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Summary

This year's output of farm-raised catfish will likely increase again, reaching a record high, but the outlook for production increases for farm-raised trout is less certain. Fish farmers' production costs will rise primarily because of higher fish feed and fingerling costs. Major fish feed ingredients include grains and protein meal.

Tight food budgets and higher travel costs may mean less fish purchases from restaurant and food services, which account for over two-thirds of retail fish and seafood sales. However, higher red meat and poultry prices this spring and summer should provide some support for catfish and trout sales.

Production of farm-raised catfish delivered to processors reached a record 46.5 million pounds (live weight) during 1980, a 14-percent increase, while processors sold an alltime high of 27.8 million pounds (dressed weight). A 29-percent boost in frozen catfish sales provided most of the increase. Prices paid to catfish producers averaged 67.6 cents per pound, up a tenth from the previous year. Processors received an average of $1.61 per pound for ice-pack catfish last year, up 12 percent, and $1.73 per pound for frozen catfish, a 13-percent gain.

A large increase in catfish pond acreage and a new major processing plant in the Mississippi Delta ensure another production increase in 1981. Rising costs of feed and fingerlings, which make up about 75 to 80 percent of operating expenses, will push up catfish production costs by one-fifth to one-third this year. Producer prices will depend on the actual production increase and processor demand for catfish. Prices received by processors for dressed catfish will depend on live catfish prices, sales strength, and rises in processing and marketing costs.

USDA reported output of foodsize farm-raised trout during the first seven months of 1980 at 28.2 million pounds. Idaho, which produces mostly for processors, reported 24.8 million pounds for that period; prices paid to producers averaged 73 cents per pound. Most production in other surveyed States went to the fee-fishing and

recreational markets, while pay higher prices, ranging from $1.41 to $1.90 per pound.

Although Idaho likely has potential for larger output, high production and distribtion costs and marketing problems may moderate growth. However, production in other States may climb to meet a projected increase in fee and recreational fishing.

Demand for fish and seafood will likely expand in upcoming years, and the growing U.S. commercial aquaculture industry can help meet the demand. Moreover, aquaculture is providing additonal agricultural revenue and jobs in some regions. For these and other reasons, the Economics and Statistics Service is initiating the *Aquaculture Outlook and Situation Report.* The report, which will be published two times a year, will present economic data on aquaculture and analyze the supply, demand, and price factors affecting the industry.

Aquaculture Situation

INTRODUCTION

Aquaculture is the controlled cultivation of aquatic animals and plants. Although aquaculture is a relatively new industry in the U.S., fish culturing probably goes back 4,000 years to ancient Near Eastern and Chinese societies.

Today, aquaculture accounts for a significant portion of the U.S. supply of catfish, trout, crayfish, oysters, and salmon. U.S. commercial culture of food fish in 1978 was estimated to be greater than 200 million pounds, probably representing between 2-5 percent of total fish consumption. The worldwide average is 10 percent; China depends on aquaculture for about 25 percent of its fish supply.

Aquaculture in the United States provides benefits to both producers and consumers. The quantity and diversity of high-quality, lowfat fish products available to consumers has increased because of fish culture. Almost all rainbow trout available commercially are farm-raised. In addition, farm-raised catfish is slowly gaining wider geographic acceptance, giving many consumers an additional fish item.

Aquaculture also provides additional stability and diversification for American agriculture and agribusiness in some areas. For example, the industry provides employment on fish farms, in feed mills, processing plants, and other supporting industries. Moreover, aquaculture gives many farmers, both large and small, an alternative farm enterprise, enabling them to maximize the income potential of land, labor, and other resources.

Finally, over the years aquaculture has augmented fish stocks for commercial and sport fisheries that declined due to exploitation, pollution, and habitat destruction. Aquaculture will continue to perform this function.

FACTORS AFFECTING THE AQUACULTURE INDUSTRY

General Economic and Credit Outlook

Although the economy is weakening from the strong performance in fourth-quarter 1980, real Gross National Product is not likely to have shown a decline during the first 3 months of 1981. However, high interest rates, slower first-quarter growth and the drag of higher Social Security taxes may lead to a mild downturn during the second or third quarter. A moderate upswing in economic activity is currently forecast for the second half of 1981.

Although nominal per capita disposal income is expected to be about a tenth above a year ago, spendable income per person, when adjusted for inflation, will be negative for first-half 1981. Also savings rates have been very low in recent months. As a result, there will be little slack in consumer budgets to maintain food quantity purchases. This implies there may be less away-from-home food consumption, tending to dampen fish and seafood sales. However, higher prices for red meat and poultry will help support sales.

Nearly a third of the catfish producers and almost a fifth of the trout farmers USDA surveyed in August 1980 indicated plans to expand their production facilities in 1981. In addition, many farmers are considering adding fish farming as an additional (or alternative) farm enterprise. For these producers, credit will likely be readily available this year. Banks in most sections of the country show high liquidity, and there should be a good balance between supply and demand for loan funds this spring. However, some farmers may not qualify for new credit because of high interest rates and an existing debt burden that reduces debt servicing capacity. Some difficulties are expected in the South due to the added debt load many farmers carry as a result of last summer's drought.

Prime interest rates of commercial banks reached 21-1/2 percent in late December, but fell to 17 percent in early April. Market rates are expected to fall to about 15 percent this spring—still high by historical standards. Farm Credit System rates in mid-March were marginally higher than a year ago and are expected to rise moderately this spring.

Feed Prospects

Feed costs represent 50 to 60 percent of the operating expenses in catfish and trout farming. Feed grains and protein meals are the primary feed ingredients. Catfish feeds contain roughly one-half soybean meal, one-fourth corn, and about one-tenth fish meal. Trout require more animal protein than catfish, so trout feeds contain about one-third fish meal, with the remainder made up of such ingredients as soybean meal, wheat middlings, dried whey, and distillers solubles.

The drought-reduced supply of corn and strong disappearance during the 1980/81 crop year has kept the price of corn since fall 1980 well above the previous year. The price of corn at Chicago (No. 2 yellow) hovered around $3.50 per bushel during that period and, in early-April, was quoted at about $3.50 per bushel, compared with about $2.60 per bushel a year ago. Corn use is expected

to be a record high during 1980/81, with larger exports and industrial use offsetting decreased feed use. Ending stocks for the current crop year will be the lowest since 1975/76. Corn prices through the spring and summer will be especially sensitive to the influence of weather on the 1981/82 crop; nevertheless, interest rates, the unsettled Eastern European political situation, Southern Hemisphere crop developments, and the relative strength of the U.S. dollar versus other currencies will also impact prices.

The price of soybean meal (44-percent protein, Decatur), after averaging over $260 per ton in November, was quoted at about $215 per ton in early April. This compares with an average price of about $155 per ton in April 1980. Decreased 1980/81 soybean production accounts for the considerably above year-earlier price of meal, while the downturn in prices since November has been brought on by high interest rates and lagging export demand. Tightening feed grain and oilseed supplies this spring and summer likely will cause soybean meal prices to rise. However, increased competition from South American meal exports and a weakened world economy will moderate meal price rises.

The price of menhaden fish meal (60-percent protein, bulk, New York City, F.O.B. East Coast and Gulf plants), an important fish feeds ingredient, was quoted at about $400 per ton during March. This equaled the year-earlier price. U.S. menhaden fish meal production last year declined about 3-1/2 percent from the record 1979. Supplies of menhaden are expected to be off slightly during 1981, thus meal production could also decline. However, menhaden meal prices this year will be sensitive to factors affecting the whole fats/oils/high-protein meals complex.

Early April prices at Delta feed mills for bulk catfish feed were quoted at about $300 per ton. This compares with the 1980 average price of about $260 per ton. Catfish feed prices are likely to rise this spring and summer.

Meat Supplies and Prices

Total U.S. supplies of red meat and poultry during 1981 are likely to be 1 to 2 percent less than last year. Increased poultry production probably will not be sufficient to offset decreased red meat supplies.

The worldwide fish and seafood harvest this year will likely be near or slightly below 1980. Supplies of cod, the primary groundfish used for fillets in the United States, are likely to be significantly down. In addition, total U.S. frozen holdings of fish and shellfish were 13 percent below a year earlier on February 1. These factors will provide some strength in seafood prices during the coming months.

Large first-quarter beef production will give way to greatly reduced second-quarter supplies. Supplies of beef during second-half 1981 will approach year-earlier levels, leaving production for the year close to 1980. Meanwhile, pork production during January-March was down about 1 percent from last year. A steep decline in commercial pork production is forecast for the remainder of 1981, leaving supplies down about 6 to 8 percent for the year. Broiler production is likely to increase about 5 percent this year, with the largest gains to occur in the second half of the year in anticipation of higher red meat and poultry prices.

Retail prices of beef are expected to rise sharply this spring as supplies are reduced. Pork production during the second quarter is expected to be 8-10 percent below a year ago. Thus retail pork prices will also likely gain strongly this spring and summer. Although poultry production will post relatively strong gains for the remainder of the year, the reduced red meat supplies will spur demand for poultry, thus keeping poultry prices at the grocery store well above 1980 for the rest of the year.

Selected retail price indices

Item	Index Base	Year 1979	Year 1980	Change from year earlier	Feb. 1980	Feb. 1981	Change from year earlier
				Percent			*Percent*
Consumer Price Index	1967=100	217.4	246.8	+13.5	236.8	263.2	+11.1
All Food	1967=100	234.5	254.6	+8.6	244.9	270.8	+10.6
Fish and Seafood	1967=100	302.3	330.0	+9.2	320.4	355.0	+10.8
Canned	12/77=100	111.7	127.9	+14.5	120.3	138.0	+14.7
Fresh and Frozen	12/77=100	117.2	124.5	+6.2	123.0	133.5	+8.5
Food Away from Home	1967=100	242.9	266.9	+9.9	258.3	284.7	+10.2
Beef and Veal	1967=100	255.8	270.3	+5.7	266.2	272.3	+2.3
Pork	1967=100	216.4	209.1	-3.4	202.8	223.6	+10.3
Poultry	1967=100	181.5	190.8	+5.1	182.6	203.7	+11.6

CATFISH

1980 in Review

Record Production Indicative Of Industry Growth

The total live weight of catfish delivered to processors was nearly 46-1/2 million pounds in 1980, a record high and 14 percent greater than 1979 (table 1). Production was substantially above a year earlier for all months except March, July, and August. July-August production rose only 1.3 percent from the previous year, partly because of extremely high temperatures and slackened sales. In addition, many producers were plagued by an"off-flavor" problem in late summer. The return of fish to"on-flavor", along with mild fall weather that allowed more catfish harvesting, advanced fourth-quarter production over 23 percent from the same period in 1979. February 1980 output of 4.9 million pounds was the largest monthly total on record.

The current expansion of the farm-raised catfish industry follows a period from 1972-1975 when annual production fell from 18.3 million pounds to 16.1 million pounds. The sharp increase in grain, oilseed, and cotton prices during 1972-74 caused the stagnation, curtailing production in two ways. First, with feed prices extremely high and other production costs up substantially in relation to prices farmers received for catfish, many producers were unwilling or unable to withstand the additional costs of production. Second, the high prices for arable crops resulted in some pond acreage being reconverted to production of crops such as soybeans, rice, and cotton. In addition, many farmers who contemplated fish farming probably decided to keep their land in traditional crop production.

Increased Frozen Catfish Sales Boost Total; Imports Down, Stock Up

Processors sold 27.8 million pounds (dressed weight) of farm-raised catfish during 1980, up 14 percent from 1979 (table 1), which was an alltime high. The bulk of the sales boost was from a 29-percent gain in frozen sales; ice-pack sales rose 4 percent from a year earlier (table 4). Frozen sales during 1980 accounted for 45 percent of the total quantity sold, up from 40 percent in 1979. The sales increase of the frozen products can probably be attributed to a larger geographic market area; increased penetration into hotel/restaurant/institutional markets; and long-term supply contracts. In general, changes in annual sales of farm-raised catfish over the past decade have paralleled changes in annual production.

Imports of freshwater catfish totaled 14.9 million pounds (dressed weight) in 1980, down 12 percent from a year earlier (tables 1 and 5). Last year marked the second consecutive decline in catfish imports, after reaching a peak of 18.4 million pounds in 1978. Almost all imports come from Brazil, where catfish are primarily caught at the mouth of the Amazon River. Although the imported product has about a 30-cent price advantage over U.S. farm-raised catfish, the improved quality and increased quantity and stability of the U.S. supply in recent years has improved the competitive position of the U.S. industry.

Catfish processors held 1.26 million pounds of finished product in frozen storage on December 31, 1980, 23 percent greater than the previous year (table 1). This was the largest end-of-year inventory since 1970 when the infant industry's production greatly exceeded market demands. Although higher inventory holdings are generally in line with expanding sales, the year-end 1980 stocks were somewhat burdensome.

Farm and Processed Prices Higher In 1980

Catfish processors paid farmers an average 67.6 cents per pound for live fish during 1980, up a tenth from 1979 (tables 2 and 7). However, farm prices averaged only 3 percent greater over the July-December period. The December 1980 price of 65 cents per pound was equal to that of December 1979 and down from the high of 69 cents that prevailed from February through July. The slowing of year-to-year price increases during the latter part of 1980 was due to large production and weakened sales.

Meanwhile, processors received a weighted-average of $1.66 per pound for dressed catfish during 1980, 13 percent more than 1979. Ice-pack prices averaged $1.60 per pound, up 11 percent; frozen catfish prices garnered $1.73 per pound during 1980, an increase of 13 percent. The price differential between the frozen and ice-pack forms widened during 1980 from about 9 cents per pound in 1979 to 13 cents per pound. The larger spread reflected higher energy costs for freezing, as well as the increased costs of holding inventories due to high interest rates.

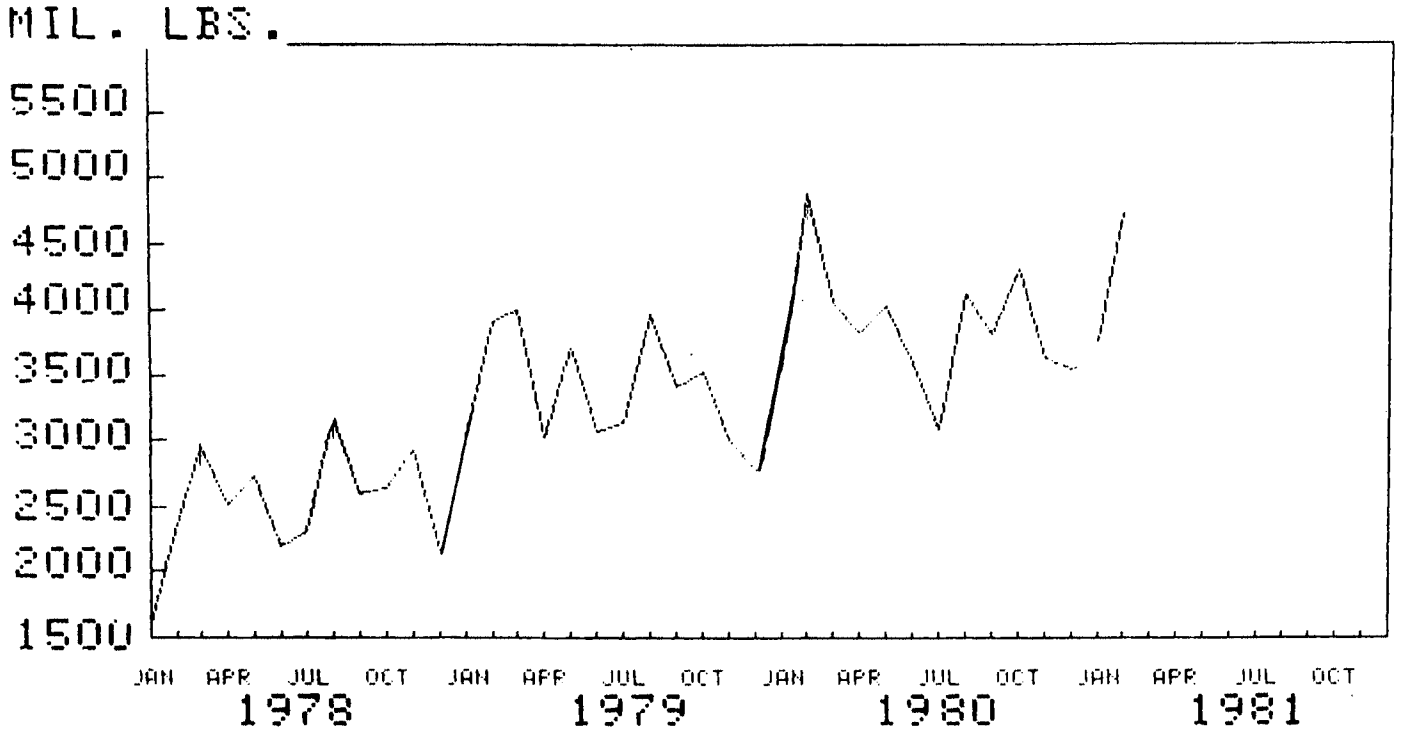
Current Situation and Outlook

Output to Increase Again in 1981

January-February catfish production for processors totaled 8.5 million pounds, 1 percent above last year's large output (table 3). February output was 3.2 percent less than in 1980, but was still the second largest quantity ever processed in 1 month. Production of processed catfish tends to be seasonally highest during the first quarter of the year, in part to meet Lenten demand. Many producers also harvest fish during winter to stock ponds with fingerlings in the spring.

This year's catfish production is almost certain to increase again, barring any natural disasters. Much of the pond acreage constructed in the past 2 years is beginning to produce foodsize fish ready to be marketed. In Mississippi alone, more than 12,000 acres came into food fish production between March 1980 and December 1980. In addition, Mississippi producers reported another

FARM-RAISED CATFISH PRODUCTION BY MONTHS*



* ROUND WEIGHT PROCESSED.

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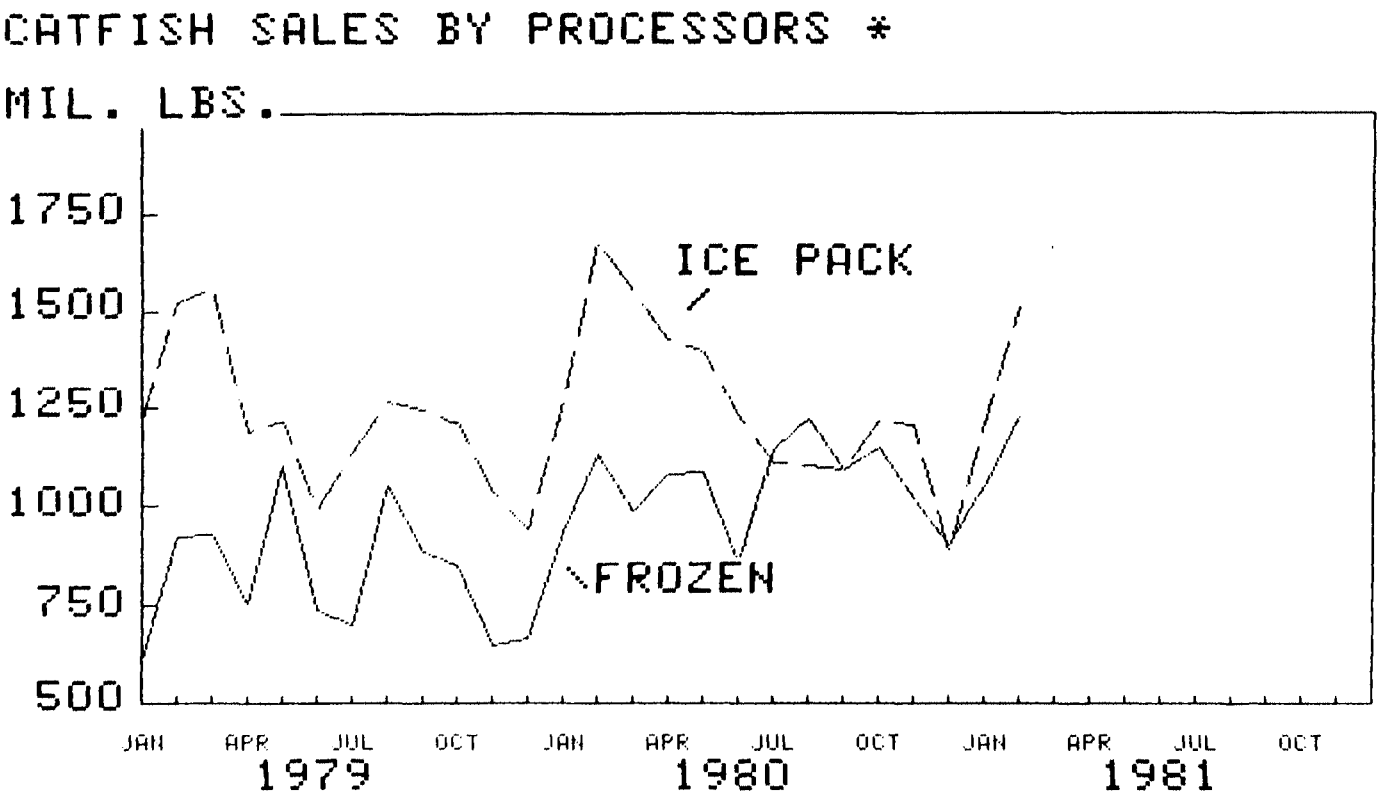
FIGURE 1

NEG. ESS 290-81(4)



USDA

FIGURE 2

NEG. ESS 291-81(4)

4,400 acres under construction in December. Given the increased acreage, along with another large processing plant opening this spring in the Mississippi Delta, production of catfish for processing could easily increase by 25 percent this year.

The industry has been concerned that there may be a shortage of fingerlings to stock all of the new acreage. Also, Mississippi Delta farmers experienced a relatively poor spawn in 1980 because of the extreme heat last summer. Although fingerlings are in tight supply in the Mississippi Delta, the shortage does not appear critical. Therefore, some fingerlings may be smaller than the desirable size, and it may take longer than the"normal" 210 days to raise the fish to foodsize. The addition of nearly 4,000 acres of ponds for fingerling production in Mississippi between March 1980 and December 1980 has helped improve the fingerling supply situation. Prices of 6-inch fingerlings are now selling at about 12 cents per fish, compared with a price of about 9 cents in 1980. Limited supplies of fingerlings in States outside the Mississippi Delta this year may limit foodsize fish production growth.

1981 Sales Steady; Stocks Up Substantially

Sales of processed catfish during January-February matched the robust commercial use during that period in 1980 (table 4). Frozen product sales increased more than a tenth from last year, offseting a 7-1/2 percent decline in ice-pack sales. Sales will likely increase seasonally through April.

The sales outlook for the rest of the year is mixed. With little slack expected in consumer food budgets, sales of catfish, especially in the important food away-from-home market, may level off. Moreover, higher travel costs may also harm restaurant sales. However, the catfish industry has historically been able to expand sales by saturating existing markets and finding new ones as production increased. Fresh farm-raised catfish is now available in 30 States. Few, if any fish species, have such widespread geographic availability. Also, catfish processors expanded sales by adding to the consumer utility of their product. The marketing of prebreaded, controlled portions of catfish and individual quick-frozen packages are two examples. In addition, retail prices of red meat and poultry will likely increase substantially this year. This could provide some support for catfish sales.

Processors' frozen catfish stocks on March 1 totaled 1.436 million pounds, up 35 percent from a year ago and 80 percent from October 1 (table 6). Unusually large production during fourth-quarter 1980 along with the seasonally low sales for that period (consumers favor such holiday meat items as turkey or ham during October-December), caused the buildup. Stock levels in coming months will depend on the relative strengths of production and sales.

Farm Prices Down; Production Costs To Increase

The weighted-average price paid to producers for catfish equaled 64 cents per pound during January and February and was 5 cents less than prices paid in February 1980. The decreased prices resulted from the large production during fall 1980 and the attendant buildup in processor stocks. However, the prices paid to producers by major processors in the Mississippi Delta increased by 2-1/2 to 5 cents in late March.

The change appears to reflect market conditions. Wholesale catfish sales were reported to be seasonally good, while supplies of fish at the farm level apparently are not as readily available as earlier in the year. A new processing plant scheduled to start buying fish during April may have kept some fish off the market.

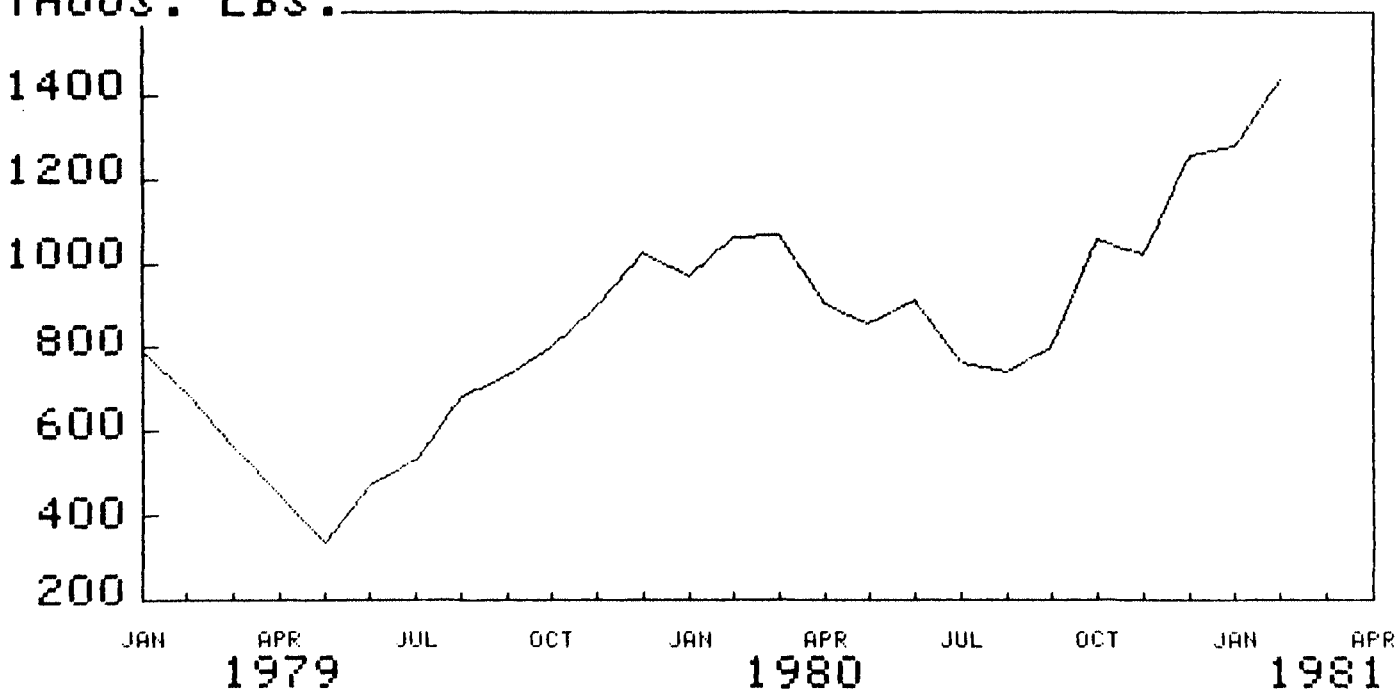
Several factors will influence prices for the rest of the year. The expected big increase in production this year will put downward pressure on prices. The current large stock of finished products, along with high interest rates, could limit processor demand for live fish in the next few months, further acting to depress producer prices. Somewhat stronger prices will likely occur if the sales growth that has characterized the industry since 1975 continues. Also, the addition of the new processing plant in the Mississippi Delta could increase competition for foodsize fish, placing some upward pressure on producer prices.

Table 1—Farm-raised catfish production, sales, Inventory and imports, 1969-80

Year	Round weight processed[1]	Quantity sold[2]	Imports[3]	Ending inventory[4]	Per capita sales
		Thousand Pounds			*Pounds*
1969	3,201	NA	3,762	875	NA
1970	5,741	[5]2,796	4,801	1,499	.014
1971	11,257	7,212	3,204	1,027	.035
1972	18,331	11,058	4,826	946	.054
1973	19,731	11,944	6,613	817	.057
1974	16,944	10,907	8,443	649	.052
1975	16,140	10,317	10,906	358	.049
1976	18,978	11,738	10,262	500	.055
1977	22,125	13,248	17,983	820	.062
1978	30,179	18,446	18,372	816	.085
1979	40,636	24,330	16,989	1,027	.111
1980	46,464	27,761	14,895	1,260	.126

[1]Total live weight of fish delivered for processing. [2]Dressed weight; includes both ice pack and frozen sales. [3]Catfish: filleted, fresh, chilled or frozen. TSUSA code 110.7024. [4]Dressed weight. [5]11-month total—January data not available. NA = Not available.

PROCESSORS' CATFISH INVENTORY*



* FROZEN, DRESSED WEIGHT STOCKS AT END OF THE MONTH

USDA FIGURE 3 NEG. ESS 293-81(4)

Table 2—Prices paid to producers for farm-raised catfish, and prices received by processors for catfish, 1969-80

Year	Prices paid to farmers[1]	Prices received by processors[2]		
		All sales	Ice pack sales	Frozen sales
	Dollars per pound			
1969	[3].374	NA	NA	NA
1970	.338	.833	NA	NA
1971	.323	.786	NA	NA
1972	.332	.808	NA	NA
1973	.441	1.008	NA	NA
1974	.460	1.074	1.057	1.098
1975	.491	1.134	1.107	1.175
1976	.527	1.208	1.182	1.254
1977	.580	1.313	1.292	1.347
1978	.545	1.306	1.283	1.342
1979	.613	1.469	1.433	1.527
1980	.676	1.655	1.595	1.727

[1]Harvested, at plant site. [2]F.O.B. plant. [3]Simple average.

Table 3—Farm-raised catfish production (total live weight of fish delivered for processing)

Month				Change from year earlier	
	1979	1980	1981	1980	1981
	Thousand pounds			*Percent*	
January	3,032	3,530	3,772	+16.4	+6.9
February	3,929	4,892	4,737	+24.5	-3.2
March	4,010	4,060		+1.2	
April	3,025	3,829		+26.6	
May	3,716	4,045		+8.9	
June	3,081	3,596		+16.7	
July	3,138	3,092		-1.5	
August	3,978	4,116		+3.5	
September	3,417	3,817		+11.7	
October	3,531	4,310		+22.1	
November	3,000	3,631		+21.0	
December	2,779	3,546		+27.6	
Annual	40,636	46,464		+14.3	

Table 4—Processor sales of catfish, ice pack and frozen (dressed weight)

Month	Ice pack			Frozen		
	1979	1980	1981	1979	1980	1981
	Thousands pounds					
January	1,223	1,265	1,213	606	933	1,055
February	1,519	1,680	1,508	924	1,134	1,230
March	1,599	1,550		931	985	
April	1,191	1,424		752	1,083	
May	1,216	1,398		1,104	1,089	
June	993	1,234		739	855	
July	1,140	1,110		699	1,144	
August	1,269	1,101		1,051	1,223	
September	1,246	1,093		784	1,090	
October	1,209	1,215		849	1,148	
November	1,038	1,206		646	1,020	
December	942	883		661	898	
Annual	14,584	15,159		9,745	12,602	

Table 5—Imports of catfish[1] and trout[2]

Month	Catfish			Trout		
	1979	1980	1981	1979	1980	1981
			Thousand pounds			
January	995	1,309	1,003	31	0	14
February	1,683	1,511	1,119	0	*	14
March	639	1,170		45	1	
April	2,522	1,045		22	12	
May	2,014	1,108		45	2	
June	946	2,225		0	13	
July	2,273	1,110		11	11	
August	759	2,430		11	3	
September	889	1,425		12	8	
October	1,298	284		10	13	
November	1,361	863		0	13	
December	1,610	443		10	9	
Annual[3]	16,989	14,922		197	82	

[1]Catfish: Filleted, fresh, chilled or frozen; TSUSA code 110.7024. [2]Freshwater trout, fresh or frozen whole, beheaded but not scaled; TSUSA code 110.1550. [3]Totals may not add due to rounding. * Less than 500 pounds.

Table 6— Processors' frozen dressed-weight catfish stocks, end of month

Month	1980	Change from year earlier	1981
	Thousand pounds	*Percent*	
January	969.6	1,278.7	+22.7	+31.9
February	1,065.6	1,435.5	+54.7	+34.8
March	1,070.9		+90.0	
April	907.3		+102.4	
May	858.3		+156.4	
June	917.2		+96.0	
July	766.1		+44.0	
August	741.4		+8.9	
September	800.6		+9.5	
October	1,060.1		+32.2	
November	1,020.0		+12.9	
December	1,259.9		+22.7	

Based on previous aquacultural production cost studies (7,13), per unit operating costs for catfish producers will probably increase between a fifth and a third from last year. Higher feed and fingerling costs, which account for 75 to 80 percent of operating expenses, will contribute most to the increase. However, the prices received by catfish producers should allow them to cover at least variable costs. Established farmers will also likely cover ownership costs. Producers over the past several years have generally made favorable returns, which is the primary reason for the rapid growth in pond acreage and production. Net returns to new producers, who encountered higher construction and interest costs, may be less favorable.

Processor Prices Stable

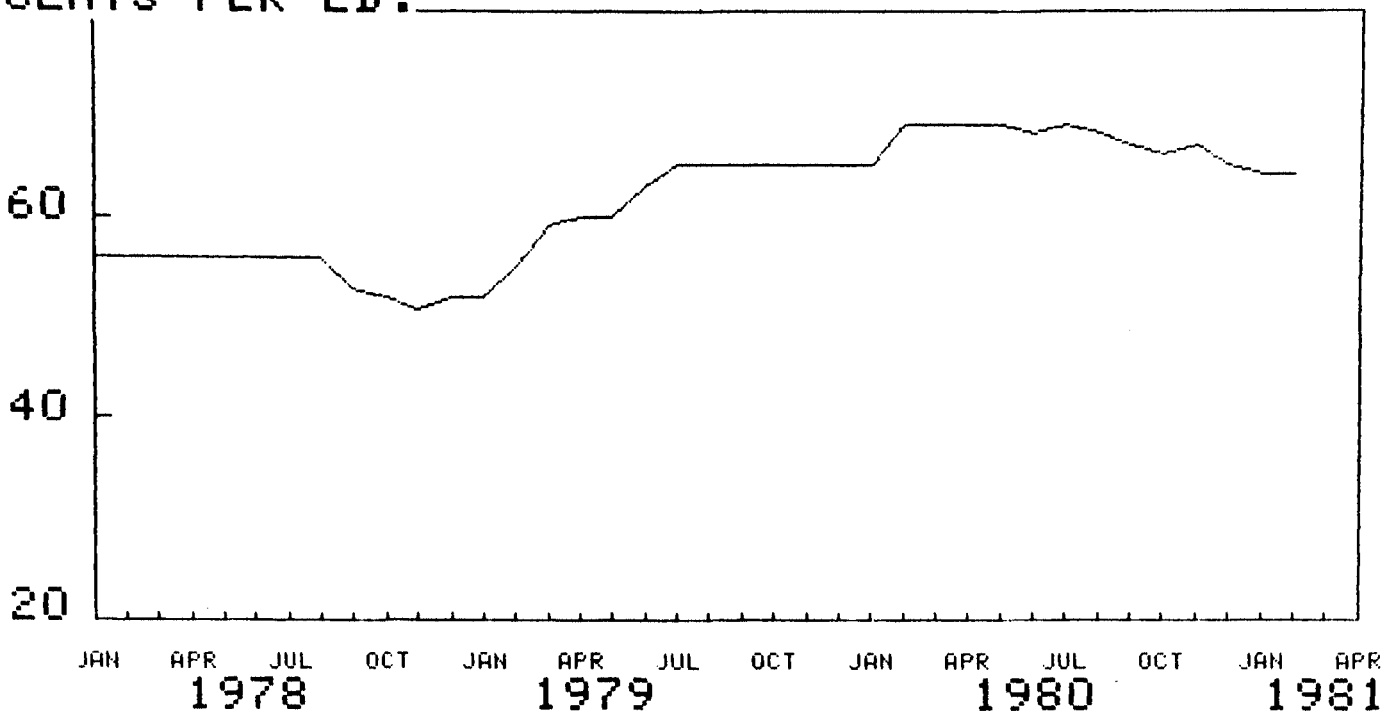
Catfish processors received an average of $1.67 per pound for all sales during February. This was 6 cents more than a year ago, but 2 cents less than prices received during December. Ice-pack prices averaged $1.60 per pound in February, down 3 cents from December, while frozen product prices at $1.76 per pound were up 1 cent from December (table 8). In general, both ice-pack

Table 7—Prices paid to producers for farm-raised catfish (harvested, at plant site)

Month	1979	1980	1980
Dollars per pound			
January	.52	.65	.64
February	.55	.69	.64
March	.59	.69	
April	.60	.69	
May	.60	.69	
June	.63	.68	
July	.65	.69	
August	.65	.68	
September	.65	.67	
October	.65	.66	
November	.65	.67	
December	.65	.65	
Annual	.613	.676	

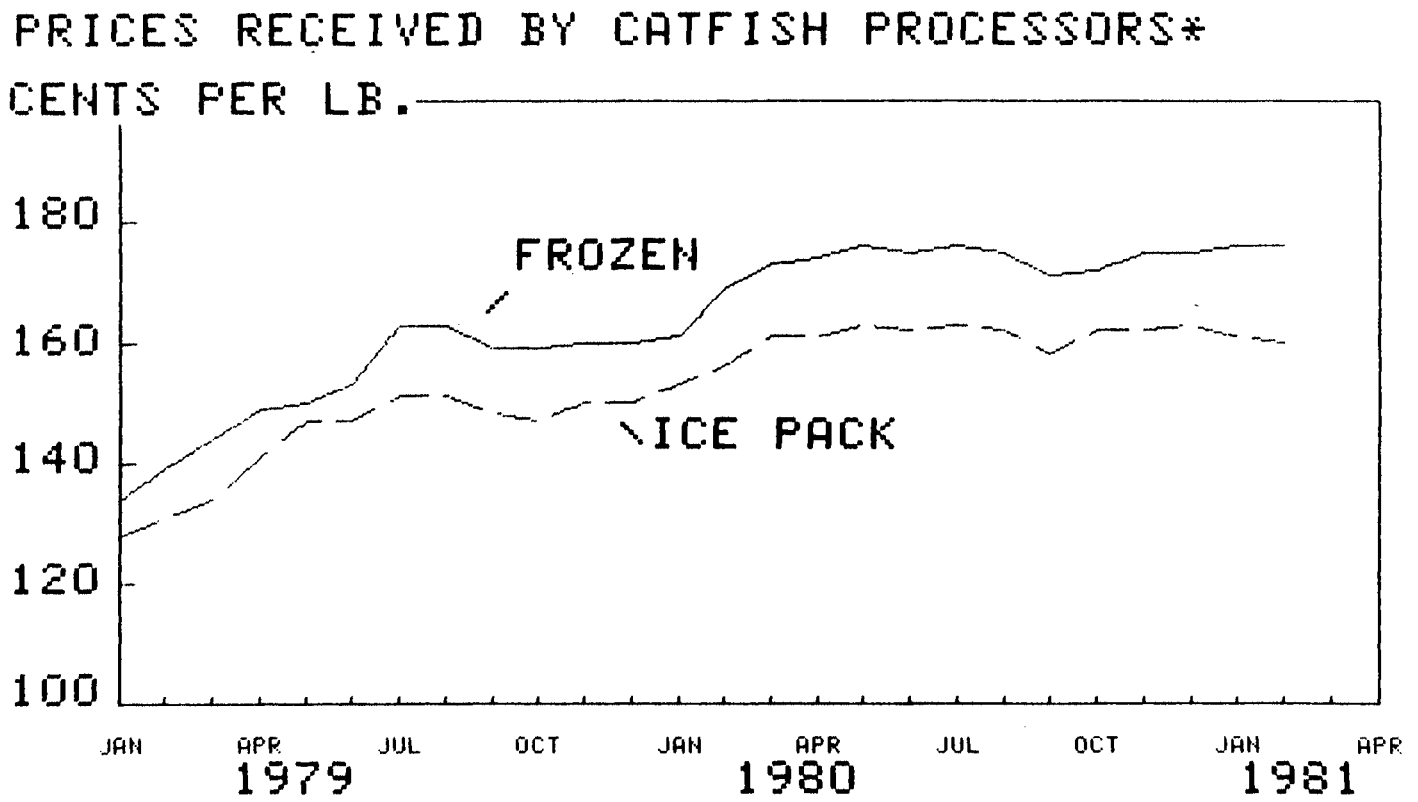
PRICES PAID TO FARMERS FOR CATFISH *

CENTS PER LB.



* HARVESTED, AT PLANT SITE.

USDA FIGURE 4 ESS NEG. 292-81(4)



USDA FIGURE 5 ESS NEG. 294-31(4)

Table 8—Prices received by processors for catfish (f.o.b. plant)

Month	Ice pack			Frozen		
	1979	1980	1981	1979	1980	1981
			Dollars per pound			
January	1.28	1.53	1.61	1.34	1.61	1.76
February	1.31	1.56	1.60	1.39	1.69	1.76
March	1.34	1.61		1.44	1.73	
April	1.41	1.61		1.49	1.74	
May	1.47	1.63		1.50	1.76	
June	1.47	1.62		1.53	1.75	
July	1.51	1.63		1.63	1.76	
August	1.51	1.62		1.63	1.75	
September	1.48	1.58		1.59	1.71	
October	1.47	1.62		1.59	1.72	
November	1.50	1.62		1.60	1.75	
December	1.50	1.63		1.60	1.75	
Annual	1.433	1.595		1.527	1.727	

Table 10—Catfish number of operations, water acreage and average size per operation, August 1, 1980; foodsize fish sales and price, January 1-July 31, 1980; selected States

State	Total operations	Percent of total	Water surface	Percent of total	Average size per operation	Foodsize fish sales[2]	Percent of total	Price per pound
	Number	*Percent*	*Acres*	*Percent*	*Acres*	*1000 Pounds*	*Percent*	*Dollars*
Alabama	524	43	9,440	17	18.0	4,700	12	.66
Arkansas	139	11	7,720	14	55.5	5,708	14	.72
California	74	6	1,640	3	22.2	606	2	1.35
Georgia	39	3	1,170	2	30.0	166	*	1.00
Louisiana	31	3	750	1	24.2	221	1	.87
Mississippi	204	17	32,620	58	160.0	27,674	69	.68
Missouri	71	6	960	2	13.3	258	1	1.03
Texas	138	11	1,480	3	10.7	517	1	1.36
Other[1]	5	*	390	1	78.0	489	1	.80
Total	1225	100	56,170	100	45.9	40,339	100	.71

[1]Idaho and Pensylvania combined to avoid disclosure of individual operations. [2]Live weight. *Less than 1 percent.

and frozen catfish prices have remained relatively stable over the past year.

The recent increase in prices paid to catfish farmers could cause similar rises in processors' wholesale prices. However, the expected large supplies of catfish available for processing this year and the current large quantities of processed catfish in storage indicate prices may not vary much from current levels. However, higher processing and marketing costs will place upward pressure on processor prices in the months ahead.

Catfish Producers: Some Structural Characteristics

As of August 1, 1980, there were 1,225 commercial catfish farmers in 10 leading production States, with total pond acreage of over 56,000 acres (table 10). These States produced 40.3 million pounds during the first 7 months of 1980.

The Southcentral United States is the primary catfish production region. Alabama, Arkansas, and Mississippi contained 71 percent of the producers and 89 percent of the pond acreage. These three States produced 95 percent of the foodsize fish during January-July 1980.

Alabama has the longest tradition of the leading catfish farming States, which explains why the State has 43 percent of the total catfish operations, 2-1/2 times more producers than any other State. Aquaculture research at Auburn University dates back to the 1930's when emphasis was on construction of small watershed reservoirs (6-10 acres) for food production, income, and recreation on Alabama farms. The primary objective of the research was, and is today, to make fish-farming an alternative or complementary enterprise so that farmers could utilize often marginal land resources to the greatest extent. While Alabama has over two-fifths of the producers, the State contains only one-sixth of the pond acreage and produces 12 percent of the foodsize catfish. The average size per operation is 18 acres, versus the national average of 46 acres.

In terms of pond acreage and production, Mississippi dominates. With about one-sixth of the total operations, Mississippi contains nearly three-fifths of the water acreage and produces over two-thirds of the foodsize fish. Almost all of Mississippi acreage is in the Mississippi Delta because of the soil's good water-retention properties, flat terrain, warm temperatures, and an adequate water supply. In short, the Delta has nearly ideal conditions for catfish culturing. Producer and processor indus-

triousness combined with public support helped Mississippi to be the largest catfish production State. The average size catfish operation has 160 water-acres.

Arkansas also has a long aquaculture tradition. In fact, today's commercial catfish industry started in Arkansas. Today, Arkansas has 11 percent of the catfish operations and a 14-percent share of the acreage and foodsize fish production. The average sized operation is 55-1/2 acres. Much acreage is also committed to the profitable rearing of bait and ornamental fish species.

The benchmark USDA survey of catfish producers (13) indicated that nearly four-fifths of the catfish production is sold to processors. An additional 13 percent is sold through the live haul and fee and recreational markets (table 11).

Table 11—Producer sales of foodsize catfish and trout by sales outlets, January 1-July 31, 1980; United States

Outlet	Catfish		Trout	
	Quantity sold[1]	Percent of total	Quantity sold[1]	Percent of total
	1000 Pounds	*Percent*	*1000 Pounds*	*Percent*
Processors	31,452	78	24,637	88
Live Haul	3,830	9	167	1
Consumers	1,866	5	607	2
Fee and Recreational	1,470	4	1,503	5
Other Producers	739	2	398	1
Government Agencies	46	*	257	1
Other Sources	936	2	590	2
Total	40,339	100	28,159	100

[1]Live weight.

TROUT

Trout producers in nine States reported foodsize fish sales of 28.2 million pounds (live weight) during January-July 1980. Of that total, 24.6 million pounds, 88 percent, were sold to processors (table 11). Sales to fee and recreational fish operations contributed the next largest portion of sales—1.5 million pounds or 5 percent of the total. Idaho producers sold 88 percent of U.S. production during the first 7 months of 1980, while California and Pennsylvania contributed 4 percent each (table 12).

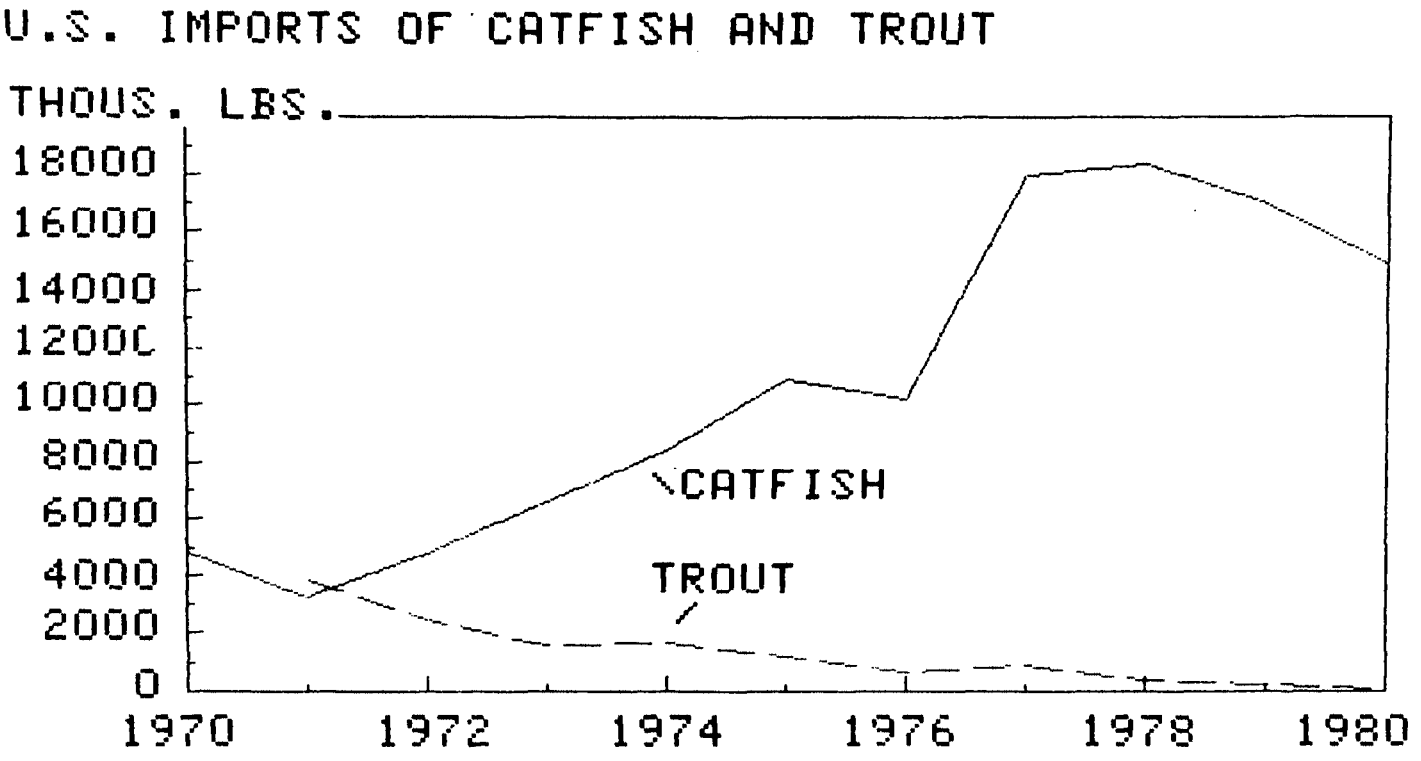
In general, production in States other than Idaho was sold to the higher-value fee and recreational fish markets. Prices for foodsize fish ranged from $1.41 per pound in Georgia to $1.90 per pound in Wisconsin and Pennsylvania. This contrasts with the 73 cents per pound producers received in Idaho.

There is an extreme lack of supply, demand, and price data for the cultured trout industry. Brown judged commercial production of rainbow trout to be 45.5 million pounds in 1975 (4, p.346). Klontz and King (9) estimated 1975 private trout production at 27 million pounds (live weight), with 20 million pounds processed for food, and the remainder sold to fee-fishing outlets. The National Marine Fisheries Service reported the annual average dressed weight quantity of processed trout at 16.3 million pounds during 1975-78; data for other years are not available (table 13). The quantities ranged from 14.4 million pounds in 1978 to 19.8 million pounds in 1977. The live weight of the quantity processed would be about 23 million pounds, assuming a 30-percent weight loss. Add in the estimate of 7 million pounds sold to the fee and recreational outlets, and the 1975-78 average live weight production would be 30 million pounds. These estimates of rainbow trout production compare with the 28.2 million pounds USDA reported for the first seven months of 1980.

Annual imports of freshwater trout declined dramatically from 3.8 million pounds in 1971 to 82 thousand pounds last year (table 13). This happened because Japan and Denmark, the world's largest trout producers, left the U.S. market. Imports of Danish trout have been banned because of disease problems, while the Japanese have found their domestic market more profitable than exports.

There are probably unused water resources in Idaho to support some expansion of rainbow trout production. Moreover, existing production facilities could be used more efficiently to increase output. However, several factors may impede growth. Major markets for the processed product are far from Idaho, so distribution costs may make rainbow trout less competitive in price. In addition, Idaho producers must import most of their feed and feed ingredients, which keeps production costs high. Also, desirable farm sites and the construction of concrete raceways for culturing have become very expensive. This has resulted in creation of production ponds using irrigation water as the culturing medium, which may cause fish quality problems. The industry is production-oriented, and marketing and sales efforts have not kept pace with production. In sum, although Idaho has potential for increased output, high production and distribution costs, along with quality and marketing problems, may limit growth of the rainbow trout industry.

Nevertheless, public demand for recreational fishing is expected to increase. As a result, trout farmers in other States, who produce mainly for the fee and recreational markets, should be able to command prices that will allow expansion. As in Idaho, water resources will be a limiting factor to growth.



USDA

FIGURE 6

ESS NEG. 295-81(4)

Table 12—Trout: Number of operations, August 1, 1980; foodsize fish sales and price, January 1 - July 31, 1980; selected States

State	Total operations	Percent of total	Food size fish sales[2]	Percent of total	Price per pound
	Number	*Percent*	*1000 Pounds*	*Percent*	*Dollars*
California	32	16	1,204	4	1.49
Georgia	11	6	198	1	1.41
Idaho	31	16	24,771	88	.73
Missouri	6	3	211	1	1.85
Pennsylvania	39	20	1,144	4	1.90
Washington	42	21	237	1	1.65
Wisconsin	28	14	311	1	1.90
Other[1]	8	4	83	*	1.67
Total	197	100	28,159	100	.85

[1]Includes Alabama and Arkansas. [2]Live-weight. *Less than 1 percent.

Table 13—Farm-raised trout production, imports of freshwater trout, and inventory of trout

Year	Production	Imports[1]	Inventory[2]
		Thousand Pounds	
1969	[3]8,470	NA	688
1970	NA	NA	907
1971	NA	3,832	1,694
1972	NA	2,501	2,601
1973	NA	1,597	2,010
1974	NA	1,663	2,801
1975	[4]16,434	1,204	1,422
1976	[4]14,505	640	1,161
1977	[4]19,075	909	2,267
1978	[4]14,414	387	2,083
1979	NA	197	1,988
1980	NA	82	1,867

[1]Freshwater Trout, fresh or frozen whole, beheaded but not scaled. [2]End of year frozen holdings as reported by the National Marine Fisheries Service. [3]Estimated. Live-weight quantity processed from Bardach, et. al. (12), 12.1 million pounds, converted to dressed weight by multipying by 0.7. [4]Dressed-weight quantity processed, reported by National Marine Fisheries Service. NA = Not Available.

AQUACULTURE IN THE UNITED STATES

In the United States, commercial attempts at trout aquaculture were made over 50 years ago, while private warm-water aquaculture had its genesis in the late 1920's and early 1930's when a few individuals began raising minnows to supply a growing demand for baitfish. Private-sector culture of saltwater species is a more recent development. In the United States today, both freshwater and marine species are cultured. However, freshwater aquaculture is better established as a commercial industry. The primary freshwater species cultivated for food are channel catfish and rainbow trout; however, crayfish and freshwater prawns will likely assume more commercial importance in the coming decade. In addition, production of freshwater baitfish and ornamental fish is also economically significant.

In contrast, commercial culture of saltwater fish and seafood, sometimes called mariculture, is still largely experimental. An important exception is oyster culture, which provides 40 percent of the U.S. oyster supply. Other cultivated species include (but are not limited to) salmon, hard calms, shrimp, mussels, and abalone.

Brown and Gratzek (6, p.10) estimated there are about 5,000 commercial fish farmers in the U.S., about 4,000 fee fish-out operations, and 150,000 farmers who raise fish for recreational use. They estimate the farm value of the cultured fish to be between $200 million and $300 million per year.

The potential for expanding aquaculture in the United States is good, but many obstacles remain. Expanded aquaculture in the United States requires space in unpolluted coastal or estuarine water and plentiful supplies of high quality freshwater—resources that are in high demand.

Institutional problems such as zoning, waste control, and licensing must be resolved. Research is needed to provide private companies and individuals with knowledge needed to increase opportunities for success. High risks and investment costs are associated with some aquacultural enterprises, and significant investment may not occur until the risks are reduced.

Catfish

Warm-water aquaculture began and is still centered in the Southcentral United States (especially the Mississippi Delta). Imposition of acreage limitations on rice in the 1950's resulted in conversion of land to fish production as an alternative use for the land. Some farmers used a rice-fish crop rotation on their land. Buffalofish was the primary specie cultivated, because it was low on the food chain and could feed on plankton that grew in the water, and because of the seasonal fluctuations in the wild supply. But lack of consumer acceptance, large weight loss in dressing out, and the inexperience of many pond operators weakened the economic feasibility of buffalofish production through the late 1950's and early 1960's.

Aquaculture research by Federal agencies and various state universities was a simultaneous development during the 1950's and 1960's. Many of the research efforts were directed to channel catfish culture. These endeavors, combined with the enterprise of farmers and processors, resulted in the growth of catfish production that continues today. In 1963, eight States reported 2,400 acres in commercial catfish production, compared with over 56,000 water acres reported in 1980. Catfish processors handled 3.2 million pounds in 1969, compared with 46.5 million pounds in 1980, further illustrating the industry's growth. In sum, strong regional demand for catfish, suitable environmental factors (climate, water and soil), producer and processor industriousness and willingness to assume risk, volatile crop prices, and support-

ing research and extension activities of government and universities made catfish culture the largest aquaculture industry in the United States.

Trout

In the United States, trout culture has the longest history of any form of aquaculture, primarily due to the popularity of trout as a sportfish. Trout prefer environments that are comparatively sterile and are among the most easily depleted species by fishing and other activities of man. Thus, it is common for state agencies to culture trout to augment and sometimes substitute for natural production in maintenance of sport fisheries.

The primary trout cultured for both sport fishery and food purposes is the rainbow trout, because it is the most tolerant of different temperatures, salinities, and population densities. In contrast to catfish, which are reared in ponds, trout culturing occurs primarily in raceways.

Idaho dominates the U.S. commercial culturing of food trout. The State owes this dominance to the Southern Idaho Aquifer. This geological phenomenon provides an abundant supply of water that is almost a steady 58 F throughout the year. The temperature and quality of the water result in ideal trout production conditions.

Although growth in U.S. trout culture has not been as rapid as that of the catfish industry, it has been substantial. Commercial U.S. cultured trout production totaled an estimated 7 million pounds in 1960. This compares with January-July 1980 output of 28.2 million pounds, of which Idaho produced over three-fourths.

Crayfish and Freshwater Prawns

U.S. culture of crayfish started around 1950 and evolved because of economic factors. From the demand side, crayfish are esteemed as both food and bait in Louisiana and are considered a delicacy in Europe, where they command high prices. With respect to supply, the wild harvest can vary greatly. In Louisiana, approximately 60 percent of the total crayfish crop is harvested from natural waters, mainly the Atchafalaya Basin. Therefore, crayfish culture was begun in Louisiana in order to exploit the demand and eliminate some of the yearly and seasonal fluctuations in supply.

Acreage devoted to crayfish culture in Louisiana increased from 6,000 acres in 1966 to 50,000 acres in 1979. These figures include wooded and open ponds as well as land where rice-fish rotation is employed. Ponds generally produce 400-500 pounds per acre, but intensively managed ponds can yield 800-1,100 pounds per acre.

Many of the largest and most desirable shrimps are freshwater prawns. In the United States, commercial prawn culture is still in its infancy. Overall 1978 production was estimated at 260,000 pounds in Hawaii, and 110-130,000 pounds outside Hawaii.

(For further information and background on the various cultured fish and seafood, see Brown and Gratzek (5), Bardach, Ryther and McLarney (2), Brown (4), and Meyer, Sneed, and Eschmeyer (10).)

SOME DEMAND FACTORS RELATING TO THE AQUACULTURE INDUSTRY

Consumption of Red Meat, Poultry, and Fish

Since 1955, annual per capita consumption of red meat, poultry, and fish in the United States increased more than a fourth to 226 pounds during 1980 (Table 14). This increase is mainly because of higher disposable consumer incomes.

Annual per capita consumption of fish and seafood (edible meat basis) has trended gradually upward over the last 25 years, from 10.5 pounds in 1955 to 13.3 pounds in 1979 (including artificially cultured fish, which accounted for less than 1/2 pound per person in 1979). Over that period, the share of fish and seafood consumption relative to total red meat, poultry, and fish consumption held steady at or near 6 percent. The increased fish and seafood consumption reflects the trend toward larger sales of food away-from-home (the food service trade accounted for 68 percent of the retail value of fish and seafood sales in 1979); higher disposable consumer income; and perhaps to a lesser extent, the recent attention on consumption of animal products with less fat. In 1979, per capita consumption of fresh and frozen fish and seafood represented 60 percent of total fish and seafood consumed; canned products, 37 percent; and cured fish and seafood, 3 percent.

Some marked changes have also occurred in the consumption mix among the various animal products. The large increase in poultry consumption is most notable. In 1955, per person poultry consumption accounted for about 15 percent of the total red meat, poultry, and fish eaten.

In 1979, poultry contributed over 25 percent of the total. Technological and structural developments in the poultry industry brought on greater output at lowered real costs. These cost savings were passed on to consumers in the form of lower real retail prices, which encouraged consumption of poultry.

Per capita beef consumption has also expanded since 1955, growing from an average of 63.7 pounds (retail weight) during 1955-59 to an average 89.2 pounds during 1975-79. Higher consumer incomes, changing tastes and preferences, and a shift of resources into cattle production mainly stimulated larger beef consumption. Annual per person pork consumption has generally ranged between 55 and 65 pounds, reflecting the relative inelastic demand for pork. Meanwhile, consumption of veal and lamb and mutton tapered off to very low.

Table 14—U.S. per capital consumption of meat, poultry, and fish, 1955-80[1]

Year	Beef	Veal	Pork	Lamb/ mutton	Total red meat	Chicken	Turkey	Total poultry	Fish/ seafood	Total meat, poultry, and fish
					Pounds					
1955	64.0	8.3	61.9	4.1	138.3	21.3	5.0	26.3	10.5	175.1
1956	66.2	8.3	62.2	4.0	140.7	24.4	5.2	29.6	10.4	180.7
1957	65.1	7.7	56.6	3.7	133.1	25.5	5.9	31.4	10.2	174.7
1958	61.5	5.8	55.9	3.7	126.9	28.2	5.9	34.1	10.6	171.6
1959	61.8	4.9	62.7	4.3	133.7	28.9	6.3	35.2	10.9	179.8
1960	64.3	5.2	60.3	4.3	134.1	27.8	6.2	34.0	10.3	178.4
1961	65.8	4.7	57.6	4.5	132.6	29.9	7.4	37.3	10.7	180.6
1962	66.2	4.6	59.1	4.6	134.5	29.8	7.0	36.8	10.6	181.9
1963	69.9	4.1	61.1	4.4	139.5	30.8	6.8	37.6	10.7	187.8
1964	73.9	4.3	60.9	3.7	142.8	31.2	7.3	38.5	10.5	191.8
1965	73.6	4.3	54.7	3.3	135.9	33.3	7.4	40.7	10.8	187.4
1966	77.1	3.8	54.3	3.6	138.8	35.6	7.8	43.4	10.9	193.1
1967	78.8	3.2	59.8	3.5	145.3	36.4	8.5	44.9	10.6	200.8
1968	81.2	3.0	61.4	3.3	148.9	36.7	7.9	44.6	11.0	204.5
1969	82.0	2.7	60.6	3.0	148.3	38.4	8.2	46.6	11.2	206.1
1970	84.1	2.4	62.0	2.9	151.4	40.5	8.0	48.5	11.8	211.7
1971	83.6	2.2	68.2	2.8	156.8	40.4	8.3	48.7	11.5	217.0
1972	85.9	1.8	62.9	2.9	153.5	42.0	8.9	50.9	12.5	216.9
1973	81.1	1.5	57.6	2.4	142.6	40.7	8.5	49.2	12.9	204.7
1974	86.4	1.9	62.2	2.0	152.5	41.1	8.9	50.0	12.2	214.7
1975	88.9	3.6	51.2	1.8	145.5	40.6	8.6	49.2	12.3	207.0
1976	95.7	3.3	54.6	1.8	155.4	43.3	9.2	52.5	13.1	221.0
1977	93.2	3.2	56.7	1.6	154.7	44.8	9.3	54.1	12.9	221.7
1978	88.8	2.5	56.5	1.5	149.3	47.5	9.3	56.8	13.6	219.7
1979	79.6	1.6	64.6	1.3	147.1	51.5	10.1	61.6	13.3	222.0
1980	78.3	1.5	69.8	1.4	151.0	51.2	11.0	62.2	[2]13.5	[2]226.7

[1]Retail weight, ready-to-cook, or edible meat basis. [2]Estimated.

Demand Relationships

Per capita consumption of fish has moved upward over the past 25 years. In addition, it is generally agreed consumers substitute red meat, poultry, and fish for each other because of budgetary concerns and for the sake of diversity in the diet. Inflationary pressures in recent years may have caused consumers to change food purchasing patterns. Earlier demand studies may not fully reflect the changes. Nevertheless, from a background standpoint, it is useful to review empirical studies concerning the nature of demand for fish and the competitive relationships among red meat, poultry, and fish.

The price elasticity of demand is a measure of how sensitive consumption of an item is to a change in the price of that item (or the price of another item) while holding other prices and income constant. Statistically, the own (cross)-price elasticity of demand is the percentage changes in quantity consumed of a commodity due to a 1-percent changes in the price of that (another) commodity. Similarly, the income elasticity of demand provides a measure of how sensitive consumption is to a 1-percent change in income while all prices are held constant.

Measurements of elasticities will vary because of differences in statistical models, estimation methods, data bases (time-series versus cross-sectional data), and the level of aggregation in commodity groups.

Own-Price Elasticity

Waugh and Norton (14), using a single commodity approach, estimated the own-price elasticity of fish to be -0.37 (that is, a 1-percent increase (decrease) in the price of fish would result in a .37-percent decrease (increase) in per capita consumption of fish). Studies by Brandow (3), George and King (8), and Ball (1), which also used time-series data but considered the interdependent nature of demand, obtained respective elasticities of -0.65, -0.23, and -0.42. More recently, an extensive study by Capps (6), using cross-sectional data from the Consumer Expenditure Survey of 1972-73 and employing the systems approach to estimation, obtained price elasticities of demand for fish that ranged from -0.66 to -2.6. The demand for fish and seafood was generally estimated to be more inelastic than the demand for beef, pork, and poultry in the studies by Brandow, George and King, Ball, and Capps.

Cross-Price Elasticity

The results of various demand studies indicate substitution among red meat, poultry, and fish, although the influences of substitutes are for the most part weak. The cross-price elasticity of demand measures the competitive relationships (or substitutability) among commodities.

Waugh and Norton reported 0.47 for the cross-price elasticity of demand between fish and red meat; Ball found 0.37. Those two studies also reported a negative cross-price elasticity between fish and poultry, although Waugh and Norton's estimate was not statistically significant.

The results of the studies by Brandow and George and King indicated rather weak responses in fish consumption to changes in the prices of beef, veal, pork, lamb and

mutton, chicken, and turkey. The elasticities ranged from a low of 0.0013 for lamb and mutton to a high of 0.026 for pork. Capps, who used two different statistical models, obtained results that generally corroborated the signs of the above studies, if not the magnitudes.

Capps also investigated demand relationships of food away-from-home. Results obtained for the cross-price elasticity of demand of fish as food away-from-home were generally negative and greater than one. This means a 1-percent increase (decrease) in the price of food away-from-home will decrease (increase) consumption of seafood by more than 1-percent. Capps concluded,"Food consumed away from home is a net substitute for red meats, poultry, other meats and pork consumed at home. On the other hand, food consumed away from home is a net complement for seafood, which suggests that consumers primarily purchase seafood products for away from home consumption (7, p. 176)." Such results highlight the fact that about two-thirds of the fish and seafood consumed in the United States is through the food service trade.

Income Elasticity

Estimates of the income elasticity of demand for red meat, poultry, and fish vary because of differences in the statistical models and procedures used, as well as the data base employed. George and King, using time-series data, obtained an income elasticity of 0.004 for seafood, compared with estimates of 0.29, 0.13, and 0.57 for beef, pork, and chicken, respectively. Using cross-section data, they produced income elasticities of -0.06 for seafood, 0.27 for beef, 0.01 for pork, and -0.034 for chicken. Waugh and Norton, using time-series data, estimated the income elasticity for fish to be -0.02, although the estimate was not statistically significant. In addition, Purcell and Raunikar (11) from their cross-sectional study, found that consumption did not increase continuously over all income categories. The above results imply a weak relationship between seafood consumption and changes in income.

In contrast, Capps' results indicate more elastic responses of meat and seafood consumption to income changes. For seafood, income elasticities ranged from 0.303 to 2.516. Capps judged that red meats, seafood, and food away-from-home are relatively responsive to income changes and that they are"luxuries"—that is, a 1-percent increase in income will result in a greater than 1-percent rise in consumption. Ball estimated expenditures elasticities of demand, which measure sensitivity of consumption to a change in consumer expenditures (rather than income). His study produced expenditure elasticies of 0.354 for red meats, 0.196 for poultry, and 0.810 for fish. This implies fish consumption is more sensitive to changes in consumer expenditures than other meats.

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