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The Poultry Sector in Middle-Income Countries and Its Feed Requirements

The Case of Egypt

Fawzi A. Taha

The poultry sector is growing in many middle-income countries such as Egypt, despite chronic feed shortages

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Abstract

In 2001, poultry production in Egypt and other middle-income countries totaled 37.5 million tons, compared with 29.3 million tons in high-income countries and only 3.6 million tons in low-income countries. The interaction between Egypt's domestic production and imports of meat and feeds—and government policies and their effect on the poultry industry—provides an example that may be applicable to other middle-income countries. This study projects Egypt's poultry and egg consumption in 2010, estimates poultry numbers (live birds) needed to satisfy this demand, and projects the derived feed requirements for the sector. Results indicate that Egypt's poultry industry is highly dependent on feed imports, with a dependency rate approaching 100 percent for soybeans and 48 percent for yellow corn in 2010. As Egypt and other middle-income countries face the challenge of greater liberalization under the World Trade Organization, the efficiency of domestic poultry industries will influence consumers, producers, and exporters competing to sell products into these growing markets.

Keywords: Egypt's poultry industry, eggs, derived feed demand, elasticities, world meat consumption, world meat production, trade policy, middle-income countries, high-income countries, low-income countries, world consumption and production of meats and eggs

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Cover photos of live chicken and egg markets courtesy of Fawzi A. Taha.

Contents

Executive Summary

In 2001, poultry production in middle-income countries totaled 37.5 million tons, compared with 29.3 million tons in high-income countries and only 3.6 million tons in low-income countries. During 1961-2001, world poultry meat output increased nearly eightfold, but output in middle-income countries rose more than twelvefold.

While income growth fuels rising demand for meat in middle-income countries, other factors often determine how that demand will be satisfied. Domestic and trade policies, as well as resource constraints, affect the mix between domestic production and imports of meat and feedgrains. Policies also shape the structure and efficiency of domestic industries. In some middle-income countries, Russia, for example, the removal of subsidies led to a significant reduction in domestic meat production, accompanied by increased meat imports. In China, growing demand has led to significant increases in feedgrain imports to support growing domestic production and some exports. Brazil, by contrast, has sufficiently expanded to allow growth in both domestic consumption and exports of both feedstuffs and poultry to world markets.

From this perspective, Egypt represents an interesting example of the interaction between domestic production and imports of meat and feeds in middle-income countries. Egyptian Government policies and their effect on the poultry industry provide valuable lessons applicable to other middle-income countries regarding policies and trends that could affect the poultry industry. Income growth in the 1980s, coupled with consumer subsidies and price controls, led to significant imports of poultry. By the end of that decade, however, subsidies of domestic production led to falling poultry imports and rising domestic production, along with rising feedgrain imports. Privatization of the poultry industry in early 1990s, in turn, fueled more efficient production and increased imports of feedgrains and soymeal, while producers were protected from import competition through high tariff barriers for imported poultry. In the early 21st century, Egypt—like many other middle-income countries—faces the potential challenge of greater liberalization under the WTO, and the efficiency of its domestic poultry industry will influence domestic consumers, producers, and exporters competing to sell either products or intermediate inputs into this growing market.

This study projects Egypt's poultry and egg consumption in 2010, estimates poultry numbers (live birds) needed to satisfy this demand, and projects the derived feed requirements for the sector. Econometric models provide estimates of the own-price, cross-price, and income elasticities used to project demand for poultry and eggs.

Although not one of the world's top consuming or trading countries in the poultry and egg market, Egypt accounted for about 30 percent of U.S. agricultural exports to the North Africa/Middle East region in 2001. Egypt has become increasingly dependent on foreign markets to meet its domestic demand for feed and food, particularly since the beginning of the 1990s. Demand for poultry and other livestock products has grown faster than Egypt's feed production, which contends with limited amounts of suitable pastureland, arable land, and water. By 2010, Egypt will likely rely on imports for nearly all of its soybeans and 48 percent of its corn.

In 2002, Egypt's poultry producers imported feedstuffs for their flocks while high tariffs restrained meat imports. But full trade liberalization under World Trade Organization (WTO) rules could soon open the Egyptian market to imports of both feedstuffs and poultry meat from the United States and elsewhere.

The Poultry Sector In Middle-Income Countries And Its Feed Requirements: The Case Of Egypt

Fawzi A. Taha

Introduction

Analysis of world meat production and consumption patterns identifies poultry as the fastest growing meat industry in middle-income countries. The major objective of this study is to project derived feed demand for Egypt's poultry sector to 2010, as a case study for middle-income countries that find themselves in a feed deficit position. Based on that information, the analysis will forecast total feed requirements to 2010, estimate the shares to be supplied from domestic production and from foreign markets, and assess Egypt's dependence on world feed markets.

Rising per capita income in middle-income countries has a significant impact on their patterns of food consumption, production, and foreign trade. According to the World Bank, middle-income countries constitute 94 of the world's 208 countries and are home to nearly 2.7 billion people, or 45 percent of the world's population. They include China, Russia, Brazil, Mexico, Argentina, Colombia, Iran, Turkey, Egypt, the Philippines, Republic of Korea, and Poland [47].[1] Their combination of large population and substantial purchasing power implies that these are significant countries for the study of evolving patterns of food demand and expenditures on food and other consumables. Current and potential demand for food in middle-income countries invites further research because of their importance in world markets. Middle-income countries also have a potential for rising expenditures year after year, because they are already in the "take-off" stage of growth. In contrast, low-income countries have, at best, a slow annual rate of economic growth. Many are stagnant, and some even show declining growth rates on a per capita basis. In high-income countries, demand for food is relatively stable.

The relationship between rising consumer demand for meat and rising feed requirements could create food-feed competition in some middle-income countries and growing dependence on foreign markets for both feed and livestock products. The magnitude of food-feed competition varies depending on available domestic natural endowments of arable land and water resources that could be used to meet expanded production of meat animals. Limited domestic opportunities for feed production could limit increases in domestic livestock products and encourage these countries to import more feed or livestock products, or both. On the other hand, abundant arable land and water resources, in conjunction with viable government production and trade policies, could encourage feedgrain and oilseed production, which in turn would enhance the initiation of a viable domestic poultry industry. In addition to natural resources and endowments, government trade policies shape the structure and efficiency of domestic industries and affect the mix between local production and imports of meat and feeds. With respect to these variables, middle-income countries could be grouped into four modalities with similar situations and common characteristics, each of which could be represented by a one-country case. Scaling down from best to least optimal situations, these cases are Brazil, Russia, China, and Egypt.

In the case of Brazil, the conversion of land to arable land in the interior states has led to increasing soybean and corn area and in cultivated pastures to support poultry and livestock production. Brazil is currently the world's second-leading producer and exporter of soybeans and soybean products, trailing the United States in soybean production and exports and following Argentina in the export of soybean meal and soyoil

[1] (Numbers in brackets refer to sources listed in the References section at the end of this report.) The World Bank defines high-income countries as those with per capita Gross National Product (GNP) above $9,265 (based on 1999 estimates), middle-income countries as those with per capita GNP between $760 and $9,265 (for combined upper- and low-middle-income countries), and low-income countries as those with per capita GNP below $760. The middle-income countries discussed in this report are classified according to the World Bank 1999 GDP estimates.

[33, 44]. Brazil is now able to meet rising demand for poultry from its own resources as well as export large quantities of poultry, pork, beef, and soybeans to world markets [44].

In Russia during the 1990s, removal of subsidies led to significant reductions in livestock inventory and meat production as the Russian economy underwent structural change. Livestock growers were unable to respond to rising domestic demand, as production remained costly and inefficient, and the country resorted to meat imports [3, 19]. In 2001, Russia was the world's second-leading importer of pork, and the third-largest importer of beef. In 2002, rising demand for poultry exceeded domestic production and imports amounted to 1.39 million tons, ranking Russia as the world's largest poultry importer. However, in March 2003, Russia imposed import quotas on poultry for 3 years; 704,000 metric tons in 2003, and 1.05 million metric tons each for 2004 and 2005 [49]. This new import policy is expected to slow down imports, push up domestic prices, and spur feed production and corn imports [44].

In China, rising poultry consumption depends on imports of both feeds and poultry meat. Taking advantage of low labor costs, China exports poultry products, primarily to Japan, including fresh, chilled products, and hand-deboned broiler meat for use in restaurants [41]. Currently, China is a net exporter of poultry meat. By 2005, however, imports are projected to exceed exports and the gap will rise substantially, due to area constraints and rising demand for imported feed. As a result, most production will be domestically consumed to meet growing demand for poultry and smaller amounts of poultry will be available for export [13, 38, 44].

Egypt typifies many countries in North Africa (Morocco, Algeria, Libya, and Tunisia) and the Middle East (Iran, Iraq, Saudi Arabia, Jordan, Syria, Israel, Lebanon, Yemen, Kuwait, and the United Arab Emirates). These countries are currently expanding their domestic livestock sectors to meet rising livestock product demand for consumption in the face of chronic shortages of feedstuffs. Consequently, Egypt presents a prototype case study of a middle-income country where shortages of arable land and water resources have spurred higher feed imports and greater dependence on foreign supplies of feeds and livestock products. The 10-year shift, which started in the early 1990s, of Egypt's poultry sector from the (mainly) public to the private domain was successful, providing a recent example for other countries. Income growth in the 1980s, accompanied by consumer subsidies and price controls, led to significant poultry imports. Subsidies for domestic production during the late 1980s, however, led to declining poultry imports and rising domestic production, along with rising feed imports.

Privatization of the poultry industry in the early 1990s, in turn, increased the sector's production efficiency and significantly boosted imports of feedgrains and soybean meal, but domestic producers were largely protected from competing poultry imports. High import tariffs (70 percent as of July 2003) and other barriers are still imposed on imported poultry.

Now, as Egypt—like many other middle-income countries—faces the potential challenge of greater liberalization under the WTO, the efficiency of its poultry industry will influence both domestic consumers, producers, and exporters competing to sell poultry products into this growing market.

Patterns of World Poultry Consumption and Production

Economic analysis of demand reveals how household expenditure patterns can change in response to changes in income. Empirical evidence shows that, as countries become wealthier, expenditures on food, education, health, and durable goods rise. However, income has the greatest influence over dietary changes, as it provides the means needed to convert desired demand for goods into effective demand for goods. For example, McDowell et. al. analyzed food expenditures for selected food items and determined that expenditures for selected food items vary by income [21]. Initial impacts of per capita income rising from low to middle income levels start with higher demand for food and foods of greater variety and higher quality. This means that the composition of food consumption changes as income rises. Consumers follow a general pattern to improve the nutritional level of the food they consume by upgrading their daily diet from basic grains and tubers toward high-protein items such as poultry, beef, pork, and dairy products, as well as more fruits and vegetables.

Engel's law states that the percentage of family income spent on food declines over time as income rises [29]. Analysis by Theil, Chung, and Seale confirmed that the budget share allocated to food is inversely correlated with income, and that high-income countries are less responsive to changes in food prices [37]. Generally speaking, when countries move from poor to middle income levels, food demand elasticities usually rise, but as income increases toward higher levels, elasticities decline.

Changing trends in food consumption patterns and income levels are described in a recent Economic Research Service publication estimating income elasticities of demand for food for three income groups [31]. From this study, income elasticities of demand for food in middle-income countries are estimated at 0.58, compared with 0.73 in low-income countries, and 0.29 in high-income countries. These differences reflect middle-income countries' rising demand for meat and other livestock products, and are supported by empirical evidence in individual countries. For example, Mergos and Donatos found that Greek consumers purchased more meat and dairy products, and less bread, as their incomes grew [23]. A high expenditure elasticity of meat demand indicates the dominant position of meat in the diet of middle-income countries. Hossain and Jenson found high expenditure elasticities for beef, pork, poultry, dairy products, sugar, milk, butter and cheese, fruits, and vegetables, and lower ones for grains and eggs in Lithuania during the 1990s [14].

Two additional factors help explain changes in food consumption when per capita Gross Domestic Product (GDP) rises. First, as populations move from low to middle income brackets, demand for livestock products and food in general will increase. Increased food consumption is further enhanced when both political and economic forces unite to reduce disparities in income distributions. Second, higher rates of economic growth will likely lead to a reduction in rural population and rising urbanization in middle-income countries, which affects food consumption patterns [30]. Rural populations usually produce a large proportion of household food requirements in their own back yards. These food items include poultry meat, meat of small animals (pork, sheep, goat, rabbit), milk, cheese, eggs, yogurt, vegetables, and sometimes fruit. However, when people move to urban centers, they begin to buy their food from retail market outlets already dressed, packed, and/or processed. In some countries, newly urbanized migrants with a strong taste for fresh meats may prefer to shop at a wet market, if they exist, where animals are freshly slaughtered and dressed. Over time, however, urban dwellers are more likely to own refrigerators for preserving perishable commodities such as meat, poultry, fruits, and vegetables.

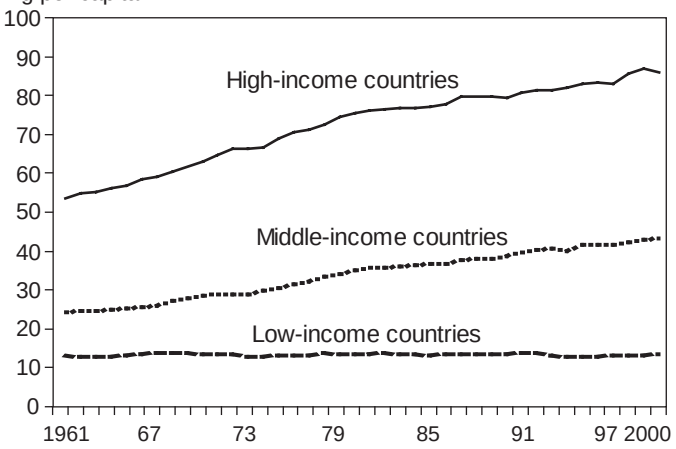
Middle-income countries, including Egypt, are characterized with increasing populations and large rural-to-urban migration as individuals seek better job opportunities in industrial and trade sectors. Their citizens' ultimate motivation is to improve their incomes, and move to higher-income classes. As they make this shift, they will probably buy most of their food items from grocery stores.

Meat Consumption in Middle-Income Countries

As indicated above, per capita meat consumption varies widely among countries according to GDP income levels. In general, per capita consumption in high-income countries is double that of middle-income countries and nearly six times the amount consumed in low-income countries (fig. 1a). Between 1961 and 2000, per capita meat consumption increased nearly 61 percent and 79 percent, in high- and middle-income countries respectively, compared with only 2 percent in low-income countries (fig. 1b).

Figure 1a

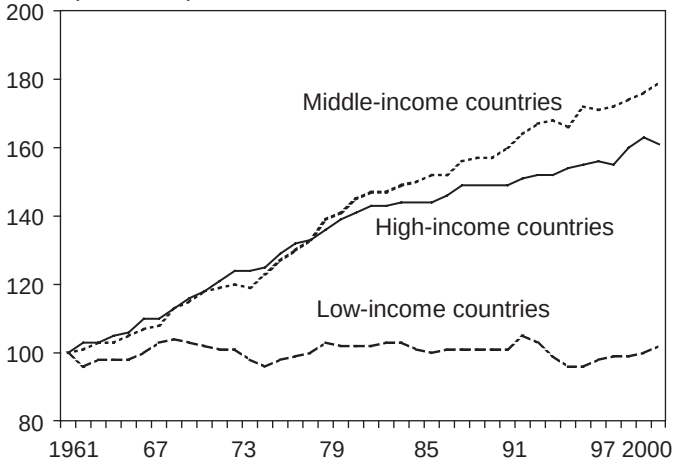
Per capita total meat consumption by income group, 1961-2000



Source: Economic Research Service/USDA.

Figure 1b

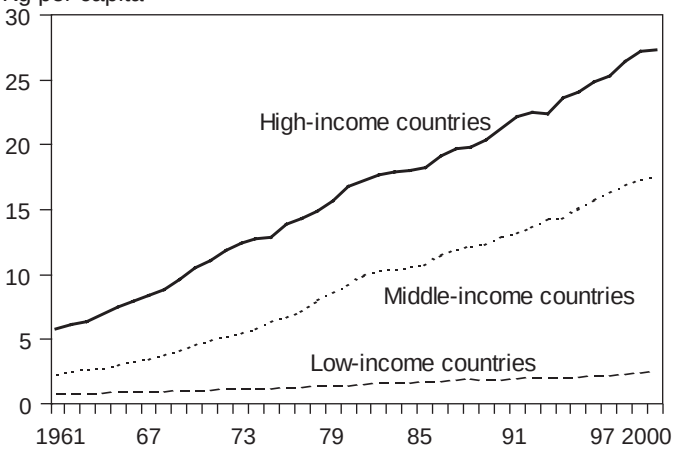
Growth of per capita total meat consumption, 1961-2000



Source: Economic Research Service/USDA.

Figure 2a

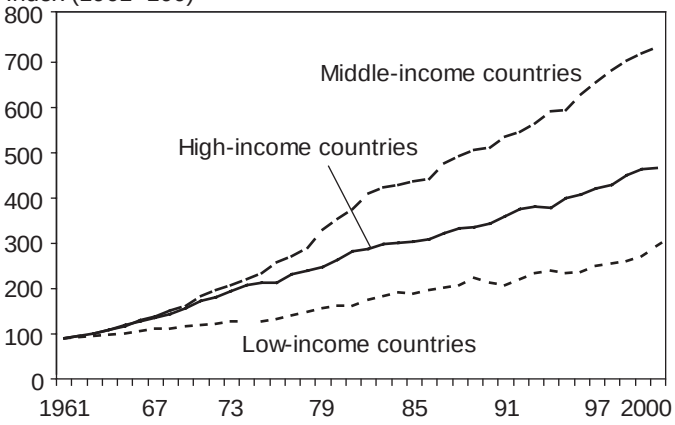
Per capita poultry meat consumption by income group, 1961-2000



Source: Economic Research Service/USDA.

Figure 2b

Per capita growth of poultry consumption by income group,1961-2000



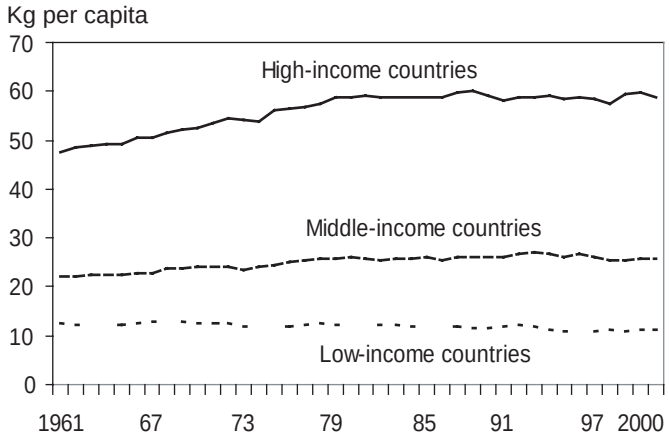
Source: Economic Research Service/USDA.

Per capita poultry meat consumption grew faster than pork, bovine (beef and water buffalo), lambs, goat, and other meat consumption in all of the three income groups. Poultry meat consumption increased faster in middle-income countries than in high- and low-income countries (fig. 2a). Between 1961 and 2000, per capita poultry meat consumption in middle-income countries grew by 635 percent compared with 370 percent in high-income countries and 201 percent in low-income countries (fig. 2b).

Per capita red meat consumption rose only 23 percent in high-income countries and 18 percent in middle-income countries, but declined 11 percent in low-income countries over the same 1961-2000 period. Per capita consumption in high-income countries was nearly 5.2 times higher than low-income countries and 2.3 times higher than middle-income countries. Between 1980 and 2000, per capita consumption of red meat was nearly unchanged at about 59 and 26 kilograms per year in high- and middle-income countries, respectively, but dropped from 12 to 11 kilograms per capita in low-income countries (fig. 2c). These trends indicate a widening gap in consumption levels across income groups, with low-income countries lagging over time (fig. 2d).

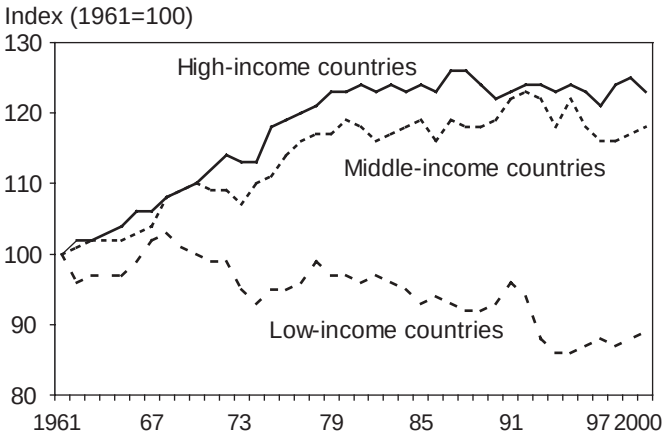
Disaggregating red meat into its main components indicates that only pig meat showed a rising per capita consumption trend during 1961-2000 (fig. 2e). Per capita consumption of bovine meat rose during the 1960s and 1970s, but declined in the 1980s and 1990s

Figure 2c
Per capita red meat consumption by income group, 1961-2000



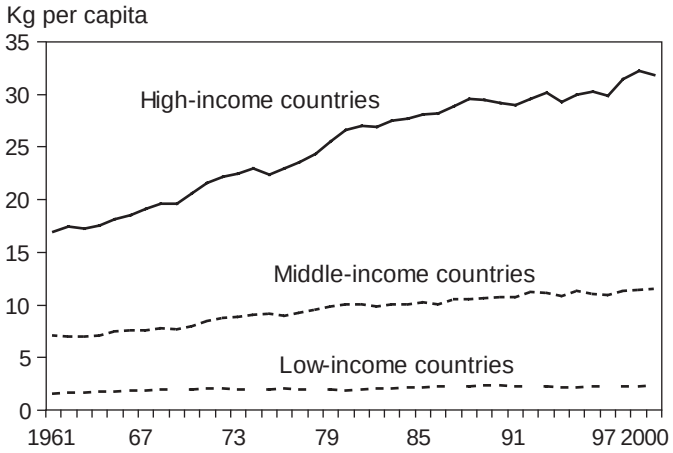
Source: Economic Research Service/USDA.

Figure 2d
Growth of per capita red meat consumption by income group, 1961-2000



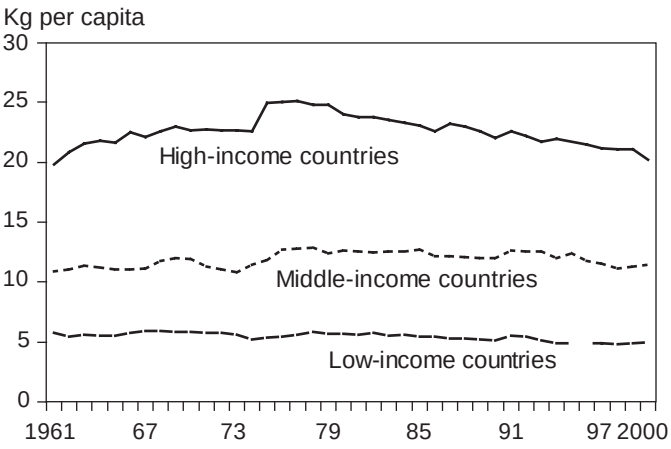
Source: Economic Research Service/USDA.

Figure 2e
Per capita pigmeat consumption by income group, 1961-2000



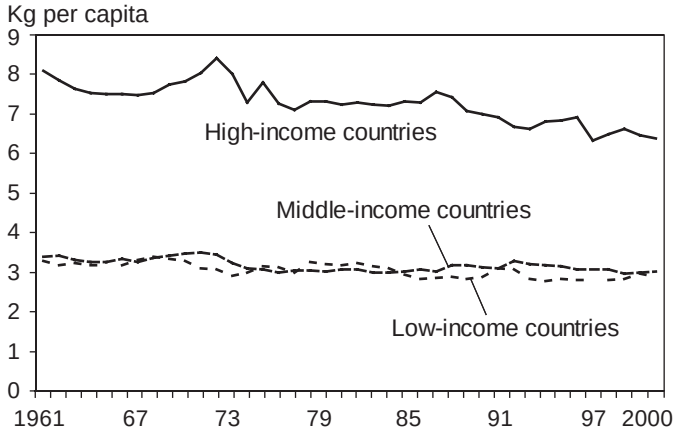
Source: Economic Research Service/USDA.

Figure 2f
Per capita bovine meat consumption by income group, 1961-2000



Source: Economic Research Service/USDA.

Figure 2g
Per capita sheep and goat meat consumption by income group, 1961-2000



Source: Economic Research Service/USDA.

in all three income groups (fig. 2f). Likewise, consumption of lamb and goat meat declined sharply in all three income groups during 1961-2000 (fig. 2g).

Meat Production is Rising, Especially in Middle-Income Countries

Worldwide, total meat production more than tripled from 71.2 million tons in 1961 to 237 million in 2001 (table 1), although growth rates slowed over time (fig. 3a). Middle-income countries showed the highest annual growth rates, while high- and low-income countries grew at slower rates in all four decades (fig. 3b). More importantly, in the 1990s poultry meat production had the fastest annual growth rates—nearly double that of pigmeat, 3.4 times that of sheep and goat meat, and 6 times that of bovine meat (table 2).

Table 1—World meat production by type, 1961-2001

Year	Bovine	Pigmeat	Poultry	Lamb & goat	Others	Total
			Million tons			
1961	28.76	24.74	8.94	6.03	2.70	71.2
1962	30.31	26.05	9.20	6.17	2.74	74.5
1963	31.98	28.01	9.74	6.16	2.75	78.6
1964	32.44	28.67	10.13	6.16	2.80	80.2
1965	33.05	31.28	10.95	6.21	2.77	84.3
1966	34.76	32.41	11.67	6.32	2.76	87.9
1967	36.51	33.86	12.37	6.49	2.82	92.0
1968	38.24	34.40	12.77	6.68	2.91	95.0
1969	39.22	34.12	13.72	6.64	3.04	96.7
1970	39.67	35.79	15.09	6.83	3.06	100.4
1971	39.42	39.41	15.71	6.95	3.07	104.6
1972	39.91	40.62	16.83	7.01	3.17	107.5
1973	40.26	40.47	17.61	6.78	3.17	108.3
1974	43.31	42.43	18.29	6.56	3.19	113.8
1975	45.20	41.66	18.66	6.79	3.24	115.6
1976	47.59	40.75	20.01	6.82	3.28	118.4
1977	47.99	42.94	21.21	6.88	3.31	122.3
1978	48.52	45.64	22.68	7.04	3.34	127.2
1979	47.37	50.08	24.54	7.04	3.43	132.5
1980	47.17	52.67	25.91	7.34	3.34	136.4
1981	47.62	52.99	27.50	7.62	3.33	139.1
1982	47.71	53.19	28.45	7.71	3.28	140.3
1983	48.98	55.47	29.19	7.99	3.35	145.0
1984	50.37	57.48	29.76	8.07	3.41	149.1
1985	51.25	59.96	31.17	8.26	3.49	154.1
1986	53.09	61.51	33.33	8.33	3.38	159.6
1987	53.18	63.62	35.90	8.66	3.48	164.8
1988	53.67	67.10	37.69	9.06	3.54	171.1
1989	53.98	68.19	38.67	9.38	3.54	173.8
1990	55.70	69.86	41.03	9.69	3.50	179.8
1991	56.35	70.91	43.14	9.88	3.56	183.8
1992	55.52	72.84	45.25	9.91	3.83	187.4
1993	55.10	75.09	48.13	10.13	3.82	192.3
1994	55.95	77.58	50.85	10.34	3.91	198.6
1995	56.93	78.56	54.64	10.55	4.15	204.8
1996	57.43	78.44	56.32	10.29	4.28	206.8
1997	58.26	82.17	59.96	10.59	4.18	215.2
1998	58.11	87.62	62.28	10.68	4.24	222.9
1999	59.36	89.70	65.32	11.11	4.27	229.8
2000	59.67	89.41	68.07	11.44	4.32	232.9
2001	59.82	91.19	70.36	11.29	4.33	237.0

Source: FAO data, http://www.faostat.fao.org/July 2002

Table 2—Annual growth rates of world total meat production, 1961-2001

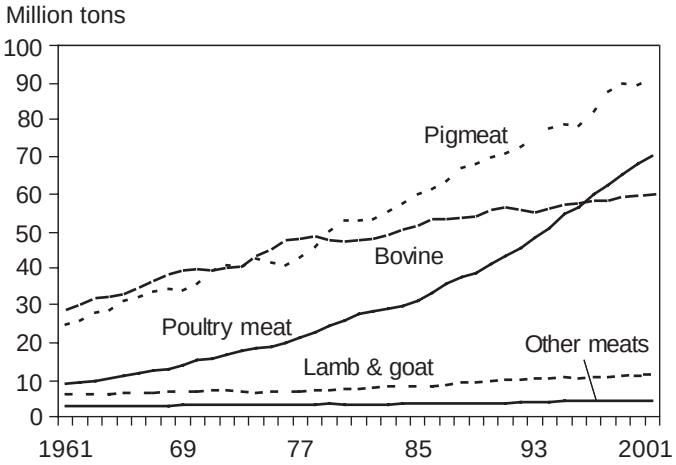
Year	Bovine	Pigmeat	Poultry	Lamb &goat	Others*	Total
			Percent per year			
1961-70	3.63	4.1	5.77	1.34	1.31	3.80
1971-80	2.49	2.84	5.41	0.52	1.03	3.00
1981-90	1.78	3.34	4.64	2.66	0.78	3.00
1991-2001	0.83	2.64	4.99	1.44	1.79	2.70

* Others include game, horse, rabbit, and camel meats.

Source: FAO data, http://www.faostat.fao.org/July 2002

Figure 3a

World total meat production, 1961-2001



Source: Economic Research Service/USDA.

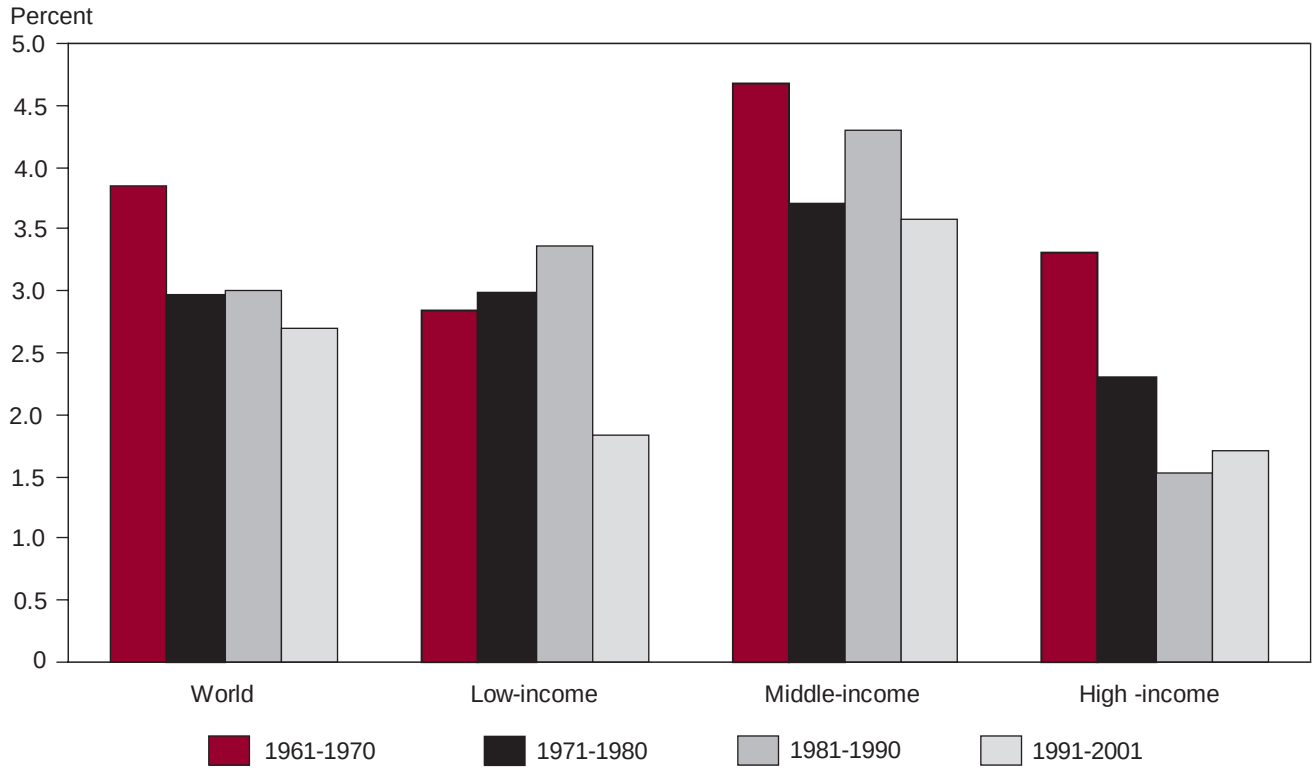
In middle-income countries, meat production showed similar trends (fig. 3c). Poultry meat rose from 10.7 percent of total meat output in 1961 to 29 percent in 2001. The shares of bovine, sheep and goat, and other meats decreased sharply, while that of pigmeat grew from 38.6 to 45.1 percent over the same period.

By 2001, middle-income countries were the largest producers of poultry, bovine, pigmeat, and sheep and goat meat compared with the other two groups (fig. 4a-d). High-income countries dominated poultry production until 1994 (fig. 4a). In aggregate, middle-income countries' poultry output exceeded that of the high-income countries in 1995 and reached 37.2 million tons compared with 29.3 million tons in high-income countries in 2001. Only 3.8 million tons of poultry meat was produced in low-income countries in 2001. The output increase was mainly due to accelerated production in China, Brazil, Mexico, and other middle-income countries.

Until 1988, bovine meat production was consistently largest in high-income countries, when it slipped below that of the middle-income countries (fig. 4b). Production in high-income countries exceeded that of

Figure 3b

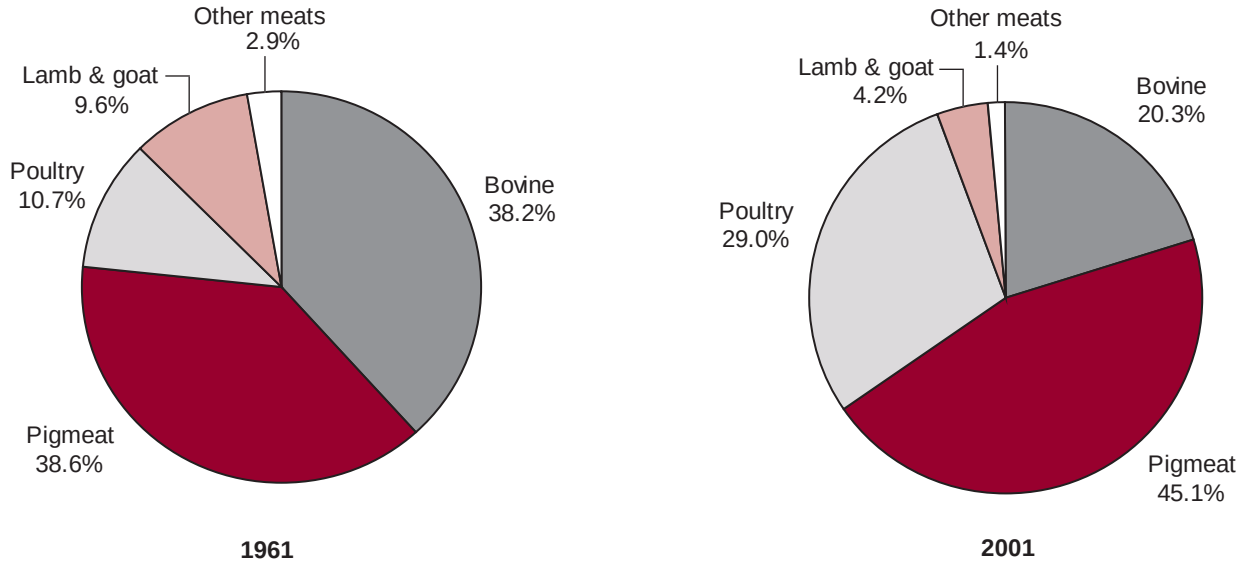
Annual growth rates of total meat production by decade and income group



Source: Economic Research Service/USDA.

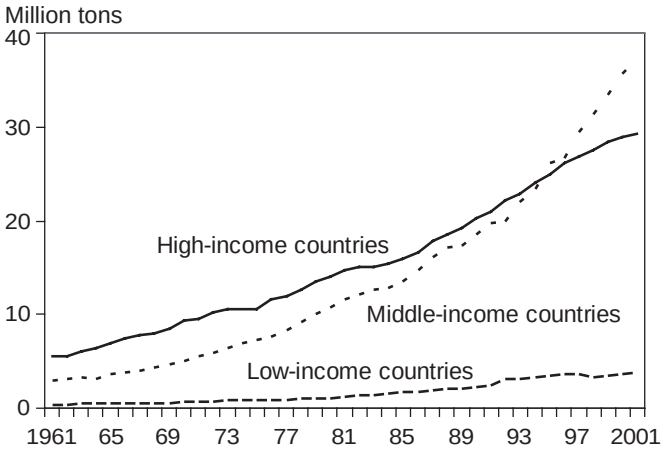
Figure 3c

Middle-income countries' total meat production distribution in 1961 and 2001



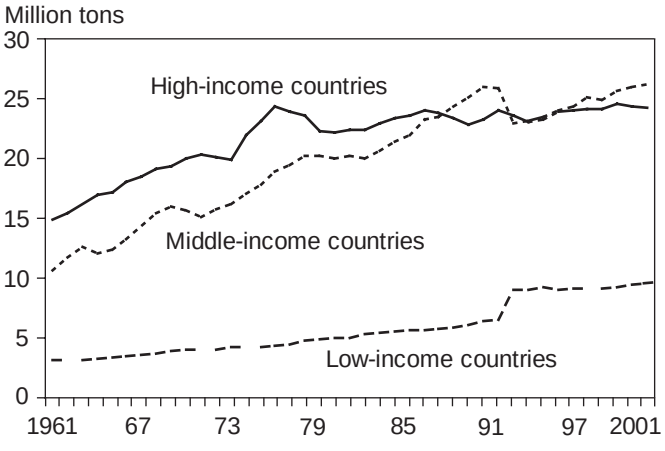
Source: Economic Research Service/USDA.

Figure 4a
World poultry production by income group, 1961-2001



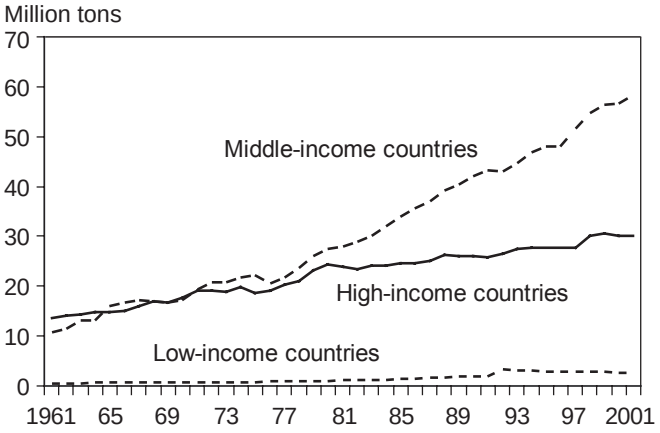
Source: Economic Research Service/USDA.

Figure 4b
World bovine production by income group, 1961-2001



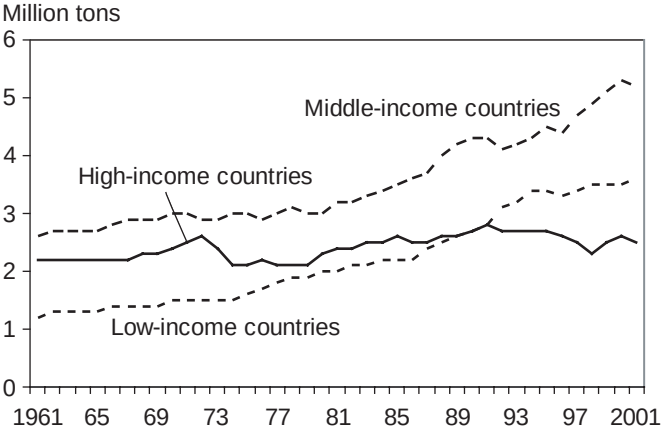
Source: Economic Research Service/USDA.

Figure 4c
World pigmeat production by income group, 1961-2001



Source: Economic Research Service/USDA.

Figure 4d
World sheep and goat meat production by income group, 1961-2001



Source: Economic Research Service/USDA.

middle-income countries again after the 1992 split of the Former Soviet Union into 15 Newly Independent States (NIS) and the reclassification of 11 NIS as low-income countries. In 1993, middle-income countries' output of bovine meat rebounded to surpass that of the high-income countries after production increases in Brazil and China during the 1990s.

Pigmeat production in middle-income countries started to outpace that of the high-income countries in the early 1960s (fig. 4c). This gap rapidly widened in the mid-1980s, due mainly to China's economic reform. Reform led to accelerated pigmeat expansion, making China the world's largest producer by 2001, accounting for almost half of the world total, compared with the European Union (EU) (19 percent) and the United States (10 percent) [42].

Sheep and goat meat production was consistently larger in middle-income countries than in the other two income groups over the entire period due mainly to prevailing climate and topographic conditions (fig. 4d).

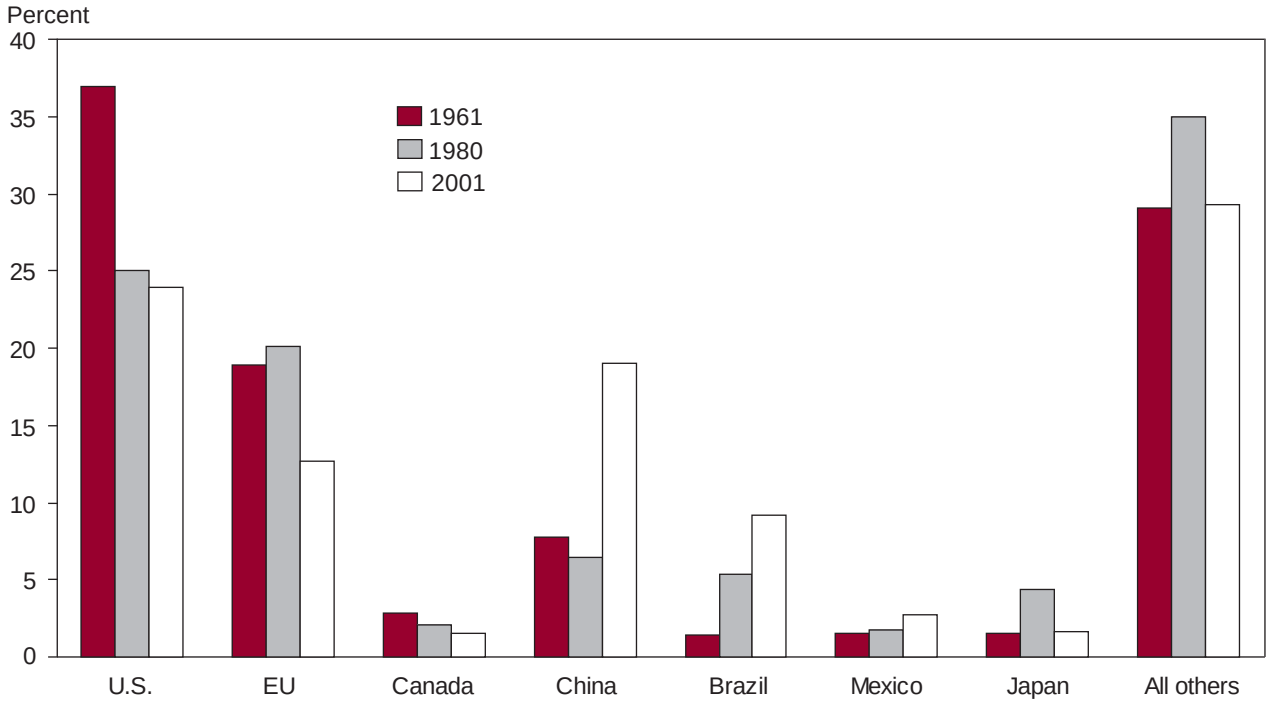
Demand for Poultry Meat Rose Fastest in Middle-Income Countries

World poultry meat output increased nearly eightfold, from 8.9 to 70.4 million tons over 1961-2001, while output in middle-income countries rose more than twelvefold, from 3.0 to 37.5 million tons. The major poultry meat producers are the United States, the EU, China, Brazil, Mexico, Canada, and Japan (fig. 5a). Among middle-income countries, China was the major producer in 2001, followed by Brazil, Mexico, Argentina, Iran, Russia, Egypt, and Poland (fig. 5b).

The combined output of China and Brazil exceeded that of the United States or the EU in the 1990s. In 1961, poultry meat output from China and Brazil, combined,

Figure 5a

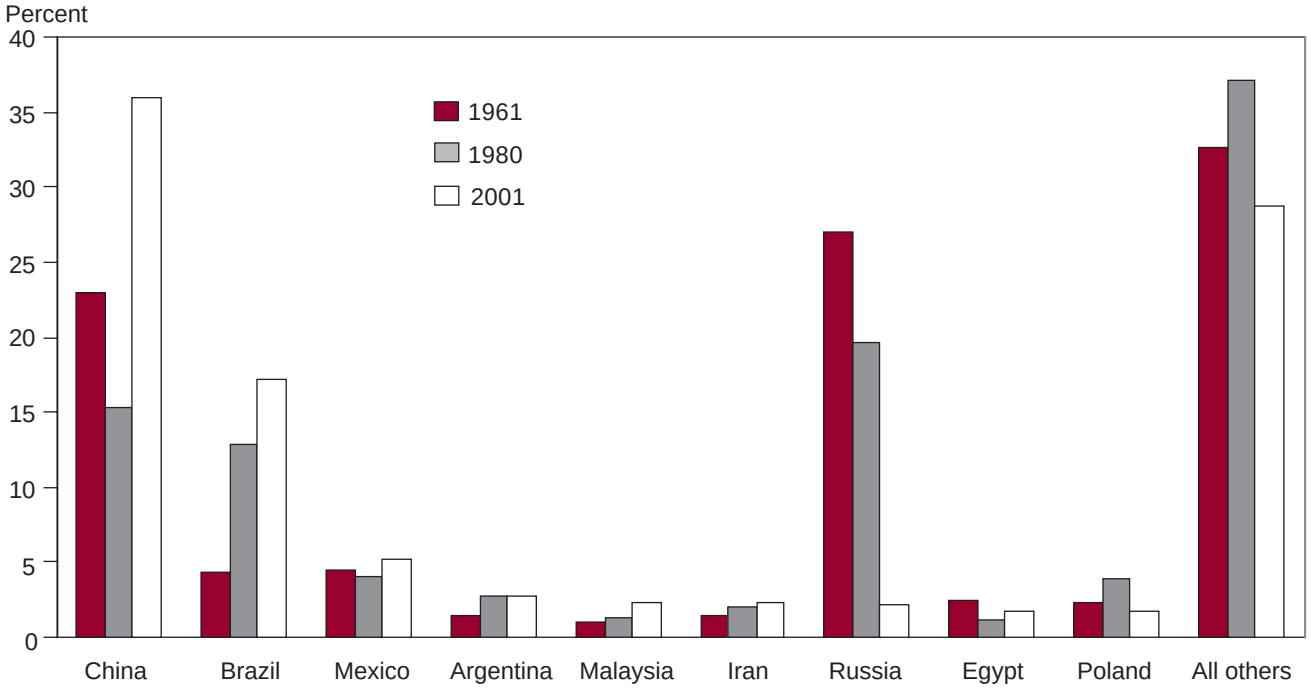
World major poultry producers; percent of world totals, 1961, 1980, and 2001



Source: Economic Research Service/USDA.

Figure 5b

Major poultry producers in middle-income countries; percent of total middle-income country production, 1961, 1980, and 2001



Source: Economic Research Service/USDA.

accounted for 9.2 percent of the world total, amounting to nearly one-quarter of the U.S. share (37 percent), or half the EU share (18.9 percent). China and Brazil's poultry meat production rose at faster rates than that of the U.S. and EU, due to agricultural economic reforms in China and the influx of foreign investments and technology into both countries during the 1980s and 1990s.

Consequently, between 1980 and 2001, poultry meat production rose 699 percent in China and 358 percent in Brazil, compared with only 158 percent and 70 percent in the United States and EU, respectively. As a result, the combined China-Brazil share of the world total rose to 28 percent, while that of the United States and EU declined to 24 percent and 13 percent, respectively, in 2001 (fig. 5a). In that year, China alone contributed 35.5 percent of total middle-income countries' output, followed by Brazil (17.7 percent), Mexico (5.2 percent), Thailand (3.6 percent), and Argentina (2.6 percent).

Before 1992, the Soviet Union was the largest poultry producer of all middle-income countries. However, after the 1992 split of the Soviet Union into the 15 NIS, Russia's output alone in 2001 declined substantially, to nearly 56 percent of its 1992 level. Production has slowed since the 1991 reforms, which decreased consumers' real income and increased production and marketing costs vis-a-vis the world market. Domestic production could not compete against rising poultry imports, especially from the United States, the Netherlands, and France. Consequently, in 2001, Russia's poultry production share (2.2 percent) ranked below that of Iran's (2.3 percent) and just above that of Egypt (1.7 percent) and Poland (1.7 percent) (fig. 5b).

In 1961, middle-income countries produced 34 percent of world poultry meat, high-income countries 61 percent, and low-income countries the remaining 5 percent. Since then, middle-income country production has been accelerating, equaling the output of high-income countries at about 47 percent by the mid-1990s. By 2001, middle-income countries accounted for the largest share of world poultry production (52 percent) compared with 42 percent in high-income countries and less than 6 percent in low-income countries (fig. 6a)

Major Types of Poultry

Poultry meat consists primarily of meat from chickens. In 1961, chicken meat accounted for 85 percent of world total poultry meat production, turkey meat made up 10 percent, and the rest was composed of ducks, geese, and pigeons. By 2001, world chicken meat production was nearly unchanged at 86 percent, turkey meat decreased to only 7 percent, while ducks, geese, and pigeons together increased to a little over 7 percent. Production of poultry types has a different distribution in each of the three income groups, depending on climate, costs of production, consumers' taste, and the state of skills, management, and technology available in a country.

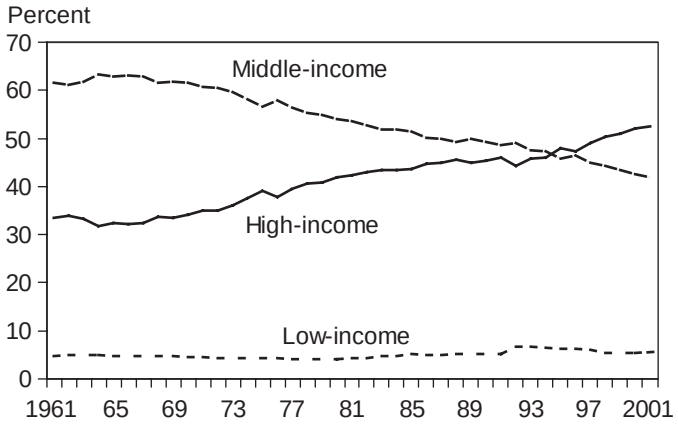
Chickens, and more so turkeys, are more sensitive to ambient environmental temperatures than ducks, geese, or pigeons. For example, turkey poults must be kept in warmer places than baby chicks, but are very sensitive to high temperatures and may die from hot weather stress more quickly than chickens. Turkeys of all weights show an abrupt drop in feed conversion efficiency at temperatures above 86 degrees Fahrenheit, while chickens tolerate that heat [10]. For both chickens and turkeys, moving air is required for them to adequately cool themselves in high temperatures.

During 1961-2001, world chicken production increased nearly 690 percent from 7.6 million tons to about 60 million tons. The largest increase was achieved in middle- and low-income countries, rising by 1,139 percent and 898 percent, respectively, followed by high-income countries at 421 percent. In 1961, high-income countries' share of chicken production was 61 percent of the world total, compared with 34 percent in middle-income countries and only 5 percent in low-income countries. In 1988, however, middle-income countries' share of about 48 percent exceeded that of high-income countries for the first time. Middle-income countries' share stayed within 1 percentage point of high-income countries' share between 1989 and 1992 before beginning a steady rise over high-income countries in 1993. By 2001, the production share of middle-income countries accounted for 54 percent of the world total, compared with 40 percent for high-income countries and 6 percent in low-income countries (fig. 6b). The United States is the world’s largest chicken producer, accounting for 23.4 percent of the world total, followed by China (15 percent), the EU (11.2 percent), and Brazil (10.2 percent) in 2001. Other small producers include Mexico at 3.2 percent and Thailand, Japan, India, and Argentina, each at about 2 percent.

Turkey meat production has been dominated by high-income countries, which accounted for 92 percent of output in 1961. A steady 8 percent were in middle-income countries, and only 0.2 percent was in low-income countries (fig. 6c). Turkey is a native bird of the Americas and is not known in many other countries. Consequently, in 1961, the United States was the world's largest single turkey meat producer, accounting for 75 percent of the world total, but production decreased to 50 percent in 2001. The EU was second

Figure 6a

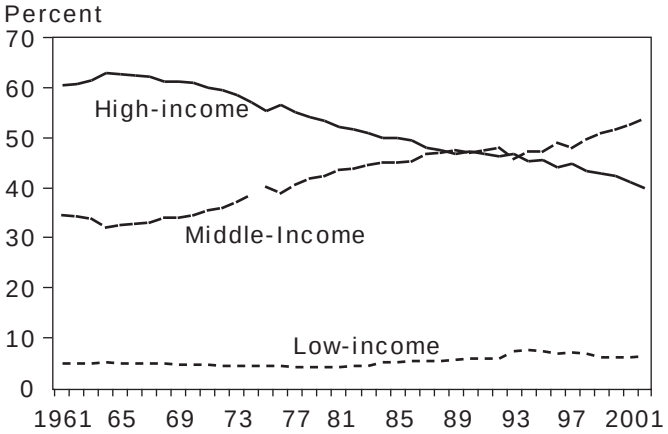
Production shares of poultry meat by income group; percent of world total, 1961-2001



Source: Economic Research Service/USDA.

Figure 6b

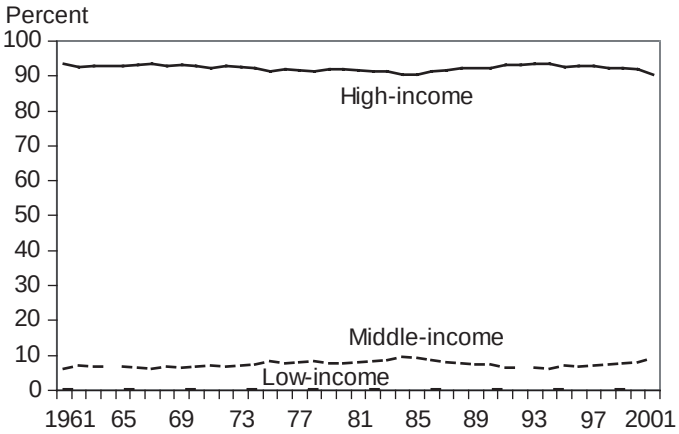
Production shares of chicken meat by income group; percent of world total, 1961-2001



Source: Economic Research Service/USDA.

Figure 6c

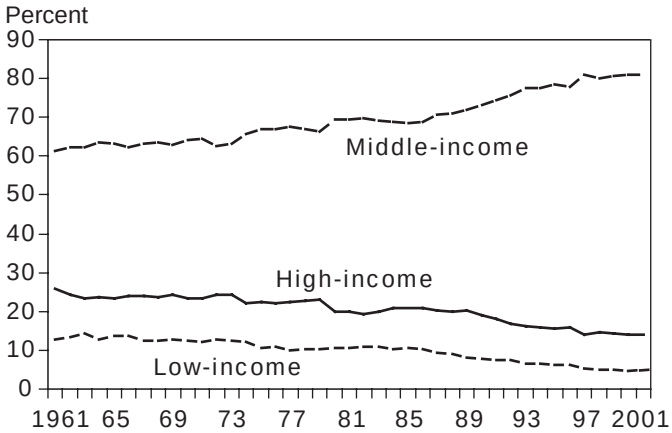
Production shares of turkey meat by income group; percent of world total, 1961-2001



Source: Economic Research Service/USDA.

Figure 6d

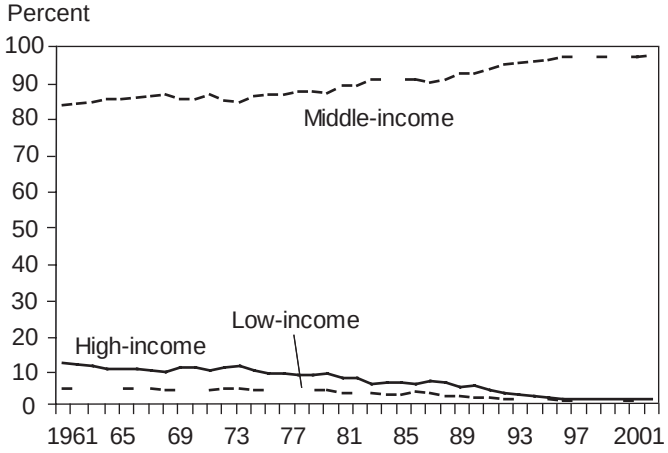
Production shares of duck meat by income group; percent of world total, 1961-2001



Source: Economic Research Service/USDA.

Figure 6e

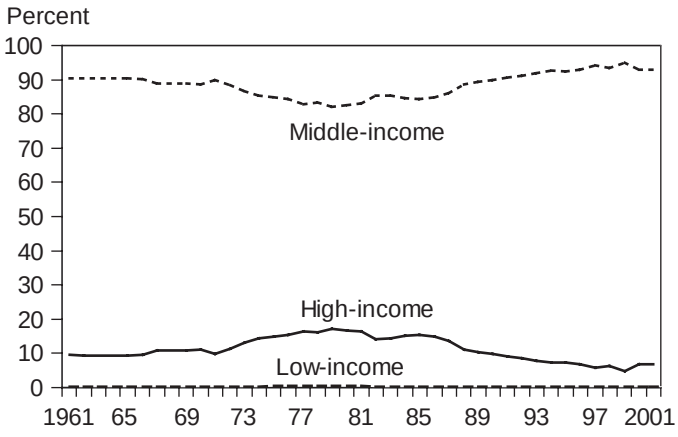
Production shares of goose meat by income group; percent of world total, 1961-2001



Source: Economic Research Service/USDA.

Figure 6f

Production shares of pigeon meat by income group; percent of world total, 1961-2001



Source: Economic Research Service/USDA.

at 37 percent, and Canada and Brazil each had 3 percent.

Ducks and geese are more tolerant of heat stress than chickens and turkeys and in many cases are raised around pastures in open areas near water. Pigeons can be reared in a variety of climates with minimal facilities. In some countries, pigeons are domesticated and raised in established roosting houses for marketing in special meat shops, because young pigeon meat is considered a delicacy. They may not feed on a regular basis, depending mostly on scavenging from nearby grain fields and household refuse.

Production of duck, goose, and pigeon meat in the middle-income countries showed the greatest increase over 1961-2001. During this period, middle-income countries' duck meat output increased from 61 to 81 percent of world production (fig. 6d). Most duck meat was produced by China, followed by the EU, Thailand, the United States, Malaysia, and Egypt. Similarly, goose meat production of middle-income countries increased from 85 to 98 percent of the world total (fig. 6e). China also produces almost all of the world's goose meat, with very small amounts produced in the EU and Thailand. Production of both goose and duck meat in high- and low-income countries decreased as indicated in figures 6c and 6d. Also, world production of pigeon meat was dominated by middle-income countries, where output actually rose from 90 to 93 percent of the world's total (fig. 6f). From 1970 to 1985, pigeon production in high-income countries such as Cyprus and France rose to nearly 20 percent of the world's total, but decreased afterwards. Egypt was the top producer of pigeon meat, with Syria, the EU, and Saudi Arabia producing minor amounts.

World Consumption and Production of Eggs

As recently as the 1950s, producing poultry meat and eggs was not considered a large-scale endeavor, but a supplemental farm enterprise utilizing marginal amounts of grains. Eggs were the result of mature flocks and either hatched for replacement birds or eaten. Meat was produced from culled birds and males. This production system still exists in many backyard enterprises.

With changes in technology and improved genetics, however, new breeds have been developed specifically for meat (broilers) or egg (layers) production. Continuing intensive inbreeding of layer strains has resulted in the development of small size laying chickens resistant to diseases, improved egg quality, and increasing annual egg production.

For example, annual egg production in the United States increased from 120 eggs per layer in 1937 to 231 in 1974 to a current average of 270 eggs per layer [22]. In addition, success in breeding a smaller laying chicken resulted in sharp decreases in the costs of egg production, such as reduced feed requirements, housing, and equipment because of the lesser space required per layer. The new layer strains were disseminated all over the world as the industry became more commercialized, boosting egg production and consumption.

Egg Consumption

Egg consumption averaged 190 eggs per capita in high-income countries, compared with 109 in middle- and 31 in low-income countries in 2000 [42]. Per capita egg consumption rose rapidly in the 1970s in the three income groups (fig. 7a). However, from 1980-2000, consumption declined by 14 percent in the high-income group, was basically unchanged in low-income countries, but showed nearly a 10-percent increase in middle-income countries.

Egg Production

Worldwide, there are two kinds of eggs produced—primary or chicken eggs and other eggs (excluding hens). Chicken egg production is the most significant, amounting to 91-96 percent of worldwide totals during 1961-2001. Other eggs (composed mainly of duck, goose, and quail eggs) are produced mainly in Asian countries including China (83 percent), Thailand (7 percent), Indonesia (3 percent), and the Philippines (2 percent). In 2001, nearly 94 percent of world non-chicken egg output was produced in middle-income countries, 5 percent in low-income countries, and less than 1 percent in high-income countries, mainly in the United Kingdom and Spain.

Worldwide, chicken egg production is a large-scale activity, more important commercially than production of other types of eggs. Therefore, this analysis focuses only on chicken egg production.

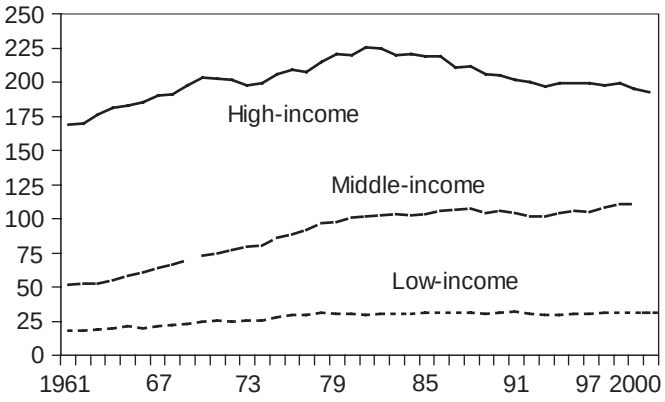
World chicken egg production increased more than fourfold during 1961-2001 and in middle-income countries more than sixfold. In low-income countries, output rose by about eightfold, but increased by only about 150 percent in high-income countries. The major chicken egg producers are China, accounting for 41 percent of the world total, followed by the EU and the United States, at 9 percent each. Other important egg producers include Japan, Russia, Mexico, and India. Japan's egg production has steadily increased, nearly doubling from 1961 to 2001, while that of the EU and the United States has decreased 2-3 percentage points below their 1961 levels. Similarly, Canada and Australia showed declining trends over the same period.

In 1961, middle-income countries' share of chicken egg production was 38 percent of the world total, high-income countries, 58 percent, and low-income countries, less than 5 percent. Since then, middle-income production has been accelerating and exceeded that of high-income countries at about 47 percent by 1977. By 2001, middle-income countries accounted for the largest share, about 66 percent, compared with 24 percent in high-income countries (fig. 7b). Among middle-income countries, China alone accounted for 62 percent of total egg production, followed by Russia, Mexico, and Brazil. After the 1992 split of the Soviet Union, Russia's production decreased falling to19 percent below 1992's 2.4-million-ton output by 2001.

The next section initially provides background information specific to Egypt, then presents forecasts for Egypt's poultry industry needs and feed requirements. The Egyptian experience, as well as projections for the future, is applicable to other countries in similar situations where protective government policies and income growth intersect in a period of pressure toward greater trade liberalization.

Figure 7a

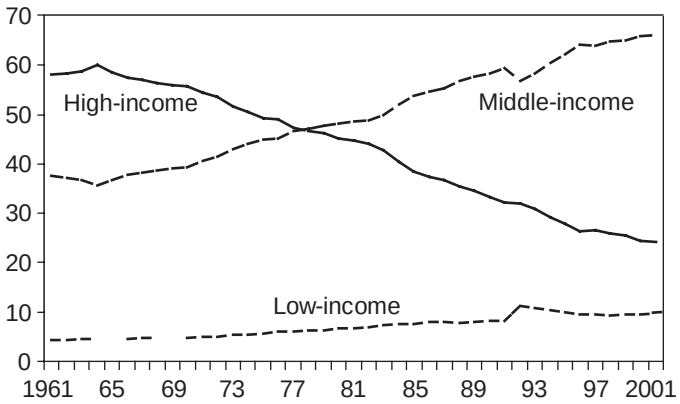
Per capita egg consumption by income group, 1961-2000



Source: Economic Research Service/USDA.

Figure 7b

Chicken egg production shares by income group; percent of world total, 1961-2001



Source: Economic Research Service/USDA.

Egypt's Poultry Sector

During the 1980s, Egypt's Gross Domestic Product (GDP) grew at an average annual rate of 5.5 percent per year. However, in 1990, growth dropped to a low of 1.1 percent as the economy underwent structural changes. GDP growth resumed slowly to average 2.9 percent in 1993, 3.9 percent in 1994, and 4.7 percent in 1995. Egypt's GDP growth rate accelerated further to average 5.4 percent annually between 1996 and 2000, and is projected to be slightly over the 5-percent range in 2001-2010 [44]. Rising per capita income encouraged animal protein consumption in the 1990s, and sustained growth in income-driven demand for poultry and other meats is expected to continue in the future. Poultry is a more efficient feed converter and has a shorter production cycle than red meat animals. Thus, in the past, Government policies leaned more toward increasing poultry meat production over red meats. Government policies continue to shape the structure and efficiency of the domestic poultry industry and trade.

Economic Reforms and Policies

The poultry and egg sector in Egypt has developed dramatically since the early 1990s, fueled by economic reform and government policy shifts. In 2001, poultry meat production, at 646,600 metric tons, exceeded all other meats, including beef and veal, buffalo meat, sheep and goat meat, camel meat, and others (fig. 8a). In value terms, 26 percent of Egypt's total livestock products came from poultry meat and egg production, and Egypt's livestock sector contributed 27 percent of total domestic agricultural production in 1999 [7].

In 1986, Egypt adopted new economic reforms and structural adjustments to reduce the role of government and encourage free market operations. The economic reform was designed to reduce fiscal deficits by eliminating price distortions through the liberalization of pricing, trade, and foreign exchange policies. Introduction of additional liberalization policies in 1991 further affected Egypt's agricultural production, competitiveness, and international trade, and created a more competitive market for feed and meat production. The commercial poultry sector became more dynamic, and rapidly overcame chronic domestic feed shortages. Egypt's limited arable land and pastureland created competition between food crops for human consumption and feedgrains, oilseeds, and green fodder for animal feeding. Currently, the country is a net food and feed importer. The ready availability of feedstuffs from abroad and subsidies for poultry producers were instrumental in encouraging producers to depend mostly on foreign feed supplies to assure the feed flow to their birds, and the poultry sector has remarkably increased meat supplies at relatively stable prices.

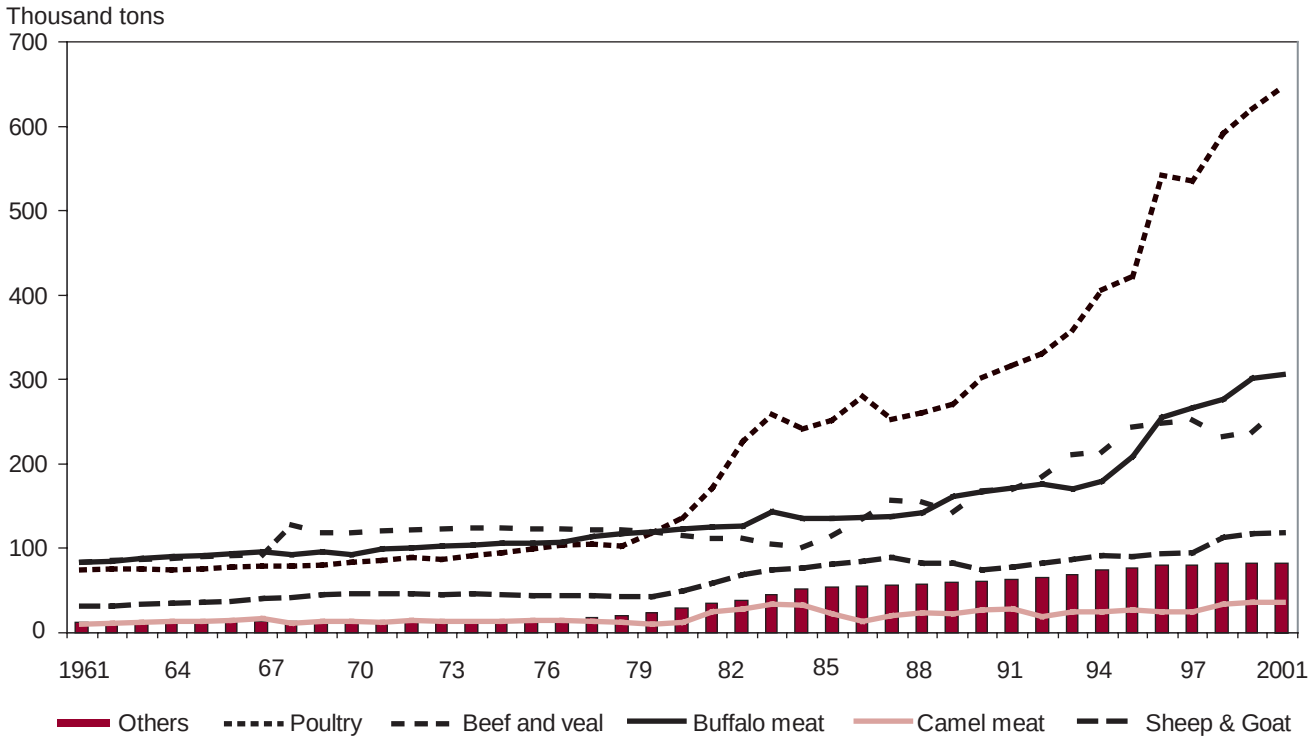
In late 1986, the Egyptian government eliminated feed subsidies for poultry producers, which forced many broiler growers to leave the sector, as they were unable to continue production with the sudden rise in feed prices. Geese, pigeons, and most turkeys and ducks are produced in small backyard operations, which rely more on locally available grains and growers' own feed production. Consequently, their relative share of total poultry production increased. However, the onset of the privatization process and the rapid acceleration of the commercial sector, due to economies of scale, reversed the output course to the benefit of the commercial sector, which was able to gradually replace backyard operations. These developments resulted in substantial gains in physical productivity and economic efficiency and led to an increasing share of chicken in total poultry meat production (fig. 8b). This share rose considerably, from 71.8 percent of total poultry production in 1990, just 1 year before the privatization process started, to 83.4 percent in 2001.

There is a strong preference in Egypt for live birds, slaughtered immediately at sale to consumers, over frozen poultry meats. It is estimated that 70 percent of chicken production is marketed live and the remaining 30 percent is sold frozen [45]. In 1997, Egypt had 19 modern and 101 traditional slaughterhouses, with total slaughter of 28.1 million and 6.3 million birds per year, respectively [42]. The available total capacity of both slaughterhouses and cold storage facilities can handle about 25 percent of total production [45]. In 2000, the government issued a decree to prohibit the marketing of live chickens in Egypt's largest two cities, Cairo and Alexandria, for sanitary reasons. The immediate goal of this decree was to increase the marketing of frozen chicken [45].

From 1986 to 1997, there was a ban on poultry imports to encourage domestic production. This ban was replaced with an 80-percent tariff rate in 1997, scheduled to decline further to 70 percent on whole birds in 1998. However, customs duties remain at 80 percent, and imports of poultry from all sources are still negligible, accounting for about 4,000 tons per year. Under the World Trade Organization (WTO) agreement, which Egypt has signed, all tariffs will have to be reduced and gradually eliminated to open

Figure 8a

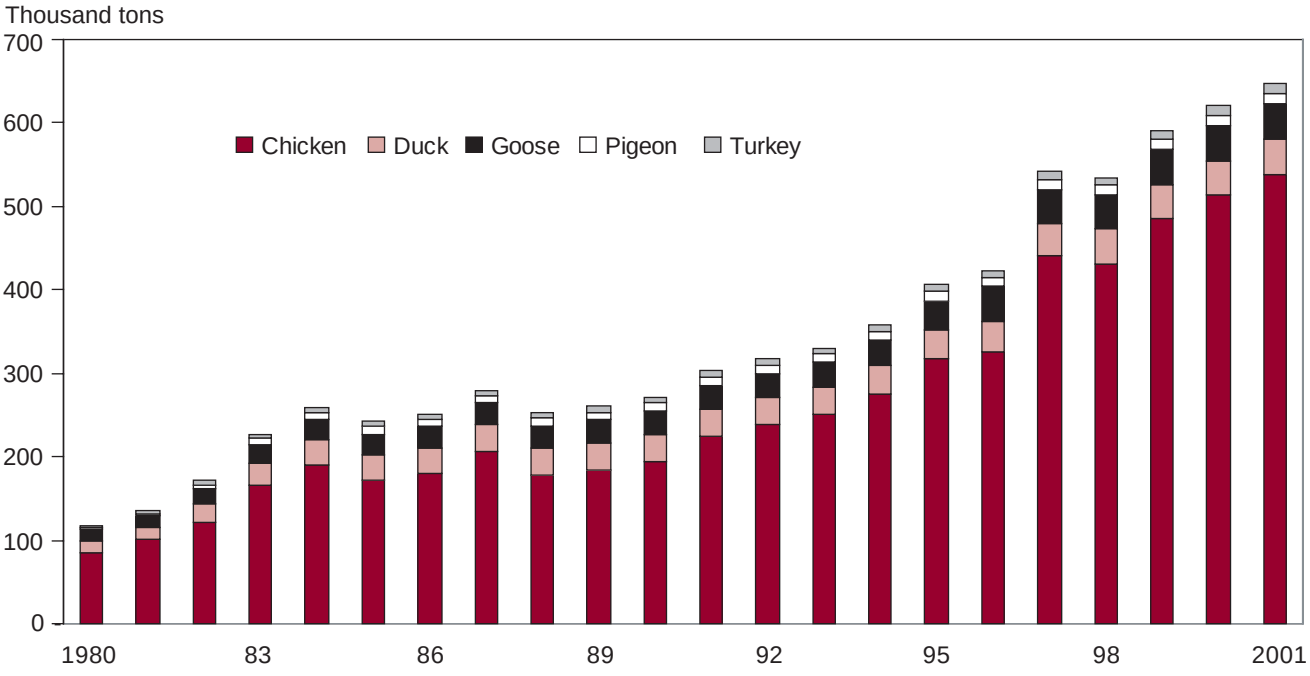
Egypt's total meat production, by type; 1961-2001



Source: Economic Research Service/USDA.

Figure 8b

Egypt's poultry meat production, by type; 1980-2001



Source: Economic Research Service/USDA.

up the market for poultry. However, the realization of such policy is unlikely during this decade. Further reduction of import tariffs will increase imports of poultry meat and reduce feed imports, causing lower domestic poultry production.

Poultry Meat Industry

Poultry types

Egypt's poultry sector includes chickens, which are further subdivided into commercial (international breeds) and Balady (traditional breeds) operations, and a classification called "other," which includes ducks, geese, turkeys, and pigeons, and is subdivided into backyard and commercial operations. In 2000, 63 percent of Egypt's chicken meat output was produced by commercial operations. The traditional (backyard) operations, in contrast, produce 22 percent of chicken meat, 64 percent of ducks, 34 percent of turkeys, and all geese and pigeons [11, 45] (table 3). According to statistics collected by the Food and Agriculture Organization of the United Nations (FAO), stocks (all sources) increased nearly fourfold, from 27.2 million birds in 1961 to 112.1 million birds in 2002. More than 82 percent of total poultry stocks were chickens, 8.1 percent were ducks, 8.1 percent were geese, and just under 2 percent were turkeys. Pigeon stocks are not recorded.

Poultry production in Egypt varies widely according to the adoption of modern technologies, available management skills, and the size of commercial (compared with traditional) operations. Chickens are kept mainly for meat and egg production, while ducks, geese, turkeys, and pigeons are kept for meat. Small growers principally operate backyard systems. They contribute a significant proportion of the poultry meat and egg production, particularly so before the start of large-scale commercial production during the 1970s. Small growers raised mainly traditional breeds (Balady), which are well adapted to harsh environmental conditions, are resistant to disease, and can accommodate feed with low nutritional value. Most small farmers keep poultry flocks of more than 20 birds, containing different varieties of poultry including ducks, geese, and pigeons.

Commercial broiler chicken breeds are more efficient in feed use with a feed-to-meat conversion ratio of 2.65 pounds of feed per pound of meat, compared with the Balady strains that average nearly 5 pounds [9]. In addition, the commercial strains average 7-week growth cycles and could complete an average of 5 cycles in a year. The Balady breeds grow more slowly and need 17 weeks to reach slaughter, and therefore

Table 3—Egypt poultry stocks by type, 1961-2002

Year	Chickens	Ducks	Geese	Turkeys	Total poultry
			Million birds		
1961	21.8	2.6	2.3	0.6	27.2
1962	22.1	2.6	2.3	0.6	27.6
1963	22.4	2.7	2.3	0.6	28.0
1964	22.7	2.7	2.3	0.6	28.4
1965	23.0	2.8	2.4	0.6	28.8
1966	23.3	2.8	2.4	0.6	29.1
1967	23.6	2.9	2.4	0.6	29.5
1968	23.9	2.9	2.4	0.6	29.9
1969	24.2	3.0	2.5	0.6	30.3
1970	24.5	3.0	2.5	0.7	30.7
1971	24.8	3.1	2.5	0.7	31.1
1972	25.2	3.1	2.5	0.7	31.5
1973	25.5	3.1	2.6	0.7	31.8
1974	25.8	3.2	2.6	0.7	32.2
1975	26.1	3.2	2.6	0.7	32.6
1976	26.4	3.3	2.6	0.7	33.0
1977	26.7	3.3	2.7	0.7	33.4
1978	27.0	3.4	2.7	0.7	33.8
1979	27.3	3.4	2.7	0.7	34.2
1980	27.6	3.5	2.7	0.7	34.6
1981	27.9	3.5	2.8	0.8	34.9
1982	28.2	5.0	4.0	0.8	38.0
1983	29.9	6.2	5.1	1.1	42.4
1984	32.0	6.7	5.5	1.2	45.4
1985	32.3	6.9	5.6	1.2	46.1
1986	32.7	7.0	5.7	1.3	46.7
1987	33.1	7.1	5.8	1.3	47.3
1988	33.5	7.2	5.9	1.3	47.9
1989	33.9	7.3	6.0	1.3	48.5
1990	37.2	7.4	6.1	1.3	52.1
1991	43.5	7.6	6.2	1.4	58.6
1992	50.9	7.7	6.3	1.4	66.3
1993	59.6	7.8	6.4	1.4	75.2
1994	62.0	7.8	6.5	1.4	77.7
1995	65.0	8.0	7.5	1.4	82.0
1996	68.0	8.5	8.8	1.5	86.8
1997	90.0	8.8	8.9	1.5	109.2
1998	86.0	9.1	8.9	1.5	105.5
1999	88.0	9.1	9.0	1.8	107.9
2000	89.0	9.1	9.1	1.9	109.1
2001	91.0	9.1	9.1	1.9	111.1
2002	92.0	9.1	9.1	1.9	112.1

Note: No data on pigeon stocks are available.

Source: FAO data, http://www.faostat.fao.org/November 2003

could complete at most 3 cycles per year [9]. Consequently, production from broiler operations using commercial techniques is increasing faster than Balady. Other poultry species are mostly raised in backyard operations using low-grade feed rations; most are domestic strains that are not efficient feed converters. Improved, more efficient international breeds and hybrids of domestic strains are slowly replacing them.

Poultry meat consumption

Poultry consumption in Egypt is far below the average for middle-income countries, but the industry most likely will continue to increase its production efficiency and poultry will continue to be the country's leading meat consumed. Per capita poultry meat consumption in Egypt has increased from 2.4 kilograms (kg) in 1961 to about 8.9 kg in 2000, but is still under the world average of 10.9 kg. Compared with other middle-income countries, Egypt's per capita consumption is considerably less than in Saudi Arabia, Brazil, Mexico, Poland, and Iran, but higher than in Morocco, Algeria, or Syria (fig. 9).

Consumption in 1988 began to suffer as prices increased after the government's decision to lift subsidies on producers and consumers that started in 1973. In addition, price controls on food, feed, and livestock products were lifted. These liberalization policies encouraged private sector investment in the poultry sector and boosted meat and egg output. During the 4 years following the sector's privatization, per capita consumption rose steadily, ending the 1990s at an average annual growth rate of 6.9 percent, or nearly double the 3.5-percent world average. Finally, because it is less expensive than beef, buffalo, lamb, goat, or pigmeat, poultry is the most consumed of all meats in Egypt.

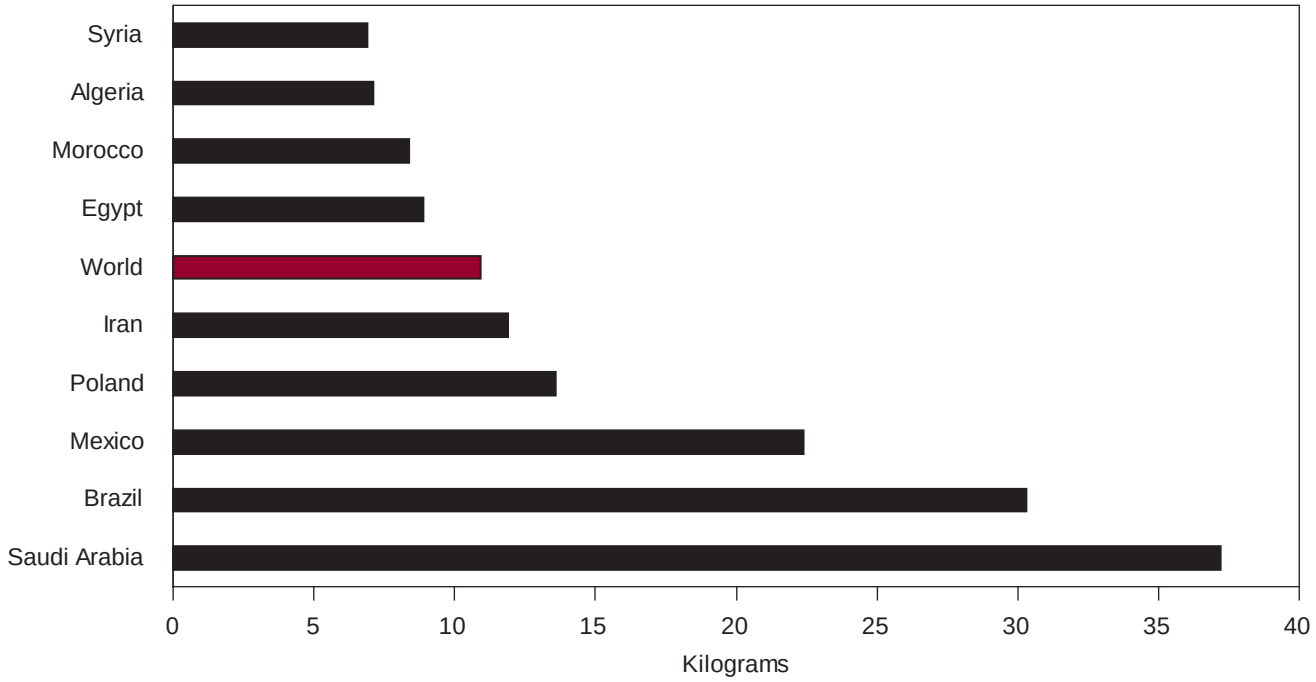
Poultry meat production

The distribution of total meat production in Egypt is quite different from that in the rest of the world (fig. 10). Egypt's total meat production, listed in descending order of importance, includes poultry, beef, buffalo, mutton and lamb, goat, camel meat, pigmeat, and others (mostly rabbits), and increased from 435,000 tons in 1980 to 1.46 million tons in 2001. The increase represents a 5.3-percent annual growth rate, nearly double the 2.7-percent world average during the same period.

Responding to increased demand, Egypt's poultry meat production has trended upward over the last 40 years. Rising demand for poultry meat pushed poultry to 44.3 percent of total domestic production compared with 29.6 percent for the world in 2001. During 1961-2001, poultry meat production grew 770 percent in Egypt, with average annual growth increasing from 1 percent during the 1960s to 8.7 percent during the 1990s.

Figure 9

Per capita poultry meat consumption in Egypt, compared with world average and selected middle-income countries; 2000



Source: Economic Research Service/USDA.

In the 1990s, Egypt's 8.6-percent annual growth rate of poultry meat production exceeded the world average of 5.2 percent and was much higher than other middle-income countries such as Saudi Arabia (5.2 percent), Turkey (3 percent), and Colombia (4.1 percent). In comparison, the U.S. annual growth rate was 4.3 percent and the EU's growth rate was 3.3 percent during the 1990s. China, Argentina, and Brazil, where poultry meat production grew at an annual rate between 9 and 12.5 percent in the 1990's, exceeded Egypt's annual growth rates (fig. 11).

Egypt's Egg Industry

Egg Consumption in Egypt

During the 1970s and 1980s, egg consumption in Egypt rose on a per capita basis and reached a peak in the late 1980s, due to heavy government subsidies designed to encourage egg and poultry consumption as an inexpensive protein source to people in low-income brackets. However, after the elimination of producer and consumer subsidies, consumption declined sharply, reaching as low as 54 eggs per capita in 1995, then rebounding to 62 eggs (about 3 kilograms) per person in 2000. Currently, Egypt's per capita egg consumption is below the world average and also below levels in many other middle-income countries. In fact, it is closer to low-income countries' average rather than the middle-income countries' average (fig. 12).

Egg imports have been banned since 1989, except for hatching eggs. At their 1982 peak, egg imports amounted to 12,000 tons, about 11 percent of total domestic supply. Imports averaged less than 6 percent of total consumption during the 1980s, before being banned to protect domestic producers. Exports, mostly to neighboring countries, are small, fluctuating between 20 and 145 metric tons per year during the 1990s [42].

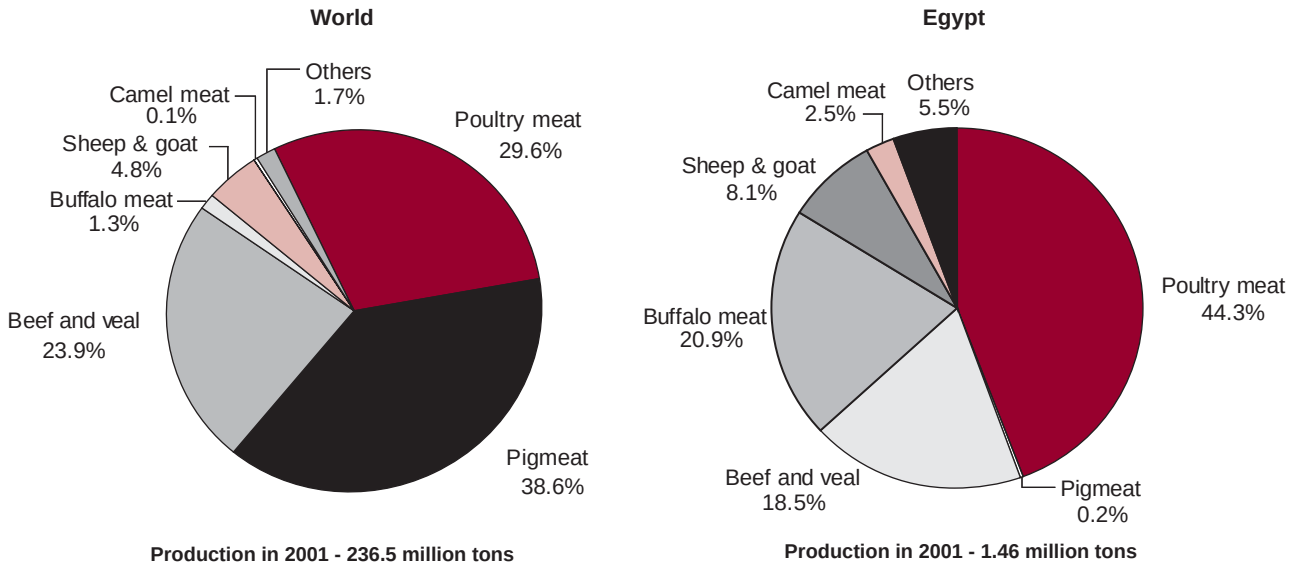
Egg Production in Egypt

Egg production made substantial progress during the 1970s, growing by 6.8 percent a year, more than double the 2.9-percent world growth rate. In the 1980s, the annual growth rate of 5.9 percent was still larger than the 3.7-percent world rate, and in the 1990s, both rates were equal at 4 percent annually. The high growth rate of the 1970s was mainly due to government feed subsidies. The government also helped producers by establishing public enterprises with the primary purpose of introducing modern technology and skilled management into the industry.

Production peaked in the late 1980s with the benefit of government price subsidies to both producers and consumers. These subsidies were lifted in 1988, however, causing a setback for the egg industry. Egg production rose at a steady rate during the 1990s. In 2000, production climbed back to about 4 billion eggs, still 8 percent below the 1980s peak.

Commercial operations supply 70 percent of total output and the backyard Balady operators produce the remaining 30 percent. The number of laying hens was estimated at 17.2 million in 2000, of which 11 million were in the commercial sector and the remainder were mostly in the backyard Balady sector. Each laying hen in a commercial operation lays about 240-270 eggs per year, compared with only 170-180 eggs for the Balady breed. Eggs produced from international breeds weigh 50-56 grams, while Balady eggs average 35-40 grams.

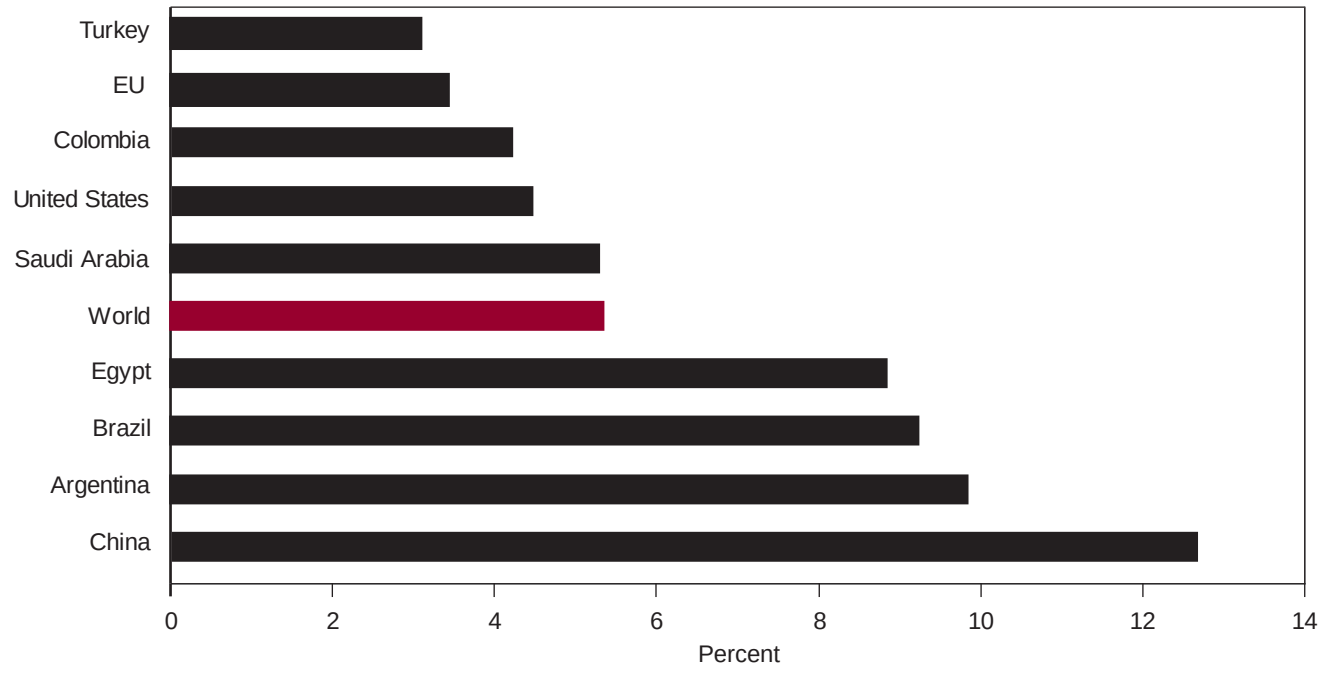
Figure 10
Total meat production distribution



Source: Economic Research Service/USDA.

Figure 11

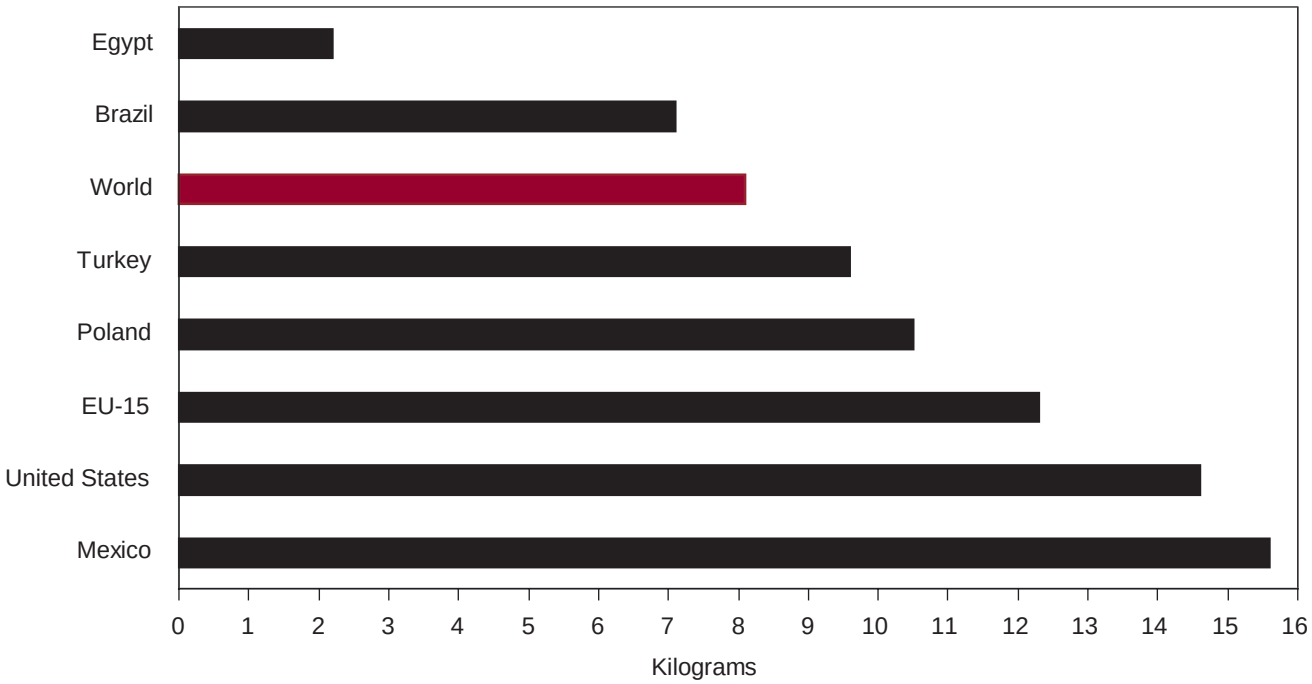
Average annual poultry production growth rates in selected middle-income countries compared with the United States, EU, and world average; 1990-2000



Source: Economic Research Service/USDA.

Figure 12

Per capita egg consumption in Egypt, compared with the United States, EU, world average, and selected middle-income countries; 2000



Source: Economic Research Service/USDA.

Forecasting Egypt's Poultry Industry Needs

This section examines estimates of own-price, cross-price, and income elasticities in Egypt and forecasts to 2010 the per capita consumption demand for poultry meat and eggs. Using results of econometric models, total poultry production in terms of live birds will be projected and used to calculate derived feed demand for Egypt's poultry sector to 2010.

Methodology

Consumer demand can be derived from a utility maximizing process, subject to a budget constraint. The general specification of the model is a simple formulation that links per capita consumption of a food item to its own price, the price of close substitute(s), and per capita GDP. The model was formulated such that:

$$\text{Ln } (Q)i_t = \alpha + \beta \text{Ln } (P)i_t + \gamma \text{Ln } (P^*)j_t + \delta \text{Ln } (M)t + \varepsilon_t$$

$$\text{Ln } (Q)h_t = \alpha + \beta \text{Ln } (P)h_t + \gamma \text{Ln } (P^*)j_t + \delta \text{Ln } (P^*)k_t + \theta \text{Ln } (M)_t + \varepsilon_t$$

Where:

$(Q)i_t$ = per capita quantity of poultry meat consumed in year t, measured in kilograms;

$(Q)h_t$ = per capita quantity of eggs consumed in year t, measured in numbers;

$(P)i_t$ = weighted-average domestic prices of poultry meat (i) in year t, measured in real 1995 Egyptian Pounds.

$(P)h_t$ = weighted-average domestic prices of eggs (h) in year t, measured in real 1995 Egyptian Pounds.

$(P^*)j_t$ = weighted-average domestic prices for the close substitute red meat (j) (includes beef, buffalo, lamb, goat, pork, and camel meat,) in year t, measured in real 1995 Egyptian Pounds.

$(P^*)k_t$ = weighted-average domestic prices for the close substitute poultry meat (k), in year t, measured in real 1995 Egyptian Pounds.

$(M)_t$ = per capita Gross Domestic Product in year t, measured in real 1995 Egyptian Pounds.

Ln (.) = natural logarithm function.

ε_t = error term in year t.

α = intercept,

β, γ, δ, θ = parameters to be estimated, which in the log functional form represent own-price, cross-price (red meat), cross-price (poultry), and income elasticities, respectively.

Time-series prices at the retail level were collected from 1965-1999 for poultry, beef, buffalo, lamb, and goat meat, and from 1976-1999 for eggs. The number of observations for meats and eggs were 35 and 23, respectively. Demand is formulated as a linear function of relative prices, per capita income, and a disturbance term. Specifically, per capita consumption of poultry or eggs is hypothesized to respond inversely to own-prices and respond directly to substitute prices and per capita GDP.

All domestic prices were deflated by the Egyptian consumer price index (CPI), and a linear regression in logarithmic form was estimated after adjusting for autocorrelation, to improve the model's forecasting capability. The logarithmic form was chosen because it generates directly, and without any further calculations, estimates that can be interpreted as elasticities.

Estimation Results

Results of the per capita demand model using the Ordinary Least Squares (OLS) regression procedure are presented in table 4. The coefficients of multiple determination show the closeness of the predicted values to the actual historical values. The goodness of fit test (R-bar-square) indicate that in the poultry meat model over 93 percent of the variation in the dependent variable is explained by the explanatory variables. In the egg model, the R-bar-square was 79 percent. The estimated values track the actual historical values fairly well and are within the 5-percent confidence intervals. The estimated coefficients have the expected signs and are significant at the 1- or 5-percent level.

As expected, the response of per capita consumption of poultry to own-price changes is statistically significant. The estimated model indicates that the elasticity of demand for poultry meat and for eggs was negative and inelastic (less than unity) with respect to their own-prices, -0.47 for poultry and -0.58 for eggs. A recent study estimated the country's poultry own-price at -1.89, using variables that included meat prices, fish prices, and Egypt's Gross Domestic Product (GDP) [42]. Despite differences in the estimated elasticity

Table 4—Ordinary least square poultry and egg regression results

Commodity	Intercept	Own-price	Poultry	Red-meat	Income	Adj. R-square
			Percent per year			
Poultry meat	-7.71	-0.47		0.55	1.08	0.93
	(-6.85)**	(-2.04)**		(1.86)*	(9.59)**	
Eggs	-12.66	-0.58	0.62	0.54	1.09	0.79
	(-4.36)**	(-4.63)**	(1.98)*	(1.73)*	(4.32)**	

Note: Numbers between brackets indicate t-value; * = significant at 5-percent level; **= significant at 1-percent level.
Source: Economic Research Service/USDA.

value (which is not unusual), results indicate that poultry became more desirable and easy to obtain in supermarkets and fast-food establishments as a whole bird or in parts, mainly because poultry is less expensive than beef, buffalo, lamb, or goat meat.

The price elasticity of poultry meat was estimated using a red meat price and an egg price as a substitute. The egg price variable proved to be insignificant in the regression and was deleted. The price elasticity of eggs was estimated using a poultry meat price and a red meat price as substitutes. All cross-price elasticities were estimated to be positive and inelastic. The positive sign means that a percentage rise in the price of one meat increases the percentage quantity purchased of other substitute meats. In the demand equation for poultry meat, the cross-price elasticity was estimated at 0.55 with respect to the weighted-average price of red meats, and was significant at the 5-percent level. In the demand equation for eggs, the cross-price elasticity was 0.62 with respect to the chicken meat price and 0.54 with respect to the red meat price. Both were significant at the 5-percent level.

Per capita GDP was positively correlated and significant at the 1-percent level in both the poultry meat and egg equations, indicating that rising income, in real terms, is associated with increasing consumer demand for poultry meat and eggs. The income elasticity was 1.08 for poultry and 1.09 for eggs, compared with 0.8 for poultry indicated in the study cited earlier [42]. The current model indicates that, as income increases, consumers are willing to spend proportionally more of their additional income on poultry meat and eggs.

Poultry Meat and Egg Demand Projections for 2010

The regression analysis revealed declining real price trends for poultry meat (1.3 percent annually) red meat (0.044 percent), and eggs (3.6 percent) annually. However, historical per capita GDP showed a rising trend of 2.2 percent per year in real terms between 1965 and 1999. Egypt's GDP is projected to increase at least 5 percent annually over the next 10 years [44]. With a 1.8-percent expected population growth rate during 2000-2010, per capita GDP will grow at a net rate of about 3.2 percent per year. Since the early 1990s, production efficiency has gained importance in the transition of the Egyptian economy toward a free-market orientation. Consequently, to forecast the levels of per capita consumption for poultry meat and eggs through 2010, three scenarios incorporating trends in meat prices and in per capita GDP noted above are proposed:

1. Scenario I is a time-trend projection assuming historical domestic prices and per capita GDP growth of 2.2 percent annually and the continuation of current feed requirements, technical production methods, and management practices.

2. Scenario II assumes a 3.2-percent per capita GDP growth rate, or approximately the rate of annual GDP forecast through 2010. It also assumes the continuation of current feed requirements, technical production methods, and management practices as in scenario I.

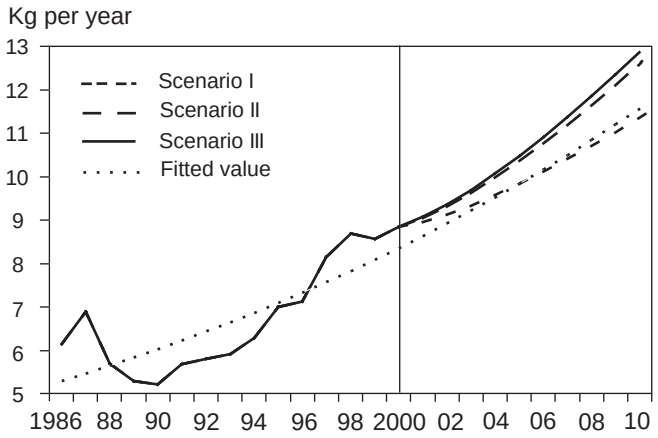
3. Scenario III assumes poultry meat and egg prices decline at an annual rate of 1 percent, due to improved management practices and feed efficiency, and increasing adoption of new technology, with the same price of substitutes, and the same per capita GDP, as in scenario II.

Projection Results

Results of the regression model show that demand for poultry meat will increase in the three scenarios during 2000-2010. In 2000, per capita poultry meat consumption was 8.9 kg, and is forecast to increase to 11.3 kg in scenario I, 12.6 kg in scenario II, and 12.9 kg in scenario III by 2010 (fig. 13). USDA's Agricultural Baseline Projections forecasts per capita poultry meat consumption for Egypt at 11.57 kg in 2010, which falls between scenario I and II [44]. Per capita poultry consumption is forecast to rise at an average rate of 4.2 percent per year in scenario I, 5.2 percent in scenario II, and 5.5 percent in scenario III. These growth

Figure 13

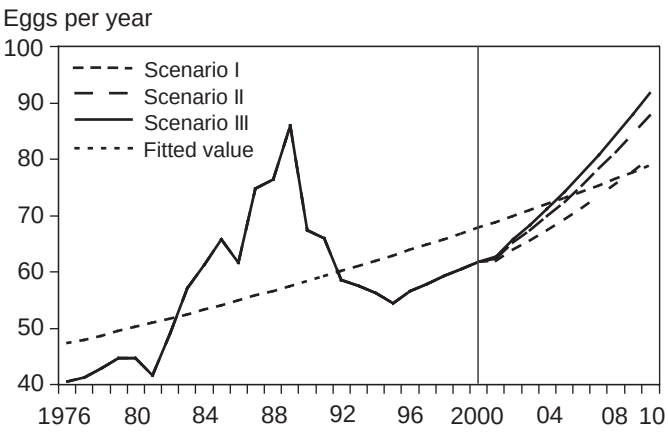
Egypt's per capita poultry meat consumption; 1986-2000 historical data, 2000-2010 forecast



Source: Economic Research Service/USDA.

Figure 14

Egypt's per capita egg consumption; 1976-2000 historical data, 2000-2010 forecast



Source: Economic Research Service/USDA.

rates are considered reasonable, although they are below the average annual rate of 7.6 percent achieved between 1990 and 2000.

Per capita egg consumption is forecast to reverse its yearly average decline of 0.6 percent during the 1990s to rise at an annual rate of 2.7, 3.6, and 4.1 percent under the three scenarios, respectively, by 2010. Per capita egg consumption is projected to rise from 62 eggs in 2000 to 80-92 eggs in the three scenarios in 2010 (fig. 14). Most of the increase will result from increasing numbers of egg layers, which is forecast to increase from 17.2 million birds in 2000 to 26.2 million in scenario I, 28.7 million in scenario II, and 30 million in scenario III (table 5). Egg projections could not be compared with the USDA Baseline because the latter does not include a per capita egg consumption forecast for Egypt.

Per capita consumption of poultry meat and eggs achieved during the 1990s are of great importance because they reflect the impact of government liberalization and economic reform in Egypt that began in 1986, and the sector's privatization in 1991. The end of government subsidies to poultry producers and the deregulation of feed prices constitute the most important variables regarding future policies and trends that most likely will be extended and continued through 2010.

These projections are sensitive to the uncertain outlook for the supply of feedgrains, oilseeds and meals (which are mostly imported), international prices, and the continuation of all government liberalization policies.

Live Poultry Projection to 2010

Forecasting per capita and total consumption of poultry meat and eggs is the starting point for projecting derived feed demand for poultry production. For Egypt to fill these forecast amounts through domestic production, feed must be provided for live birds, which will also be forecast. First, total live broilers, layers, and other poultry types that correspond or produce the total amount of poultry meat and eggs forecast in each of the above three scenarios are forecast. These calculations are based on average bird weight, given slaughter-dressing percentages, number of cycles per year, and adjustments for mortality rates throughout the lifespan in each poultry type per year. Simulation models are developed to estimate numbers of live birds by species in 2010 for each scenario, assuming that basic carcass characteristics and consumer preferences for average bird weight remain unchanged from the 2000 base year. Also, it is assumed that there will be no modification in the genetic composition of the current flocks. Simulation model projections based on these assumptions are shown in table 6. Results indicate that the total number of live poultry birds increases from a calculated 852 million birds in 2000 to 1.272 billion birds in 2010 in scenario I, 1.412 billion birds in scenario II, and 1.444 billion birds in scenario III.

Total numbers of commercial and Balady broilers are forecast to increase from a calculated 664 million birds in 2000 to 1.062 billion birds in 2010 in scenario I, to 1.18 billion birds in scenario II, and to 1.21 billion birds in scenario III. Other poultry, essentially ducks, geese, turkeys, and pigeons, are forecast to increase from 189 million in 2000 to 210 million in 2010 for

Table 5—Total number of egg-layers and their feed requirements, 1995-2010

	Egg-layers			Feed requirements		
	Scenario I	Scenario II	Scenario III	Scenario I	Scenario II	Scenario III
		Million birds			*1,000 tons*	
1995	13.8	13.8	13.8	473.4	473.4	473.4
1996	14.6	14.6	14.6	500.2	500.2	500.2
1997	15.2	15.2	15.2	521.7	521.7	521.7
1998	15.9	15.9	15.9	544.1	544.1	544.1
1999	16.5	16.5	16.5	566.3	566.3	566.3
2000	17.2	17.2	17.2	588.6	588.6	588.6
2001	17.5	17.6	17.7	599.4	604.7	606.9
2002	18.4	18.7	18.9	630.6	642.1	646.9
2003	19.1	19.7	19.9	656.1	674.1	683.4
2004	20.0	20.8	21.2	686.6	711.9	725.1
2005	21.0	21.9	22.4	718.3	751.3	769.1
2006	21.9	23.2	23.8	751.7	793.7	815.1
2007	22.9	24.4	25.2	785.6	836.9	862.5
2008	24.0	25.8	26.7	821.6	883.3	915.9
2009	25.1	27.2	28.3	860.1	932.9	971.4
2010	26.2	28.7	30.0	898.7	983.7	1,028.7

Source: Economic Research Service/USDA.

scenario I, to 234 million for scenario II, and to 239 million for scenario III.

For a more detailed forecast of the derived poultry sector demand for metabolizable energy and crude protein requirements, breeding stocks for both commercial and Balady operations should be included. Commercial broiler breeding stocks, estimated at 6.72 million birds in 2000, are forecast to increase to 11.44 million in scenario I, to 12.70 million in scenario II, and to nearly 13 million birds in scenario III in 2010 (table 7). Commercial layer breeding stocks, estimated at 0.44 million in 2000, are expected to grow to 0.68 million birds in scenario I, 0.74 million in scenario II, and to 0.78 million in scenario III in 2010. Likewise, breeding stocks of Balady broilers were 2.13 million in 2000, and are forecast to reach 2.64. 2.93, and nearly 3 million birds in the three scenarios, respectively, in 2010. No published data are available for Balady layer parents, but they are assumed to decline as the number of commercial layer parents increases by year 2010.

Forecasting Derived Feed Requirements

Forecast energy and protein requirements are derived for the total forecast live bird numbers estimated above. The forecast includes broiler and layer inventories as well as the breeding stock for both commercial and Balady operations. The procedure begins with a determination of required metabolizable energy (ME) and crude protein (CP) needed per bird during its lifespan (see box, "Feed Requirements"). A simulation model, based on fundamentals of physiology and nutrition sciences, was also used to calculate total ME and CP for individual poultry types. Quantity measures of ME and CP were converted to yellow corn and soybean meal, on a dry-matter basis, and then to actual tons of traded corn and meals using conversion factors and tables supplied by the National Research Council. This simulation model is superior to the usual approach of utilizing a feed-to-meat ratio, because results were extracted through experimental trials on individual poultry types [28].

Analysis of ME and CP requirements for Egypt's total poultry population shows that chickens have higher ME and CP requirements than any other species, followed by ducks, geese, and turkeys. Total aggregated metabolizable energy (ME) needed for Egypt's poultry live birds were estimated to increase from 10,330 million mcal[2] in 2000 to 15,593 million mcal in 2010 in scenario I, to 17,262 million mcal in scenario II, and to 17,729 million mcal in scenario III (table 8).

ME requirements are largely supplied by yellow corn and soybean meal, as well as minor items such as fish and meat meal and wheat bran. On a dry-matter basis[3], total poultry feed requirements will rise from 3.12 million tons in 2000 to 4.72 million tons, 5.22, and 5.36 million tons for the three scenarios, respectively, in 2010 (table 9). On an actual basis, yellow

[2] mcal=1 million calories, while kcal is kilocalorie, or 1,000 calories.

[3] Dry-matter basis is calculated on zero moisture content, while actual basis includes the moisture normally found in feeds.

Feed Requirements

Feed diet modeling is based on the concept that poultry receive energy needs from daily feed consumption, assuming that the diet is adequate in essential nutrient requirements, including amino acids, vitamins, and both macro- and micro-minerals. In Egypt, yellow corn contributes most of the carbohydrates to poultry diets, while soybean meal, meat meal, or fish-meal provides total protein and amino acids. Protein and amino acid requirements vary considerably according to a bird's growth rate, body size, and egg production, which in turn are determined by genetics. In addition, daily feed rations differ depending on the age and activity of the bird (growing, laying, or breeding). Poultry go through several stages of growth, each with different feed requirements. Therefore, dietary requirements for chickens vary according to whether the birds are broilers being started and grown for market, broiler breeder pullets and hens, broiler males, or layers for egg production.

Poultry in backyard operations are not fed soybean meal and yellow corn on a regular basis as is the case in commercial operations. Instead, a substantial amount of backyard feeds consist of white corn, sorghum, wheat and rice brans, low-quality barley, wheat grains, and broad beans that are not considered suitable for human consumption. Also, the exact formulations of feed ingredients used in backyard operations are not known, changing considerably according to harvesting seasons and market availability.

The procedure begins with a determination of required metabolizable energy (ME) and crude protein (CP) needed per bird during its lifespan. These are calculated from the daily ME and CP requirements for each bird type and are based on National Research Council (NRC) formulas [28]. For example, broilers are usually allowed to feed under the *ad libitum* feed system (eat all they want) that ensures rapid development to market size. During their life cycle, body weights of commercial meat-type chickens usually increase 50-55 fold by 7 weeks after hatching.

In Egypt, broilers are raised to a preferred live body weight of 1.6 to 1.65 kilograms (kg) for marketing. To reach this desired weight, a cumulative energy consumption of 11,900 ME kcal (kcal=1,000 calories) per bird with a 20 percent CP content is required. These ME and CP requirements are satisfied with typical corn-soybean-meal based feeds composed of 68-72 percent yellow corn, 18-21 percent soybean meal, and other ingredients, such as fish or meat meals, minerals, vitamins, medicines, etc [28]. One kg of this mixture usually provides 3,200 kcal and 0.20 kg of CP. This implies that a total intake of about 3.8 kg of such feed is required for the lifespan of a broiler. Total ME and CP values were also calculated for ducks, geese, and turkeys over their whole lifespan and converted to actual amounts of yellow corn and soybean meal feeds. From a base year, demand for total feedstuffs is finally calculated, according to the forecast numbers of live broilers and layers and the breeding stocks of broilers and layers, as well as the number of eggs per hen per year in each of the three proposed scenarios.

The derived feed demand is developed by aggregating the chemical composition of each feed item to cover a bird's total ME and CP daily nutritional requirements over its lifespan. ME value and CP contents of individual feedstuffs are obtained from Egyptian feed composition tables [25], which are generally comparable to those available in the United States/Canadian tables [28]. Egypt's feed manufacturing mills produce poultry feed mix consisting of 70 percent yellow corn, 19.4 percent soybean meal, 3.4 percent wheat bran, and 1.9 percent broiler concentrates (fish or meat meals). The remainder includes different additives including minerals, vitamins, vaccines, medicines, etc. [12]. Some Egyptian publications estimate that poultry rations include 68-72 percent corn, and 18-21 percent soybean meal [41, 46]. Publications by the National Research Council recommend a similar feed mix for different poultry age groups, including starter, grower, finisher, and breeders, especially in the commercial operations [28]. Egg-layers use a similar formulation with more minerals, particularly calcium and phosphorus.

In some cases, large commercial operations mix their own feeds, substituting certain ingredients depending on availability and price to obtain a least-cost formulation. However, with trade liberalization and unrestricted feedstuff imports beginning in the early 1990s, formulation of poultry feed has been increasingly established around the mix described above. These percentage rates are used in converting the estimated ME and CP to equivalent corn and soybean meal on a dry-matter basis, then adjusted for actual equivalence (as fed to poultry) after accounting for the moisture content normally found in Egypt's corn and soybean meal.

Table 6—Forecast annual number of live birds by poultry type, 2000-2010

	Chickens		Others				
	Commercial	Balady	Ducks	Geese	Turkeys	Pigeons	Total poultry
			Million birds				
Scenario I							
2000	519	145	69	70	16	35	852
2001	542	145	70	69	15	35	877
2002	567	148	70	71	16	35	907
2003	597	151	71	72	16	36	942
2004	631	155	72	73	16	36	983
2005	667	159	73	74	16	37	1,026
2006	706	163	73	74	17	37	1,071
2007	748	167	74	75	17	38	1,119
2008	790	171	75	76	17	38	1,167
2009	835	175	76	77	17	39	1,219
2010	883	179	77	77	17	39	1,272
Scenario II							
2000	519	145	69	70	16	35	852
2001	547	147	70	70	16	35	886
2002	579	151	72	72	16	36	926
2003	616	156	73	74	16	37	972
2004	657	161	75	76	17	38	1,024
2005	703	168	77	77	17	39	1,081
2006	752	174	78	79	18	40	1,140
2007	803	180	80	81	18	41	1,202
2008	859	186	82	82	18	42	1,269
2009	918	192	83	84	19	43	1,339
2010	980	198	85	86	19	43	1,412
Scenario III							
2000	519	145	69	70	16	35	852
2001	549	147	71	70	16	35	888
2002	581	152	72	72	16	36	930
2003	620	157	74	74	17	37	979
2004	663	163	76	76	17	38	1,034
2005	711	170	77	78	17	39	1,093
2006	762	176	79	80	18	40	1,155
2007	816	183	81	82	18	41	1,221
2008	874	189	83	84	19	42	1,291
2009	936	196	85	86	19	43	1,366
2010	1,003	203	87	88	20	44	1,444

Source: Economic Research Service/USDA

corn requirements are forecast to increase from 2.46 million tons in 2000 to 3.71 million tons in scenario I, to 4.11 million tons in scenario II, and to 4.22 million tons in scenario III by 2010.

Soybean meal requirements are forecast to increase from 667,000 tons in 2000 to 1.01, to 1.12, and to 1.15 million tons, respectively, in the three scenarios in 2010 (table 10).

Sensitivity Testing of Feed Requirement Forecasts

To evaluate the reasonableness of these feed requirement forecasts, the feed-to-meat conversion rate for Egypt's commercial operations was calculated, from forecast feed requirements and forecast commercial poultry production, to equal a 2.59 feed-to-meat ratio. This result is comparable to that of a previous study undertaken in Egypt, which estimated the rate at 2.65 [9]. Also, it is comparable with another estimate's range of between 2.4 and 2.5 for commercial broilers [42]. Most recently, the feed conversion rate for poultry in Egypt was reported at 2.5 [45]. These citations indicate that this study's projections are comparable with previous studies and consistent with expectations. Currently, the feed-to-meat conversion rate in the United States is estimated between 1.9 and 2.0, which indicates the U.S. sector's scale of efficiency compared with Egypt's poultry industry.

Table 7—Parent stocks of commercial and Balady broiler and commercial layers, 1995-2010

Year	Commercial broiler parents			Balady broiler parents			Commercial layer parents		
	Scenario I	Scenario II	Scenario III	Scenario I	Scenario II	Scenario III	Scenario I	Scenario II	Scenario III
					Million birds				
1995	4.91	4.91	4.91	1.68	1.68	1.68	0.36	0.36	0.36
1996	5.12	5.12	5.12	1.66	1.66	1.66	0.38	0.38	0.38
1997	5.60	5.60	5.60	1.99	1.99	1.99	0.39	0.39	0.39
1998	6.26	6.26	6.26	2.11	2.11	2.11	0.41	0.41	0.41
1999	6.25	6.25	6.25	2.10	2.10	2.10	0.43	0.43	0.43
2000	6.72	6.72	6.72	2.13	2.13	2.13	0.44	0.44	0.44
2001	7.02	7.09	7.11	2.15	2.17	2.17	0.45	0.46	0.46
2002	7.34	7.50	7.53	2.18	2.22	2.23	0.48	0.48	0.49
2003	7.73	7.97	8.03	2.23	2.30	2.31	0.49	0.51	0.52
2004	8.17	8.51	8.59	2.28	2.38	2.40	0.52	0.54	0.55
2005	8.64	9.11	9.21	2.35	2.47	2.50	0.54	0.57	0.58
2006	9.14	9.74	9.87	2.40	2.56	2.59	0.57	0.60	0.61
2007	9.68	10.41	10.57	2.47	2.65	2.69	0.59	0.63	0.65
2008	10.23	11.12	11.32	2.52	2.74	2.79	0.62	0.67	0.69
2009	10.82	11.88	12.12	2.58	2.84	2.89	0.65	0.70	0.73
2010	11.44	12.70	12.98	2.64	2.93	2.99	0.68	0.74	0.78

Source: Economic Research Service/USDA

Table 8—Forecast feed sources of ME requirements (dry-matter basis) for Egypt's poultry sector, 2000-2010

Year	Total feed requirements			ME from yellow corn			ME from soya meals			ME from other feeds*			Total ME requirements		
	Scenario			Scenario			Scenario			Scenario			Scenario		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
	1,000 tons			*1,000 tons*			*1,000 tons*			*1,000 tons*			*Million Mcal*		
2000	3,124	3,124	3,124	2,187	2,187	2,187	625	625	625	312	312	312	10,330	10,330	10,330
2001	3,207	3,240	3,248	2,245	2,268	2,274	641	648	650	321	324	325	10,605	10,713	10,740
2002	3,327	3,395	3,413	2,329	2,377	2,389	665	679	683	333	340	341	11,001	11,227	11,283
2003	3,461	3,569	3,597	2,423	2,498	2,518	692	714	719	346	357	360	11,445	11,799	11,895
2004	3,615	3,765	3,806	2,531	2,636	2,664	723	753	761	362	377	381	11,953	12,449	12,584
2005	3,781	3,978	4,032	2,647	2,784	2,822	756	796	806	378	398	403	12,501	13,153	13,332
2006	3,952	4,201	4,269	2,767	2,941	2,988	790	840	854	395	420	427	13,068	13,890	14,114
2007	4,134	4,436	4,519	2,894	3,105	3,163	827	887	904	413	444	452	13,671	14,668	14,941
2008	4,318	4,684	4,785	3,023	3,279	3,350	864	937	957	432	468	479	14,277	15,487	15,823
2009	4,514	4,946	5,067	3,160	3,462	3,547	903	989	1,013	451	495	507	14,925	16,355	16,753
2010	4,716	5,221	5,362	3,301	3,654	3,753	943	1,044	1,072	472	522	536	15,593	17,262	17,729

* Other feeds include fish meal, meat meal, and wheat brans.

Source: Economic Research Service/USDA

Table 9—Forecast total feed requirements (dry-matter basis) for broilers, layers, parents, and grandparents, 2000-2010

Year	Feed requirements for poultry meat			Feed requirements for egg-layers			Feed requirement for paretns & grandparents (broilers & layers)			Total poultry feed requirements (meat, layers, parents, and grandparents)		
	Scenario			Scenario			Scenario			Scenario		
	I	II	III	I	II	III	I	II	III	I	II	III
	1,000 tons											
2000	1,979	1,979	1,979	589	589	589	557	557	557	3,124	3,124	3,124
2001	2,035	2,056	2,061	599	605	607	573	579	580	3,207	3,240	3,248
2002	2,103	2,148	2,157	631	642	647	593	606	608	3,327	3,395	3,413
2003	2,188	2,257	2,273	656	674	683	617	637	641	3,461	3,569	3,597
2004	2,284	2,381	2,402	687	712	725	645	672	678	3,615	3,765	3,806
2005	2,388	2,516	2,545	718	751	769	674	710	718	3,781	3,978	4,032
2006	2,496	2,657	2,693	752	794	815	705	750	761	3,952	4,201	4,269
2007	2,611	2,807	2,851	786	837	863	738	793	805	4,134	4,436	4,519
2008	2,726	2,963	3,017	822	883	916	770	837	853	4,318	4,684	4,785
2009	2,848	3,129	3,192	860	933	971	805	885	903	4,514	4,946	5,067
2010	2,975	3,303	3,377	899	984	1,029	842	934	956	4,716	5,221	5,362

Source: Economic Research Service/USDA

Table 10—Forecast actual yellow corn and soybean meal requirements for Egypt's poultry sector, 1990-2010

Year	Yellow corn as fed-basis*			Soybean meals as fed-basis*		
	Scenario I	Scenario II	Scenario III	Scenario I	Scenario II	Scenario III
			1,000 tons			
2000	2,457	2,457	2,457	667	667	667
2001	2,523	2,548	2,555	685	692	693
2002	2,617	2,670	2,684	710	725	729
2003	2,722	2,807	2,829	739	762	768
2004	2,843	2,961	2,993	772	804	812
2005	2,974	3,129	3,171	807	849	861
2006	3,108	3,304	3,357	844	897	911
2007	3,252	3,489	3,554	883	947	965
2008	3,396	3,684	3,764	922	1,000	1,022
2009	3,550	3,890	3,985	964	1,056	1,082
2010	3,709	4,106	4,217	1,007	1,115	1,145

* Dry-matter basis is calculated on zero moisture content, while actual fed-basis includes the moisture normally found in feeds.

Source: Economic Research Service/USDA

Egypt's Production of Coarse Grains, Oilseeds, and Oilseed Meals

Coarse Grain Production Expands

Egypt's total coarse grain production, including corn, sorghum, barley, and rye, increased from 3.98 million tons in 1980 to 5.59 million tons in 1990 and to 7.54 million tons in 2000 (fig.15). Corn production grew from 4.80 million tons in 1990 to 6.47 million tons in 2000, accounting for 85.9 percent of Egypt's total coarse grain production (table 11). Ninety-seven percent of Egypt's corn production consisted of white corn, which is less preferred for poultry feed than yellow corn. In 1973, yellow corn was imported for the first time into Egypt and paid for by the government in foreign exchange. This marked the true start of the poultry industry in Egypt. Imported yellow corn was then distributed mainly to a few public sector poultry companies at heavily subsidized prices. White corn was largely produced for human consumption, but increasing incomes have spurred a shift away from white corn to wheat and rice. Consequently, there has been a substantial increase in the proportion of white corn fed to livestock. During the 1990s, unofficial estimates indicate that the share of corn used as feed increased from 53 to 79 percent of total corn supplies [9, 11, 18, and 25].

Sorghum production, ranked second, increased from 629,600 tons in 1990 to 941,200 tons in 2000. However, barley production, the third-ranking coarse grain crop, decreased from 142,000 to 99,400 tons during the 1990-2000 period. Sorghum and barley continue to be mostly fed to animals. Rye production, new in Egypt, rose from 16,500 tons in 1990 to 26,000 tons in 2000.

Oilseed Production Shrinks

Despite strong demand for oilseeds in Egypt, production actually decreased from 996,600 tons in 1990 to 636,800 in 2000, falling at a rate of 4.23 percent annually over the 1990s. In 2000, over 89 percent of oilseed output consisted of cottonseed, 4.7 percent linseed, 4.3 percent sunflower seed, and only 1.7 percent soybeans. Over the 1980s and 1990s, cottonseed production declined sharply, due mainly to substitution of other field crops for cotton (fig. 16a). Likewise, Egypt's production of sunflower seed dropped from 30,900 to 27,500 tons over the 1990s, due to inefficient crushing facilities. However, the largest decrease of all oilseed production was in soybeans, which plummeted by over 90 percent to only 10,500 tons, an annual decline of 19 percent during the 1990s.

Farmers consider current soybean yields too low to compete with other crops for the use of land [6]. Soybeans were introduced into Egypt in 1972 and first planted on 1,193 hectares (ha) with yields averaging only 1.136 tons/ha. Cultivated acreage increased steadily to a maximum of 61,000 ha in 1983 and yields more than doubled. In 2000, Egypt's soybean yield of 2.72 tons/ha (due to irrigation) was much higher than the world average of 2.18 tons/ha. It was also slightly higher than yields in the United States (2.56 tons/ha), Argentina (2.34 tons/ha), Brazil (2.4 tons/ha), and Canada (2.55 tons/ha), but lower than the EU (3.27 tons/ha) [42].

Oilseed Meal Production Rebounding

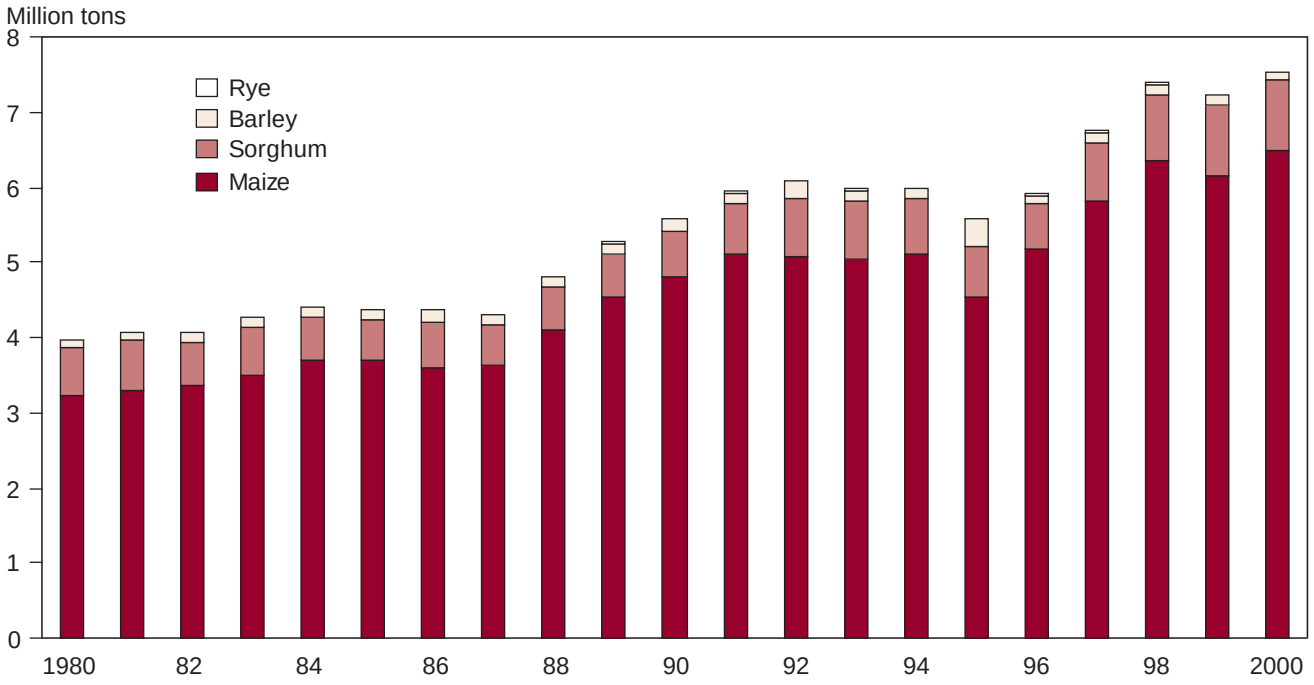
Total production of oilseed meals decreased sharply from 503,300 tons in 1980 to 271,300 tons in 1990, but then increased to 354,000 tons in 2000 (fig.16b). Production of cottonseed meal has ranked first in Egypt for many decades simply because it was a byproduct of cotton, Egypt's largest export crop. However, following the liberalization of cropland allocation and price policies, the area planted to cotton decreased sharply, as did cottonseed and meal production. Cottonseed meal production decreased from 422,000 tons in 1980 to 109,600 tons in 2000 and its share dropped from 74 percent to only 31 percent of Egypt's total oilseed meal production. The decrease in production of cottonseed meal, used to feed large and small farm animals, caused severe shortages in the availability of meal in Egypt and resulted in rising demand for soybean meal as a substitute.

During 1980-2000, demand for soybean meal was greater than all other oilseed meals in Egypt, prompting an increase in milling from 70,400 tons to 174,400 tons. Expansion of commercial poultry operations increased the demand for soybean meal, which was first imported. Import substitution rose with the establishment of private soybean-crushing facilities that depend mostly on soybean imports. In 1999, for the first time, soybean meal production exceeded cottonseed meal in Egypt. Soybean meal prices are much higher than cottonseed meal, because only soybean meals are suitable for feeding poultry stocks.

Egypt's other meal production came from linseeds, which made up nearly 8.3 percent of total production in 2000, and sunflower meal (3 percent) (table 11).

Figure 15

Egypt's total production of coarse grains, 1980-2000



Source: Economic Research Service/USDA.

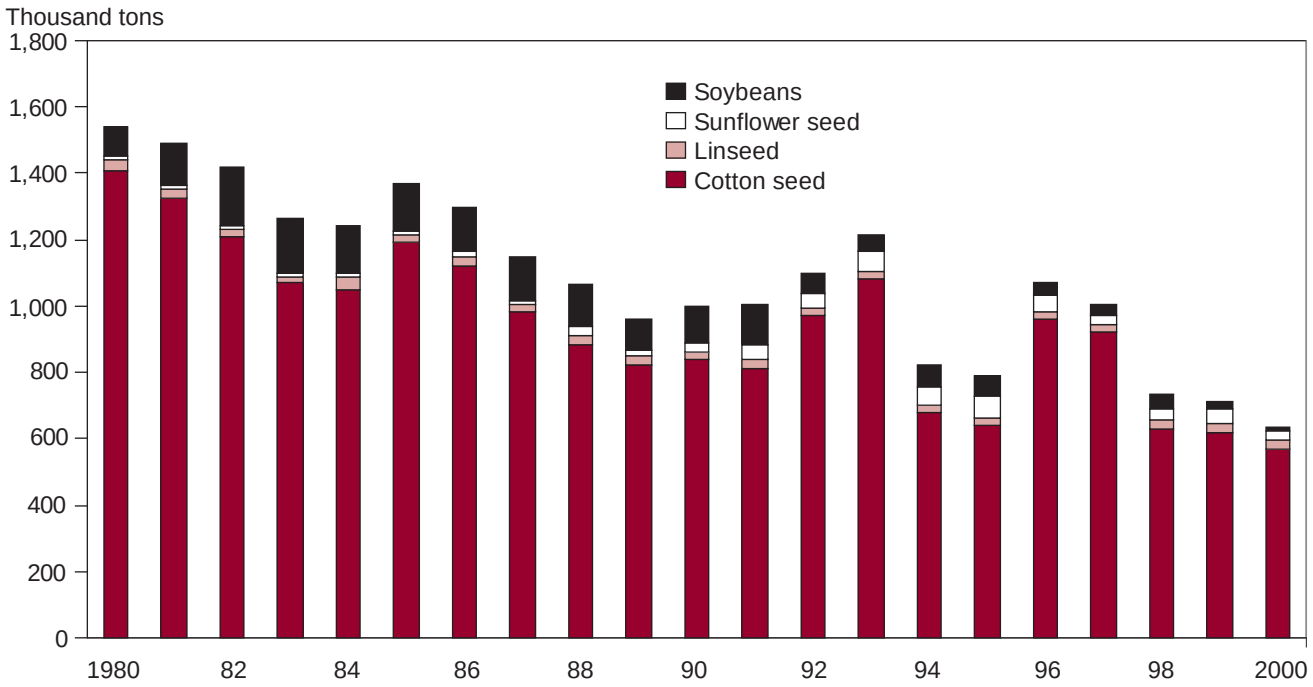
Table 11—Egypt's coarse grain, oilseeds, oilseed meal production, and annual growth rates,1980-2000

	Production			Production share	Annual growth rate	
Commodity	1980	1990	2000	in 2000	1980s	1990s
	1,000 tons				*Percent*	
Coarse grains						
Barley	107	142	99.4	1.3	2.67	-3.25
Corn	3,231.1	4,798.6	6,474.5	85.9	3.52	2.90
Rye	0	16.5	26.0	0.3	0.31	6.17
Sorghum	643	629.6	941.2	12.5	-0.68	3.32
Total coarse grains	3,981.0	5,586.8	7,541.0	100	2.95	2.83
Oilseeds						
Seed cotton	1,408.30	838	568.8	89.3	-5.07	-3.95
Linseed	34.0	21.0	30.0	4.7	-0.65	2.72
Soybeans	92.4	106.7	10.5	1.7	-1.92	-18.99
Sunflower seed	9.2	30.9	27.5	4.3	10.73	-2.64
Total oilseeds	1,543.9	996.6	636.8	100	-4.44	-4.23
Oilseed meals						
Cottonseed meal	422	172.7	109.6	31.0	-9.89	-4.02
Linseed meal	7.6	13.2	29.5	8.3	5.62	7.00
Soybean meal	70.4	72	174.4	49.3	3.66	8.58
Sunflower meal	3.3	13.4	10.5	3.0	11.51	-3.61
Others	0	0	30.0	8.5	0	1.20
Total oilseed meals	503.3	271.3	354	100	-5.77	2.13
Total	6,028.2	6,854.7	8,531.8			

Source: FAO Data, http://faostat.fao.org/August 2002

Figure 16a

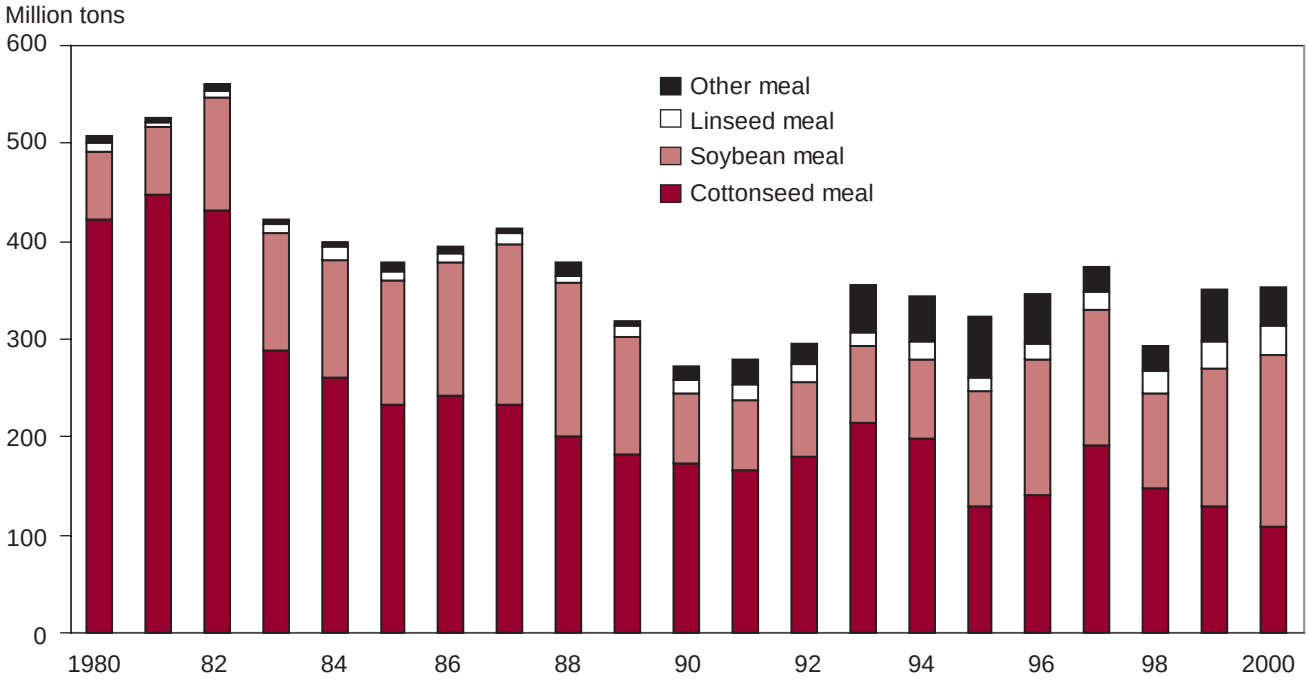
Egypt's total oilseed production, 1980-2000



Source: Economic Research Service/USDA.

Figure 16b

Egypt's total production of oilseed meals, 1980-2000



Source: Economic Research Service/USDA.

Egypt's Imports of Coarse Grains, Oilseeds, and Oilseed Meals

A close look at Egypt's feed availability and nutritional requirements reveal substantial supply shortages of major feed items, especially those providing high energy and crude protein. During 1989-2000, Egypt's total feedstuff imports rose from 1.71 million tons to 6.66 million tons—from $270.5 million to $797.8 million in nominal value terms (table 12). In volume terms, 92-95 percent of total feed imports were classified under three categories: coarse grains, oilseeds, and oilseed meals (table 13). Of this total, 76 percent were coarse grains, 16 percent oilseed meals, and 3.5 percent oilseeds in 2000 (fig.17).

Coarse Grain Imports Rise Steadily

Coarse grains constituted the largest share of Egypt's total feedstuff imports, increasing from 1.39 million tons in 1989 to 5.05 million in 2000. Imports of yellow corn were the largest, fluctuating between 98 and 100 percent of total coarse grain imports during 1989-2000. The remaining 2 percent included barley, sorghum, and rye. Yellow corn imports rose from 1.36 million tons in 1989 to 5 million tons in 2000, ranking Egypt as the world's fourth-largest corn market, after Japan, Mexico, and Taiwan. Egypt imports corn mainly from the United States and Argentina. However, due to its high quality, U.S. corn dominated in all years from 1989 to 2000, ranging from a maximum of 92 percent in 1990 to a minimum of 60 percent in 1998 of all corn imported by Egypt. In 2000, the United States was the largest exporter of yellow corn to Egypt, accounting for 76 percent of total Egyptian imports (table 14). According to the most recent data, exports of U.S. yellow corn to Egypt nearly quadrupled from 1.07 million tons in 1989 to 4.2 million tons in 2001 [43].

Oilseed Imports Grow Rapidly

Egypt's total oilseed imports rose from 38,400 tons in 1989 to 235,000 tons in 2000, growing at 29.7 percent annually. In 1989, all of Egypt's oilseed imports were soybeans. This share decreased to 83 percent in 2000, with other oilseed imports including 27,400 tons of linseed and 5,570 tons of sunflower seed. In 1989, all of Egypt's soybean imports were shipped from the United States. However, due to competition from Argentina, U.S. shipments declined to 50 percent in 1993, and 21 percent in 1998, but increased steadily to 70 percent in 2000 [11]. U.S. soybean prices are usually competitive during August-January, while Southern Hemisphere suppliers, such as Argentina and Brazil, are more competitive during February-July.

Rapid growth in soybean imports (over fivefold) was mainly due to the recent development of crushing capacity in the private sector. Due to a lack of crushing facilities, Egypt tended to import soybean meals ready for feeding, a situation that will change after the completion of two new private crushing facilities in Alexandria and in Damiatta, which will depend totally on imports. The two plants are under construction but have run into substantial delays and are not expected to become operational in the near future [11].

In 2000, Egypt imported small amounts of linseed (27,400 tons) from Canada and sunflower seed (5,400 tons) from the Russian Federation.

Oilseed Meal Imports Grow Strongly

Egypt's total oilseed meal imports rose from 189,300 tons in 1989 to 1,025,000 tons in 2000, an annual growth rate of 15.2 percent. These imports were composed totally of soybean meal, except in 1996, when Egypt's total oilseed meal imports were 84 percent soybean meal and 11 percent sunflower. Most of the rest was cottonseed meal. In 1989 and 1990, the United States was the largest exporter of soybean meal to Egypt, accounting for 86 and 74 percent of total imports, respectively. However, this share declined sharply to 24 percent in 2000, due to competition from Argentina and Brazil. In 1991, Argentina entered the market for the first time, taking a 34-percent market share, ranking second after the U.S. share of 45 percent, and exceeding Brazil's 21-percent share. Argentina's share increased to 76 percent in 2000, while the U.S. share was 24 percent, and Brazil's was only 0.5 percent.

Egypt's imports of sunflower meal were erratic, fluctuating from 1,000 tons from Greece in 1992, 4,000 tons from the United States in 1995, and 4,000 tons from Romania in 1998, to 62,300 tons from Argentina in 1996, and 18,100 tons from Argentina in 2000. Other oilseed meal imported into Egypt included 23,800 tons of cottonseed meal from China in 2000.

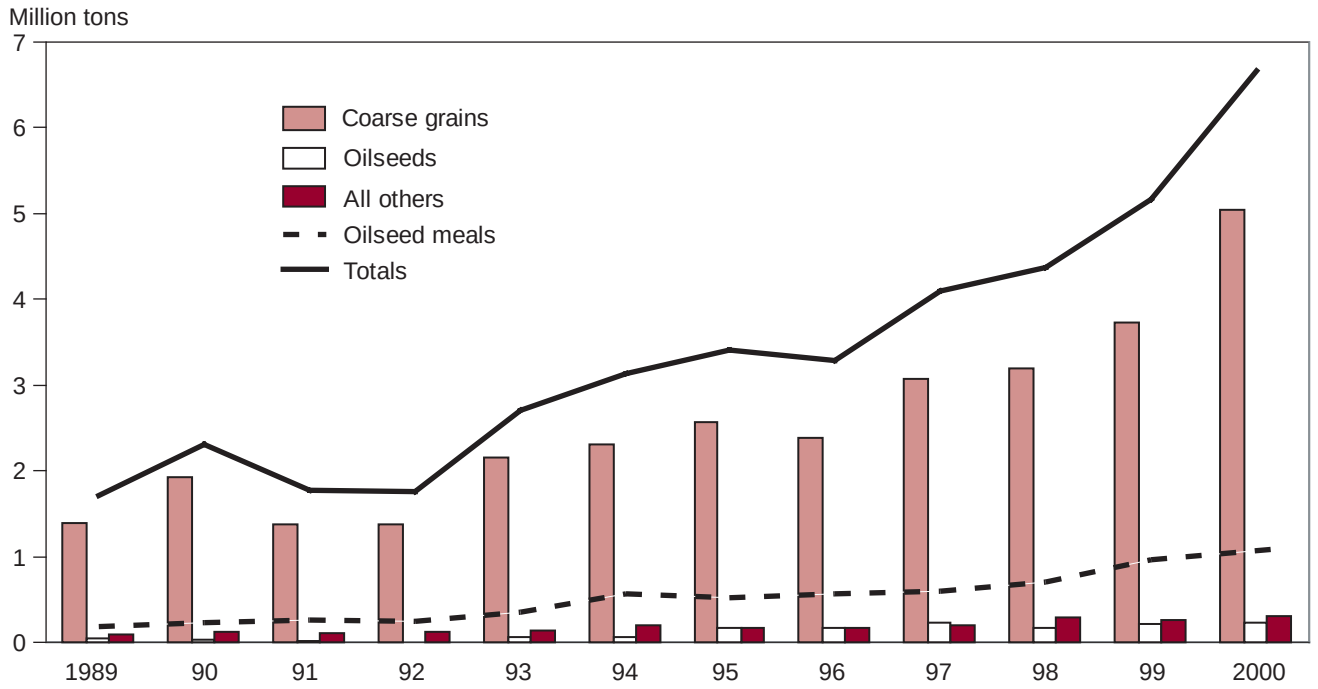
Table 12—Egypt's imports of feedstuffs from the world by value, 1989-2000

Commodity - (SITC code)	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
						Million $						
Coarse grains (0430-04729)	169.0	217.1	146.4	144.7	230.9	247.8	304.7	383.7	366.6	324.4	347.5	459.5
Oilcakes (01831-08139)	46.9	44.0	47.7	44.5	66.6	101.9	82.3	125.7	159.4	113.5	133.9	188.0
Oilseeds (2222-2237)	12.3	11.6	4.9	2.2	19.6	17.1	62.7	54.4	82.0	67.7	55.8	49.4
Prepared animal food,nes. (08199)	31.4	32.5	28.8	29.8	30.0	35.9	39.3	35.3	38.3	56.7	34.4	43.2
Flr. etc .meat, off. an. feed (08141)	7.6	7.3	8.3	11.3	12.2	16.9	18.4	21.5	25.3	34.9	14.6	19.5
Residue, mfg.starch (08151)	0.8	2.3	0	0.8	0	0	0	1.8	0	5.1	4.5	16.5
Flr. etc. fish, animal feed (08142)	2.4	2.3	3.2	2.6	3.7	4.5	3.8	5.3	4.3	9.8	23.7	15.4
Fodder roots, forage,etc. (08113)	0.3	0.3	0.5	1.1	1.8	0.1	0.2	0.3	0.6	0.7	1.9	3.4
Brans (8123-8126)	0	0	0	0.1	0	3.4	0	0	2	2.4	5.6	2.9
Lucerne (alfalfa) (08112)	0	0	0	0	0.4	0.3	0	0	0	0.5	0	0.1
Cereal straw, husks, unprd. (08111)	0	0	0	0	0	0	0	0	0	0	0.1	0
Vegetable residues etc. (08119)	0	0	0	0.5	0	0	0	0	0.1	0	0	0
All others	42.4	44.8	40.9	46.2	48.1	61.2	61.7	64.2	70.7	110.2	84.9	100.9
Totals	270.5	317.5	239.9	237.6	365.3	428.0	511.4	628.1	678.7	615.7	622.2	797.8
Total coarse grains,oilseeds, and meals	228.1	272.7	199.1	191.4	317.1	366.8	449.7	563.8	607.9	505.5	537.2	696.9
						Percent						
Share of coarse-grains, oilseeds, and meals	84.3	85.9	83.0	80.6	86.8	85.7	87.9	89.8	89.6	82.1	86.3	87.4

Source: United Nations Statistics Division, Website http://intranetapps.fas.usda.gov/untrade/June 2002

Figure 17

Egypt's total feed imports, 1989-2000



Source: Economic Research Service/USDA.

Table 13—Egypt's imports of feedstuffs from the world by volume, 1989-2000

Commodity - (SITC code)	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
						1,000 tons						
Coarse grains (04730-04729)	1,388.2	1,928.7	1,380.9	1,382.0	2,157.7	2,308.3	2,561.5	2,387.4	3,070.3	3,192.7	3,732.1	5,050.5
Oilcakes (01831-08139)	189.3	230.4	263.1	242.2	348.6	562.3	512.3	563.6	595.8	704.7	958.9	1,067.20
Oilseeds (2222-2237)	38.4	29.7	18.9	0.9	66.2	65.7	166.9	167.1	234.7	174.7	217.8	235.0
Prepared animal food, nes. (08199)	68.7	75.0	75.7	78.5	77.9	92.1	94.7	82.0	88.1	123.4	80.4	103.0
Flr. etc. meat, off. an. feed (08141)	18.9	23.3	26.9	35.9	40.4	53.9	59.7	65.9	72.7	97.5	53.6	63.3
Residue, mfg. starch (08151)	2.5	21.1	0	2.7	0	0	0	5.2	0	15.2	20.5	57.7
Brans (8123-8126)	0	0	0	1.2	0	39.1	0.1	0	24.0	38.8	56.5	40.9
Flr. etc. fish, animal feed (08142)	4.4	4.4	5.7	4.2	6.4	8.6	6.5	7.9	6.3	13.3	41.9	29.7
Fodder roots, forage,etc (08113)	1.1	1.3	1.9	3.8	8.1	0.4	0.7	1.0	3.2	2.6	6.5	16.0
Lucerne (alfalfa) (08112)	0	0	0	0	1.4	0.9	0	0	0	2.4	0	0.4
Cereal straw, husks, unprd. (08111)	0	0	0	0	0	0	0	0	0	0	1.5	0
Vegetable residues etc. (08119)	0	0	0	3.1	0	0.2	0.2	0.1	0.2	0.3	0	0
All other feedstuffs	95.6	125.1	110.2	129.4	134.3	195.3	161.8	162.2	194.5	293.5	261.0	311.0
Totals	1,711.5	2,313.9	1,773.1	1,754.5	2,706.8	3,131.6	3,402.5	3,280.3	4,095.3	4,365.7	5,169.8	6,663.7
Total coarse grains, oilseeds, and meals	1,615.9	2,188.8	1,662.9	1,625.1	2,572.5	2,936.3	3,240.7	3,118.1	3,900.8	4,072.2	4,908.8	6,352.7
						Percent						
Share of coarse grains, oilseeds, and meals	94.4	94.6	93.8	92.6	95.0	93.8	95.2	95.1	95.3	93.3	95.0	95.3

Source: United Nations Statistics Division, Website http://intranetapps.fas.usda.gov/untrade/June 2002

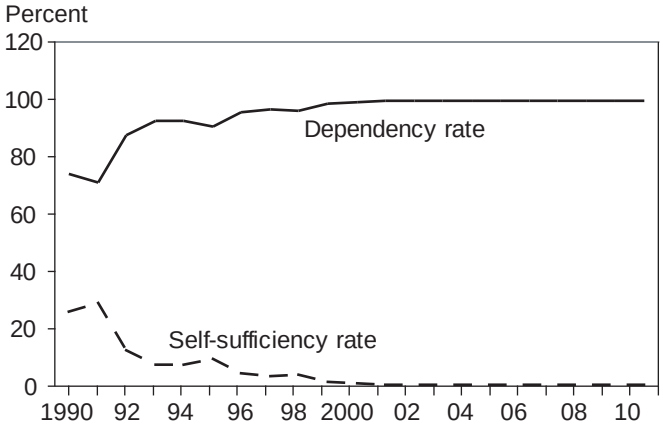
Egypt's Dependency on Feed Imports Rising

This report's assessment of Egypt's increasing dependence on world markets during the 1990s focuses only on yellow corn, soybeans, and soybean meals. Egypt imports both soybeans and soybean meal. Almost all soybean imports are crushed to produce soybean meal and soybean oil, and only a few thousand tons are used to produce other food items. Thus, meal is converted into soybean-equivalent so that both imports can be related to domestic production to measure import dependency rates. Measuring the dependency rate this way assumes constant stock levels and negligible export volumes, assumptions that are realistic for Egypt. Results shows that the soybean and meal equivalent import dependency rate has substantially increased from 74 percent in 1990 to 99 percent in 2000, indicating only a 1 percent self-sufficiency (SS) rate for Egypt (fig. 18a). This is mainly due to rapidly declining domestic production and increasing demand for soybean meals to expand domestic poultry and other livestock production. Using USDA's Baseline, Egypt's soybean-equivalent import dependency rate will continue to increase to an estimated 99.6 percent in 2010 (fig. 18a).

In the case of corn, Egypt's import dependency rate is much lower, 48.3 percent in 2000, but still substantially up from 29.7 percent in 1990. The corn dependency rate is forecast to rise to 50.1 percent in 2010 (fig. 18b).

Figure 18a

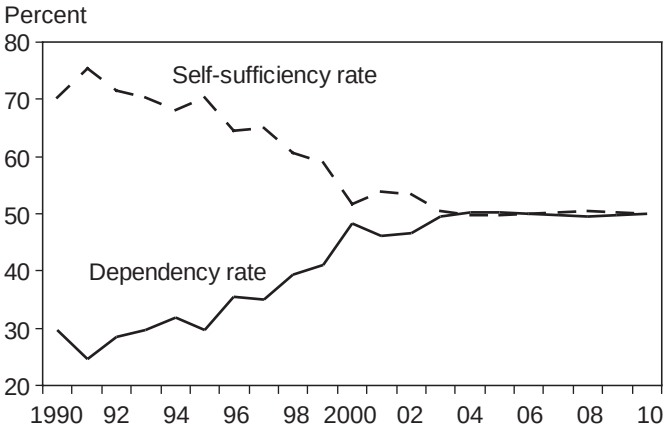
Egypt's soybean and meal equivalent dependency rate; 1990-2000 historical data, 2001-2010 forecast



Source: Economic Research Service/USDA.

Figure 18b

Egypt's corn import dependency rate; 1990-2000 historical data, 2001-2010 forecast



Source: Economic Research Service/USDA.

Table 14—Egypt imports of major poultry feeds from the world and the United States, 1989-2000

Year	Imports from the world			Imports from the United States			U.S. share of the Egyptian markets		
	Corn	Soybean meal	Soybeans	Corn	Soybean meal	Soybeans	Corn	Soybean meal	Soybeans
		1,000 tons			*1,000 tons*			*Percent*	
1989	1,358	189	38.5	1,067	162.9	38.4	79	86	100
1990	1,927	230	24.8	1,774	171.5	24.8	92	74	100
1991	1,260	263	0	1,072	118.6	0	85	45	0
1992	1,382	242	0	1,019	46.5	0	74	19	0
1993	2,147	348	63.0	1,909	120.6	31.5	89	35	50
1994	2,255	559	58.1	1,601	142.0	18.7	71	25	32
1995	2,511	509	107.4	2,267	147.3	77.7	90	29	72
1996	2,359	475	138.9	1,987	62.2	113.4	84	13	82
1997	3,059	596	121.6	2,167	162.9	52.1	71	27	43
1998	3,187	699	91.8	1,917	151.5	19.3	60	22	21
1999	3,731	959	174.8	3,092	102.0	100.5	83	11	57
2000	5,003	1,025	194.2	3,780	243.7	135.0	76	24	70
					Percent				
Annual growth rate	10.9	15.2	50.6	9.5	2.0	83.2	-1.4	-13.2	32.6
(t-value)	7.88	13.02	2.0	4.95	0.51	1.52	-1.37	-3.78	1.11

Source: United Nations Statistics Division, Website http://intranetapps.fas.usda.gov/untrade/June 2002.

Table 15—Egypt's soybean production, imports, and forecast poultry feed requirements, 2000-2010

	ERS Baseline forecast					Forecast derived soybean demand for meat and eggs		
	Soybeans		Soymeals		Total consumption	Scenario I	Scenario II	Scenario III
Year	Production	Imports	Imports	Soybean equivalent	(soybean-equivalent)	Soybean- equivalent		
				1,000 tons				
2000	16	334	1,040	1,316	1,666	889	889	889
2001	9.8	495.2	1,146	1,451	1,956	912	922	924
2002	8.4	595.2	1,335	1,690	2,294	946	966	971
2003	10.6	595.8	1,414	1,789	2,396	985	1,015	1,023
2004	10.4	620.8	1,460	1,847	2,479	1,028	1,071	1,083
2005	10.3	646.2	1,489	1,885	2,542	1,075	1,132	1,147
2006	10.3	669.7	1,508	1,909	2,589	1,124	1,195	1,214
2007	10.3	693.1	1,517	1,920	2,623	1,176	1,262	1,285
2008	10.3	715.2	1,532	1,939	2,664	1,228	1,332	1,361
2009	10.3	733.8	1,558	1,972	2,716	1,284	1,407	1,441
2010	10.3	752.2	1,573	1,991	2,753	1,341	1,485	1,525

Source: Production and import forecast data are quoted from ERS-Baseline (44).

Table 16—Egypt's corn production, imports, and forecast poultry feed requirments, 2000-2010

	ERS baseline forecast			Forecast		
Year	Production	Imports	Totals	Scenario I	Scenario II	Scenario III
			1,000 tons			
C2000	5,650	4,700	10,350	2,457	2,457	2,457
2001	5,638	5,100	10,738	2,523	2,548	2,555
2002	5,957	5,100	11,057	2,617	2,670	2,684
2003	6,106	5,133	11,239	2,722	2,807	2,829
2004	6,308	5,440	11,748	2,843	2,961	2,993
2005	6,432	5,735	12,167	2,974	3,129	3,171
2006	6,551	6,021	12,572	3,108	3,304	3,357
2007	6,642	6,405	13,047	3,252	3,489	3,554
2008	6,791	6,823	13,614	3,396	3,684	3,764
2009	6,912	7,212	14,124	3,550	3,890	3,985
2010	7,077	7,509	14,586	3,709	4,106	4,217

Source: FAO Data, http://faostat.fao.org/August 2002

Factors Affecting Prospects for Egypt's Poultry Sector

Productivity is low in Egypt's poultry sector and great advances could occur with improvement in management practices, feed efficiency, and the adoption of new technology to achieve higher productivity. These include modernization of feed manufacturing plants and improvement of feed rations. Efficiency could increase further with increased private sector adoption of advanced production techniques and management skills. Also crucial would be substitution of recognized breeds of broilers and egg-layers for Balady breeds, which would reduce the amount of feed per bird and increase the number of broiler cycles per year, improving the offtake rate. Offtake is the proportion of inventory that goes to slaughter each year. Higher offtake rates contribute to higher levels of efficiency and reduced production costs. For example, a commercial-breed broiler in Egypt needs about 50 days to reach a live weight of 1.63 kg, consuming 3.8 kg of feed (dry-matter basis). In contrast, a Balady broiler needs 120 days to reach the same weight and consumes 8.1 kg of feed. Risk-averse farmers prefer to raise Balady breeds because they are more resistant to heat and diseases than commercial birds, and farmers are ready to pay for extra feed as a premium. Consumers also pay a price premium (10-15 percent) for Balady chicken. Currently, the broiler offtake rate in Egypt is low compared with other countries, but could rise by 20-30 percent.

Another possibility for the Egyptian poultry sector to improve performance would be to increase the average weight per bird. Consumers currently prefer a carcass weight of slightly over 1 kg. However, since changes in consumers' tastes and preferences progress slowly, current slaughter weights for broilers and other poultry types are assumed unchanged over the forecast period. Yet, heavier birds produced over a shorter time period would provide a major vehicle for increasing sector performance.

Finally, at the same time the poultry industry is expanding, Egypt is becoming more dependent on imports of yellow corn, soybeans, and soybean meal from world markets. Import demand for these commodities is projected to strengthen in the future, based on the increase projected for per capita demand for poultry meats and eggs as a result of continued economic growth. Egypt's increasing dependence on world markets could represent a substantial burden on its trade balance in the future.

All corn imports are yellow corn, and domestic cultivation of yellow corn is not anticipated to expand substantially from its current share of 3 percent of total corn production to meet rising future demand. Development of new corn hybrids and cultivation of high-yield varieties cannot be assumed, despite the country's fertile soils and dependable irrigation systems.

Factors that could reduce feed requirements per pound of meat for Egypt's poultry include breeding programs to improve characteristics of the traditional Balady birds and replacing Balady operations with commercial operations using imported breeds. In addition, better managers with improved resources are the ones most likely to shift from Balady to commercial poultry meat and egg production. Historical trends indicate that this is gradually happening, but it could be accelerated by introducing commercial breeds that have been developed over many years in the United States and Europe. Use of this genetic stock would lead to higher efficiency and lower production costs, particularly as improvement translates to lower total metabolizable energy and crude protein requirements.

Egypt's limited arable land and pastureland created competition between food crops for human consumption and feedgrains, oilseeds, and green fodder for animal feeding. Domestic and trade policies, as well as resource constraints, affect the mix between domestic production and imports of either meat or the feedgrains required to produce it. From this perspective, Egypt presents an interesting example of the way in which these factors interact. The country's "Economic Opening Era" of the early 1980s led to significant poultry imports. Subsidies for domestic production led to falling poultry imports and rising domestic production, along with feedgrain imports. The phasing out of government consumer subsidies and price controls that started in the late 1980s, coupled with the privatization of the poultry industry beginning in 1991, fueled more efficient production and significantly increased imports of feedgrains and soymeal, but in an environment that offers producers substantial protection from competing imports. Now as Egypt—like many other middle-income countries—faces the potential challenge of greater liberalization under the WTO, the efficiency of its domestic poultry industry will be a topic of great interest to domestic consumers, producers, and exporters competing to sell either poultry products or intermediate inputs into this growing market. Currently, the country is a net food and feed

importer, as more than half of domestic food and feed consumption is imported. Egypt has become a large international buyer of agricultural commodities and the largest U.S. market in the Middle East, accounting for nearly a third of total U.S. agricultural exports to the Middle East/North Africa region in 2000. For years, U.S. grains dominated Egyptian imports of wheat and corn, with market shares ranging between 71 and 92 percent during the 1990s [43]. Most imports from the United States consist of foodgrains, feedgrains, oilseeds, oilseed meals, vegetable oils, and livestock products.

Implications for Other Countries

Worldwide, the poultry meat sector is growing faster than any other meat production sector. Especially in middle- and low-income countries, poultry is the meat most likely to fill the gap between supply and demand for animal protein at low prices. Consequently, poultry meat production is receiving great attention worldwide. What is happening in Egypt has implications for other countries, including, Algeria, Cyprus, Indonesia, Iran, Iraq, Israel, Jordan, the Republic of Korea, Lebanon, Libya, Mexico, Morocco, Oman, Saudi Arabia, countries of the South African Custom Union, Tunisia, the United Arab Emirates, and Yemen.

Rising Dependence on Feed Imports

Projections of Egypt's poultry and egg production and resulting feed requirements compared with domestic feed production show a rising dependence on feed imports during the 2000-2010 period. Rising dependence on feed imports will ultimately require a government decision to continue increasing imports to feed domestic poultry, or to lower high poultry meat import tariffs to allow more meat into the country, or both.

A government decision on the issue based on economic and welfare loss and gain considerations might benefit the lower income population. The vast majority of Egypt's population has a strong preference for live birds, slaughtered immediately at the point of sale, over frozen poultry meat. However, imports of frozen poultry would benefit a sizable population segment, mostly those in low-income brackets, who would purchase the less expensive frozen poultry. Although other countries may not have strong consumer preferences for live birds, they are faced with the policy decision of whether to foster feed imports or poultry meat imports.

Privatization Boosts Poultry and Egg Production

The end of feed production subsidies, liberalization of feed imports, and start of privatization in 1991 fostered private investments and technology development in Egypt's poultry sector. Backyard poultry and egg production has been gradually replaced by commercial operations that have rapidly adopted new technologies, improved feeding systems, and acquired new management skills. These changes spurred gains in physical productivity and economic efficiency and have led to expanding poultry production and lower prices. Consumers responded by expanding poultry meat purchases in an upward spiral, rising 113 percent from its pre-privatization level 10 years ago. Countries like Egypt, with unmet meat demand, can expect poultry industry expansion and modernization under similar policy scenarios.

Feed Industry Lagging

Modernization of feed manufacturing can improve feed production efficiency and reduce poultry production costs. Under governmental ownership and management, Egyptian feed mills operated on extremely rigid schedules, often resulting in short supplies of feedgrains and other ingredients. Also, government-run mills often replaced expensive ingredients with whatever was available, without consideration to nutritional value or price of the final products. After privatization, however, competition intensified between feed producers to improve the quality of feed rations and reduce production costs and prices.

Currently stalled, Egypt's feed industry could be revitalized in two major ways. First, there needs to be accelerated specialization and differentiation efforts in manufacturing processes to produce a nutritionally balanced feed-mix for various poultry types, ages, breeds, and broiler and egg production. Second, mills need to apply the principle of relative value analysis to develop highly nutritional least-cost formulations for standard recommended rations. Substitution among ingredients should be viewed in terms of price and nutritional value. For example, under different prices, the absolute advantage of sorghum, barley, or any other energy-supplying feed could shift, causing substitution for corn in feed mixes.

Unfortunately, information on daily feed prices is not available on a regular basis, and commodity futures markets do not exist in Egypt. If price information were available, and least-cost ration formulation technology was widely adopted, competition would result in lower feed prices.

WTO Impact on Egyptian Poultry Production

Egypt's poultry producers currently import feedstuffs to raise their growing flocks while high tariffs restrain meat imports. Although the poultry import ban was lifted in 1997 and replaced by an 80-percent import tariff, imports remained negligible (about 4,000 tons

per year). However, Egypt, as a WTO member, has to reduce and gradually eliminate all tariffs, opening up the market for imported poultry. Further reduction of import tariffs will increase imports of poultry meat and reduce feed imports.

Egypt will continue to be a lucrative world market for feeds, meat, or both. Traditionally, U.S. corn dominated Egypt's corn imports, due to its quality and prices, accounting for 75 percent of total corn imports in 2000. Likewise, U.S. soybeans were 63 percent of total soybean imports in 2000. If the market shifts to mea t imports in the future, Egypt will be a new market for U.S. poultry exporters, as it was during the 1970s and 1980s, despite competition from the EU, Brazil, and some Eastern European countries. Finally, full trade liberalization under WTO rules will most likely make the Egyptian market more lucrative for U.S. and other world exporters of feedstuffs and poultry meat. Liberalization will also intensify competition between domestic and world poultry producers, decreasing prices to consumers' advantage and benefit.

Applying the Methodology To Other Countries

The model represented here can provide an analytical basis to project derived feed demand for poultry and eggs using endogenous indicators that reflect a country's actual production and price trends. The methodology achieved its goal of estimating feed demand in the poultry sector. It could be applied in other countries with the necessary data, including the proportion of commercial and backyard broiler and egg-layer operations, domestic and foreign breeds, and the number of eggs per year of each breed. Statistical data needs also include the daily nutritional feed rations, mortality and morbidity rates, number of cycles per year for each poultry type, offtake rates (the proportion of inventory that goes to slaughter each year), and the national flock composition by poultry type. The same data are needed for other poultry types (i.e., ducks, geese, and turkeys).

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