CASE STUDIES

INTRODUCTION

Examples are often useful to illustrate ideas. This section provides examples of segments of the poultry value chain by reviewing aspects of the poultry industry in New Zealand, the Philippines, Indonesia and the U.S.

One of the themes in the New Zealand case study is the importance to the New Zealand poultry industry of the absence of several major poultry diseases. Since one of the recommendations of this report is to create "reasonable phytosanitary standards", the New Zealand case study may serve to illustrate a different perspective on "reasonable standards" as well as illustrate production practices in New Zealand.

The case studies that cover the poultry industry in the Philippines and in Indonesia are useful to illustrate the production practices of countries that are not the most highly developed. Production practices for feedmilling, the broiler industry, and the egg industry for those countries are illustrated.

The U.S. case study focuses on food safety issues in the U.S. poultry industry. Included are HACCP guidelines and ideas to improve food safety in the U.S. poultry industry.

THE NEW ZEALAND POULTRY INDUSTRY

The poultry industry in New Zealand is divided into two major sectors; poultry meat production, including livestock breeding, and table egg production. These two industries were linked via commercial hatcheries and large feedmills, which are generally owned by vertically integrated poultry processing and breeding companies.

The poultry industry is a dynamic section of New Zealand agriculture. In 1997, on average, each New Zealander ate 25 kg of poultry meat and consumed 200 eggs which were supplied from modern efficient operations.

Economies of scale and enhanced productivity within the industry have led to continued price reductions, consumption increases of poultry meat, and stable consumption of eggs in real terms. Annual retail sales of poultry meat and eggs are now over NZ$650 million, with growth expected to continue (particularly in the poultry meat sector).

New Zealand is currently free of three major exotic poultry diseases (Newcastle disease, virulent IBD and Avian Influenza), thus government quarantine regulations are imposed to protect the unique health status of the national poultry flock and native birds. Consequently, there are no imports of uncooked fresh or frozen poultry meat or table eggs in order to ensure that these diseases are not introduced. These quarantine restrictions are scientifically based under the sanitary and phytosanitary GATT/WTO agreement.

This unrivaled environment of low disease is one reason New Zealand has achieved an internationally coveted performance in livestock production parameters such as growth and feed conversion rates, and in egg production.

The New Zealand poultry industry has a small but growing export base. At present, significant numbers of live day old chicks and fertile hatching eggs are exported to Papua New Guinea, Southeast Asia and the Oceania region. New Zealand also exports a small amount of poultry meat products and table eggs, primarily to the Pacific Islands.

The Poultry Meat Industry

The poultry meat industry is relatively new to New Zealand and is expanding rapidly. It has become the major intensive livestock industry in New Zealand. In 1997, the poultry industry produced

92,500 metric ton (MT) of poultry meat, almost solely for the domestic market. Of this total, over 95% was chicken meat produced from nearly 61 million broiler chickens with turkey, duck, and roasting fowl making up the remaining 5%.

The poultry meat industry earns almost $500 million in retail sales and provides about 3000 jobs. Declining prices in real terms, lifestyle changes, and consumer perceptions have encouraged poultry consumption. Consumption continues to increase, up from 14 kg per capita ten years ago, to over 25 kg per capita in 1997, which now represents 25% of total meat consumption.

Increases in chicken consumption have been mainly in the fresh and further processed areas, with almost 70% of chicken now sold fresh, and less than 40% of chickens sold as whole birds. This growth has been driven by added convenience, variety and price competitiveness of chicken, relative to other meats, and by the very positive consumer perception of the high quality of New Zealand chicken due to the almost total lack of medication or other potentially harmful residues in the product. A high level of vertical integration in the industry enables participants to maintain control over all facets of production, promote quality management, increase efficiency, and plan for the future.

The Egg Industry

In 1997, New Zealand's estimated 2.5 million laying hens produced around 62 million dozen eggs. Over 85% of eggs were sold as table eggs within the domestic market, with the remainder used in the baking and catering industries. Retail sales of eggs were worth around $160 million.

Total egg production has remained relatively static for the past decade, with per capita consumption now around 200 eggs per person. Most eggs produced in New Zealand are from caged hens, with free range and barn egg production accounting for 5% of the total.

The late 1980's saw the abolition of both price and production controls in the egg industry, and the disestablishment of the New Zealand Poultry Board. Deregulation changed the relationship and relative profitability of producers and egg wholesalers. Many producers now sell direct to the wholesale and retail trade rather than through co-operatives or other organizations.

New Zealand currently has approximately 160 commercial egg producers, with the largest 20 producers accounting for over 50% of total production. Since deregulation in the late 1980's, the number of commercial egg producers has declined rapidly. The cyclical nature of the egg industry continues with an oversupply of eggs experienced during 1997, and the ensuing low prices continuing through 1998. The last decade has also seen a wider choice of egg types available from standard white and brown to whole grain, vegetarian, omega enriched, barn, and free range eggs.

THE PHILIPPINE CHICKEN INDUSTRY

Feedmilling

The Philippine Bureau of Agricultural Statistics reports the 1997 national feed production to be 2,529 million MT, coming from 268 feedmills with an aggregate capacity of 15,408 MT per 8-hour shift. The top 34 feedmills account for 61 % of the aggregate capacity indicating the proliferation of small feedmillers in the county. Among the top 34 feedmills, company owned feedmills of the large poultry integrators such as San Miguel Corporation, Swift Foods, Inc., Vitarich Corporation, and

Purefoods Corporation account for 42% of the rated capacity.

The major domestically available feed ingredients are corn, full fat rice bran, copra meal, and coconut oil. Other materials, available in limited quantities, are cassava meal, banana meal (from export rejects), sweet potato meal, ipil-ipil meal, pollard, poultry meal, limestone, corn gluten, brewer's dry yeast, and brewer's spent grains. Rice bran comes directly from rice milling and is used without further treatment or de-fatting. Copra meal is the by-product residue left after the extraction (usually by expeller) of coconut oil from copra. Coconut oil is used after extraction without refining.

Domestic corn supply is inadequate and has to be supplemented with imported corn, usually from the United States. The other major imported feed ingredients are soybean oil meal, primarily from the United States, Brazil, India or China; and fish meal, primarily from Peru or other South American countries. Imported minor ingredients include vitamins and minerals (or premixes), amino acids, binders, and feed additives such as growth promoters, mold inhibitors, and enzymes.

Feedmillers normally buy their domestic feed materials through traders. However, the major feedmillers send buyers to corn producing regions to purchase corn directly from farmers during the harvest season. Some feedmillers have established corn buying stations in various regions in the country to ensure a share of the corn crop.

In general, prices of domestically produced raw materials are higher because of low farm productivity, inadequate post-harvest technology and facilities, and the lack of bulk handling facilities. Imported materials are purchased in bulk because of shipping requirements. In some instances, such as in the case of U.S. soybean oil meal, group buying has been done to reduce freight charges.

Raw material deliveries are sampled for physical inspection and chemical analysis to ensure that they conform to quality standards. Depending on the material being received, physical parameters may include appearance, color, odor, particle size, and presence of adulterants. And, depending on the material, chemical analysis may include crude protein, crude fiber, ash, moisture, percent purity, among others. Corn is analyzed periodically for mycotoxins. Among large feedmills, wet chemical analyses are usually performed by an in-house laboratory. The use of NIRS (Near-Infrared Reflectance Spectrophotometry) has begun to speed up proximate analysis and material acceptance.

Materials are usually transported in 50 kg sacks made of woven polypropylene. Even imported materials shipped in bulk are often placed in sacks before transport to the feedmills. Most feedmills store their materials in sacks stacked on pallets in warehouses under ambient conditions. A few large feedmills have silos for storing major materials but still use sacks for minor ingredients. Vitamins and their premixes are stored under cool conditions.

Feed formulation is done by animal nutritionists using computer programs capable of least cost formulation and multiblending. U.S. NRC tables are often used as reference for setting up ingredient nutrient profiles. However, large companies usually make adjustments with respect to the 'normal' quality of ingredients received, based on their experience, their studies, or upon advice of external consultants, both local and foreign. Purchase prices of raw materials are set also by pick-up values obtained from the formulation software.

Large feedmills use dosing silos and automated computerized batching with electronic scales. Different scales may be used to handle major and minor ingredients. Premixes may be added by hand to the mixer. The batch computer's record of the

prepared batches can be used for process control. Scales are calibrated regularly. Batching equipment is usually imported from the United States or Europe. Small feedmills still do manual batching.

Most of the feedmills are pregrind mills. The preferred hammer mills are manufactured by California Pellet Mill or Buhler. A number of recently constructed large feedmills, however, are postgrind. In both cases, particle size distribution is controlled by proper hammermill speed and screen size because they affect mixing and pelletizing efficiencies.

Horizontal or paddle type mixers are the most commonly used. Locally fabricated mixers are available. Mixing time for good mixers ranges from 3 to 5 minutes. Mixers are regularly subjected to a mixing efficiency test where 10 samples from a single batch mix analyzed for salt content should not have a coefficient of variation exceeding 10%.

From the mixer, the feed goes to the conditioner. Some conditioners have multiple conditioning chambers (instead of the usual single conditioner) to improve the conditioning and the subsequent pelletizing step. Steam is injected into the conditioner where temperatures of up to 90 degrees Centigrade can be achieved. In order to minimize cost, binders are used only as a last resort for hard-to-pellet mixes. The most common pelletizers are those made by California Pellet Mill and Buhler. To maintain pellet quality, conditioner temperature and feed residence time are controlled. The pellets must meet pellet standards such as the “durability index” and “percentage fines” standards.

The pellets may be passed through a crumbler for preparation of starter feed. Crumbler speed and screen size are set to produce starter crumble of maximum particle size and maximum fines. Expander use is not common in the Philippines. Some feedmills have extruders but these are mainly used for shrimp and fish feeds.

Coconut oil, because of its ready availability, is the fat of choice in producing high energy feeds required by broilers. Coconut oil is added to the mixer if mash feeds are being produced. For pellets, the amount of coconut oil that can be added to the mixer is limited as it affects pelletizability. Most of the oil is added after pelleting using a fats coater. Again, fats coaters made by California Pellet Mill and Buhler are commonly used.

The finished feed, either in mash, crumble or pellet form, are placed in 50 kg woven polypropylene bags. The feed is weighed automatically during filling to ensure proper weight of each bag. The bags are closed by sewing. Samples of the finished feed are taken during bagging for testing its conformance to physical and chemical quality standards. The most common chemical parameters are crude protein, crude fiber, crude fat, moisture, calcium, and phosphorus. As in the case of raw material analysis, NIRS are beginning to be used to facilitate analysis. Batches passing quality control are released for distribution.

Equipment and conveyors are cleaned before changeover to control cross contamination. Silos are cleaned and emptied before the material or finished product assigned to it is changed. Bagged raw materials always have proper identification.

In order to control *Salmonella* contamination of feed, the raw material warehouse is separate from the finished goods warehouse. Proper dust control equipment is installed to prevent raw material dust contamination of finished feeds. Pelletizing temperatures are allowed to reach 90 degrees Centigrade. Potentially contaminated raw materials such as fish meal and poultry meal are checked for *Salmonella* upon receipt and finished feeds are tested also for *Salmonella* on a regular basis.

Finished feeds are transported in covered trucks to keep them dry during distribution. The finished feeds are loaded and unloaded manually into trucks. Feeds intended for use by an integrator's internal farms are sent directly to farms. Commercial feeds intended for sale to independent farms usually go first to regional warehouses, then to feed dealers and then to farms. There may be cases, however, when commercial feeds go directly to distributors and independent farms.

Broilers

The Philippine broiler industry in 1997 was estimated by the Bureau of Agricultural Statistics to have produced close to 500,000 MT of dressed chicken compared with the Philippine Association of Broiler Integrators estimate of 350,000 to 400,000 MT (valued at P20 to 25 billion). The major producing areas are Southern Tagalog and Central Luzon. The market was expected to grow at about 5 to 6% annually within the last 5 years but government estimates show that the supply grew at an average annual rate of 9.76% from 1994 to 1997, resulting in a glut in the broiler industry. The per capita consumption of dressed chicken was 6.96 kg in 1997.

Most of the broiler production come from the major broiler integrators such as San Miguel Corporation, Swift Foods, Inc., Vitarich, and Purefoods. Independent farmers, usually purchasing chicks and feed, or feed concentrate, are a minor part of the market and supply an estimated 15% to 25% of the industry. The integrators import their grandparent stock, produce the parent stock, hatch their eggs, and grow and dress their broilers. The major broiler breeder stocks are Arbor Acres, Cobb, Avian, Peterson, Hybro, Ross, and Hubbard. The breeder chicks are purchased from the United Sates, Malaysia, Taiwan, Thailand, Holland, and the United Kingdom, among others. Broiler production costs are affected by the high cost of feed materials and the high financing rate that farmers have to contend with in building their facilities or purchasing their stock.

Breeder Operations

Breeder operations typically follow the 'brood-grow-transfer-lay' set-up. There are integrators, however, who follow the 'brood-grow-lay' set-up. Brood-grow houses are litter type while the lay houses, and the brood-grow-lay houses are mixed litter and slat type. About 10% of breeder houses are now tunnel ventilated with side curtains and complete or partial blackout and sometimes have cool cells. The majority are still open-sided with curtains and rely on natural ventilation. In order to reduce heat build-up inside these open-sided houses, they are elevated to improve air flow and have monitors in the roof. Houses usually have an east-west orientation and are divided into pens for ease of management.

Coconut lumber made from the trunks of mature coconut trees is used for posts and structure. Reinforced concrete posts can also be used, particularly in elevated houses. The roof is made of galvanized iron sheets. The litter used is rice hulls and the slats are generally made of bamboo, although a few now use plastic slats.

Required brooding temperatures are attained with liquefied petroleum gas (LPG) fired infrared heaters. Brooder guards are set up to identify chick comfort zones. Chick feeders and waterers are used initially but are soon replaced by the permanent feeders and waterers. Tube feeders and bell type waterers are the usual choices although there are a few farms that use chain or automatic pan feeders and nipple waterers.

Breeder starter feeds are normally fed during the brooding stage, breeder grower and developer feeds during the growing stage, breeder prelay feed shortly

before laying, and breeder layer during the laying stage. Feed nutritional values and feed regimentation approximate breeder stock supplier recommendations. Pan feeders can be mechanically linked to be lowered or raised simultaneously so that during restricted feeding, all birds can start feeding at the same time, thereby improving flock uniformity. Feeds are delivered to the farms in 50 kg sacks and stored in a small farm warehouses. The feeds to be consumed for that day are transferred to each house daily.

Most farms practice separate male and female feeding as recommended by the breed supplier. Use of feeder guards ensure that the males do not consume part of the female feed when feeding mixed flocks.

The lighting programs designed to stimulate sexual development follow the breeder stock supplier recommendation. Lighting stimulation has been improved in flocks placed in dark-out houses.

The growing flock is sampled weekly for liveweight to determine if target weights are attained. The weight uniformity is calculated and the weight range should typically be within 10% of the target weight. Feeding is adjusted depending on whether the birds are above or below the target weights.

At about 16 weeks, the birds are ready to be transferred to laying houses, or in the case of brood-grow-lay operations, ready to be housed. The litter of brood-grow-lay houses is replaced at this stage. Wooden nest boxes are installed with clean rice hulls as the nesting material. Eggs are collected manually from the nests 3 to 7 times a day depending on the daily egg production and the availability of labor. Floor eggs are rejected. The eggs are inspected and graded to eliminate those that do not meet standards (e.g., dirty, cracked, and misshapen eggs). The hatching eggs are either disinfected with hydrogen peroxide or fumigated with formalin, placed in egg trays, and stored in air conditioned egg rooms. Collected hatching eggs are transferred daily by air conditioned vans to the hatchery. The egg vans are cleaned and disinfected in the farm after every delivery.

Biosecurity measures include fencing of the farm, restricted entry, shower and change to clean clothes before entry, birdproofing of houses, footbaths, truck dips, absence of other animals in the farm, rat control, fumigation of materials before entry, and proper distances between houses (up to 30 meters) and between the fence and the nearest house. After each house is emptied, the litter and droppings from the slats are removed. The nests, feeders, and waterers are removed, cleaned and disinfected. The house are cleaned, disinfected and allowed to dry before they are loaded again, ordinarily after 4 to 6 weeks.

Hatchery Operations

Multiple setter and hatcher hatchery facilities are common. Chickmaster and Jamesway brands are popularly installed in favor of locally produced equipment because of their automatic operation. Hatcheries are laid out to follow a cleanest to dirtiest material flow, i.e., from hatching egg receiving to day-old chick dispatching. Air flow systems design and specifications follow the equipment manufacturer's and/or the breed supplier recommendations.

Egg vans delivering hatching eggs from the breeder farms are cleaned and disinfected externally before entry to the hatchery compound. The eggs are regraded upon receipt to recheck farm grading and to remove eggs damaged during transit. Those that are not set immediately are stored in the egg cool room.

The setters and hatchers are operated at the conditions recommended by the equipment manufacturers and/or the breeder stock supplier.

Pullout of chicks is scheduled to allow chick delivery to the receiving farms during evening or early morning. Chicks are graded and counted manually. Chicks that are small in size and/or with physical defects (e.g., unhealed navel, limping, among others) are rejected. Chick vaccination is done usually in the broiler farm. However, spray vaccination may be done at hatchery as demanded by animal health considerations. Parent chicks are sexed, detoed, dubbed, and vaccinated at the hatchery.

The chicks are packed per 80 to 100 in one-way carton boxes or returnable plastic trays. Paper trimmings are placed at the bottom to cushion impact during transit and absorb droppings. The packed chicks are placed in chick vans fitted with louvered sides and ventilation fans and delivered directly to the farms.

Biosecurity procedures include restricted entry into the hatchery building, showering in and changing to clean uniform before entry, and regular fumigation of all hatchery rooms. All material and supplies for hatchery use are fumigated before they are brought into the hatchery. The chick room is cleaned and disinfected after dispatch of pulled-out chicks. Setters and hatchers are cleaned and disinfected with quaternary ammonium after every use. A few large hatcheries use automatic tray washers. Fluff test count, water analysis, and microbiological analysis of swabs of setters, hatchers, and air sedimentation samples are done periodically.

Broiler Growing

Commercial independent broiler farms do not follow any particular specification and the specification probably depends on the financial capability of the owner. The majority are substandard compared to farms under contract growing arrangement with companies with integrated broiler operations. The latter follow minimum design standards set by the integrator. Standards that are often compromised by independent farms are distance between buildings, orientation, and the presence of biosecurity measures.

Farms contracted by large integrators have elevated slat houses constructed in an east-west orientation. Posts are either reinforced concrete or coconut lumber. The general structure is generally made also of coconut lumber. The slats are made of bamboo. Houses are open sided with curtains and the roof is at least 6 to 8 ft from the floor, includes a monitor, and is made with galvanized iron sheets. Average houses can hold from 5,000 to 12,000 broilers. Distance between houses is about 10 to 20 meters. Building and equipment costs are estimated at P110 to P130 per bird capacity but may be as low as P90 per bird capacity in rural areas where the local building materials are abundant. About 20 to 30% of broiler houses have ventilating fans. Typical farms have a small feed warehouse or "bodega" near the farm entrance.

Most of the houses still use manually serviced equipment waterers such as basins or PVC pipes or bamboo for drinkers and about 15 to 18% may be using bell drinkers. Feeders may be troughs fabricated from galvanized iron or bamboo, or tube feeders made of galvanized iron or plastic. The use state of the art equipment such as automatic auger pan feeders and nipple drinkers is minimal, probably because of cost and poor after-sales service.

Independent commercial growers can readily buy their hybrid chick requirements in the open market. Day old broilers are supplied by independent breeder farms and large companies with links with breed suppliers. Integrators supply their contract growers with their own chicks. Both chick suppliers and integrators deliver directly to the farms. The entire farm is loaded house by house in a few days to allow an all-in/all-out operation. About 75% of farms use

LPG infrared heaters during brooding. The rest, mostly independent and backyard raisers, use charcoal fed heaters with hovers or electric bulbs. Used cleaned feed bags covered with rice hulls are placed on the slat floor inside the brooder guard to minimize air currents coming from beneath the slats. Chick feeders and waterers are used at this stage. Brooder guards, and the floor covering are removed after brooding.

Broilers are fed chick booster, starter, grower, and finisher feeds although some integrators will not use chick booster. Most feeds will be in mash form with crumble-pellet feeds in the minority. Feed nutrient specifications used by integrators and commercial premium broiler feeds will normally follow breeder stock supplier recommendations. A number of commercial feeds, usually from small feedmillers, have lower nutrient densities in order to address the small independent growers whose working capital is limited.

The normal practice is *ad libitum* feeding, that is, feed is available all the time. Tube feeders allow semi-automatic feeding. There are growers who practice meal feeding where measured amounts of feed are given after the last meal has been eaten. To reduce heat stroke mortality, feed intake may be depressed during hot days by withdrawing feed in the afternoon when temperatures are highest. Feeding is resumed in the late afternoon and evening.

Broilers are grown to about 1.45 kg to 1.65 kg liveweight. In the rural areas where the average income is lower, the smaller broiler is preferred. The size range is dictated also by the fast food market where serving size is tightly controlled because chicken is sold by piece.

The grown broilers are harvested manually by contracted service crews and placed in plastic coops. The coops are loaded and stacked in open trucks for transport to the integrator's dressing plant. Hauling trucks and coops are cleaned and disinfected after each haul. For independent growers, middlemen buyers or "viajeros" usually come to purchase the broilers ex-farm and bring them to nearby wet markets where they are dressed prior to sale. Prices of live broilers vary widely depending on the supply-demand situation. Swings of more than 10% a week may happen. In times of glut, "viajeros" wait until the broilers get big so that the growers have to sell at a discount in order to unload the birds. When there is a shortage situation, the opposite pattern prevails.

After each house is emptied, the partially dry droppings (chicken manure) underneath the slats are removed and sold as fertilizer. The feeders and waterers are removed, cleaned, and disinfected. The house is likewise cleaned and disinfected.

The entire farm is thus emptied as required by an all-in-all-out operation and will be loaded again in 2 to 4 weeks. Other biosecurity procedures include fencing of the farm premises, occasional birdproofing, prohibition of other farm animals in the farm, and limited traffic into and out of the farm.

The variability of broiler farms and farm practices, as well as the variety of feed results in widely varying farm efficiencies. Feed conversion can vary from 1.95 to 2.5 kg feed per kg bird liveweight. Harvest recoveries can range from 92% to as high as 97%. With diseased flocks, however, these can go below 90% or even wiped out in the case of Newcastle Disease afflicted flocks.

Contractor Toll Arrangements

Contracting of operations is a common practice among broiler integrators. Starting with contract broiler growing in the early 1970's, the practice has extended to toll feedmilling, contract broiler breeding, contract hatcheries, and toll feed truckers and broiler haulers. In general (see summary in Table 4), the company provides the technical aspects of the

facility and operation, and the material and livestock inputs, while the contractor provides the capital inputs, labor and direct supervision, and utilities. In return, the contractor is paid per unit of output based on his variable expense and a fair return on his investment.

The contracting arrangement has proven to be popular from the point of the integrator company, because it reduces capital requirements and decreases the day to day supervision of so many labor intensive and dispersed operations. Contracting improves the relations and influence of the company in the community because, in many cases, the contractors are respected members of the community. From the point of view of the contractor, it provides him with an opportunity to have his own business with reduced marketing risks and lower operating capital (material and livestock inputs are owned by the integrator). In addition, contracting contributes to rural development in terms of income and employment.

Layers

The Philippine chicken egg supply in 1997 was estimated by the Bureau of Agricultural statistics to be about 196,046 MT, which had increased by an average of 4.41% per year since 1994. About 2% of eggs produced go into processing, 6% are hatched, and the rest go to food use. Per capita consumption stood at 2.87 kg per year in 1997.

The major egg producing regions are Southern Tagalog and Central Luzon. Most of the egg producers are independent farmers rather than large company integrators. Many of the independent farmers in Luzon, however, have farm sizes large enough to have their own small feedmills prepare their feed. The farmers in Vismin tend to be smaller and rely more on commercial feeds. Most farmers buy their hybrid day-old pullets from large companies, mostly situated in Luzon. Popular hybrids are Babcock, Starcross, Hyline, and Lohmann, among others.

Breeder Operations

Inasmuch as the layer breeder operations are similar to broiler breeder operations with respect to house design, equipment, husbandry practices, biosecurity, and egg handling procedures, only some of the differences will be discussed. A 'brood-grow-lay' set-up is common; that is, the birds stay in the same house from chick loading to culling. Some farmers practice the 'brood-transfer-grow-lay' set-up; that is, the birds are transferred to another house right after brooding.

From day-old to 5 weeks, a breeder starter ration with 20% crude protein and 2900 kcal/kg feed must be fed ad libitum to both males and females. If the target weights recommended by the breeder stock supplier for both sexes are not achieved by 5 weeks, the shift to grower feed is delayed until the body weight targets are reached. Underweight birds can occur because of low intake of the birds under hot and humid conditions in the tropics. Breeder grower feed is fed from 6 to 20 weeks (15 % crude protein and 2,900 kcal/kg). At 21 weeks when 5% hen day egg production is expected, a breeder layer type diet is provided (17% crude protein and 2,900 kcal/kg).

Pullet Growing

Farms in the Vismin area tend to grow their own ready-to-lay pullets. In Luzon, farmers may simply buy their ready-to-lay pullets or raise them themselves. Typical farm capacities can range from 1,000 in all-in/all-out operations to more than 10,000 in multiple age operations.

House design and types of materials are similar to that of broilers. Equipment and growing practices are similar to broiler operations also. In some instances, however, battery brooders from day-old to 6 weeks and grow-out cages from 6 to 12 or 16

Table 4. Contracting or Tolling Arrangements in the Philippines

Particulars	Feedmilling	Breeding	Hatchery	Broiler Growing	Processing
What the company provides	• Feedmill design, including needed equipment • Monitors feedmill construction • Technical and managerial training • Feed Materials • Process and quality controls • Advice on operational improvements	• Breeder farm and house design, including auxiliary facilities • Monitors farm construction • Technical and managerial training • Day-old parent stock • Feed • Husbandry and animal health services •Advice on operational improvements	• Feedmill design, including equipment needed • Monitors hatchery construction • Technical and managerial training • Hatching eggs • Process and quality control • Advice on operational improvements	• Broiler farm and house design, including auxiliary facilities • Monitors farm construction • Technical and managerial training • Day-old boiler stock • Feed • Husbandry and animal health services •Advice on operational improvements	• Processing plant and cold storage design, including equipment needed • Monitors plant construction • Technical and managerial training• Grown birds •Process and quality control • Advice on operational improvements
What the contractor or toller provides	• Land and capital investment • Builds feedmill according to company design • Operation of feedmill including direct supervision, labor, utilities, other supplies • Securing all necessary government permits	• Land and capital investment • Builds farm according to company design • Operation of farm including direct supervision, labor, utilities, other supplies • Medication •Delivery of hatching eggs to the hatchery in his egg van • Securing all necessary government permits	• Land and capital investment • Builds hatchery according to company design • Operation of hatchery including direct supervision, labor, utilities, other supplies •Delivery of day-old chicks to the farms in his egg van • Securing all necessary government permits	• Land and capital investment • Builds farm according to company design • Operation of farm including direct supervision, labor, utilities, other supplies • Medication • Harvesting of grown birds • Securing all necessary government permits	• Land and capital investment • Builds facility according to company design • Operation of facility including direct supervision, labor, utilities, other supplies • Securing all necessary government permits
Basis for tolling fee	All direct costs plus a fair return on contractor's investment	All direct costs plus a fair return on contractor's investment. Incentive bonus given for higher than standard egg production.	All direct costs plus a fair return on contractor's investment. Incentive bonus given for higher than standard % hatchability.	All direct costs plus a fair return on contractor's investment. Incentive bonus given for higher than standard harvest recovery and feed conversion.	All direct costs plus a fair return on contractor's investment.

weeks are used in order to eliminate the adjustment later to layer cages.

Chick booster feed with 23% crude protein and 2,950 kcal/kg is fed from day-old to 5 or 6 weeks. Chick starter with 20% crude protein and 2,900 kcal/kg is then provided from 5 to 6 weeks to 10 to 12 weeks. Chick grower with 5% crude protein and 2850 kcal/kg is then fed from 10 to 12 weeks or 18 weeks. Since attaining the optimum body weights is a major problem, feed consumption is not restricted during the growing period. Feeding programs are usually based on the recommendations for the particular strain of chicken and are adjusted based on target weights during a particular growth phase.

Pullets are debeaked between 5 to 10 days. This is repeated prior to caging if the first debeaking is not successful. Weekly body weight monitoring is conducted. The frequency may vary, depending on the breed supplier recommendations or farm convenience. Selective culling is done in some farms based on weights. Flock uniformity is also measured during weighing. Feed level are adjusted based on weight and flock uniformity.

Biosecurity measures employed are similar to breeder farms. This includes cleaning between loadings, providing foot baths, and disinfecting vehicles that enter or restricting entry to a dirty area. Visitor traffic is from youngest to oldest flock. Houses are usually not bird proof. Growout houses are designed to fill-up at least one layer house.

Pullets are weighed prior to transfer to the layer house. Total sampling is recommended but this will vary from farm to farm. Pullets within the standard weight are moved to the layer cages as early as 12 weeks and not later than 18 weeks of age. The usual age of transfer is about 16 to 18 weeks. Pullets not within the standard will be extended in the grow-out house until such time they are within the standard weight. In farms with excess ready-to-lay pullets, under-weight birds are sold to outside buyers.

Layer Operations

Typical layer houses are elevated, open sided and without birdproofing. Layer cages are made of steel wires or bamboo and wood. Three tiers of cages are common although this can be reduced to two where high temperature and humidity problems are encountered. On the other hand, some farms can go up to four tiers. Commercial cages are usually designed for 4 ready-to-lay pullets, although some farms have cages that enable them to load up to 10 pullets per cage.

Trough type continuous feeders made of galvanized iron sheets or wood are provided in front of the cages for each tier. The most common waterer is trough type also made of galvanized iron sheets or PVC pipes located at the back of the cages. Water is continuously flowing from a faucet located at the end of the cages. Some of the more sophisticated farms use individual cup or nipple drinking systems. The most common laying cage in use is the reverse-type cage. This has a longer front and a narrower depth. Capital investment cost for house and equipment is estimated to be about P60 to P120 per bird depending on materials used.

Upon transfer and caging, pullets are given anti-stress medication for the first few days. Pullets are given grower feed until 5% hen day production is obtained. Some farms use a pre-lay feed which is given between the grower and layer feed to condition the pullets to a higher calcium diet. Layer feed is given from 5% hen day production onwards. Some farms use different layer feeds (phase feeding) during the laying stage to optimize feed cost. As the hens progress through their laying cycle, their feed consumption increases, resulting in weight gain and reduced egg production. A lower nutrient density

layer feed can be given after peak production has been achieved. Farms practicing phase feeding would have from 2 to 4 different layer diets during the whole laying period. During summer, bulk of the feed is given during early morning and late afternoon when temperatures are cooler.

The lighting program consists of gradual increase of lighting hours starting from 12 hours upon caging of the pullets until it reaches 16 hours. Light increases are in increments of 30 minutes to 1 hour per week depending on the age of transfer.

Selective culling is practiced occasionally. Hens that are no longer 'in lay' are removed from the flock and sold as culls. Once the pullets are caged, no regrouping is done. During times when egg prices are low, some farms practice force molting. This is usually done between 60 to 65 weeks or 75 to 80 weeks of age. This practice saves feed and the resulting hens will produce relatively more and larger eggs. Normal culling age is 80 weeks or when the flock drops to 65% hen day or, when egg prices justify it, to 50% hen day.

Eggs are collected at least 2 times per day. The cracked and broken eggs are separated and the intact eggs are graded visually. Middlemen normally come to the farm to buy the eggs and transport them to their customers.

Once the pullets are caged, there is practically no biosecurity except for occasional foot baths before entering the house. Vehicles are allowed in the dirty area only but visitors movement is not as restricted as in breeder and broiler farms. No cleaning is done during the laying cycle. After culling, the droppings are collected and the cages and house are cleaned with a power washer. They are then disinfected and rested for up to 4 months.

Animal Health

The major chicken diseases, their occurrence, and control are summarized in Table 5. Diseases can present serious problems, particularly in major growing areas, because of the high chicken population density. Often there are improper or non-existent biosecurity procedures, lack of diagnostic laboratory services (outside some major broiler integrators) and nominal government control. The government provides no veterinary services for farms, no reliable reporting system of disease incidence in chicken farms, and therefore is not in a position to control the spread of diseases. Under this situation, a good farm animal health program is essential. For contract growers, the integrator assures them of the quality of their chicks and provides them their broiler vaccination program and veterinary and diagnostic services. Independent growers have to rely on private professional services or veterinary services provided by feed manufacturers.

Vaccines and medications from major companies are available. Meriel, Schering Plough, Intervet, Boehringer, Sanofi, Elanco, Pfizer, Bayer, and Upjohn products, among others, are available readily.

Processing

The main processing plants of major integrators have company-owned, modern, automated slaughtering and dressing equipment from abroad such as Meyn and Storck processing equipment. The integrators also have smaller processing plants, some with less than 1,000 birds/hour, where most of the steps are done manually. Many of them are under tolling arrangements where the toller builds the plant according to the integrator's design and operates it for a fee according to the integrator's procedures (see Table 4).

Table 5. Summary of Chicken Diseases in the Philippines

Disease	Occurrence	Control
Newcastle disease	Endemic nation-wide in commercial and native stocks with periodic outbreaks particulary during the onset of the rainy season.	Primarily by vaccination but most growers neglect biosecurity.
IBD	Endemic nation-wide with regular and cyclical outbreaks.	Virulence of the virus has intensified gradually and the only effective control is hyper immunization of breeders and use of hot strain vaccines in broilers; outbreaks generally occur where mild vaccines are used; influence of biosecurity is inconsistent.
Infectious bronchitis	Usually interplays with MG, Newcastle and E. coli to produce CRD; primarily causes upper respiratory infection but occasionally causes high mortality when mutants are involved.	Probably the lest recognized of the major viral diseases and are therefore not addressed by vaccination; best control method is good clean out and vaccination at day old except for mutants/variants where appropriate vaccines are not yet approved by the government.
E. Coli	The most common pathogen but usually only acts as opportunist to primary Newcastle, bronchitis or IBD to produce CRD.	Controlled by antibiotic medication during chick-in and in some integrators, several times during the growing season.
Mareks	Endemic wherever mature chickens including gamecocks are raised.	Only large companies vaccinate so outbreaks still occur in gamecock farms; virus has become more virulent so Rispens type vaccines are increasing in market share lately.
Fowl Cholera	Endemic with similar epidemiology as Mareks.	Controlled by medication in most operations; few integrators depend on vaccination.
Coryza	Major problem in breeders and layers affecting mature chickens.	Usually controlled by antibiotic medication and vaccination; few realize importance of biosecurity.

Integrators will sell their birds as whole dressed broilers, preferably chilled, although there is a market for frozen broilers, even in some outlets where transport time is not a problem. Small independent processors situated in or near wet markets process birds manually, and sell their dressed chicken warm as an indication of their freshness.

Although most of the broilers sold by integrators are sold eviscerated, there is also a market for dressed intact broilers still with the internal organs. In wet markets, the vendors will do the cutting up as a service to their customers who buy whole birds. A significant amount of chicken is sold by vendors who cut up whole chickens and sell them piece by piece.

The slaughtering and processing to produce a dressed eviscerated whole bird follows the normal procedure practiced worldwide. The general steps are:

- Birds are unloaded from the coops and hung manually on chain conveyors. Extremely small and extremely large birds are separated and sold as live birds.
- Birds are electrically stunned to render them unconscious. The use of carbon dioxide is not yet practiced.
- The birds' necks are slit and the blood collected.
- Birds are scalded at preset temperatures and durations. The degree of scalding is adjusted according to market preference or further processing requirements.

- Birds are defeathed by machines that have rubber fingers mounted on rotating drums.
- The birds are washed and then go into a series of steps where the bird undergoes automatic evisceration, the heart, liver and gizzard recovered, and the head and feet removed.
- The eviscerated birds are washed before going to the chiller(s) where the temperature of the birds are lowered immersing them in chlorinated water (25 ppm) at about 4 degrees Centigrade. Duration of chilling is controlled so as not to unduly increase moisture pick-up. The use of air chilling is not yet practiced in the Philippines.
- The birds are sorted and graded according to physical defects. Birds with bruise discolorations, missing parts, cuts, tears, broken and disjointed bones, blisters, and feathers are downgraded or condemned depending on the degree of the defect.
- Automated plants, particularly those catering to food service or doing further processing sort the dressed birds by weight.
- The chilled birds are packed in polyethylene bags or fitted with leg bands for brand identification. The packed or tagged birds are placed in open plastic crates, topped with shaved ice, and shipped to customers. Birds destined to be frozen are blast frozen.

Further processing of birds is done to serve food service as well as commercial branded product requirements. In general, most processing is done manually with small tools and occasional use of batch-type equipment. Exceptions will be products that require forming such as chicken patties and nuggets, and breading.

The variety of further processed products today in the market include:

- Marinated bone-in chicken. This is the largest selling and fastest growing segment of the market, primarily sold through fast food chains. Birds within the target size range are cut into several pieces according to specifications and marinated, mostly in vacuum tumblers. The marinated chicken are delivered to the customer who batter and/or bread them before frying. In alternative cases, the plant does the flouring or battering and breading with automated equipment. For whole chicken, marination is done by injection machines.
- Cut-ups. As indicated earlier, cut-ups prepared at the plant represent a small portion of the market. Plant produced cut-ups are sold mostly at supermarkets. Cut-up operations also serve products that utilize deboned parts.
- Deboned parts. Marinated deboned breast is the most common product. Deboned meat and trimmings of deboned meat are used in products that utilize chopped pieces such as the longanisa (Asian hotdog) and formed products such as nuggets.
- Formed products. Patties and nuggets are produced by mixing the ingredients in a bowl chopper and passing the resulting emulsion in an integrated line consisting of a forming machine, battering, breading, flash frying, and frozen in spiral freezers.
- Chicken based hotdogs and sausages, chilled or in cans. Product is made from deboned meat, sometimes with turkey meat and extenders.
- Chicken dishes. Ready to cook frozen dishes, some marinated, some with sauces included are available. Locally produced cooked, heat and serve-type products have not received much attention yet.

In view of foreign franchised fast food chains' requirements and increasingly stringent safety and sanitation standards abroad, some integrators are instituting HACCP programs in their plants even though this is not yet required by the Philippine FDA (see the U.S. case study for more information about HACCP programs).

Good Manufacturing Practices and Standard Sanitation Operating Practices are observed. Among others, workers are free of any jewelry, wear clean outer garment uniforms and safety paraphernalia consisting of headcaps, aprons, boots, gloves, and masks. There are footbaths and handwash stations at each entry point. Workers wash their hands before entry and periodically during production. All equipment, tools, and production areas are cleaned. They are sanitized before and after completion of

operations. All equipment is rechecked for cleanliness prior to operation. Plastic crates for the dressed chicken are washed and sanitized prior to use.

HACCP procedures include antibiotic withdrawal during the finisher feed stage, feed withdrawal 6 to 8 hours before harvest, counterflow of scalder and chiller water, control of chiller and carcass temperature, control of chlorine levels in process water, visual inspection for signs of fecal contamination, and periodic sampling and analysis for *Salmonella*, *Coliform*, and standard plate count.

Many of the by-products are recovered and sold. The heart, liver and gizzards are sold together with the whole chicken. Feet, intestines and heads are sold wholesale to buyers who find use for them as food, soupstock, or fish feed. The excess, together with the blood, entrails and feathers end up in the rendering plant and processed as poultry meal or feather meal.

Processing plants are required by the government to have wastewater treatment facilities that can reduce their effluent BOD to 50 ppm or lower before the wastewater can be discharged. Practices to reduce wastewater BOD include water wastage minimization, care in blood recovery and solid waste recovery to prevent their ending up with the wastewater. Recycling of process or chiller water is not practiced.

Philippine Industry Problems

Among the problems identified in the Philippine poultry industry are:

- High prices of feed raw materials. The country has to import its feed protein ingredients. Domestic soybean production is minimal and domestic fish meal is limited because of a small fish processing industry.
- Upgrading of feed nutritional value of domestic feed raw materials such as copra meal and rice bran.
- High financing rate. The lending rate can reach up to 22%. Investors in farms aim for a payback in about 3 years. The small producer also has difficulty getting loan approvals when credit is tight because of high risk in the livestock business.
- Lack of reliable animal health services. As stated in the report, government and university facilities for disease diagnosis is lacking in quantity and quality. Government monitoring and control of disease situation is needed.
- Reliable farm housing and housing equipment coupled with good after sales service.
- Environmental concerns. Although environmental regulations are not as strict as those in well developed countries, the additional cost of environmental compliance among farms and processing plants adds to the cost of production. The product remains mainly a commodity type where affordability is a prime determinant of market demand. With regard to farms, community pressures because of the smell of manure and the presence of flies is increasing. Zoning laws plus increasing population density limit potential sites.

THE INDONESIAN CHICKEN INDUSTRY

Reliable feedmilling and chicken industry figures are difficult to obtain in view of the economic crisis the country is experiencing today. Trends and situations existing before the monetary devaluation probably are likely not valid. Nonetheless, it still is safe to say that most of the best practices observed in the Philippines will probably be true in Indonesia, with or without the economic difficulties.

Feedmilling

The industry today has an installed capacity of 10 million MT per year. About 50% of this capacity was commissioned in 1996 to 1997 as a result of the

expansion in 1993. As a result of the currency crisis, production in 1997 was estimated to have reached only 5 million MT, down by 1 million MT compared to the previous year. Production this year is expected to reach only 2 million MT.

Feed production in Indonesia primarily services the chicken industry under normal conditions. At least 85% of feed production is estimated to be fed to chickens. Most of the capacity is situated in the island of Java where chicken operations are concentrated. Major feedmillers are PT Charoen Pokphand Indonesia and PT Japfa Comfeed Ind.

The industry depends on imports for the majority of its raw material requirements. Local corn production is not sufficient to meet the feed industry's normal requirement. This year is an exception, since Indonesia has exported about 460,000 MT to date because of low domestic demand. All protein materials such as soybean oil meal, groundnut meal, fish meal, meat and bone meal, and rapeseed meal are imported. The local fishmeal industry is not well established and there is a problem of widely varying quality. Poultry meal is not widely available because poultry processing is not yet well established and the existing modern processing plants do not have rendering facilities. Tapioca (cassava) is widely available. Indonesia is, in fact, a major exporter of cassava meal. Rice bran is available also but supply with consistent quality is limited. Crude palm oil is available but expensive particularly in view of the current currency exchange rate.

Raw material prices continue to be high this year even during the harvest time of corn and tapioca. The foreign exchange rate has been affecting market prices of the local and imported materials. Only rice bran prices have declined, as demand from the feedmillers and layer farms has decreased significantly.

Large feedmills utilize the newest technology and therefore feedmilling practices will be similar to those in the Philippines. Most feedmillers have silos that can store corn inventory for up to a 3 to 4 months supply. The feed is delivered direct to 'poultry shops' (to be discussed below) and large farms.

Broilers

Broiler meat consumption in 1996 was estimated by the Directorate General of Livestock Services to be about 605,000 MT. Taking into consideration the consumption of native chicken, estimated at 317,400 MT and the spent layer chicken, at 21,300 MT, total chicken consumption amounted to 943,700 MT in 1996. The broiler hybrid meat industry, which was growing at an average rate of 15% per year during the period 1992 to 96, grew only by an estimated 8% in 1997 to 656,300 MT due to the economic and monetary crisis which started in July 1997. Per capita consumption was equivalent to 1.96 kg and 2.38 kg in 1996 and 1997, respectively. Metro Jakarta remains the major consuming area, accounting for more than 50% of consumption in 1996. Broiler meat consumption is expected to be weak this year and is projected to be equal to 110 to 115 million kg or 16% of 1997 consumption level.

The broiler breeding industry has an installed production capacity of 1,000 million day-old broilers per year. Most of this volume goes to internal requirements of the integrators. Even before the crisis, the breeding capacity exceeded the industry requirement. The over expansion by both integrators and independents occurred during the period 1993 to 1996. Today, most of these independent breeders have closed.

Before the currency and economic crisis, the chicken industry was primarily in the hands of small independent farmers because of government

regulations limiting the size of layer farms to a maximum of 10,000 bird capacity and broiler farms to a maximum of 15,000 bird capacity. Large companies integrate their operations by establishing large broiler estates where the facilities are advanced to farmers. Farmers buy day-old chicks and feed from the company, the company provides extension services and buys back the birds from the farmers at a rate below market price. Facilities and practices in these estates are comparable to the best in the Philippines.

Independent broiler raisers today suffer a profit squeeze as a result of higher input costs. The integrators, Charoen Pokphand, Japfa Comfeed, A. Sierad and Wonokoyo, now supply a major percentage of the chicken meat demand. These integrators operate through a combination of Kemitraan and other contract growing schemes to support their processing plants. The once-idle farms of independent broiler raisers are now contracted and supervised by these companies. The contract farms are paid on a per bird basis. Other companies without processing plants such as Samsung, implement buy back arrangements to support their commercial broiler feeds sales.

Integrators, such as Charoen Pokphand and the others, have also penetrated the traditional markets for live broilers, which can no longer be supplied by the independent broiler raisers. This situation has elicited complaints from independent broiler raisers, charging the integrators and other large feedmillers of taking advantage of small entrepreneurs.

Practically all the broilers raised are now foreign hybrids rather than the local chicken (ayam kampung). Available broiler hybrids are Arbor Acres, Hubbard, Lohman, Cobb, Hybro, Shavers, Hubbard, Peterson, and Ross, among others. Today, only a few hybrids such as Arbor Acres (Charoen Pokphand), Lohman (Comfeed-Multibreeder) and Hubbard (Wonokoyo) account for the majority of supply.

Breeding farm management practices are basically similar to those in the Philippines. The best breeder farms utilize cool cells and tunnel ventilation. The management practices of feedmillers/integrators implement stricter bio-security than independents.

Most commercial broiler farms are small; typical sizes are 2,500 birds and 5,000 birds. Farm practices in these farms are generally poor. The prevalent practice is a ‘contract to buy’ arrangement in which all the inputs are sold to the growers with a buy back arrangement either at fixed price or prevailing market price.

The ‘poultry shops’ have played an important role in the broiler production system in Indonesia. The poultry shops acted as feed and day-old chick distributors and also provided working capital to farmers on a similar ‘contract to buy’ arrangement. The majority of the chicken supply before the crisis passed through this system. Other schemes are now evolving which are similar to the contract growing schemes in the Philippines. The majority of the growing capacities are small. The grow-out will remain a bottleneck in the entire chain even after the economic recovery.

Today, the role of the poultry shops has been altered. They now also act as ‘contract to buy’ contractors for the feedmillers/integrators. When the economy recovers at some point in the future, the role of poultry shops will still be vital.

Before the crisis, about 10% of the dressed supply was supplied by modern processing facilities using Stork and Meyn equipment and 90% by traditional processing plants (manual and small capacities). Consumers still prefer to buy live chicken from the traditional wet markets. The

modern processing plants cater mostly to the food service sector such as hotels, restaurants and chicken houses.

The popular sizes for live broilers now are in the range of 0.6 to 1.0 kg and 1.1 to 1.2 kg. It is estimated that volume in these size ranges accounts for 65% of total. These sizes also command higher prices by about Rp 150 to 200 per kg.

The availability of day-old broilers in the market today is very limited, thereby pushing prices upward. Only Charoen Pokphand, Multibreeder, Wonokoyo, Samsung remain active in the broiler chick breeding. These companies, however, are limiting their production to internal requirements and contract farms. Together, they account for 40% of the industry's installed breeding capacity of 1,000 million breeder chicks per year. The current production output of these companies, however, totals only 40% of their combined capacity.

Demand for chicken meat will continue to be depressed as prices, although below production costs, remain beyond the reach of most people. Demand will principally come from upper and middle class segments in the major urban centers particularly Metro Jakarta. Other alternatives, including beef, are in short supply and are expensive also.

Layers

Egg consumption in 1996 was estimated by the Directorate General to be about 488,200 MT, excluding consumption of duck eggs and native chicken eggs, and had increased by an average of 12% per year over the last 5 years. Egg consumption in 1997 grew by an estimated 7% to 523,000 MT. Consumption, however, is expected to drop in 1998 due to the ongoing economic crisis. Per capita consumption was equivalent to 2.50 kg and 2.62 kg in 1996 and 1997, respectively.

Unlike in the broiler industry, there are a number of large layer farms, mostly located near sources of local raw materials, principally corn, rice bran, tapioca and limestone. Thus, most layer farms with layer population of 25,000 birds and above mix their own feed using local materials and protein concentrates purchased from the feedmillers. Vitamin & mineral pre-mixes are supplied by companies such as Roche and Rhone Poulenc.

Today, the industry is badly affected by the economic crisis, and is characterized by farm closures and depopulation. Other than the high cost of materials and operating expenses, a major deterrent to continued farm operation in some areas is the increased level of security risks because of political instability.

Unlike the Philippines, Indonesians prefer brown eggs instead of white. The most preferred breeder stocks are Isa Brown (dominant market share), Lohman Brown, and Hysex Brown. Other layer hybrids include Isa Brown, Shaver, Hyline, and Bromo, among others.

Most GP and PS farms use cool cells. PT Isa Inkud is an independent GP breeding company selling PS day-old pullets to feedmillers/integrators and other independent PS breeding companies and is dominant in the market. The PS breeding industry today, however, is operating at very low production utilization, estimated at only 15% of industry production capacity of 120 million pullet chicks per year. The GP breeding companies have likewise reduced output by as much as 80%.

Layer farm operation is basically similar, except that Indonesian farms tend to use more people per house compared to those in the Philippines. Eggs are sold on a per kg basis; thus there is no egg sizing and grading activity.

Prices of table eggs have been increasing but are still below production costs. Market prices reacted to the limited egg supply due to farm closures and increased cost of production. The aftermath of the May riots continues to affect many areas. Farmers cite increased levels of security risks on the farm and in the egg delivery as reasons forcing them to cease operations. Those who continue to operate hire additional security personnel, thereby incurring additional costs.

There is no supply of day-old pullets in the market today. Although Charoen Pokphand and Multibreeder are still active, their chick production goes mostly to internal requirements for egg production and pullet raising. These two companies account for 39% (Charoen Pokphand, 23%, and Multibreeder, 16%) of the industry production capacity of 120 million chicks per year and currently produce less than 40% of capacity. Moreover, Isa Inkud, which supplies PS to Charoen Pokphand, and the other GP breeder companies have reduced operations by 80%.

The scarcity will affect the replacement programs of those layer farms still operating. Under normal situations, stock replacement occurs during the period June to August in anticipation of high egg demand in December to January. There is a waiting time of 4 to 5 weeks for day-old pullet orders today. On the other hand, ready-to-lay pullets are available from both Charoen Pokphand and Multibreeder but demand is lacking due to uncertainty. Both companies are now looking for idle farms to use for commercial layer operations.

As a consequence of the lack of day-old pullet supply, table egg prices are expected to increase in the coming months as egg supply continues to decline due to decreasing layer population. Political unrest remains the single most important factor deterring farmers from continuing operations.

FOOD SAFETY IN THE UNITED STATES

Food safety is not a new issue in the US. In 1906, Congress passed the Pure Food and Drug Act and Meat Inspection Act.[5] Given that no fines or regulations were established, the act had little effect. Federal inspection of poultry has been ongoing on a voluntary basis since 1926. The Poultry Products Inspection Act was enacted in 1957, and poultry inspection became mandatory for interstate processors of poultry products. In 1968, the law was amended to bring nearly all poultry products under federal inspection. Other laws that have had an effect on food safety issues are the 1960 Color Additives Amendment, the 1966 Fair Packaging and Labeling Act, the 1970 Egg Production Inspection Act, and the 1971 Freedom of Information Act, which opened government actions to public scrutiny.

Food safety regulation is far more complex than the mentioned regulations. In July 1996, the U.S. Department of Agriculture's (USDA) Food Safety and Inspection Service promulgated the Hazard Analysis and Critical Control Point (HACCP) regulation for meat and poultry plants[6]. Complete with microbiological testing and performance standards, this rule represents the most important single development of food safety in the last 40 years. Plants with more than 500 employees were

[5] Seanaurer, Asp and Kinsay. Food Trend, Eagen Press, 1991 pp.243.

[6] Roberts, Tanya, Jean C. Burzby, and Michael Ollinger. "Using Benefit and Cost Information to Evaluate a Food Safety Regulation: HACCP for Meat and Poultry." *Amer. J. Agr. Econ*. 78 (December 1996): 927-1301.

required to have HACCP systems operating by January 1998. In the U.S., these large plants represent approximately 75% of the slaughter production and 45% of the processed products production. Small plants, defined by the USDA as having 10 or more employees, but fewer than 500, are required to implement HACCP by January 25, 1999.

Currently, the Food and Drug Administration is considering developing HACCP regulations as a standard throughout much of the rest of the U.S. food supply, including juices, fruits and vegetables.[7] A number of U.S. food companies already use this system in their manufacturing processes (cheese, frozen dough, cereals, etc) and it is in use in other countries, including Canada. The regulations would cover both domestic and imported foods.

While the American food supply is among the safest in the world, there are still millions of Americans suffering from foodborne diseases every year, and some 9,000 a year--mostly the very young and elderly--die as a result. The hazards are numerous, ranging from *Escherichia coli* (*E. coli*) O157:H7, *Salmonella* in meat and eggs to *Cyclospora* on fruit, and many others.

The U.S. is making a large effort to provide a safer food system, putting in place science-based HACCP regulatory programs for seafood, meat, and poultry. Additional current and future regulations will encourage the use of HACCP principles throughout the food industry in order to provide a safer food supply for the 21st century.

Overview of the Current Situation

The Council for Agricultural Science and Technology, a private nonprofit organization, in its 1994 report suggested that two types of bacteria are estimated to cause up to 6.5 million illnesses each year and as many as 9,000 deaths. These bacteria (*Salmonella* and *Campylobacter*) cause the symptoms that are traditionally associated with mild cases of food poisoning, and several other serious conditions, including death. According to some studies conducted in this field, children and adults over 60 years, persons with lowered immunity due to HIV/AID, cancer treatment, organ transplantation, etc., are especially at risk. The consequences of foodborne disease are particularly serious for those with inadequate access to health care, such as homeless people and others.

In general, consumers and society pay a high economic cost for these illness in the form of medical expenses and days absent from work. According to estimates calculated by the USDA, these costs from only *Campylobacter* and *Salmonella* range between $.8 billion and $3.4 billion annually (see Table 6). Consequently, improving food safety would improve consumer welfare as well as reducing economic costs.

HACCP Guidelines

Traditionally, industry and regulators have depended on spot-checks of manufacturing conditions and random sampling of final products to ensure safe food. The HACCP, however, tends to be proactive, rather than reactive, in ensuring food safety.

According to the USDA, HACCP involves seven steps:[8]

1) Analyze hazards. Potential hazards associated with a food and measures to control those hazards are identified in this first step. The hazard could be biological, such as a microbe; chemical, such as a

[7] Federal Register, vol. 63, no. 84 (Friday, May 1, 1998). Proposed Rules.

[8] See http://www.fsis.usda.gov

Table 6. Estimated medical costs and productivity losses for selected human pathogens, 1993.

Pathogen	Meat & Poultry (cases / year)	Meat & Poultry (deaths / year)	Total public costs ($ U.S. billions)
Campylobacter	1,031,250-1,312,500	83-383	0.5-0.8
Salmonella	348,000-2,880,000	348-2,160	0.3-2.6
Other pathogens	768,263-774,284	964-1,198	1.0-1.4
Parasites	2,056	41	2.7
Total	2,149,569-4,968,940	1,436-4,232	4.5-7.5

Source: U.S. Department of Agriculture, "Pathogen Reduction: Hazard Analysis and Critical Control Point (HACCP) Systems Proposed Rule," 9 CFR Part 308, et. al, Federal Register, vol. 23 (1995).

pesticide; or physical, such as ground glass or metal fragments.

2) Identify critical control points. These are points in a food's production (from its raw state through processing and shipping to consumption) at which the potential hazard can be controlled or eliminated. Examples are cooking, cooling, and packaging.

3) Establish preventive measures with critical limits for each control point. For example, in frozen food, this might include setting the minimum cooling temperature required to ensure the elimination of any microbes.

4) Establish procedures to monitor the critical control points. Such procedures might include determining how and who should monitor frozen time and temperature.

5) Establish corrective actions to be taken when monitoring shows that a critical limit has not been met--for example, reprocessing or disposing of food if the minimum frozen temperature is not met.

6) Establish procedures to verify that the system is working properly--for example, testing time-and-temperature recording devices to verify that a cooking unit is working properly.

7) Establish effective record keeping documenting the HACCP system. This would include records of hazards and their control methods, the monitoring of safety requirements and action taken to correct potential problems.

Each of these steps are to be backed by sound scientific knowledge. Given that this HACCP program is so recent, evaluations of its goals and achievements are not yet completed.

Critical Points in the Poultry Processing Industry

Numerous studies have reported that the percentage of carcasses contaminated with *Salmonella* and other bacteria increases during the processing. [9] Figure 16 provides a brief review of the poultry processing procedure and points where harmful bacteria may be passed from one carcass to others (e.g., scalding, defeathering, evisceration, and chilling)

After blood is drained from the carcass, it enters large tanks of hot water for scalding. All the contamination of the skin and feathers is put in the scald tank. Although the water is hot enough to. loosen the feathers, often is not hot enough to kill bacteria, and contamination levels rise in the tank as processing continues. The broilers are then defeathered mechanically. This part of the

[9] The source of this document is The Council for Agricultural Science and Technology http://www.cspinet.org/reports/pol.html

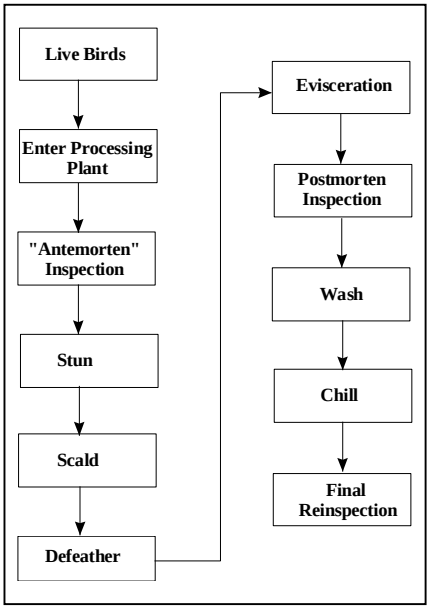

Figure 16. Critical points in the poultry processing industry.

processing is another possible source of contamination. The mechanical fingers that remove the feathers are not cleaned between each bird which could allow cross-contamination. Evisceration (either done manually or mechanically) is a key point of possible cross-contamination. Washing and cleaning is done at different stages. Although this can remove the contamination of the surface, it often doesn't reach the microorganisms in the pores of poultry skin. Finally, birds are chilled in large vats of water called immersion chillers. In this stage, *Salmonella* and other bacteria can be redistributed from one carcass to the others in the tank. Chlorine is often used to minimize cross-contamination, but there are questions about its effects in the human body.

These points of possible cross contamination point to some possible recommendations to help prevent food borne diseases. This is the topic of the next section.

Other Possible Food Safety Recommendations

New processes and technology may increase the safety of poultry in the U.S. Below are some hygienic measures to prevent food-borne pathogens.

1) Reprocessing. In the beef and pork industry, the dirty areas of the skin must be trimmed to remove contamination, while the poultry industry is still allowed to wash the contaminated areas.

2) Cold Air Chilling. The USDA permits poultry chilling by totally immersing the poultry carcass in cold water, usually with added chlorine. However, beef and pork can be chilled using only cold air with spray chilling. Many European and Canadian producers use air chilling rather than water chilling to produce their poultry. With this method carcasses are cooled through an air-chill chamber, which eliminates the possibilities of cross-contamination. With the current immersion chilling, the poultry may be cross-contaminated in the water tank and immersion chilling has often been associated with cross-contamination of poultry products. At the same time, chlorine has been controversial as a food additive.

3) Skin removal. Skin removal is also a critical part of the processing since bacteria are concentrated on the surface of the birds. USDA regulations allow skin in and on poultry products, with allowable amounts ranging from 8% to 20%. Skin may be added to processed products, such as ground poultry and poultry burgers, and in regular poultry. Conversely, ground beef must be made with beef of skeletal origin. USDA should require the removal of skin to help to reduce the prevalence of pathogens found in ground products.

4) Competitive exclusion. Competitive exclusion is another technique being used in Europe. Poultry become infected with small amounts of salmonella in the first days of life; after that the bacteria start an exponential reproduction process. Treatment with competing bacteria shortly after hatching will reduce the possibility of the bird being colonized with salmonella.

5) Steam pasteurization. Steam pasteurization is a process that exposes the internal and external surface of carcasses to high-pressure steam to kill harmful bacteria. This system was approved in December 1995, following extensive testing of steam pasteurization for beef carcasses. The system assures to kill pathogens such as E-coli and salmonella on beef carcasses. If effective in poultry carcasses, this could be an excellent mechanism to reduce bacteria contamination.

Irradiation is another technique that has been approved for poultry products. This technology uses electron irradiation, or X-rays to kill harmful bacteria. Its implementation has been restricted because of consumers' concerns. In general, technical innovation is a crucial factor to minimize the contamination of poultry products. However, the technical innovations should be combined with appropriate practices to assure that contamination is reduced.