Egg production in China

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Abstract

China has been the world's largest producer of eggs for the last 30 years. There have been considerable recent changes in the structure of the egg industry due to rapid economic growth, improved supply chains and favorable prices. The objective of this report is to examine the changes in the egg industry in China with a special focus on the methods used by poultry producers for egg production within the country.

Egg production in China continues to provide the population with a high proportion of their intake of high quality dietary protein. Egg consumption will continue to increase with the rise in the urban population. It is probable that the major increase in demand for eggs will be for out of home consumption and their use in processed food products. Higher levels of production are associated with the spread of intensive systems. The poultry sector is no longer dominated by hundreds of millions of smallholders keeping birds as a sideline activity and many small farmers have ceased production. It is expected that the intensification process will continue to increase. Chinese consumers are becoming more focused on the quality and safety of eggs. Therefore the future developments in the egg production may concentrate on egg quality, safety and traceability of eggs.

Keywords: egg production; laying hen; China

Introduction

China produces more than 40% of all the eggs in the world and its annual production keeps increasing. China is the largest egg producer in the world (Aho, 2002; Magdelaine, 2011). Rapid economic growth, improved supply chains and favourable prices have led to a constant rise in egg consumption. Improving the national food security is a major long-term strategy of the Government and so it has encouraged the development of the laying hen industry within the country (Iddamalgoda *et al*., 2001; Windhorst, 2006). China has a 5000 year history of egg production but, for almost all of this time, this has been achieved by small-scale backyard family units. However, since the 1980s there has been a rapid expansion of the egg production within the country. Early expansion of the egg industry was led by state-run farms, but the private farming sector now dominates this area of poultry production (Yang, 2000). The numbers of large-scale, vertically-integrated, intensive egg production units have increased significantly at the start of the 21st century. However, smaller husbandry systems that are owned and operated by individual farmers continue to represent a significant part of the overall egg output in the country and still play a key role in a large number of people's livelihoods (Yang, 2011).

China is self-sufficient in egg production although a significant proportion of feed ingredients needed for this production is imported. Outbreaks of high pathogenic H5N1 avian influenza virus in China since 2004 have caused serious concern to the laying hen industry and the Chinese Government (Martin *et al*., 2011). The Government has taken measures to improve biosecurity in the nation by, when necessary, prohibiting all live bird markets in the cities and closing many small egg production farms (Tan *et al*., 2013). These regulations have hastened

change in the Chinese egg production industry in the early years of the 21st century.

Egg production in China continues to be the largest in the world but there have been considerable recent changes in the structure of the industry. It is important to not only understand the structure of the current Chinese egg industry but also to understand the changing demand for eggs in the Chinese egg market. The objective of this review is to examine the recent changes in the egg industry in China. A further objective is to understand how the industry manages to supply their eggs to the areas of demand and also to explain the methods used by poultry farmers for egg production within China.

Production and demand for eggs in China

Egg production in China has continued to increase in each of the years since 2000. The average annual growth rate of egg production was approximately 0.6 million tonnes per year from 2000 to 2016 (FAO, 2017). In 2016, the total eggs produced in China reached a peak of 31 million tonnes. All of the increase in hen egg consumption in China has been achieved by increasing the amount of domestic production. China is self-sufficient in shell egg production and has a very small number of imported eggs that is offset by a larger, but still relatively small, net export of eggs (FAO, 2017): In 2013, the quantities of imported and exported eggs were 175 and 100 000 tonnes, respectively. More than 70% of imported eggs are hatching eggs destined for use as breeding stock. The majority of exported shell eggs are sent to Hong Kong (90%) and Macau (10%). Exported eggs account for only 0.5% of the annual domestic production (USDA, 2014).

The egg consumption of the Chinese population has continued to increase in recent years. Eggs contribute approximately 6% of the protein supply in the diets of Chinese citizens. This proportion has increased slowly in recent years, although not at the same rate of increase that

65 has occurred for pig and poultry meat (Figure 1). Meanwhile, the contribution of protein from
66 cereals has markedly decreased. Urban residents eat approximately 70% more eggs than rural
67 residents but this difference is rapidly changing; The greatest increases in egg consumption
68 have been in the population living in rural areas, whereas egg consumption in the urban
69 population has remained approximately stable (Figure 2). Egg consumption in rural families is
70 still much lower than that in urban families (5.9 kg eggs per capita vs. 10.5 kg eggs per capita
71 in 2012), but with the rapid increase in urbanization it is expected that the future demand for
72 eggs will continue to increase (Wang *et al.*, 2015). In 2010, home consumption of eggs
73 accounted for 53% of egg sales with out of home consumption accounting for 28% and 19%
74 further processed egg (Figure 3). Home consumption of shell eggs increased slowly whereas
75 further processed egg consumption more than doubled (144% increase) between 2000 and 2010,
76 and out of home consumption rose by approximately 40% during this time.

77 In the five years since 2012, the annual revenue for the poultry industry has grown at an
78 average rate of 8.7% per annum (NBSC, 2017). Eggs are mostly sold by the farmers to
79 wholesalers. The proportion of eggs sold through supermarkets is increasing, although not at
80 the rate of the wholesale market for eggs. There is an increasing number of small shops or street
81 stalls that sell poultry products and this remains the dominant route for egg sales in the country.

82 The retail egg price is approximately 30-40% greater than the price received by the egg
83 producers. Urban families with high incomes are becoming increasingly concerned about their
84 long-term health and the state of the environment and some are prepared to buy organic or free-
85 range eggs. Speciality eggs are emerging in response to the demand from these affluent urban
86 consumers (Zhang *et al.*, 2016; Godfray *et al.*, 2010). Approximately five percent of eggs are

87 branded and this yields a 2 to 5-fold premium in margin over the generic product (Ke and Han,
88 2007).

89 Egg price has relatively little effect on consumer demand for eggs: The egg market in
90 China is relatively price inelastic and this is particularly the case in urban residents and most
91 profound in those in high income brackets (Table 1) (Ke and Han, 2007). Demand for eggs is
92 more price elastic in rural communities but this is also less evident in high income households
93 with high protein intakes. Low income households have relatively low protein intakes (Popkin
94 and Du, 2003), and at times of high animal protein prices, they would change to buy cheaper
95 alternative foods such as pulses and a higher proportion of grains. The farm price of eggs is
96 therefore highly sensitive to changes in production levels and the supply of eggs. There are
97 seasonal fluctuations in egg price with the lowest prices occurring in late spring and the highest
98 in the autumn (CAAA, 2017) (Li *et al.*, 2010). As discussed in the next section, there is a
99 significant proportion of egg production systems that do not use fully environment-controlled
100 buildings. These systems most probably have large seasonal changes in their egg production
101 from spring to autumn and so have a significant effect on the numbers of eggs that enter the
102 wholesale market at these times. A three year cycle in egg prices is also evident in the Chinese
103 market (Figure 4). Relatively small egg producers tend to have low-cost poultry houses and so
104 have low fixed capital costs for their egg production enterprise. These producers may delay
105 restocking their houses at times of low egg prices and so this results in this cycle of changing
106 egg prices (Gueye, 2009; Zhou and Li, 2012). The decision to

107 Table 1 Income elasticity estimates for eggs for urban and rural households in China, 2005 (Ke
108 and Han, 2007).

Urban households

Income group	lowest	low	Lower middle	Middle	Upper middle	High	Highest
	10%	10%	20%	20%	20%	10%	10%
Egg consumption(kg)	8.3	10.2	11	11.6	11.9	12.5	11.5
Elasticity for eggs	-	0.469	0.158	0.167	0.081	0.213	-2.027

Rural households

Income group	low	Lower middle	Middle	Upper middle	High
	20%	20%	20%	20%	20%
Egg consumption (kg)	2.6	3.7	4.6	5.6	7.3
Elasticity for eggs	-	0.852	0.389	0.372	0.609

restock may also be affected by changes in the costs of production. In the last decade, egg production costs at farm level have generally changed with the change in layer feed prices. Both the production cost and the feed price reached a peak in 2013. Average cost of the egg production was 8.7 Yuan/kg ($1.31 /kg) and the average feed price was 2350 Yuan/ tonne ($352 /tonne) (IEC, 2016). Variation in feed costs remain the major, but not the only, influence on production costs.

In conclusion, the egg production continues to provide the population with a high

proportion of their intake of high quality dietary protein. Egg consumption will continue to increase with the rise in the urban population. It is probable that the major increase in demand for eggs will be for out of home consumption and their use in further-processed food products.

Structure of industry

Egg production in China has grown steadily over recent years and there was a 24% increase in production in the ten years from 2006 to 2015. Eggs are produced in all provinces of China but now production is concentrating in a relatively few provinces (Figure 5). Ten Chinese provinces produces 80% of the national eggs. In order to meet the consumer's demands in the whole nation there is a substantial movement of eggs around the country. Eggs are transported from North and Northeast China to Southeast and South China as well as into big cities like Beijing, Tianjin and Shanghai. The province of Guangdong, in the south of China, has the largest gap between supply and demand with an inflow of 2 million tonnes each year, followed by Shanghai (0.75 million tonnes), Zhejiang (0.7 million tonnes) and Beijing (0.6 million tonnes) (Table 2). The concentration of egg production in the North and North-East of China is probably mostly due to the availability of locally produced cereals as well as good access to ports for imported feedstuffs. Recent major improvements in the transport infrastructure by the Chinese Government have facilitated this centralization in the egg production industry (Démurger, 2001).

Table 2 Net egg flows (million tonnes/ year) and resident population (year-end) (10 000 residents) of each province in China in 2015 (Adapted from China Animal Agriculture Association, 2017 and National Bureau of Statistics of China, 2017).

Province	Egg flows (million tonnes/ year)	The population (million)
Hebei	1.8	74.3
Henan	1.7	94.8
Liaoning	1.5	43.8
Shandong	1.0	98.5
Jilin	0.5	27.5
Hubei	0.4	58.5
Heilongjiang	0.4	38.1
Sichuan	0.3	82.0
Inner Mongolia	0.3	25.1
Shaanxi	0.1	37.9
Ningxia	0.1	6.7
Xinjiang	0.1	23.6
Tibet	0.1	3.2
Hunan	0.1	67.8
Qinghai	0.1	5.9
Hainan	0.1	9.1
Shanxi	0.1	45.7
Jiangsu	0.1	79.8
Gansu	-0.08	26.0
Guizhou	-0.1	35.3
Anhui	-0.15	61.4
Yunnan	-0.2	47.4
Chongqing	-0.23	30.2
Guangxi	-0.25	48.0
Jiangxi	-0.3	45.7
Tianjin	-0.4	15.5
Fujian	-0.55	38.4
Beijing	-0.6	21.7

Zhejiang	-0.7	55.4
Shanghai	-0.75	24.2
Guangdong	-2.0	108.5

*Positive number represents the quantity of the exported eggs to other provinces; Negative number represents the quantity of the imported eggs to the province.

Henan, Shangdong, Hebei, Liaoning, Sichuan and Jiangsu, the six largest egg-producing provinces, accounted for nearly 61% of the total production of the country (NBSC, 2017). Most of these provinces have increased their egg production in recent years, except for Hebei. The reduction in egg production in Hebei may be due to the relatively large number of small egg producers in this province that may be ceasing production due to Government legislation, the poorer viability of relatively small-scale production methods and the availability to them of other employment opportunities in the nearby, rapidly developing, urban areas (Li *et al*., 2010).

Intensification of egg production has occurred throughout the country. In 2008, 43% of all eggs produced were from flocks with sizes less than 2000 hens, but in 2014 this size of egg producer only supplied 4% of the total eggs produced in China (Table 3). Large numbers of relatively small independent egg producers still exist and, in 2014, over 50% of all eggs produced were from flock sizes of less than 10 000 hens. However, large integrated companies have also been established and many of these manage large operations. The top six largest egg producers (Beijing Huadu Yukou Poultry Company, Beijing Pinggu Charoen Pokphand, Beijing Deqingyuan Poultry Company, Anhui Rong Da and Shanxi Dajiang Nongke) have flock sizes of more than 5 million laying hens. Such companies are mostly vertically integrated and manage the bird husbandry, feed milling, transport and distribution of the eggs. The recent increases in

the average size of Chinese egg production units are similar to the way which the egg production industries of developed countries, such as European Union and United States, changed in previous years (Mench *et al*., 2011).

Table 3 Size of laying hen units and their contribution to the proportion of total eggs produced in China in 2008 and 2014 (Adapted from China Animal Agriculture Association, 2016)

Size of production unit (Number of hens)	Contribution to total egg production in 2008 (%)	Contribution to total egg production in 2014 (%)
<2 000	43.6	3.5
2 000~4 999	16.0	27.5
5 000~9 000	18.0	25.9
10 000~50 000	17.0	34.9
50 000~100 000	2.9	5.7
100 000~500 000	2.5	2.5

Management methods

Eggs are primarily produced in cage systems regardless of the size of the enterprise. Ninety percent of eggs are produced from cage systems with 9% in free-range systems and 1% in barn systems (IEC, 2016). Large, modern egg production farms increasingly use environment-controlled buildings in which cages incorporate automatic feed delivery and automatic egg collection equipment (Table 4). Recently built egg production farms are typically on sites with up to half a million hens. There are only a few sites that have more than a million birds.

Small egg production farms (less than 10 000 hens) typically use houses, such as polythene

tunnels, old greenhouses, or other farm buildings, that have little, or poor, environmental control. The tiered cages that are installed in these buildings often have little automation and so feed is delivered by hand and eggs are collected manually (Table 4). This type of production requires a high labour input and this is mostly provided by farmers who are keeping birds as a sideline activity. However less people now like to work in the rural countryside an there are better employment opportunities in urban areas. Many small farmers have given up production.

There has been growth in the free-range and organic chicken production segments over the past five years, but these account for a very small number of chickens farmed. However this is slowly shifting as Chinese consumers are now increasingly willing to buy cage-free eggs (Wang *et al*., 2017; Rakonjac *et al*., 2014; Zhang *et al*., 2016).

Laying hen strains that produce brown shelled eggs are the predominant stock used in the Chinese industry. Approximately 70% of eggs sold are brown shelled (IEC, 2017). Hyline supplies 77% of all the laying stock (brown shelled eggs) whereas a Chinese breeding company, Jinghong and Jingfen, supply 12% of the birds (tinted brown shells) (NBSC, 2017). The remaining 11% of laying stock are supplied by Lohmann (brown shelled eggs), Nongda (white shelled eggs) and there are some traditional breeding companies that produce stock that lay green shelled eggs.

193 Table 4 Management methods in different scale farms (Yang *et al*., 2014).

Number of hens/ farm	Percent in tiered cages	Drinker type		Feeding type		Egg collection	
		Water trough	Nipple or cup drinker	Manual feeding	Automated feeding	Manual egg collection	Automated egg collection
<2 000	92.5	22.2	77.8	98.5	1.5	99.5	0.5
2 000~4 999	87.2	15.1	84.9	96.9	3.1	99.7	0.3
5 000~9 000	87.7	11.1	88.9	88.9	11.1	99.4	0.6
10 000~50 000	92.9	8.6	91.4	61.6	38.4	96.1	3.9
50 000~100 000	91.4	2.3	97.7	31.8	68.2	88.1	11.9
100 000~500 000	95.2	10.0	90.0	15.1	84.9	77.8	22.2

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There are no formal regulations for stocking densities in laying hen units, so farmers tend to stock to the economic optimum. Most large integrated companies keep flocks for a 60 to 70 weeks laying period whereas small independent producers may use extended laying periods depending on the market conditions that prevail.

Conclusions

Egg production continues to provide the population with a high proportion of their intake of high quality dietary protein. Egg consumption will continue to increase with the rise in the urban population. It is probable that the major increase in demand for eggs will be for out of home consumption and their use in further-processed food products. The poultry sector is no longer dominated by hundreds of millions of smallholders keeping birds as a sideline activity. Many small farmers have given up production, especially in the economically more developed eastern provinces of the country. In the future, it is expected that the intensification process will continue. Small-scale and non-commercial farmers will continue their exit from the industry. It is possible that the number of poultry farmers in China could halve by 2020. The egg production is concentrated in some regions of China and there is a logistical network evolving that distributes the eggs to the consumer. Chinese consumers are becoming more focused on the quality and safety of eggs. Therefore the future developments in the egg production market may concentrate on egg quality, safety and traceability of eggs.

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Figure 1 The contribution of different human foods to the total protein supply in China (Adapted from FAO, 2017).

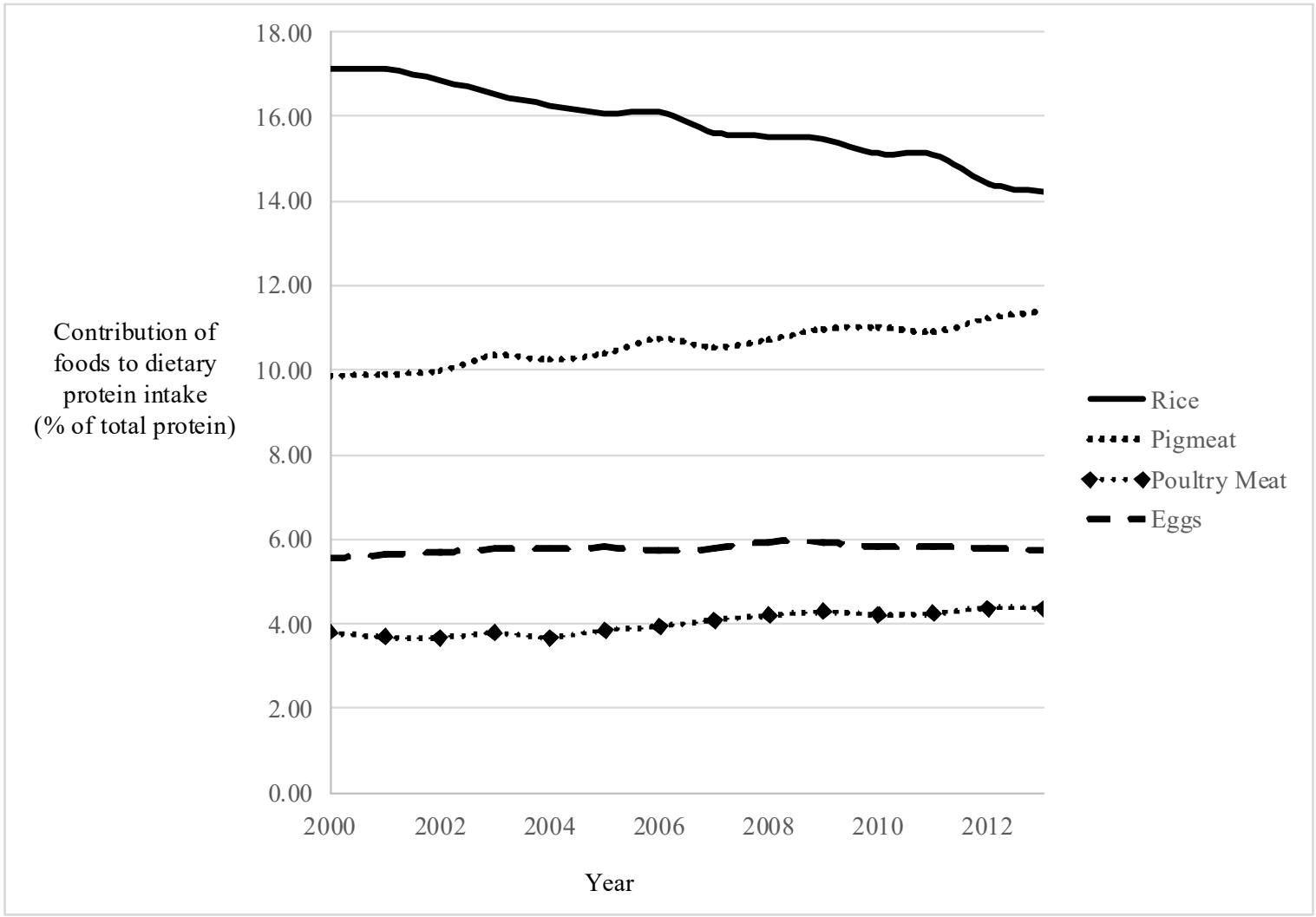


Figure 2 Egg consumption of urban and rural people in China (Adapted from National Bureau of Statistics of China, 2017).

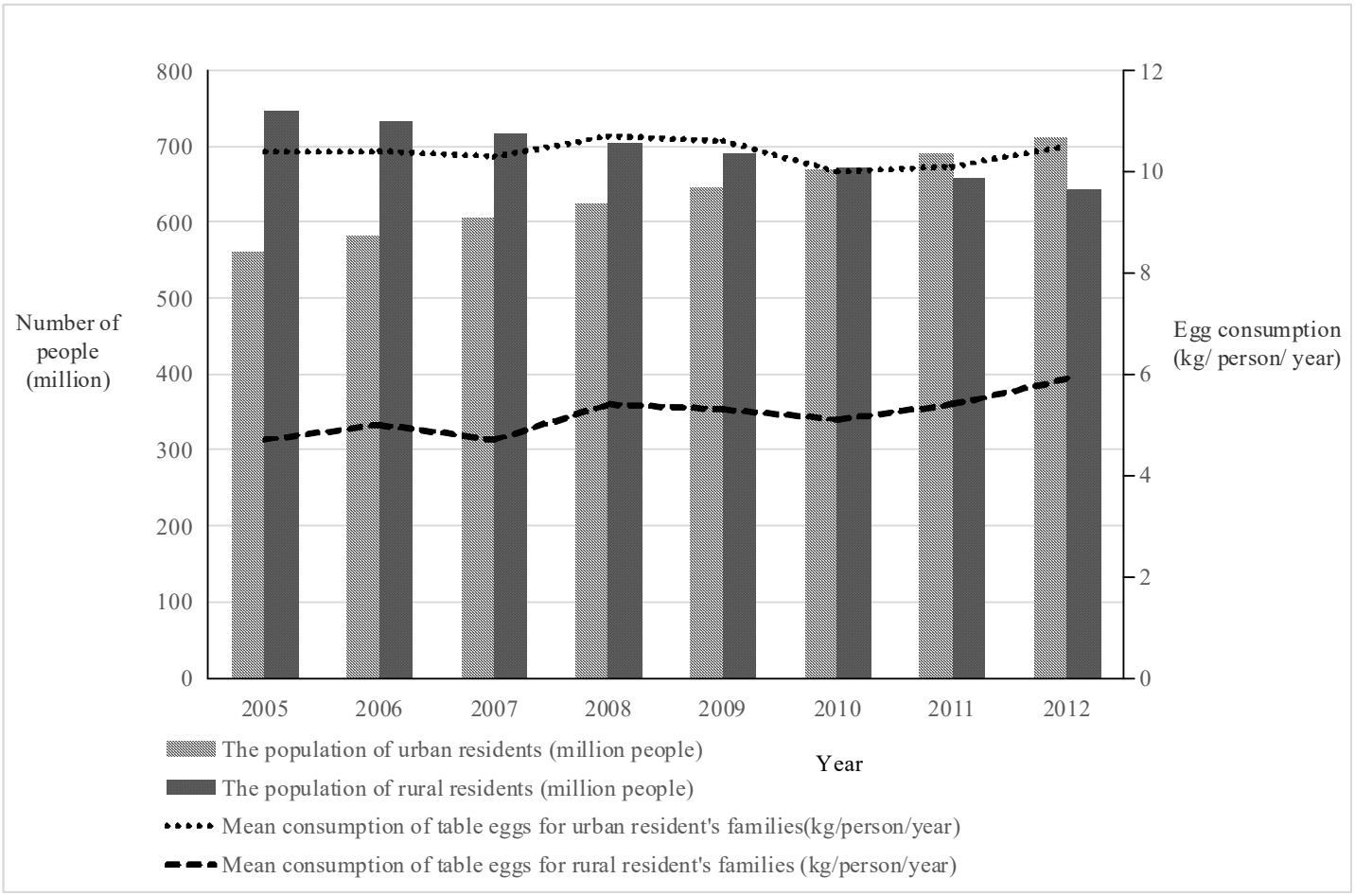


Figure 3 Egg consumption in China from 2000 to 2010 (Adapted from National Bureau of Statistics of China, 2017).

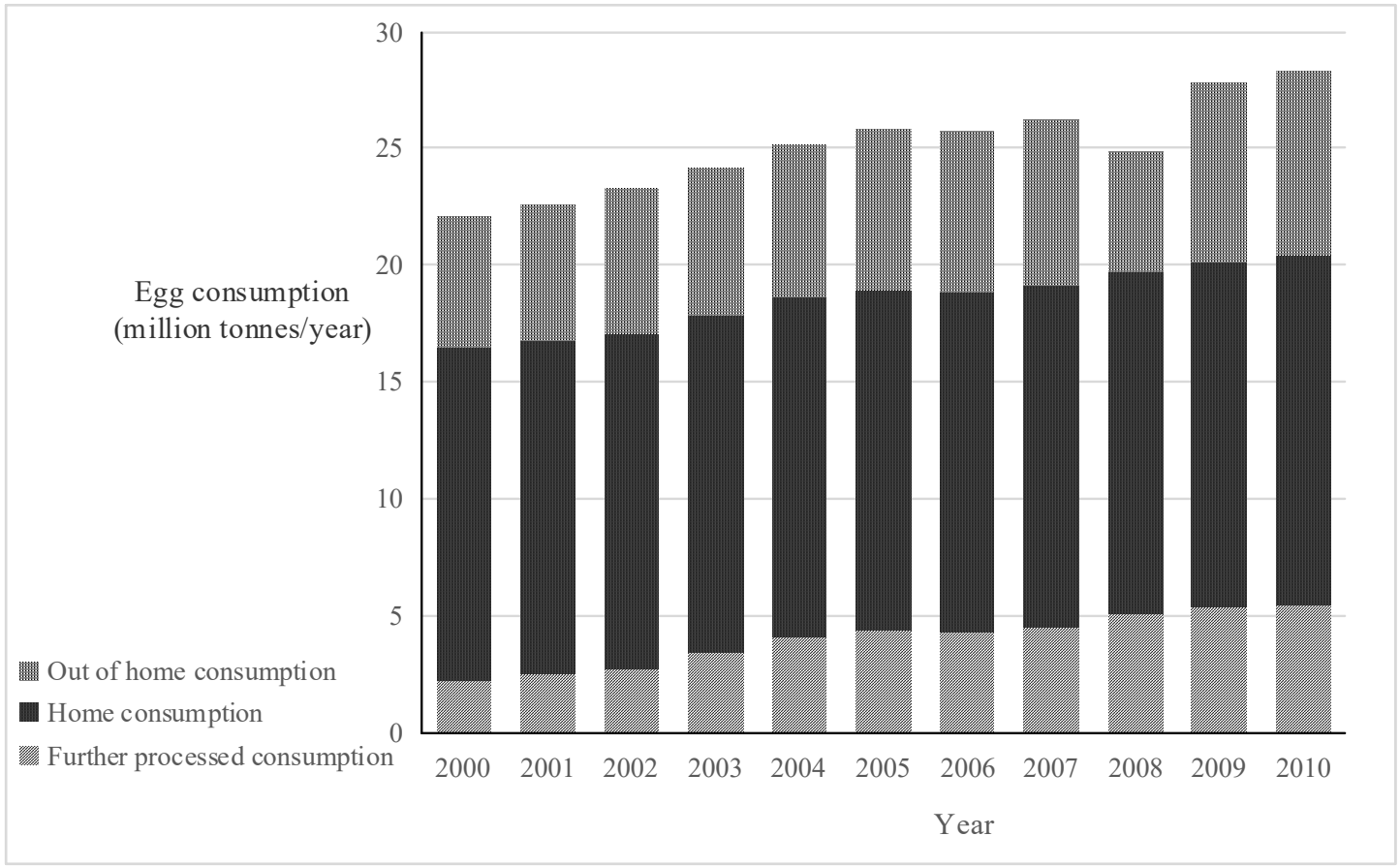
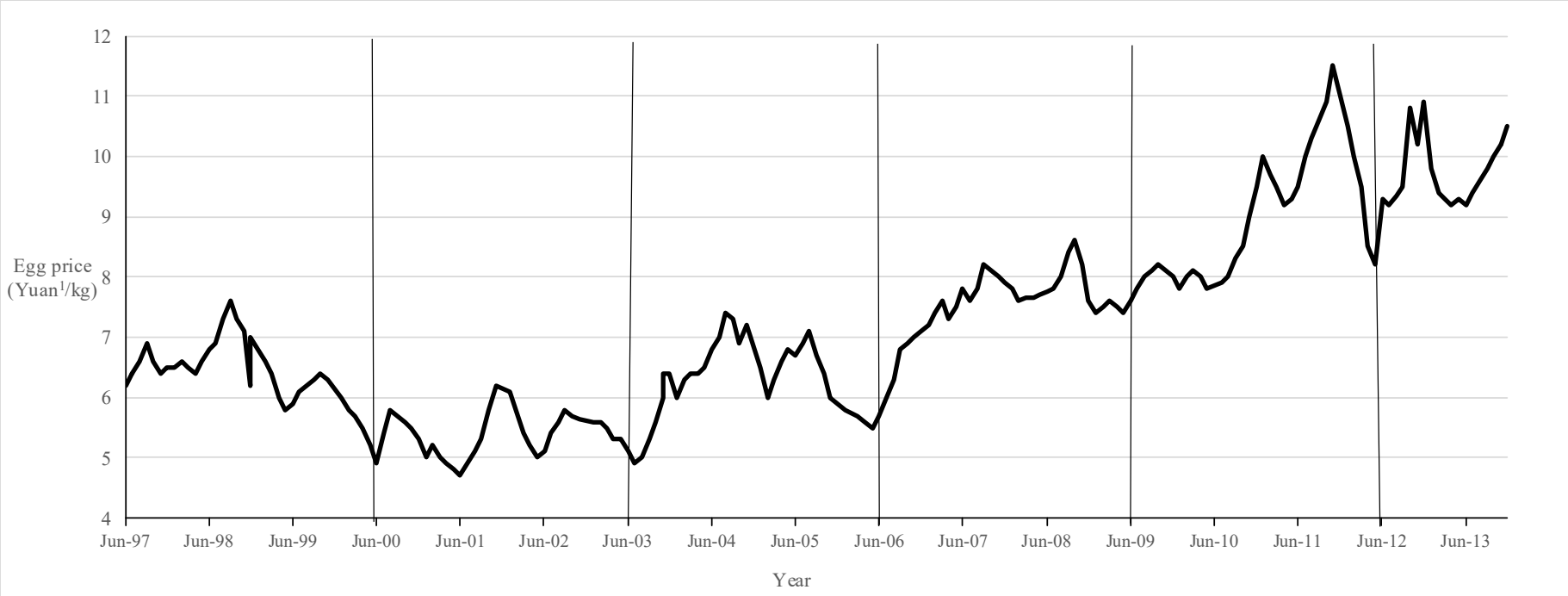


Figure 4 Annual trend of egg price in China from 1997 to 2013 (Yuan[1]/kg) (Adapted from China Animal Agriculture Association, 2017).



[1]Currency conversion used: One Chinese Yuan =0.15 US$

[2]Vertical lines indicate the duration of egg price cycle.

Figure 5 The output of poultry eggs (million tonnes per year) and the resident population (year-end) of China in 2015 (Adapted from National Bureau of Statistics of China, 2017).