009; Yang and Wang, 2015; Zhang and Huang, 2015). As for the application of B2B in AE, supermarkets will have a distinct advantage in the future, due to the rapid development of supermarket chains in China (Chou, 2011; Gui and He, 2011). Gui and He (2011) point out that there will be further development opportunities for B2C in AE with the improvement of consumption levels and the change in consumption patterns in China. There are two barriers to C2C application in China: first, the variety of agricultural products for sale online are very limited at present; second, most farmers do not yet have the skills to operate an online shop. Chou (2011) proposes that small agri-product processing enterprises (as customers) can apply the C2B model because it can reduce procurement costs. Huang *et al.* (2009) conducted a study on the C2B model applied to food souvenir products in Taiwan, and found that there are still some potential problems such as the high stock levels of products and raw materials and the complex ordering processes. They therefore developed a model that introduces a common platform which sends the order information to the factory, raw material suppliers and the shop at the same time and arranges the delivery to customers directly from the factory rather than from the shop. Zhang and Huang (2015) and Yang and Wang (2015) are in favor of the O2O community model, a new model of online-offline interaction, supported by logistics of cold chain with intelligent terminal pickup and delivery to residential communities.

■ The firm-level tactics of agri-food e-commerce

About 40% of the papers identified are centered on the firm-level tactics of AE and they can be divided into three groups: tactics of agricultural firm websites, tactics of third party e-commerce platforms, and tactics of offline supply chain management.

Many agribusiness firms conduct e-commerce by establishing and operating their own websites. Some authors put forward tactics of firm websites based on evaluating the website quality or identifying success factors for website-based e-commerce. Information is quite an important component of a firm’s website. For example, Internet sites provided by agricultural input suppliers offer extraneous information including not only current market price, but also crop market forecasts, market trend analyses, technical information on weed identification, online interaction with experts and so on (Just and Just, 2006). It seems that simply establishing a point of presence on the web is not enough (Volpentesta and Ammirato, 2007). It is necessary to improve message clarity and content accuracy, provide information on technical subjects, and update information on the website on time (Andreopoulou *et al.*, 2008; Bodini and Zanolli, 2011; Ernst and Hooker, 2006; Yu and Zhao, 2014). Communication is also a key aspect of a firm’s website. Two-way communication between both parties in the transaction is critical to successful individual relationships (Ernst and Hooker, 2006). The website designers should put much more emphasis on enhancing customer communication

services, especially allowing their visitors to communicate with the company or via 'chat rooms' with virtual or real person customer service (Andreopoulou *et al.*, 2008; Tsekouropoulos *et al.*, 2012). Yu and Zhao (2014) provide empirical evidence that service quality is the most important factor affecting the internet portal selections of online consumers. Other tactics like providing visitors with the possibility to tour the website as well as to be connected via this site with other websites, enabling the realization of commercial transactions, improving efficiency of navigation, paying attention to the optimization of search engines, increasing the exposure of websites, and pouring more money into Internet marketing, are also mentioned by some authors (Andreopoulou *et al.*, 2008; Bodini and Zanoli, 2011; Yi and Rong, 2010).

Electronic commerce platforms are provided by a third party service supplier supporting online transactions between sellers and buyers. Some trade platforms are established by private firms, while others are funded partly or entirely by governments. There were 85 AE platforms/portals in the US and EU in 2000, but only 25 remained active in 2002. Fritz *et al.* (2004) identify a range of strategic development best practices of the successful platforms, which include initiating cooperation with other platforms, gaining support from major market participants, improving trading functionalities, and expanding value-added services. Yang *et al.* (2008) and Lu *et al.* (2011) suggest that the local government should perfect the function of online transaction, and continuously improve the functional innovation, technological innovation and management innovation of the public platform. A study on the US-based electronic commerce platform called MarketMaker shows that encouraging producers to update their site profiles frequently, specifically their contact information and attributes and the availability of their products, is needed for further development (Zapata *et al.*, 2013).

Firms should bear in mind that e-commerce requires a strong business plan, a sound business structure and a carefully managed supply chain (Montealegre *et al.*, 2007). Ha and Hong (2005) propose a supply chain partner selection process system for e-collaboration and apply it to the food supply chain. Bacarin *et al.* (2008) construct a framework for contract e-negotiation in agricultural supply chains. A strategic decision-support framework is designed by Stritto and Schiraldi (2013) for food and beverage e-supply chain management. Hung *et al.* (2010) propose an organic e-farming system based on three business value models which they call value chain, value shop, and value network, for the purpose of creating high-end agricultural businesses in the era of the Internet. Van der Vorst *et al.* (2002) argue that the value chain business-web is likely to become widespread in food supply chains due to the importance of tracking and tracing of products related to food safety and environmental issues and the presence of quality certification programs in these supply chains. Some authors also put forward an information-sharing mechanism in the agricultural products supply chain enabled by e-commerce (Li and Gao, 2011). With the available information technology, it is feasible for companies in food supply chains to implement systematic planning and response measures. Kinsey (2000) gives a brief introduction to cooperative planning, forecasting and replenishment, a system that involves manufacturers and retailers each using real-time data to forecast future demand, share their forecasting information and agree to deliver and to receive merchandise on a prearranged schedule. Survey results indicate that full participation in e-marketplaces requires enterprises to integrate their internal and external supply chain activities and share strategic information (Eng, 2004). It is also important to have suppliers and distributors show enthusiasm and sincerity in their services (Chen *et al.*, 2014). Logistics distribution and home delivery are also discussed. Online organic home delivery may be the most successful type of online food retailing; for agricultural product logistics it is advisable to implement a quick response distribution task management tool; Internet-only food-retailing companies should fulfil orders by at least having warehouses; building a comprehensive information platform is required for agricultural products logistics (Cai *et al.*, 2015; De Koster, 2002; Murphy, 2003; Zhang and Zhang, 2013).

4.3 The firm-level performances of agri-food e-commerce

Financial, online marketing and cross-border market entry performance are reported here. Motiwalla *et al.* (2005) present an intra- and inter-industry financial performance analysis and their comparative results show that the electronic business (EB) companies did better than their non-EB counterparts in the post-EB period and the food, beverages and tobacco sector performed better than the retail and consumer products sectors.

An evaluation index system of agri-products' online marketing performance was designed by Jiang and Wang (2009), and included 12 aspects: return on net assets, growth rate of sales profit, customer satisfaction, inventory turnover ratio, safety reliability, web page hits, website social popularity, consumer loyalty, average retention time per visitor, function comprehensiveness, information update frequency, and style uniqueness. This provides a basis for studying how to improve network marketing performance for agribusiness firms.

It is generally accepted that e-commerce can provide small and medium enterprises and bigger companies alike with the same access to global markets. But Giustiniano and Fracocchi (2002) find that the Internet is yet to become a tool for promoting the internationalization process for Small and medium-sized enterprises. By analyzing the data collected from wine and olive industries in Italy, three reasons for this are revealed: first, most of the firms only approached the Internet in 2000 and have not yet developed a significant level of competence with respect to this new strategy; second, the companies seem not to have implemented Custom Relationship Management tools; finally, Internet has been considered merely as an adjunctive distribution channel.

4.4 Factors affecting the regional development of agri-food e-commerce

Some papers discuss the factors affecting the regional development of AE (Table 2). The factors from within the agri-food industry affecting the regional development of AE are seen as internal factors, and those from outside agriculture are defined as external factors. Three dominant internal factors are proposed by Leroux *et al.* (2001) including agri-food industry structure, product complexity, and the high-touch nature of transactions (i.e. building close relationships with clients). Mueller (2001) argues that two internal causes will drive the evolution of e-commerce: network effects (i.e. the value of good changes increases because of the increasing number of people using the good changes) and competition among markets for patronage and trading volume. Both Gan *et al.* (2011) and Jiong *et al.* (2013) applying AHP method reveal that the most important factors to the AE development are logistics costs, cognition and information quality of peasants, sales channels and service quality. Wu *et al.* (2010) identify two additional key factors, i.e. talents, branding and standardization in agri-products: severe shortage of e-commerce talents poses a barrier to the regional development of AE, and the construction of branding and standardization in agricultural products should be speeded up. In addition, more investment is needed for the expansion of AE; however, the exact timing of an investment is a key decision. To address this, Wang *et al.* (2015) propose an evolutionary discounted cash flow model showing that the optimal investment time depends on the consumers' switch rate from the physical store to e-store and the urbanization rate. Other external factors such as customs fees, technological changes and accessing international markets are also put forward by some scholars (Boyd *et al.*, 2003; Hobbs *et al.*, 2003; Mueller, 2001).

4.5 The regional development modes of agri-food e-commerce

Some academics propose new development modes for the regional agri-food industry based on e-commerce. Wang (2010) presents a government-driven mode in which governments assume an intermediary role between farmers and businesses thanks to their credibility and authority. In addition, the government not only assumes the responsibility of infrastructure investment and the improvement of e-commerce market regulation but also provides public services (e.g. information delivery, production guidance, and training) to farmers and agri-food enterprises. Kang *et al.* (2010) propose another type of government-driven mode, in which governments establish regional agricultural e-commerce centers, public platforms and information database affiliated to the government. Zhao and Tian (2014) identify a service provider driven mode in which a local service provider is responsible for bringing the products of individual farmers and agricultural cooperatives together, putting them in consolidated warehouses and helping sell products via an e-commerce platform. The cooperative-driven mode indicates that the agricultural cooperatives buy in and sell farmers' products on their own e-commerce portals and facilitate the two-way information flow between farmers and consumers (Liu and Li, 2011; Liu *et al.*, 2011).

4.6 The regional development impacts of agri-food e-commerce

The rapid development in e-commerce can bring about some changes in the demand for labor. An input-output model is used by Schluter and Lee (2005) to examine the effects of e-commerce boom on the demand for high-skilled and low-skilled workers and they find that food and agricultural trade has reduced low-skilled labor demand in the US because the New Economy emphasizes knowledge-based labor practices. Huang (2006) conducts a study on the revitalization of the leisure farm industry by implementing an e-commerce strategy and finds that the revolution of e-commerce in leisure agriculture does impact traditional leisure farm businesses and challenges all traditional travel suppliers. All leisure farm owners should improve their service ability and build marketing alliances through e-commerce development in order to seize resource and achieve performance advantages (Huang, 2006). Based on a survey, Baourakis *et al.* (2002) tried to examine the impact of e-commerce on agri-food marketing in Crete and found that most of the cooperatives and firms gained little benefit as they only used the Internet for e-mail communication rather than for transactions or other important activities, i.e. online banking, bill-paying, B2B trading, or supply chain management.

5. Discussion

5.1 Descriptive findings

Generally, there was an upward trend in the number of publications from 2000 to 2015, showing that AE research has attracted more and more attention from academics. However, the number and sub-optimal quality of the selected papers shows that academic research lags behind the rapid development of AE practice.

In terms of the distribution across countries, there was some predominance from China and the USA. However, around 85% of the articles written by Chinese authors were only presented at international conferences, with few citations. In contrast, all of the papers published by American scholars were journal articles of relatively higher quality, the majority of which were published before 2007.

By analyzing the distribution of publications across disciplines, agricultural economics and agribusiness management occupies a dominant position in terms of number of publications and is followed by operations management (OM) and information systems (IS). However, the impact factor of AE journals is generally low. It is envisaged that there is great potential for OM and IS scholars to contribute to this topic. We are aware that the literature on non-agricultural e-commerce is increasing in IS literature. With the fast development of AE practice, it is expected that many IS researchers will be attracted to this field. It is also advisable for scholars researching agricultural supply chain from an OM/Supply Chain Management background to enter into this promising field of research.

As for the research methodologies used, there are 21 papers adopting a theoretical or conceptual approach without empirical evidence. But the theoretical foundation is often missing. Case studies and modelling seem to be under-represented. It is proposed that more case studies should be carried out to explore this field. Furthermore, none of the selected papers carried out a literature review specifically about AE.

5.2 Development of an integrated model

To synthesize the thematic findings and signpost some future research directions, we developed a conceptual model based on the literature gaps and industry reports on AE practice in China where people have witnessed a rapid development of AE in recent years. The Chinese central and local governments have paid unprecedented attention to the AE development through policy and public investment. As presented in Figure 4, the model comprises two basic parts: one is built around AE adoption at a firm-level, and the other looks at development modes at a regional level. The relationship between them is reciprocal: the firm-level adoption provides a micro-level foundation for the regional level AE development, and the regional development can lead to the widening and deepening of firm-level adoption and multiplying effects.

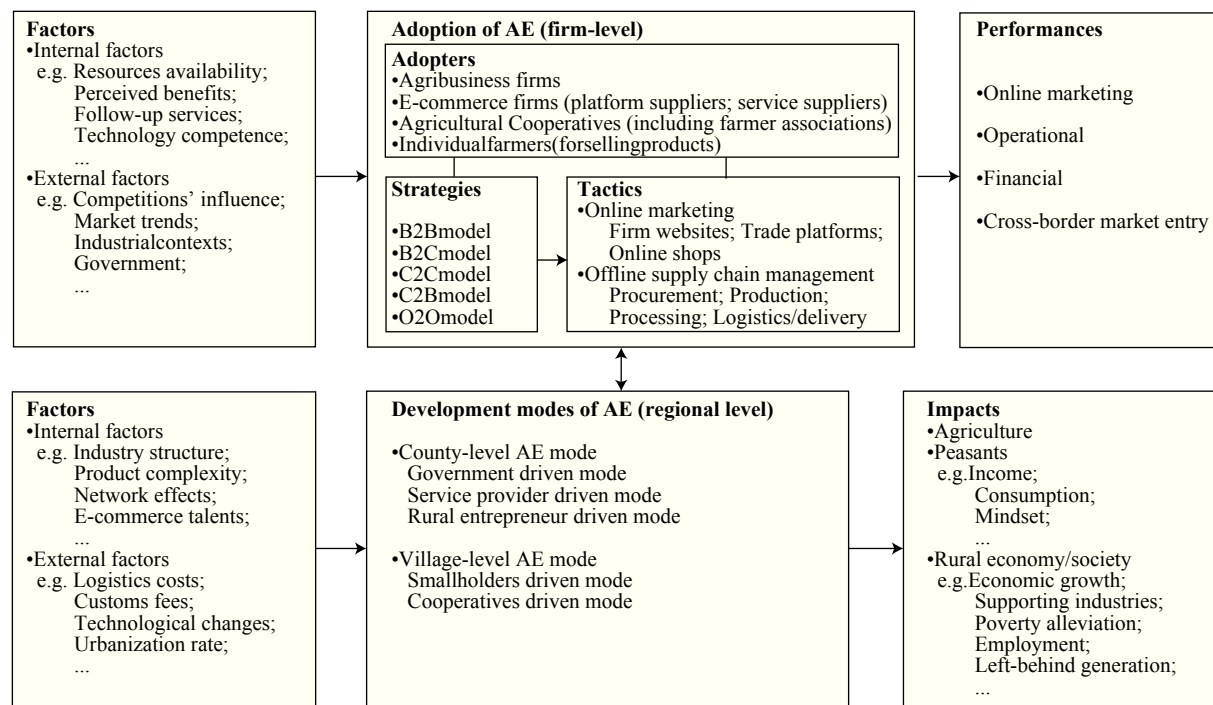


Figure 4. A conceptual model of agri-food e-commerce (AE). Models: B = Business; C = Customer; O2O = Online to Offline.

At a firm-level (upper part of Figure 4), there are three boxes: factors affecting AE adoption, AE adoption and associated performance. Within the adoption of AE box, adopters indicate the subjects that adopt or drive the adoption of AE and tend to be agribusiness firms, e-commerce firms (e.g. Alibaba), agricultural cooperatives and individual farmers. These adopters can choose various business strategies/models (e.g. B2C), which determine the tactics (i.e. online marketing and offline supply chain) used. Online marketing consists of a number of tactics which vary for firm websites, trade platforms or online shops. After deciding a business model, the AE adopter faces the issue of configuring its offline supply chain, including but not confined to procurement, production, processing, logistics and delivery.

The influencing factors are classified as internal (e.g. resource availability) and external dimensions (e.g. government policy) and affect the level of AE adoption at a firm level. We propose four approaches to evaluating the performance of AE adoption, including online marketing, operation, finance, and cross-border market entry. Marketing and financial performance are found in the reviewed papers. Operational performance is included because it is affected by AE adoption, for example on-time delivery. Cross-border market entry is proposed as a performance measure because there is an emerging phenomenon of cross-border e-commerce which changes the traditional internationalization process of firms.

As for the regional level (lower part of Figure 4), we identify two development modes of regional AE from industry reports and news coverage on China's AE practice: county-level mode and village-level mode. We summarize that county-level AE refers to a mode in which a whole county¹ is committed to AE development of normally a few agricultural products (e.g. pecan), carrying out strategic planning and prioritizing financial allocation to help the product gain access to national or even international markets. Three county-level modes are identified based on the drivers of the AE development in the initial stage: government-driven mode, service provider driven mode, and e-businessmen driven mode.

¹ China has four levels of local governments, i.e. province, county, township and village.

The village-level AE mode refers to a kind of AE development pattern emerging in certain villages in China, where quite a number of smallholders or agricultural cooperatives located within their villages sell their agri-products via Internet, which is the main source of income to the villages (AliResearch, 2015). The concept of Taobao Village first appeared in the news in 2009 and Alibaba Group officially adopted it in 2013. The term Taobao County emerged in 2014. Both concepts indicate those villages and counties that meet a certain criterion set by Alibaba selling their products through the Taobao e-portal. The very first batch of Taobao Villages were recognized and presented with a plaque by Alibaba in December 2013.

Again, the influencing factors are classified as internal (e.g. industry structure) and external dimensions (e.g. technological change), which affect the level of AE development and the choice of development modes in a region. Based on China's 'San Nong'² policy, the impacts of regional AE development can be classified as follows: agriculture, peasants, and rural development.

5.3 Future research directions

■ Four types of adopters

We identify four types of adopters at the firm-level, i.e. agribusiness firms, e-commerce firms, agricultural cooperatives, and individual farmers. For the factors affecting the adoption of e-commerce, existing scholars only focus on one type of adopter, i.e. the agribusiness firms, while ignoring other types. Some Chinese e-commerce companies/service providers, such as Alibaba, began to put a lot of emphasis on exploiting the agricultural e-markets in rural areas. For instance, Alibaba tries to promote the sale of agricultural products from rural to urban areas by establishing Rural Taobao Service Stations ('Cun Tao' in Chinese) in many villages. According to the statistics of AliResearch (an internal research institute established by Alibaba), 9,278 such stations were established by December 9th, 2015 (AliResearch, 2015). The number of farmer cooperatives in China has increased fast since the enactment of the Specialized Farmers Cooperatives Law in 2007, and some cooperatives have tried to adopt e-strategies in recent years. In addition, more and more Chinese smallholders sell their agri-products directly to consumers online. It presents a trend for the development of C2C e-commerce in agriculture. Hence, much more research should be devoted to other types of adopters in addition to agricultural firms.

■ Implementation of online and offline marketing

The implementation of online marketing and offline supply chain management for various adopters is still not well understood. More research is needed to understand the best practices of online marketing. Most of the existing literature is focused on the success factors of the firm websites and only four papers discuss those of trade platforms, while few articles focus on the tactics of online shops. In China, more and more agribusiness firms tend to open online shops on third party trade platforms because their own websites do not have transaction functions and/or the desired number of visits (Cui *et al.*, 2014). Some agricultural cooperatives and individual farmers are also active in opening and operating their own online shops. With the rapid increase in the number of online shops, the competition in online marketing among the adopters is considerably fierce (Zeng *et al.*, 2015). Therefore, making online shops attract visitors, in order to survive and set a foot in the hyper competitive e-marketplace and then look for further expansion is a critical issue that scholars should investigate in the near future. Another important tactic is how to improve the supply chain efficiency after AE adoption. It is expected that, after the adoption of e-commerce, many changes will have to be made in every process of the food supply chain including procurement, production, processing, logistics and delivery. However, few articles make a systematic and comprehensive analysis of the tactics of every process of the whole food supply chain enabled by e-commerce for agribusiness firms. This is an obvious gap which researchers could address. For greater performance, the adopters should be aware of

² China's 'San Nong' is concerned about agriculture, peasants and rural development. All three words have an initial character of 'Nong' in Chinese.

the need to align online marketing with offline supply chain management and adjust one or both constantly according to the dynamic interaction between them.

■ *Quantifying performances of agri-food e-commerce*

There is a lack of a commonly-used index to quantify the performances of AE activities and potential links between specific tactics and performances at a firm level. We have identified four categories of AE performance: online marketing, operation, finance, and cross-border market entry at a firm level. Operational performance weighs the benefits that firms have gained from offline food supply chain management after the adoption of e-commerce and can be evaluated by many aspects such as production costs, lead time, inventory stock-out, delivery reliability and the flexibility of the process (Devaraj *et al.*, 2007). Financial performance is an ultimate goal and the most important trigger for firms that wish to implement e-commerce programs. It is logical to infer that positive online marketing performance and operational performance leads to positive financial performance (Jiang and Wang, 2009; Motiwalla *et al.*, 2005). Cross-border market entry performance represents the market access capability and cost reduction of firms in the internationalization process with the help of e-commerce. On the one hand, e-commerce allows retailers to conduct global sourcing and marketing (Zwass, 1998); on the other hand, the cross-border e-tailers need to address some challenges, such as custom procedures, cultural adaption, and dispute resolution (Sinkovics *et al.*, 2007; Stylianou, 2008). In addition to the unified index systems and measurements to evaluate the performances of AE activities, there is a clear research need to establish the potential links between specific AE tactics and enhanced online marketing, operational, financial and cross-border market entry performance, so as to provide more accurate and practical measures for organizations to adopt e-commerce.

■ *Regional development modes of agri-food e-commerce*

Much emphasis should be put on the emerging phenomenon of regional development modes of AE. China's best practices in recent years have provided a great opportunity for the further development of AE in the developing world and have presented new opportunities for AE research. This is evidenced by the emergence of county-level and village-level modes.

There are three kinds of county-level modes identified, which we can illustrate with live examples from industry reports or news coverage. Cheng County, a small county in the mountainous area in Gansu Province in China, is a representative sample for the government-driven mode. Without the leadership of the county governor, Li Xiang, it would be hard to imagine AE developing so rapidly there (Wei, 2014). Cheng County is famous for some local agri-products such as pecan, garlic, honey and pork. However, before the advent of AE, these products were only sold to local agricultural product market or traders at low prices. In June 2013, Li tried to sell pecans via a micro-blog online and attracted many consumers, successfully helping some local peasants solve the problem of market access. Then the county government decided to promote the development of network marketing by enacting policies and taking measures such as engaging in public relationships with media, providing training to peasants, supporting the establishment of Cheng County E-commerce Association, building Longnan E-commerce Incubation Park and Cheng County E-commerce Logistics Park, and signing a cooperation contract with Alibaba for setting up Rural Taobao Service Stations in the villages. The AE development was so successful that there were 676 online shops with an annual revenue of 370 million RMB³ by the end of 2015 and Cheng County was named the 'National Comprehensive Demonstration County of Introducing E-commerce into Rural Areas' by the Ministry of Finance and the Ministry of Commerce in July, 2015.

Tongyu County, a county in Jilin Province in North China, developed another mode called service provider driven mode. Before the adoption of AE, Tongyu County was an underdeveloped county due to its geographical location and resource restraints. In recent years, with the help of a service provider called Yunfeihewu

³ RMB = Chinese yuan. 1 Chinese yuan = 0.145285 USD, calculated on the basis of the exchange rate on April 13, 2017.

E-commerce Company (YEC), Tongyu County has made great progress. YEC was established in October 2013, as a local service provider responsible for selling local agricultural products online. YEC put much emphasis on building a well-known brand called 'San He Mu' and provided ample guidance to local agricultural producers on how to standardize production and offer higher prices than before for purchasing agri-products from farms. YEC applied the unified package, put on their own-brand labels, and sold the products online via Taobao platform through its professional marketing team. Tongyu's practices provide great evidence of how to develop AE in less developed areas without any prior knowledge of e-commerce (Mo, 2015). In this case, the government assumed a supportive role.

Suichang County, a county in Zhejiang Province in China, promotes AE development through a mode called rural entrepreneur driven mode, which Avgerou and Li (2013) call netpreneur. Suichang County has a superior ecological environment and produces high-quality local agri-products such as yam, camellia oil, alpine vegetables, free range chicken, and edible fungi. However, due to the small production scale, the peasants' position remains weak in the supply chains. In 2005, several smallholders began trying to sell pecans through online shops spontaneously and attracted more and more participants. In March 2010, Suichang E-businessmen Association (SEA) was established thanks to the strong push of Pan Dongming, an excellent entrepreneur who returned to Suichang County from Shanghai after quitting a highly paid job. He then became the president of SEA. As a non-profit organization, SEA is set up to provide public services (e.g. growing technique advice, training, pooling common resources, information sharing and negotiation with logistics companies) and ensures industry self-regulation. Being registered with SEA, two enterprises called Suiwang E-commerce Company (SEC) and Ganjie E-commerce Company (GEC) were founded in 2011 and in 2013 respectively. Pan became the principal business partner of both, providing strategic advice. SEC has a profound influence on promoting AE development in Suichang County, serving as a comprehensive service provider similar to YEC in Tongyu County. GEC set up Ganjie E-commerce Stations in villages helping peasants purchase/sell products online. Under the guidance of SEA, AE in Suichang County is developing fast, making Suichang County well-known throughout China.

We have also identified two different types of village-level AE modes: smallholder-dominated and cooperative-oriented mode. Noticeably, more and more Chinese smallholders are selling their agricultural products directly to urban consumers, mostly through e-shops at Taobao's online portal. When the number of these smallholders in the same village reaches a certain level, Alibaba company recognizes this village as an Agro-Taobao Village. It is a new kind of industry cluster based on C2C e-commerce and located in rural areas, which has rarely been seen in other countries (Zeng *et al.*, 2015).

In some villages, given the difficulties of AE adoption by local individual peasants, farmer cooperatives (e.g. Akesu Feng Guo Agricultural E-commerce Cooperatives in Xinjiang, Hua Sheng Xiang Grape Cooperatives in Shandong Province) represent a different mode from the smallholders driven mode. In a cooperative-driven mode, peasant e-tailers collaborate through co-operatives and sell products online to non-local wholesalers in bulk or consumers piecemeal through the co-operative or third party e-portal. Chen *et al.* (2015) summarize three approaches to implementing e-commerce by farmer cooperatives: releasing product information on the public agricultural websites; self-operating online shops; and entrusting third party e-commerce trade platforms.

For the regional AE development modes, there is an imminent need for researchers to keep observing and summarizing the best practices and theorizing them. In practice, successful experience and policies from the best practices should be summarized and recommended to other countries, particularly those in the developing world. Due to the exploratory and under-researched nature of the topic, a grounded theory case study method may be applied in future research reporting the 'best practice' case studies, including the mechanisms behind the complex phenomena, which help theorize at a later stage. Some typologies of different modes may be developed.

■ *Impacts of agri-food e-commerce development*

Few papers were found focusing on the impacts of AE development. Future researchers should first of all develop and validate the measures for impact and then focus on empirically testing the impacts of the AE development. China's AE practices have revealed that AE development has many positive economic and social impacts. Zeng *et al.* (2016) argue that e-commerce is becoming a new engine in solving China's 'San Nong' issues. Based on the tenets of 'San Nong', there are three aspects of agriculture, peasants, rural societies or communities.

Agriculture is the foundation of the national economy but still the least developed industry in China. The modernization of agriculture is a critical issue for policy makers. The emerging best practices show that e-commerce can be an effective approach. With the help of e-commerce, agri-products can be sold at higher prices, while getting rid of the constraints of space and time (Mo, 2015). The online marketing competition also compels producers to improve the quality of agri-products and the efficiency of the food supply chain. The determining factor for the improvement of competitiveness lies in offline production and supply chain capability in the long run (Zeng *et al.*, 2016).

The peasant issue is a central one within the 'San Nong' framework, having attracted much attention from academics, due to the fact that the economic and social gap between peasant class and non-peasant class is getting wider. In recent years, some peasants have become richer and happier by selling products in their own online shops (AliResearch, 2015; Zeng *et al.*, 2016). More and more peasants are learning how to shop online, and their mindsets towards Internet and information are gradually changing (AliResearch, 2014; Zeng *et al.*, 2015).

E-commerce can also be very useful for promoting the development of the rural economy and society in such facets as economic growth, poverty alleviation and employment. According to the report on e-commerce and poverty alleviation published recently, 832 nationally-underdeveloped counties sold products via Alibaba's platforms for a total of 12 billion RMB yuan in 2014 (Zhang and Jiang, 2015). It is estimated that there were more than 70 thousand households or 280 thousand individuals (on average four employees per household) in employment in the 212 Taobao Villages by late December, 2014 (AliResearch, 2014). In addition, e-commerce can give an impetus to its supporting industries like network infrastructure, road reconstruction, logistics, finance, education, technology and online services (Cai *et al.*, 2015; Cui *et al.*, 2014; Zeng *et al.*, 2015). For example, with the emergence of Taobao Village, logistics companies seeking economies of scale establish many new distribution hubs and collection points in rural areas. In addition, AE development in rural areas can attract migrant workers in cities back to their hometowns and promote local employment, helping to resolve many social problems such as the left-behind generation (AliResearch, 2014).

For the positive effects of the regional AE development on the 'San Nong' mentioned above, it is expected that future researchers could make an effort to explore the possible mechanisms that may lead to the positive impact on San Nong with sound theoretical foundation. For example, the positive impact on farmers' income of AE adoption may result from different channels such as the sales growth, investment in production and operation, profitability and the increase in absolute working hours. These promoting mechanisms based on rigorous analyses and when well-understood can provide meaningful guidance for the future development of AE. On the other hand, rigorous empirical designs and analyses based on a large sample size are necessary to improve our understanding of the more accurate effects of AE. To draw valid causal inferences without estimate bias caused by endogeneity, some more rigorous methods such as propensity score matching can be used to study the adoption and effects of AE at the household or community level.

Every coin has two sides. It is also necessary for researchers to identify the potential negative effects of AE development and find out how to cope with them. For example, some opinion leaders in China are concerned by the fact that peasants have to invest too much money in the operation of their e-shops in the form of advertisement, and the competition for ranking shops on the Taobao platform is increasingly fierce

(Zhang and Ma, 2015). This situation has eroded the profits of e-shop owners and even forced some to exit the market. Furthermore, there are some challenges in implementing AE, i.e. the lack of AE talents, the imperfections of the logistics system and the low degree of agri-food standardization (Mo, 2015; Wu *et al.*, 2010). Finding solutions to these problems will be a daunting task for future researchers.

6. Conclusions

It has been indicated that the adoption and development of e-commerce is an innovative way of influencing food systems and market access for smallholders. As far as we are aware, this may be the first study to systematically review the literature on AE. Based on research at Scopus, 41 journal articles and 23 conference papers were finally identified. Descriptive analysis results show that there has been a general increase in the number of publications since 2000, indicating that AE research has attracted more and more interest from scholars in different countries and across multiple disciplines. The 64 articles identified were coded and summarized into a number of themes. We contribute to the agricultural e-commerce research by developing a conceptual model based on a systematic review and some industry reports, and proposing a number of future research directions. In particular, the regional development modes of AE and their impacts on agriculture, peasants, and rural economy and society pose significant agri-food policy implications for the developing countries. Market access for smallholders is a long-term topic in agricultural economics literature, and e-commerce is an eye-opening experience and revolutionary change for smallholders, since it could disintermediate middlemen including traders, distributors, and retailers removing information asymmetry. Policymakers in developing countries may learn from the best practices in China, and more research is needed to understand the regional development of AE.

Supplementary material

Supplementary material can be found online at <https://doi.org/10.22434/IFAMR2016.0156>.

Table S1. List of the selected papers and demographic information.

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