



Chicken by the Sea: The Differential Impact of Ecology and Socio-Economics on the Evolution of Value Chains for Chicken in Japan and Peru

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ABSTRACT

Chicken demand and supply has increased in many developing countries in the last few decades. Peru is one of those countries. When we analyze the increase in Peru since the 1990s, compared with the case of Japan between the 1960s and 1980s in which demand and supply also increased, we find common factors such as the development of intensive agriculture that depends on imported feed grains. However, because of several distinguishing ecological and socio-economic factors, the development of the value chain for chicken in Peru has been different from Japan, especially in the integration of further food processing and handling in chain activities.

Keywords: Broilers, Integration, Processing, Relative Prices, Economic Growth

INTRODUCTION

Economic growth, if not development, is often associated with changes in food consumption patterns. At the most basic level, as incomes improve, poor consumers typically increase their total food consumption as well as diversify what they eat. In many developing countries, this pattern translates into a shift away from a strictly plant-based, subsistence diet to one in which consuming meat and purchasing animal-based products assume greater importance. Often, these changes in food consumption patterns have important implications for nutrition levels as well. Furthermore, these shifts in consumption and nutrition frequently result from or are accompanied by demographic changes such as migration from the countryside to the city or from the highlands to the lowlands.

Previous research has often focused on the drivers behind the shifts in income that catalyzed the evolution of dietary patterns noting the relative influence of increased income on the in-take of different livestock products (Alexandratos, 2008; Delgado *et al.*, 1999; Pingali, 2006). Alternatively, studies have examined the ecological dimension of shifting cropping patterns affected by the changing composition of food demand, or how changes in internal migration contribute to changes in eating habits (Escobal and Caverro, 2012; Rose *et al.*, 2009; Scott, 2011; Scott and Suarez, 2012). Given the importance of

meat and animal products as a component of changes in food consumption and nutrition across the world, this paper compares and contrasts the role of ecology and other socio-economic factors in the experience of a developed country and a developing country and the evolution of their respective value chains for chicken.

The paper first analyzes the evolution of chicken consumption in Japan and Peru over the last several decades in response to economic growth. After noting the remarkable increase in chicken consumption in both countries and the socio-economic factors contributing to these trends, the paper then looks at the role of ecology in animal production—contrasting its powerful influence on the supply chain for chicken in Peru with that of a more subtle, but equally profound, effect on a very different experience in Japan. The paper concludes by summarizing these various considerations as a prelude to presenting different scenarios for chicken consumption and production in the two countries in the years ahead.

MATERIAL AND METHODS

This paper utilizes a value chain framework to analyze the increase in chicken consumption and production in Japan and Peru (Chitundu *et al.* 2009; GTZ, 2007). In that sense, it first focuses on the linkages between changes in consumption and

production over time, and the magnitude and tendency of those changes. It subsequently analyzes how different participants in the value chain: producers, processors, wholesalers, retailers, and consumers modified their behavior to bring this about; and, more importantly how those shifts in established practices or patterns were in turn influenced or were affected by ecological and socio-economic factors as well.

The paper utilizes production and food supply data from the Statistics Division of the Food and Agriculture Organization of the United Nations (FAOSTAT data) to compare trends in output and utilization for chicken. It also employs data on production and consumption of chicken from Peru's Ministry of Agriculture (Ministerio de Agricultura: Minag) to complement the analysis of FAOSTAT data. To examine relative price changes among various types of animal protein, it also uses data from the Statistics Bureau of the Ministry of Internal Affairs and Communications of Japan (SBMIAC) and Peru's National Institute of Statistics and Information (Instituto Nacional de Estadística e Informática: INEI).

Regarding the influence of ecology on chicken production, the study of the Japanese case is mainly

based on a concise synthesis of Japanese literature. The Peruvian case is based on interviews with managers at Peruvian broiler companies and visits to production installations during July and August 2007 and 2008 (Shimizu, 2011).

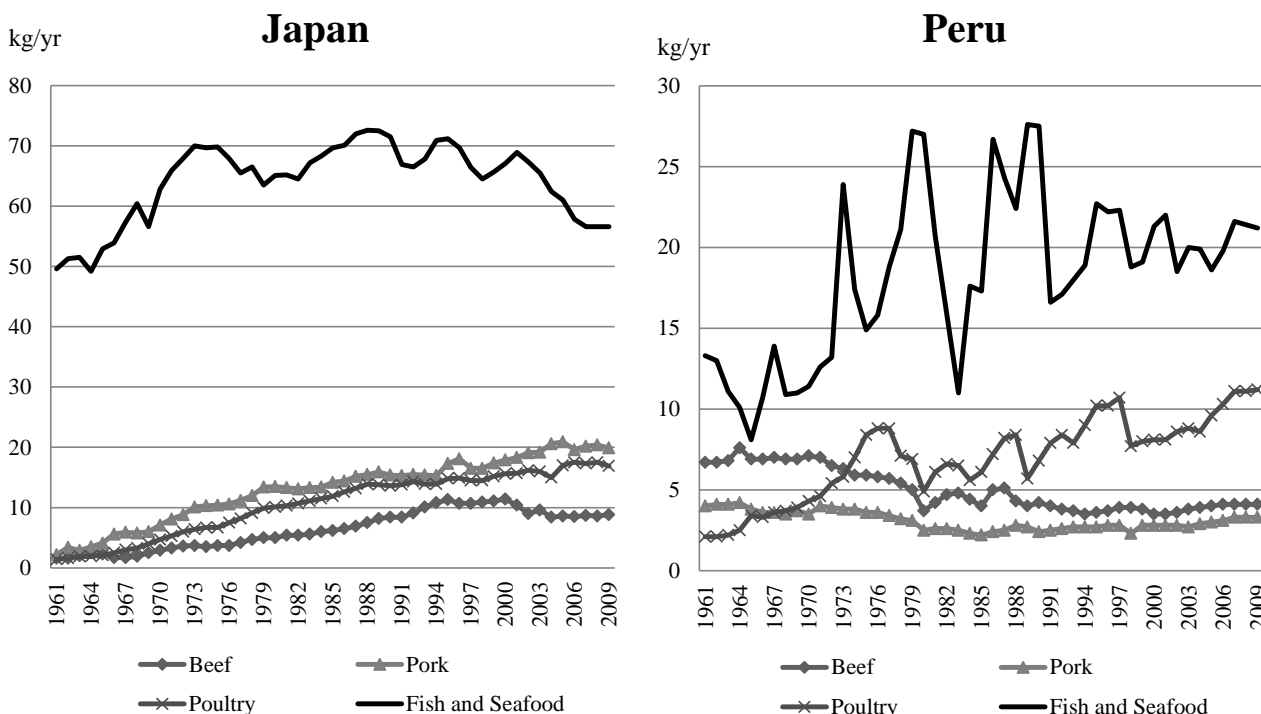
Our analysis of the integration of the value chain is based on an examination of the shifting relationship among the people engaged in producing, processing, marketing, and consuming chicken.

RESULTS AND DISCUSSION

Evolution of chicken consumption

Because Japan and Peru have long coastlines and rich fishing grounds, fish and seafood have long been an important part of their respective diets (Figure 1). In both countries, people still consume far more fish and seafood than any single type of meat (Table 1). However, although the annual per-capita consumption of fish and seafood has decreased slightly or remained steady over the last decade, that of poultry has increased steadily. In the following sections, we explain the evolution of chicken consumption in Japan and Peru.

Figure 1: Average per capita consumption of fish and meat in Japan and Peru, 1969-2009.



Source: FAOSTAT data.

The changes in consumption in Japan

In Japan, chicken consumption has increased from 4.0 kg per capita in 1969 to 16.9 kg in 2009 (Table 1), while consumption of fish and seafood, the major protein source for Japanese, has not changed much. Today, chicken is the most important source of animal protein from meat. Rapid economic development accompanied by the Westernization of the Japanese diet and a decrease in the relative price of chicken have been and remain the main factors influencing increased chicken consumption in Japan.

The Japanese economy grew rapidly during the 1960s until the end of the 1980s. Japan's current gross domestic product (GDP) per capita increased from US\$1,669 in 1969 to US\$24,506 in 1989 as Japan reemerged as a major global economic power (Table 1). Over this same period, the Japanese diet became more westernized. Meat became more prominent and plant-based foods declined in importance in the average diet. For example, according to FAOSTAT data, the consumption of rice, a Japanese staple, dropped dramatically from 92.9 to 65.5 kg/yr from 1969 to 1989

while meat consumption more than doubled from 15.8 kg to 38.8 kg (Table 1). As a result, Japanese daily protein supply per capita increased by more than 20%. The main source of protein changed from vegetable products to animal products (Table 1).

In Japan increased in-take of animal products largely consisted of increased consumption of chicken (Table 1). One reason for this increase has been the

shift in relative prices. The price of beef and pork increased rapidly during the 1970s and 1980s. For example, between 1969 and 1989, the price of beef and pork increased by 290% and 170%, respectively, while that of chicken increased by only 40% (SBMIAC website). As a result, chicken became the cheapest source of meat-derived protein.

Table 1: GDP per capita and diets in Japan and Peru in 1969, 1989 and 2009

	Japan			Peru		
	1969	1989	2009	1969	1989	2009
GDP per capita (current US\$)	1,669	24,506	39,473	487	969	4,412
Food Supply (kg/capita/year)	1969	1989	2009	1969	1989	2009
Cereal	146.4	132.2	114.7	93.4	107.0	127.9
Rice	92.9	65.5	54.0	31.2	42.3	48.7
Wheat	41.1	44.2	48.0	51.4	47.6	54.8
Meat	15.8	38.8	45.9	21.0	15.1	20.8
Beef	2.5	8.2	8.8	6.9	4.0	4.1
Pork	6.0	15.9	19.9	3.7	2.7	3.3
Chicken	4.0	13.8	16.9	3.9	5.7	11.2
Fish and Seafood	56.6	72.5	56.6	11.0	27.6	21.2
Food supply quantity (kcal/capita/day)	1969	1989	2009	1969	1989	2009
Total	2697	2966	2723	2313	2183	2563
Vegetable	2289	2345	2158	2057	1866	2281
Animal products	408	621	566	256	317	283
Protein supply quantity (g/capita/day)	1969	1989	2009	1969	1989	2009
Total	81.2	98.1	89.6	57.6	53.9	71.2
Vegetable	46.5	42.3	39.0	37.1	33.7	46.2
Animal products	34.7	55.8	50.6	20.5	20.3	25.0
Meat	5.3	12.6	15.0	9.7	7.5	10.2
Beef	0.9	3.2	3.5	4.1	2.4	2.4
Pork	1.6	4.4	5.4	1.0	1.1	1.3
Poultry	1.4	4.6	6.0	2.0	2.8	5.6
Fish and Seafood	19.0	27.6	20.8	3.0	6.4	5.6
% of total protein supply	1969	1989	2009	1969	1989	2009
Vegetable products	57%	43%	44%	64%	63%	65%
Animal products	43%	57%	56%	36%	38%	35%
Meat	7%	13%	17%	17%	14%	14%
Beef	1%	3%	4%	7%	4%	3%
Pork	2%	4%	6%	2%	2%	2%
Poultry	2%	5%	7%	3%	5%	8%
Fish and Seafood	23%	28%	23%	5%	12%	8%

Source: FAOSTAT data. GDP per capita is from World Bank, World Development Indicators.

During the 1970s and 1980s, the price of fish also increased significantly compared with chicken. As the annual catch of horse mackerel, one of the most popular fish species in Japan, imploded from 560,000 metric tons (mt) in 1965 to 150,000 mt in 1980, the price jumped to 15 times its previous level. In the case of tuna, an expensive fish for Japanese, the decline in the yearly catch was more modest: from 430,000 mt to 380,000 mt. Nonetheless, the retail price of tuna increased by more than five-fold during the same period (SBMIAC website).

A key factor keeping the price of chicken low in Japan has been improved production efficiency. The feed conversion ratio, i.e. the amount of feed needed to produce one unit of meat, steadily declined over the years in Japan, from 2.34 in 1965 to 2.10 in 1983, and then to 1.91 in 2004 (Nobunkyo, 2009; MAFF, 2006).

The relatively low price of chicken helped popularize chicken-based dishes such as *karaage* (Japanese-style fried chicken) and *yakitori* (grilled chicken on a skewer) among Japanese consumers. In addition, the food service industry (catering companies, restaurants, hotels, ready-made meal companies) chose chicken as an ingredient for processed food products because it was a less expensive source of raw material than other types of meat.

The changes in consumption in Peru

In Peru, average per capita chicken consumption also increased, particularly since the early 1990s. As economic growth gradually increased, real income levels slowly recovered (de Althaus, 2007; Jaramillo and Silva-Jáuregui, 2011) thereby increasing food demand. These trends combined with internal migration and changes in consumer eating habits (e.g. a trend towards eating out more) have played important roles in increasing chicken consumption (Scott, 2011; Scott and Zelada, 2011).

After the hyperinflation and economic crisis at the end of the 1980s, the Peruvian economic recovery took off in the 1990s. Strong growth continued well into the 2000s. As a result, per-capita GDP in Peru increased from US\$969 in 1989 to \$4,412 in 2009. During this period, the per-capita supply of cereals increased by 20%. In addition to potato and wheat, rice became an important part of the Peruvian diet (Table 1).

Due to the economic crisis at the end of the 1980s, per-capita meat consumption decreased from 21.0 kg in 1969 to 15.1 kg in 1989, and then recovered to 20.8 kg in 2009. Although the level of meat consumption in 1969 and 2009 is similar, the composition is quite different. Beef was the most popular meat in 1969; however, it was replaced by chicken in 2009, with per-capita consumption of 11.2 kg (Table 1), although some sources put this figure at twice that level or more.* Chicken consumption in Peru is still relatively low compared with other countries in

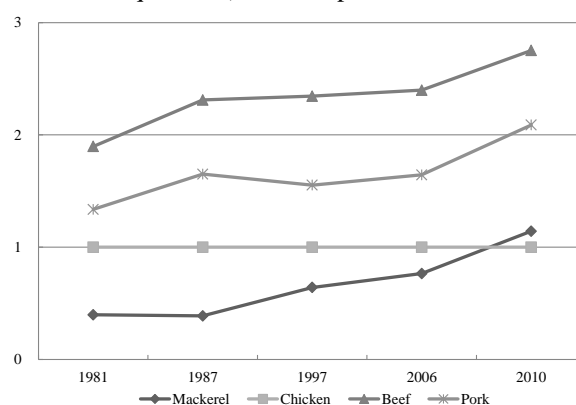
* There is an important discrepancy in the per-capita chicken consumption data figures between the Food Balance Sheet (11 kg in 2007, Minag, 2008: 98) and the poultry industry report (27.1 kg in 2007, Minag, 2011: 116). See the Appendix below for details.

South America. Annual per-capita consumption of chicken exceeds 30 kg in Argentina, Brazil, Chile, and Venezuela. In Colombia and Ecuador, which have similar levels of per-capita GDP as Peru, per-capita consumption is 23 kg (FAOSTAT data).

An important driver of the recent increase in chicken consumption in Peru has been its low price relative to other sources of animal protein. Chicken is cheaper than beef and pork, and has been getting cheaper over the last several decades (Figure 2).

Improved production efficiency has been a key factor behind this trend. According to Peru's Ministry of Agriculture, the number of days necessary for broilers to reach 2 kg decreased from 70 in 1960 to 38 days in 1999 (Minag website).

Figure 2: Relative retail prices for animal protein (fresh equivalent) in Metropolitan Lima.



Source: INEI Boletín Anual: Indicadores de precios de la economía, various years.

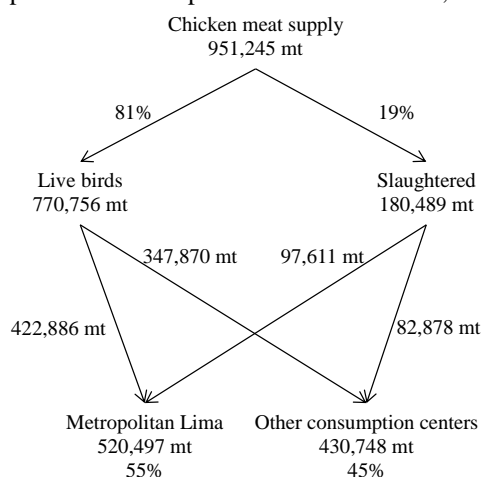
In recent years, chicken has also become cheaper than mackerel, a fish popular among Peruvian consumers. This can be attributed largely to the precipitous drop in the mackerel catch in recent years. As high as 724,000 mt in 2001, the catch shrank in the following years to reach less than 20,000 mt in 2010 (INEI series nacionales). As a result, the retail price of mackerel that was between S/.3.00 and S/.4.00 per kg at the end of the 1990s rose to more than S/.6.00 per kg by 2010. Moreover, as of December 2010, consumer prices for various types of meat and fish in the Metropolitan Lima area were S/.16.84/kg for beef, S/.12.78/kg for pork, S/.6.99/kg for mackerel, and S/.6.12/kg for a whole chicken. Although the mackerel catch recovered to 135,000 mt in 2011, the retail price of mackerel decreased only slightly to S/.6.30/kg by the middle of 2011 (Instituto Cuánto, 2011; INEI, various years; US\$1.00 = S/.2.82).

Other factors influencing increased chicken consumption in Peru have been internal migration and the concentration of the population in coastal cities, especially the Metropolitan Lima area. The percentage of the population living on the coast increased from 49.8% in 1981 to 54.6% in 2007. In absolute terms, the population in the coastal region increased by almost 6.5 million during the period while the mountain and jungle regions increased around 2 million each. Among the cities in the coastal region, the Metropolitan Lima area is the most heavily populated. According to census data, Lima's population increased from 4,573,000 in

1981 (26.9% of the total population) to 8,473,000 in 2007 (30.9%) (INEI, 2009).

Internal migration induced increased chicken consumption partly because most large-scale commercial chicken production takes place in the coastal region. Lower transport costs help keep down the retail price as well as facilitate the continuous sale of fresh product. Hence, Metropolitan Lima is not only home to 30% of the national population, 55% of the broilers produced in the country are sold there as well (Figure 3). Per-capita consumption by Lima residents in 2010 was an estimated 59.1 kg, which is almost twice the national average of 32.3 kg (MINAG, 2011).[†]

Figure 3: Estimated volumes of chicken sales by consumption center and product channel in Peru, 2010¹.



Source: Elaborated based on Minag (2011).

¹Volumes of live bird sales were all converted to carcass weight equivalents.

In addition, a change in consumer preferences also helped spur increases in chicken consumption. In Peru, one of the most popular dishes for eating out is *pollo a la brasa* or spit-roasted chicken. Broilers weighing less than 2 kg are used. A whole broiler is marinated and then roasted in a special oven in which the broilers rotate over charcoal. This dish was reportedly invented in the 1950s at a restaurant outside Lima, and has become the most popular dish at restaurants among residents in Lima, the capital city, and increasingly in the provincial cities as well (Scott and Ocampo, 2013). A restaurant that specializes in serving this dish is called a *polleria*. The number of *pollerias* in Peru is estimated at around 4,300, out of which 1,800 are in Lima (*El Comercio*, July 10, 2012: B10). According to a chicken industry expert, around 40% of the chicken sold in Peru is used for this dish (*El Comercio*, June 22, 2012: 8). In 2010, the Peruvian government declared the third Sunday in July as the day for *pollo a la brasa*. Today, it is a signature dish that represents Peruvian gastronomy. Significantly, a recent marketing survey found that *pollo a la brasa* had replaced *ceviche* - a plate of raw fish marinated in lime juice and spices, as the favorite dish among Peruvian consumers (Bendezu *et al.*, 2010).

[†] Please see the Appendix for estimates of per-capita consumption.

Role of ecology and socio-economic factors

Responding to the increased chicken demand, the value chains for supplying chicken developed in Japan and Peru. We focus on the period between the 1960s and 1980s for Japan and since the 1990s for Peru, when the chicken supply increased rapidly.

As shown in Figure 4 (left), domestic production of chicken expanded rapidly during the 1970s and 1980s. It increased from 490,000 mt in 1970s to 1,128,000 mt in 1980, and peaked at 1,445,000 mt in 1988. After that, Japan started to import chicken from such countries as the United States, Thailand, China, and later from Brazil to help complement domestic production and satisfy growing internal demand. Since the 2000s, around 40% of the chicken consumed in Japan is imported. Although chicken produced in Japan is sold as fresh table meat for home consumption, imported chicken is used in two ways. One is frozen chicken meat mainly imported from Brazil and the United States. Most of that type of chicken is used as raw material by the food processing and food service industries. The other is processed or semi-cooked products such as *karaage* and *yakitori*. These products are imported from Thailand and China, where labor costs are lower.

Meanwhile, in Peru, chicken production has been increasing rapidly since the 1990s (Figure 4, right). The annual supply of chicken increased from 246,000 mt in 1990 to 1,020,000 mt in 2010. Peru did import some frozen chicken when there was a supply shortage in the 1980s. However, consumers never liked frozen chicken, and the country has remained nearly self-sufficient since then (Shimizu, 2011).

Development of intensive livestock production

During the development of the chicken industry, ecology has also played an important role in Japan and Peru. Although the limited availability of agricultural land prompted the development of intensive livestock production that depended on imported grains in both countries, different ecological conditions led to differences in production zones and differences in the integration of their respective value chains.

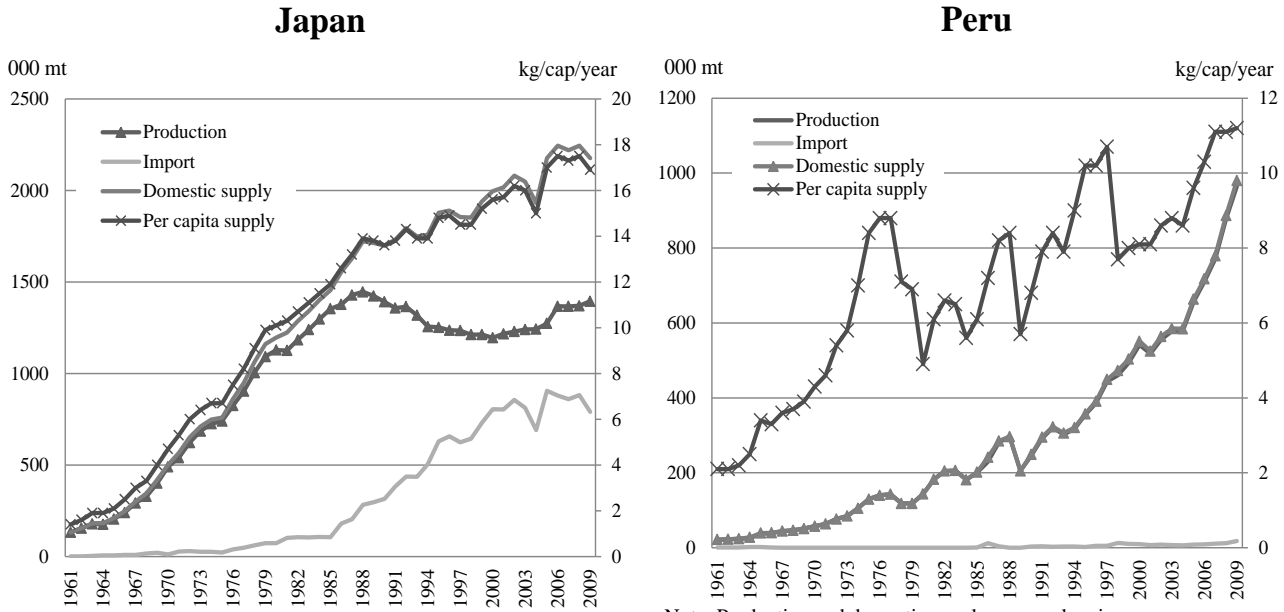
According to FAOSTAT data, the agricultural area per agricultural population (economically active population in agriculture) in 2009 was 3.0 hectares (ha) for Japan and 5.8 ha for Peru while the number for other major countries in the Americas, such as Brazil, Argentina, and the United States was 24.1, 101.4, and 160.0 ha, respectively. Neither Japan nor Peru has a comparative advantage in extensive agriculture such as the cultivation of feed grains or free range livestock production, in which economies of scale work.

Therefore, Japan and Peru developed input-intensive chicken production based on feed grains imported from other countries. Almost 100% of the maize for feed grains in Japan is imported. In recent years, Japan imported around 16 million mt of maize annually, out of which 12 million mt was for feed production. By way of contrast, Peru produces 1.5 million mt of feed grain annually and imports roughly an equal amount -- three-quarters of which goes for feed. This dependence has not changed much

throughout the development of the broiler industry in

Japan and Peru (figures are based on FAOSTAT data).

Figure 4: Poultry meat supply in Japan and Peru, 1961-2009.



Source: FAOSTAT Data.

Note: Production and domestic supply are overlapping.
Source: FAOSTAT Data.

Location of production

Although Japan and Peru have developed chicken industries based on imported feed grains, the location of the production varies in each country. In Japan, chicken production has relocated far away from major cities. In Peru, production operations are still fairly close to major consumption centers such as Lima.

The development of the Japanese chicken industry can be divided into three stages (Nobun-kyo, 2006; Yoshida, 1980). In the first stage, until large-scale chicken production started in the 1960s, many farmers raised chickens on the outskirts of major cities. Chicken production was a part of farm production that used residues from farmers’ fields for feed. In the second stage, after new breeds were introduced from abroad during the 1960s, the scale of chicken production increased, coinciding with the rapid growth of the Japanese economy and urbanization. Therefore, the principal centers of production moved away from cities to less populated areas.

In the third stage, starting in the 1980s, broiler production moved further away from major cities to rural areas, on southern Kyushu (the southernmost island among the four main islands in Japan) and northern Tohoku (the northernmost part of the principal island, Honshu). Both regions are located more than 500 km away from the main consumer markets.

These two areas became the most important broiler production zones in Japan for two reasons. One relates to the availability of production factors, especially land suited for broiler production. Due to the smell and to prevent contagious diseases for broilers, broiler producers looked for places away from cities and residential areas. The two abovementioned areas satisfied these conditions. The other important factor was the development of nearby ports, in which large-scale port elevators for feed grains were constructed at

the beginning of the 1980s, and Panama-class freighter ships could unload grains from abroad. Because the ports specialized in grain reception, these two production centers had a cost advantage in the case of feed over other production locations in Japan. By the middle of the 1990s, southern Kyushu and northern Tohoku produced more than the half of all the broilers produced nationally (Nagasaka, 1993).

Unlike in Japan, broiler production in Peru has remained concentrated in coastal areas relatively close to Lima and Trujillo, major cities on the central and northern coast. Even though the scale of production has increased rapidly since the 1990s, the principal production centers have not changed. According to Ministry of Agriculture statistics, about 80% of all broilers were produced in the three coastal regions (Lima, Trujillo, and Ica) in 2000 (Minag, 2001). This concentration of production is not only a function of the proximity to major urban markets but also the ecological characteristics of the production zones themselves.

In Lima, broilers used to be produced in the outskirts of the city. By the 1980s, because of urban sprawl and the growing scale of chicken operations, broiler production was relocated away from the capital. As production increased, installations sprang up north and south of Lima along the Pan-American Highway. Today, most installations of the broiler industry, which include breeder farms, hatchery plants, feed mills, and grow-out farms, are located within 200 km of Lima (Shimizu, 2011: 21).

The concentration of broiler production in the coastal area not far from Lima is an important characteristic of the Peruvian broiler industry. There are two reasons for this concentration: desert and transportation. Lima is surrounded by desert with an unusual climate quite suited to broiler production. Even

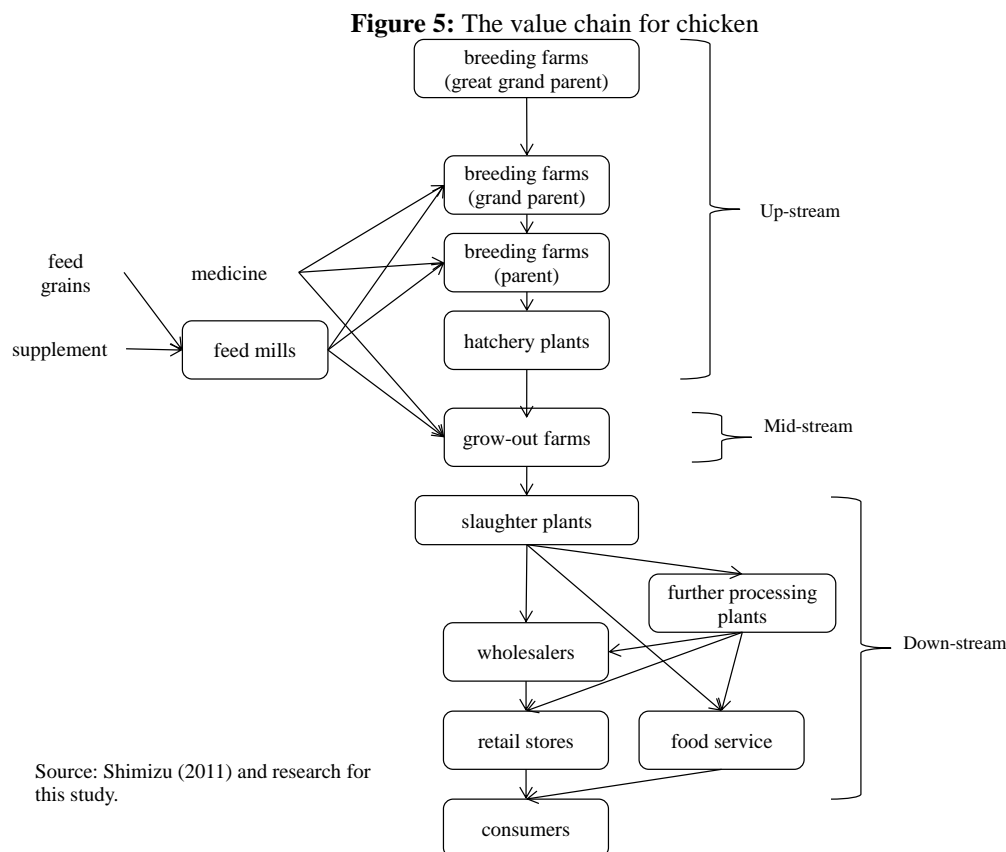
though this desert receives little precipitation, unlike hot deserts, this desert is mild and stable throughout the year because of the clouds constantly generated by the Humboldt Current, a cold ocean current that flows off the coast of Peru. For example, the average monthly maximum temperature in Lima is around 26 degrees Celsius, and the minimum is around 15 degrees Celsius with monthly precipitation less than one mm. Because of the lack of water, much of this desert is not suitable for agricultural production. However, these conditions are very favorable for broiler production, which requires a stable climate and relatively little water compared with other agricultural activities. Because of this climate, the chicken housing can be rustic, low-cost, and with simple heating and cooling equipment. Energy costs for heating and cooling are also low. In addition, the desert is suited for broiler production from the viewpoint of animal health because it is isolated from animals that are a source of infectious diseases such as bird influenza.

Another reason for the concentration of broiler installations in the desert outside Lima is the access to urban areas where consumers are concentrated. The Pan-American Highway, which runs all along the coast, connects Lima and the production zones. Most sections of the highway around Lima are well maintained with double lanes in each direction. This access lowers the transport costs for feed and chickens. The majority of the feed grains used for large-scale broiler production in

Peru are imported from abroad and unloaded at the port of Callao, Peru's main commercial seaport. The feed grains are then trucked to the feed mills located north and south of Lima. Mixed feed prepared at the mills is delivered in specialized trucks to grow-out farms. When the broilers are grown, they are put in cages, and most are transported alive by trailer trucks to Lima. For these operations, the desert outside Lima has become a preferred production zone for the Peruvian broiler industry. These characteristics apply to not only Lima but also Trujillo, the principal, northern coastal city in the La Libertad Region, the second-largest broiler producer after the Lima region (Shimizu, 2011).

Integration of the value chain

In addition to the differences in the location of production, the degree of integration constitutes another important difference in the organization of the value chain for chicken in Japan and Peru. As shown in Figure 5, the value chain can be divided into three stages. Up-stream activities are focused on inputs, which include feed mills, breeding farms, and hatchery plants. Mid-stream operations are all about broiler production, which includes grow-out farms. Down-stream is chicken meat processing and distribution, which includes slaughtering plants, additional processing plants, and distribution to wholesalers, retailers, and food service.



In Japan, transactions between each stage are integrated by “integrators.” Here, the word “integrate” means that instead of selling and buying on open markets like wholesale markets, integrators coordinate transactions between each stage, or sometimes they

own businesses in more than one stage. In general, the core business of integrators in Japan is slaughtering and further processing of broilers. To secure a stable supply of broilers for the integrators’ plants, integrators contract farms to grow broilers, provide inputs (chicks

and feed) from hatchery plants and feed mills, or make arrangements for inputs. When the broilers' weight reach a certain level, integrators collect them from the farms, slaughter them in their plants, and prepare cut-up parts and package them to ship to supermarkets. In some cases, integrators further process broiler meat for food service (Zhang and Saito, 2004).

In Peru, although the up-stream and mid-stream stages are fully integrated, down-stream activities are not integrated for most broiler production. The principal broiler companies have slaughtering and further processing plants to supply supermarket chains and food service. However, these companies slaughter and process only a small portion of the broilers produced. The rest of the broilers are sold to wholesalers and retailers as live birds. Hence, the bulk of all transactions along the value chain are executed on the open market. According to Ministry of Agriculture statistics, only around 20% of broilers produced in the country are slaughtered at slaughtering plants operated by broiler companies. The rest is estimated to be distributed as live birds. There are around 15 collection points for live birds (wholesale markets) in the vicinity of Metropolitan Lima in which 519,000 mt of live birds were traded in 2010 (Minag, 2011).

The more limited integration of the value chain in Peru can be explained by various factors, such as the lack of development of a cold chain in traditional wet markets; consumer preference for fresh meat (not refrigerated nor frozen); and the loose sanitary controls by agricultural authorities (Shimizu, 2011).

In addition to these factors, ecological factors that influenced the location of the broiler industry influenced the integration of the respective value chains as well (Shimizu, 2011). In both countries, at the initial stage of the development of the broiler industry, chickens were transported alive from grow-out farms in production centers to wholesalers and specialized chicken meat retailers in cities where consumers were located. Specialized retailers were the ones that slaughtered and prepared cut-up chickens for consumers.

However, as the distance between producers and consumers increased in Japan, and clients for chicken meat changed from wholesalers and specialized retailers to supermarkets and food service firms, the form of chicken transportation changed. To limit weight loss, chickens were transported as carcasses instead of being transported as live birds. Intermediaries set up simple plants in production centers to slaughter chickens. Carcasses were cooled with ice and shipped to cities. Specialized retailers prepared cut-up chicken for consumers. By the 1980s, broiler production had been shifted further away from cities and concentrated in the northern and southern regions of Japan. To take advantage of economies of scale, integrators built large-scale processing plants in the proximity of farm operations. The integrators not only slaughtered chickens but also prepared cut-up chickens and further processed products. By then, specialized retailers had been replaced by supermarkets. Therefore, integrators prepared cut-up chickens in packages ready to be displayed on shelves in supermarkets. Integrators

transported these final products in refrigerated tracks to distribution centers for supermarkets and food service (Yoshida, 1980; Nagasaka, 1993).

In Peru, the production centers have migrated away from the outskirts of major urban markets, but still remain relatively short distances away. Therefore, producers can transport live birds from grow-out farms to Lima or Trujillo without worrying about significant weight loss. In addition, the market share of supermarkets is still small in Lima, around 35% for food (USDA, 2011). Most consumers, especially middle- and low-income families, prefer to buy meat at local wet markets, not at supermarkets (Ipsos Apoyo Opinión y Mercado, 2006). Therefore, instead of slaughtering and processing broilers at plants, the major companies transport around 80% of the broilers to Lima's wholesale market for live birds (Shimizu, 2011). In 2006, only 14% of broilers were killed at company plants, out of which 12.3% were sold as whole chickens and only 1.4% and 0.3 % were sold as cut-up parts (breast, leg, etc.) and further processed products, respectively (Llaque, 2008). In effect, the integration of mid-stream and down-stream processing in value chain for chicken has remained minimal in Peru up to now.

CONCLUSIONS

During the course of the expansion of supply and demand for chicken meat, in Japan between the 1960s and 1980s and in Peru since the 1990s, ecology and other socio-economic factors have played important roles (Table 2).

On the demand side, rising consumer incomes was one key driver behind the increase in the demand for chicken. In addition, the decline in fish catches pushed up fish prices, and lowered the price of chicken relative to fish. As a result, chicken has become the most important source of animal meat protein in both Japan and Peru.

On the supply side, the limited agricultural land in both countries prompted development of intensive livestock production that depends on imported feed grains. Introduction of new technology in genetics and nutrition improved efficiency and led to expanded supply.

However, differences in ecology and other socio-economic factors resulted in differences in the development of industry as well. On the demand side, different chicken products are preferred. Although consumers buy chicken parts and further processed products in Japan, consumers in Peru prefer to buy whole chickens and prepare them at home. In addition, many Peruvians prefer to purchase food in traditional wet markets rather than modern supermarkets.

On the supply side, the distance between the production and consumption centers is quite long in Japan but relatively short in Peru. In addition, the regulation of the broiler industry, such as authorization and sanitary control of chicken processing plants is much less systematic in Peru. The combined set of supply and demand factors explains why up to now down-stream activities in the broiler value chain in Peru

is much less integrated than in Japan, and most chickens are still distributed alive in Peru rather than further processed and then frozen prior to sale.

Table 2: Development factors and their differential impact on the value chain for chicken in Japan and Peru, 1969-2009.

Common factors and similar impacts

Factors	Impacts in Japan and Peru
Income increase	Demand increase for chicken
Increase of relative price of fish	
Development of intensive agriculture	Supply increase of chicken
Introduction of new production technology	
Increase of imported feed grains	

Different factors and different impacts

Factors	Japan	Peru
Distance between production and consumption zones	Long	Short
Labor cost	High	Low
Processed products	Many	Few
Regulation on bird distribution	Rigorous	Limited
Consumers' preference for shopping	Supermarket	Wet market
Impacts		
Integration of processing and marketing	High	Low

Source: Elaborated based on research for this study.

What will happen with supply and demand for chicken in Peru in the future? The development of the broiler industry in Japan since the 1980s provides one benchmark. Although broiler production stopped growing in Japan at the end of the 1980s, consumption increased. The gap between supply and demand has been filled with frozen chicken imported from Brazil and processed chicken-based products imported from Thailand and China. Today, Japan imports not only almost 100% of the feed grains but also around 40% of the chicken meat consumed.

At present, Peru relies on imports for about 50% of the feed grains required by the broiler industry. Additional economic growth likely will increase chicken consumption not only in Lima and coastal cities but also in the mountain and jungle regions of Peru as well. How will the industry meet the growing demand for chicken? Peru has several options.

One option is simply to continue on importing more feed grains and producing broilers in the coastal region. However, the international price of feed grains has increased in recent years because of increasing demand from bio-fuel industry and emerging demand for livestock products in emerging countries. The cost of chicken production based on imported grains is increasing.

A second option is importing chicken from other countries such as Brazil. At present, Peruvians strongly prefer fresh chicken meat, and the underdeveloped cold supply chain discourages imports of frozen chicken. However, this situation could change rapidly. Due to the increases in income, cash-rich and time-poor consumers' demand for processed and pre-cooked foods will soon increase. Current food processing technology can overcome the differences in raw

material. The rapid expansion in supermarkets and fast food restaurants will fill the gaps in the deficient cold supply chain. Food processing and retail companies can take advantage of these situations and supply imported chicken meat products.

A third option is to increase production of feed grains and broiler not only in the coastal region but also in the jungle region as well. Maize for feed is produced in jungle region, such as San Martin. However, yields per ha in the region are far lower than those in the coastal region. Technological innovations can help improve the efficiency of feed grain and broiler production in both locations.

In terms of food security, the third option offers a distinct advantage. In order to pursue that option, increases in productivity on the farm through adoption of improved technology are imperative. It also requires greater integration of the value chain among up-stream (production), mid-stream (processing) and down-stream (distribution and marketing). For example, it is important to upgrade often antiquated wet market facilities and develop a cold chain from production centers to wholesale and retail markets.

Appendix Discrepancies in the data for per-capita consumption of chicken in Peru

Comparing international and national sources, major differences exist in the respective estimates of per-capita chicken consumption in Peru. According to the Food Balance Sheet (Hoja de Balance de Alimentos), domestic production of chicken (*pollo pelado crudo* or skinned raw chicken) in 2007 was 770,444 mt. Summing imported and exported chicken, the domestic chicken supply was 778,029 mt, among which 466,817 mt were classified as waste (*desperdicios*) leaving only 311,211 mt available for human consumption. Per-capita consumption of chicken was estimated to be 11 kg per year (Minag, 2008).

A recent study of the livestock sector in Peru, "Producción Perucaria e Industria Avícola 2010," reported very different data for per-capita consumption. For 2007, the domestic supply for poultry (chicken, hens, ducks, and turkeys) was 778,877 mt, and that for chicken was 704,847 mt in carcass weight. At the national level, total per-capita consumption of poultry was estimated to be 27.1 kg while that of chicken only is 24.5 kg. For Metropolitan Lima level, per-capita consumption of poultry was 51.7 kg while that only for chicken was 48.6 kg (Minag, 2011).

This discrepancy seems to be an error in the conversion into human consumption. On the Food Balance Sheet, the conversion coefficient for chicken waste was 60% of fresh weight (Minag, 2008). This means that 60% is wasted, and only 40% went for human consumption. The per-capita consumption of chicken meat is calculated after 60% of the domestic supply is discounted. However, this is accurate only when the domestic supply weight is expressed in live bird weight, which is not in this case. According to the livestock sector report, live bird weight for poultry production in 2007 was 939,600 mt (Minag, 2011), and the domestic supply of poultry was 770,444 tons

weight, which coincides with the percentage of carcass weight estimated in the livestock sector report (Minag, 2011). In addition, the chicken supply on the Food Balance Sheet includes not only broilers but also other poultry such as hens, ducks, and turkeys.

In Peru, the per-capita consumption cited in the livestock sector report is often quoted. This figure is based on carcass weight, which includes not only breast and leg meat but also wings, spine, neck, head, feet, etc. Consumption limited to breast, leg and chicken wing meat is 51% of the carcass weight, 14.1 kg for poultry meat and 12.7 kg for chicken meat in 2007 (Minag, 2011).

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