

# **The Economic Contribution and Long-Term Sustainability of the Delmarva Poultry Industry**

**Report prepared for the  
Maryland Agro-Ecology Center, Inc., Queenstown, Maryland**

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## EXECUTIVE SUMMARY

**P**OULTRY IS CENTRAL TO THE ECONOMY of the Delmarva Peninsula, the lynchpin of the farm sector, crucial to employment in many communities, and creator of economic activity throughout the regional economy. While the modern broiler industry had its birth and early growth in Delmarva, in recent years the continued expansion of the industry has occurred elsewhere. The apparent increase in the comparative advantage of other regions relative to Delmarva, and increasing pressures stemming from conversion of farmland to nonagricultural uses and environmental problems that have triggered State regulatory action and may generate more, impel us to consider the following questions: What is the real economic contribution of the poultry industry – and what would be lost in its absence? What are the prospects for the future viability of this industry, and what are the chief threats to that viability?

This report's detailed analytical work pertains chiefly to the first question in a short-term context, and through historical review and assessment addresses longer-term viability issues. The basic economic contribution of broiler production and processing stems from the employment of 2,720 people in broiler growing (as of 2001) and 12,320 workers in processing. The full impact however must take into account indirect impacts on the economy, which requires a complex economic analysis. We estimate that, including these broader impacts, the broiler industry accounted for \$1.28 billion or 9 percent of Delmarva's gross regional product and 33,500 jobs as of 2001, one in every twelve jobs in Delmarva. Through loss of tax revenues and sales to Delmarva from Maryland's western shore, the whole state would realize smaller but still significant further losses in the absence of the industry.

The poultry industry is the largest agricultural sector on Delmarva. In the four counties of Maryland's lower Eastern Shore, Delaware's two rural counties, and Accomack County in Virginia, farm revenue from poultry enterprises make up three-fourths of the total value of farm sales. And most of the rest of farm sales come from feed crops, which are almost entirely fed to Delmarva poultry. Thus without the poultry industry there is real reason to question the continued viability of agriculture in this large area.

Is the future of the Delmarva poultry industry at risk? Undoubtedly there are reasons for worry. There has already been a loss of competitiveness as compared to other regions of the United States, as Delmarva's recent loss of market share makes clear. The regulatory results of environmental concerns, and the loss of public confidence of which regulation is the political expression, also contribute to pessimism about the industry's future. Nonetheless, our analysis is not supportive of gloom. Extension service budgets for broiler growing indicate that, especially compared with other agricultural products in recent years, broilers remain an attractive farm enterprise. Broiler production, while no longer expanding, is not contracting either. And, notwithstanding the loss of farms and farmland to development throughout the Mid-Atlantic states, cropland devoted to corn, soybeans, and wheat on Maryland's Eastern Shore has not significantly declined since 1980. The responses of the industry to regulatory policy changes and emerging problems in nutrient management, labor markets, and farmland preservation have been sufficient to forestall significant decline in the Delmarva poultry industry in the immediate future. Still, the razor-thin margins on which both broiler growers and processors operate, and the opportunities open for the processing industry at other locations, indicate that even seemingly small events or policies could worsen the prospects considerably.

# INTRODUCTION

**P**OULTRY IS ONE OF THE major success stories in U.S. agriculture. Of all the livestock sectors, it has achieved the greatest increase in production efficiency, whether measured in terms of cost, feed efficiency, or output per worker. Translated to consumers, the real cost of poultry products has decreased more than any other livestock product. The result is that poultry is the only livestock sector that has achieved a growing market share as well as increasing per capita consumption over the last three decades. Indeed, during the early 1990s, consumption of chicken surpassed that of beef, making it the most consumed meat in the United States. In addition, the U.S. poultry industry is highly competitive as the world's largest producer and exporter of poultry meat. In 2001, U.S. poultry meat production totaled 50 billion pounds, with a farmgate value of \$24.6 billion – the third largest sector in agriculture.

The most economically significant part of the poultry industry is the raising of broiler chickens for meat. The birth of the modern broiler industry took place on the Delmarva Peninsula in the early 1920s. During the 1920s and 1930s, Delmarva south of Wilmington was an economically depressed region. Broilers provided a desperately needed cash crop that was increasingly in demand in the urban markets of Boston, New York, and Philadelphia. By the mid-1930s, two out of every three broilers in the U.S. were raised in Delmarva. The growth of Delmarva broiler production stimulated the expansion of local hatcheries, breeding operations, and feed companies, and eventually local processors.

A large increase in the production of commercial broilers continued during the latter half of the twentieth century, but with the most significant gains in other growing regions. No longer the nation's leading broiler production area, Delmarva is now ranked as the sixth-largest – behind Georgia, Arkansas, Alabama, Mississippi, and North Carolina. This has raised questions about the Delmarva industry's evolving competitive situation, tempering optimism about the future. And issues have arisen concerning the situation of workers in processing plants, growers under contract, and environmental impacts of both broiler processing and associated farm enterprises.

## **Study Objectives and Report Overview**

This study focuses on the economic role of the Delmarva broiler industry. How does the industry influence the regional economy and what would be the consequences of changes in the size of the industry? With broiler production the center of the integrated industry, connections to feed sources and hatcheries as well as to processing facilities are critical linkages to consider in the industry's overall economic contribution. While broiler production is the centerpiece of the analysis, what are the economic effects of changes in other sectors linked to the industry? For instance, what are the implications for the broiler industry of a major loss of grain-growing farmland? Are enhanced environmental regulations concerning chicken litter resulting in diminished competitiveness of the industry?

This report is organized into four parts following the introduction. The first part describes the broiler industry in the United States – its growth, organizational structure, and regional locations.

Second, we place the Delmarva broiler industry's development into an industrial cluster analytical framework. An industry cluster is more than just a geographic concentration of companies – contract growers and processors within the same industry. Clusters also include suppliers that provide a full range of inputs, customers and supporting private-sector and public agencies.

The third part of the report addresses the overall economic contribution of the Delmarva poultry industry to the agricultural economy and to related sectors, using an input-output modeling framework. Such a model is essentially a general accounting system of the transactions taking place between industries, businesses, and consumers within a regional economy. These purchases and sales are adjusted for in-state and out-of-state sources and then summed to arrive at estimates of total impacts arising from changes in the poultry industry. In addition, we assess the interregional effects of the Delmarva poultry industry.

Lastly, we consider a number of economic development, environmental, and regulatory issues confronting the broiler industry in Delmarva.

## GROWTH OF THE BROILER INDUSTRY IN THE UNITED STATES

IN THE EARLY DAYS of the twentieth century, most farms had a poultry enterprise, as did many homes in rural areas and small towns.<sup>1</sup> Flocks were most often small, with the output of eggs and meat used largely in the farm kitchen and the surplus sold to provide petty cash for the farm household. Back then, chicken meat production was a byproduct of the farm egg enterprise. Given the lack of refrigeration and rapid transportation, neither was a major commercial endeavor. Only on the periphery of large cities were there specialized poultry farms that sold most of their output – and at that, almost exclusively eggs – to urban markets. Chicken meat was generally considered a luxury; most chickens that were eaten were old hens and surplus roosters since killing a young chicken tender enough for the frying pan was considered an extravagance.<sup>2</sup>

In 1923, an event on the Delmarva Peninsula marked the beginning of the modern broiler industry in the U.S. The story is that a farm housewife, Cecile Steele of Ocean View, Delaware, mistakenly received 500 chicks from her hatchery supplier. Instead of sending them back, she raised these chickens for meat and later sold them to a local buyer, who in turn found northern markets for them. The success of this enterprise led other farmers to begin raising chickens solely for meat (Williams 1998). By the mid-1930s, broiler production in the United States had increased to 34 million birds annually, with Delmarva raising about two-thirds of the total. Four counties on the Delmarva Peninsula – Sussex County in Delaware, Worcester and Wicomico in Maryland, and Accomack in Virginia – were among the top five broiler production counties in the nation.

In 1940, broilers were still more expensive than other meats: average American consumption was 124 pounds of red meat (beef, veal, pork, and lamb) versus 15 pounds of chicken. Profit potential inherent in broiler production became evident during World War II. Poultry, unlike the red meats, was not rationed during the war, and as a result broiler production nearly tripled between 1940 and 1945.

Such developments undoubtedly played a role in the postwar market allocation of capital for facilities and research. Adoption of technological advances in genetics, disease control, nutrition, housing, and materials-handling in the 10-year span following the war was significant. The introduction of new breeds for meat, along with better nutrition, disease control, and management, made it possible to raise flocks in confinement, which led to year-round production. Substantial investments were made to develop strains of chicken that were bred strictly for their meat qualities, particularly for the yield of meat from breasts, thighs, and drumsticks. Research on feed formulations led to substantial improvements in feed efficiency. Antibiotics such as Aureomycin® (chlortetracycline) were discovered during this time and were found to have great value as both growth stimulants and in disease control. Advances in feed medications and vaccinations through drinking water further aided larger commercial-sized flocks and reduced labor costs. Mechanical innovations such as automatic feeding conveyors

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<sup>1</sup> “Poultry” also includes other domesticated fowl – turkeys, ducks, geese, emus, ostriches, and game birds.

<sup>2</sup> For more detail on this and other aspects of the history of the broiler industry, see Martinez (1999, 2002), Perry, Banker, and Green (1999), Rogers (1998), and Williams (1998).



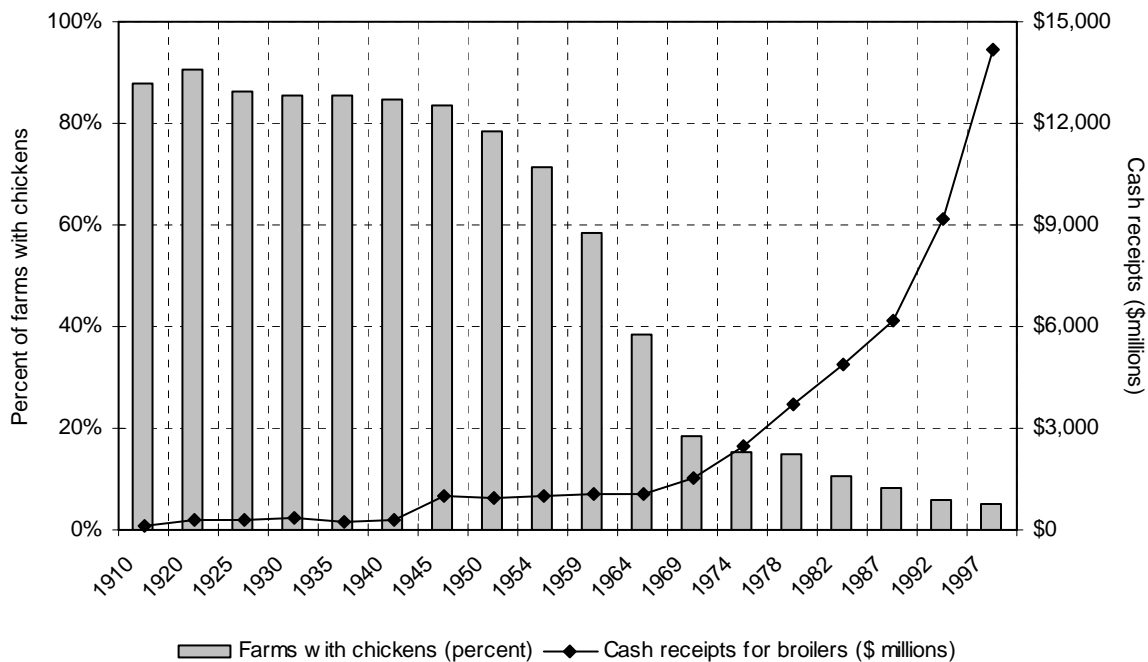
significantly improved production efficiency by reducing labor requirements and improving the broiler-growing environment. Other equipment innovations included waterers, ventilation systems, chick sorters, and feed cleaners.

These innovations increased the size of the lowest-cost production units. In the mid-1950s, no farm was selling as many as 100,000 broilers; by the mid-1960s, one of every eight farms sold 100,000 or more broilers. Thus, broiler production began to develop independently from other poultry enterprises. The resulting specialization meant fewer farms with chickens, even as farm receipts for broilers and chicken consumption grew rapidly (Figures 1 and 2).

### **Contracts and Vertical Integration in the Broiler Industry**

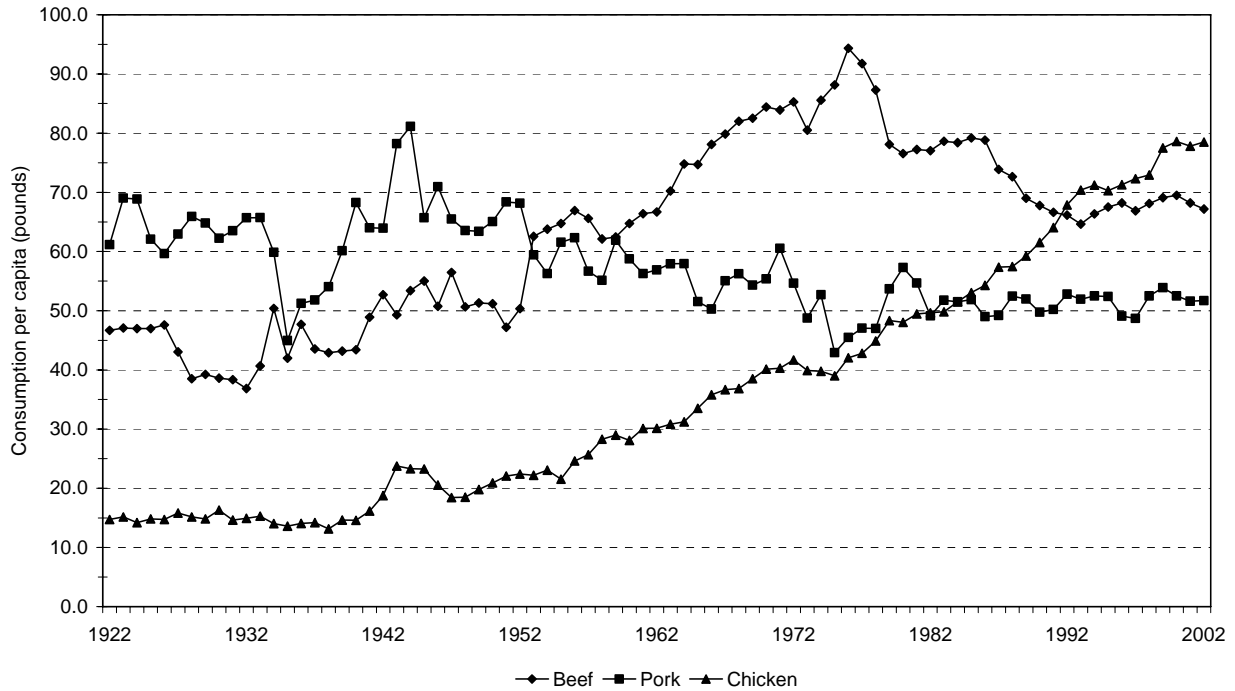
As broiler production expanded and growers began operating larger chicken houses, financial resource requirements increased. Growers and lenders, however, disliked the risk posed by the increased capital requirements for growers given the volatile market price for live broilers. Moreover, lower costs were passed through to buyers as lower market prices. From 1945 to 1960, for example, the average price for live broilers dropped from thirty to seventeen cents per pound (Figure 3).

Feed companies recognized the broiler industry’s potential for growth and the market that the broiler industry represented for their feed. With feed representing about 70-75 percent of grow-out costs for broilers, feed companies had earlier bought up hatcheries as part of their comprehensive involvement in the broiler industry. Beginning in the late 1940s, feed companies expanded their coordination role within the broiler industry by attaching themselves to a large



**Figure 1. Farms with Chickens, and Cash Receipts for Broilers, United States, 1910-1997**

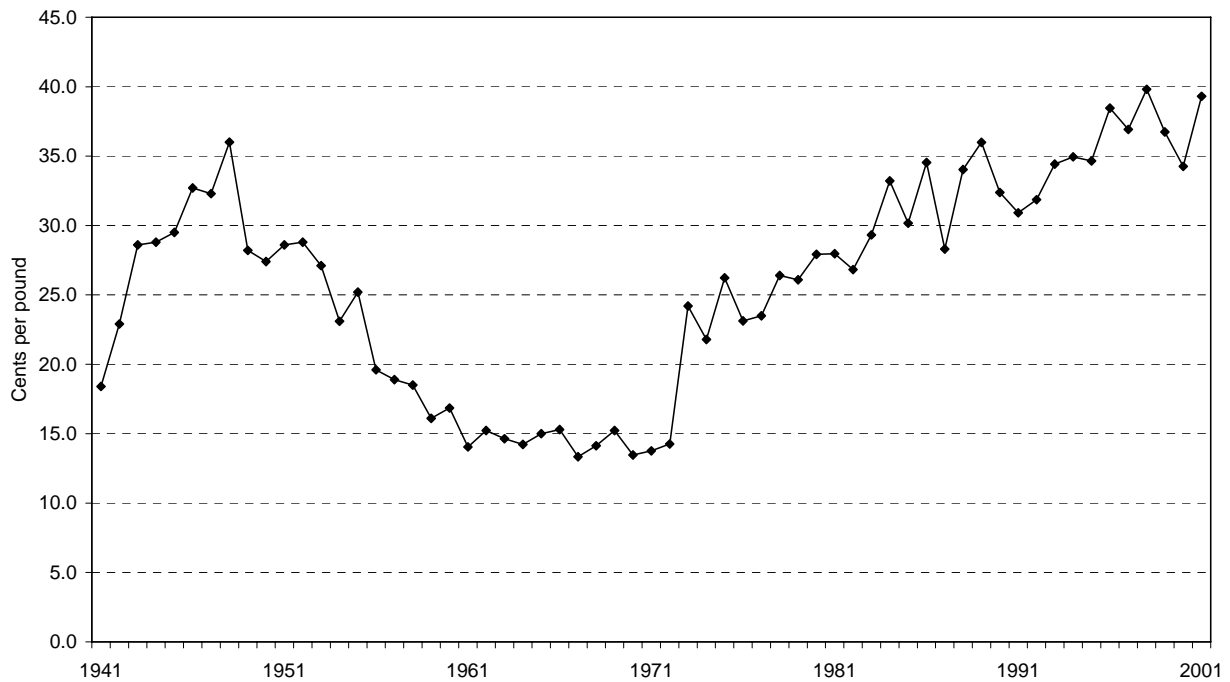
Source: U.S. Census Bureau, *Census of Agriculture*, various years; USDA, National Agricultural Statistical Service, *1997 Census of Agriculture*, 2001



**Figure 2. Meat Consumption in the United States, per Capita 1922-2002**

Notes: Per capita consumption is on a retail weight basis; 2002 is forecast

Source: USDA, World Agricultural Outlook Board, 2002



**Figure 3. Average Prices for Broilers, Liveweight Basis, 1941-2001**

Source: USDA, National Agricultural Statistical Service, *Agricultural Prices*

number of growers through a production contract system. Growers/farmers were receptive to arrangements that lowered their price risk and stabilized earnings. These contracts later evolved to ensure a market outlet for feed supplies and to reduce growers' financial and income risks, and to create incentives for growers to produce efficiently (Box 1). Risk and management responsibilities were increasingly transferred to feed companies – also referred to as integrators – with some companies moving into processing as well. Still other feed companies entered the grow-out stage, when their affiliated farmers went under.

The use of production contracts in raising broilers spread quickly until today nearly all broilers are grown under contract or in integrator-owned facilities (Figure 4). Prior to 1950, 95 percent of broiler producers were independent. Coupled with this rise of production contracts was a further increase in the scale of broiler operations. By 1997, two-thirds of all growers nationwide were producing 100,000 or more broilers annually. The number of farms with broiler sales declined by more than one-fourth between 1969 and 1997, while total poultry sales

### **BOX 1. Evolution of the Broiler Industry Contract**

The first contracts between the integrator and growers were called *open account contracts*. Under these arrangements, credit was extended to the growers, easing their capital constraints. The growers provided housing, equipment, labor, fuel, and other inputs. When the broilers were sold, the grower in turn repaid the debt. Profit to the feed company came from markups on inputs or from a flat service charge.

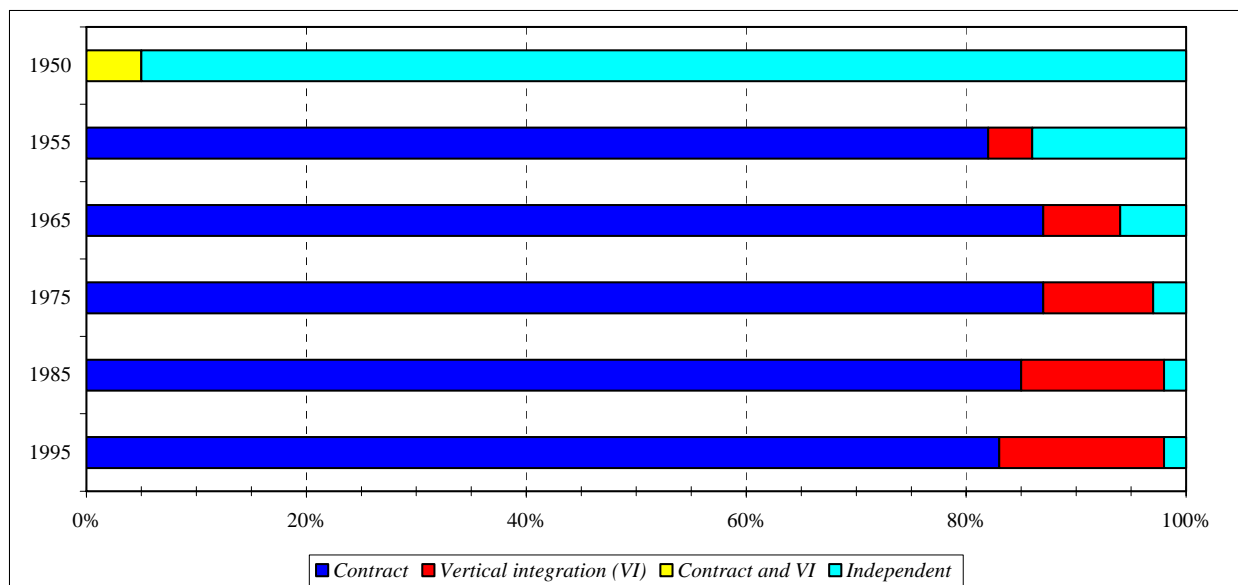
All profits and losses, however, were sustained by the grower. Later, *guaranteed price contracts* lowered grower price and output risk and reduced financial constraints. Under these contracts, the feed company furnished supplies for a fee. Because the grower was guaranteed a certain price when the birds were sold, price risk shifted to the integrator.

In the 1950s and 1960s, *flat-fee contracts* became the most widely used arrangement. Under this arrangement, the integrator retained ownership of the birds, supplied the feed and medication, and provided supervisory field personnel. The grower no longer purchased these inputs from the integrator. When the birds were sold, the grower received a flat fee per bird (or per pound, or per week of growing season) as compensation for labor and some inputs. Capital requirements and financial risk for growers were reduced because they were no longer indebted to the integrator for inputs.

Integrators later developed variations of this flat-fee contract to deter shirking by growers and to share output price risk. Under *share contracts*, for example, the integrator provided the chicks, feed, medicine, and fuel, while the grower provided the chicken house, equipment, and labor. Bird receipts in excess of integrator costs were shared by the integrator and grower, giving each party a joint interest.

*Feed-conversion contracts* were designed to provide an incentive for improved production practices. A feed-conversion bonus was paid to the grower, along with the flat fee payment, based on the pounds of feed per pound of bird. Here, the grower's income was directly related to a performance level.

Finally, *combination contracts* included desirable features of previously implemented contracts. Such contracts involved a flat-fee payment to the grower adjusted by some bonus payment based on performance level (e.g., profit-sharing, feed efficiency, mortality). In addition, the integrator adjusted the bonus payment according to the grower's performance relative to other growers, such as the average cost of production.



**Figure 4. Proportion of Broilers Produced under Contracts, Vertical Integration and Independent Production, 1950-1995**

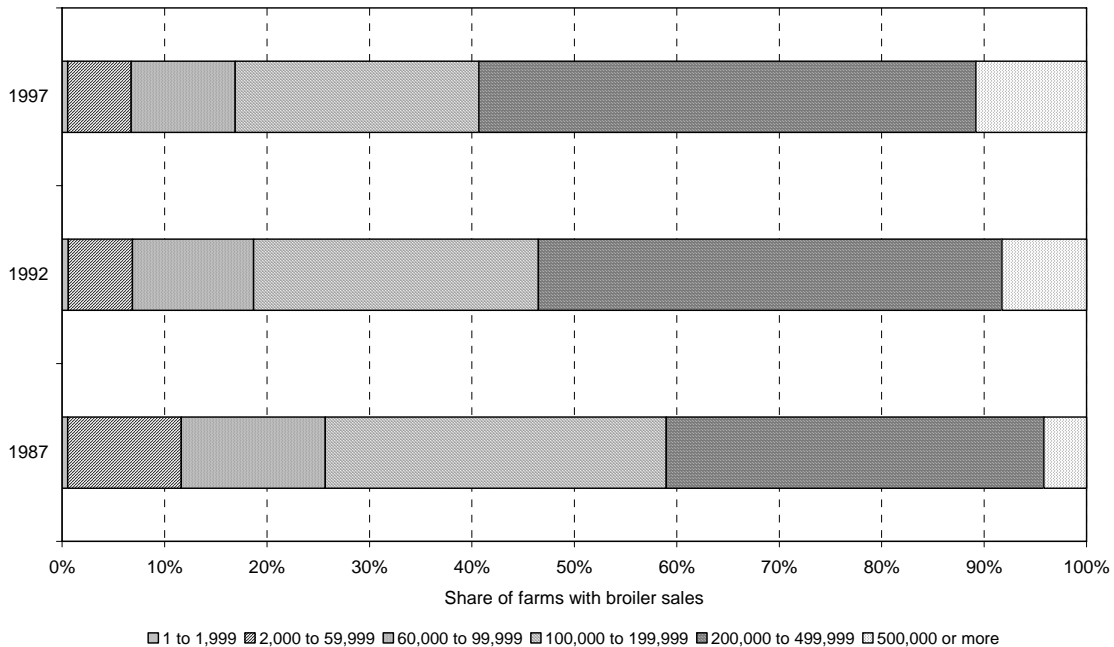
Source: Martinez, *Vertical Coordination of Marketing Systems: Lessons from the Poultry, Egg, and Pork Industries*, 2002

increased by more than 185 percent. Average sales per farm in 1997, at 281,000 birds, were four times greater than in 1969.

Production concentration was even more pronounced in major producing regions like Delmarva. More than eight out of every ten Delmarva growers were producing 100,000 or more broilers; six out of ten growers were producing 200,000 or more broilers (Figure 5).

As mentioned earlier, beginning in the late 1940s feed companies became more directly involved in the broiler business, coordinating production capacity at each stage. The feed and hatchery stages, for instance, became integrated as feed companies added hatcheries and expanded growing operations. In addition, feed companies developed closer ties with processors by acquiring or merging with processors and by building their own processing facilities. Processors were in a better position than producers to coordinate hatching-egg operations. Independent processors and independent producers found themselves with fewer markets for buying and selling broilers. Consequently, many independent processors established their own contracts with feed companies to obtain chicks or with growers to produce the birds.

A distinctive feature of the broiler industry is therefore the degree to which it is vertically integrated, with the processors controlling the vertical stages in the industry by either owning or contracting each stage of the vertical system – from breeding stock to market-ready products. These processor-integrators own breeder farms and hatcheries where they breed the parent stock, produce hatching eggs, and hatch the eggs. Providing baby chicks, feed, veterinary services, and advice, they contract with growers to raise the chicks. The grown broilers are slaughtered and dressed for market by the processor. Further processing may be done in company-owned plants or by other processors who do not slaughter the birds (cut-up, deboning, or product preparation



**Figure 5. Delmarva Farms with Broiler Sales, by Size of Operation: 1987, 1992, and 1997**

Sources: U.S. Bureau of Census, *Census of Agriculture, 1987, 1992*; USDA, National Agricultural Statistics Service, *Census of Agriculture, 1997*

for food service companies). Most recently, processor-integrators have utilized excess chicken litter from their contract growers for conversion to fertilizer pellets.<sup>3</sup>

### Location of Broiler Production

Broiler production is concentrated in the “broiler belt” of states, beginning at the Delmarva Peninsula and swinging down through the Southeast to east Texas. California is the only top-ten production state outside this region (Table 1). These leading ten states account for 80 to 85 percent of all broiler production.

In 1950, Georgia, Arkansas, Alabama, North Carolina, and Mississippi together accounted for 27 percent of U.S. broiler production; by 1965, these five states had become the top producing states in the nation. In 2001, these five states accounted for 58 percent of the nation’s broiler production. During the same time period, Delmarva’s share of national production has steadily declined from 28 percent in 1950 to below 10 percent in 2002.<sup>4</sup> Since the early 1990s, broiler production growth in Delmarva has been relatively flat. Other producing regions – notably Southeast states but also other areas (Texas, Oklahoma, and Kentucky) – continue to

<sup>3</sup> In 2001, Perdue-AgriRecycle opened a chicken litter palletizing plant in Delmarva. The plant is capable of taking in 96,000 tons of litter each year and converting the waste to 82,000 tons of pasteurized organic fertilizer for sale in the home and garden retail market.

<sup>4</sup> Annual broiler production in 2002 for the Delmarva region was 526.888 million birds or 2.802 billion pounds; the latter production measure was a slight gain of 0.7 percent over 2001 (Agri-Stats, 2003).

capture an increasing share of national production growth. Production costs were much lower in the Southeast due largely – at least historically – to lower wage rates. Hatchery efficiency gains also contributed to lower chick prices in the Southeast. In the early 1960s, the Southeast became the low-cost broiler producer; production costs in the Southeast were estimated to be about 15 percent lower than on the Delmarva Peninsula.

**Table 1. Production of Broilers in the United States, 2001**

<b>State</b>	<b>Number produced (1,000 birds)</b>	<b>Pounds produced (1,000 lbs)</b>	<b>Value of production (\$1,000)</b>
Georgia	1,247,300	6,236,500	2,432,235
Arkansas	1,170,900	5,737,400	2,237,586
Alabama	1,007,600	5,138,800	2,004,132
Mississippi	765,300	3,826,500	1,492,335
North Carolina	712,300	4,202,600	1,681,040
Texas	565,500	2,714,400	1,058,616
<b>Maryland</b>	<b>287,800</b>	<b>1,381,400</b>	<b>552,560</b>
<b>Virginia</b>	<b>271,500</b>	<b>1,330,400</b>	<b>518,856</b>
<b>Delaware</b>	<b>257,700</b>	<b>1,494,700</b>	<b>597,880</b>
Kentucky	253,400	1,292,300	503,997
Oklahoma	226,800	1,111,300	433,407
Tennessee	198,300	932,000	363,480
South Carolina	198,000	1,049,400	409,266
Pennsylvania	132,300	701,200	287,492
Florida	115,300	634,200	253,680
West Virginia	89,800	368,200	143,598
Minnesota	43,900	219,500	85,605
Ohio	40,100	212,500	82,875
Wisconsin	31,300	137,700	53,703
Nevada	3,400	18,000	7,020
New York	2,300	12,200	5,002
Hawaii	900	3,800	2,071
Other states	767,400	3,690,900	1,487,433
<b>TOTAL, United States</b>	<b>8,389,100</b>	<b>42,445,900</b>	<b>16,693,569</b>
<b>Total, Delmarva states</b>	<b>817,000</b>	<b>4,206,500</b>	<b>1,669,296</b>
<b>Total, Delmarva region</b>	<b>534,792</b>	<b>2,783,189</b>	<b>1,113,276</b>

Notes: “Delmarva states” consists of Delaware, Maryland, and Virginia; the total for the Delmarva states is simple aggregation of these three states; “Delmarva region” consists of the entire state of Delaware, plus the eastern shore of Maryland and Virginia. The total production figures are from Agri Stats, Inc. Production numbers for California were not disclosed, but estimated at 1,350,000 (1,000 lbs).

Sources: USDA, National Agricultural Statistics Service, *Poultry Production and Value, 2001 Summary*, April 2002a; Agri Stats, Inc., *Live Production Analysis for 2001*, September 2002

## BROILER INDUSTRIAL CLUSTER ON THE DELMARVA PENINSULA<sup>5</sup>

**I**NDUSTRY CLUSTERS ARE GROUPS OF economically related firms within a common geographic area. Delmarva’s integrated broiler industry is a regional cluster composed of hatcheries, growers, grain farmers, feed mills, geneticists and veterinarians, suppliers, integrators-processors, shippers, marketing firms, fertilizer pellet plants, and institutional agencies. Within the broiler industry cluster are two core sectors: broiler production, consisting of farms growing broiler chickens, and processing. Surrounding these core segments are breeder farms; hatcheries; grain farmers and feed mills; geneticists, nutritionists, and veterinarians; suppliers; shipping and distribution firms; marketing companies; and institutions. Figure 6 shows the relationships among these industry segments. Table 2 indicates their relative sizes. Table 3 shows their location by county.

In 2001, farm cash receipts from Delmarva broiler production amounted to \$1.12 billion. Preliminary estimates of value of production in 2002 of Delmarva broilers was \$874 million, down by over 21 percent from the 2001 value of production (Figure 7). The decline is likely attributable to lower prices. USDA’s estimate of the live broiler price, constructed largely from fees paid under contracts, decreased from 39 cents per pound in December 2001 to 29 cents per pound in December 2002 (USDA 2002b). Overall, production since 1995 has been relatively flat, averaging around 530 million birds annually (Figure 7).

Poultry production provides a tremendous demand for Delmarva grain production – in fact, virtually all of the corn and soybeans grown in Delmarva are used for local chicken feed.

**Table 2. Broiler Industry Cluster in Delmarva, 2001**

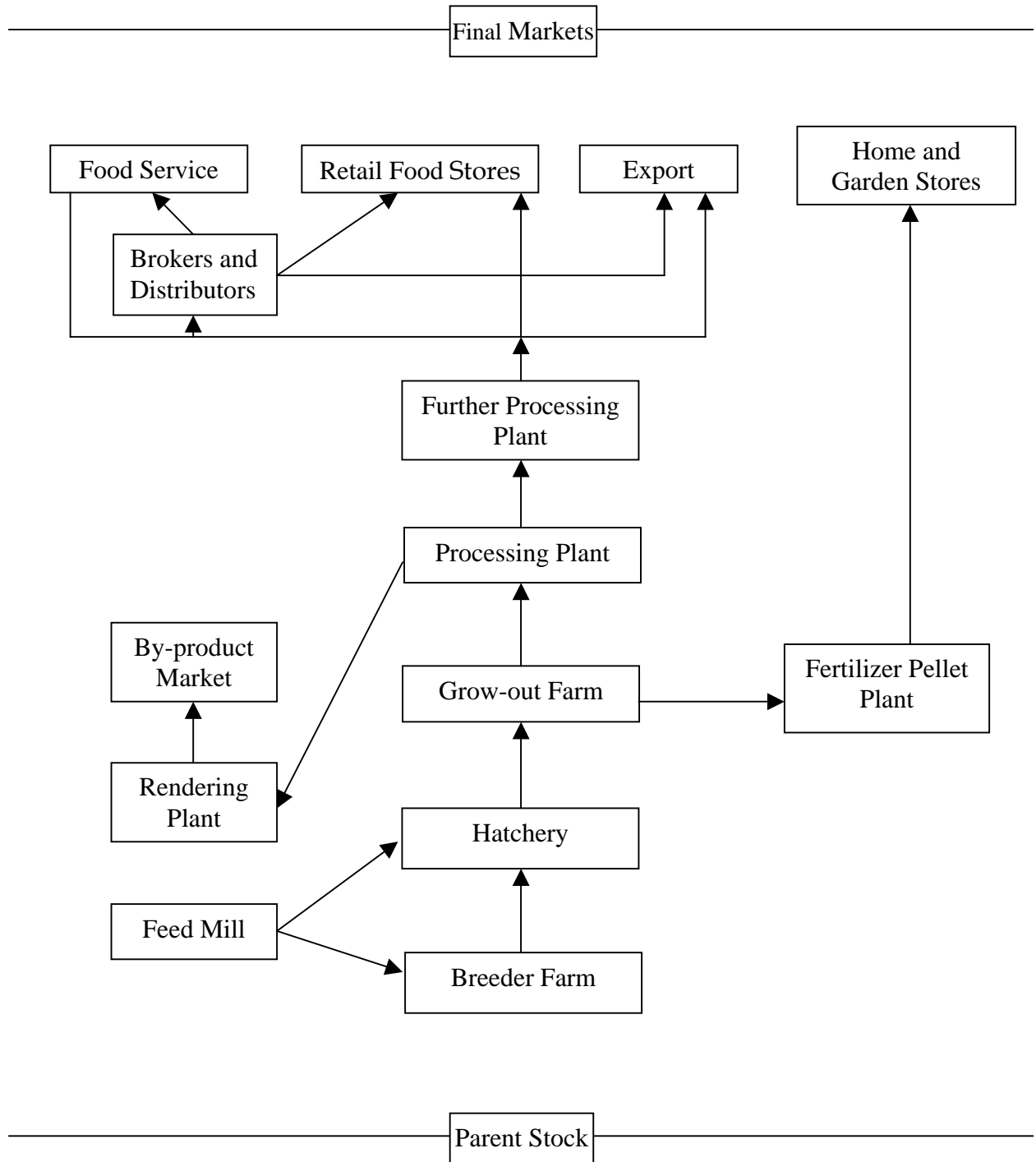
Cluster segment	Establishments	Employment	Payroll (\$1,000)
Breeders	212	250	NA
Hatcheries	14	420	10,100
Growers	2,300	2,720	NA
Feed Mills	10	430	14,900
Processing plants	20	12,320	282,300
Agricultural services	360	1,200	33,400
Administrative headquarters	3	430	19,350
Fertilizer pellet plant	1	30	NA
<b>Total</b>	<b>2,920</b>	<b>17,800</b>	<b>NA</b>

Notes: Estimated from various sources; NA is not available

Sources: Delmarva Poultry Industry, Inc.; U.S. Bureau of Labor Statistics; WATT Poultry USA

<sup>5</sup> The Delmarva Peninsula is composed of the entire state of Delaware (New Castle, Kent, and Sussex counties), the nine counties (Cecil, Kent, Queen Anne’s, Caroline, Talbot, Dorchester, Wicomico, Somerset, and Worcester) on the eastern shore of Maryland, and the two counties (Accomack and Northampton) on Virginia’s eastern shore. The analysis here includes the entire Delmarva Peninsula except for New Castle, the most urbanized county in Delaware, and Northampton County, Virginia. Once a major broiler producing county, New Castle had only three farms producing broilers by 1997, the latest census year. Northampton County had none.

**Figure 6. Vertical Structure of the Broiler Industry**

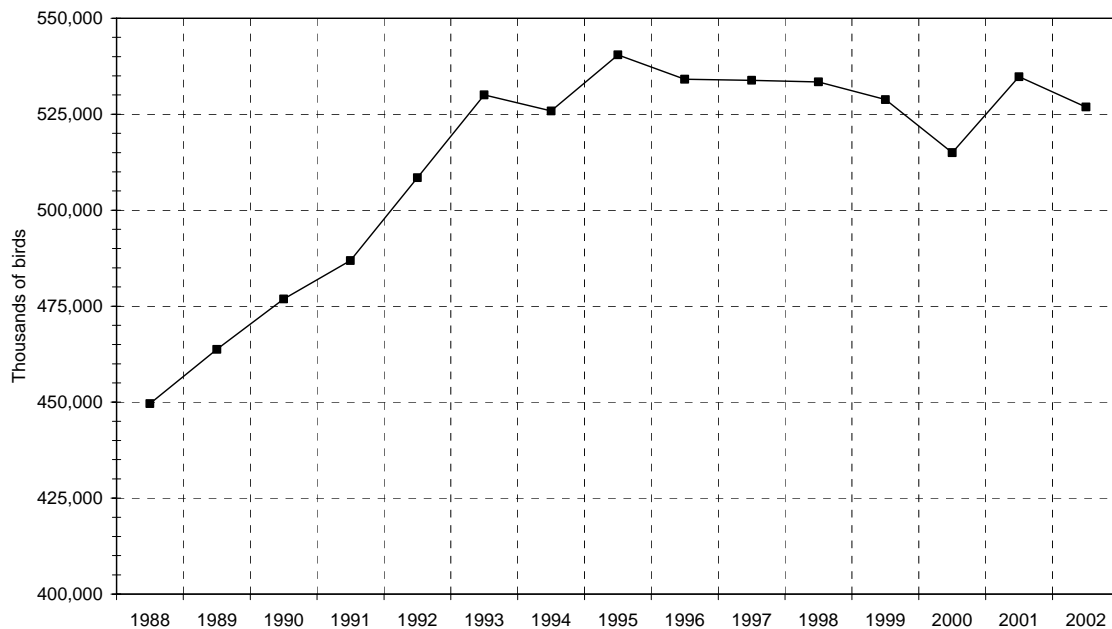




**Table 3. Location of Broiler Industry Production and Processing Facilities in Delmarva**

<b>Location</b>	<b>Farms</b>	<b>Hatchery</b>	<b>Feed Mill</b>	<b>Processing Plant</b>	<b>Company Headquarters</b>
<b>Delaware</b>	<b>802</b>	<b>3</b>	<b>4</b>	<b>6</b>	<b>3</b>
Kent	133	0	0	0	0
Sussex	669	3	4	6	3
<b>Maryland</b>	<b>958</b>	<b>10</b>	<b>6</b>	<b>6</b>	<b>1</b>
Caroline	138	0	0	0	0
Cecil	3	0	0	0	0
Dorchester	71	2	1	1	0
Kent	12	0	0	0	0
Queen Anne's	33	0	0	1	0
Somerset	150	3	1	0	0
Talbot	35	0	0	1	0
Wicomico	283	3	1	1	1
Worcester	233	2	3	2	0
<b>Virginia</b>	<b>61</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>0</b>
Accomack	61	1	0	2	0
<b>Delmarva</b>	<b>1,824</b>	<b>14</b>	<b>10</b>	<b>14</b>	<b>4</b>

Sources: USDA, NASS, Census of Agriculture, 1997; Delmarva Poultry Industry, Inc.



**Figure 7. Annual Broiler Production in Delmarva, 1988-2002**

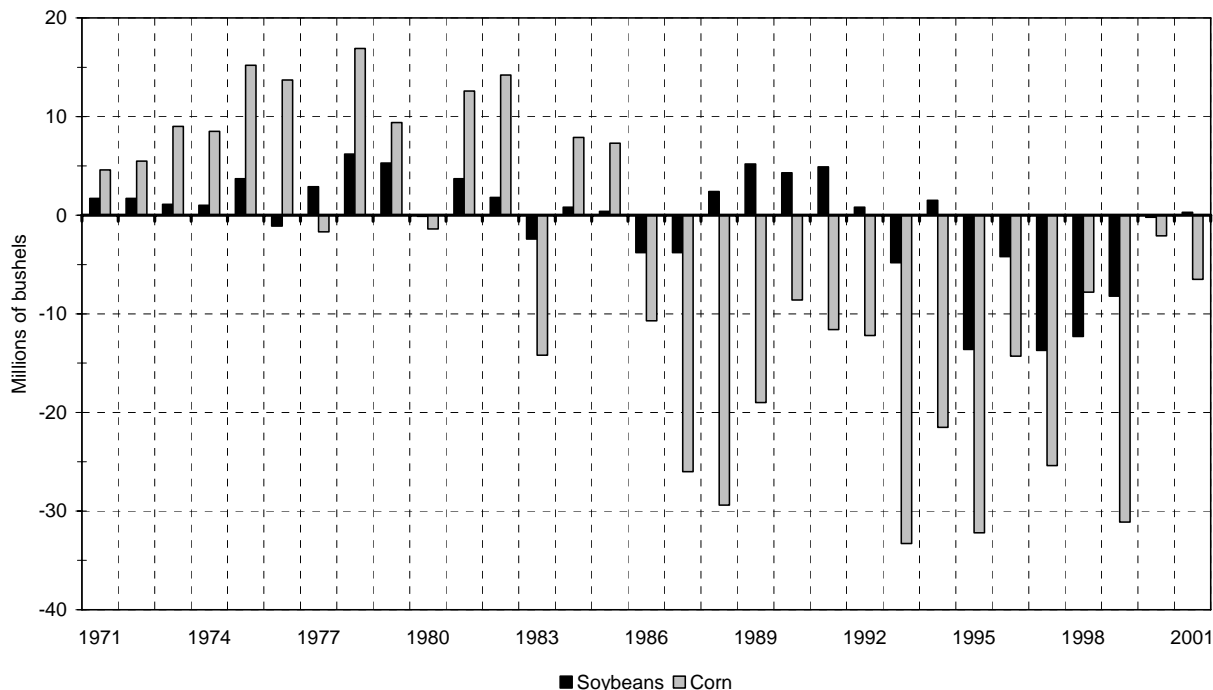
Note: Annual broiler production estimated for Delmarva region

Sources: USDA, National Agricultural Statistics Service; Agri Stats, Inc.

Despite increased grain production, the Delmarva broiler industry has been a net importer of feed grain in most recent years (Figure 8). With feed representing approximately 70-75 percent of the grow-out costs for broilers, the 2001 feed bill for broilers amounted to \$434 million (Delmarva Poultry Industry, Inc., 2002). Integrators service their broiler feed needs from 10 feed mills located on the Delmarva Peninsula.

Besides feed, Delmarva integrators provide contract growers with chicks obtained from their 14 hatcheries. Eggs for hatching are produced at breeder operations in Delmarva; in 2001, breeders shipped 686.4 million eggs to hatcheries on the Peninsula. After hatching, some 563 million chicks were transferred from these hatcheries to 2,300 growers and raised in 5,690 broiler chicken houses. Technical assistance in the form of veterinary services, geneticists, and nutritionists is provided at the various stages of broiler production – from breeders and hatcheries to growers. Growers received payments amounting to \$131 million in 2001 and \$127 million in 2002 for growing the birds to maturity (Delmarva Poultry Industry, Inc., 2002; Agri Stats Inc., 2002).

At maturity, the poultry are shipped for immediate processing to one of twelve first-stage processing facilities in Delmarva. Further processing of broilers occurs at two value-added processing plants on the Peninsula. The high cost of transporting live birds requires integrators to locate their processing facilities near their contract growers. In 2001 these facilities employed an estimated 12,300 workers with an annual payroll of \$282.3 million. The processed broilers – estimated at \$1.37 billion in value – are then shipped to various domestic and export markets.



**Figure 8. Broiler Feed Deficit (Production less Consumption), Delmarva, 1971-2001**

Notes: Deficit represents net feed grain needs for broilers unmet by local grain production. Surplus represents net feed grain needs for broilers exceeded by local grain production

Sources: Delmarva Poultry Industry, Inc.; USDA, National Agricultural Statistics Service

## ECONOMIC CONTRIBUTION OF THE DELMARVA BROILER INDUSTRY

**G**ROSS REGIONAL PRODUCT, like its national counterpart, is the most widely used measure of an area's economic activity. In 2001, gross regional product in Delmarva was estimated at \$19.18 billion, or about 3.9 percent of the combined Delaware-Maryland-Virginia gross state product of \$497.6 billion. Personal income – composed of wages, salaries, proprietors' income, and other labor income earned by job-holders working in the Delmarva region – was valued at \$18.4 billion in 2001. Employment, including full- and part-time wage and salary employees and self-employed workers, totaled 395,610 in Delmarva, or about 4.9 percent of the combined three-state total, in 2001 (Table 4).

**Table 4. Demographic and Economic Profile of Delmarva and States of Delaware, Maryland, and Virginia, 2001**

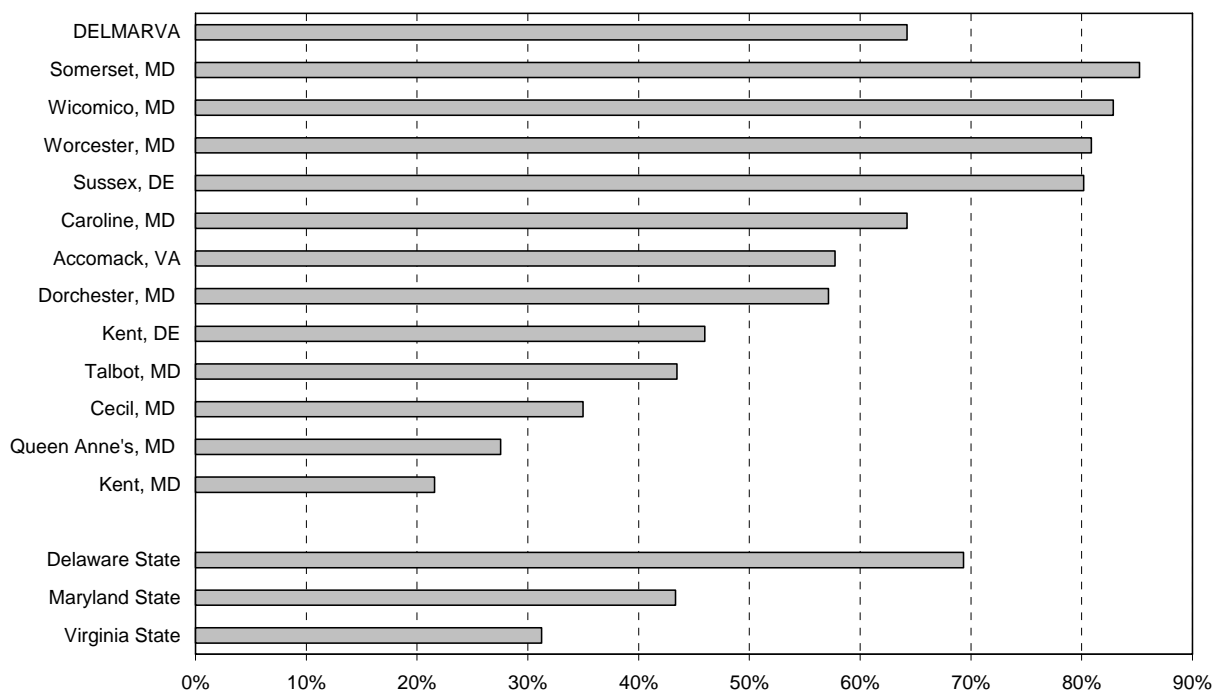
Category	Delmarva				Total,	Delmarva
	Peninsula	Delaware	Maryland	Virginia	3 states	Share
Population	743,579	796,599	5,386,079	7,196,750	13,379,428	5.6%
Gross Regional Product (\$mil.)	\$19,185	\$39,460	\$196,762	\$261,355	\$497,577	3.9%
Personal income (\$millions)	\$18,418	\$25,624	\$190,015	\$232,730	\$448,369	4.1%
Employment	395,610	509,896	3,128,370	4,445,124	8,083,390	4.9%
Proprietors	78,308	68,254	495,643	633,595	1,197,492	6.5%
Wage and salary employees	317,302	441,642	2,632,727	3,811,529	6,885,898	4.6%

Sources: U.S. Census Bureau; U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis

The broiler industry is a key component of the Delmarva economy not only because of its own sales volume but also through its effects in related industries. Most closely related economically to broiler processing is Delmarva farming. Poultry is by far Delmarva's leading agricultural product, accounting for almost two-thirds of farm output value. Over 534 million broilers were produced by 2,512 Delmarva growers in 2001 (with an average of some 212,600 broilers per grower). These broilers were raised in nearly 5,700 chicken houses.<sup>6</sup> For a number of counties broilers represent 80 percent or more of the county's total farmgate value of production (Figure 9). The crucial dependence of Delmarva farming on the broiler industry is shown more starkly in the case of the most broiler-intensive counties on the lower Eastern Shore of Maryland along with Kent and Sussex Counties in Delaware and Accomack in Virginia. In those counties three-fourths the value of farm production is generated by poultry and most of the rest by crops fed to poultry. Poultry and grain together accounted for 88 to 96 percent of the value of farm output in Maryland's four lower Eastern Shore counties in 1997 (Table 5).

To assess the full picture of economic impact it is necessary to consider the effects of broiler production and processing on the full range of inputs – chicks, feed, fuel and utilities, veterinary services, and the like – which are purchased by producers. Such production inputs represent the indirect effects of the industry.

<sup>6</sup> Further details about Delmarva poultry growers as of the mid-1990s are given in Michel et al. (1996).



**Figure 9. Poultry Production as Share of Total Farmgate Value, 1997**

Source: USDA, National Agricultural Statistics Service, *U.S. Census of Agriculture, 1997*

**Table 5. Delmarva County Farm Cash Receipts, 1997**

	million dollars			fraction of total farm receipts		
	poultry	grain	total	poultry	grain	both
MD lower Easter Shore:						
Dorchester	47	25	82	0.57	0.31	0.88
Somerset	82	10	97	0.85	0.11	0.96
Wicomico	154	16	186	0.83	0.09	0.91
Worcester	119	23	148	0.81	0.15	0.96
Delaware:						
Kent	71	35	154	0.46	0.23	0.69
Sussex	401	58	500	0.80	0.12	0.92
Virginia:						
Accomack	49	15	85	0.58	0.18	0.76
Total	924	183	1252	0.74	0.15	0.88

Source: USDA, 1997 Census of Agriculture

In addition to the direct and indirect economic effects resulting from broiler production, processing, and input supply activities, income earned in these agriculturally related components of the broiler industry is spent within the rest of the regional economy. These expenditures stimulate a wide range of sectors, including consumer-oriented businesses, and are termed the “induced” spin-off effects. The broiler industry thus provides benefits to the rest of the regional

economy through purchase of goods, materials, and services throughout Delmarva; tax payments made to state and local governments; and employment of residents both directly within the industry and indirectly through the purchase of a wide array of inputs. Thus there are two types of spin-off effects: indirect effects through suppliers that provide goods and services directly to the broiler industry, and induced effects through consumer industries that sell goods and services to the employees of the broiler industry and their suppliers.<sup>7</sup>

To identify and estimate these economic effects, an input-output (I-O) model was configured for the Delmarva Peninsula. This I-O model is based on the “IMPLAN” system, first developed by the U.S. Forest Service. An input-output model is basically a general accounting system of transactions taking place between industries, businesses, and consumers in an economy. These purchases and sales are adjusted for in-region and out-of-region sources and then summed to arrive at estimates of total impacts arising from the direct effects of a policy change or scenario.

Here, the basic scenario in the analysis is to assess the overall importance and contribution of the broiler industry to the Delmarva economy based on 2001 level of production in the Delmarva broiler industry. This is essentially asking what the impact would be of removing the industry from the peninsula. As a result, the full set of linkages of broiler production to in-region feed grain production and processing are included as part of the total impacts. Details of the analytical method and data used are given in the Appendix.

The results of the I-O analysis are presented in Table 6, with estimates of total sales or output, personal income, value-added, and employment presented at a 20-sector level of detail. The table for this baseline scenario presents estimates of the number of jobs directly and indirectly related to the Delmarva broiler industry. In total, the spin-off industries employ around 18,400 people or 1.2 times the number of people employed directly. Adding both the direct and spin-off or indirect together totals 33,500 jobs – the number of jobs that the broiler industry supports in Delmarva. These 33,500 jobs directly and indirectly dependent upon the broiler industry, represent over one out of every twelve jobs in the region. The broiler industry’s employment multiplier is 2.23, meaning that one broiler industry job indirectly supports 1.23 other jobs in the Delmarva economy.

Other economic measures – value-added, labor income, and output – show similar substantial effects. For example, value-added in an industry is the increase in value of a produced good over the cost of materials used in the production of the good, other than capital and labor.<sup>8</sup> The IMPLAN model estimates that the \$449 million in value added by direct broiler activity (production and processing) generates an additional \$806 million value-added from spin-off

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<sup>7</sup> An alternative analytical approach is to consign broiler marketings to the hub with various *backward linkages* (including purchased inputs, supplies, and services) used by producers and *forward linkages* of further value-added activities. The forward or “downstream” effects – for example, retail business of stores selling Delmarva’s broilers – are excluded in our analysis, following standard practice for regional input-output studies. The assumption is that if Delmarva broilers were not available in grocery stores, they would be replaced almost pound for pound by broilers from other places.

<sup>8</sup> The sum of value-added across all industries is equivalent to the region’s gross regional product, analogous to the nation’s gross domestic product.

**Table 6. Total Economic Activity Due to Delmarva Broiler Industry, 2001**

<b>Industry</b>	<b>Jobs</b>	<b>Output/Sales (in \$millions)</b>	<b>Total Value-added (in \$millions)</b>	<b>Labor income (in \$millions)</b>
Agricultural services	2,537	\$55.7	\$32.7	\$23.8
Retail trade	1,576	\$65.2	\$58.3	\$30.3
Health/medical	1,150	\$83.4	\$58.3	\$44.2
Transportation	973	\$90.7	\$41.4	\$27.4
Wholesale trade	960	\$106.3	\$64.0	\$39.9
Construction	810	\$57.3	\$41.6	\$27.6
Eating places	765	\$29.3	\$20.4	\$10.9
Business services	706	\$55.0	\$39.2	\$28.1
Other manufacturing	479	\$149.7	\$33.4	\$24.6
Banking	369	\$59.5	\$28.1	\$15.5
Housing	298	\$89.6	\$68.7	\$5.3
Personal services	221	\$21.5	\$9.5	\$9.0
Entertainment	214	\$9.3	\$3.7	\$3.0
Paper products	198	\$33.2	\$11.8	\$6.5
Insurance	133	\$25.9	\$11.3	\$9.5
Utilities	124	\$69.4	\$36.2	\$12.1
Government	117	\$19.8	\$7.3	\$4.9
Communications	78	\$23.6	\$10.9	\$5.2
Feed processing	122	\$44.5	\$12.5	\$3.5
Feed crops	96	\$82.2	\$36.2	\$2.6
Other sectors	6,552	\$1,033.9	\$209.1	\$150.4
<b>Total spin-off activity</b>	<b>18,478</b>	<b>\$2,235.0</b>	<b>\$836.1</b>	<b>\$484.3</b>
Production	2,720	\$1,113.3	\$104.7	\$78.2
Processing	12,320	\$1,372.2	\$344.3	\$282.3
<b>Total direct activity</b>	<b>15,040</b>	<b>\$2,485.4</b>	<b>\$448.9</b>	<b>\$360.5</b>
<b>Grand Total</b>	<b>33,518</b>	<b>\$4,720.4</b>	<b>\$1,285.0</b>	<b>\$844.8</b>

activity. Thus, for each dollar of value added by the Delmarva broiler industry, the industry supports an additional \$1.80 of value-added within the regional economy, and the value-added multiplier is 2.9.

These estimates depend on assumptions made in the IMPLAN model as well as the accuracy of the baseline input/output data. The margin of error in the input/output data is not sufficient to change the above findings significantly, as these data are well grounded in U.S. Census and industry surveys. However, the assumptions made in the model are more open to question. For example, Table 6 shows an \$82.2 million loss of sales of feed crops, and associated \$36 million

loss of value added. IMPLAN's assumption is that grain now fed to chickens would not be produced if the broiler industry were absent. Actually, much grain now sold for feed would in the absence of demand in Delmarva be shipped to other distribution points in the national grain market. Losses would arise because mainly this redirection of grain would bring lower prices and that would cause less grain production. Similarly, the effect on jobs in the induced spin-off sectors assumes that workers who are laid off because of declining demand for their industry's output remain unemployed. Actually, in the absence of broiler processing, many workers would after a period of time find employment elsewhere, and enterprises that lost sales to the broiler industry would re-focus their business and regain some lost sales. Thus, the estimates of Table 6 should be taken as short-run or "shock" effects of the absence of the broiler industry. Longer-run effects could be quite different.

With respect to multipliers, such as the estimate that 2.3 jobs are generated for every job in broilers, their values are determined not only by the assumptions just discussed but also by details of the definition. For example, some multipliers for poultry have considered only the processing sector as the direct activity, with farm-level broiler production as an indirect effect. If we took this approach with the data of Table 6, the result would be an employment multiplier of  $(33,518/12,320=)$  2.7 rather than 2.3. Or, if we took farm-level broiler production as fundamental (as the historical origins suggest) the multiplier would say how many jobs are created by each farmer raising broiler chickens, and the answer would be  $(33,518/2,720=)$  12.3! These examples suggest that a focus on multipliers is not all that instructive. The basic point from the IMPLAN analysis is the estimate that 33,518 jobs are at stake, an estimate that one cannot produce just by looking at the raw data on employment.

### **Interregional Trade Effects of the Delmarva Poultry Industry**

Beyond the jobs and income that the poultry industry provides to residents in predominantly rural Delmarva, what are the impacts of the Delmarva broiler industry on the more urbanized areas of western shore Maryland (i.e., counties west of the Chesapeake Bay)? Such areas might be assumed to be insulated from changes affecting natural resource industries in rural areas. But important economic impacts may be overlooked (Krugman, 1991, 1995). Critical to the modeling of economic linkages between Delmarva and the western shore is estimation of interregional trade flows. The modeling construct again utilizes the IMPLAN framework to develop a multi-regional input-output model of the Delmarva and western shore economy. Methods and procedures for estimation of interregional trade (e.g., poultry products, inputs) and factor flows (e.g., labor and capital) are found in earlier studies (Chase, Pascall, and Gross 1997; Roberts, 2000; Holland and Pirniquie, 2000).

The area of these two regions is comprised of the following (Table 7): the Delmarva region contains the eastern shore counties in Maryland along with the southern two counties of Delaware and the two eastern shore counties in Virginia. The western shore region includes all of the other counties in Maryland, including the City of Baltimore.

Economic interdependency between the Delmarva and western shore regions is estimated using flows of goods and services between the two regions. Interdependency also is apparent in labor and capital flows between regions – an example is cross-regional commuting, where wages

**Table 7. Delmarva and Western Shore Regions**

<b>Delmarva</b>		<b>Western shore</b>	
Accomack County	Virginia	Allegany County	Maryland
Caroline County	Maryland	Anne Arundel County	Maryland
Cecil County	Maryland	Baltimore City	Maryland
Dorchester County	Maryland	Baltimore County	Maryland
Kent County	Delaware	Calvert County	Maryland
Kent County	Maryland	Carroll County	Maryland
Northampton County	Virginia	Charles County	Maryland
Queen Anne's County	Maryland	Frederick County	Maryland
Somerset County	Maryland	Garrett County	Maryland
Sussex County	Delaware	Harford County	Maryland
Talbot County	Maryland	Howard County	Maryland
Wicomico County	Maryland	Montgomery County	Maryland
Worcester County	Maryland	Prince George's County	Maryland
		St. Mary's County	Maryland
		Washington County	Maryland

are paid to workers residing within the western shore region but working in Delmarva, or vice versa. But here we estimate only the trade flows between the two regions.

Total 2001 Delmarva commodity and services exports to the rest of the United States totaled \$8.19 billion, from a total of 91 Delmarva industries. Of this total, \$1.18 billion of Delmarva exports went to the western shore, and \$507 million (43 percent) of those exports were of processed poultry (details in Table 8). The economic impact on the western shore of removing those poultry exports would be minor, as other sources could be found at only marginally higher cost. More important is the potential loss of markets in Delmarva for western shore products. In 2001, western shore to Delmarva export trade was \$6.42 billion, or almost six times greater than the Delmarva to western shore trade. Nearly a third (\$2.02 billion) of the total export value from the western shore region to Delmarva was in finance, insurance, and real estate services. A total of 167 western shore industries exported products and services. In the absence of the Delmarva poultry industry, a portion of those sales would be lost as the Delmarva economy declined. Our estimate from IMPLAN is that due to contraction of the Delmarva economy of the magnitude shown in Table 6, 33,518 jobs and \$845 million in labor income, the demand for western shore goods and services would decline by about \$51 million, entailing a loss of \$11 million in value added and 391 lost jobs. This is not a huge dent in the western shore economy, but it is not negligible either.



**Table 8. Delmarva and Western Shore Commodity and Service Trade (Millions of \$), 2001**

<b>Sector</b>	<b>DELMARVA EXPORTS TO WESTERN SHORE</b>	<b>DELMARVA IMPORTS FROM WESTERN SHORE</b>	<b>DELMARVA IMPORTS FROM ENTIRE U.S.</b>	<b>DELMARVA EXPORTS TO ENTIRE U.S.</b>
Other agriculture	\$61.17	\$0.00	\$70.80	\$203.01
Other nat. resources	\$12.75	\$31.30	\$238.08	\$151.07
Mining	\$1.07	\$2.79	\$157.90	\$31.65
Construction	\$162.72	\$0.00	\$0.00	\$285.72
Poultry processing	\$507.09	\$0.00	\$1.83	\$890.84
Other food process	\$121.68	\$105.35	\$934.57	\$771.02
Textiles and apparel	\$16.97	\$3.58	\$236.98	\$45.25
Lumber and wood	\$57.98	\$0.00	\$31.37	\$0.00
Furniture	\$19.25	\$3.22	\$36.74	\$2.23
Pulp and paper	\$0.06	\$9.68	\$282.40	\$1.26
Printing and publish	\$0.00	\$39.21	\$261.71	\$172.18
Chemicals & allied	\$26.17	\$239.78	\$379.90	\$1,623.11
Petroleum refining	\$0.00	\$31.35	\$6.04	\$0.00
Rubber and plastics	\$0.00	\$0.00	\$7.80	\$2.55
Stone, clay & glass	\$0.28	\$0.00	\$131.94	\$137.82
Primary metals	\$0.00	\$0.30	\$12.53	\$5.84
Fabricated metals	\$0.00	\$20.21	\$324.21	\$246.56
Industrial machinery	\$2.52	\$22.78	\$84.02	\$12.16
Elect. equipment	\$130.33	\$1.32	\$200.58	\$50.21
Transport equipment	\$20.55	\$0.00	\$71.66	\$60.14
Instruments	\$0.08	\$47.43	\$25.85	\$45.11
Misc. manufacturing	\$0.42	\$129.85	\$42.27	\$45.43
Transport services	\$0.00	\$175.03	\$14.43	\$40.53
Communications	\$0.00	\$387.80	\$0.00	\$0.00
Utilities	\$0.00	\$182.80	\$31.40	\$79.12
Wholesale trade	\$0.00	\$821.43	\$0.00	\$0.00
Retail trade	\$0.00	\$101.61	\$97.25	\$546.12
F.I.R.E.	\$0.00	\$2,016.19	\$0.00	\$1,171.16
Hotels and lodging	\$0.00	\$51.71	\$0.00	\$148.73
Personal services	\$0.00	\$24.69	\$0.00	\$0.00
Business services	\$0.00	\$845.04	\$0.00	\$2.63
Repair and services	\$0.00	\$168.90	\$0.00	\$65.19
Entertainment svcs.	\$0.00	\$39.85	\$0.00	\$63.32
Health services	\$38.98	\$0.00	\$38.98	\$64.00
Ed. and social svcs.	\$0.00	\$53.44	\$0.00	\$23.34
Member organizations	\$0.00	\$26.41	\$0.00	\$33.84
Engineer. & account.	\$0.00	\$342.07	\$0.00	\$7.42
Govt. services	\$0.00	\$514.63	\$58.19	\$16.99
<b>Total</b>	<b>\$1,180.07</b>	<b>\$6,423.40</b>	<b>\$3,823.30</b>	<b>\$7,006.56</b>

Note: Western shore imports from Delmarva are equal to Delmarva exports to the western shore, and western shore exports to Delmarva are equal to Delmarva's inputs from the western shore.

## ISSUES FACING THE DELMARVA BROILER INDUSTRY AND POLICY IMPLICATIONS

**W**E HAVE SEEN THAT THE BROILER INDUSTRY is economically crucial for the farm economy of Delmarva, a lynchpin in the employment opportunities in several important Delmarva industries, and creator of substantial economic activity through induced spending throughout Delmarva and even to some extent on Maryland's western shore. The decline or demise of the broiler industry would have a huge impact on Delmarva's farm economy, and would be a major source of distress for Delmarva's workers, and cause significant losses to taxpayers, businesses, and all others who benefit from economic prosperity in Maryland.

Yet the industry faces problems and dissatisfactions. Adverse conditions facing some growers and workers in the industry, and water quality problems tied to nutrients, have led to scrutiny and increased regulation, notably under Maryland's Water Quality Improvement Act of 1998. The U.S. Conservation Reserve Enhancement Program seeks to remove environmentally sensitive cropland from grain production, and together with continuing commercial development of farmland may significantly reduce the local feed supply. Michel et al. (1996) reports on the attitudes of Delmarva poultry growers about some of these issues. This study does not address the pros and cons of environmental, land use, or other regulatory requirements that the poultry industry is confronted with. Rather, we will consider the narrower but important question of how economically vulnerable the Delmarva poultry industry may be to increased stringency of regulation or pressures from loss of cropland. The fact that the industry is just holding its own in Delmarva while continuing to expand elsewhere indicates a lessening of comparative advantage which could be a precursor of sensitivity to future adverse developments.

### **Grower Cost and Returns**

To provide baseline information about the economic situation for broiler growers, an enterprise budget is shown in Table 9. This budget was developed from financial records of a county extension agent who is a broiler producer plus his information from other growers and broiler supply firms. While each production situation is different, the budget presents information typical of what growers experience. The budget provides economic information for growers, potential growers, other persons in the broiler industry, and policymakers on required inputs and investments by and potential profit levels of broiler growers. Such information is crucial for individuals considering broiler production. This budget indicates that a grower can earn about \$584 per year in profit for a single house after allowing \$3,300 or \$8.00 an hour for labor committed and a 9 percent return on invested capital and a \$60 per acre land charge. Cash flow for debt servicing and other uses is \$21,600. The results will of course vary with different production and price situations. This budget is available on a spreadsheet so that individuals can carry out calculations that fit their specific situations. Box 2 provides details.

While this budget indicates a sufficient return to repay the grower's investment of time, energy, and capital, it also indicates vulnerability to either lower poultry returns or higher costs. The cost structure implies substantial risk. Less than 25 percent of the total costs of about \$30,500 are variable costs. Thus, costs are not reduced as output decreases as much as in other

**Table 9. Farm Broiler Production Enterprise Budget**

Square feet of house	23,600	Flocks/year	5.5		
Bird density	0.75	Birds/year	173,067		
Number of birds/flock	31,467				
	<b>Unit</b>	<b>Quantity</b>	<b>Price</b>	<b>Total</b>	<b>Cash Flow</b>
<b>Item</b>					
Gross Income					
Grower payments	1000 birds	173.067	\$180.00	\$31,152.00	\$31,152.00
Purchased Input or Service					
Costs					
Electricity	flock	5.5	\$545.00	\$2,997.50	\$2,997.50
Telephone		1.0	\$300.00	\$300.00	\$300.00
Supplies and miscellaneous	house	1	\$1,300.00	\$1,300.00	\$1,300.00
Building and equipment repairs	house	1	\$1,500.00	\$1,500.00	\$1,500.00
Crust out	flock	5.5	\$135.00	\$742.50	\$742.50
House cleanout	flock / 12	0.4583	\$360.00	\$165.00	\$165.00
Interest on operating capital	1 month	\$7,005.00	9%	\$9.55	
Total variable costs listed above				\$7,014.55	\$7,005.00
Owner's inputs and fixed costs (do not duplicate costs listed above)					
Owner's labor	hours / flock	75.0	\$8.00	\$3,300.00	
Building depreciation	total	\$102,000.00	5.00%	\$5,100.00	
Equipment depreciation	total	\$69,500.00	6.67%	\$4,635.65	
Interest on investment	avg. invest.	\$85,752.00	9.00%	\$7,717.68	
Taxes and insurance	tot. invest.	\$180,700.00	1.50%	\$2,710.5	\$2,710.50
Land charge	acre	1.50	\$60.00	\$90.00	
Total cost listed above				\$30,568.38	\$9,715.50
Net income over variable and fixed costs listed above				\$583.62	\$21,436.50
<b>ADDENDUM: INVESTMENT DETAIL</b>					
Fixed investment	Unit	Quantity	Price	Total	
Tunnel house	house	1	\$102,000.00	\$102,000.00	
Electric generator	house	1	\$17,000.00	\$17,000.00	
Equipment	house	1	\$50,000.00	\$50,000.00	
Site preparation	house	1	\$8,000.00	\$8,000.00	
Outside electric lights, alarm, generator boxes, etc.	house	1	\$2,500.00	\$2,500.00	
Well and water system	house	1	\$1,200.00	\$1,200.00	
Total Investment				\$180,700.00	

## **BOX 2. Budget Details**

The budget of Table 9 follows a standard animal production budget format used in the Maryland Cooperative Extension Service. The top section contains basic production information such as number of flocks per year and square feet in the house. The main data provided are gross income, variable costs, fixed costs and net income. The Addendum shows investment requirements for the enterprise. A spreadsheet links different sections. Many of the fixed costs are based on the investment components or totals – for example, building depreciation is 5 percent of the purchase cost in the investment section. In addition, many of the entries are also linked to the basic production data – for example, quantity of birds is calculated by dividing birds per year by 1000.

The budget shows economic costs rather than financial or tax accounting costs. Depreciation is based on the expected life of the investment rather than the tax accounting rules. For example, the house depreciation is based on 20 years rather than 10 years used for tax depreciation assuming that the house can be used for production for 20 years. Opportunity costs of owned labor, equity, and land resources are also included in the budget. Net income is the amount available after all the resources are compensated.

In contrast, the cash flow numbers in the right-hand column of Table 9 do not include costs for owned resources. The residual for the cash flows is therefore the amount available for debt payments and other uses.

animal production situations where the farmer pays for feed and veterinary supplies or in crops where the farmer supplies seed, fertilizer, pesticides, and other production inputs. For example, gross income drops to \$28,320, total costs to \$29,913, and net income to (\$1,593.81) when number of flocks/year is reduced one-half a flock to 5.0. The reduction in costs is very small because most costs are fixed. However, most of these fixed costs are non-cash, ownership costs so cash flows are still nearly \$19,000. This reduction in cash flow would put pressure on a grower with large loan payments. This pressure would be felt by agricultural lenders who have financed a large number of poultry houses. However, a grower without loan payments would not have cash flow problems. This cost structure therefore has considerable short-term risk for growers who borrow most of the cost of their houses but does not pose such a risk for growers who have not borrowed much or have repaid their loans. Over the longer term, all costs must be covered to prevent decline in the industry. For marginal growers at least, even relatively modest costs increases could tip the scales to a situation of substantial decline in Delmarva poultry growing.

## **Longer-Run Dynamics**

A key issue if there begins to be a retrenchment in broiler growing is the subsequent reaction to an initial decline. This issue goes beyond the previous section's input/output analysis that linked segments of the broiler industry with related spin-off activities. The concern here is with the sequential dynamics of broiler growing and processing itself. The linkages of an initial decline with further shrinkage of the industry has been discussed in terms of the concept of "critical mass."

The idea of critical mass for an industry is that a certain overall level of production is necessary to provide the volume of business needed for support industries to be maintained, and costs of production to remain competitive. The demise of the broiler industry in New England suggests that a critical mass could exist for broilers. Recently, Lynch and Carpenter completed a study on this issue in a broader context, where the question involved whole counties' agriculture in aggregate. That study found instances of critical mass failure of agriculture in some counties prior to 1970, where a declining agriculture sector led to accelerated decline subsequently. But, surprisingly, the incidents of rapid decline of county-wide agriculture have been scarcer in the last two decades, and the study found no evidence of critical-mass collapse in the Northeastern and Mid-Atlantic states since 1970 despite decreasing agricultural production in most of the region.

With respect to broilers more narrowly, it is notable that the data of Table 1 demonstrate that the size of viable broiler industries varies greatly across the United States. With 1.2 billion birds, Georgia has nearly twice as many birds as the three Delmarva states taken together. However, much smaller production areas also exist with apparent stability. Pennsylvania has only 132 million birds and West Virginia only about 90 million. In the Midwest, Minnesota, Ohio, and Wisconsin each have less than 44 million birds. Nevada is even smaller with 3.4 million birds. While technology could change in the future to favor larger producing areas, currently greatly varying scales of broiler production appear sustainable. A large reduction in scale would be necessary before reaching a nonviable critical mass. While reductions in broiler production would have important economic impacts, as this study has already documented, we see no threat of a dramatic cascading decline due to a critical-mass failure in the near future.

A more specific concept of critical mass has been identified as a possible problem for Delmarva. It is possible that declining grain acreage could lead to a situation in which the higher cost of importing feed to Delmarva would in turn lead to a decline in the processing industry. And if the processing industry became too small, a loss of scale economies could generate further decline and a further loss of market for the remaining grain producers. This concern was heightened by recent increases in incentives for landowners to keep land out of crop production under the Conservation Reserve Enhancement Program (CREP). A complete assessment of the factual basis for this concern is beyond the scope of this study as neither the static input-output models like IMPLAN nor historical experience provides empirical evidence on the issue. It is worth noting that through April 30, 2003, CREP has enrolled 47,714 acres of Delmarva cropland, 42,715 acres of which are in Maryland's Eastern Shore counties. If this acreage were to double (and not run up against the enrollment cap of 25 percent of any county's farmland), a total of about 12 percent of today's Delmarva cropland would be lost to grain production. Generally, grain acreage in Delmarva has not shown a downward trend. Figure 10 shows that Maryland's Eastern Shore harvested acreage of corn, wheat, and soybeans has been about level since 1982. The last two years could be leading indicators of future acreage decline, but this evidence is too slim to support a pessimistic forecast with any confidence. Nonetheless, housing and other non-agricultural development continue taking land from farms, which could have a future impact, and in some cases already make farming more difficult on remaining farmland.

The preceding suggests that the Delmarva poultry industry is not under immediate threat of a decline in locally produced grain. There is however the reciprocal issue of how a decline in the poultry industry would affect Delmarva grain production and economic returns. Table 6 above

provided an estimate of a substantial effect, ignoring the likelihood that Delmarva grain producers would sell their output elsewhere. This is too pessimistic, but even if Delmarva grain could go elsewhere, what would be the Delmarva price net of transport costs to get there?

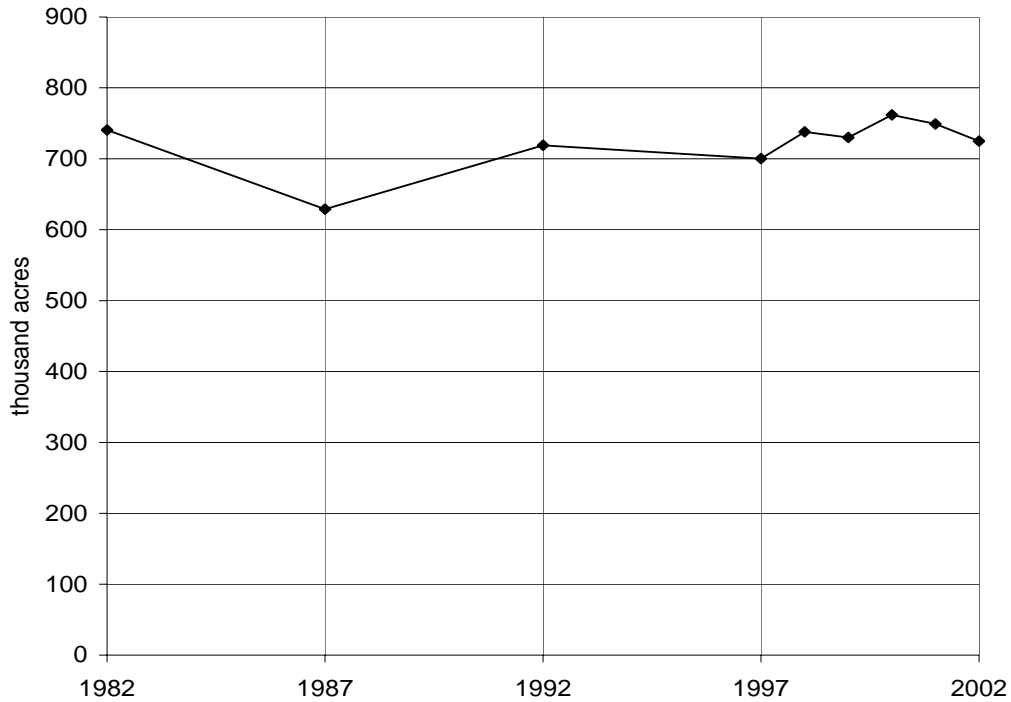
We investigated the possibilities of losses to grain producers by considering the basis between cash grain markets and future market prices for Delmarva and Southeastern Pennsylvania. In considering implications of losing the broiler industry, it is important to remember that Pennsylvania is a large livestock and poultry producing area. In that state, animal sales were \$2.7 billion and feed purchases were \$973 million in 1997 compared to \$853, million and \$435 million, respectively, in Maryland. Lancaster County is the center of this production having \$665 million sales and \$275 million feed purchases. Southeastern Pennsylvania has large grain deficits – the Pennsylvania deficit ranged from 30 to 92 million bushels in 1994-1999 (Dunn). Corn production in Maryland Eastern Shore averaged less than this deficit at 23-37 million bushels for the above years (Maryland Department of Agriculture). Thus, Eastern Shore farmers could find a market for their corn in Pennsylvania if the broiler industry did not exist, replacing current imports, largely from further distant Ohio. The average basis (relative to Chicago futures) for 1990-2002 for Southeastern Pennsylvania is \$0.31 per bushel, and for the Upper Eastern Shore the basis is \$0.12 (Appendix Table A-4). With a transportation cost between these areas of about \$0.15 per bushel, farmers in those counties could net about \$0.16. While farmers can gain little if any from marketing their corn in Pennsylvania currently, neither would these have a lower price per bushel if they chose to do so without a market in the poultry industry. In high production years in either or both states, the corn deficit would not be large enough to accommodate the Maryland crop. Thus, the impact of an end of the broiler industry on upper Eastern Shore corn prices would likely be small so long as the current level of animal production continues in Southeast Pennsylvania. For the lower Eastern Shore corn, and soybeans generally, the prospects are less favorable. For each 10 cents per bushel the corn and soybean price falls, lower Eastern Shore corn and soybean crop values fall \$2 million at the 2001 production level.

Another line of argument suggests that even if the demand for grain should decline substantially, farming in Delmarva is not so much at risk as we have been presuming because producers could switch to alternative crops. Indeed, some vegetables, fruits, or specialty crops may turn out to be higher-valued alternatives in any case. The problem however is that it would take only a relatively small increase in the average of high-value crops to rapidly reduce the market returns from growing them. The entire state of Maryland now grows only about 60,000 acres of all vegetables, fruits, and specialty crops. If this acreage could be doubled and all of the additional acreage placed in Maryland's Delmarva counties, that would still replace less than 10 percent of the 750,000 acres now in grains and soybeans in these counties. In short, these traditional crops will necessarily constitute the vast bulk of Delmarva crop farming for the foreseeable future.

Finally, farmers' investments in chicken houses are fixed assets without good alternative uses. As such, the value of these assets would fall precipitously if processor demand for chickens were to decline unexpectedly. The risk of such problems was made real with the recent closing of a Tyson's Food Corporation processing plant, when growers had problems finding an alternative contractor for which to grow broilers. Growers who financed their houses with a loan find it especially difficult to cope with such shutdowns because they must continue making

payments on debt even while no revenue is coming in. We did not have sufficient information on growers' asset/debt structure to quantify the extent of this risk, but it is undoubtedly considerable. In addition, a write-down in the value of these assets would reduce the property tax revenues of local governments. This is one of the key sources of the \$19.8 million annually in government services that Table 6 above attributes to the broiler industry.

Overall, while there are many uncertainties in how Delmarva's economy would react to the severe decline or loss of the broiler industry, it clear that a tremendous scale and risk of adjustment would ensue, and the costs to workers, farmers, and a wide range of business enterprises would be enormous, particularly in the short run.



**Figure 10. Corn, Soybean, and Wheat Harvested Acres, Eastern Shore, Maryland**

# APPENDIX ON PROCEDURES AND DATA

## Data and Methods

The primary tool for measuring the economic contribution of Delmarva's poultry-related activities is a static Input-Output (I-O) model based on the IMPLAN system developed for the Delmarva economy. An I-O model is essentially a generalized accounting system of a regional economy where purchases and sales among businesses, services, and households are recorded. The I-O model takes account of these inter-industry transactions, adjusts for in-state versus imported sources, and then sums the successive rounds of transactions to arrive at an estimate of total impacts stemming from the initial direct impact (poultry production and processing, for example). Transactions are traced on the basis of dollar of output activity in each sector and then reported for other measures of economic activity, including income, value-added, and employment effects. Income measures wages, salary, and proprietors' incomes; value-added includes all earned and unearned income plus profits and taxes paid; and employment is measured on a per job basis. For this study, the relevant assumptions of the I-O model are

- that the I-O coefficients accurately capture the technology in the economy,
- that market conditions such as the availability of the products and inputs are captured by the purchase coefficients, and
- that households purchase according to the consumption coefficients in the model.

The inter-industry relationships identified within the I-O accounts contain much useful information on the input-purchasing patterns of each industry at each level of the system, and also an estimate of the in-state sources for these inputs. In order to focus on only the in-region impacts related to the poultry sector, the following principles were employed in this study:

- The preferred measures of economic contribution are value-added and employment in order to avoid double-counting of raw agricultural commodities as they move through the processing system.
- Inputs are best estimated by determining the backward linkages from each system component to their suppliers. This can be estimated with the indirect coefficients from an I-O model.
- The induced multiplier effect (the additional economic impacts created when the income generated by the sector is re-spent by employees, proprietors, owners, and investors), while a legitimate impact of a sector if measured correctly, should not be claimed as part of the sector itself.
- The entire poultry system is the target of this study and not just the farm-level production. Therefore, the processing sector is defined to include the value added to processed food purchased from out-of-region producers. Similarly, the in-state producers and the distribution sector includes value added to food products produced outside of Delmarva but distributed to Delmarva consumers. In neither case is the value of out-of-state products themselves included.



## **Data Sources**

A variety of data sources was used to estimate values at each stage of the poultry system. Cash receipts from poultry marketings for 2001 are based on data from the National Agricultural Statistics Service (USDA 2002a) and Agri Stats Inc. (2002). Employment and income levels in the poultry processing sector are based on data from the U.S. Bureau of Labor Statistics (BLS). Since BLS statistics on farm and self employment are sketchy, employment in these sectors is derived from the Bureau of Economic Analysis Regional Economic Information System (REIS) income and employment data. Direct contribution to value-added from distribution, food manufacturing, and inputs was estimated by multiplying estimated sales by direct value-added:sales ratios.

**Table A-1. Delmarva Farm Income, 1970-2000 (selected years)**

	1970	1980	1990	1995	2000
Total cash receipts from marketings (\$000)	388,280	896,498	1,518,471	1,622,601	1,681,087
Cash receipts: livestock and products	252,298	626,949	1,010,984	1,139,597	1,188,954
Cash receipts: crops	135,982	269,549	507,487	483,004	492,133
Other income	29,583	58,584	133,316	167,410	265,924
Government payments	6,252	2,508	13,583	14,142	85,331
Imputed and misc. income received	23,331	56,076	119,733	153,268	180,593
Total production expenses	345,600	1,023,082	1,402,523	1,629,317	1,759,302
Feed purchased	125,406	380,572	441,445	521,887	586,928
Livestock purchased	43,777	101,660	162,895	157,753	173,669
Seed purchased	7,273	19,440	32,048	37,192	47,109
Fertilizer and lime	27,579	98,968	95,018	117,721	109,894
Petroleum products purchased	9,465	37,033	28,939	30,257	39,506
Hired farm labor expenses	32,889	62,246	105,450	131,013	149,408
All other production expenses	99,211	323,163	536,728	633,494	652,788
Total value of inventory change	-4,062	-14,663	6,490	-28,503	13,259
Value of inventory change: livestock	426	3,618	-4,493	-2,086	-2,061
Value of inventory change: crops	-4,299	-18,281	10,983	-26,417	15,320
Total cash receipts and other income	417,863	955,082	1,651,787	1,790,011	1,947,011
Realized net income	72,263	-68,000	249,264	160,694	187,709
Total net income inc. corporate farms	68,212	-82,663	255,754	132,191	200,968
Total net farm proprietors' income	65,953	-64,174	224,504	123,384	190,736
Farm wages and perquisites	24,384	51,257	71,572	81,792	96,807
Farm other labor income	676	3,004	3,996	5,099	5,608
Total farm labor and proprietors' income	90,693	-9,913	300,072	210,275	293,151

**Table A-2. Delmarva Full- and Part-time Employment, 1970-2000 (selected years)**

	1970	1980	1990	1995	2000
<b>Total full- and part-time employment</b>	<b>222,505</b>	<b>249,917</b>	<b>326,061</b>	<b>350,180</b>	<b>391,851</b>
Wage and salary employment	182,915	205,636	263,803	282,693	314,472
Proprietors' employment	39,590	44,281	62,258	67,487	77,379
Farm proprietors' employment	11,486	9,143	7,674	7,129	6,381
Nonfarm proprietors' employment	28,104	35,138	54,584	60,358	70,998
Farm employment	20,686	16,820	12,981	11,869	11,350
Nonfarm employment	201,819	233,097	313,080	338,311	380,501
Private employment	157,726	188,647	262,013	283,637	321,331
Ag. services, forest, fish, and other	5,236	7,348	7,779	8,065	9,290
Mining	351	303	303	363	630
Construction	10,913	14,100	25,519	23,160	26,909
Manufacturing	49,490	48,113	47,925	47,105	46,071
Transportation and public utilities	10,500	11,508	13,094	13,473	14,572
Wholesale trade	6,256	8,392	10,334	11,213	11,816
Retail trade	32,566	40,510	61,571	70,778	77,856
Finance, insurance, and real estate	9,798	13,687	20,669	22,217	29,919
Services	32,616	44,686	74,819	87,263	103,392
Government and govt. enterprises	44,093	44,450	51,067	54,674	59,170
Federal, civilian	7,013	5,708	6,219	6,148	6,127
Military	15,249	8,698	8,902	8,673	7,308
State and local	21,831	30,044	35,946	39,853	45,735
State	(N)	11,599	14,207	15,918	18,350
Local	(N)	18,445	21,739	23,935	27,385

Note: Delmarva region is defined here to include the following counties – Kent and Sussex in Delaware; Caroline, Cecil, Dorchester, Kent, Queen Anne's, Somerset, Talbot, Wicomico, and Worcester in Maryland; and Accomack and Northampton in Virginia. New Castle County in Delaware is not included.

Source: U.S. Bureau of Economic Analysis, 2002

**Table A-3. Delmarva Personal Income, 1970-2000 (selected years)**

	1970	1980	1990	1995	2000
<b>Personal income (\$000)</b>	<b>1,665,052</b>	<b>4,419,384</b>	<b>10,750,055</b>	<b>13,457,127</b>	<b>17,810,901</b>
Nonfarm personal income	1,574,359	4,429,297	10,449,983	13,246,852	17,517,750
Farm income	90,693	-9,913	300,072	210,275	293,151
Population (number of persons)	466,135	539,402	616,060	675,816	733,335
<b>Per capita personal income (dollars)</b>	<b>3,572</b>	<b>8,193</b>	<b>17,450</b>	<b>19,912</b>	<b>24,288</b>
Earnings by place of work	1,277,637	2,763,016	6,522,127	7,854,056	10,195,505
Net earnings by place of residence	1,291,249	2,959,263	7,056,545	8,455,186	11,203,740
Dividends, interest, and rent	224,972	815,874	2,240,348	2,774,628	3,715,748
Transfer payments	148,831	644,247	1,453,162	2,227,313	2,891,413
Wage and salary disbursements	969,100	2,191,110	4,865,286	6,056,359	8,016,309
Other labor income	68,410	301,684	707,418	883,016	965,279
Proprietors' income	240,127	270,222	949,423	914,681	1,213,917
Farm proprietors' income	65,953	-64,174	224,504	123,384	190,736
Nonfarm proprietors' income	174,174	334,396	724,919	791,297	1,023,181
Farm earnings	90,693	-9,913	300,072	210,275	293,151
Nonfarm earnings	1,186,944	2,772,929	6,222,055	7,643,781	9,902,354
Private earnings	888,685	2,113,362	4,800,726	5,847,146	7,670,699
Ag. services, forest, fish, and other	24,085	41,569	76,710	81,446	110,828
Agricultural services	13,339	21,134	43,098	55,776	78,757
Mining	10,096	32,844	35,399	25,786	31,644
Construction	93,757	226,921	669,968	646,252	860,814
Manufacturing	290,854	631,862	1,120,843	1,318,423	1,558,744
Durable goods	80,651	166,128	331,228	416,975	551,821
Nondurable goods	229,024	471,148	827,739	953,556	1,024,080
Food and kindred products	109,978	233,110	422,856	478,428	503,158
Transportation and public utilities	76,926	190,565	351,260	418,968	540,046
Railroad transportation	7,043	16,881	16,358	21,558	26,922
Trucking and warehousing	30,243	68,482	148,475	168,612	193,509
Electric, gas, and sanitary services	18,579	48,592	92,699	128,923	137,452
Wholesale trade	50,621	127,993	277,999	326,512	435,041
Retail trade	148,631	345,201	779,644	977,228	1,270,132
Eating and drinking places	26,608	75,861	193,137	285,284	376,275
Finance, insurance, and real estate	40,549	100,762	288,170	404,336	582,454
Services	154,310	430,216	1,226,900	1,659,519	2,304,139
Personal services	14,706	24,859	59,720	71,636	92,734
Business services	12,183	53,686	160,049	213,977	312,797
Health services	62,849	176,642	500,921	694,455	960,213
Government and govt. enterprises	288,284	633,682	1,377,068	1,747,434	2,169,814
Federal, civilian	65,468	126,946	242,259	306,738	329,024
Military	103,930	139,085	244,668	284,609	307,093
State and local	128,144	402,273	945,900	1,213,286	1,606,138
State	(N)	191,614	430,020	536,198	716,506
Local	(N)	215,421	528,962	696,640	915,167

**Table A-4. Corn Nearby Futures Price Basis for Southeast Pennsylvania and Maryland Upper Shore, 1990-2002**

<b>Year</b>	<b>Southeast Pennsylvania</b>	<b>Southeast Pennsylvania - \$0.15</b>	<b>Upper Eastern Shore, Maryland</b>
1990	33	18	12
1991	27	12	6
1992	32	17	5
1993	26	11	10
1994	30	15	12
1995	17	2	12
1996	51	36	12
1997	39	24	17
1998	33	18	18
1999	36	21	21
2000	21	6	7
2001	21	6	-4
2002	40	25	19
Average	31	16	11

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