Chapter 1
Food Security and Collaborative Advantage: Scoping the Scene

Lily Kiminami

Abstract Generally, the food we eat today has to travel a long distance "from farm to table". As for the agents connected with food, the roles that the distribution and processing industries play are growing, in addition to those of farmers and consumers. Moreover, since food production is based on biological production and located in rural areas, it is strongly subject to the influence of the natural environment, and its relationship with the social and economic background of farm villages is also important. Therefore, a perspective on the "food system", which covers problems involving foodstuffs such as the flow of food and the environment surrounding it, is needed.

On the other hand, since the issues of food security are conventionally regarded as problems in a single country (one sector) or problems at a certain stage of development, such a viewpoint has become an obstacle to WTO negotiations on agriculture, which makes the liberalization of global trade more difficult. Therefore, it is necessary to apply a framework that ranges across different areas of a country, different stages of development and relationships of interdependence among countries, and to cover these problems from an international perspective.

Additionally, in recent years, studies on industrial clusters have made significant achievements in regional development for seeking new growth strategies based on collaborative advantage which is a paradigm shift from the comparative and competitive advantages of conventional economics. The policy design for improving the capability of collaboration among entities and accepting the diversified and pluralistic nature of entities is an urgent necessity for solving the problem of food security and realizing the sustainability of regional development as well.

Keywords Food security • Food system • Collaborative advantage • Sustainability of regional development • Innovation

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1 The Perspective on the Food System

Food is a general term including agricultural products, such as grains, vegetables, livestock products, fruits, oils and fats, sugars, marine products, and related processed goods. Generally, the food we eat today has to travel a long distance "from farm to table". As for the agents connected with food, the roles that the distribution and processing industries play are growing, in addition to those of farmers and consumers. Moreover, since food production is based on biological production and located in rural areas, it is strongly subject to the influence of the natural environment, and its relationship with the social and economic background of farm villages is also important. On the other hand, due to the influence of history and culture, etc., food consumption, in addition to being concerned with life, has relationships with various environments beyond the consumption of common goods. Furthermore, the problematic food-related domain is further expanded by the development of biotechnology, the preservation of biodiversity, and the promotion of the utilization of biomass, etc. Therefore, a perspective on the "food system", which covers problems involving foodstuffs such as the flow of food and the environment surrounding it, is needed (Kiminami 2009).

Since food problems are conventionally regarded as problems in a single country (one sector) or problems at a certain stage of development, such a viewpoint has become an obstacle to WTO negotiations on agriculture, which makes the liberalization of global trade more difficult. Therefore, when considering today's food problems, it is necessary to apply a framework that ranges across different areas of a country, different stages of development and relationships of interdependence among countries, and to cover these problems from an international perspective, rather than in one country (area) or one sector (field). Meanwhile "being international" in this case means that not only the supplier or source of the food are global, but also the local and global food economies are linked to each other.

2 Global Food Security and the Strategy of Collaborative Advantage

Here, we consider food security as a problem of the whole globe, comprising both the developed and developing countries, including newly emerging markets (see Fig. 1.1). Initially, developed countries are assumed to have met the minimum level of food security, but developing countries have not yet done so (point A). Along with the growth of the economy in developing countries, the level of food security in these countries is assumed to be improving. Under the same rationale, if there is no cooperative relationship on food security between developing and developed countries, there is a possibility that this may reduce the level of food security in developed countries (point A′, or a shift to point C). However, if both developed and developing countries cooperate and compete with each other (converting to a complementary relationship via trade-offs), it is possible that the level of food security for both parties can be improved (point D).

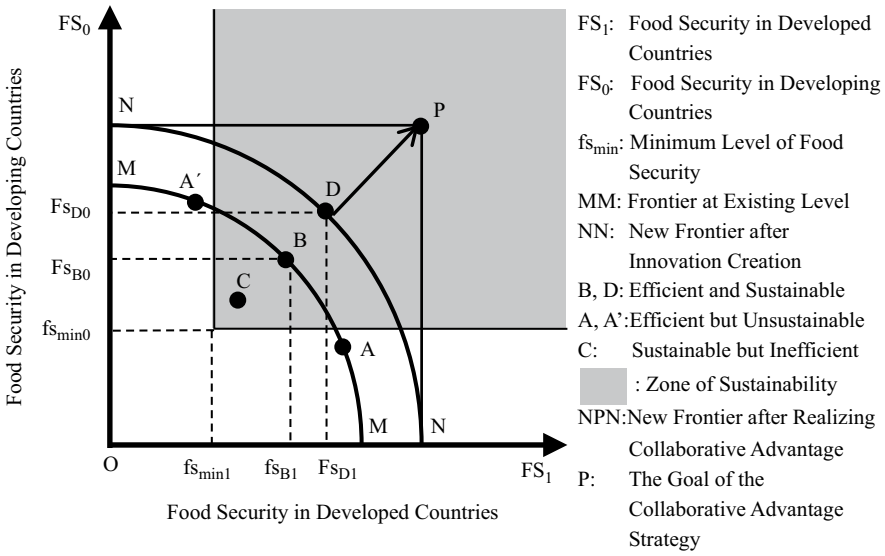

Fig. 1.1 Food security and collaborative advantage (Source: Kiminami (2011a, p. 13))

Additionally, in recent years, studies on industrial clusters have made significant achievements in regional development for seeking new growth strategies (Porter 1998).[1] However, the cluster strategy is based on collaborative advantage (Huxham 1996) which is a paradigm shift from the comparative and competitive advantages of conventional economics.

With a strategy of collaborative advantage, greater results can be obtained by strategically forming a network and collaboration between companies and regions, which contribute to sustainable development in particular. Therefore, Fig. 1.1 shows an ideal state for food security (point P), to be realized by innovation creation through cluster formation, which is a definite breakthrough in accordance with the principle of collaborative advantage. It could be a powerful strategy for the sustainable development of industries, regions and food security amid today's globalization. Furthermore, such a way of thinking advances the conventional discussion for food security oriented toward the food self-sufficiency ratio.

Moreover, existing empirical research shows that local food industrial clusters are also being formed in Northeast Asia, such as in Japan, China and South Korea. In addition, the food industry in Northeast Asia is strengthening the relationship among local clusters across national borders against the backdrop of geographical proximity, varied natural conditions, and the social and economic environments.

[1] Porter (2000) defined clusters as "geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standards agencies, trade associations) in a particular field that compete but also cooperate".

3 The Theoretical Model of Network Formation: The Incentive Mechanism of Collaborative Advantage

3.1 Relationships Between Innovation and the Quality (Price) of Products

Here we shall focus on the relationships between innovation and the quality and price of goods in the course of examining the significance of cluster formation through business alliances. First, we assume that there are two types of product differentiation, namely horizontal and vertical differentiation, and second, that the market is characterized by monopolistic competition in which there are many buyers and sellers, and price is determined by markups added to production costs. Such a market structure can be indicatively considered as a transitional stage from growth to maturation, rather than a nascent stage.

Figure 1.2a shows the typical economic benefits associated with ordinary innovation in companies. The vertical axis shows production costs/prices, and the horizontal axis represents quality, where G_A, G_B, G_C, G_D, and G_E are goods or services produced and sold by companies A, B, C, D, and E, respectively. WTP (willingness-to-pay) is a curve that indicates the price at which consumers are willing to pay for the quality of each product. For example, among the five types of companies, G_B represents the quality and cost of goods or services produced by company B at a middle level, and are sold at a middle-level price as well.

In addition, we assume here that the sources of differentiation of products and services mainly come from the knowledge and technologies held independently by each company which cannot be easily imitated. However, there are numerous other companies of the same type for each of companies A, B, C, D, and E, which results

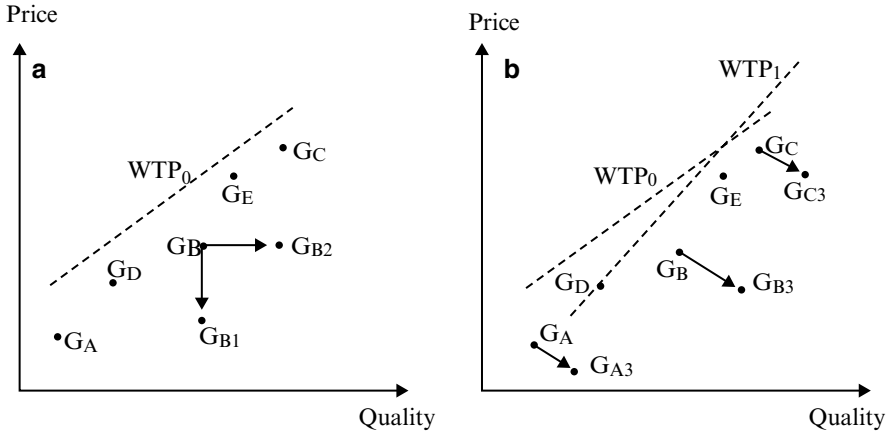

Fig. 1.2 Innovation and industrial clusters. (**a**) typical economic benefits, (**b**) production costs all go down, while the quality goes up (Source: Furuzawa and Kiminami (2011) with reference to Swann (2009, p. 53))

in horizontal differentiation. Furthermore, the vertical difference between WTP_0 and G_B represents the consumer surplus. Because the price for each company is equal to the costs of production plus a markup, there is no excess profit generated in this stage. Hence, each company adopts a strategy to maximize profits through innovation.

Here, suppose that company B succeeds in innovating. First, as the result of a process innovation, point G_B in Fig. 1.2a shifts downward to point G_{B1}, which is considered a cost-reduction innovation at a lower price level with a constant quality. In contrast, as the result of a product innovation, point G_B shifts right to point G_{B2}, which is considered a quality-enhancing innovation since quality goes up while production costs keep constant. Excess profits are generated and the market share of each company changes as the innovations are realized. Since each product can be replaced by others in either of the cases above (i.e., where G_B shifts to G_{B1} or G_B shifts to G_{B2}), the markets for products G_A, G_C, G_D, and G_E would shrink, and that for product G_B would grow. However, market shrinkages for G_C and G_E in the former case, and for G_A and G_D in the latter case, are respectively relatively large.

If three companies such as A, B, and C form a cluster through a business alliance and each company simultaneously realizes both process innovation and product innovation as shown in Fig. 1.2b, the production costs of their products G_A, G_B, and G_C all go down, while the quality goes up (shifts to G_{A3}, G_{B3}, G_{C3}) as a result of the spillover effects. Meanwhile, as the market becomes saturated in terms of quantitative size and the rise in living standards, a higher quality of goods and services would be demanded by consumers, which shifts the WTP curve from WTP_0 to WTP_1. Furthermore, if the entities that make up the cluster are able to establish win-win relationships, the competitiveness of the entire cluster would be improved which would lead to a concurrent increase in consumer surplus. In contrast, the demand for the products produced by companies D and E, which are not in the cluster, declines.

3.2 The Policy Implications of Network Formation

In the following section, the profit-maximization behavior of enterprises will be theoretically formulated by considering business alliances as the network formation, and the influence of policy on the network formation of enterprises will be taken into account as well.[2]

The profit of an enterprise, π, can be stated as Eq. 1.1, where, P is the price of the product, F (L, K, N) is the production function, and A is the technical level of the enterprise. L, K and N are the inputs of labor, capital and network formation (stock), respectively. We assume the prices of each factor to be w, r, and b, in which w and r are decided by the market. On the other hand, the cost of network formation contains the cost of searching for partners, consensus building to form a network and maintaining the network, which is difficult to identify directly. Once the network is

[2] Please see Furuzawa and Kiminami (2011).

formed, costs will be generated and the enterprises in the network will be drained if the effectiveness of the network cannot be produced. Furthermore, the effectiveness of a network is dependent on the amount and the quality of information about business partners, the content of transactions and the business alliance, and the predictions regarding partners' behavior.[3]

$$\pi = P(N) \cdot F(L, K, N, A) - (wL + rK + bN) \tag{1.1}$$

The first order condition of profit maximization can be represented as follows:

$$MPL = \partial F / \partial L = w / P \tag{1.2}$$

$$MPK = \partial F / \partial K = r / P \tag{1.3}$$

The equilibrium condition of network formation can be expressed using the concept of marginal revenue as follows:

$$MRN = (\partial F / \partial N) \cdot P + (\partial P / \partial N) \cdot F = b \tag{1.4}$$

It is safe to say that success in development of new products through marketing and business alliances will cause a rise in the sales price per unit[4] and the level of network formation will be decided at the crossing point of the marginal revenue curve (the effects of the network on the increase in production + the increase in unit price) and the cost of network formation (Fig. 1.3). Additionally, the promotion of business alliances through subsidies is considered as the decrease in the cost of network formation from b to $b - s$. In other words, the effect of policy is considered as a part of the externality of developed technology and business model spread as public knowledge after the business alliance succeeds. Moreover, the economy of agglomeration is realized through geographic concentration, etc., which reduces the transaction costs of enterprises that lead to a decline in the cost of network formation, and the spillover of knowledge leads to the improvement of quality (price increase).

However, the effect of the spillover of knowledge formation and the cost of the network is not only affected by the level but also by the structure of networks (the proximity of the network). As for the structure of networks, the formation of small-world networks as opposed to random networks, would result in lower costs associated with network formation, in addition to greater economic benefits from higher prices. The policy implications of network formation are that the quantitative and qualitative differences in networks not only have consequences for the business

[3] For instance, the enactment of a commercial code improves the incentive for business contacts to abide by the rules, and improves the effectiveness of dealings. In addition, the cost of network formation for an enterprise is decreased via the facilitation of the prediction of the business contacts' actions.

[4] Moreover, it is necessary to consider the relationship with the content of the contract, including the purpose and the distribution of profits, when thinking about the reality of corporate behavior.

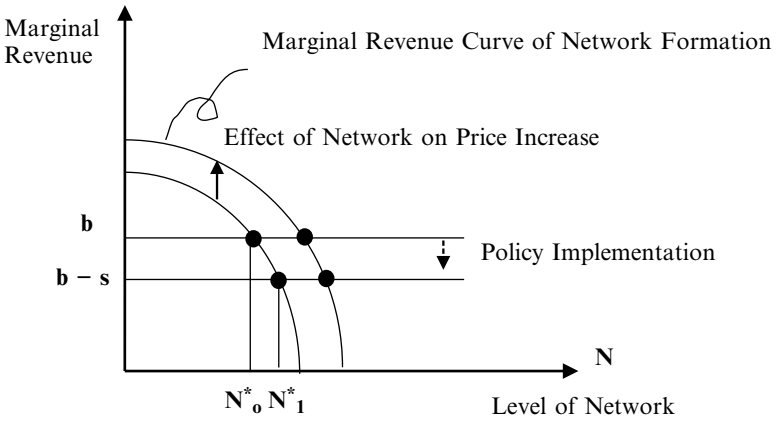

Fig. 1.3 Policy and optimal point of network formation (Source: Revised based on Kiminami (2011b, p. 248))

performance of corporate entities, but also have the potential to bring about differences in regional development (Kiminami et al. 2010, p. 468).

Therefore, collaborative advantage is understood as a strategy of the maximization of effects through the minimization of the cost (transaction costs in the broad sense) of governance and maximizing the benefits of "knowledge creation potential". The cost of governance here can be summarized from the perspectives of transaction costs theory, agency theory and ownership theory as follows: first, the transaction cost in the narrow sense of consensus building for cluster formation; second the cost of enforceable rules for suppression of the principal-agent problem based on information asymmetry, such as moral hazard; and third, the cost of preventing the problem of a free ride through the operation and regulation of knowledge ownership and promoting spillover and knowledge creation.

4 Selective Review of Research on Cluster Formation and Regional Innovation

4.1 Research on Agricultural Clusters

Relatively little research has been done on clusters which relate specifically to the agricultural and food sectors. There are some notable examples of studies, including Lagnevik et al. (2003), Hauknes (2001), Bertolini and Giovannetti (2003), and the European Monitoring Centre on Change (2006). However, the body of research into the role that agricultural cluster formation plays in the economic development of agriculture and rural communities is still small.

4.2 Research on Cluster Formation and Regional Development

Porter (2003) found that clusters affect regional employment, wages, and innovation levels to a great degree, which strengthened the theoretical foundations for the notion of regional development through cluster formation. There are also a number of studies that examine the role of clusters in regional development. For example, Porter et al. (2004) analyzed clusters from the perspective of regional development in economically advanced countries, while Ketels et al. (2006), OECD (2005), Bojar and Olesiński (2007), Kuchiki and Tsuji (2005), Otsuka and Sonobe (2006), Kuchiki (2007), and Ding (2007) took the same perspective but studied developing countries and Eastern European countries. Another pertinent example is Puppim de Oliveira (2008), the thesis of that the key to innovation and dynamic economic development is "social upgrading" among SMEs and clusters in developing countries.

4.3 Research on Cluster Initiatives

Most conventional studies on industrial clusters do not explicitly state who or what drives cluster formation and translates the benefits of clusters into real economic results, nor the way in which such results are achieved. The development and competitiveness of clusters rely largely on organized campaigns called cluster initiatives (CIs), which seek to advance precisely for the goals of those organizations that have ties to the relevant companies, the government, and research institutions within the region. Given this trend, one method effective for analyzing clusters is to focus not on the clusters themselves so much as on these cluster initiatives, taking into consideration the broad spectrum of circumstances in which these clusters were formed, and assessing them within the framework of cluster initiative models, i.e., examining what sort of influence factors such as initial conditions, purposes, and processes have had on the results. In the field of CI research, once the initial conditions, purposes, processes, and results are known, comparative analyses can be performed which measure the effects of those initial conditions, purposes, and processes on the results. In fact, a large-scale international CI survey project is currently underway by the Global Cluster Initiative Survey (GCIS), and as part of the project studies by Sölvell et al. (2003) and Ketels et al. (2006) have clearly identified the importance of CIs in cluster formation.

4.4 Research on the Economic Effects of Clusters

Most existing research on the economic effects of clusters tends to focus on industrial agglomeration. Theories of economic growth in recent years have recognized that innovation is essential for sustained growth, that knowledge (or technology)

spillover is the root of such innovation, and that industrial agglomeration contributes to economic growth by promoting spillover. Therefore, it is possible to think of an economy of agglomeration as a manifestation of a dynamic external economy. The external economic effects of what we know as "spillovers" were noted by Marshall (1890), formulated by Arrow (1962), and applied to endogenous economic growth models by Romer (1986). According to Glaeser et al. (1992), dynamic external economies can be classified according to differences in the locations and market climates in which spillovers occur. Spillover can occur within a single industry or among different industries. It can also be spurred on by monopolistic/oligopolistic markets on one hand, and competitive markets on the other. Marshall (1890), Arrow (1962), Romer (1986), and Porter (1990) focused on spillover within a single industry, and theorized that regional specialization in an industry contributes to economic growth. Marshall (1890), Arrow (1962), and Romer (1986) speculated that monopolistic market structures facilitate spillover, but Porter (1990), in contrast, holds that competition promotes spillover. Jacobs (1969), on the other hand, places an emphasis on spillover among different industries, asserting that the agglomeration of diverse industries drives the creation of ideas and facilitates innovation. By extension, industry diversification contributes to economic growth.

It should be noted that because it is practically impossible to measure spillover directly, most empirical research relies on analyses of the relationship between industrial agglomeration and economic performance. For example, Glaeser et al. (1992) use an employment growth approach to perform an empirical analysis that explicitly adopts the notion of dynamic external economies through industrial agglomeration, while Beeson (1987), Dekle (2002), and Henderson (2003) take total factor productivity approaches to the same. However, as McCann (2008) points out, there are problems inherent in economic analyses of industrial agglomerations posed by understandings of the agglomerations themselves. Specifically, industrial agglomerations may make it easier for spillovers to occur, but that does not mean that spillovers necessarily *do* occur because of industrial agglomeration. When examining agglomeration economies, it is at least necessary to know the extent of business collaborations. However, exhaustively ascertaining all business collaborations among companies would require a study of massive proportions involving micro-level data. As is clear from the above, many issues remain for the study of the economic effects of clusters.

4.5 Research on Regional Innovation Strategy and Innovation System

Innovation is the buzzword of the times, although misunderstanding of this concept is also prevalent. Rather than technological progress, innovation is "creative destruction". Through paying attention to the contemporary context in which management finds itself and returning to the classic definition of innovation, Christensen (1997)

rediscovered the essence of innovation using the concept of "destructive innovation", which was first focused on by Schumpeter (1934).[5]

Since the beginning of the 1990s, the theory of regional innovation has spread as policy in North America and the clusters introduced by Porter (1998), based on the theory of competitive advantage accumulated through knowledge in theoretical, empirical and policy terms (Cooke et al. 2004; Lundvall 1992). However, the following two problems have been pointed out by Matsubara (2013, pp. 11, 22), such as the insufficiency in the theoretical consideration of seeing the picture for the region and the knowledge spillover, and a lack of detailed empirical analysis about the actual condition of regional innovation systems. Moreover in Tödtling and Trippl (2005), the obstacles in regional innovation are classified into the surrounding area, the long-term industrial area, and the metropolitan area. Furthermore, the obstacles for the regions in the studies having the two aspects of the "surrounding area" and the "long-term industrial area" are the shortage (thinness of an organization) of resources, such as innovative companies, talented people, and research institutions, etc., and the fixation (lock-in) of relationships among industry, academia and government (Matsubara 2013, pp. 22–23).

Therefore, if innovation in a given region is regarded as a process of knowledge creation and application of the interaction of related entities, analysis of the relationship among innovation, the cognitive characteristics of corporations and the knowledge spillover in the process of cluster formation is considered to be important.

5 Sensitive Issues for Food Security in Northeast Asia

5.1 Factor Analysis on Food and Agricultural Trade Among China, Japan and S. Korea[6]

Questions over changes in the balance of trade between countries tend to arise in debates over the issues of food and agricultural trade. From a practical standpoint, however, it is reasonable to conduct the analysis of agricultural trade from the viewpoint of linking the agricultural sector of a given country with the total sectors of each country. Here, we suppose the change in the food and agricultural exports from Country A to Country B consists of three factors, namely: (i) the change in the importance of food and agricultural exports of Country A; (ii) the change in the exports of the total sectors of Country A; and (iii) the change in the importance of Country B as the destination for exports from Country A.

The value of sector *i*'s exports from Country A to Country B (X_{abi}) is expressed as follows:

[5] See also Schumpeter (1950) for the classification of innovation.

[6] This section is revised based on Kiminami (2010).

$$X_{abi} = X_{abi} / X_{awi} \times X_{awi} / X_{aw} \times X_{aw} \tag{1.5}$$

where X is the value of exports; a is country A; b is country B; w is the world; and i is the ith sector.

Equation 1.5 can be converted to Eq. 1.6 as follows:

$$G(X_{abi}) = G(X_{abi} / X_{awi}) + G(X_{awi} / X_{aw}) + G(X_{aw}) \tag{1.6}$$

where $G(\cdot)$ = growth rate function; $G(X_{abi})$ = growth rate of the value of sector i's exports from country A to country B; $G(X_{abi}/X_{awi})$ = growth rate of the share of country B in the value of sector i's exports from country A; $G(X_{awi}/X_{aw})$ = growth rate of the share of sector i in the value of exports from country A; $G(X_{aw})$ = growth rate of the value of exports from Country A.

In the following sections, the international trade in food and agricultural products among Japan, China and S. Korea since 1985 will be analyzed using the above factor decomposition.

5.1.1 Food and Agricultural Exports from Japan to China and S. Korea

The most important factor for explaining the rise in food and agricultural exports from Japan to China before 1990 is the growth of Japan's total exports. Since 1990, as China's economy and population grew, so did its importance as a destination for food and agricultural exports, eventually becoming the most important among the factors. As a result, the Japanese food sector became a superior export sector compared with other sectors after 1995; particularly in the years after 2000, this trend had been continually strengthened up to 2005. Since 2005, China's priority as an importer for Japanese food and agricultural products has declined (Table 1.1).

Likewise, the growth of food and agricultural exports from Japan to S. Korea had been spurred by the importance of Korea as an importer up to 2000. Although S. Korea's priority as an importer for Japanese food and agricultural products has declined since then, the initial growth of food exports to the country had been caused by both the growth of total exports and the increase in the share of food and agricultural products in the total exports of Japan. However, the importance as an export market for Japanese food and agricultural products declined after 2005 (Table 1.2).

5.1.2 Food and Agricultural Exports from China to Japan and S. Korea

The growth of food and agricultural exports from China to Japan stems primarily from the growth of China's total exports. On the other hand, the superiority of the food and agricultural sectors, in terms of exports, and the priority of Japan as an importer declined somewhat in this period (Table 1.3).

Table 1.1 Decomposition of the growth of food exports from Japan to China. All figures are percentages

		Factor		
	Growth rate of export value	Importance as export market	Importance as export sector	Advantage of total exports toward world
Period	$G(X_{abi})$	$G(X_{abi}/X_{awi})$	$G(X_{awi}/X_{aw})$	$G(X_{aw})$
1985–1990	5.6	1.8	−6.0	10.3
		(29.4)	*(−97.6)*	***(168.2)***
1990–1995	28.8	26.0	−6.3	9.1
		(90.2)	*(−21.8)*	*(31.5)*
1995–2000	9.1	7.2	0.2	1.6
		(80.0)	*(2.3)*	*(17.7)*
2000–2005	20.4	12.7	2.3	4.4
		(65.4)	*(11.8)*	*(22.7)*
2005–2010	6.3	−3.4	4.5	5.3
		(−52.9)	*(70.5)*	***(82.4)***

Source: UN COMTRADE (United Nations Commodity Trade Statistics Database, retrieved 11 July 2014) http://comtrade.un.org/, SITC Revision No. 2 [Section 0. Food and Live Animals]
Note: Figures in parentheses are each factor's contribution to "$G(X_{abi}/X_{awi}) + G(X_{awi}/X_{aw}) + G(X_{aw})$"

Table 1.2 Decomposition of the growth of food exports from Japan to S. Korea. All figures are percentages

		Factor		
	Growth rate of export value	Importance as export market	Importance as export sector	Advantage of total exports toward world
Period	$G(X_{abi})$	$G(X_{abi}X_{awi})$	$G(X_{awi}/X_{aw})$	$G(X_{aw})$
1985–1990	26.9	22.3	−6.0	10.3
		(83.8)	*(−22.4)*	*(38.6)*
1990–1995	14.8	12.3	−6.3	9.1
		(81.4)	*(−41.5)*	*(60.1)*
1995–2000	18.3	16.2	0.2	1.6
		(90.0)	*(1.2)*	*(8.8)*
2000–2005	7.7	0.8	2.3	4.4
		(10.4)	*(30.6)*	***(58.9)***
2005–2010	5.6	−4.0	4.5	5.3
		(−69.9)	*(78.3)*	***(91.6)***

Source: As Table 1.1
Note: As Table 1.1

Meanwhile, food and agricultural exports from China to S. Korea increased rapidly in the 1990s, a phenomenon caused mainly by the increased priority of S. Korea

Table 1.3 Decomposition of the growth of food exports from China to Japan. All figures are percentages

		Factor		
	Growth rate of export value	Importance as export market	Importance as export sector	Advantage of total exports toward world
Period	$G(X_{abi})$	$G(X_{abi}/X_{awi})$	$G(X_{awi}/X_{aw})$	$G(X_{aw})$
1985–1990	99.1	65.0	1.1	19.4
		(76.0)	*(1.3)*	*(22.7)*
1990–1995	21.0	11.9	−9.3	19.1
		(54.8)	*(−42.6)*	***(87.8)***
1995–2000	4.1	−0.3	−5.9	10.9
		(−5.6)	*(−125.0)*	***(230.6)***
2000–2005	8.2	−4.1	−9.8	25.0
		(−37.1)	*(−87.6)*	***(224.7)***
2005–2010	2.8	−8.9	−2.4	15.7
		(−204.1)	*(−55.8)*	***(359.9)***

Source: As Table 1.1
Note: As Table 1.1

Table 1.4 Decomposition of the growth of food exports from China to S. Korea. All figures are percentages

		Factor		
	Growth rate of export value	Importance as export market	Importance as export sector	Advantage of total exports toward world
Period	$G(X_{abi})$	$G(X_{abi}/X_{awi})$	$G(X_{awi}/X_{aw})$	$G(X_{aw})$
1985–1990	–	–	–	–
	–	–	–	–
1990–1995	7.7	−0.3	−9.3	19.1
		(−3.3)	(−97.4)	**(200.7)**
1995–2000	27.4	22.1	−5.9	10.9
		(81.6)	*(−21.8)*	*(40.2)*
2000–2005	12.8	0.0	−9.8	25.0
		(−0.2)	*(−64.0)*	***(164.2)***
2005–2010	3.3	−8.5	−2.4	15.7
		(−176.7)	*(−50.8)*	***(327.5)***

Source: As Table 1.1
Note: As Table 1.1

as an importer. However, since 2000, with its decline in priority, food and agricultural exports from China to S. Korea have declined as well (Table 1.4).

Table 1.5 Decomposition of the growth of food exports from S. Korea to Japan. All figures are percentages

		Factor		
	Growth rate of export value	Importance as export market	Importance as export sector	Advantage of total exports toward world
Period	$G(X_{abi})$	$G(X_{abi}/X_{awi})$	$G(X_{awi}/X_{aw})$	$G(X_{aw})$
1985–1990	11.5	−0.5	−3.7	16.5
	(−4.5)	*(−30.6)*	***(135.1)***	
1990–1995	4.5	−1.0	−7.4	14.0
	(−18.8)	*(−131.8)*	***(250.6)***	
1995–2000	−1.4	0.5	−8.0	6.6
	(−60.2)	***(923.8)***	*(−763.6)*	
2000–2005	−6.3	−6.8	−9.0	10.5
	(128.1)	***(170.0)***	*(−198.1)*	
2005–2010	4.4	−4.8	−0.6	10.4
	(−96.6)	*(−12.8)*	***(209.4)***	

Source: As Table 1.1
Note: As Table 1.1

Table 1.6 Decomposition of the growth of food exports from S. Korea to China. All figures are percentages

		Factor		
	Growth rate of export value	Importance as export market	Importance as export sector	Advantage of total exports toward world
Period	$G(X_{abi})$	$G(X_{abi}/X_{awi})$	$G(X_{awi}/X_{aw})$	$G(X_{aw})$
1985–1990	–	–	–	–
	–	–	–	–
1990–1995	13.4	7.4	−7.4	14.0
	(52.6)	*(−52.6)*	***(99.9)***	
1995–2000	6.4	8.5	−8.0	6.6
	(119.6)	*(−113.1)*	*(93.5)*	
2000–2005	16.4	15.8	−9.0	10.5
	(91.3)	*(−52.3)*	*(61.0)*	
2005–2010	17.1	6.7	−0.6	10.4
	(40.8)	*(−3.9)*	***(63.1)***	

Source: As Table 1.1
Note: As Table 1.1

5.1.3 Food and Agricultural Exports from Korea to Japan and China

Food and agricultural exports from S. Korea to Japan have been falling since 1995, a phenomenon attributed chiefly to the decline in Japan's priority as an importer and the decline in the competitiveness of Korea's food sector in terms of the nation's total exports (Table 1.5). Despite this decline in competitiveness, food and agricultural

Table 1.7 Basic structure of networks

		1985	1990	1995	2000	2005
Distance index	Diameter	3	4	4	4	4
	Average distance	1.605	1.732	1.847	1.842	1.947
Cohesion index	Degree of density	0.432	0.374	0.337	0.326	0.295
	Transitivity	0.602	0.564	0.564	0.507	0.504

Source: Kiminami (2009), Kiminami and Furuzawa (2014)
Notes: Calculated from *Asian International Input–Output Table*, editions for 1985, 1990, 1995, 2000, and 2005, Institute of Developing Economies using the Simple Network Analysis Tool (software)

exports from S. Korea to China have been on the rise, primarily due to the increase in Korea's total exports and the increase in China's priority as an importer (Table 1.6).

According to the above-mentioned analyses, the interdependence of international food and agricultural trade among Japan, China and S. Korea can be summarized as follows. First, since 1985, food and agricultural exports from China to Japan and S. Korea have increased consistently, although this rise was caused by different factors. In the 1990s, both Japan and S. Korea were important export markets for Chinese food and agricultural products. However, their relative importance has fallen after 2000. Second, for Japan and S. Korea, the relative importance of China as an importer is rising whereas the importance of Japan for S. Korea and that of S. Korea for Japan as a food importer are declining. In other words, China's influence in Northeast Asia as a major food consumer, not only as a food supplier, is growing.

5.2 Regional Interdependence in the Agriculture and Food Manufacturing Sectors in Northeast Asia

By using the Asian International Input–Output Table, we take a look at the changes in the network of agricultural and food manufacturing industries from 1985 to 2005 (Table 1.7). The results show that the bonding effect of the whole network is declining, while the average distance increased from 1.605 in 1985 to 1.947 in 2005, and in addition to the degree of density decreased from 0.432 to 0.295.

Furthermore, the change in network centeredness is summarized in Table 1.8. First, the centrality of the food manufacturing industry is higher than that of agriculture as a whole, and a network of agriculture and food manufacture centering on Japan was formed during the period of 1985–1990, and continued until 2000. However, the centrality of China's food manufacturing industry (AC008) grew from 2000 to 2005. The changes in the centrality of networks are considered as a reflection of the following three transactions: (i) intermediate inputs from Malaysia's agricultural sector to China's food manufacturing sector (from AM001–003 to AC008); (ii) intermediate inputs from Thailand's agricultural sector to China's food manufacturing sector (from AT001–003 to AC008); and (iii) intermediate inputs from China's food manufacturing sector to the U.S. food manufacturing sector (from AC008 to AU008). Furthermore,

Table 1.8 Centrality of the network

		1985		1990		1995		2000		2005	
		Degree	(Stand.)	Degree	(Stand.)	Degree	(Stand.)	Degree	(Stand.)	Degree	(Stand.)
Indonesia	AI001-003	4	0.211	6	0.316	3	0.158	4	0.211	3	0.158
	AI008	9	0.474	9	0.474	5	0.263	9	0.474	6	0.316
Malaysia	AI001-003	8	0.421	5	0.263	5	0.263	4	0.211	3	0.158
	AI008	12	0.632	7	0.368	10	0.526	10	0.526	7	0.368
Phillipines	AI001-003	5	0.263	3	0.158	2	0.105	3	0.158	4	0.211
	AI008	9	0.474	8	0.421	10	0.526	5	0.263	3	0.158
Singapore	AI001-003	10	0.526	11	0.579	10	0.526	14	0.737	9	0.474
	AI008	14	0.737	13	0.684	13	0.684	12	0.632	12	0.632
Thailand	AI001-003	7	0.368	5	0.263	1	0.053	3	0.158	3	0.158
	AI008	11	0.579	9	0.474	9	0.474	10	0.526	9	0.474
China	AI001-003	3	0.158	2	0.105	2	0.105	2	0.105	1	0.053
	AI008	8	0.421	7	0.368	8	0.421	7	0.368	10	0.526
Taiwan	AI001-003	4	0.211	1	0.053	1	0.053	1	0.053	1	0.053
	AI008	7	0.368	8	0.421	8	0.421	5	0.263	4	0.211
Korea(S.)	AI001-003	1	0.211	1	0.053	1	0.053	1	0.053	2	0.105
	AI008	12	0.632	10	0.526	9	0.474	6	0.316	6	0.316
Japan	AI001-003	2	0.105	2	0.105	2	0.105	2	0.105	4	0.211
	AI008	18	0.947	17	0.895	13	0.684	13	0.684	12	0.632
U.S.A.	AI001-003	5	0.263	5	0.263	6	0.316	4	0.211	2	0.105
	AI008	15	0.789	13	0.684	10	0.526	9	0.474	11	0.579
Centralization			0.573		0.579		0.386		0.456		0.374

Source: As Table 1.7

Notes: "001–003" is an aggregation of "Paddy", "Agricultural products" and "Livestock". "008" indicates "Food, beverages and tobacco". The top three countries/sectors are highlighted for each year

the driving forces of the transactions which strengthened the presence of China's food system in the region are considered to be the early harvest for the agricultural sector in the FTA with ASEAN in 2003 and China's accession to the WTO.[7]

[7] China and ASEAN signed the comprehensive framework agreement in November 2002 and the FTA started in full in July 2005 (ACFTA). In advance of the ACFTA, the customs duty on agricultural products of types 1–8 among the double figure HS codes was reduced to 10 % of the highest tax rate from 1 January 2004, as the early harvest measure. It was agreed to abolish tariffs gradually (Thailand carried this out in October 2003, and the Philippines in January 2006).

See JETRO Business Information Service Division (2012) and Kiminami and Furuzawa (2014) for more details.

6 Ongoing as well as New Challenges

A common thread to the above analytical results has been picked out in this research that the issues of food security are not solely the problems of dealing agricultural and food products among other countries. Moreover, since the type of knowledge, the optimal timing and combination of networks in the clustering change dynamically, the policy design for improving the capability of collaboration among entities and accepting the diversified and pluralistic nature of entities in the network is an urgent necessity for solving the problem of food security in Northeast Asia and realizing a sustainable development of the region as well.

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