

Processing Food in Farm States: An Economic Development Strategy for the 1990s

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Officials in farm-dependent states are turning to the food processing industry as a critical source of economic growth in the 1990s. Many of these farm states—found mostly in the western Corn Belt and northern Great Plains—have yet to replace jobs lost in the deep farm recession in the 1980s, despite three years of strong farm recovery more recently. The 1980s farm downturn is strong evidence that farm production alone is no longer a sufficient engine for farm state economies. Consequently, turning farm products into food products is viewed as a key to stronger economic growth in the 1990s.

What can farm states do to encourage food processing activity in the 1990s? They face an uphill battle in expanding food manufacturing, but a strategy of developing food products suited to farm output and consumer markets will pay some dividends. The first section of this article identifies seven farm states with the greatest

potential to expand food processing activity: Arkansas, Idaho, Iowa, Kansas, Minnesota, Nebraska, and Wisconsin. The second section examines how these states can develop food products to encourage growth in food processing and identifies four products best suited to the seven states. The third section considers the outlook for these four food products in the 1990s. The article concludes that a successful food processing strategy will depend on investments in emerging food technologies that could offset the distance separating the farm states from major consumer markets.

I. Farm States with Food Processing Potential

All farm states are interested in developing more food processing, but not all share the same prospects for success. Comparing the location of farm and food production is a useful first step in assessing development prospects. All farm states face a location disadvantage—they are a long way from major population centers. Nevertheless, farm states that are closer to major popu-

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Table 1

Average Hourly Earnings in Various Industries, December 1989

<u>Industry</u>	<u>Average hourly earnings</u>
Manufacturing	\$10.66
Durable goods	\$11.18
Electrical equipment	10.52
Motor vehicles and equipment	14.50
Nondurable goods	9.95
Food and kindred products	9.47
Beverages	13.36
Grain mill products	11.26
Bakery products	10.69
Dairy products	10.34
Fats and oils	9.94
Sugar and confectionery products	9.61
Preserved fruits and vegetables	8.99
Meat products	7.82
Textile mill products	7.86
Apparel	6.45
Paper and allied products	12.11
Printing and publishing	11.07
Leather and leather products	6.73
Transportation and public utilities	12.70
Wholesale trade	10.62
Retail trade	6.66
Finance, insurance, and real estate	9.76

Source: U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings*, February 1990.

lation centers or have a base of food processing companies already established are more likely to succeed in expanding the food industry.

Why is food processing important to farm states?

Farm states have linked their economic futures to food processing because it can boost economic activity arising from their abundant farm production. Food processing is a manufacturing industry that inherently increases the economic activity attached to farm products. It combines labor, machinery, energy, and technology to convert bulky farm products into packaged, palatable foodstuffs (Connor 1988, p. xxiii). Thus, food processing allows farm state economies to increase employment and income before farm products are shipped to distant markets.

The food processing industry is a big industry to target. Food processing shipments totaled \$388.4 billion in 1989, ranking first among the 20 key types of U.S. manufacturing during the year. The industry employs nearly 1.7 million people, making it the fourth-biggest manufacturing jobs category, after electrical machinery, nonelectrical machinery, and transportation equipment (Bureau of Economic Analysis 1990).

Targeting the food processing industry is desirable for farm states because the industry is so stable. The economies of farm states were highly cyclical in the 1980s. Historically, food manufacturing has been very steady and much less cyclical than many other types of manufacturing.¹

Food processing jobs also generally pay attractive wages and thus have a welcome impact on state incomes. At \$9.47 an hour, food wages are not the highest among manufacturing industries, yet they are high relative to other types of nondurable manufacturing often found in rural areas—such as textiles, apparel, and leather goods (Table 1). Even so, wages paid in the food

industry range widely—from \$7.82 an hour in meat products to \$13.36 an hour in beverage products.

Which states depend on farm production?

The first step in identifying states where a food processing strategy will be important is to define farm states. There is no accepted definition of a farm state in common usage. For the purposes of this article, a farm state is a state where farm output is significant to its overall economy. States that depend on agriculture have a sizable stake in adding economic value to their farm output.²

Specifically, farm states can be defined as states where farm output as a share of gross state output (GSP) is at least twice the national average.³ Nationally, farm output is 2.2 percent of the total output of goods and services. The farm share of GSP is at least double the national average in just ten states: South Dakota, North Dakota, Nebraska, Iowa, Idaho, Kansas, Arkansas, Montana, Minnesota, and Wisconsin (Chart 1 and Table 2).

These ten farm states can expect stiff competition for the nation's food processing activity. The primary competition will come from other states that produce a large volume of farm products. The ten biggest include only half of the ten farm states—Iowa, Minnesota, Nebraska, Wisconsin, and Kansas. The five other states that lead the nation in agricultural production have large, diversified economies including strong food processing industries. The food processing industries in these larger, more diversified states are the primary competition for food processing initiatives in the farm states.⁴

Where is food processed?

How successful can the ten farm states be in developing more food processing? One way to begin answering this question is to compare

Table 2

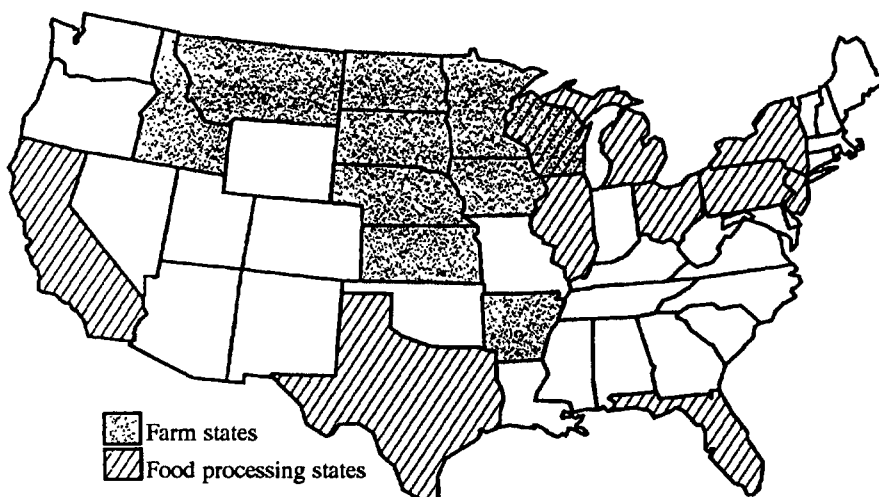
The Importance of Farm Production in the 50 States, 1984-86 Average

Farm share of gross state product					
Rank	State	Share (percent)	Rank	State	Share (percent)
1	South Dakota	17.48	26	Delaware	2.17
2	North Dakota	14.51	27	Illinois	2.06
3	Nebraska	13.85	28	New Mexico	2.01
4	Iowa	11.25	29	Arizona	1.93
5	Idaho	10.11	30	California	1.88
6	Kansas	6.77	31	Texas	1.77
7	Arkansas	6.34	32	Wyoming	1.71
8	Montana	5.55	33	Utah	1.63
9	Minnesota	5.02	34	Maine	1.51
10	Wisconsin	4.46	35	South Carolina	1.41
11	Kentucky	4.18	36	Ohio	1.37
12	Mississippi	4.14	37	Michigan	1.34
13	Oregon	3.54	38	Pennsylvania	1.22
14	Oklahoma	3.26	39	Virginia	1.16
15	Vermont	3.15	40	Louisiana	1.06
16	Indiana	3.01	41	Maryland	.93
17	Washington	2.94	42	Nevada	.74
18	Missouri	2.82	43	West Virginia	.70
19	North Carolina	2.71	44	New Hampshire	.52
20	Colorado	2.59	45	New York	.50
21	Alabama	2.54	46	Rhode Island	.45
22	Hawaii	2.44	47	Connecticut	.42
23	Florida	2.29	48	New Jersey	.39
24	Tennessee	2.24	49	Massachusetts	.30
25	Georgia	2.18	50	Alaska	.11
				National average	2.17

Source: U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, May 1988, and unpublished data.

Chart 1

The Leading Farm and Food Processing States



Source: See Table 3.

the location of farm production and food production. Are the farm states already processing a lot of food? If not, are they near regions that do? The answers to these questions will describe the amount of food processing activity already occurring in the farm states and reveal the major source of competition the farm states face in further developing their food processing industries.

In general, farm states account for a relatively small share of the nation's total food processing output (Table 3). Some overlap exists in the location of the nation's farm production and food processing activities, but the overlap is relatively small.

The nation's food processing activity is con-

centrated in two regions, the Sun Belt and the industrial states spanning the Great Lakes and the Northeast. As shown in Chart 1, the top ten food processing states include three Sun Belt states (California, Florida, and Texas) and seven industrial states in the Great Lakes and Northeast regions (Wisconsin, Illinois, Michigan, Pennsylvania, New York, and New Jersey). These seven industrial states form a major food processing belt that accounts for more than a third of the nation's food processing activity.

Food processing appears to have located in the Sun Belt and Northeast primarily because these regions are close to the nation's major population centers. Nine of the ten leading food

Table 3

Population and Food Processing Activity in the Major Food Processing States and the Farm States

Major food processing states	Population ¹		Share of U.S. food processing output ²		Food processing share of Gross State Product ²	
	Thousands	(Rank)	Percent	(Rank)	Percent	(Rank)
California	29,063	(1)	11.90	(1)	1.67	(22)
Illinois	11,658	(6)	7.32	(2)	2.54	(10)
New York	17,950	(2)	5.90	(3)	1.23	(33)
Texas	16,991	(3)	5.86	(4)	1.31	(31)
Pennsylvania	12,040	(5)	5.34	(5)	2.12	(16)
Ohio	10,907	(7)	4.72	(6)	1.92	(19)
New Jersey	7,736	(9)	4.38	(7)	2.14	(15)
Wisconsin	4,867	(17)	3.56	(8)	3.27	(6)
Michigan	9,273	(8)	3.37	(9)	1.60	(24)
Florida	12,671	(4)	3.37	(10)	1.45	(30)
Farm states						
Wisconsin	4,867	(17)	3.56	(8)	3.27	(6)
Iowa	2,840	(29)	2.57	(13)	4.04	(2)
Minnesota	4,353	(21)	2.56	(14)	2.42	(13)
Nebraska	1,611	(36)	1.49	(22)	4.01	(3)
Kansas	2,513	(32)	1.48	(23)	2.50	(11)
Arkansas	2,406	(33)	1.47	(24)	3.35	(5)
Idaho	1,014	(42)	0.80	(32)	4.31	(1)
South Dakota	715	(45)	0.35	(39)	2.60	(9)
North Dakota	660	(47)	0.23	(42)	1.45	(29)
Montana	806	(44)	0.13	(48)	0.77	(42)

¹ 1989.

² 1984-86 average.

Sources: U.S. Department of Commerce, Bureau of the Census, Current Population Reports, *Population Estimates and Projections, State Population and Household Estimates: July 1, 1989* (population data); Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, May 1988, and unpublished data (Gross State Product data).

processing states—all except Wisconsin—rank among the ten most populous states in the nation. More than half of the nation's population resides in the ten leading food processing states (Table 3). Unlike the three Sun Belt states, which are leaders in both farm and food production, all of the states of the northeastern food processing belt—except Illinois—produce a comparatively small volume of farm products.

In contrast to the high concentration of food processing activity in the Northeast and Sun Belt states, such activity in the ten farm states is limited. The ten farm states account for only 15 percent of the nation's total food output. Only one of the ten farm states, Wisconsin, is among the ten leading food processing states. Food processing activity in the ten farm states generally diminishes in states further removed from the food processing belt. For example, each of the westernmost farm states—Idaho, Montana, North Dakota, and South Dakota—processes only a small fraction of the nation's food. On the other hand, the three farm states adjacent to the food processing belt—Iowa, Minnesota, and Wisconsin—are the leading food processors among the ten farm states.

The food processing industry is nonetheless a vital part of the economy in farm states. Food processing accounts for an average 1.7 percent of GSP for the 50 states as a whole. Eight of the ten farm states exceed that average by a considerable amount (Table 3). By contrast, both food processing and farm production play a relatively small role in the large, well-diversified economies of the major food processing states. The clear challenge for farm states wishing to boost food processing activity is to find ways to compete effectively with the location advantages of the major food processing states.

Which farm states can expand food processing?

Which farm states appear most able to

expand food processing in the 1990s? Two criteria define a farm state's ability to expand. The first is the distance from the state to major population centers. All farm states face a location disadvantage, but some are farther from major markets than others. The second is the presence of a viable food processing base from which to grow. States that have little or no food processing already established probably have little likelihood of successfully entering the competitive, capital-intensive industry.

One indicator of a farm state's food processing base is the amount of food processed in the state compared with the amount of farm products produced there. Put another way, the ratio of farm output to food processing output in each farm state approximates how much of the state's farm output is already processed before it is shipped elsewhere. A high farm-food output ratio indicates relatively little food processing activity and points to only a small base from which to expand. Conversely, a low farm-food output ratio indicates a much stronger food processing base that can be expanded more readily. In short, farm states do not share the same capacity to expand food processing. Those with more favorable location and with a food industry base already established have better prospects to expand.

Two groups of states emerge from examining the farm-food output ratios of the farm states. All ten farm states have farm-food output ratios above the national average of 1.25 (Table 4). But of more importance, the ten states appear to fall into two groups representing high and low potential for expanding food processing. The two groupings appear consistent with the location of the states relative to population centers.

High-potential farm states. The seven high-potential states have relatively low farm-food output ratios and are within striking distance of major consumer markets. The farm-food output ratios range from 1.36 in Wisconsin to 3.45 in Nebraska. The range of ratios indicates a big-

Table 4
Major Farm Products and Food Processing Industries in the Farm States

Panel A—High Potential States				
Major farm products	Farm-food output ratio	Product share of state farm cash receipts (percent) ¹	Major food processing industries	Industry share of state food employment (percent) ²
<i>Wisconsin</i>	1.36			
Dairy products		60	Dairy products	32
Meat animals		20	Meat products	23
			Preserved fruits and vegetables	14
<i>Arkansas</i>	1.89			
Poultry and eggs		45	Meat products	62
Meat animals		13	Preserved fruits and vegetables	12
Food grains		13		
Oil crops		13		
<i>Minnesota</i>	2.07			
Meat animals		30	Meat products	31
Dairy products		20	Dairy products	17
Feed grains		16	Preserved fruits and vegetables	12
Oil crops		15		
<i>Idaho</i>	2.35			
Meat animals		29	Preserved fruits and vegetables	61
Vegetables		21		
Dairy products		13		
Food grains		10		
Feed grains		10		
<i>Kansas</i>	2.71			
Meat animals		62	Meat products	50
Food grains		15	Bakery products	11
Feed grains		13	Grain mill products	11
<i>Iowa</i>	2.78			
Meat animals		50	Meat products	50
Feed grains		22	Grain mill products	20
Oil crops		20		
<i>Nebraska</i>	3.45			
Meat animals		63	Meat products	56
Feed grains		22	Grain mill products	14

Table 4 - Continued

Panel B—Low-Potential States				
Major farm products	Farm-food output ratio	Product share of state farm cash receipts (percent) ¹	Major food processing industries	Industry share of state food employment (percent) ²
<i>South Dakota</i>	6.73			
Meat animals		57	Meat products	63
Feed grains		13	Dairy products	16
Oil crops		10	Bakery products	10
<i>Montana</i>	7.20			
Meat animals		52	Meat products	15
Food grains		24	Dairy products	29
Feed grains		13	Grain mill products	16
			Bakery products	21
<i>North Dakota</i>	9.98			
Meat animals		26	Meat products	11
Food grains		30	Dairy products	14
Feed grains		14	Preserved fruits and vegetables	17
Oil crops		12	Sugar and confectionery products	17
¹ Average 1986-88.				
² 1987.				
Sources: U.S. Department of Agriculture, Economic Research Service, <i>Economic Indicators of the Farm Sector, State Financial Summary, 1988</i> (product share of state farm cash receipts); U.S. Department of Commerce, Bureau of the Census, <i>County Business Patterns, 1987</i> , various issues (industry share of state food employment).				

ger food processing base in some states than others. Nevertheless, each state in the high-potential group—Wisconsin, Arkansas, Minnesota, Idaho, Kansas, Iowa, and Nebraska—has a strong food processing base from which to grow.

The seven high-potential states face different

challenges in terms of their location. Wisconsin, Minnesota, and Iowa are along the western fringe of the northeastern food processing belt. Arkansas is well-positioned to serve the Sun Belt population centers. Idaho, Kansas, and Nebraska are somewhat further removed from consumer markets. Despite their location differences, all

of the high-potential states face a distinct challenge in overcoming the high shipping costs that result from their distance to population centers.

Low-potential farm states. Low-potential states have a weak food processing base and are a long way from consumer markets. Farm-food output ratios in the low-potential states range from 7.0 to 10.0, significantly higher than in the high-potential states. Farm output is generally smaller in Montana, North Dakota, and South Dakota than in the other farm states. Nevertheless, farm output far outweighs food production in these northern Great Plains states. These states lack a dominant farm commodity to spark food processing development. In addition, these three sparsely populated states are a long distance from population centers, a strong negative factor for expanding food processing activity. Given the limited potential for expanding food processing in these three states, the remainder of this article will focus on the seven states with high potential for expanding their food processing industry.

II. The Challenge for Farm States: Developing Successful Food Products

States with high potential for expanding their food processing industry already have a food processing base from which to grow; but how can they expand that base? The answer lies in developing successful food products. Product development is a combination of four steps: choosing, where possible, food products in growing demand; assessing the competition in food product markets; developing promising technologies; and adding value to farm state products. In brief, the farm states must target markets carefully, choosing to compete in markets where prospects for growth are bright, where competition is less concentrated, and where technological developments may open new market niches. But

these steps must be taken within the overall constraint of using the states' own farm products. This section examines the factors affecting each of the four product development steps and concludes by identifying four promising food products farm states can target to boost food processing activity.

Choosing growth markets

Farm states should target food products that promise to be in growing demand. Demographic trends in the consumer population are likely to play a strong role in determining patterns of growth among various food products. By anticipating the influence of these demographic trends on patterns in food demand, farm states can improve their chances of success in expanding their food processing activity.

The major trend likely to characterize the U.S. food market in the years ahead is clear: the consumer will demand more food products offering greater convenience with high nutritional value. Spurring the demand for such food products is a changing U.S. lifestyle that will limit the time available for meal preparation. More than four-fifths of all U.S. households now have a single parent or two wage earners. Within five years, two-thirds of all households will contain just one or two persons; two-thirds of all women will be in the work force; and three-fourths of all households will own microwave ovens (U.S. Department of Commerce 1990). With meals on-the-run becoming the national norm, continued growth in the consumer's demand for convenient food products can be expected.

At the same time, consumers are becoming increasingly concerned about the nutritional value of processed food products. As a result, consumers will demand—and be willing to pay for—a growing variety of food products that provide a high level of convenience without sacrificing nutritional quality. This strong trend in consumer food demand is almost certain to play a

major role in determining prospects for growth in the food processing products of greatest importance to the farm states.

Assessing the competition

Farm states are most likely to succeed by targeting food products with markets that can be entered easily. Thus, states must promote food products that can compete in a crowded national food market. Economic incentives—gains in employment and income—resulting from increased food processing activity range widely across the many food industries. Farm states can expect stiffer competition in those food industries where economic incentives are greater. Some of the food industries that offer the largest economic payoffs are already highly concentrated and thus are virtually closed to entry by the farm states. Futile efforts to enter those industries would simply deplete scarce development funds. Instead, farm state strategies should target those food industries where the probability of successfully entering the market is reasonable, even if the potential rewards are somewhat smaller.

The economic boost likely to accompany increased food processing ranges widely across food products, depending on the value added to raw farm products and the number of jobs created. Food products associated with higher levels of value added and increased employment naturally attract strong competition. Thus, farm states targeting such food products face a low probability of successful entry into these markets.⁵ In addition, production of many high value-added products is dominated by a few large, well-entrenched firms. If farm states target those products, they must recruit branch plants of large companies. Studies show that recruiting out-of-state manufacturers is less effective than fostering indigenous businesses (Smith and Fox 1990). Processing activity in some food markets is also highly concentrated geographically. Farm states are likely to have difficulty promoting

products whose production and distribution are based elsewhere, unless ways of overcoming locational disadvantages are found. Farm states are more likely to boost activity in food industries that are more diffuse geographically, especially those industries that use locally produced farm products.

Developing new technologies

Farm states should focus additional effort on emerging food technologies that offer great promise for boosting local processing activity. New methods in both production and distribution will help farm states capitalize on their abundance of raw food products, while effectively minimizing the distance from their fields to major food markets.

Emerging technologies with the greatest promise for farm states are developments in weight-reducing processes, packaging, and biotechnology. Weight-reducing processes reduce shipping costs. For example, in recent years meat packers have cut beef into frozen portions and shipped them in boxes, rather than shipping the much heavier carcasses. The development of boxed beef has helped encourage the meat packing industry to move from urban centers to the southern plains states. In the future, similar innovations in other food products could offset the distance from farm states to consumer markets.

Two other new types of packaging promise to extend product shelf life and allow shipment to distant markets. Controlled-atmosphere packaging involves placing a food product in a sealed package with low levels of oxygen and high levels of carbon dioxide to maintain freshness. Retort pouch packaging replaces the customary can or jar with a paper-foil pouch in which food is sealed and heated under pressure. The pouch packaging weighs less than conventional packaging materials, which reduces shipping costs and helps farm states overcome their locational disad-

vantage. In addition, the method leads to a high-quality product because the heating time required to ensure sterility is reduced (Labuza 1985, p. 74).

Advances in biotechnology may also open new food frontiers to farm states by developing new farm products and creating new uses for existing farm products. Genetic engineering may enable plant and animal scientists to develop crops and animals with more desirable food qualities. For example, wheat varieties may be developed with protein characteristics suited to a particular bakery product. Or, cattle may be genetically altered to reduce particular types of fat. Genetic advances such as these may not lead immediately to greater food processing activity; yet they may enhance cooperation between farm producer and food processor, a link that may lead to more economic activity in the farm states.

Biotechnology may also lead to fermentation techniques that would convert farm products into enzymes with useful properties. Worldwide, the food processing industry uses \$445 billion of enzymes in producing its products (Hopper and Lund 1990). For example, producing the artificial sweetener aspartame requires the use of an enzyme reaction. New research may find ways to produce these enzymes from current crops, enhancing the opportunity to add value to raw farm products.

Adding value to farm state products

Market growth, market access, and technology will be important factors in successful food product development. But farm states must build their food processing strategies on the farm and food product strengths they already have. A readily available supply of certain farm products provides food processing industries in the farm states one competitive advantage to help offset the disadvantage of being far from consumer markets. But to take advantage of their cheap supply of farm products, compatible food prod-

ucts must be developed. Farm and food production activities differ markedly among the farm states. Nevertheless, the farm states are similar in that the food processing activity already underway in each state is based on its leading farm products (Table 4).

The seven high-potential farm states—Wisconsin, Minnesota, Arkansas, Idaho, Iowa, Kansas, and Nebraska—have successfully built strong food processing industries around a diverse set of homegrown farm products. The dairy industry is a leading industry in Wisconsin and Minnesota. Wisconsin's dairy industry generates about three-fifths of all farm product sales in the state and about a sixth of all dairy farm sales in the nation. The dairy processing industry, in turn, is Wisconsin's dominant food processing industry, employing nearly a third of the state's food processing workers.⁶ Dairy production is also a leading industry in Minnesota's farm economy, but the state's livestock, grain, and soybean production yield a farm economy that is more diverse than that of Wisconsin. Meat and poultry dressing plants and the dairy processing industry are the leading food processing employers in the state, accounting for nearly half of the state's food processing employment.

Arkansas and Idaho are similar in that each has successfully exploited a relatively narrow food market niche. In Arkansas, broiler production generates 45 percent of the state's farm product sales. In turn, the state's huge broiler industry supports a poultry dressing and processing industry that accounts for more than 60 percent of the state's food processing employment. In Idaho, more than 60 percent of the state's food processing workers are employed in the vegetable processing industry, which is spawned by the state's substantial vegetable production.

The three remaining high-potential farm states, Iowa, Kansas, and Nebraska, produce a broad range of similar farm and food products. Huge grain and soybean crops support large livestock feeding industries, the dominant farm

enterprise in each state. Together, Iowa, Kansas, and Nebraska account for about 30 percent of the nation's livestock sales, a volume that has given rise to the region's large meat products industry. The meat products industry—primarily meat packing plants—employs at least half of all food processing workers in each of the three states. In addition to providing ample feed for livestock in these states, grain production serves as the raw material for a number of grain and bakery products. These grain processing industries are the second leading food processing employers in the three states.

In sum, the seven farm states with high potential for developing additional food processing activity have already established a base in four key industries: meat products, dairy products, preserved vegetables, and grain products. The challenge facing the farm states is determining how to unlock even more value from these homegrown farm products before they are shipped elsewhere.

III. Prospects for Key Food Products in the Farm States

As farm states grapple with strategies for developing their food products, what are their prospects for succeeding in the 1990s? Put another way, when farm state officials combine all elements of food product development—growth in consumer markets, access to markets, and new technology—what is the outlook for each of the four key food products?

Meat products

Large livestock production has already allowed the farm states to establish a strong beachhead in the meat products industry. Growth in the industry will be strongly influenced by the consumer's growing appetite for convenient food products. Favoring the industry's growth are emerging packaging technologies that mesh

with growing demand for processed meat and poultry products requiring little preparation time.

The demand for all meat products has trended higher in recent years, largely due to a surge in poultry consumption. Rising poultry consumption, however, has been accompanied by a sharp drop in red meat consumption. After cresting in 1976, per capita consumption of red meat has fallen about 21 pounds (16 percent). More than offsetting the slump in demand for red meat has been a 23-pound (63 percent) surge in per capita poultry consumption (Putnam 1990).

The shift in consumption from red meat to poultry is due in part to the consumer's acceptance of the poultry industry's numerous offerings of innovative, competitively priced food products. Although the red meat industry has lagged behind in developing new product offerings, the industry has begun to add more value to its products before shipping. For example, about 86 percent of the nation's total beef production is now shipped as boxed beef (U.S. Department of Commerce 1990).

Looking ahead, the red meat industry's ability to curb the consumer's shift to poultry will depend on whether it can develop new convenience products to meet consumer demands. New packaging technologies may play a major role in determining the balance between the demand for red meat and poultry. Meat packers already ship beef and fresh turkeys to processing plants under controlled-atmosphere storage. Further innovations in controlled-atmosphere packaging might expand meat markets by extending the shelf life of meat products. Retort pouch packaging could be used for meat products, reducing weight and shipping costs relative to shipping boxed beef. Thus, further packaging innovations may allow farm states to add more value to meat products before shipping.

Favoring further development of the meat products industry in the farm states is the relative ease with which farm states can enter meat prod-

Table 5

Characteristics of Farm State Food Processing Industries

	Four-firm concentration ratio¹	Four-state concentration ratio²	Value ratio³
	(percent)	(percent)	(percent)
<i>Food and kindred products</i>	n.a.	28	39
<i>Meat products</i>	n.a.	26	21
Meatpacking plants	29	37	17
Sausages and other prepared meats	19	32	22
Poultry dressing plants	22	45	34
Poultry and egg processing	22	41	20
<i>Dairy products</i>	n.a.	35	29
Creamery butter	41	63	5
Natural and processed cheese	34	60	22
Condensed and evaporated milk	35	53	42
Ice cream and frozen desserts	22	33	27
Fluid milk	16	27	32
<i>Preserved fruits and vegetables</i>	n.a.	35	50
Canned fruits and vegetables	21	46	46
Dehydrated fruits, vegetables, and soup	42	83	41
Frozen fruits and vegetables	27	57	46
<i>Grain mill products</i>	n.a.	31	44
Flour and grain mill products	40	31	31
Cereal breakfast foods	86	55	97
Blended and prepared flour	58	43	30
Wet corn milling	74	76	36
Dog, cat, and other pet food	52	36	60
Prepared feeds	20	30	24
<i>Bakery products</i>	n.a.	31	73
Bread, cake, and related products	34	32	76
Cookies and crackers	59	40	67

1 1982.

2 1987.

3 1986 ratio of value added in processing to value of product shipments.

Sources: U.S. Department of Commerce, Bureau of the Census, 1982 *Census of Manufactures, Concentration Ratios in Manufacturing* (four-firm concentration ratio); U.S. Department of Commerce, Bureau of the Census, *County Business Patterns, 1987*, various issues (four-state concentration ratio); U.S. Department of Commerce, Bureau of the Census, unpublished data (value ratio).

uct markets. This article uses two gauges of market competition to measure this ease: 1) the four-firm concentration ratio, or the share of the market in a given product controlled by the four largest firms, and 2) the four-state concentration ratio, or the share of jobs found in the four dominant states for each product. The four-firm concentration ratio in meat products is relatively low, ranging from only 19 percent in sausages and other prepared meats to 29 percent in meat packing plants (Table 5). Similarly, at 26 percent the four-state concentration ratio is the lowest among the four major food industries of importance to the farm states. The low concentration ratios indicate that competition in meat product markets is relatively diffuse. Although more recent data may reflect a more concentrated industry, the market for meat products is more open to the farm states than markets for many other food products. Thus, there appears to be an opportunity to build on the existing meat processing activity the farm states already enjoy.

Economic activity generated by the meat products industry is smaller than that generated by many other food processing industries, however. The amount of value added to raw farm products in meat processing is relatively low. One measure of the amount of value added to raw farm products in various food processing industries is the ratio of value added in processing to the total value of food shipments. A high ratio indicates a substantial amount of economic activity generated by the processing industry. Only 21 percent of the value of the meat products industry's total shipments is added in processing plants, well below the average 39 percent added by all food processing industries. On the other hand, the meat products industry is relatively labor intensive, promising the creation of many jobs. But the industry's average wage is relatively low (Table 1). Still, with new technologies promising to boost the amount of value added in the industry's plants, and with a strong farm state presence in the industry already in

place, the meat products industry is a likely target for farm state development efforts.

Dairy products

Prospects for further developing the dairy products industry in the farm states are relatively bright. Although new entrants to the industry will face well-entrenched competition, two of the farm states, Minnesota and Wisconsin, are already among the industry's leaders. Moreover, technological advances could boost milk processing activity in the farm states.

Consumer demand varies widely across the range of dairy products. Per capita consumption of all dairy products has grown slowly in recent years, edging up only 7 percent during the 1980s to 582 pounds in 1988 (Putnam 1990). The market for fluid milk and cream has been one of the weakest segments of the dairy market, with per capita consumption falling sharply in the 1970s and edging down further in the 1980s. Similarly, consumption of frozen dairy products has stagnated since the early 1970s. Sales of low-calorie frozen desserts, however, are expected to be relatively strong in the years ahead, as makers of ice cream and other frozen desserts recognize the consumer's growing nutritional concerns. The cheese market is expected to be the strongest in the dairy industry, spurred by increased use of cheese in convenience foods and other food products (U.S. Department of Commerce 1990).

This array of prospects for various dairy products suggests that dairy processing strategies in the farm states—especially Minnesota and Wisconsin—have successfully targeted the strongest segments of the dairy products market. A strong position in butter, condensed milk, and cheese production has placed Minnesota and Wisconsin among the four leading dairy processing states. Thus, the industry's relatively high four-firm and four-state concentration ratios do not necessarily preclude additional dairy process-

ing activity in the farm states (Table 5). Still, Minnesota and Wisconsin lag behind other states in fluid milk processing, largely due to their distance from major consumer markets.

Recent advances in milk processing techniques, however, may bolster prospects for fluid milk processing in these two farm states. Much of the fluid milk produced in Minnesota and Wisconsin is processed into other products because milk, which is 87 percent water, is heavy and costly to transport long distances to major consumer markets. Although processing milk into other products adds value and economic activity, milk supplies in these two states are so large that further gains are available from shipping more milk to other parts of the country.

Two new technologies may eventually boost milk shipments from the farm states. Newly emerging membrane filtration techniques remove the water from milk through a series of fine filters while retaining nutritional and taste qualities. Milk could be transported in concentrated form and then reconstituted near the point of final sale (Fleming and Kenney 1989).⁷ A second new technique is freeze concentration, the same process used to concentrate fruit juices, which would provide a milk concentrate to be sold in the frozen food case. In sum, these new food packaging technologies could significantly enhance dairy processing activity in the farm states by shrinking the locational disadvantage.

Preserved fruits and vegetables

Prospects are mixed for bolstering food processing activity in the preserved fruits and vegetables industry, the dominant processing industry in Idaho. A relatively high value added rewards successful entrants into this market. A handful of states—including Idaho—have captured a substantial share of the market, however, and will be formidable competition for new entrants to the industry. Advances in food technology should continue the industry's record

of success in meeting the consumer's demand for convenient, highly nutritious products. But the new technologies are likely to offer only marginal gains to the industry's activity in the farm states.

The consumer's increasing appetite for food products that provide both convenience and nutrition has had a major impact in the preserved fruits and vegetables industry. Many of the industry's product offerings are microwavable, spurring demand among a consumer population with limited time for meal preparation. For example, per capita consumption of frozen vegetables increased a fourth during the 1980s, to nearly 18 pounds, and per capita consumption of frozen potatoes increased two-thirds since the early 1970s, to about 22 pounds in 1988. The consumer's increasing concern for nutritional value—as well as for convenience—promises to maintain the market's growth. In addition, the rapidly increasing number of elderly Americans provides another source of growth for easily prepared, highly nutritious product offerings (U.S. Department of Commerce 1990, and Putnam 1990).

Successful new products in the rapidly growing market would likely be rewarded with a substantial boost in economic activity. Processing activity in the preserved fruits and vegetables industry accounts for half of the value of product shipments, the second highest among all food processing industries (Table 5).

New activity in the farm states, however, will meet strong competition from established market players. Although firm concentration ratios are relatively low, geographic concentration ratios in the industry are high. Nearly 60 percent of the nation's employment in the frozen fruits and vegetables industry and over 80 percent of employment in the dehydrated fruits and vegetables industry are located in just four states (including Idaho, a high-potential farm state).

New food packaging technologies further enhance the prospects for the preserved fruits and vegetables industry and might allow farm states

some additional diversification of their crop bases into fresh produce. Some food companies are already using controlled-atmosphere packaging to ship lettuce plants (complete with roots) in a package infused with carbon dioxide. Such "living plants" arrive at retail markets in better condition and have a longer shelf life than lettuce packaged more conventionally. Similarly, the retort pouch can be used to boost the quality of processed vegetable products. These new technologies may allow farm states to make additional inroads into the fruits and vegetables processing industry. But the new technologies will benefit the industry's established players as well, and farm state gains are likely to be limited.

Grain mill and bakery products

Further processing of huge, locally grown grain crops appears to be a natural method of stimulating additional economic activity in farm states. The value added in selected grain processing industries is among the highest of all food processing industries. But the market for these highly desirable industries is also highly concentrated among a few large firms, potentially limiting farm state gains.

Demand for flour and cereal products has risen in recent years, a positive factor for farm state milling and baking industries. Wheat flour is the dominant product in this food group, accounting for three-fourths of total flour and cereal product consumption. Driving the increase in consumption is a strong demand for fresh baked goods, crackers, pasta products, and breakfast cereals. Consumption of cereal and bakery products is larger in older households, indicating the demand for flour and cereal products will remain strong as the large baby-boom generation ages (Putnam 1990, and U.S. Department of Commerce 1990). With demand strengthening for flour and cereal products, the grain and bakery products industries would seem a natural source for adding value to the huge

grain crops produced in the farm states.

In addition, these industries offer substantial economic benefits. For example, in the cereal breakfast foods industry, the value added in processing is 97 percent of the value of product shipments, the highest percentage among all food processing industries (Table 5).

Farm states may have difficulty tapping these markets, however. Markets for many grain-based products tend to be dominated by a few large well-capitalized firms in a few states, posing an effective barrier to entry by farm states. For example, 86 percent of the market for cereal breakfast food is controlled by four firms, one of the highest concentration ratios in the food industry. More than half of the breakfast food industry's jobs are found in just four states. Similarly, four-firm and four-state concentration ratios are relatively high for flour, wet corn milling, and cookies and crackers. Thus, these markets appear difficult to enter unless farm states chase branch plants of major food companies, a costly and difficult approach to development.

Although the grain product markets appear to be natural avenues for using farm state grains, the cost of shipping farm state grain to distant processing points is relatively inexpensive. In addition, technological advances that would enhance grain processing activity in the farm states by reducing the cost of shipping finished grain products or by some other means do not appear likely. In sum, a large portion of the farm states' huge grain crops are likely to remain a ready supply for processing industries elsewhere.

IV. Conclusions

Officials in farm states are turning to food processing as an engine for economic growth in the 1990s. The food industry is an attractive target for economic development because adding value to abundant farm production creates jobs and boosts incomes. Yet the ten farm states are

not major food processing states. To the contrary, a corridor of states spanning from the Great Lakes to the East Coast processes more than a third of the nation's food supply. Based on a comparison of farm output relative to food output, the seven farm states with the greatest potential to expand food processing are Arkansas, Idaho, Iowa, Kansas, Minnesota, Nebraska, and Wisconsin.

Overall, farm states face an uphill battle in becoming major centers for processing the nation's food supply. They have a huge supply

of farm products to process, but they are removed from the nation's population centers. Thus, farm states may need help from new technology to offset their locational disadvantage. In the past, farm states have made enormous investments to boost the productivity of agriculture through the funding of research at agricultural experiment stations and land grant universities. Adding value to farm production may require that more of the research effort be focused on the development of new food processing and transportation technologies.

Endnotes

¹ One piece of evidence indicating the stability of food processing is the pattern of growth in the food processing component of the nation's aggregate gross state product (GSP). The food processing component of manufacturing has grown more slowly than other manufacturing industries, but food processing has been more stable. Based on a regression from 1972 to 1986, the manufacturing component of the nation's GSP grew 2.27 percent a year with a standard error of 0.35 percent. Food processing grew 2.18 percent a year, with a standard error of 0.21 percent. Non-food manufacturing grew 2.27 percent a year, with a standard error of 0.38 percent.

² The farm state definition used in this article is similar to the U.S. Department of Agriculture's definition of a *farm-dependent* county. A farm-dependent county is one in which agriculture accounts for more than 20 percent of the county's total personal income. In addition, the Agriculture Department defines a *farm-important* county as a county where farming accounts for 10 to 20 percent of the county's total personal income.

An alternative definition of farm state is a state that produces a large quantity of farm production. But many of the states with large farm output have large, diversified economies and thus are much less dependent on a food processing strategy. California, the nation's largest producer of farm products, is a prime example.

³ The most recent gross state product data available are for 1986. This analysis is based on an average of the GSP

data for 1984 through 1986 to smooth variations in the data caused by changing weather, shifts in farm policy, and other short-term effects.

⁴ The ten states that lead the nation in farm output in descending order are California, Texas, Iowa, Illinois, Florida, Minnesota, Nebraska, Wisconsin, Kansas, and North Carolina. Thus, the five nonfarm states among the ten leading producers of farm products are California, Texas, Illinois, Florida, and North Carolina. Two of these five states (Texas and Illinois) are focusing some development effort on food processing, but the strategy is generally aimed at rural development rather than statewide development.

⁵ In essence, farm states must consider both the risks and the rewards of pursuing various food processing industries. A strategy designed to capture industries offering the greatest rewards—in terms of jobs and income created in adding value to raw farm products—may also face the greatest risk of failure. For example, the cereal breakfast food industry leads all food processing industries in the amount of value added to raw farm products. But the breakfast food industry is highly concentrated in the hands of a few well-entrenched firms. Thus, a potentially large economic payoff—the large value added—is offset by a very slight chance of successfully capturing a piece of the industry. In contrast, the meatpacking industry offers a lower reward (in terms of value added) than the breakfast food industry. But since the industry is not as concentrated