Pro-Poor Livestock Policy Initiative
A Living from Livestock
Research Report

RR Nr. 08-09; September 2008

Supply Chain Auditing for Poultry Production in Thailand

S. Heft-Neal, J. Otte, W. Pupphavessa, D. Roland-Holst, and D. Zilberman

ABSTRACT

This report provides a schematic overview of the supply chain and resource flows for three models of poultry production: backyard producer, medium contractor, and industrial. By elucidating the vertical and horizontal linkages that bind these actors into a web of formal and informal economic relationships, we want to facilitate better understanding of how actors will be affected by changes in policy regulation or shocks to the sector. For the Thai poultry sector, this is important for several reasons. Large scale industrial poultry production is one of the economy's most important sources of animal-derived food, employment, and income. At the other extreme, smallholder backyard production remains nearly ubiquitous across an extensive low income rural population. The former group is tied to some of the most important food industries in the economy, and the health of the industrial sector is critical to the country's trade and urban living standards. The latter group is linked through local livestock markets to low income networks of small enterprises that spread pro-poor multiplier effects across most of the country's diverse land area.

We conclude that each production model has advantages and disadvantages and none is likely to disappear completely. This kind of structured perspective on an essential food and livelihood sector can support more effective actions by decision-makers who have the responsibility to design and implement policies affecting a broad spectrum of market participants.

1. Introduction

The poultry sector has been widely acknowledged as the greatest agro-business success story in Thailand. In 2005, poultry was estimated to comprise 52% of total meat production in Thailand (NaRanong, 2007). The sector has transformed itself over the past four decades from near universal backyard farming into a leading exporter. Today Thailand has one of the most advanced broiler production sectors, with levels of efficiency and overall performance equal or exceeding that of most countries (Jaffee, 1993). In turn, production and consumption of poultry have greatly increased over the past few decades. Per capita consumption of chicken meat rose from 2 lbs per year in 1970 to 22 lbs per year in 1992 (Willis *et al*, 1992). As a result of decreasing prices and increasing incomes, chicken has become the most affordable and most popular source of meat in Thailand (Costales *et al,* 2005).

This report provides a schematic overview of the supply chain and resource flows at each stage for three archetype production models: backyard producer, medium contractor, and large-scale industrial. By elucidating the vertical and horizontal linkages that bind these actors into a web of formal and informal economic relationships, we want to facilitate better understanding of how actors will be affected by changes in policy regulation or shocks to the sector. For the Thai poultry sector, this is important for many reasons. Large scale poultry production (and processing) is one of the economy's most important sources of animal-derived food, employment, and income. At the other extreme, smallholder backyard production remains nearly ubiquitous across the extensive low income rural population. The former group is tied to some of the most important food industry groups in the economy, and the health of the industrial sector is critical to the country's trade and urban living standards. The latter group is linked through local livestock markets to low income networks of small enterprises that spread pro-poor multiplier effects across most of the country's land area.

Poultry production in Thailand can be classified into three primary systems; large-scale industrial production, semi-industrial production, and smallholder backyard farming. Industrial production normally consists of vertically integrated companies controlling every stage of production from breeding hens to marketing processed chicken. The growing stage has often been contracted out to medium and large farms, while remaining production stages are controlled by the integrating firm. Firms also raise broilers on company farms. Industrial poultry products are both exported and sold domestically. Semi-industrial farms are small or medium size farms that raise poultry for commercial purposes but are not independent from other levels of the production system. Semi-industrial farms tend to be characterized by medium intensive inputs and marketing. Smallholder backyard farms are characterized by low inputs and generally raise poultry for non-commercial reasons (i.e., consumption) but may receive an important source of supplemental income from selling surpluses to local markets.

There are two natural divisions among poultry raisers in Thailand, by production system and by breed raised, and they are somewhat, but not exclusively, linked to one another. The breeds can be divided into three main groups (not including layers which like broiler are of industrial breeds often imported from abroad), broilers, indigenous breeds, and cross-breeds. A significant majority of chickens raised are broiler 'breed' which are conducive to industrial raising because of, among other features, their fast growth rate, good feed conversion and large meat volume. Native chicken breeds, on the other hand, possess slow growth rates, low egg-laying rates, and less meat. However, native breeds are inherently disease resistant and have the ability to scavenge for food making them the ideal breed for low income smallholders. Both large and small farms may raise cross-bred chicken to a lesser extent although the birds are generally unable to survive on scavenging alone.

On the demand side, hypermarkets and other "convenience" outlets have increased in popularity. Such outlets require suppliers that are able to provide steady and timely flows of standardized, high quality products. This emergent demand has led to market segmentation between producers who can meet these demands (formal supply chain) and those who cannot (informal supply chain). As formal supply chains expand, informal supply chains are displaced, leading to decreased demand for products that traditionally supplied wet markets. However, despite the expansion of supermarkets, many countries have also seen the persistence of informal markets, due mainly to preference for tradition products (Reardon *et al,* 2003).

This report examines the supply chain and resource flows at each stage for the industrial and smallholder production systems. Viewing the entire supply chain as a system advances understanding of the effects that shifts in one part of the system have upon other parts of the system and upon the system as a whole. The methodology employed consists of utilizing a combination of tools to break down the main components of production. Each production system is broken down into three parts;

1. Resource Flows - Examines horizontal resource flows into and out of individual stages of production by diagramming flows and discussing production inputs.
2. Production Scheduling - Explores the time dimension of production by laying out examples of typical production schedules for overall production and farm level production.
3. Supply Chain - Breaks down supply chains (e.g. egg to market). The supply chain diagrams vertical flows between stages of production for each supply model and the relationships among supply chain participants are dissected.

The primary goal of this exercise is to inform stakeholders who have a material influence on the supply chain, including insiders and outsiders. In particular, this kind of structured perspective on

an essential food and livelihood sector can support more effective actions by those in Thailand who have the responsibility to design and implement policies that can affect market participants.

In this report, we map out the sector schematically, diagramming relevant production systems and highlighting potential issues that may arise from interactive vertical and horizontal effects. In future work, we plan to calibrate these schematics to facilitate assessment of economic linkages and the extent to which these confer welfare effects across the supply chain. For this case, we have chosen poultry because of its essential role in the food supply, its importance to livelihoods of the rural poor, and the diversity of the sector as it experiences historic transition.

The report is divided into the five sections as follows: The first discusses the evolution of the Thai poultry sector over the past four decades, from exclusive smallholder production to production dominated by large commercial firms using modern international standards of production. The subsequent section uses the tools described above to decompose the resource flows of vertically integrated industrial broiler farms and briefly discusses industrial layer farms. A section on contract farming examines two typical broiler contract farm production models as well as a prototypical layer contract production model. The following section focuses on independent farmers, which consist primarily of backyard farms raising native breeds of chicken. The report ends with a discussion highlighting important relationships and resource movements that should be considered when calculating effects of changes in the poultry sector.

2. Development of the Thai Poultry Sector

Early Development

Chicken production was first promoted nationally by King Rama V who introduced at least three new breeds of chicken into Thailand around the turn of the 20th century (Rhode Island Red, White Leghorn, and Barred Plymouth Rock) (Thammabood, 1988). Prior to the 1950s the Thai poultry sector was comprised of smallholders raising birds for own consumption supplemented by local sale. The first move toward industrialization occurred in 1950 when the layer industry began at Kasetsart University in Bangkok (FAO, 2003). Nonetheless, specialization in broiler production did not begin until the 1960s, developing along with urbanization and infrastructure development that was taking place rapidly in Thailand (NaRanong, 2007). During these early stages, there were 40-50 poultry wholesalers in Bangkok who purchased live chickens that had been collected by traders from across central and eastern Thailand (Poapongsakorn, 2005). However, as specialization increased, production became increasingly concentrated on large farms in the central region around Bangkok.

The most influential firm, consistently at the forefront of the sector's development, has been the Charoen Pokphand company (CP) that was founded as a feed company in Bangkok in 1928. In 1970 the feed company CP began a calculated effort to transform poultry production from traditional to intensive commercial systems in Thailand (Farrelly, 1996). First, the company formed a strategic partnership with the American firm Arbor Acres. Through this partnership, a major shift in the broiler industry occurred when commercial breeds were introduced from the UK and the United States. This began a four generation process of adopting productive broiler breeds to Thailand (Farrelly, 1996). Initially day-old-chicks were purchased from Arbor Acres and imported. However, the joint domestic venture between the firms in the 1970s used imported grandparent stock to develop sufficient parent stock and by the early 1980s all aspects of the breeding process were taking place inside Thailand (Poapongsakorn, 1982).

Initially the CP-Arbor Acres partnership began constructing corporate farms to raise the imported chicks. However, they were not achieving economies of scale. Out of this predicament arose contract farming (Farrelly, 1996). CP was the first company to introduce wage and price guaranteed contracts between chicken growers, hatcheries, and feed companies in Thailand. From the beginning of contracting, the firm helped farmers secure loans through commercial banks for constructing grow-out facilities. Initially, the contract firms were able to hold an average of 10,000 birds, with some farms raising up to 70,000 birds (Farrelly, 1996). As a result of these developments, 1973 and 1974 saw the beginning of large-scale chicken meat production (Thammabood, 1988). When CP began implementing its production plan in 1970, 2% of growers raised more than 5,000 birds per year. However, five years later in 1975 96% of commercial growers raised at least 5,000 birds annually (Bishop, 1990). Later, in 1979, the 5th Economic Plan of Thailand was the first national plan to promote production of native chicken nationally (Haitook, 2006).

For the duration of the decade and into the 1980s contract farmers were the main source of broiler meat in Thailand. The layer sector also continued to adopt new technologies and increase the scale of production. Meanwhile, although their economic weight decreased, small farmers across the country continued to raise imported and native breeds of poultry for consumption and sale. In 1985, it was estimated that 99.7% of chicken producers were still backyard growers (Costales *et al,* 2005).

Advances in Technology

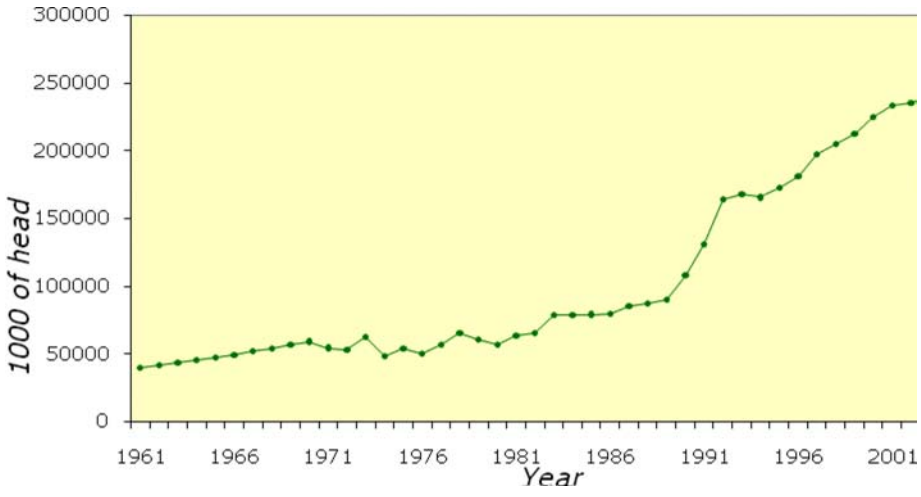
Once broiler production became a resource intensive activity, taking place on large farms, technological advancements became the most viable manner for improving high quality, low cost production. The most effective way to decrease costs was to improve feed conversion ratios and reduce growth time. Consequently lowering costs of feed grains became the leading objective for

participants in the sector (Farrelly, 1996). CP, as a feed company which initiated integration with other sub-sectors, may have had an advantage producing inexpensive feed.

The CP Feed company determined that the best way to improve cost productivity of feed grains was through new hybrid seeds. It was for this reason that CP entered into joint research ventures with firms such as DeKalb and Cargill (Farrelly, 1996). CP feed company then promoted the new technology by entering into contracts with maize producers, creating contractual agreements with farmers who were willing to adopt the specified improved seeds. By 1992 farmers who were not using the hybrid seeds were averaging 400 kg maize/rai while farmers using the hybrid seeds averaged 1,200 kg maize/rai (Willis *et al*, 1992).

Cheap feeds and investment in other farm technologies adopted from abroad led to an increase in poultry production (Figure 2.1). The provision and adoption of technology by commercial contract farmers widened the gap between contract and independent broiler farms. Contract farmers were often provided access to new technologies as part of the agreement. Integrators, and their subcontractors, benefited from economies of scale, resulting in lower average production costs, as well as the opportunity for adopting costly new technologies that small farmers could not afford.

Figure 2.1: Total chicken production in Thailand (1961 – 2002)



Source: FAO, 2005

In the 1990s, poultry production was dominated by CP and its smaller competitors. Commercial systems of poultry production used large scales of production with specialized mechanized facilities and low levels of labour. Broiler production tends to have very high initial costs, vast efficiency gains from economies of scale, and an emphasis on technological advances. The implication is that firms that operate below average efficiency are likely to be eliminated (Freivalds, 1985). In fact, Kehren and Tisdell (1996) reported that by 1996 twelve companies

controlled about 80 percent of broiler production. Contract farming was accompanied by vertically integrated production schemes located primarily in central Thailand. The size of farms, and the number of chicken raised continued to increase while the number of market participants decreased (NaRanong, 2007). That trend is illustrated by the fact that only the largest categories of farms grew during the second half of the 1990s (Poapongsakorn *et al*, 2003, Table 2.1).

The most important technological advance of this period was the adoption of the evaporative cooling system (EVAP) by most commercial farms. This system increases growth and survival rates despite the tropical climate in Thailand. Moreover, it allows for higher density rearing thus decreasing average costs per bird (Haitook, 2006).

Table 2.1: Number of Commercial Holdings & Chickens in 1993 & 2003

Holding size class (heads)	Number of holdings		% Change
	1993	2003	
1 – 19	1,681,300	361,600	-78.5
20 – 99	863,809	580,543	-32.8
100 – 499	53,064	65,943	24.3
500 – 999	3,861	1,851	-52.1
1,000 - 9,999	13,042	14,224	9.1
10,000 and over	2,336	4,028	72.4
Total	2,617,412	1,028,189	-60.7

Source: Table in (NaRanong, 2007). Data from National Statistic Office. Agricultural Census 1993 and 2003.

Economic Crises

The mid 1990s saw the Asian Financial Crisis drastically slow the Thai economy. However, prior to the economy wide crisis, during 1994 and 1995, Thai poultry exports and the price of chicken both decreased significantly. In response to these events, leaders of the broiler industry came together and formed the Broiler Breeding Stock Centre in order to control supply of breeding stock and thus limit the supply of broilers (NaRanong, 1999).

The national economic crisis followed in early 1997 first in the form of an economy wide export slump, followed by a balance of payment and exchange rate crisis. This led to the final financial and banking crisis which significantly depressed Thailand's economy and led to a drastic depreciation of the Baht. However, despite the national economic downturn, the poultry sector was relatively successful during this time.

NaRanong (1999) credits the broiler sector's success during the crisis to shifts in the industry. Low labour costs meant that the most important export item had been boneless chicken, which is more labour intensive than boned chicken. However, the Thai labour advantage was decreasing as domestic wages rose in the 1990s relative to China and Viet Nam, and a shift toward higher value-added products had already begun. As a result of the rise in unskilled labour costs, many

exporters began to switch from producing frozen boneless to pre-cooked chicken. These high value-added products were very successful exports due to their increased competitiveness caused by the Baht devaluation.

However, domestic demand also decreased significantly during this crisis period. Per capita egg consumption decreased by more than 10% and per capita chicken meat consumption by 20% between 1997 and 1998. Additionally, the price of imported feed inputs and medicines doubled. However, for large firms these costs were more than offset by the increase in high value-added exports (NaRanong, 1999). In fact, NaRanong suggests that the most serious effect of the crisis may have been the credit crunch that delayed more producers from switching to higher value-added products which in turn prevented companies from reaping the full benefits of the Baht devaluation. Small and medium sized farms, as well as layer farms, which did not rely heavily on exports were more affected by the crisis.

Table 2.2: Total Production and Export of Chicken Meat (1961-2004)

Year	Production (tonnes of meat)	Exports Qty (tonnes of meat)	Export Value (1,000 US $)
1961	82,000	7	4
1971	190,000	1	2
1981	320,000	26,805	54,756
1991	774,000	164,200	402,797
2001	1,230,000	309,543	538,708
2002	1,320,000	330,381	534,657
2003	1,227,000	343,496	597,634
2004	878,489	26,548	43,507
2005	950,000	4,547	13,507

Source (FAO, 2005)]

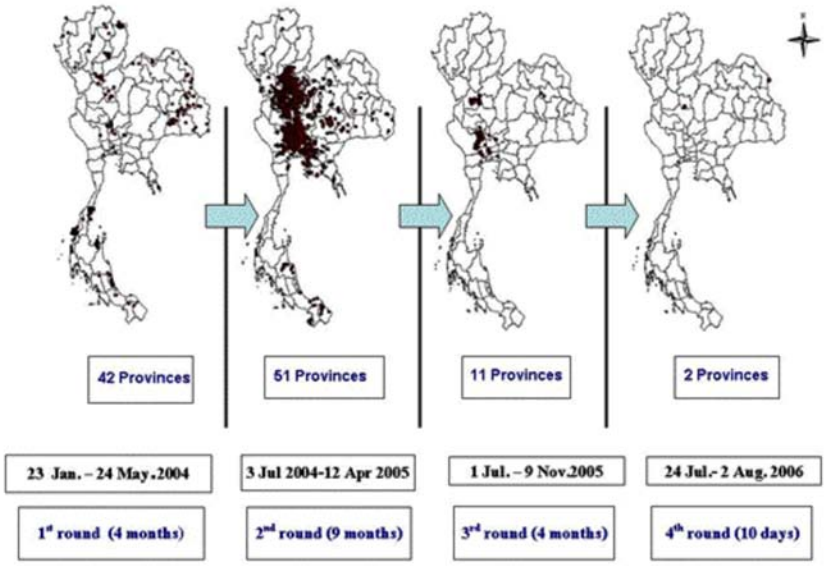
Disease Outbreaks and Quality Control

Commercial poultry production this decade has largely been shaped by producers reacting to quality control issues. Early in 2000 the European Union (EU) detected Nitro-furans (a banned group of antibiotics) and Dioxin in some broiler imports from Thailand. This finding, in addition to new animal welfare standards in the EU, brought about a set of export restrictions that led many firms to exert more control over production in order to ensure quality standards.

While vertical integration became more common in the early part of the decade as a reaction to EU export controls, the most influential event in shaping the poultry sector has been the incursion of the Highly Pathogenic Avian Influenza (HPAI) H5N1 virus that was first announced in early 2004.

Thailand has experienced four rounds of Avian Influenza outbreaks. The first round (23 January - 24 May 2004) affected 42 provinces, and resulted in 320,000 birds being culled. The second round (3 July 2004 - 12 April 2005) resulted in 63,000,000 birds culled in 51 provinces. The third round (1 July - 9 November 2005) affected 11 provinces and resulted in 450,000 birds being culled. The fourth round (24 July -2 August 2006) affected 2 provinces and resulted in a limited number of cullings (Department of Livestock Development, 2007).

Figure 2.2: Location of HPAI Outbreak Zones



Source: Department of Livestock Development

According to the Department of Livestock Development (DLD, 2006a), government response to the outbreaks consisted of three phases (different from the rounds of outbreaks). During the first phase (23 January- 10 February 2004) diagnosis was based on positive HPAI tests and the policy entailed having all poultry, products, feed, bedding, waste and manure from infected flocks destroyed immediately. Furthermore, all flocks within 5 kilometers of confirmed cases were preemptively culled. Because of the widespread nature of the outbreaks, the normal 75% of market value compensation for culling was raised to 100% of market value. Market prices were based solely on the breed of chicken.

During the second phase (11-29 February 2004) a new policy for diagnosing HPAI was implemented in addition to testing. Under the new definition, a “case” was defined as any positive test, any instance where the poultry death rate in a flock was >10% within a single day, or any instance where the death rate in a flock exceeded a cumulative >40% over three days and the flock displayed other signs of infection (e.g., diarrhea, ruffled feathers, depression, etc). Flocks considered to be a positive case were culled with the normal compensation of 75% of market price. The new policy also entailed pre-emptive culling within a reduced 1 kilometer radius. A

flock was defined as “a farm or village”. The third phase (after February 2004) consisted of culling only positive “cases” within 5 kilometers with no pre-emptive culling.

This response has generally been considered successful in controlling the outbreaks in Thailand, however, many people believe that HPAI has become endemic in some countries, suggesting that outbreaks will continue to affect producers all over the world.

Initially the producers directly affected by the outbreaks were farmers whose flocks were culled. However, immediately following the first HPAI outbreaks, there was a decrease in domestic and foreign demand for Thai poultry products. Both Japan and the European Union initiated export restrictions for fresh and frozen products. At the time, these products constituted two-thirds of exports (NaRanong, 2007).

Domestic demand also decreased immediately. The shock affected poultry producers of all sizes. Economically, large producers sustained the biggest losses. The Thai Broiler Exporter Association estimates that the industry lost 5-6 million Baht as a result of the outbreaks in 2004 alone (USDA, 2005). Domestic demand also decreased immediately. Many small producers who rely on poultry as an important part of their livelihood were also adversely affected by the culling of their flock or loss of income from decreased demand.

The most important change that resulted from the HPAI outbreaks may be the domestic Farm Standard regulations established by the DLD as well as the new export regulations imposed by the EU and Japan. The Farm Standard practice means that companies have more incentive to vertically integrate in order to ensure these standards are met at every stage of production. While transition in the broiler sector toward integrated production systems had already been occurring over the previous decade, the avian influenza outbreaks accelerated the process.

Constructing the government containment policies, and subsequent regulations, is a complex task requiring policy makers to balance the interests of the many stakeholders. The Farm Standard regulations are arguably biased in favour of commercial farms because the requirements are such that most commercial farms already passed the inspection while most independent farmers were forced to consider costly upgrades of their infrastructure (NaRanong, 2007). However, the standard is only required for poultry farms that export or transit products across provincial lines (DLD, 2007). Therefore, it does not apply to most small farmers who raise for home consumption or sell at local markets. An additional source of complexity is the fact that avian influenza is an issue attracting high levels of international interest. The acceleration of production integration in response to export restrictions, in addition to the pressure governments often feel to carry out mass culling, are examples of how these interest play out. In general, the politics of policy response to avian influenza forces policymakers to consider international public image, business interests, and poor people’s livelihoods, whose interests may not coincide.

Overview of Current Conditions

The broiler industry has experienced increased integration which in turn limits the demand for subcontractors. In addition, CP has been promoting new housing systems since the outbreaks, which has forced remaining subcontractors to invest in upgrading their holding facilities or to risk losing their contracts (Costales *et al,* 2005).

Table 2.3: Chicken Stock in Thailand by Region (1995-2005)

Year	Central	North-Eastern	Northern	Southern	Total
1995	62,589,266	24,446,914	15,039,270	9,575,060	111,648,510
1996	69,963,645	37,506,727	23,028,677	14,080,379	144,579,428
1997	79,928,557	42,104,802	24,457,990	18,194,493	164,685,842
1998	77,224,601	38,176,754	23,841,418	16,081,873	155,324,646
1999	78,067,555	47,210,939	27,327,803	17,026,210	169,632,507
2000	98,968,145	44,958,278	27,906,485	17,508,202	189,341,110
2001	111,819,685	54,106,254	30,829,909	18,223,233	214,979,081
2002	127,411,495	56,429,660	28,677,030	16,242,141	228,760,326
2003	153,275,177	51,686,324	32,798,811	14,958,571	252,718,883
2004	89,684,664	49,542,774	28,070,941	12,440,431	179,738,810
2005	135,513,828	62,516,470	38,723,520	17,450,250	254,204,068

Source: DLD (2006b).

Table 2.4: Chicken Stock in Thailand by Bird 'Type' (2002-2005)

Year	Broiler Chicken birds (% of total)	Layer Chicken birds (% of total)	Native Chicken birds (% of total)	Total
2002	145,992,322 (63.8)	25,006,697 (10.9)	57,761,307 (25.3)	228,760,326
2003	165,314,786 (65.4)	24,312,523 (9.6)	63,091,574 (25.0)	252,718,883
2004	102,680,366 (57.1)	20,864,273 (11.6)	56,194,171 (31.3)	179,738,810
2005	147,674,157 (58.1)	44,401,154 (17.5)	65,219,757 (22.7)	254,204,068
Growth rate 2003-2004	-37.9%	-14.2%	-10.9%	-28.9%
Growth rate 2004-2005	43.8%	112.8%	16.1%	41.4%

Source: DLD (2006b)

Table 2.5: Farm Numbers by Size and Chicken 'Type' (2006)

Flock Size Group	Bird Type		Flock Size Group	Bird Type
	Broilers	Native		Layers
501 – 1000	238	3,597	100 - 300	539
1001 – 2000	324	477	301 - 500	160
2001 – 5000	1,073	526	501 - 1000	261
> 5000	3,033	0	>1000	2,123
Total Farms	**4,668**	**4.600**	**Total Farms**	**3,083**
Total Birds	**99.7 million**	**7.4 million**	**Total Birds**	**29.2 million**

Source: DLD (2006b). Note: Native Chicken data does not include smallholders (<500 chickens) but does include cross-bred chicken which likely accounts for the majority of farms with >1000 chickens.

Recent escalations of food crop and fuel prices have resulted in higher feed and transport costs. Nonetheless the broiler industry has largely recovered from the losses caused by the HPAI outbreaks. Since April 2007, the industry has increased productivity, reduced pressures from

high breeding stocks, and benefited from increased prices both domestically and abroad (USDA, 2007).

The new export requirements, banning imports of frozen chicken from Thailand, have also increased incentives for commercial producers to continue the move to pre-cooked chicken which began in the early 1990s. In fact, exports of pre-cooked chicken doubled after 2004 and were 97% of export quantity in 2006 (Costales *et al,* 2005). While many had expected integrated firms to put more emphasis on value-added products (e.g., pre-cooked chicken), adjustments to the HPAI outbreaks accelerated the process (NaRanong, 2007).

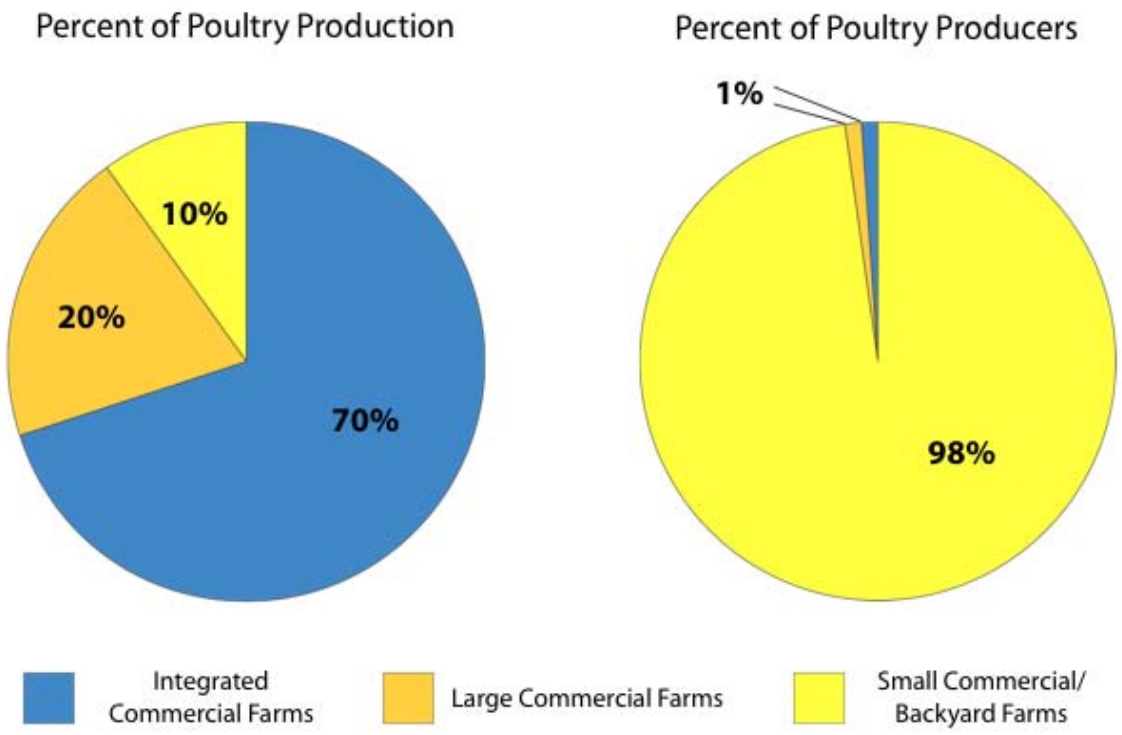
There are two primary divisions that can be made among poultry raisers in Thailand, by production system and by breed raised. The two distinctions are somewhat, but not exclusively, linked to one another. The breeds can be divided into three main groups (not including layers which like broiler are of industrial breeds often imported from abroad), broilers, indigenous breeds, and cross-breeds.

A large majority of chickens raised are broiler breeds which are conducive to commercial raising because of, among other features, their fast growth rate and large meat volume. Native chickens, on the hand, have lower growth rates, lower egg-laying rates, and less meat. However, native breeds are more disease resistant and have the ability to scavenge for food making them the ideal breed for low income smallholders (WORD FOR WORD in the INTRODUCTION). For the remainder of the paper it is assumed that large farms (both integrated and contracting) raise broilers for meat while independent farmers (small to medium size) raise native breeds of chicken. Both large and small farms may raise cross-bred chicken to a lesser extent. The main distinction between farms that raise cross-breeds, and the production systems discussed here, would be the production schedule. Cross-bred chickens tend to be reared in 12-16 weeks depending on the quality of inputs (Loupaibal *et al,* 1999). Other facets of production will be similar to those discussed in this paper.

The broiler industry has experienced increased integration which in turn limits the demand for subcontractors. In addition, CP has been promoting new housing systems since the outbreaks which has forced remaining subcontractors to invest in upgrading their holding facilities else risk losing their contracts (Costales *et al,* 2005).

Semi-industrial farms now also have to conform to the Farm Standards regulations, even though they do not export chicken. This has caused some actors to switch production to other livestock or crops. Moreover, raising poultry and fish in integrated systems, long a productive practice, has been prohibited in most areas (NaRanong, 2007).

Figure 2.3: Percentage of Poultry Production and Producers by Farm Type (2006)



Source: Adapted from table in Rushton et al, 2005.

Many observers have long expected smallholder and small independent farmers to abandon poultry production because they cannot compete with large integrated systems. They have higher production costs and lower quality output. After the HPAI outbreaks, many farmers ceased to raise native chickens for sale. Moreover, decreased demand and changes in regulations have contributed to many more farmers abandoning their ventures in the years following the initial outbreaks. Despite movements out of the poultry sector, people continue to raise local chicken for marketing, especially in more rural remote areas. In addition, the majority of households that raised chickens in the past continue to raise chickens for consumption. While large industrial farms make up 70% of total chicken production, they only make up 1% of total producers. In fact 98% of producers are backyard or small semi-industrial farms (Figure 2.3). Consequently, despite their lack of economic weight, the welfare of smallholders should be an important consideration in the poultry sector.

3. Vertically Integrated Production

At its most extreme, integrated production involves a single firm owning and operating every aspect of production from importing parent stock to marketing packaged meats in company owned outlets. This allows the firm to achieve economies of scale, decrease transactions costs, as well as the ability to closely monitor product quality at every stage of production by controlling all inputs and processes at every level. There are several firms in Thailand who use a vertically

integrated production model for at least part of broiler production, most notably the CP company. Discussion of vertically integrated layer production is omitted in this section. However, there are six to seven extremely large integrated layer farms in Thailand. Collectively, these farms control up to 80% of market share (NaRanong, 1999).

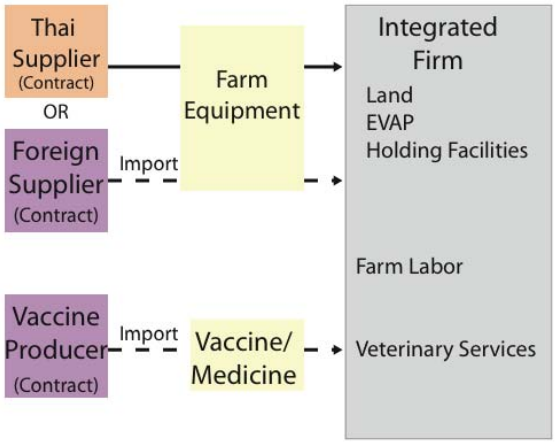
Broiler production is the most economically important poultry sub-sector in Thailand. Most chickens produced in Thailand are broilers and broiler meat is the biggest livestock export.

Resource Flows

The integrator controls every stage of production and hence is the provider of all major farm inputs along the vertical supply chain. Most inputs are supplied by companies under the same ownership (e.g. breeding company, hatchery, feed company).

Multiple stage input supply: Certain inputs are used at multiple stages of production. Examples include pharmaceuticals, EVAP systems, and other production equipment. Poultry producers have contractual agreements with manufacturers to supply these inputs (Figure 3.1). Pharmaceuticals are imported. Farm equipment can be imported or purchased from one of several Thai manufacturers (Fugile, 2000). The Department of Livestock also manufactures vaccines. However, these vaccines are primarily distributed to independent farmers.

Figure 3.1: Multiple Stage Resource Flows



Feed companies: Feed is the primary variable cost, comprising up to 75% of total production costs (Chinrasri, 2004, Farrelly, 1997). Consequently access to low-cost, high-quality feed is necessary for firms to remain competitive. A large amount of research goes toward improving feed efficiency. Broiler production in Thailand requires more than 3 million tons of feed annually (Table 3.1). Feed is provided to the breeding company, hatchery, and broiler farm from the company feed producer. Resource flows for the feed company, shown in Figure 3.2, include both

domestic and imported products which are secured from contracts with producing farms (Farrelly 1996, NaRanong 1999). Maize and soybean meal/cake are the primary inputs for broiler feed, both of which are cultivated in Thailand (fishmeal is a common source of protein for other types of poultry reared). Maize is not a significant part of Thai diets and instead is cultivated in Thailand primarily for use in livestock feeds (Wanapat, 2003). Soy bean/meal, alternatively, is both consumed and used for livestock feeds. The high demand for soy means that Thailand is a large importer of soy (Table 3.2).

Table 3.1: Major Protein Sources Used in Poultry Feeds, 2000 (tonnes)

Species	Feed Use	Fishmeal	Soybean Meal
Broilers	3,354,302	-	1,006,290
Parent Stock	462,510	13,875	115,627
Growing layers (pullets)	552,652	16,579	138,163
Layer, hens	1,181,960	59,096	295,490
Layer, parent stock	20,025	601	5,006

Source: Cited in Wanapat, 2003. Data from Association of Feed Mills of Thailand, 2000.

Table 3.2: Production and Consumption of Feed Crops in Thailand, 2002 (tonnes)

Crop	Production	Exports	Imports
Soybean	261,000	-	1,529,000
Soy Meal	799,000	-	1,752,000
Maize	4,230,000	163,000	5,000
Broken Rice	1,967,000	-	-
Cassava	16,868,000	3,802,000	-

Source: Rojanasaroj et al, 2004

One potential barrier to expansion of the broiler industry is the inability to secure inexpensive soy products (NaRanong, 1999). Most soybean producers in Thailand are smallholders. Consequently, soybean is the most protected crop in Thailand. Maize is also protected, albeit to a lesser extent (NaRanong, 1999).

Table 3.3: Past, Current and Projected Demand for Feed (tonnes)

Year	Broiler Feed Inputs		Layer Feed Inputs	
	Maize	Soybean meal	Maize	Soybean meal
2003	1,953,000	1,052,000	838,000	137,000
2004	2,053,000	1,105,000	839,000	137,000
2005	2,158,000	1,162,000	841,000	137,000
2006	2,267,000	1,221,000	843,000	137,000
2007	2,383,000	1,283,000	845,000	138,000
2008	2,504,000	1,348,000	846,000	138,000
2009	2,632,000	1,417,000	848,000	138,000
2010	2,766,000	1,489,000	850,000	139,000

2011	2,907,000	1,565,000	852,000	139,000
2012	3,055,000	1,645,000	853,000	139,000
2013	3,211,000	1,729,000	855,000	140,000
2014	3,375,000	1,817,000	857,000	140,000
2015	3,546,000	1,909,000	860,000	140,000

Source: Rojanasaroj et al, 2004

Table 3.4: Price of Feed Inputs (Baht/kg)

Year	Maize	Soybean Meal	
		Domestic	Import
1997	4.77	10.81	10.65
1998	5.02	11.25	10.50
1999	4.67	9.65	7.47
2000	4.80	9.98	9.21
2001	4.37	10.94	10.70
2002	4.68	10.47	10.16
2003	4.94	11.96	11.07
2004	5.70	13.77	14.61
2005	5.50	12.02	11.92
2006	6.18	11.03	10.53

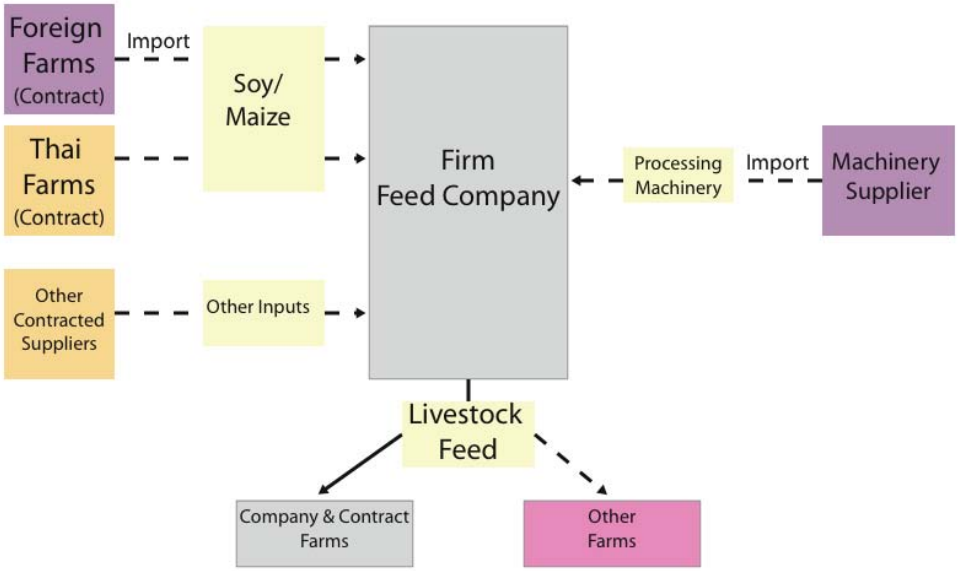
Source: Association of Feed Mills of Thailand, 2007.

More generally, securing feed inputs is one of the main challenges facing the poultry industry in the future (Wanapat 2003, Rojanasaroj *et al,* 2004). The livestock industry is competing with rising human consumption and (increasingly bio-fuels) for a limited supply of crops. Wanapat (2003) recommended emphasizing the use of more available crops (i.e., cassava) as feed inputs. In the mean time demand levels (and imports) are expected to rise in the future (Table 3.3).

In addition to feedstuffs, feed processing requires specialized machinery which, like other farm equipment, may be imported or purchased from Thai manufacturers under contractual agreements.

Most of the poultry integrators began as feed companies and continue to supply feed to farms outside their integrated systems. The largest feed mills consistently distribute half of the feed produced within their own integrated system (company or contract farms) and sell half to other producers. The top six feed companies in Thailand provide more than half of total feed mill capacity. CP and Betagro Agro are the two largest feed millers (Fugile, 2000).

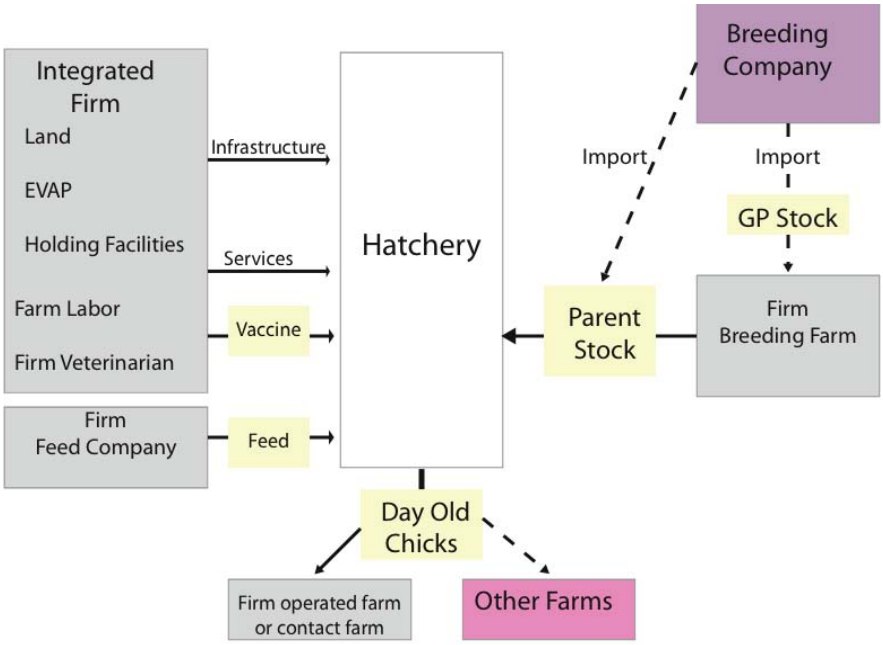
Figure 3.2: Feed Company Resource Flows



Hatcheries: Presently, approximately twelve breeding companies supply the breeding stock from which almost all commercial poultry meat is derived world-wide (Fallon, 2001). Hatcheries purchase grandparent or parent stock. In the case of grandparent stock, the imported birds are kept on a separate breeding farm. Parent stock are spread out across the hatcheries. Hatcheries, in turn, use parent stock to produce chicks that are reared for meat. In January, 2008 19,170 chicks were imported into Thailand to supply breeding stocks (DLD, 2008).

On both the broiler farm and at the hatchery production consists of high fixed costs including land, holding facilities and EVAP cooling systems. Included in the costs of constructing holding facilities are installing automated feeding mechanisms, electrical systems, and other structures for keeping chickens (Haitook, 2006). Similarly to feed producers, hatcheries can purchase machinery from Thai manufacturers or import it. Pharmaceuticals are imported (Fallon, 2001). Poultry exporters are provided a tax break for inputs they import (NaRanong, 1999). Companies often have contractual agreements with suppliers of all of the above inputs (particularly the breeding company).

Figure 3.3: Hatchery Resource Flows



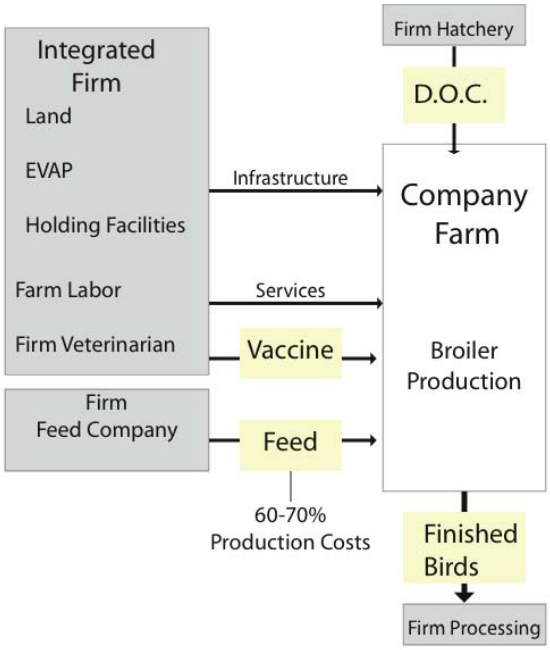
On-farm production: Completely integrated supply chains use company farms to rear broilers (Figure 3.4). Fixed costs include land, holding facilities and EVAP systems. The cost of constructing a closed holding system for 10,000 birds has been estimated at 1,100,000 Baht (Sudsawasd and Pupphavesa, 2008). The cost of installing an EVAP system has been estimated at 280,000 Baht (Taenkaew, 2001). Holding systems, including EVAP, are generally based on foreign designs but are adapted to suit local conditions and to utilize locally available materials. The primary variable cost is feed, which constitutes 60-75% of production costs and is provided by the integrated feed company (Farrelly 1996, NaRanong 1999, Haitook 2006). Other variable costs include pharmaceuticals and workforce. Employees include farm workers and a staff veterinarian that oversees multiple farms. One survey of broiler producers found that large farms (>10,000 birds) employed an average of 1,168 permanent employees and 2,270 casual hires or daily workers (Sriwichailamphan, 2003). The average weight of an individual live broiler is currently 2.4-2.5 kg per bird (USDA, 2007).

Table 3.5: Costs of Integrated Broiler Production (Baht/kg)

Year	D.O.C.	Feed	Vaccine / drugs	Labour / Other	Total	∆%
2006a	6	19.0	1	3	29.00	--
2006b	5	18.5	1	3.5	28.00	- 3.4
2007a	--	--	--	--	30.17	+ 7.2
2007b	7	18	1	3.5	29.50	- 2.2
2008a	--	--	--	--	28.50	- 3.4

Source: USDA Semi-Annual/Annual Reports: Thailand Poultry and Products 2006-2008 (a=Costs at beginning of year, b= Costs mid year, -- input costs unavailable).`

Figure 3.4: Integrated Farm Resource Flows



Processing: The first processing stage is slaughtering the chicken at an abattoir. In 2006, there were 1,796 poultry abattoir registered with the Department of Livestock (DLD, 2006). Many abattoir are constructed in conjunction with further processing plants on adjacent lots in order to decrease transaction costs. Processing facilities are modern, efficient, highly mechanized, and built to meet the standards for export (Farrelly, 1996).

After slaughtering primary processing takes place in processing plants and involves chilling, maturation, weighting/grading, cutting, packing, and weighting/pricing. Some products also go through a stage of secondary process including pre-cooking, adding dressings or spices, any other value-added processes. Final processing can include packaging, labeling, and freezing (Yakovleva and Flynn, 2003). An average broiler chicken yields 52% of its weight in meat for processing (Department of Industrial Works, 2001).

The primary inputs for industrial processing are water, energy, machinery, chemicals, packaging, and labour (Yakovleva and Flynn, 2003). High fixed costs (associated primarily with machinery) and health standards mean that processing firms are primarily large enterprises integrated into other levels of the supply chain (Poapongsakorn, 2005). Most firms operating in the formal supply chain have branded packaging for their products.

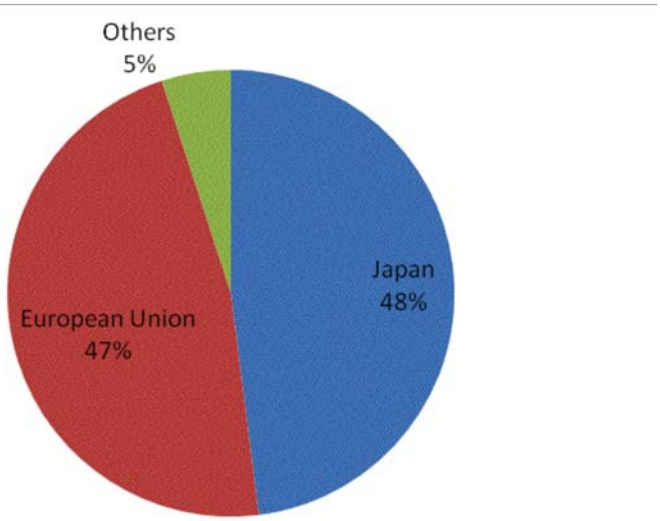
The labour intensity of processing depends on the cuts being processed. De-boning chicken is a labour intensive activity, while packaging boned chicken is less labour intensive (NaRanong, 1999). The premium cuts, often packaged individually, are either exported or distributed to supermarkets. Uniformity in the size and shape of chickens produced has in turn allowed for a higher degree of mechanization in slaughter and processing, thereby reducing labour costs associated with these processes (Burgos, 1992).

Distribution: Most distribution of poultry products takes place at night. Transporting products during the night saves costs because cooler temperatures allow for the use of transport trucks without cold storage (Farrelly, 1996). In some cases supermarkets have distribution centers where all types of fresh foods are brought. Subsequently, supermarket trucks distribute various fresh products to company outlets in cold storage trucks. This system allows supermarkets to allot products to their outlets according to daily demands. Other systems involve the delivery of poultry products directly to the supermarket outlet (Smith, 2006).

Similarly, distribution to large wet markets, or wholesalers, generally takes place in the middle of the night. Delivery to smaller markets can either involve motorbike delivery people employed by the production firm or informal channels (e.g., traders or market vendors selling to other vendors). Alternatively, market vendors can buy from wholesalers who purchase large quantities of poultry (generally through informal contracts) from producers and sell medium to large quantities of meat to vendors or restaurants during the night or early morning. One recent study that while integrators controlled more than 75% of the chicken sold in Bangkok, traditional wholesalers and retailers have largely managed to survive and remained competitive (Poapongsakorn, 2005). Major inputs for distribution include fuel and labour costs. Inputs for wholesalers include ice, water, energy, and rental space.

Marketing: Thailand is the world's fourth largest exporter of poultry products. Since the export restrictions in the wake of the HPAI outbreaks, there has been a shift to value added processed products. The primary importers of Thai poultry products are the EU and Japan. In fact, 35% of the European Union's chicken import quota is taken up by Thai companies (USDA, 2007). Recently Chinese exports to Japan have overtaken Thai exports. However, this is somewhat misleading in that some of Thailand's major poultry exporters are multinationals with large production in China**.** In this instance, viewing exports through a national lens can be misleading. If, in order to reduce transaction costs, the CP Group were to shift some of their contracts with Japanese importers to their production facilities in China then it would appear as if Thai companies had lost share in the Japanese market when in fact the CP Group's market share had not changed. Nonetheless, China and Viet Nam have challenged Thailand's competitiveness with low labour costs (NaRanong, 2007).

Figure 3.5: Broiler Exports by Importing Country (2005)



Source: The Ministry of Commerce, 2006.

Export demand driven production has implications for the structure of the poultry industry. Exporting firms are subject to inspection not only by the Department of Livestock Development, but also organizations from importing countries. Only large well organized producers can meet these requirements. Consequently, all exports come from large (mostly) vertically integrated firms. In 2006 and 2007 pre-cooked products made up 99% and 92% of total exports respectively.

Table 3.6: Exports 2006-2007 (tonnes, 1,000 Baht)

Year	Frozen Meat		Pre-Cooked Products		All Exports	
	Tonnes	Baht	Tonnes	Baht	Tonnes	Baht
2006	2,285	96,663	248,491	29,825,603	250,776	29,922,266
2007	23,841	1,308,583	290,345	33,136,298	314,186	34,444,881
% Δ	**+ 943**	**+ 1,254**	**+ 17**	**+ 11**	**+ 25**	**+ 15**

Source: (DLD, 2008). Note: There were no frozen meat exports Feb-Jun 2006.

Unlike higher levels on the supply chain, the livestock revolution did not play as much of a role in changing the retail sector. Instead, increased levels of income have shifted consumer expectations and demands (Poapongsakorn, 2005). Domestic consumption, after a sharp decrease in 2004 during the primary HPAI outbreaks, has increased back to 2003 levels (Table 3.7). In Thailand there are several types of outlets for chicken meat and eggs. Traditionally, food is purchased from “wet markets” where vendors of many products come together to sell products they have purchased or raised themselves. The main inputs for market vendors are labour (often unpaid family labour), raw poultry, electricity, water, ice, cleaning cost and daily rental payments to the market owner. Increasingly, wet market vendors are forced to compete with hypermarkets.

Rising incomes and shifting preferences in the 1990s contributed to dramatic increases in the popularity of supermarkets. The number of outlets expanded greatly, from 80 outlets in 1998 to

491 outlets in 2006 (Table 3.8). It has been estimated that by 2003 supermarkets made up 45% of total food retail sale (TDRI, 2004).

The emergence of large retailers alters the manner in which poultry meat is assembled, inspected, processed, packaged, and supplied to consumers. Large retailers require a reliable supply of products from suppliers with consistency in volume and quality (Costales *et al*, 2003). Consequently, supermarket outlets are becoming increasing integrated into food production systems. Some large poultry producers have formally invested in partnerships with large retailers (e.g., the CP Group was formerly a part owner of Tesco Lotus supermarket chain).

Table 3.7: Domestic Chicken Consumption

Year	Chicken Meat		Eggs	
	Total (tonnes)	Per Capita (kg/yr)	Total (tonnes)	Per Capita (kg/yr)
1970	210,982	5.00	302,544	8.00
1975	287,186	6.00	314,573	7.00
1980	327,290	7.00	332,391	7.00
1985	420,207	8.00	379,358	7.00
1990	513,337	9.00	571,003	10.00
1995	806,085	13.00	597,002	10.00
2000	822,324	13.00	614,586	10.00
2001	856,669	13.00	600,739	9.00
2002	898,073	14.00	639,942	10.00
2003	751,117 (FAO) 775,000 (USDA)	11.92	630,800	10.00
2004	632,000	--	--	--
2005	750,000	--	--	--
2006	780,000	--	--	--

Source: FAO STAT (1970-2003), USDA Annual Report: Thailand Poultry and Poultry Products (2003-2006),

Table 3.8: Number of Supermarkets and Convenience stores in Thailand

Store	1998	2006	% Δ
Carrefour	7	24	+ 243
Tesco Lotus	13	56	+ 331
Tesco Lotus Market	0	23	--
Lotus Express	0	245	--
Big C	20	49	+ 145
Leader Price	0	5	--
Tops Supermarket	40	89	+ 122
Total	**80**	**491**	**+ 514**

Source: Adapted from NaRanong (2007)

In addition to outlets selling raw poultry, there are many vendors who further process the poultry by adding ingredients and cooking meat to be sold from street booths. Vendors purchase pre-cooked or raw poultry products and prepare them to be sold as finished meals. Inputs for cooked food vendors include poultry products, cooking equipment, energy costs, water, and serving materials (i.e., boxes or bags and spoons/forks). Vendors selling cooked products are especially important in urban areas where many people live in apartments without kitchens and are therefore inclined to purchased cooked food to take home.

Supply Chain

Integrated supply chains benefit from a wide oversight that allows integrators to provide inputs in an efficient manner in order to better align supply with demand.

Hatcheries import parent/grandparent stock. Grandparent stock is kept at a separate breeding farm. Parent stock (imported and from breeding farm) are kept at the hatcheries. Day old chicks are either sent to company farms (or contract farms) or sold to other producers (Fallon, 2001). The farm raises the chicken until they are market weight, normally 40-45 day (NaRanong, 1999). Upon reaching market weight finished birds are transported to a company slaughterhouse. The slaughtered birds are sent to a processing facility (often at the same site) where they are cut, (sometimes) dressed and cooked, and packaged.

Byproducts can be processed into pre-cooked products or sold on the domestic market (wet markets). These extra parts, along with whole birds and premium parts, are sent to wholesalers who then distribute bags of meat to wet markets. While nearly all broiler meat in wet markets comes from large commercial producers, unlike meat on the supermarket shelves, meat in wet markets is not visibly labeled. Parts and whole birds are distributed in large plastic bags that are generally removed prior to display in the market. However, corporate signage is generally displayed behind the booth to advertise the meat source.

Wholesalers and wet market vendors who purchase broiler meat often have informal oral agreements with distributors stipulating time, quantity, and price of regular purchases. These transactions generally take place at the marketplace. Company employed delivery people deliver chicken daily. Wholesalers and large vendors may also re-sell the product to other vendors. One common process at a large market is that a few vendors, restaurant, and institutional consumers purchase large quantities (e.g. 10,000kg/day) of chicken from a company deliveryman in the middle of the night. Vendors sell the chicken to other vendors in the early morning and consumers during the day. Wholesalers sometimes extend credit to vendors or restaurants who regularly purchase large quantities of chicken meat.

Supermarkets prefer to have contracts with large retailers so they are assured a steady flow of high-quality products (Costales *et al,* 2005). Production firms often have formal contracts to supply particular supermarket chains. In addition, restaurants and other food outlets are increasingly being integrated into the poultry production system as well (Costales *et al,* 2005). For example, the CP company not only owns 7-11, where a variety of pre-cooked chicken products are sold, but also KFC and Chester Grill which use CP chicken as ingredients.

Figure 3.6: Vertically Integrated Supply Chain

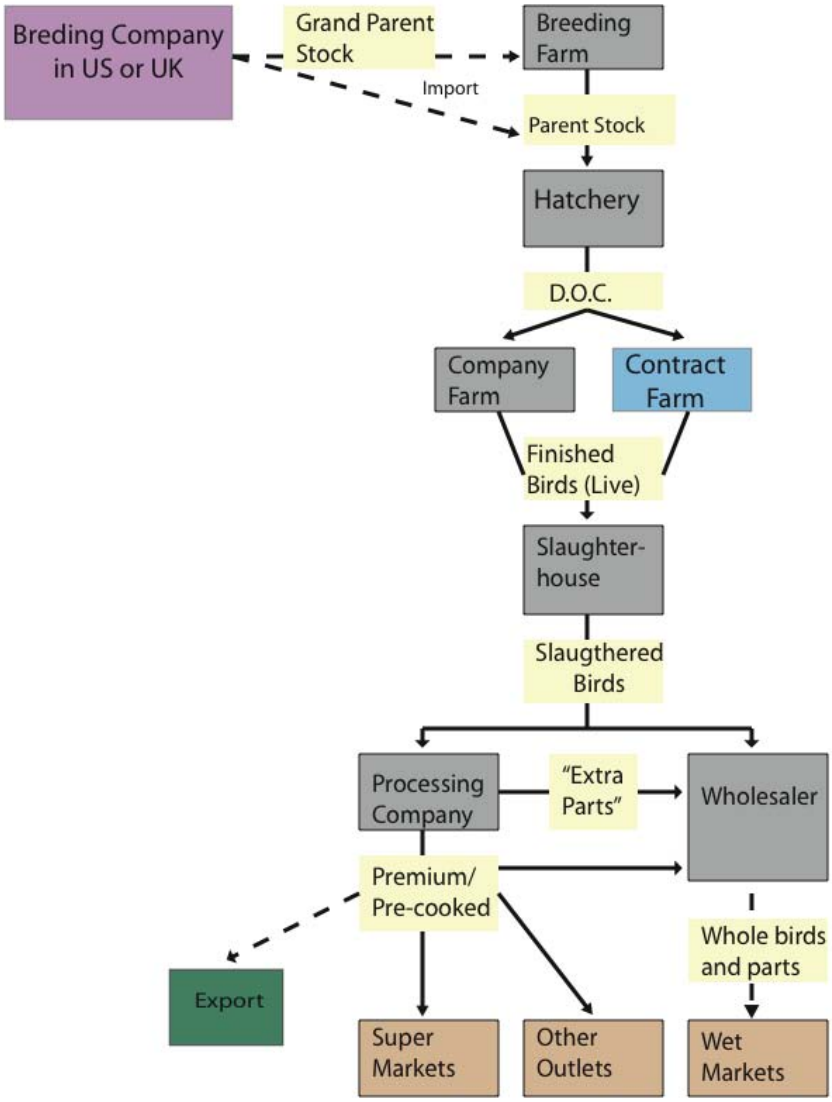


Figure 3.6 depicts an example of a vertically integrated supply chain. Dotted lines represent market transitions while solid lines show internal resource movements.

Production Timeline

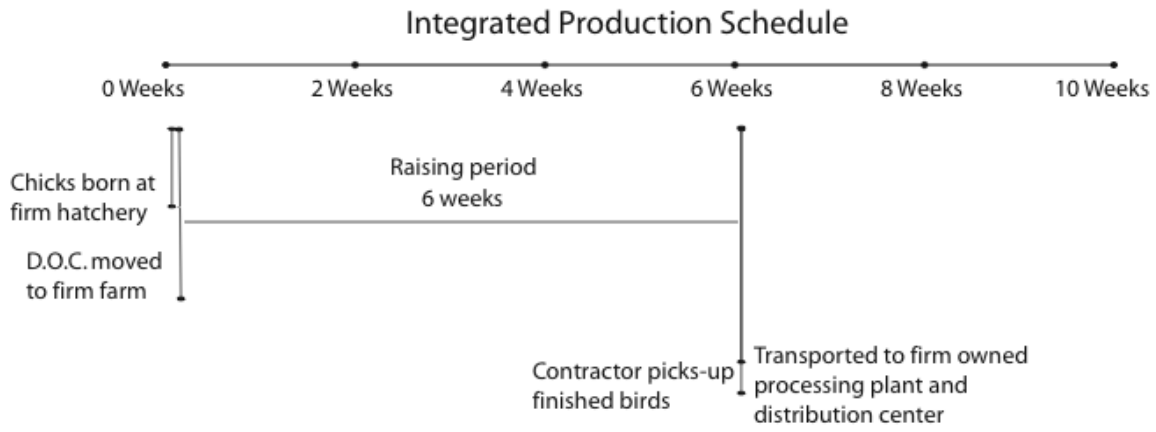
One principal reason that broiler production is an industry that lends itself to vertical integration is because of the timing precision required Hatcheries transport chicks to the rearing farm the day after they are hatched, where they are raised to market weight in the shortest period possible. In addition, with feed making up the majority of on-farm production costs, there are strong incentives to slaughter birds immediately after they reach market weight so that expenses are not wasted on extra feed. Moreover, producing a perishable product requires that processing and distribution take place in a timely manner. Aligning supply and demand allows firms to match the

flow of inputs with the supply of products to the market. Moreover, integrators can adjust flows of live chickens to the capacity of the processing facility (Martinez, 1999).

Figure 3.7 presents an example of an integrated production schedule. The incubation period on industrial farms is approximately 21 days (Yakovleva and Flynn, 2004). Utilizing the best technologies available, the raising period lasts approximately six 40-42 days (Haitook, 2006).

With the development of cold storage technologies, products that are going to be cooked can be stored between processing stages. One study found that in the UK the average length of time between hatching and appearing on the shelf as a cooked chicken product was 71 days (Yakovleva and Flynn, 2004).

Figure 3.7: An Example Production Schedule for a Vertically Integrated Production System



Summary and Implications

Vertical production chains consist of a single company controlling all aspects of each stage of production. Hatcheries, farms, feed companies processing plants, distribution, and markets can all be integrated into a single congruent supply system. In response to shifting conditions in both export and domestic markets, many producers are shifting their production further into these types of vertical systems. Moreover, a select number of firms control the majority of the market. There are some dangers of a few large integrated systems controlling the poultry sector.

One potential hazard of firms operating at this scale is the spread of disease. Even if large firms take extensive precautions to prevent disease, widespread movement of poultry, poultry parts and production supplies across the country, and international livestock trade carries the risks of spreading disease across Thailand and the world. Disease fears were brought to the forefront during the HPAI outbreaks. Hence many companies have been addressing this issue by

exercising greater control over the grow-out stage and shifting toward producing pre-cooked products (especially for export). Nonetheless, as Thai companies are major international suppliers of parent stock, chicks, and poultry meat, their supply chains and safety standards will come under scrutiny.

The shift from contract farming to integrated production systems has the most direct effect on the subcontractors themselves. Many farms that previously operated with broiler contracts have been unable to renew contracts and thus switched to duck or pork production (NaRanong, 2007).

Lastly, the move further down the supply chain, with single firms controlling poultry production and marketing outlets (i.e. restaurants and supermarkets) could be problematic for the consumer. As Thai consumers increasingly shop at supermarkets, they are generally presented with a single company's chicken branded in different manners (e.g., "Tesco brand" chicken comes from CP farms). In the extreme hypothetical that wet markets were replaced by supermarkets, only a few producers would have access to a primary market for poultry in Thailand.

4. Contract Farming

Broiler Contracts

Broiler contracts consist of contracting out the growing stage. Integrators (i.e. the firm that controls or contracts out each stage of production) recruit large farms (subcontractors) to rear broiler chickens for meat according to contractual guidelines.

From the time CP company introduced price and wage guarantees in the early seventies, contract farming has played an important role in the development of broiler production systems. One of the key advantages to subcontracting broiler rearing, from the integrator's perspective, is that it allows for flexibility in production volumes. This is a valuable ability in an industry with rapidly shifting demands. From the farmers' perspective, contracts with integrators provide them access to many facets of production that may otherwise be unavailable including credit, production technology, and the world market. Farming contracts can also help farmers mitigate risks posed by fluctuations of input prices and provide a secure market outlet for their product. The latter is especially important because of the limited facilities that process chickens raised by independent farmers. While current trends are moving producers toward vertical integration, there remain many farms currently under contract or with unused infrastructure from past contracts.

In general, there are three types of agricultural contracts with increasing degree of integration between the integrator and the subcontractor. These contracts cover four main elements; price, quality, quantity, and time. The first type, procurement contracts, only specifies the conditions of input purchases and the conditions of output sale. The second type, partial contracts, also stipulate input prices, however, some inputs are provided by the contractor. Lastly, total contracts work as though the subcontractor is renting out their farm; the firm supplies and manages all inputs while the subcontractor provides the land and labour (Singh, 2005).

Resource Flows

There are two main types of broiler contracts in Thailand (Figure 4.1a, 4.1b). The first type of contract is a procurement contract which specifies input prices and output prices. Out-prices are often tied to various performance indicators (Delgado *et al*, 2001). One example of a payment scheme is that integrators base payment on the feed conversion ratio required to raise birds to market weight. Farmers are either penalized or rewarded for the feed conversion ratio depending on the achievement standard set by the company. Procurement contracts are often used by the company Saha Farms. The second type of contract is a total contract where the contractor provides all major inputs at no cost and the subcontractor is paid per bird or per kg for the chickens produced. Total contracts are commonly used by the CP company (Sudsawasd and Wisarn, 2008).

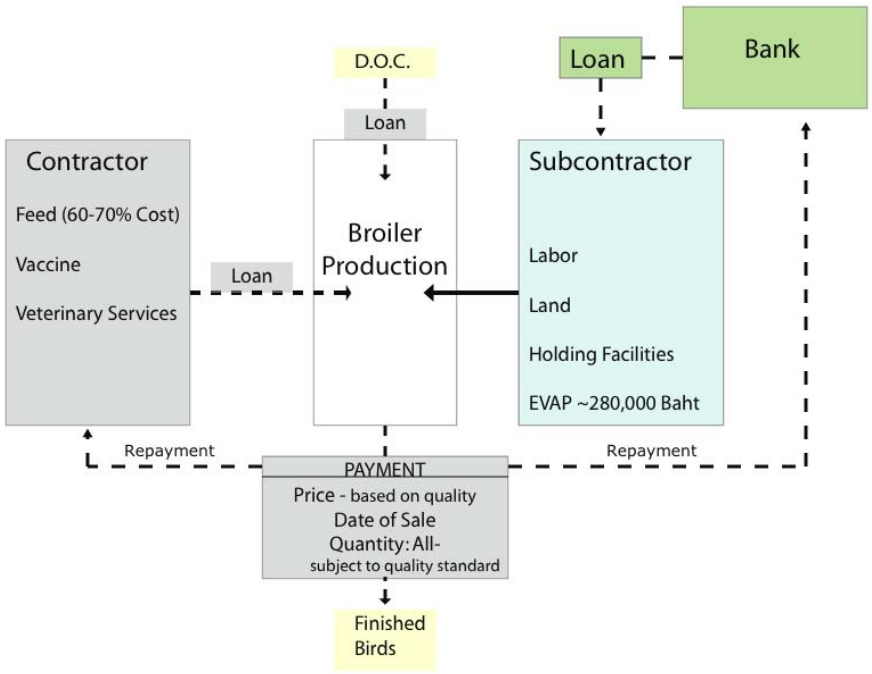
Table 4.1: Number of Farms with CP Contracts

	1999	2000	2001	2002	2003
Broiler Chicken	2,298	2,780	2,685	2,448	2,446
Layer Chicken	366	397	386	399	403

Source: Report on the investigation on contract farming of the senate committee on agriculture and cooperatives, 2003 (in Thai) cited in Sudsawasd and Pupphavesa, 2008.

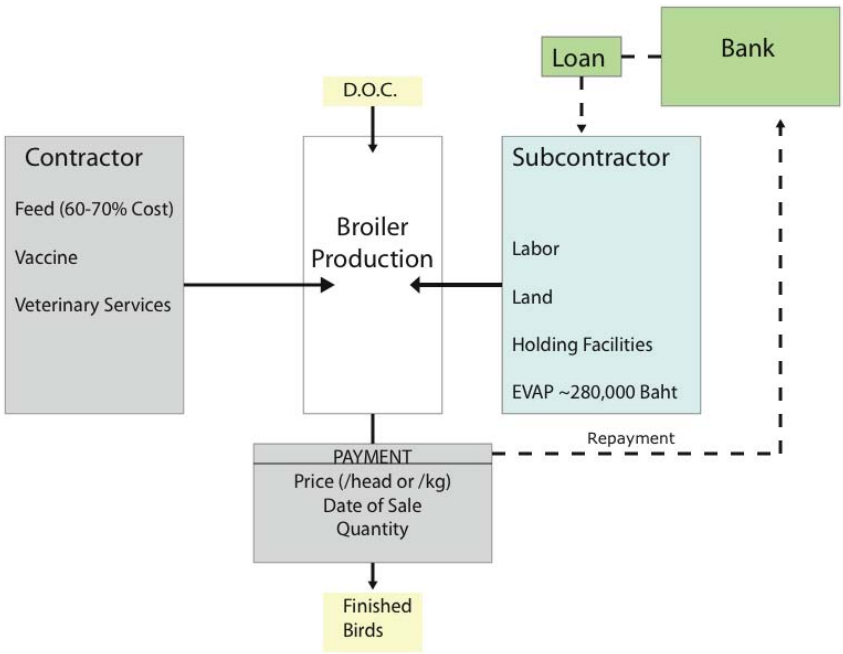
With procurement contracts, subcontractors cover all variable costs at contractual prices. Many integrators provide “loans” by initially providing inputs at no cost and later recovering the costs by taking it out of the subcontractor payment. Alternatively, total contracts necessitate that the subcontractor only provide infrastructure and labour, thus the output prices tend to be very low (e.g. 5 Baht/bird) [Haitook, 2006].

Figure 4.1a: Type 1 - Procurement Contract



Farm resource inputs for procurement contracts. Dotted lines indicate a loan or sale. Input prices are stipulated. Inputs are often loaned initially with costs taken out of the payment. The out-price may be tied to performance indicators. Formal financial institutions provide credit for subcontractors to invest in expensive infrastructure (contracts can generally be used as collateral to secure loans). 280,000 Baht is a cost estimate for installing an EVAP system on a farm with capacity of 7,000 head of broiler (Haitook, 2006). 110,000 Baht is a cost estimate for a closed system that holds 10,000 birds (Sudsawasd and Pupphavesa, 2008). With procurement contracts, subcontractors cover all variable costs at contractual prices. Many contractors provide 'loans' by initially providing inputs at no cost and later recovering the costs by taking it out of the subcontractor payment.

Figure 4.1b: Type 2 – Total Contract



Farm resource inputs for contracts. The subcontractor provides only infrastructure and labour while the contractor provides all remaining inputs. Output price is specified in the contract on a per bird or per kg basis.

Supply Chain

Most integrators in Thailand engage in a combination of contract farming and in-house farm production. Consequently, the firms are always involved in every stage of production. Subcontractors receive chicks from the firm hatcheries, feed from the firm feed company, veterinary services from the company veterinarians, etc. Therefore, while there are key differences between contract farming and complete vertical integration (e.g. who supervises over important growth stages), most aspects of the supply chain are the same.

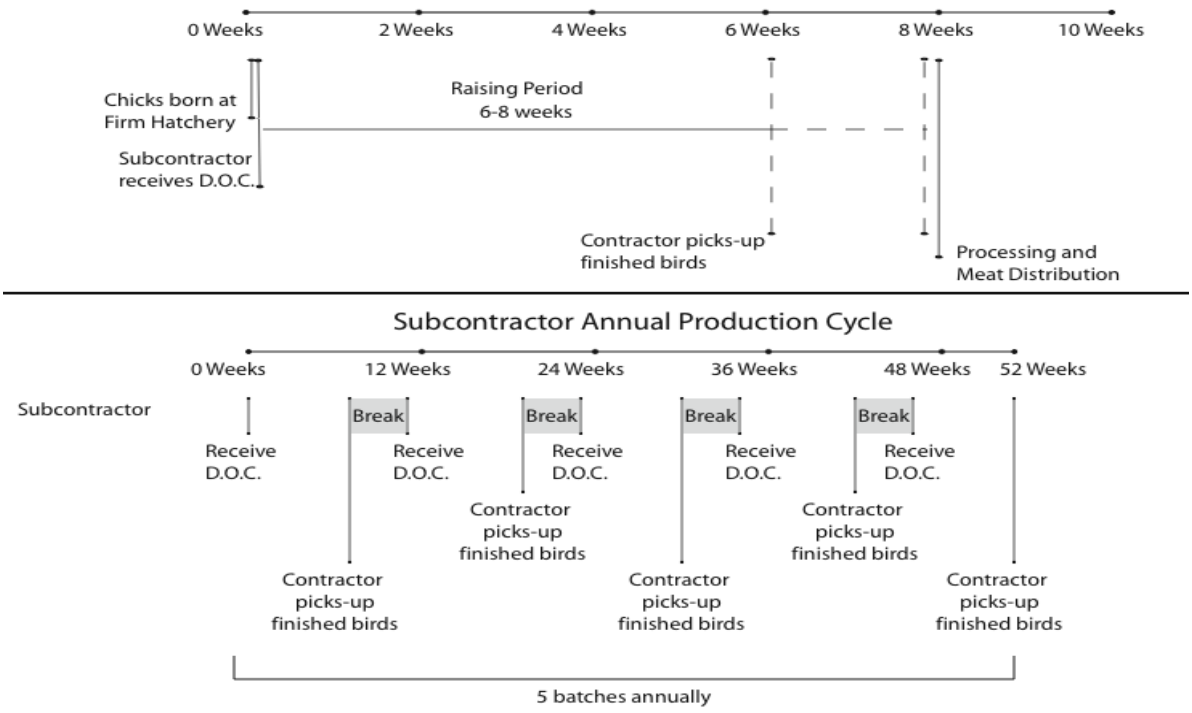
One of the most important considerations in constructing a contract is which party retains ownership of the birds during the growing stage because ownership dictates the levels of incentives for all parties involved (Farrelly, 1996). There are important implications for the incentives of all parties involved. Generally, procurement contracts dictate that the subcontractor buys the chicks from the contractor and thus the subcontractor acquires ownership for the duration of the growing period (i.e., until finished birds are sold back at the price stipulated in the contract). Alternatively, total contract arrangements dictate that the contractors retain ownership of the birds during the growing stage because the subcontractor receives all inputs (including chicks) free of charge. The implications of these varying incentives are discussed later.

Production Schedule

Akin to completely integrated production systems, all scheduling in contract production systems is controlled by the contractor (Figure 4.2, top). The integrator thereby garners the benefits of efficient scheduling and decreased transaction costs. The raising period will be similar to vertically integrated production, with more variation relating to varying levels of technology adoption (6-8 weeks).

There is an additional scheduling feature of contracting which is the annual schedule of the subcontractor (Figure 4.2, bottom). The figure shown depicts a common arrangement for subcontracting. Once the contractor has picked up the finished birds the subcontractor may have a 4-6 week “break” period where they are not raising chicken. This open period can be used to clean out the facilities. A typical subcontractor working at capacity can raise five or six batches of broilers per year.

Figure 4.2: Contract Production Timeline



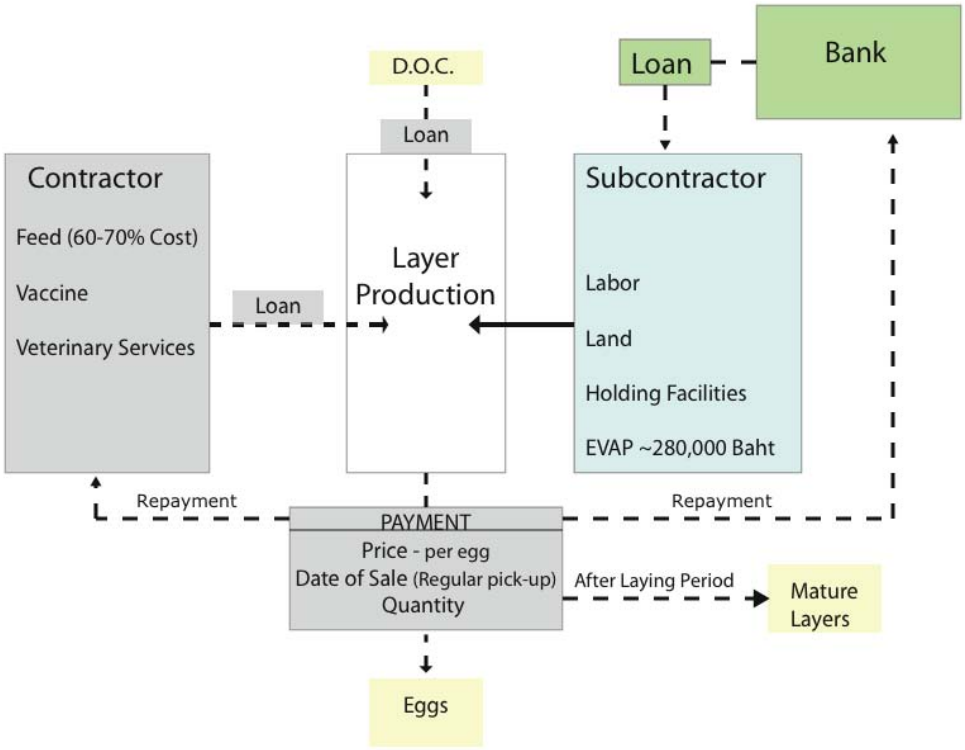
Layer Contracts

Like broiler production, many firms outsource layer egg production to contract farms. However, there is a degree of specialization in layer production that means three separate farms are often contracted within a single production system.

Resource Flows

During the first and third stages of production, layer contract resource flows are similar to broiler contract resource flows (Figures 4.1a, 4.1b) with the exception of special feeds provided by the contractor. The laying stage of production, however, is unique because the focus is egg production (Figure 4.3). Eggs are picked up regularly and payments are made on a per egg basis. Layers are sold for meat after their prime laying periods.

Figure 4.3: Resource Flows for Layer Egg-Production Contract (Contract Farm 2 in Figure 4.4)



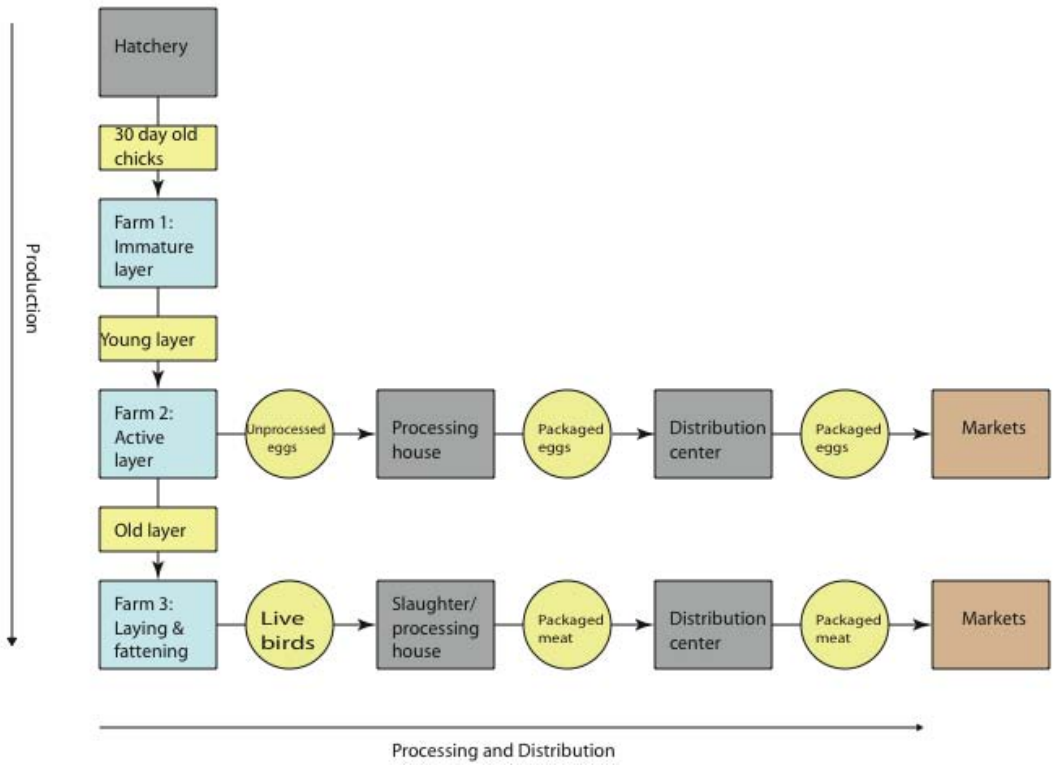
Supply Chain

The process of layer production is unique in that different products are produced at different stages of the supply chain. Throughout the supply chain all resource flows are controlled by the integrating firm.

The firm hatchery provides the first farm with 1-30 day old chicks which are then reared until they have reached a productive age. Egg producing layers are transported to the laying farms. Fresh eggs are continually picked up and taken to the processing facilities for market preparation. Upon being cleaned and packaged, eggs are distributed through pre-established channels to supermarkets, wet markets, and other outlets.

In addition to producing eggs, layers past their prime are transported to the third farm in order to be fattened for meat. During this stage of production layers may continue to produce eggs, albeit considerably less than during the previous stage. Once they have reached the desired weight, live layers are sent to firm owned slaughterhouse for processing and then distribution. Layer meat may be distributed with broiler meat.

Figure 4.4: Supply Chain for Layer Contracts



The first farm produces young layers for farm 2. The second farm produces eggs and the third farm produces layer meat.

Production Timeline

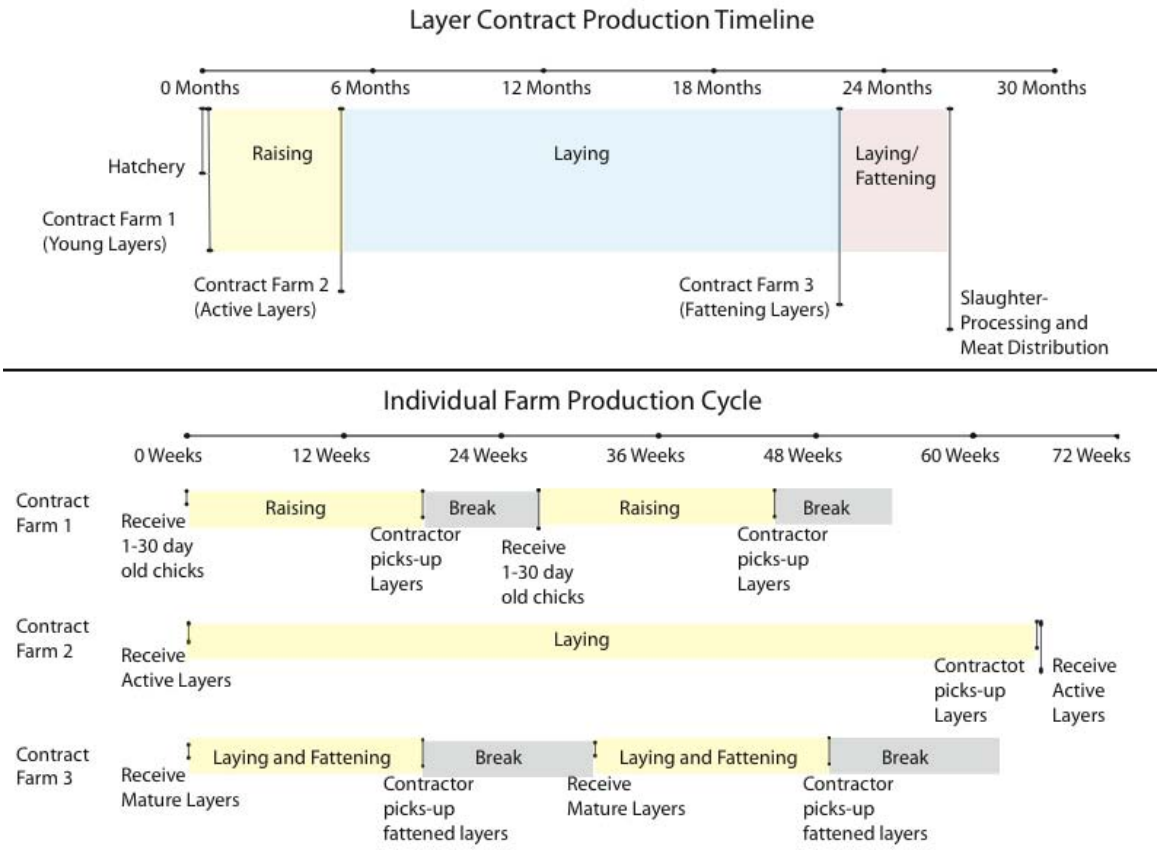
Layer production management is particularly intricate because of the many actors involved. Figure 4.5 describes production management both at the product level (top) and the farm level (bottom).

Chicks are hatched at the firm hatchery before being transported to the first contract farm whose responsibility it is to raise the chicks into egg-producing layers. The first farm is not equipped for handling eggs but instead specializes in raising layer chicks to their ideal laying state in the shortest period possible, which ranges from about 12 to 16 weeks. At the farm level, the subcontractor may have a break between batches of approximately 6-8 weeks before receiving another batch of layer chicks. This 'rearing' farm will rear two to three batches per year.

The second stage of production is laying. During this period, which lasts approximately 18 months, the layers produce eggs for sale. The farms are constructed to handle egg production and are continually active (i.e., they do not have breaks between batches).

Farms under contract for the third stage of production must be able to handle egg production while the layers undergo the fattening period. Over an approximately 18 week period the layers produce eggs and gain weight.

Figure 4.5: Layer Contract Production Timeline and Farm Production Cycle



Summary and Implications

Vertical Integration

There are many benefits of integrating and coordinating every stage of poultry production, however, there are also potential drawbacks. In general, there may be an efficiency trade-off between increasing integration and increasing market power of the primary actors. While coordination between production stages decreases costs, it can also create entry barriers for potential competitors decreases competition and may leave the remaining actors with the power to control the market (Sudsawasd and Pupphavesa, 2008).

Feed

One of the major challenges facing the poultry sector is continuing to secure low cost inputs for feed production. Use of soy has exceeded domestic production since 1992. By 2002 imports of soy were almost six times greater than domestic production. Recent rises in crop prices have indeed increased the price of feed, the primary input for broiler production. One factor in higher prices is increased demand for biofuels. A significant part of maize, soy, and cassava production has been shifted toward gasohol and bio-diesel production (NaRanong, 2007).

Recently, there have been more efforts to research alternative inputs that are expected to be more sustainable low cost inputs (Wanapat, 2003). Use of genetically modified crops is prohibited by Thai law.

Hatcheries and Breeding Companies

Hatcheries have the important role of stabilizing the industry. Controlling breeding stock is the primary vehicle for influencing broiler prices. Consequently, since the mid 1990s the main broiler producers have worked together to regulate breeding stock. This program has been relatively successful at preventing oversupply of breeding stock (aside from the years during primary HPAI outbreaks).

Despite industrial breeding companies' success in providing high performance poultry breeds, there are concerns that high throughput animal husbandry reduces food quality and, in some cases, may lead to the development of antibiotic resistance (Cole *et al*, 2000; Silbergeld *et al*, 2008).

Farms

In addition to safety standards, importers are increasingly requiring producers to meet animal welfare standards. Moreover, the demand for pharmaceutical-free products is also increasing (NaRanong, 2007). There are already a handful of producers who have the capacity to produce chemical-free broilers. However, many farms remain dependent on pharmaceuticals. The desire for pharmaceutical and vaccine free chicken also must be balanced with disease risk, particularly in light of the fallout from the HPAI outbreaks. The market for this type of chicken is expanding in both the EU and Japan.

There are also general risks associated with industrial production systems. While large industrial farms in Thailand undertake extensive precautions to prevent disease, recent outbreaks in highly developed poultry sectors (i.e. US, UK, Netherlands, Canada) demonstrate that industrialized systems are not immune to disease outbreaks. One risk to communities near farms is exposure to drug-resistant bacteria from poultry housing. Poor waste management practices also increase the potential for the spread of antibiotic resistant bacteria from farms to surrounding communities (Chapin *et al*, 2005; Sapkota *et al*, 2007; Anderson and Sobsey, 2006; Leibler, 2008; cited in Leibler, 2008). High concentrations of industrial chicken production intensifies the risks that these exposures pose to nearby communities (Silbergeld *et al*, 2008)

Contracting

Contract farming has played an important role in the expansion of the broiler and layer subsectors. Contracting out the growing stage allows integrators to maintain flexible production

levels and achieve economies of scale at the growing stage without investing in the initial costs associated with constructing a large farm (land, infrastructure, etc). However, contracting out any stage of production necessitates relinquishing some control of production oversight. Recently, contractors have been decreasingly willing to rely on subcontractors who operate without the same incentives to achieve care of the highest quality. More generally, unaligned incentives of the parties entering into a contract is a principal hazard associated with contract farming.

There are four central components of alternative incentives relating to contract farming. The first is the quality of care the chickens receive during the growing stage. The second issue is that when the contractor has invested heavily in production (i.e., total contacts), or the stipulated output price is very low, the subcontractor has incentives to sell some finished chickens to other outlets for higher prices. The third issue is that the contractor has total control over the production schedule and may have incentives to hold birds out of market if there is an oversupply. Finally, there are negative health and social externalities associated with large scale poultry production and it is important to consider which party is responsible for managing hazardous byproducts (Leibler *et al,* 2008). Construction of the contract, especially which party retains ownership of the birds, will determine the level of incentives for most cases.

During the growing stage, whichever party retains ownership of the chickens has higher incentives to provide quality care. In the case of procurement contracts, it is the subcontractor, which is also beneficial for the contracting company (they will later be marketing the chickens). However, with total contracts, the subcontractor has lower incentives to provide quality care because they are only being compensated for their land and labour. In this case the contractor may be forced to demonstrate greater oversight during the raising process. It is also possible to construct contracts in order to modify incentives (e.g., low quality care will lead to penalties or contract cancellation).

There may also be high incentives for subcontractors involved in total contracts to sell finished birds in the local market. The subcontractor has not invested in most production inputs, and will therefore receive a low price for the finished birds. However, by selling birds outside of the contract, he or she risks losing the contract and being left with expensive unused infrastructure. The same incentives may exist, albeit to a lesser extent, with procurement contracts if the stipulated price is too low. However, with procurement contracts, the contractual out-prices are higher and the subcontractor has invested more in the production process thereby lowering potential profit from breaking the contract. These adverse incentives are one reason it is beneficial for contractors to provide a reasonable stipulated price else they have to closely monitor the contract farms to ensure they are not selling product elsewhere.

From the contractor's perspective, during periods of over-supply, there are strong incentives to delay delivery of day-old-chicks or pickup of finished birds if the subcontractor retains ownership of the birds (i.e., as was the case during the HPAI outbreaks). By slowing down production the contractor may be able to keep prices stable. Moreover, by holding birds out of market that they do not own the firm can transfer the costs of excessive inventory to the subcontractor while continuing to market the birds being produced in vertically integrated or total contract systems. The subcontractor has little control in these circumstances though incentives for breaking their contract increase. However, with few alternatives for the future (aside from agreeing to a contract with a different firm) the subcontractor may not want to risk cancellation of their contract which would likely have a greater long-term cost.

Similarly, many contracts are renewed on a yearly basis and integrators may choose not to continue contracts if there are already sufficient levels of production. This poses problems for subcontractors who take out long term loans to finance the upgrades necessary to receive a contract. In fact, one study found that average debt per contract farming household was 300,563 Baht compared to a national average debt per household of 37,231 Baht (Delforge, 2007).

An additional facet of contractual production that is particularly important to society is waste management. Industrial production produces large volumes of animal wastes that can be hazardous to the environment and are potential disease carriers (Leibler *et al*, 2008). Many contracts stipulate that the subcontractor is responsible for the costly management of these wastes. However, when integrators are not responsible for waste management costs, they have distortedly high incentives to increase production density without regard to costs or environmental constraints posed by the disposal of a high volume of wastes (Leibler, 2008).

Contract systems have been operating in Thailand for three decades. Integrators have much experience balancing incentives for optimal production systems. Nonetheless, these issues will continue to be revisited anytime there are problems in the sector. Consequently, there will always be a need to re-evaluate production as systems as the sector evolves and continues to expand. The recent shift toward vertical integration has come partly out of these considerations.

Processing

There is mounting worry about the environmental impacts of industrial processing. Exporting companies have to comply with regulations set by importing countries which increasingly contain stipulations about the environmental impact of production (Sriwichailamphan, 2003). Air emissions, wastewater, and chemical waste are the main waste outputs from processing. Heavy reliance on machinery and refrigeration mean that the processing stage of the system is energy intensive (Yakovleva and Flynn, 2004). In the future, producers may be inclined to incorporate more environmentally friendly and energy efficient equipment and practices.

Distribution

Recent rises in fuel prices raise incentives to move the various stages of production closer together. One option is to create industrial centers where all stages of processing take place in a single area. While this decreases transportation costs, it also increases potential for the spread of disease.

In terms of exports, rising fuel costs have potential to change the dynamics of exports. In addition to production costs, proximity to markets becomes increasingly important to competitiveness. The two major importers of Thai poultry products, the European Union and Japan, offer different challenges in this sense. Thai companies must compete with China and Vietnam for Japanese market share, while the U.S. and Brazil benefit from their proximity to Western Europe. Currently, Thailand accounts for almost half of the EU import quota. While this is unlikely to change soon, if transportation costs continue to rise unmitigated, Thai products will become less competitive on the European market.

Marketing

Rapid expansion of poultry production, driven largely by export demand, has also contributed to the decline in chicken prices. Domestically, Thailand has seen an increased use of chicken in restaurants and among food vendors as an ingredient in cooked meals. Some restaurants are owned by poultry producers and hence are integrated into the production system. The developments of new products such as chicken sausages, chicken meat balls, and fried/roasted chicken parts have also contributed to increased demand of products. Moreover, as real incomes rise in Thailand, individuals place a higher value on their time and are more likely willing to pay a premium for cooked food. These trends suggest that selling cooked chicken products in informal booths on the street may provide the greatest employment opportunity for poor labourers in the poultry sector (Poapongsakorn, 2005).

For the export market, the OIE accepts a compartmentalization approach where integrated broiler production is treated as a separate system with separate inspections for meeting export requirements. Thailand hopes to restart frozen chicken exports to the EU and Japan (USDA, 2007). Compartmentalization is also increasingly important, given the demand for pharmaceutical-free products, because of the emphasis on decreasing the use of chemicals (NaRanong, 2007).

5. Independent (Smallholder) Farmers

Independent farmers raise chicken without formal ties to feed, processing or any other companies from other poultry subsectors. In the past, some independent commercial broiler

producers have been able to exist. Many of these farms were in the transitional stage, developing the farm in order to be eligible for a production contract. However, independent farmers are increasingly unlikely to raise broiler chickens because they cannot compete with integrated commercial suppliers whose highly efficient production systems produce low cost, high quality broiler meat. In addition, without contracts to use as collateral, it is difficult for many independent farmers to secure loans, and when loans are available the rates are generally high (Sudsawasd and Pupphavesa, 2008). For smallholders, some of their independent farms' primary advantages are no longer permitted in many areas. Previously, lower investment costs in housing as well as integrated chicken and fish farms increased the viability of independent farms. However, in response to the HPAI outbreaks the Farm Standards were passed which prohibit these activities considered risky (NaRanong, 2007). In response, some farmers have switched to duck or swine raising, or moved out of the livestock sector altogether.

Unlike broiler production, which is undertaken almost exclusively for commercial purposes, there are many motivations for raising chickens on backyard farms. Common purposes for raising include; household consumption, supplementing income, and cock fighting. Native chickens are not exported and have limited supply chains. Independent farmers rearing native chickens are inherently different from commercial broiler producers because their production decisions are less likely to be driven by market conditions for their product.

Most smallholders generate a majority of their income from activities other than raising poultry. However, farmers have low incomes and receive an important source of supplemental income from chickens. While independent farmers do not carry the economic weight of the large producers, they do represent the largest number of farms involved in poultry production. In fact, one study found that 95% of rural households in the northeast reared chicken, most with flocks ranging from 5 to 50 birds (Chantalakhana and Skunmun, 2002).

It has long been recognized that native breeds of poultry in Thailand are favorable for low income producers. Native breeds provide various benefits including; heat tolerance, disease resistance, the ability to scavenge for feed, and (to many) a preferable taste.

Resource Flows

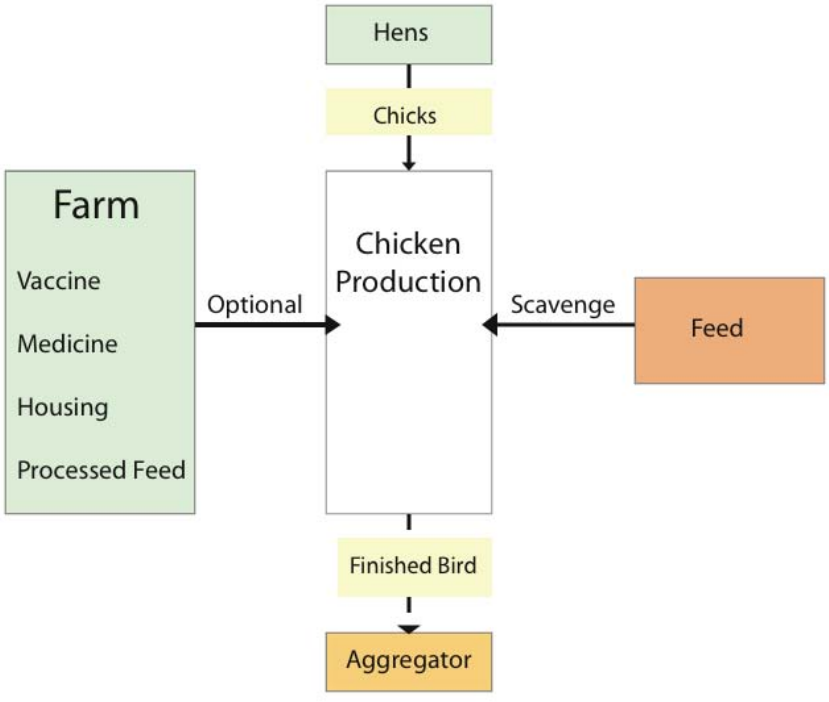
Native chicken breeds are ideal for smallholder farmers, in large part because they are not capital intensive. Hens on farm are used for restocking the flock and may provide some eggs for consumption (native breeds have low hatchability rates). One study found that more than 70% of farmers reproduce their own stock (Haitook, 2006).

Most birds scavenge for naturally occurring feed sources (worms, seeds, etc.), rice byproducts (polished paddy rice and broken rice) or for household food scraps (Haitook, 2006). Some farmers provide their flocks with nominal inputs of feed, though rarely more than one feeding per day (Haitook, 2006). Given the expense of commercial feed, and the native chicken's ability to scavenge, normally it is not cost-effective to provide the birds with commercial feeds. Chicken housing is often minimal or non-existent, and a limited number of farmers use vaccines or medicines.

One study of backyard farmers in the northeast of Thailand (Chantalakhana and Skunmun, 2002) found that that 73% of backyard farms had never vaccinated their flock. Of the 27% of households that did vaccinate, 73% purchased vaccines from a drug store and 24% purchased it from government agencies. An earlier study (Ratanapanya *et al,* 1989) found three primary reasons that backyard independent farmers did not vaccinate 1) Farmers felt that native breeds of chicken were disease resistant thus rendering vaccination unnecessary; 2) Small flocks make chickens less economically important and farmers did not feel it was cost effective to vaccinate, and 3) Vaccines were not readily available at the village level.

Low cost inputs mean that unlike broiler contract farmers, most independent farmers do not need to take out loans to finance poultry raising. Instead, households rely on a combination of profits from raising poultry as well as income from other employment to finance their backyard farms.

Figure 5.1: Resource Flows of Independent Farmers

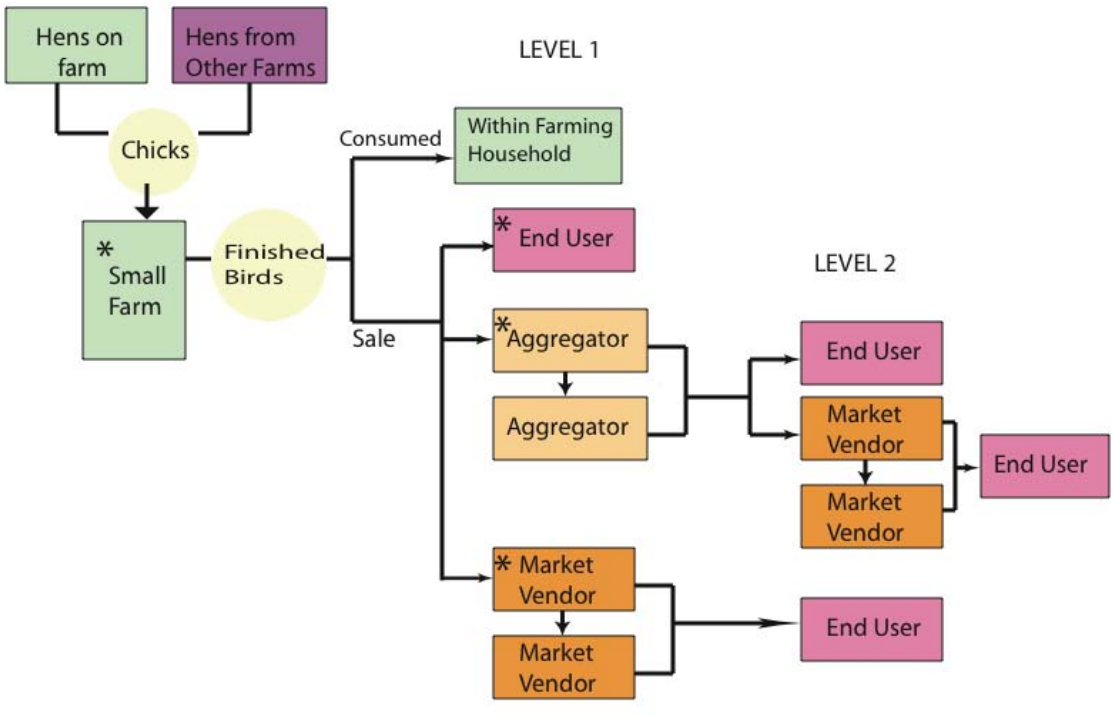


Oversight of smallholder poultry production is based primarily on the village animal health volunteer system. The system stipulates that each village has a volunteer who is trained by the Ministry of Public Health about basic animal care. Subsequently, the volunteer visits households that raise chicken and informally monitors production as well as offering basic advice about chicken rearing. Benefits of this system include low overhead costs and the utilization of existing relationships (i.e., oversight by peers). These relationships were exploited in some places during mass culling to locate households that reared chicken (most backyard farms are not registered with the DLD). One potential downside to this system is that village volunteers may be reluctant to assist authorities in locating peers' chickens for culling or may feel inclined to inform other villagers that authorities are coming to cull chickens. Despite these disadvantages, the village volunteer system could be an effective way for the government to reach rural farming households and disseminate knowledge at a reasonable cost.

Supply Chain

Unlike commercial and semi-commercial farms, chicken from small independent farmers are not exported and rarely transported large distances. Most birds are consumed locally, either by the household that raised them, or sold through a local network. Most backyard farms consume a portion of the birds they raise. The surplus can then be sold to supplement household income. Within this system, poultry is generally sold at the gate to one of three parties.

Figure 5.2: Independent Farm Supply Chain



Independent farmers have minimal inputs with on-farm hens providing stock, birds scavenging for food, and selective disease prevention methods.

Supply Chain Level 1

Case 1: End User

In the first case, one or two birds are sold to a neighbor within the village for consumption. With this type of transaction, birds are usually sold live for the buyer to slaughter themselves. In some cases the farmer will slaughter the bird prior to the sale for a small premium. Generally chickens sold to neighbors are priced by the head (Haitook, 2006).

Most often there is not any type of agreement prior to purchase. Villagers know which households raise chicken within their social network and can go purchase birds from a trusted source. Price is negotiated or set by the farmer.

Unlike commercial producers, small independent farmers existing outside of formal channels do not have to conform to standardized safety standards. Normally, safety certification helps to overcome the market failure that is caused by asymmetric information, where the consumer lacks knowledge of the risk they are undertaking. However, in the case of farm-end user transaction, social capital serves a similar purpose. If there is a problem then the consumer can hold the source farm responsible.

These transactions are not subject to regulations or transaction fees and are thus somewhat insulated from problems that occur in the wider market. However, because of their nature, there is a limited demand. The market is restricted primarily to households within the village or another social network. Moreover, in villages where most households raise chicken, demand is limited primarily to particular periods such as Thai or Chinese New Year. Under conditions that prevent backyard farm products from reaching the market (e.g., if meat sold in wet markets were required to have safety certification) farmer-end user transactions are likely to continue and be the primary outlet for sale.

Case 2: Aggregator

The most common channel available for farmers to sell larger surpluses is the aggregator. Aggregators serve an essential role in a functioning supply chain for independent farmers. They collect chickens from a variety of farms and sell them to one of the three channels discussed in this section (end user, aggregator, or market vendor). Aggregators are the main enabler of trade outside of the village and thus determine the extent to which rural farmers are connected to urban markets. Generally, aggregators drive motorbikes (or in some cases trucks) from village to

village inquiring about purchasing birds from many different farms. Often the aggregator offers to purchase as many birds as the farmer is willing to sell. The transaction takes place at the farm gate and involves live birds. Birds sold via this type of transaction are generally priced by weight (Haitook, 2006).

The aggregators dictate the price of the sale because they have bargaining power. There are many farms that aggregators can use as substitution, however, if the farmer does not want to sell for the price offered then the household may not be able to sell the chickens at all. Some farmer-aggregator transactions happen without previous consultation; the aggregator sees chickens, stops, and inquires about making a purchase. It is not uncommon for a farmer to decline a sale at the time of inquiry but agree to a time and quantity of sale in the future. The price may be stipulated or negotiated on the sale. Some independent farmers, especially larger ones, have regular arrangements with particular aggregators.

Case 3: Market Vendor

Market vendors are another common outlet for backyard poultry. Here we define a market vendor as anybody who sells chicken from a stall in a market. Market vendors often have more than one role within the supply chain. For example they may raise poultry themselves, and purchase birds from other farms to supplement supply. Vendors can also serve the role of aggregators, collecting birds from various farms and selling them to other market vendors. Transactions between vendors and farmers are also most likely to take place at the farm gate. Similarly to farmer-aggregator transactions, the purchaser has substitute sellers and thus more power to dictate price.

Vendors who sell chickens in the market every day (most vendors) need to have a regular supply of product. Common supply sources are birds raised by the vendor, purchases from aggregators, or purchases from farmers. Some vendors hold birds at their homes for a few days before they take them to market. Regular purchases are most likely to entail some an informal agreement while supplemental purchases may be made without prior agreement.

Many vendors sell more than one breed of chicken. In this case, wet market vendors participate in both the formal and informal supply chains, selling both native, broiler, and/or cross-bred poultry that come from backyard farms and integrated production systems, purchasing native chickens from the independent farm supply chain is only part of a larger venture that entails purchasing and re-selling broiler meat from commercial enterprises.

Supply Chain Level 2

Case 1: Aggregator-(Market Vendor or End User)

The most common outlet for aggregators is a market vendor. There are two primary scenarios for this interaction. The first is that the aggregator delivers slaughtered birds to the market in the morning for sale during the day. Such transactions sometimes take place along the guidelines of an oral agreement. Larger vendors are more likely to have established relationships that ensure a regular flow of product. The second scenario is an informal contract that dictates delivery of live birds to the vendor's home, often the evening prior to sale. The vendor can then slaughter and prepare the birds for market in the morning. Such home delivery requires an agreement which usually entails a stipulated quantity and price of birds (that may or may not be regular).

Transactions between aggregators and end-users are inclined to take place between familiar parties. The obvious reason being that aggregators do not have infrastructure (else we call them market vendors) dictating that they deliver to end users which requires communication prior to the transaction. One could imagine an exception where an aggregator kept live birds at their home prior to sale that locals visited to purchase chicken. This scenario would be more likely in villages with few farmers. Else, the trader would deliver to an end-user a pre-determined quantity (dictated by purchaser) of birds at a specified price (dictated by seller).

Another important role that the aggregator often serves is slaughterer. Because formal slaughtering facilities are not generally used by independent poultry farmers (small volumes of birds are easy to slaughter) the aggregator is the most common slaughterer. Live birds are rarely, if ever, sold in Thai markets.

Aggregators selling to market vendors (at the market) will slaughter the birds first. Other transactions (sale to other aggregators, vendors at home, and end users) could take place with live or slaughtered birds.

Case 2: Market Vendor-(Market Vendor or End User)

Market vendors by definition sell poultry from a market stall. As noted, the sale of live birds in wet markets is rare in Thailand. Therefore almost all birds are slaughtered by the time they reach a marketplace. At large wholesale markets vendors may sell large quantities of chicken at a discounted price to other vendors. Transactions of this type likely have oral agreements because larger quantities need to be planned in advance. Vendors who buy chicken at markets are most likely to re-sell them at peripheral markets where they can charge a premium to end-users who do not want to travel to the central market where lower prices are available.

In the second case, where vendors sell to end-users, the purchasers are likely to be of two types; households who will cook the meat and restaurant/shop owners. However, restaurants generally do not use expensive native breeds for chicken dishes unless it is a special dish that highlights the use of native breeds. Restaurant owners are more likely to purchase larger quantities and have oral agreements dictating quantity and price while households generally buy small quantities without any pre-established conditions. Prices may be negotiable though most vendors have set prices for whole, and various parts of the chicken.

Production Timeline

Unlike industrial production, backyard production does not consist of batches or production schedules. Rather, most backyard farms continually raise birds and keep a flock of various ages. Low inputs permit households to continue sustaining finished birds without substantial costs (alternatively, commercial producers have strong incentives to move birds along the supply chain as quickly as possible to save money on feed and make room for a new batch of birds).

One corollary of low inputs and no housing, is that native chickens on backyard farms have significantly slower growth rates than broilers on commercial farms. However, breed characteristic is an equally or more important factor. One study (Jaturasitha *et al*, 2002) found that even with comparative raising techniques, chickens of native breeds took twice as long as broilers to reach market weight (12 and 6 weeks respectively). In addition, the average market weight of the native birds was significantly lower (1.2 kg for native breed and 1.9 kg for broiler). However, despite the lower growth rate, the noted attributes of disease resistance, low inputs, and for some, superior meat quality make native chickens ideal for backyard farmers. Native chickens receive a higher price in the market than broiler meat, however, there is a limited market for native chicken meat.

Summary and Implications

The importance of native poultry breeds to the livelihoods of rural households has long been recognized in Thailand. Past studies have proposed various approaches to using chickens as a tool for promoting poverty alleviation. Approaches that have been suggested include encouraging higher levels of rural poultry consumption to increase rural household protein intake (Ratanawraha, 1997), alternative supply chains (Haitook *et al*, 2003), improving breeding techniques and increasing the use of cross-breeds (Loupaibol and Chitpraneechai 1999), as well as developing low cost feeds to improve performance, and increasing knowledge dissemination and technical assistance.

However, the HPAI outbreaks forced all other issues into the background and subsequently any promotion of backyard poultry rearing requires bio-security considerations and has become more complicated in general. Given the circumstances, a positive outcome would be for improved bio-security to coincide with increased income for poor rural households. If local supply chains were to be cut off for any reason, backyard farmers are likely to revert to consumption complemented by inter-village sale as opposed to ceasing to rear chickens. However, this would cut off a source of income to some of the lowest income groups in Thailand, and potentially drive local poultry trade underground.

In order to achieve higher levels of bio-security on backyard farms, it would be advisable to promote a system where smallholders feel it is in their own interest to improve bio-security. Otherwise, rural households are unlikely to comply with regulations that are seen as detrimental to their livelihoods and difficult to enforce. Some obstacles can be anticipated from the reasons given for not vaccinating in a previously cited study of smallholders (Ratanapanya *et al*, 1989). The study found that there were three primary reasons that farmers did not vaccinate their flock:

1. Farmers felt that native breeds of poultry were disease resistant and thus vaccination was unnecessary.
2. Small flock sizes meant that chickens were less economically important than other farming activities and thus did not warrant investment.
3. Vaccines were not readily available at the village level.

The first two responses point to incentive problems, while the third response highlights resource barriers to bio-security improvements.

In addition, there are other problems with lacking incentives. High mortality rates are common on backyard farms and losing a flock to disease might be seen as a normal part of livestock rearing that does not necessitate changes in behaviour. Also, there is currently minimal economic benefit garnered from improving bio-security. A farmer is likely to receive similar market prices for chickens raised under the house that scavenges and chickens provided with closed housing and vaccines because quality information is lost in the supply chain. Any effective policy would need to address both lack of incentives for, and barriers to, improving bio-security on backyard farms.

Market-oriented smallholder poultry enterprises are increasingly being recognized as options for poor households (Ahuja *et al*, 2008). One successful example is that of a company that supplies a cross-breed chicken in India which is adapted to village poultry rearing and raised by rural households. The bird, known as Kuroiler, involves a five stage supply chain that has proved effective in providing a regular flow of higher performance birds to backyard farms (See Ahuja *et al*, 2008). The success of the brand relies not only on the chicken, but also on the establishment of the supply chain (Ahuja *et al*, 2008). The incentives are structured so that all actors are

interdependent in the production system. Regional hatcheries are established where chicks are hatched and raised to an age of 2-4 days, before being moved to a “mother farm” where they are raised to an age of 6-8 weeks. Undertaking early growing stages on farms where the chickens can be vaccinated greatly decreases mortality once the chickens are moved to the rearing farms.

Birds are raised both for consumption and for sale. Some farmers sell their birds in local markets, however, other times the chick supplier connects rearers with buyers for a small fee. Many rural households now choose to keep Kuroilers because of the improved performance. One could imagine a system that goes even further where suppliers buy back birds and market them under a brand name. It would be unlikely that such a system could compete with integrated producers. However, Ahuja *et al*, 2008, point out that in India, there are distinct segmented supply chains (Kuroiler and the traditional broiler) and there is minimal competition with large-scale actors.

Cross-bred chickens are appealing because they can improve on some disadvantages of indigenous breeds, primarily slow growth and low hatchability, while having higher survival rates and retaining the taste that some consumers prefer. Similarly to India, Thai consumers have traditionally preferred the taste of native chicken breeds, although it is unclear how strong of a preference there might be among the younger generation that grew up with a wide variety of CP products. Alternatively, smallholders might be able differentiate a branded product based on other guidelines. Upgrading inputs and constructing some basic infrastructure might allow smallholders to market a ‘Free Range’ chicken. Additionally, if smallholders could produce a safe product they might be able to market an ‘Organic’ chicken. Whatever the approach, costs will have to be low while providing sufficient economic benefits rewarding the additional effort farmers would undertake.

6. Conclusions

This report presents a decomposition of the supply chain for each of the three main chicken production and marketing systems in Thailand. This structured perspective on an essential food and livelihood sector is aimed at supporting effective and equitable actions by those in Thailand who have the responsibility to design and implement policies that can affect a variety of market participants.

In this report, we map out the sector schematically, diagramming relevant poultry production and marketing systems and highlight potential issues that may arise from interactive vertical and horizontal effects. In future work, we plan to calibrate these schematics to facilitate assessment of economic linkages and the extent to which these confer welfare effects across the supply chain. We have chosen poultry because of its essential role in the food supply, its importance to livelihoods of the rural poor, and the diversity of the sector as it experiences historic transition.

There are many reasons for the success of the industrial poultry sector in Thailand. Gradual changes meant that firms have built up the human capital necessary to stay competitive. Moreover, with the logical succession of progressions, growth remained balanced without any one subsector lagging behind (Farrelly, 1996). While the government has played a limited role in promoting chicken production, it has not prohibited its growth. Low export tax and providing incentives for research and quality control services have played an important role in the development of the commercial sector (Costales *et al*, 2005).

There are many motivations that can help explain the poultry sector's recent shift toward vertical integration. Among them, response to export restrictions, reactions to shifts in the domestic market, and the pressure to further increase feed productivity, decrease transaction costs, and improve scheduling in order to succeed in an extremely competitive industry. In assessing the requirements for intensive broiler production, it will be difficult for many independent commercial farmers will be able to participate in this subsector in the future (NaRanong, 2007; Costales *et al*, 2005, Pupphavesa and Sudsawasd, 2008). The high fixed costs of processing, controlled primarily by the integrators, is one example of the barriers prohibiting entry of independent farms into broiler production. Moreover, there are obstacles to entering into contracts with integrators. The high costs required to build the necessary infrastructure, and difficulty of securing loans without collateral, make it unlikely that low income households would be able to enter into the growing stage of industrial poultry production. Even farmers that presently have contracts may have difficulty adapting to the current hyper competitive conditions if they are required to make expensive upgrades to farm infrastructure.

Nonetheless, there are many benefits of the industrial poultry sector development. As a result of increased scale and integration, average cost of production has greatly decreased thereby decreasing the price of chicken meat. In turn, chicken has become the most affordable source of meat protein in Thailand. Consumption has increased accordingly. In addition, employment in the industrial poultry sector has increased from 52,460 people in 1980 to 110,000 people in 2000 (Poapongsakorn, 2005). Moreover, the low cost of chicken meat means that selling cooked food with chicken inputs at informal street booths is a viable employment opportunity for many low income workers (Poapongsakorn, 2005). However, despite the many benefits, experience from other countries with highly industrialized poultry production systems demonstrate that there are some disadvantages to such production systems.

Leibler *et al*., 2008 suggest that in the U.S. poultry sector, low costs for poultry meat mask significant externalities associated with industrial food animal production, which may have dramatic impacts on public health. Among these externalities are the increased risk of disease spread from animals to humans (especially antibiotic resistant bacteria) and environmental

hazards stemming from the disposal of large volumes of animal waste. High density of production intensifies the impacts of these exposures.

Whether backyard or industrial farms are more risky in terms of spreading disease, and HPAI in particular, is a contentious issue. Large farms take extensive precautions to prevent disease, but raise high densities of breeds that are highly susceptible to disease. In addition, large farms have a much higher potential to spread diseases over greater distances. Smallholders generally take few precautions to prevent disease. However, the breeds raised are disease resistant and, given the localized supply chain, smallholders are unlikely to spread diseases over a large distance. Ideally, both production systems will continue to exist while mitigating the risks as much as possible.

Consumers' perception of quality is continuously evolving and producers must adapt to these perceptions (Costales *et al*, 2005). These reactions in turn influence which supply models are utilized. Most recently, the industry has adapted to the HPAI outbreaks by exerting increasing control over every stage of production and emphasizing their safety standards in their marketing campaigns. Additionally, because of export restrictions and changing consumer demands, processing plays an increasingly important role in production. Pre-cooked products are exported and marketed domestically in increasing numbers.

The objective of this report has been to describe the supply chain for the main chicken production systems in Thailand. In doing so, the expectation is that it can serve as a framework for those who have the responsibility of constructing policies which will in turn impact all market participants. As with constructing disease control policies, regulating the poultry sector in general requires balancing of a complex set of interests that are often conflicting. Addressing and balancing these concerns will be the most important regulatory task in the future.

This supply chain audit approach can be applied to other categories other agricultural products. In subsequent studies, we will use it to elucidate the working of markets for chickens, ducks, and other livestock varieties in other countries, distilling more general lessons to support pro-poor livestock policy and food security.

Figure 6.1: Summary of Poultry Production and Marketing Systems

Characteristic Investments:	Independent Rearer	Contract Farming			Vertical Integration
		Contract Farming	Total Contract	Procurement Contract	
Housing and equipment, raising facilities	By Farmer	By Subcontractor	By Subcontractor	By Subcontractor	Large-scale company that covers all supplies itself (seed, feed mill, drugs, farms, slaughter and processing factory, etc.)
Chicks, seed/feed, drugs/vaccines	Purchase with Cash or Credit and Management by Farmers	Supplied by contractor, managed by farmer	Supplied and managed by contractor	Supplied by contractor, but farmers purchase	
Technologies	Farmer breeding, scavenged feed, no special housing, small scale (1-50 birds)	High level of technology adoption	High level of technology adoption	High level of technology adoption	Proprietary technology
Markets	Home consumption or flexible for any market by rearer	By Contractor	By Contractor	By Contractor	Markets own products (meat, processed food, etc.) within country and for export.
Farm Gate Price	Dependent on market	Contract Price	Contract Price		
Income	High variability, depending on both inputs and outputs	More Consistent: Depends on Terms, Capacity	Consistent earning, paid small price (per bird or kg)	Variable, depending on markets	
Risk Level	High	Low	No Risk	High of technological adoption	
Advantage for Subcontractor	Needs experience, needs a market niche	New Farmers will be Trained by Contractor	Business could start at once as housing available; experienced farmers	Farmers have available capital; expenses could be deducted directly from contract	
Policies / Institutions	None or government poultry distribution	Contracts, subject to contractor and government quality controls	Contracts, subject to contractor and government quality controls	Contracts, subject to contractor and government quality controls	

Source: adapted from Taenkaew, 2001 (cited and translated in Haitook, 2006 p. 47) and Farrelly, 1996

7. References

Ahuja, V., M. Dhawan, M. Punjabi, L. Maarse (2008) “Poultry based livelihoods of rural poor: Case of Kuroiler in West Bengal”. South Asia Pro Poor Livestock Policy Programme, initiative of NDDB and FAO: Document 12, April 2008.

Bishop, R., L. Christensen, S. Mercier, L. Witucki (1999) “The World Poultry Market – Government Intervention and Multilateral Policy Reform.” USDA/ERS.

Chantalakhana, C., P. Skunmun (2002) “Sustainable Smallholder Animal Systems in the Tropics.” Kasetsart University Press, Chatuchak, Bangkok, Thailand.

Chinrasri, A. (2004) “Poultry Production Technology.” Apichart Printing Press, Mahasarakam Province, Thailand (in Thai).

Choprakorn, K., V. Wattanakul, K. Wongvisit, V. Suriyachanthrathong (2000) “Indigenous Chicken and Hybrid chicken: Past and Present.” Thailand Research Foundation, Ratchatewi, Bangkok (in Thai).

Costales, A., P. Gerber, H. Steinfeld (2005) “Underneath the Livestock Revolution.” FAO Livestock Report 2005, in Global Development.

De Haan, C. (2003) “The livestock revolution: Environmental, social and health impacts.” World Bank, New York, USA.

Delgado, C., C. Narrod, M. Tiongco (2008) “Policy, Technical, and Environmental Determinants and Implications of the Scaling-Up of Livestock Production in Four Fast-Growing Developing Countries: A Synthesis.” Project on Livestock Industrialization Trade and Social-Health-Environment Impacts in Developing Countries. Research Report 157. Submitted to FAO by IPFRI.

Department of Livestock (2006a) “HPAI Control Measures Undertaken since 2004.”

Department of Livestock (2006b) Annual Data: http://www.dld.go.th (retrieved July 30, 2008).

Department of Livestock (2008) “Statistics on Imports and Exports of Livestock Products” January 10, 2008 (in Thai).

Fallon, M. (2001) “Traceability of poultry and poultry products.” Review of Science and Technology. Off. Int. Epiz., 2001, 20 (2), 538-546.

FAO (2003) “The Livestock Industries of Thailand.” Food and Agriculture Organisation of the United Nations. Bangkok, Thailand.

FAO (2005) “Livestock Sector Brief: Thailand.” Livestock Information, Sector Analysis and Policy Branch (AGAL).

FAO (2005) FAOSTAT. http://www.faostat.org (accessed July 23, 2008)

Farrelly, L. (1996) “Transforming Poultry Production and Marketing in Developing Countries: Lessons Learned with Implications for Sub-Saharan Africa.” MSU International Development Working Paper No. 63.

Freivalds, J. (1985) “The Growth and Integration of Jamaica Broilers.” In Freivalds, John ed. Successful Agribusiness Management. Gower Publishing Co., Vermont.

Fugile, K. (2000) “Agricultural Development in Thailand.” USDA Economic Research Service. Private Investment in Agricultural Research/ AER-805.

Haitook, T. (2006) “Study on Chicken Meat Production for Small-Scale Farmers in Northeast Thailand.” Heiheft Nr. 87 zu Journal of Agriculture and Rural Development in the Tropics and Subtropics, kassel university press GmbH.

Haitook, T., E. Tawfik, M. Zobisch (2003) “Options for Native Chicken (Gallus dometicus) Production in Northeastern Thailand.” Conference on International Agricultural Research for Development. Deutscher Tropentag 2003. Gottingen, October 8-10, 2003.

Isriyodom, S. (2000) “Evaporating Cooling System and Closed Housing.” The 60th Anniversary of the Poultry Promotion Association of Thailand under the Patronage of His Majesty the King of Thailand. Experimental Farm, Animal Husbandry Department, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand (in Thai).

Jaffee, S. (1993) “Exporting High Value Food Commodities: Success Stories from Developing Countries.” IBRD/World Bank discussion paper No. 198. Washington, DC.

Jaffee, S. (1993) “Exporting High-Value Food Commodities: Success Stories from Developing Countries.” IBRD/World Bank discussion paper No. 198. Washington DC.

Jaturasitha, S., V. Leangwunta, A. Leotaragul, A. Phongphaew, T. Apichartsrungkoon, N. Simasathitkul, T. Vearasilp, L. Worachai, U. ter Meulen (2002) “A Comparative Study of Thai Native Chicken and Broiler on Productive Performance, Carcass and Meat Quality." Deutscher Tropentag 2002 Witzenhausen, October 9-11 2002, Conference on International Agricultural Research for Development.

Kehren, T., C. Tisdell (1996) “The pig and poultry industries in Thailand: development, trade and commerce.” Sasin Journal of Management, Bangkok.

Leibler, J.H., M.J. Otte, and E.K. Silbergeld (2008) “Zoonotic Disease Risks and Socioeconomic Structure of Industrial Poultry Production: Review of the US Experience with Contract Growing”. FAO PPLPI Research Report No 08-02, August 2008.

Loupaibol, B., and S. Chitpraneechai (1999) “Study on Native Chicken Production in the Village of Amphur Muang, Changwat Khon Kaen.” Research Paper. Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand (in Thai).

Martinez, S (1999) “Vertical Coordination in the Pork and Broiler Industries: Implications for Pork and Chicken Products (AER777)” Economic Research Service, United States Department of Agriculture: Washington, DC.

Minot, N.W. (1986) “Contract Farming and Its Effect on Small Farmers in Less Developed Countries.” Michigan State University, East Lansing, MI. Department of Agricultural Economics, working paper No. 31.

NaRanong, V. (1999) “The Financial Crisis and the Livestock Sector in Thailand.” Thailand Development Research Institute. Bangkok. Commissioned by FAO Regional Office for Asia and the Pacific: Bangkok, Thailand.

NaRanong, V. (2007) “Structural Changes in Thailand’s Poultry Sector and its Social Implications.” Thailand Development Research Institute. Bangkok, Thailand.

Otte, J. (2006) “The Hen Which Lays the Golden Eggs: Why Backyard Poultry are so Popular”, PPLPI Feature, www.fao.org/ag/pplpi.html

Poapongsakorn, N. (1982) “Factors Affecting Production, Processing, and Marketing of Broilers and Hogs in Thailand.” in Fine, Jeffrey C. and Ralph G. Lattimore, eds. Livestock in Asia: Issues and Policies. International Development Research Centre, Ottowa, Canada. pp. 97-104.

Poapongsakorn, N. (1985) “The commercial broiler and swine industries in Thailand.” Food Policy Analysis in Thailand, Allied Printers, Bangkok, 1985.

Poapongsakorn, N. (2005) “Poultry Processing and Marketing in the Bangkok Metropolitan Area.” Report to FAO, AGAL

Poapongsakorn, N., C. Pinthong, C. Pinthong, D. Mongkolsmai (1986) “Food Processing and Marketing in Thailand.” UNCTAD.

Poapongsakorn, N., V. NaRanong, C. Delgado, C. Narrod (2003) Livestock Industrialization Project: Phase II "Policy Technical, and Environmental Determinants and Implications of the Scaling up of Swine, Broiler, Layer, and Milk Production in Thailand".

Porn-Amart, T. (2003) "The Success of Native Chicken Raising as a Minor Occupation in Sansai District, Chiang Mai Province." Master Thesis, Faculty of Agriculture, Chiang Mai University, Chiang Mai, Thailand (in Thai).

Ratanawraha, A. (1997) "Native chicken: Economic animals at small-scale level." Matichon Publication, Bangkok (in Thai).

Reardon, T., C. Timmer, C. Barrett, J. Berdegue (2003) "The Rise of Supermarkets in Africa, Asia, and Latin America." American Journal of Agricultural Economics, December 2003.

Rojanasaroj, C., S. Wonlertprayoon, P. Krittaphol, W. Phojeen, P. Pattamawipak and S. Ninragsa (2004) "Prospects of Feed Crops in Southeast Asian Countries: Thailand (FEED SEA)." United Nations Economic and Social Commission for Asia and the Pacific, CAPSA Monograph No. 47.

Singh, S. (2005) Role of the state in contract farming in Thailand: experience and lessons. ASEAN Economic Bulletin. Monday, August 2 2005.

Smith, D. (2006) "The Role of Retailers as Channel Captains in Retail Supply Chain Change: the example of Tesco." PhD Thesis, Department of Marketing, University of Stirling.

Sriwichailamphan, T. (2003) Global Food Chains and Environment: A Case Study of Frozen Chicken Industry in Thailand.

Sudsawasd, S., Wisarn, P. (2008) "Structural Transition in Thailand's Poultry Sector." Thailand Development Research Institute.

Taenkaew, S. (2001) "Financial Cost and Benefit Analysis of Broiler Farming Investments of Contract Raisers and Contract Farming of Farmers in the Central Region." Master Thesis, Department of Agriculture and Resources Economics, Kasetsart University, Bangkok, Thailand (in Thai).

Thammabood, S. (1988) "Native chicken and chicken raising." Proceedings of the 2nd Conference on Native Chicken, 17-19 August 1988, Northeast Regional Office of Agriculture, Khon Kaen Province. Thailand (in Thai).

Tidsell, C., T. Murphy, T. Kehren (1997) "Characteristics of Thailand's Commercial Pig and Poultry Industries with International Comparisons." FAO.

USDA Foreign Agriculture Services (2004-2008). "Poultry and Products Thailand, Annual Report." http://usda.fov.gov (retrieved July 29, 2008).

Wanapat, M. (2003) "Current livestock production and protein sources as animal feeds in Thailand." Protein Sources for the Animal Feed Industry, FAO 2004.

Willis, V., R. Goldberg (1992) "Charoen Pokphand Group." Harvard Business School.

Yakovleva, N., A. Flynn (2004) "Innovation and the Food Supply Chain: a Case Study of Chicken." The Centre For Business Relationships, Accountability, Sustainability and Society, Working Paper Series No. 20.

8. Disclaimer & Contacts

PPLPI Research Reports have not been subject to independent peer review and constitute views of the authors only. For comments and / or additional information, please contact:

Samuel Heft-Neal, David Roland-Holst, David Zilberman
Department of Agricultural and Resource Economics
207Giannini Hall
University of California Berkeley
CA 94720 - 3310 USA
E-mail: dwrh@rdrc.net

Joachim Otte
Food and Agriculture Organization - Animal Production and Health Division
Viale delle Terme di Caracalla, 00153 Rome, Italy
E-mail: joachim.otte@fao.org

Wisarn Pupphavesa
Thailand Development Research Institute
565 Soi Ramkhamhaeng 39
Ramkhamhaeng Rd.
Wangthongklang
Bangkok 10310, Thailand

Or visit the PPLPI website at: www.fao.org/ag/pplpi.html