Lettuce: An Economic Assessment of the Feasibility of Providing Multiple-Peril Crop Insurance

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Executive Summary

U.S. farms produced $1.5 billion worth of lettuce in 1993. Three types of lettuce dominate commercial production: head or iceberg, 74 percent of the value of output, leaf lettuce, 17 percent, and romaine, 9 percent. Lettuce is produced and shipped year round in the U.S. with the source of supplies changing with the seasons. U.S. lettuce production and utilization has leveled off since 1987 after growing rapidly in the 1970s and early '80s. Only a small share of U.S. output is exported, mainly to Canada, and very little lettuce is imported.

Although lettuce is produced in many states, California and Arizona dominate U.S. production. California, which produces lettuce year round, accounted for 76 percent of U.S. production in 1993. The major lettuce area in California is the Salinas Valley, where lettuce is harvested from early April through early November. In winter, most California production shifts southward to Imperial County. Arizona is the leading lettuce state during winter, accounting for about 19 percent of U.S. annual production in 1993.

About 2,200 U.S. farms grow lettuce, according to the 1987 Census of Agriculture. Most lettuce farms are large, and many grow other vegetables in addition to lettuce. More than half of the farms producing lettuce in the top six states (California, Arizona, Colorado, Florida, New Mexico, and New Jersey) had more than $100,000 in crop sales in 1987; about half of the farms in California and more than 60 percent in Arizona had crop sales above $500,000. Lettuce farms are much smaller in the remaining top ten states. About 30 percent of the farms in Michigan, 40-45 percent in New York and Texas, and 50 percent in Washington sold less than $25,000 in crops in 1987. Lettuce is a cool season crop that grows best when day temperatures are between 70-75 degrees with nights at 45 degrees. Ideal conditions--cool temperatures, low humidity, and adequate water for irrigation--are present in different parts of California at different times of the year and in Arizona in the winter. The time from emergence to harvest of lettuce ranges from 55 to 70 days under normal day length and temperature conditions. Fall-seeded lettuce, however, may take upwards of 140 days to mature because of slower growth during the cool months.

Almost all lettuce acreage in the U.S. is irrigated. Major natural perils during the summer are excessive rain, excessive heat, and hail; in winter the major perils are freeze damage, excessive moisture, and excessive wind. Poor weather not only can directly damage a crop but can weaken the plants, making them more susceptible to damage from diseases and pests. The major diseases of lettuce in the U.S. are big vein, lettuce mosaic, downy mildew, and tipburn. Lettuce can be attacked by several insects, including cabbage looper, beet armyworm, tobacco budworm, aphids, fleabeetles, sweetpotato whitefly, and thrips. The whitefly has been a particularly serious problem in the desert areas of California and Arizona in recent years.

Most lettuce is harvested by hand labor. Mechanical harvesting is rare because of the lack of uniformity in maturity within a field. Labor for

harvesting is usually supplied by a labor contractor who charges on a piece rates basis; thus harvesting costs vary directly with yield. Harvesting typically accounts for more than half of production costs.

Historical ad-hoc disaster payments for lettuce provide an indication of high-loss areas and may indicate areas that would face relatively high risk under a FCIC lettuce policy. Disaster assistance payments for lettuce totalled more than $8.2 million during 1988-93, peaking at $2.5 million in 1988, and exceeding $1 million in each of the years 1989, 1991, and 1993. Payments for lettuce were spread over a geographically broad area. Payments were made in 38 states in at least one of the 6 years. Five states--Michigan, New Jersey, New York, Ohio, and Texas--collected payments in all years.

A crop insurance program for lettuce is complicated by lettuce's extended growing season during which yields, risks, and market prices can vary greatly. In some areas, lettuce growers schedule planting over several months in order to ensure a prolonged harvest. An insurable event that causes severe losses to a crop may not result in indemnity payments if output over the rest of the growing season raises the season-average yield above the yield guarantee. In Florida, for example, it is not uncommon for a freeze or excessive rain to destroy nearly all of the lettuce that would have been harvested during part of the season while reducing the season-average yield by only 10-20 percent.

Lettuce prices are volatile, and low prices may be lettuce growers' greatest peril. A steady demand for lettuce combined with lettuce's perishability means that small changes in production result in large changes in prices. A revenue insurance scheme, covering low yields, low prices or a combination of both, would likely provide lettuce growers with much stronger risk protection and could at the same time avoid indemnity payments to growers who, despite low yields, had a good return because of high market prices.

Introduction

Lettuce, along with celery, escarole, and a variety of miscellaneous green vegetables such as chicory and parsley, are called the salad crops. There are four major types of lettuce: (1) crisphead, (2) butterhead, (3) cos or romaine, and (4) leaf or bunching. There is minor production of a fifth type called stem lettuce.

Most of the commercial lettuce produced in the United States is the crisphead type. Crisphead lettuce is characterized by firm heads and the brittle texture of its leaves. Because of its firm heads, crisphead lettuce sustains less damage from the rigors of harvest, long-distance shipment, and final marketing than the other types. The lettuce referred to in commercial trade as "iceberg" or "head lettuce" is crisphead lettuce.

The butterhead type, smaller and more delicate than crisphead, is characterized by soft pliable leaves, which barely overlap to form a head. Butterhead lettuce must be handled with greater care than crisphead to prevent tearing and crushing of the leaves. "Boston" and "Bibb" are butterhead lettuces.

The cos or romaine-type is characterized by the upright growth of the plant, the long loaf-shaped head, and the long and relatively narrow spatulate leaves. The most common cos varieties are self-closing--the leaves curl inward at the tips, forming compact heads, and the inner leaves become blanched. Loose-closing cos lettuce does not form closed heads and the leaves appear coarse, but they are tender and sweeter than other varieties.

Looseleaf or bunching lettuce forms clusters of leaves rather than heads. Looseleaf lettuce also requires delicate handling to prevent mechanical damage and leaf deterioration during long-distance transportation. The major loose leaf varieties are Black-seeded Simpson, Prize Head, Grand Rapids, and Salad Bowl.

The edible part of stem lettuce is the enlarged seedstalk, which may be peeled and eaten raw or cooked. "Celtuce" is the only stem lettuce cultivar grown in the United States.

The farm value of U.S. lettuce production was $1.5 billion in 1993, $1.1 billion of which was head lettuce (USDA). Romaine production was valued at $135 million and leaf lettuce was valued at $250 million.

California ships lettuce year round and is the largest supplier (Figure 1). The farm value of California's production in 1993 was $1.1 billion, with head lettuce accounting for 73 percent of this amount.

Arizona is the second largest producer, with supplies available October-April. The farm value of Arizona's lettuce was $260 million, 74 percent of which was head lettuce varieties. Florida is third in production importance, selling $26 million in 1993.

Overall lettuce supplies are fairly constant throughout the year. There is usually a slight peak in romaine production from April to August, while supplies become somewhat less available between January and March.

This report examines considerations that pertain to the feasibility of developing a successful lettuce insurance policy. It first examines the supply, demand, and price situation for lettuce, and then discusses industry characteristics. Cultivation and management practices are addressed, as are natural perils, loss prevention methods, harvesting, and marketing. This is followed by a section containing state-specific analyses of factors pertaining to the offering of crop insurance for lettuce. The final sections examine historical disaster payments for lettuce and insurance implementation issues.

The Lettuce Market

Supply

Although head lettuce production increased substantially during the 1970's and early 1980's, it has been relatively flat since 1987. Total lettuce production has risen slightly, however, because of an increase in romaine and leaf lettuce output, which nearly doubled between 1988 and 1993. Most lettuce is produced for the U.S. domestic market.

U.S. head lettuce production increased from 4.8 billion pounds in 1970 to 6.8 billion in 1987 (Table 1). Annual production exceeded 7 billion pounds between 1988-92, dropped slightly to 6.8 billion in 1993, and is projected to reach 7 billion pounds in 1994. About 7 percent of U.S. production is exported, mostly to Canada. The United States imports a small amount of lettuce from Mexico and Canada, but imports account for a minuscule share of total supplies.

Romaine and leaf lettuce output rose sharply from 780 million pounds in 1985 to 1,498 million in 1993 (Table 2). Most of the growth occurred in California and Arizona. About 15 percent of romaine and leaf lettuce production was exported in 1993. As with head lettuce, romaine and leaf lettuce imports account for a very small share of domestic supplies.

California is by far the major head lettuce-producing state (Table 3). In total, the National Agricultural Statistics Service (NASS) collects data for 11 head lettuce-producing states. Four states are reported by NASS as producing leaf and romaine lettuce.

All lettuce is sold for fresh use. Most is sold as whole heads, but a portion, perhaps as much as 15 percent in 1992, is marketed as fresh processed--chopped or shredded and packaged, ready for use in salads and sandwiches. Fresh processed lettuce is sold mostly to foodservice chains and wholesalers. Increasingly, processors are preparing pre-cut salad mixes in retail-size packages. The fresh processing use is the fastest growing segment of the lettuce market.

Table 1-U.S. fresh head lettuce: Supply, utilization, and price, 1970-94

Year	Supply: Production 1/	Supply: Imports 2/	Supply: Total	Utilization: Exports 2/	Utilization: Total 3/	Utilization: Per capita use	Season average price 4/: Current dollars	Season average price 4/: Constant 1987 dollars 1/
	Million pounds					Pounds	$/cwt	
1970	4,836.5	2.3	4,838.8	250.5	4,588.3	22.4	4.75	13.53
1971	4,936.7	4.5	4,941.2	292.8	4,648.4	22.4	6.31	17.05
1972	5,047.0	1.2	5,048.2	338.3	4,710.0	22.4	5.73	14.73
1973	5,243.5	1.9	5,245.4	345.5	4,899.9	23.1	7.40	17.92
1974	5,323.1	3.3	5,326.4	300.6	5,025.8	23.5	6.93	15.43
1975	5,410.8	2.2	5,413.0	329.6	5,083.4	23.5	6.71	13.64
1976	5,640.0	3.0	5,643.0	360.8	5,282.2	24.2	8.26	15.79
1977	6,043.2	3.8	6,047.0	359.5	5,687.5	25.8	6.94	12.42
1978	6,052.8	5.7	6,058.5	459.9	5,579.9	25.1	9.90	16.42
1979	6,143.9	13.0	6,156.9	480.6	5,648.5	25.1	9.23	14.07
1980	6,336.3	15.1	6,351.4	488.5	5,836.9	25.6	8.89	12.40
1981	6,268.2	11.4	6,279.6	523.9	5,728.6	24.9	10.90	13.81
1982	6,294.9	14.6	6,309.5	499.3	5,789.9	24.9	12.00	14.32
1983	5,775.5	21.4	5,796.9	519.2	5,258.6	22.4	12.30	14.11
1984	6,397.6	32.6	6,430.2	524.1	5,894.7	24.9	11.00	12.09
1985	6,133.4	37.8	6,171.2	507.4	5,644.9	23.7	10.90	11.55
1986	5,829.0	20.4	5,849.4	553.6	5,278.8	21.9	11.90	

12.28
 1987 6,787.7 18.3 6,806.0 542.5 6,242.2 25.7 14.80
14.80
 1988 7,050.5 37.4 7,087.9 431.3 6,625.4 27.0 14.80
14.24
 1989 7,523.1 59.1 7,582.2 463.6 7,118.6 28.8 12.60
11.61
 1990 7,320.1 17.2 7,337.3 396.9 6,940.4 27.8 11.50
10.16
 1991 7,077.8 21.1 7,098.9 496.7 6,602.2 26.1 11.40
9.68
 1992 7,081.0 21.2 7,102.2 476.8 6,625.4 25.9 12.50
10.34
 1993P 6,781.4 21.0 6,802.4 465.0 6,337.4 24.5 16.00
12.87
 1994F 6,980.0 21.0 7,000.9 480.0 6,520.9 25.0 N/A
N/A

P = preliminary. F= forecast.
1/ Source: USDA, National Agricultural Statistics Service. Production data were adjusted by ERS
for 1970-81 to account for States not included in NASS estimates. Farm weight. 2/ Source: U.S.
Dept. of Commerce, Bureau of the Census. Prior to 1989, trade includes leaf lettuce. From 1978-89,
exports were adjusted using Canadian import data. 3/ Includes shipments to U.S. territories from
1978-88. 4/ Constant dollar prices were calculated using the GDP implicit price deflator, 1987=100.

Table 2--U.S. romaine and leaf lettuce: Supply and utilization, 1985-94

Year	Supply			Utilization		
	Production 1/	Imports 2/	Total	Exports 2/	Total	Per capita use
	Million pounds					Pounds
1985	778.7	--	778.7	--	778.7	3.3
1986	571.2	--	571.2	--	571.2	2.4
1987	613.0	--	613.0	--	613.0	2.5
1988	784.2	--	784.2	--	784.2	3.2
1989	915.8	23.5	939.3	57.9	881.4	3.6
1990	1,061.6	12.1	1,073.7	130.6	943.1	3.8
1991	1,157.5	8.3	1,165.8	152.7	1,013.1	4.0
1992	1,388.7	5.9	1,394.6	195.0	1,199.6	4.7
1993P	1,497.6	7.0	1,504.6	225.0	1,279.6	5.0
1994F	1,550.0	7.5	1,557.5	235.0	1,322.5	5.1

-- = Not available. P = preliminary. F = ERS forecast.

1/ Source: USDA, NASS (1992-93); ERS (85-91), based on State-supplied data and AMS shipments. Farm weight.

2/ Source: U.S. Dept. of Commerce, Bureau of the Census.

Table 3--Lettuce Acreage and Production, 1991-93

State	Area Harvested			Production		
	1991	1992	1993	1991	1992	1993
	Acres			1,000 cwt		
Head lettuce:						
Arizona	49,000	49,300	49,400	15,440	13,728	13,396
California	152,000	147,000	141,000	50,920	52,920	50,760
Colorado	4,700	3,400	3,600	1,034	1,020	1,044
Florida	5,700	6,300	5,900	1,197	1,134	1,003
Hawaii	240	240	200	30	24	18
Michigan	800	280	300	200	84	75
New Jersey	2,500	2,100	1,900	363	368	418
New Mexico	2,100	2,800	2,200	620	854	528
New York	2,600	1,900	1,100	494	304	253
Texas	1,200	500	500	168	88	88
Washington	1,300	1,300	1,100	312	286	231
U.S.	222,140	215,120	207,200	70,778	70,810	67,814
Leaf lettuce:						
Arizona	N/A	5,300	4,500	N/A	1,113	990
California	N/A	32,000	35,000	N/A	6,880	7,175
Florida	N/A	600	500	N/A	81	70
Ohio	N/A	520	550	N/A	161	135
U.S.	N/A	38,420	40,550	N/A	8,235	8,370
Romaine:						
Arizona	N/A	2,900	3,300	N/A	725	957
California	N/A	15,500	20,500	N/A	4,650	5,330
Florida	N/A	1,200	1,300	N/A	180	182
Ohio	N/A	380	390	N/A	97	137
U.S.	N/A	19,980	25,490	N/A	5,652	6,606

N/A = Not available.

Source: USDA, National Agricultural Statistics Service.

Additional data are reported in Appendix table 11.

The quantity of lettuce available for sale can vary substantially from day-to-day or week-to-week depending on the amount reaching maturity. Once lettuce has reached marketable size it must be harvested within a very few days or be abandoned. The time between when a head of lettuce can first be harvested and when it becomes too mature to sell is about 5 to 7 days, depending on temperatures during the growing period.

Growers schedule plantings so as to have a uniform quantity of lettuce reaching marketable size each week. Unexpected weather, however, especially unusually high or low average temperatures, can speedup or slowdown the rate at which lettuce grows and thereby disrupt growers' plans for a uniform supply. Lettuce matures slowly if temperatures are cool during the growing period, and this can lead to a temporary short-fall in planned supply. At other times, when temperatures during the growing period are warmer than usual, lettuce can mature ahead of schedule resulting in actual availability exceeding planned supply.

Demand

Crisphead (or iceberg) is the most consumed lettuce in the U.S., although recently leaf lettuce has been gaining in sales. In 1992, per capita head lettuce consumption was more than five times that of leaf and romaine lettuce. The butterhead and stem lettuce market is very small compared to the others.

Total lettuce use per person has been relatively flat since 1987. U.S. consumers used about 30 pounds (all types) per person in 1993, up just slightly from 28 pounds in 1987 (Tables 1 and 2).

Lettuce is a basic ingredient in a wide variety of salads that can include other vegetables, fruits, seafood, and meats. Use of lettuce in sandwiches is widespread, especially in the fastfood industry. Lettuce does not have many acceptable substitutes and is considered by many consumers to be a vital accompaniment to many meals.

Because many users view lettuce as a vital accompaniment to their meals and are reluctant to use substitutes, they are slow to alter the quantity demanded when prices change. As a result, a given change in price is associated with a less-than-proportional change in the quantity of lettuce demanded. Conversely, a larger-than-proportional change in price is associated with a given change in the quantity supplied. This characteristic is referred to as an inelastic demand. Statistical studies (both farm-gate and retail) of the demand relationship between lettuce prices and quantities show the quantity demanded rising (falling) 0.14 to 0.22 percent for each one-percent decline (increase) in price (George and King, Huang, Wohlgenant).

Prices

Highly variable prices are the direct consequence of the fundamental characteristics of lettuce demand and supply: 1) the inelastic demand and 2) substantial week-to-week variability in supply. Tables 4 and 5 show monthly variability in grower prices for various years. Weekly prices

Table 4--Iceberg lettuce: U.S. f.o.b prices, monthly average 1989-93

Month	1989	1990	1991	1992	1993
			$/carton[1]		
January	9.71	4.36	5.86	3.95	5.58
February	6.26	3.32	3.60	3.50	9.10
March	7.40	3.82	5.46	5.72	8.24
April	4.49	4.24	5.31	4.29	18.42
May	3.94	3.83	12.70	4.97	5.69
June	6.96	4.47	6.94	5.31	5.42
July	8.14	6.25	4.18	6.36	9.10
August	5.59	5.95	4.38	8.73	6.53
September	6.37	9.26	4.82	8.61	7.18
October	6.66	8.98	6.61	5.77	5.23
November	5.13	6.66	9.90	4.97	4.45
December	3.33	5.02	5.06	6.91	4.37
Season	6.16	5.51	6.23	5.76	7.44

[1]Carton of 24 heads.

Source: USDA, Agricultural Marketing Service.

Table 5--Romaine lettuce: U.S. f.o.b prices, monthly average 1989-93

Month	1989	1990	1991	1992	1993
			$/carton[1]		
January	6.50	4.98	8.55	4.52	9.71
February	7.23	4.32	5.89	4.12	13.38
March	4.30	4.92	4.82	5.94	6.90
April	4.22	5.45	7.24	8.66	9.79
May	6.19	3.72	6.38	7.35	6.31
June	5.75	3.55	4.14	5.59	6.19
July	5.15	4.48	4.59	5.34	5.76
August	5.64	6.06	4.99	6.79	6.62
September	6.94	7.32	5.43	8.43	6.78
October	12.63	11.55	4.79	6.74	8.32
November	10.90	7.99	6.48	5.70	7.48
December	6.25	5.25	6.30	12.39	5.00
Season	6.81	5.80	5.80	6.79	7.69

[1]Carton of 24 heads.
Source: USDA, Agricultural Marketing Service.

vary even more than monthly averages as illustrated by prices in California during the spring of 1993, which fell from $25 a carton during the third week of April to $5 two weeks later (Agricultural Marketing Service, unpublished price data).

Between 1981 and 1992 the prices received by growers for lettuce averaged lowest during February and highest during November (Figure 3). Although the average of monthly prices moved upward from February to November and dropped sharply from January to February, lettuce prices can peak at almost any time during the year. The wide band encompassing one standard deviation on either side of the mean suggests that the seasonal price index is a weak indicator of trend for lettuce prices.

Demand disruptions in the short-run can exacerbate price variability. Snowy weather at some major eastern terminal markets during the winter of 1994 disrupted consumer shopping patterns and resulted in a decline in the demand for lettuce. Growers in California reportedly sustained considerable economic losses as a result of weakened demand and low prices.

Industry Characteristics

Those characteristics of the lettuce industry which hold particular significance with respect to determining the potential demand for crop insurance are: 1) a moderate degree of diversification between lettuce and other farm enterprises, especially other vegetables, 2) limited income diversification between farm and off-farm employment, 3) spreading of risk on the part of some larger producers, achieved through harvesting and marketing over an extended season, and 4) widespread use of irrigation as a protection against drought. The primary source of available information on farms producing lettuce is the 1987 Census of Agriculture.[1]

Lettuce Farms

The U.S. Census of Agriculture reported 2,200 farms with sales of lettuce in 1987 (Appendix table 1). California had 31 percent of the farms and 67 percent of the U.S. lettuce acreage in 1987. Arizona had just five percent of the farms but 21 percent of the acreage. New Jersey and New York each had about eight percent of farms and one percent of acreage.

Most farms growing lettuce in 1987 were large operations: over 46 percent (about 1,020) had total crop sales of $100,000 or more (Appendix table 2). In California, almost half the farms with lettuce reported crop sales of $500,000 or more, while 30 percent had sales of less than $100,000. In Arizona, 67 of the 107 farms with lettuce reported total crop sales of $500,000 or more, while only 8 had sales of less than $100,000.

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[1] Results for the 1992 Census of Agriculture will become available in September, 1994.

The most common type of ownership of farms growing lettuce was individual or family ownership (Appendix table 3). Partnerships or corporate arrangements (either family-held or other) were more common among larger farms, however. Seventy-five percent of the farms with sales of $500,000 or more reported partnership or corporate-type ownership.

Eighty-five percent of the operators on all farms growing lettuce reported that farming was their main occupation in 1987 (Appendix table 4). However, of operators of small farms, those with less than $25,000 in sales, about 67 percent indicated that farming was their main occupation. About a third of all farms reported an operator working off the farm at least 1 day during the year.

Income Diversification on Lettuce Farms

Diversification enhances the ability of lettuce producers to manage risk. The more diversified producers are between lettuce and other enterprises, the greater their ability to recover from a loss of lettuce income with returns from other crops. Lettuce growers in the major producing areas also spread their risks by marketing over an extended season. This provides the opportunity to recoup losses from a part of the crop with returns from the remainder of the crop.

Market sales for lettuce growers are diversified between lettuce and other crops, especially other vegetable crops. Of the $1,829 million in crop sales reported by farms growing lettuce in the 1987 Census of Agriculture, $1,483 million (81 percent) were from vegetable crops including lettuce (Table 6). The Census does not report separately the sales of lettuce. The National Agricultural Statistics Service of USDA estimated the value of 1987 lettuce production at $1,003 million, 55 percent of the total crop sales of farms growing lettuce reported in the Census.

A more recent survey that included lettuce growers gives an indication of crop diversity on farms producing lettuce. Lettuce and vegetable growers in 10 states took part in USDA's 1992 Vegetable Chemical Use Survey. In California, all of the surveyed farms with lettuce also grew other vegetables, and lettuce accounted for 55 percent of their total vegetable acreage (Table 7).

The variety of crops grown by farms producing lettuce may indicate lettuce growers' familiarity with crop insurance. According to the Vegetable Chemical Use Survey, 21 percent of California farms growing lettuce also grew fresh tomatoes, a currently insurable vegetable crop (Table 8). FCIC data show a participation rate of just one percent for fresh tomatoes in California, however, and 22 percent for processed tomatoes (Table 9).

The practice by larger lettuce producers, especially in Arizona, California and Florida, of scheduling planting and harvesting over a period of weeks or months effectively serves as a risk management technique. Insurable events, such as flooding, freeze, excess rain, and high winds, usually destroy only that part of the crop in the field at the point in time when the event occurs.

Table 6--Market value of sales on farms producing lettuce, 1987

State	All products	All Crops	Vegetables & melons	Lettuce[1]
		$ mil.		
Arizona	269	268	210	159
California	1,191	1,179	960	747
Colorado	13	13	10	14
Florida	124	124	105	37
Hawaii	7	7	7	2
Michigan	14	13	12	4
New Jersey	34	34	32	5
New Mexico	25	25	19	9
New York	34	33	30	10
Ohio	23	23	22	6
Oregon	4	4	4	NR
Texas	43	41	38	6
Washington	9	9	8	4
other	39	38	26	NR
U.S.	1,829	1,811	1,483	1,003

NR = not reported.

Source: U.S. Dept. of Commerce, Census of Agriculture; lettuce sales from Vegetables, USDA, National Agricultural Statistics Service. The category "other" is computed as the U.S. total minus listed states.

Note: For Colorado, the value of lettuce sales exceeds the value of production from all products. This is due to the use of two different (and at times, conflicting) data sources in constructing the table.

Table 7--Enterprise diversification on farms growing lettuce, 1992

State	Farms sampled	Farms growing other vegetables	Lettuce acreage as share of vegetable acreage
	Number	Percent	Percent
Arizona	35	94	87
California	156	100	55
Florida	12	75	51
Michigan	16	88	15
New Jersey	28	93	19
New York	35	97	42
Texas	11	100	12

Source: USDA, Vegetable Chemical Use Survey. 1992.

Table 8--Insurable crops on farms producing lettuce, 1992

State	Farms sampled	Farms growing				
		Onions	Sweet Corn - Fresh	Sweet Corn - Processed	Tomatoes - Fresh	Tomatoes - Processed
	Number	Percent				
Arizona	35	20	0	0	0	0
California	156	17	20	12	21	10
Florida	12	0	50	42	25	0
Michigan	16	38	44	31	38	0
New Jersey	28	0	39	43	61	0
New York	35	37	54	40	69	0
Texas	11	55	36	55	64	0

Source: USDA, Vegetable Chemical Use Survey. 1992.

Table 9--Crop insurance participation rates, 1992

State	Onions	Sweet Corn - Fresh	Sweet Corn - Processed	Tomatoes - Fresh	Tomatoes - Processed
	Percent of insurable acres				
California	--	--	--	1	22
Florida	--	39	--	15	--
Michigan	9	--	--	--	51
New Jersey	--	--	--	--	8
New York	19	--	3	--	10

Source: USDA, FCIC. Special participation analyses.
No data indicates insurance not offered or none sold.

Losses, consequently, may represent only a small part of the grower's expected sales for the year.

Extended drought is a minimal risk in most areas because almost all lettuce is grown on irrigated land. The Census of Agriculture indicated all the acreage in Arizona, California, Colorado, and New Mexico was irrigated in 1987 and virtually all of the acreage in most of the other States (Appendix table 1).

Cultivation and Management Practices

Recommended cultivation and management practices provide the background information on the growing conditions and production techniques necessary to maintain high lettuce yields. Care requirements also provide an indicator of the potential for moral hazard as a problem in offering insurance.

The ideal conditions for head lettuce--cool temperatures, low humidity, and adequate moisture from irrigation--are present in different parts of California at different times during the year, and Arizona offers these conditions during the winter. Although lettuce is grown in other states, few locations have as ideal conditions as Arizona and California.

Climate

Lettuce is a cool season crop that grows best when there are wide differences between day and night temperatures. The most favorable day temperature for growth and head formation is about 70-75°F with nights at 45°F. Temperature requirements are more critical for crisphead than for other types. Leaf width increases with day length and light intensities and leaf length increases with short days and low light conditions. At temperatures above 80°F, heads develop poorly and the plants form seed stalks. Cool nights are essential for quality lettuce as high temperatures tend to produce bitterness.

Small, immature lettuce plants tolerate mild freezing, but as they approach maturity, freezing damages the leaves and reduces shipping quality. Lettuce plantings in areas with high temperature and humidity are more likely to suffer losses than those grown in cool, arid conditions.

Soils

The ideal soil for lettuce is fertile, well-drained, and sandy clay loam with a neutral pH. However, lettuce is grown successfully on a wide range of soils ranging from sand to clay and peat. Salinity in lettuce soils should be avoided as much as possible. It is especially harmful to germinating seed and seedlings.

Lettuce needs adequate soil moisture, especially at the time of heading. Low soil moisture and high temperature may cause a disorder called tipburn in which the tips of the inner leaves decay.

Excessive soil moisture also can be detrimental to lettuce. Excessive irrigation or rain just before or during the harvest season, especially if temperatures are high, may result in loose, puffy heads. Excessive moisture when heads are approaching market maturity or are overmature also may cause bursting of the heads.

In western regions of the U.S., where lettuce is raised almost entirely without rainfall, irrigation enables the grower to accurately control soil moisture. In the eastern and southern regions, growers can use supplemental irrigation to exercise some control over drought, but they can not avoid excessive moisture due to extreme rainfall. One estimate places the rainfall requirement for growing a crop of lettuce in the East and South during the spring at 5-8 inches or the equivalent in irrigation water (Thompson). The amount required depends on such factors as temperature, character of the soil, amount of cloudy weather, and prevalence of winds.

Cultural Practices

In the Western and Southwestern states lettuce is planted in 40-inch beds, two rows per bed, with 14 inches between rows. Leaf lettuce may be spaced more closely. Lettuce is seed-planted at a higher rate than the desired final plant population. The plants are thinned 2-4 weeks after planting to 10-14 inches between plants. A desired final plant population for head lettuce is about 29,000 per acre.

In other lettuce production areas of the United States, single rows on raised beds or on flat surfaces are used. Distance between single rows range from 12 to 20 inches with a preference for spacings of 18 to 20 inches. Spacings of 18 inches between rows and 12 inches between plants within the row give a potential plant population of 29,040 plants per acre.

Lettuce may be either direct seeded or transplanted. When direct seeded, pelleted seeds are mechanically planted and the field irrigated to obtain uniform emergence. Precision planting reduces the cost of labor required for thinning.

Planting Dates. Planting dates are usually used as reference time points in specifying insurance sign-up dates and policy closing dates. Growers may plant lettuce over a period of months in order to have crop maturing for an extended marketing period (Table 10).

Transplanting may be used to decrease the length of time plants are grown in the open field and reduce the risk of exposure to frost or freezing or to high temperature during periods of head development. Direct seeding is most typical in the southern California desert area (Imperial and Riverside counties), but both direct seeding and transplanting are common in California's Salinas Valley.

The time from emergence to harvest ranges from 55 to 70 days under normal day length and temperature conditions. But, fall-seeded lettuce may take upwards of 140 days to mature due to slower growth during the cool months (Nonnecke).

Table 10--Usual planting and harvest dates for lettuce

State	Planting date	Usual harvest date - Begin	Most active	End
Arizona	Aug. 15-Feb. 15	Nov. 1	Dec. 1-May 1	Jul. 1
California	See Table 13 in California state analysis section.			
Colorado	Mar. 20-Jul. 10	Jun. 10	Jun. 15-Sep.15	Oct. 1
Florida	Aug. 25-Apr. 1	Oct. 20	Nov. 15-May 1	Jun. 1
Michigan	Apr. 1-Jul. 15	Jun. 25	Jul. 1-Sep. 20	Oct. 10
New Jersey	Apr. 1-Aug. 10	May 15	May 20-Nov. 15	Nov. 30
New Mexico	Jan. 15-Feb. 1	Apr. 25	May 1-Mar. 31	Jun. 5
New York	Mar. 25-Jul. 15	Jun. 1	Jun. 20-Sep. 20	Oct. 25
Ohio	Apr. 1-Jul. 31	May 20	Jun. 1-Oct. 1	Nov. 1
Texas	Aug.15-Nov.30	Oct. 1	Oct. 15-Feb. 28	Mar. 31
Washington	Mar. 24-Aug. 15	Jun. 25	Sep. 10-Nov. 1	Nov. 15

Source: USDA, Statistical Reporting Service.

Note: Dates reported in this table may differ slightly from those reported in the "State Analyses" section. Dates in that section largely reflect personal communication with extension specialists.

Growing periods tend to be slightly shorter for leaf lettuce than head lettuce.

Thinning. Growers plant seeds closer than the desired spacing for mature lettuce to compensate for anticipated losses (due to insects, diseases, birds, and other hazards). Thinning is done 2 to 4 weeks following planting to remove the excess plants. Traditionally, thinning of lettuce has absorbed large amounts of labor.

Fertilization. Lettuce requires moderately large amounts of nitrogen and phosphorous and fertilization depends on the nutrients available in the soil. In California, growers apply 200-250 pounds of nitrogen per acre for the season, usually one third at preplant and two-thirds during active growth. Phosphorus is applied prior to planting at 60-200 pounds per acre depending upon the soil type.

Weed control. Weeds are a serious problem in lettuce culture because young lettuce plants are poor competitors and will not survive under weed pressure. Also, several common weeds are alternate hosts of insect and disease pests of lettuce. Both herbicides and hand hoeing are used to control weeds.

Irrigation. Almost all lettuce in the United States is grown with irrigation. In California, sprinkler irrigation is common for germination and seedling emergence, but furrow irrigation is practiced through the remainder of the season. The frequency of irrigation after thinning depends on the character of the soil and climatic factors. In parts of the Monterey area, where the climate is cool and the rate of evaporation is moderate to low, lettuce may go as long as 30 days without irrigation (Veihmeyer and Holland).

Crop Rotation. Crop rotation is used to help prevent buildup of serious soil-borne pests or diseases unique to lettuce or to control weeds and nematodes. Rotation with crops such as tomatoes, alfalfa, sweet corn, spinach, and beets or carrots, which do not share soil pathogen organisms with lettuce, help disrupt the buildup of lettuce diseases and insects. During the early days of lettuce growing in the Imperial Valley, a lettuce-alfalfa rotation was common but now occurs less frequently than in the past. Today, barley, wheat, or cantaloupes often are grown after early lettuce in that area, and grain sorghum after late lettuce (Mayberry). Imperial Valley growers sometimes plant lettuce in the same fields for several years.

Harvesting and Packing

Harvesting is an important issue for crop insurance purposes because harvesting costs vary with yield and because they generate over half the total production cost. Growers occasionally abandon a portion of their crop because market prices drop below variable harvesting and marketing costs (expenses for cutting, packing, hauling, and selling). Economic abandonment creates the situation where an insurance indemnity would result in a higher net return than harvesting and marketing. This situation may create moral hazard, particularly if prices are low near harvesttime.

Lettuce is harvested by hand labor with the occasional assistance of mechanical aids. Although mechanical harvesting may be possible for uniformly matured crops, commercial mechanical harvesting is rare because there is no practical way to assess maturity and to remove lettuce heads flawlessly. Labor is the major part of harvest costs regardless of method of harvest (Zahara et al.). Labor for harvesting is usually supplied by a labor contractor who charges on a piece rate basis; thus, harvesting costs vary with yield.

Per acre yield depends to some extent on the market price for lettuce, being higher when prices are high and being lower when prices are low. When prices are higher, a grower will make a second or even third cutting at 7-10 day intervals, giving small heads time to develop to marketable size. In addition, if prices are sufficiently high the market will accept smaller heads (such as those requiring 30 heads to fill a carton) that would have been abandoned at lower prices.

Lettuce for the fresh market is field packed in cartons, hauled to vacuum coolers, and shipped to market in refrigerated trucks. Field packing of "naked" heads in cartons is the most common. However, some companies bulk harvest a portion of their lettuce for fresh processing. In bulk harvesting, the cut lettuce is loaded into bulk bins which are then brought to a packing plant. Heads are cored and cut into various forms for sale to foodservice and retail establishments. The variable harvesting costs are substantially lower for bulk harvesting than for harvesting and placing the heads in cartons.

There are two basic field pack systems: ground pack and film wrap. The ground pack system is presently the standard harvest method in California, although about a quarter of the lettuce reportedly is film wrapped. For ground-pack lettuce, a team of two cutters and one packer cuts and hand-places 24 heads in each box (18 for shipment to Canada). Placing the lettuce in a cardboard box ends the field operation. Cardboard cartons are lifted onto a lettuce field truck which takes them directly to the vacuum cooler.

For the film-wrap system, packing is usually done on a portable field packing station where the heads are wrapped in plastic film and heat treated to seal the wrapping before being placed in the cartons. Once the lettuce is packed it is hauled to a vacuum cooler.

Before shipping, ground pack and film-wrapped lettuce are both vacuum cooled to 34^{o}F to remove field heat and stored for truck transit to terminal markets. A small amount of lettuce is also shipped by rail. The key to successful delivery of fresh lettuce thousands of miles away rests upon rapid removal of field heat and shipping in refrigerated trucks or rail cars. Also, film wrapping reduces water loss in transit which prevents deterioration during transit due to drying out (Nonnecke). Practically, the quality of lettuce deteriorates beyond marketability when stored beyond two weeks. Field grown leaf lettuce and butterhead lettuce can be cooled in the same way as head lettuce. Storage life of leaf lettuce is about one week if the product is held at or near 32^{o}F (Nonnecke).

Marketing

Marketing considerations are important for insurance because the lack of a profitable market raises the potential for moral hazard. Although uncertainty as to availability of buyers does not appear to be a major issue for lettuce, low prices at times may cause growers to abandon portions of their crop.

Most lettuce is grown for the fresh market (including fresh processed). Although official USDA statistics do not report fresh and fresh processed separately, shipment statistics indicate that about 15 percent of the U.S. lettuce crop was fresh processed in 1993 (USDA/AMS shipments).

Crisphead lettuce can be sold for either fresh or fresh processed. This provides handlers having facilities for fresh processing sales with some flexibility for deciding between the fresh and processing markets near harvest time. The amount of flexibility is limited, however, because processors usually contract with packers for a certain quantity and lettuce diverted from fresh use may exceed the contracted amount.

Producers in some cases pack their own fresh market lettuce and deliver it to a shipper who acts as the sales agent. In other cases, the grower contracts with a packer-shipper for packing services in a piece-rate agreement, or enters into a joint risk-sharing venture. A number of larger producers, however, act as their own shipper and sales agent. Due to lettuce's perishability, practical storage is limited to just a few days.

The primary customers for fresh packed lettuce are chain stores and other retailer-wholesalers, terminal market brokers, wholesale handlers, the military, and food processors. The biggest customers for fresh processed lettuce are fastfood chains, but retail chains increasingly are handling fresh processed lettuce in retail-size packages.

Costs and Returns

The timing of expenditures is an important consideration for crop insurance. A second consideration is that the value of lettuce in the field is much less than its value at the first delivery point, which may create the potential for moral hazard.

Preplanting and planting expenses usually represent a large share of total growing costs, but substantial expenses also are incurred throughout the growing period for pest control, supplemental fertilization and other cultural operations. In Monterey county, California, for example, $855 of the $1,590 in preharvest costs for iceberg lettuce are classed as growing expenses (Tables 11 & 12).[2] If an insurable loss occurs prior to the crop reaching

[2] Detailed cost estimates for head lettuce in Monterey county, California, and leaf lettuce in Imperial county, California, are presented in Appendix tables 9 & 10.

Table 11--Iceberg lettuce production costs

	California		Arizona			New Mexico
	Imperial	Monterey	Yuma	Maricopa	La Paz	Dona Ana
	50 lbs. carton/acre					
Yield	500	750	590	380	450	500
	$/acre					
Pre-harvest	1,491	1,590	1,556	1,022	805	842
Land preparation	271	219	196	187	183	104
Growing	835	855	923	601	486	575
Overhead	385	415	437	234	136	163
Harvesting	1,600	2,625	1,943	1,251	1,485	1,810
Total	3,091	4,215	3,498	2,274	2,290	2,652

California costs are for 1992; Arizona for 1993. New Mexico does not include land rent in overhead. Harvesting costs per carton: California, $3.40-$3.50; Arizona, $2.40-$3.30; New Mexico, $3.62.
Source: State-specific Cooperative Extension budgets.

Table 12--Leaf lettuce production costs

	California		Arizona	New Jersey	
	Imperial 1989	Imperial 1992	Yuma	Spring	Fall
	35 lbs. carton/acre				
Yield	700	700	690	1,200	1,200
	$/acre				
Pre-harvest	1,208	1,547	1,074	1,541	1,185
Land preparation	210	231	240	N/A	N/A
Growing	669	867	412	N/A	N/A
Overhead	329	450	423	N/A	N/A
Harvesting	1,890	1,890	2,831	1,780	1,792
Total	3,098	3,437	3,905	3,322	2,979

Yuma county, Arizona costs are for 1993; New Jersey for 1986. Harvesting costs per carton per carton: California, $2.70; Arizona, 3.50; New Jersey, $1.50.
Source: State-specific Cooperative Extension budgets.

maturity, the grower may not have incurred all of the expenses classed as preharvest cost.

In addition, harvesting and marketing expenses usually are not incurred if an insurable loss occurs. Harvesting and marketing expenses typically amount to over half of total production costs. Consequently, FCIC may want to provide insurance protection only for expenses actually incurred.

Production Perils

The natural perils that are most likely to result in indemnities under a lettuce policy vary from area to area and depend partly on the time of year production and harvesting activities are taking place. The major perils during the winter are freeze damage, excessive moisture, and excessive wind. In the summer, the major perils are excessive rain, excessive heat, and hail.

Diseases

Lettuce diseases are a serious problem for the lettuce grower. For many diseases, there is no control once the crop has become infected. Lettuce diseases may be due to virus, fungi, bacteria, nematodes, or nonpathogenic sources. Some are seed-borne and others are soil-borne. Some diseases are transmitted by insects or microorganisms, others are carried by the wind, irrigation water, or the movement of contaminated soil and equipment.

Four major diseases of lettuce in the United States, ranked in order of their probable economic importance, are big vein, lettuce mosaic, downy mildew, and tipburn. Other diseases include Sclerotinia, aster yellows, botrytis, and bacterial spot.

Big vein. Big vein is a soil-borne disease of lettuce first reported from the Imperial Valley in 1934 (USDA/ARS; Jagger and Chandler). Today, big vein is a production problem in a number of production areas.

Infected plants show a characteristic clearing of the area around the leaf veins. Such plants remain small and stunted, never producing marketable heads. Big vein tends to develop when air temperatures are cool, between 42-60^{o}F (USDA/ARS). The symptoms are less pronounced at higher temperatures and lettuce planted during warm periods frequently escapes infection. Chemical control of big vein has not been practical. The organism remains active in the soil for many years. Development of tolerant cultivars offers the best hope for control.

Lettuce Mosaic. Lettuce mosaic is a virus spread by insects, primarily the green peach aphid. Usually the virus is seed-borne to a maximum of about three percent. This low percentage of infected seed is sufficient to spread the disease throughout the field as well as to adjacent plantings. A typical symptom of the disease is misshaped leaves--irregularly shaped and inward rolling. Such plants remain stunted, yellowish, and never develop into marketable heads. Planting virus-free seed is the best method to prevent this disease. The two major lettuce-producing areas in California, the Salinas and

Imperial Valleys, stipulate that all lettuce seed planted in the area must be mosaic-free. Most other areas require or ask for low-mosaic seed (USDA/ARS).

Downy Mildew. Downy mildew is present in most lettuce-growing regions during cool, moist weather. The causal agent is a fungus, spread by windblown spores that require moisture to germinate and become infective. Symptoms are irregular spots on the underside of the outer leaves, sometimes covered with white, fluffy spore masses. The infected areas become brown and eventually the entire leaf is destroyed.

In California, downy mildew is often prevalent in the early spring and late fall or in summer in the coastal regions. The disease is of minor importance in the Imperial, Palo Verde, and Coachella Valleys. Resistant cultivars and fungicides provide control for downy mildew.

Tipburn. Tipburn is a plant disorder that occurs during warm, humid weather (USDA/ARS). Tipburn is caused by a calcium imbalance within the plant and tends to occur when there are: 1) low temperatures during early development followed by high temperatures as the crop nears maturity or 2) a fluctuating water supply as the crop matures. The symptoms are dark brown spots on the margins of the leaves. The breeding of resistant cultivars has improved the control of tipburn, although it is still a problem.

Insects

Lettuce is attacked by a myriad of insects including the cabbage looper, the beet armyworm, the tobacco budworm, aphids, fleabeetles, sweetpotato whitefly, and thrips. The whitefly has been a particularly serious problem in the desert areas of California and Arizona in recent years. Insect control is achieved through following good field sanitation practices, careful monitoring of insect populations, and the use of an approved pesticide program.

Soil Salinity

High soil salinity is probably one of the most serious problems affecting lettuce in the desert areas (the Imperial Valley and Coachella Valley in California and the Arizona production areas). Excess salinity not only reduces and delays seed germination and seedling emergence but also reduces yield, head size, and crop uniformity. Slow-growing, weak, salt-affected plants are also more subject to attack by insects and plant pathogens than fast-growing, robust plants. Since fields are seldom uniform, salinity commonly occurs unevenly within the field. Delays in emergence promotes irregular lettuce stands and usually results in variable crop maturity at harvest. There is no known chemical which can be applied to soils to reduce salinity. Salinity is controlled in the Imperial Valley by careful choice of land, drainage improvements, and proper selection and use of irrigation and cultural practices.

State Analyses

The following section describes those aspects of lettuce production in the major lettuce-growing areas which pertain to the feasibility of offering crop insurance.

California[3]

California has many climatic zones that provide near optimal conditions for growing lettuce in one district or another throughout the year. Unlike other states, California produces lettuce in roughly equal quantities every month of the year.

The California discussion focuses primarily on the crisphead (iceberg) lettuce because this type dominates production in California. To the extent it is available, information unique to production and marketing of leaf lettuce is also included. In most cases, however, production and marketing practices are similar for both types.

Lettuce Production in California

California produced 76 percent of U.S. lettuce production on 72 percent of U.S. lettuce acreage in 1993. Although leaf and romaine lettuce accounted for only about 18 percent of all U.S. lettuce in 1993, California supplied 86 percent of the leaf lettuce and 81 percent of romaine output. The total value of California's lettuce production (head, leaf, and romaine) was $1.14 billion (USDA/NASS).

Head lettuce is the single most important vegetable crop in California, accounting for 17 percent of the State's total value of vegetable crop production. Among all of California's agricultural crops, head lettuce is the 8th largest in value.

Although annual production of head lettuce in California has been relatively flat at around 2.5 million tons since 1987, leaf lettuce output has increased (Appendix table 5). Over the period 1985-1992, leaf lettuce production rose about 36 percent. This increase has been the result of acreage expansion because per acre yields remained fairly constant. Romaine acreage has also expanded, more than doubling since 1985. Per acre yield for head lettuce is higher than leaf or romaine lettuce because of the compactness and slightly higher water content of head lettuce. However, lower yields for leaf and romaine lettuce are compensated by higher unit prices, which result in per acre revenue being similar for all types.

Lettuce Producing Regions in California

This section uses California NASS and County Agriculture Commissioners' data, which are not necessarily consistent with the state data presented elsewhere in this report. However, the county-level data provided in Appendix tables 5-8, and reported in this section, offer considerably greater detail for recent years than is available from other sources.

Monterey and Imperial counties are the two most important counties for both head and leaf lettuce production in California (Appendix tables 6 and 7). Monterey county produces about 50 percent of California's head and leaf lettuce. Imperial county produces about 15 percent of the state's head and leaf lettuce. Other important California lettuce counties are: Fresno (around 10 percent of California production), Riverside, Kern, Santa Barbara, San Luis Obispo, and Ventura counties.

Optimal planting and harvest dates depend on weather conditions. Given the range of weather in California, production practices tend to differ depending on the geographical location. California lettuce growing areas can be broadly grouped into five regions, each with similar growing seasons:

1) **The Salinas region** contains several districts surrounding the Salinas Valley, but consists mainly of the Salinas-Watsonville and Gilroy-Hollister districts. The Salinas-Watsonville district extends from the southern tip of Santa Cruz county to Monterey county and the Gilroy-Hollister district includes the southern part of Santa Clara county and northern part of San Benito county. This area's lettuce production is mostly represented by Monterey county, where about half of the lettuce crop in California is produced. There is also a high concentration of lettuce producers in this area.

2) **The Imperial Valley-Blythe region** is represented by Imperial county and the Blythe district in Riverside county. The Blythe district is a minor lettuce producing region compared to the Imperial Valley, which is the second largest lettuce producing region in California. Farms in the Imperial Valley tend to be larger in size but fewer in number than those in Monterey (Mayberry). Currently, there are about 30 farms in the Imperial Valley-Blythe region.

3) **The Santa Maria-Oceano district** includes the northern coastal area of Santa Barbara county and the southern coastal tip of San Luis Obispo county.

4) **The Inland area** includes the southern part of the San Joaquin Valley--mainly the Westside district in Fresno county and the north central part of Kern county.

5) **The South Coast region** consists of the coastal area, south from the Oxnard district in Ventura county. This area includes Ventura, Los Angeles, and Orange counties.

Ventura county (Oxnard district) is the third largest leaf lettuce producing county. However, given the small amount of leaf lettuce production compared to head lettuce, this region contributes only a small amount to total lettuce output. In 1992, leaf lettuce produced in California (365 thousand tons) amounted to about 15 percent of the State's head lettuce production (2.5

million tons). Historical production of head, leaf, and romaine lettuce are presented, by region and county, in Appendix tables 6, 7, and 8.

Head lettuce production in California may be becoming more geographically concentrated. Production in all of the counties comprising the Salinas area increased between 1980 and 1992. With the exception of Fresno county in the Inland area, production in the other areas either declined or showed no pronounced trend. Some of the decline in head lettuce production may have been the result of switching to leaf lettuce. Given the modest overall growth in California head lettuce output, this pattern suggests that production may be concentrating in the Salinas Valley area.

Unlike head lettuce, leaf lettuce production has increased substantially in most lettuce-growing counties. This growth in leaf lettuce production reflects improvements in shipment technology and an expanding market for leaf lettuce.

Since the Salinas Valley is the primary lettuce-growing region and provides the most favorable climate for lettuce production, it's geographical features and climate will be described in greater detail. The Valley is bounded by two mountain ranges--Santa Lucia Range on the west and the Gabilan Range on the east. It's soils are predominately alluvial and are highly productive. The northern end of the Valley is open to the sea at Monterey Bay. During the summer, the prevailing winds are from the ocean, producing cool weather and fog. This unique geophysical setting provides the northern end of the Valley with an almost ideal climate for summer production of cool-season vegetable crops which require low nighttime temperatures. Rainfall in the vegetable-producing portion of the Valley decreases with distance away from the ocean. Over 90 percent of the rainfall occurs in the six-month period from November through April. Growers supplement the natural rainfall with irrigation water because precipitation is inadequate for intense crop production. Virtually all of the irrigation water is pumped from the ground, which is recharged from the flow of the Salinas River.

Planting and Harvesting Dates

Planting and harvesting dates are usually used as reference time points in specifying insurance sign-up dates and policy closing dates. With its diverse climatic conditions, planting and harvesting dates in California differ substantially from region to region and in some cases within regions. Table 13 summarizes planting and harvesting periods for California's lettuce-producing regions.

In the Salinas area, planting starts from early- to mid-February and lasts until mid-September, and harvest starts in early April and lasts until early November. In the Imperial Valley, lettuce is planted from September through mid-November and is harvested from mid-November through March.

Growers in California are able to harvest and market lettuce throughout the year by shifting production from region to region according to the season. In the central coast area (from Monterey south to Santa Barbara), the harvest

Table 13--Planting and Harvesting Dates for California Lettuce Production

Regions	Planting dates (Beginning-end)	Harvesting dates (Beginning-end)	Marketing period (Seasons)
Salinas:			
	Feb. 10-mid Sept.	Early Apr.-early Nov.	Spring-Fall
Imperial Valley:			
	Sept. 1-mid Nov	Mid Nov.-Mar. 31	Fall, Winter
Riverside (Blythe):			
	Sept. 1-Jan. 31	Nov. 1-Jan. 20	Fall, Winter
		Mar. 10-Apr. 10	Spring
Fresno & Kern:			
	Jan. 10-Feb. 28	Mar. 20-early May	Spring
	Jul. 1-Aug. 31	Oct. 1-Nov. 20	Fall
Santa Maria-Oceano:			
	Jan. 1-Sept. 31	Apr. 1-early Dec.	Spring-Fall
South Coast:			
	Jan. 1-Mar. 10	Early Mar.-early Jun.	Spring
	Aug. 1-mid Sept.	Late Oct.- early Nov.	Fall

Source: California Agriculture 1989 Dot Maps, and various other sources.

extends from spring through fall, while harvesting in the Imperial Valley runs from late fall through early spring. The Inland area (Fresno and Kern) produces fall and spring crops. The Imperial Valley and the Inland areas do not produce summer crops due to their warmer weather. Some minor producing regions in the south coast area (Ventura) produce spring (early March-early June) and fall (late October-early November) crops.

Production Perils

There are a number of potential production perils in California, such as weather events, earthquakes, diseases, and insects, but growers generally feel that they can deal with these problems. Losses from earthquake could occur due to damage to water distribution systems or roads and bridges that prevented irrigating or field access at critical times.

Weather Events. In general, direct losses from perils such as drought, wind, unusually warm or cold weather, hail, flood, and earthquake are rare in California and growers do not perceive them as serious production risks. Furthermore, unlike field crops, the season for lettuce (and some other vegetables) is spread over several months and the loss of part of the crop is partly offset by replanting the damaged fields.

While weather is key for lettuce growing, the probability of extremely cold weather which would seriously damage the crop is low in the regions where lettuce is grown. Weather problems mostly cause slow and weak growth of the crop. And, when plant growth is not vigorous, plants become vulnerable to disease and insect attacks.

Diseases. Losses due to uncontrolled disease infections are a constant threat, but growers feel that these risks can be managed through a combination of constant observation and aggressive control measures.

Insects. As with plant diseases, lettuce losses from uncontrolled insect infestations are a constant threat. In general, growers believe that they can manage insect risks with aggressive monitoring and control. A serious white whitefly infestation, however, caused exceptionally low yields in 1982 and 1983 in the desert area. Infestation by a new strain of whitefly (the sweetpotato whitefly) in the fall of 1991 resulted in lowered yields during November 1991 to January 1992.

Production Costs

The Cooperative Extension Service of the University of California estimates costs of production for major crops, including lettuce, in the leading producing areas in California. Estimates of production costs are summarized for Monterey and Imperial counties in Tables 11 and 12 (for detailed information see Appendix tables 9 and 10). Per acre yields are assumed to be 750 50-lb cartons in Monterey county and 500 in Imperial county. The land preparation costs include all variable costs incurred during the pre-planting period. Growing period expenses include all variable preharvesting costs from planting forward.

For iceberg lettuce, the estimates indicate that per-acre costs are higher in Monterey county, $4,215, than in Imperial county, $3,091. Per-carton costs are similar in both areas ($5.62 in Monterey and $6.18 in Imperial) because the per-acre yield in Monterey county is also higher than in Imperial county. Harvesting costs are more than half of total costs, which is typical for hand-harvested vegetables. Lettuce is usually harvested on a contract basis and costs include expenses for cutting, packing, and hauling. Per carton harvest costs average $3.50 in Monterey county and $3.20 in Imperial county.

Irrigation Water Issues in California

Irrigation water availability is a critical issue for all of California's agriculture, but it is particularly serious in the west side of the San Joaquin Valley. Farmers in the West Side (mainly Kern county) are facing irrigation water shortages and higher water costs due to cutbacks of the water from the Central Valley Project and state water projects.

Despite water shortages and higher costs, lettuce production is likely to continue in the San Joaquin Valley, while the acreage of other crops may be reduced. Lettuce is a minor user of irrigation water in the San Joaquin Valley and the revenue per acre foot of consumptive water use for lettuce is among the highest for the major crops grown (Kern County Water Agency). It is likely that irrigation water would be shifted from crops with relatively low value per acre foot of water, such as cotton, alfalfa, and sugarbeets, to crops with relatively high value, such as lettuce, if water is not available for all uses.

Another important water issue is salt water intrusion in the Salinas Valley. Sea water has been creeping into Salinas Valley aquifers for more than 50 years because of heavy use of groundwater for irrigation. Since the 1930's, 120 wells west of Salinas have been closed because of salt water problems. The rate of sea water encroachment increased during the last 5 years due to extended drought. Currently, farmers in the Salinas Valley must operate within a mandatory ground water management plan which establishes upper pumping limits, mandated use of water meters, and ground water extraction fees.

Grower-Shipper Arrangements

Because lettuce is a perishable product, precision coordination is needed between growers and shippers to assure swift and timely harvesting and marketing (including packing, shipping, and finding buyers). The following discusses the major ways growers and shippers coordinate the growing, harvesting, and marketing of lettuce in California and the risk-sharing implications of these arrangements.

Most of California's lettuce is produced by a relatively few, large, vertically-integrated operations in which a single firm grows, harvests, packs, sells, and ships. These firms are referred to as grower-shippers.

Grower-shippers reportedly handle the largest share of California's lettuce. In 1979, approximately 40 shippers handled about 75-78 percent, by volume, of

California lettuce (Schaffner, Carter). Thirteen shippers handled about 56 percent, and the three largest shippers handled roughly 30 percent.

Some shippers contract with individual farmers to grow lettuce for the shipper to pack and ship. Most small and medium size farms operate in a joint venture with a shipper and grow lettuce at a fixed rate (price) per acre or under some output sharing arrangement.

Forward contracting between the grower and shipper--locally known as "deals" --provides a common method of: 1) assuring growers a market for their production; 2) sharing the risk of the final market price; 3) and furnishing some portion of the operating capital needed in growing. Contracts also provide the shipper with a steady and predictable supply of produce (Moore and Snyder). Fresh vegetable "deals" can be broadly classified into the following three categories:

Flat-Rate Contract. A flat-rate contract specifies the crop, area to be planted, the approximate planting date, and the amount of money to be paid per acre for the crop. Since the farmer receives his payment regardless of the eventual yield, the risk of price and yield variability is shifted to the packer-shipper. Although not very common, this type of contract provides the grower with an assured revenue and operating capital, since the payments are made during the growing season. A county farm advisor estimated that 10 percent or less of the acreage in Imperial county is grown under a flat-fee arrangement between the grower and shipper (Mayberry).

Open-Price, Output-Sharing Contract. The most prevalent deal is the open-price contract with an output sharing arrangement. The contract does not specify the price received by the grower but usually specifies the planting date and the amount of production inputs each party will provide. The shipper generally harvests and markets the crop. There are two types of open-price contracts: 1) those with minimum price guarantees and 2) those without minimum price guarantees. In the case of contracts with no minimum price provision, the shipper usually purchases a specified share in the crop either through cash advances or by providing certain inputs (Moore and Snyder).

Open-price contracts specify a negotiated harvesting cost per carton, which the shipper subtracts from the gross sales price before splitting the remainder with the grower. The split between these two parties is typically 50/50 but sometimes 60 for the grower and 40 for the shipper. Usually the growers receive at least a 50-percent share. The open-price contract between the shipper and the grower provides an opportunity to share production/market risks and a source of operating capital to the grower.

Cooperative Membership. The third type of arrangement, the vegetable marketing cooperative, is not a marketing contract in the strictest sense. The marketing co-op maintains labor crews and farm equipment and it harvests, packs, and markets lettuce for its members. Growers belonging to marketing

cooperatives continue to bear full market risks and to provide their own operating capital.

Demand for Crop Insurance

Crop insurance participation, particularly with a policy that protected against yield loss alone, would likely be quite low among California lettuce growers. Production perils are relatively minimal and the major risk comes from low market prices due to over-production. However, several California requests for a lettuce insurance policy have been received by FCIC in recent years. Perhaps a policy, such as a revenue insurance plan, that protected against low returns regardless of whether it was due to low prices, production losses, or a combination of the two would be of interest to more California lettuce growers than a plan providing only a yield guarantee.

Lack of Major Production Perils. Because several lettuce crops can be grown in a single season, production perils are usually less of a risk in growing lettuce in California than for producing field crops. Losses due to hail, wind, excess rainfall, and extreme temperature are uncommon in California because the climate in the major lettuce-growing areas is usually highly predictable. Drought is not a big risk in California lettuce production. Because of its high value per acre, irrigation water would be reallocated to lettuce from other crops during periods of water shortages. Growers can generally control losses from lettuce insects and disease through careful attention to pest control.

Greatest Risks are Low Market Prices. Lettuce growers in California are more concerned about excessive production and low prices than about yield losses. Excessive production results in market gluts which drive prices down and reduce total income. Lettuce growers as a group are better off when there is an industry-wide production shortfall than when there is excessive production because higher market prices more than offset the smaller quantity.

The effects of production declines on incomes are illustrated by the organized labor strike in the winter of 1979 in the Imperial Valley. The strike impaired the lettuce harvest and lettuce prices skyrocketed (the Imperial Valley was the major supplier at the time). As a result of the strike, lettuce producers may have received higher incomes than if there had not been a supply-disrupting strike (Carter et al.).

Excessive production is usually less of a risk for other states than for California. Any major shortfall (or glut) in production in other states does not have as significant a market impact (except perhaps in the case of Arizona during the fall) because of California's market domination.

Arizona

Arizona is surpassed only by California in the amount of lettuce produced, harvesting about 57,000 acres of head, leaf, and romaine lettuce annually. Lettuce is the highest value vegetable crop in Arizona, tallying $260 million

farm value in 1993 (USDA/NASS). Arizona accounted for 19 percent of total U.S. lettuce production in 1993.

In 1987, the Census of Agriculture reported 107 farms with lettuce in Arizona, averaging 497 harvested acres. Sixty-three percent had crop sales totaling $500,000 or more and 93 percent had crop sales of $100,000 or more.

The largest acreage is in the Yuma-La Paz production area in southwest Arizona, with Yuma County having the greater area. Production from the Yuma-La Paz area is primarily for the winter market. Other counties (Cochise, Maricopa, Pima, and Pinal) produce lettuce mostly for the spring and fall markets. All lettuce in Arizona is grown on irrigated land.

Lettuce planting in Yuma County begins in late August and extends through the middle of February. Harvesting begins in mid-November and lasts through April.

Perils

The major perils in lettuce production in Arizona are insects (especially the white fly), plant pathogens (soil borne as well as mildews), and weather-related damage. Frost can damage mature plants from November through March while high winds can cause damage to small, immature plants.

Whitefly. The whitefly is a small insect which becomes destructive to lettuce and certain other crops when populations build up, usually in the fall following unusually hot weather. Losses to lettuce can result from virus diseases transmitted by the whitefly or from weakening of the plants due to the feeding of the insects. Whitefly populations typically decline and the insect ceases to be a serious problem with the onset of cooler temperatures. An unusually severe infestation of whitefly in the California and Arizona desert areas in the fall of 1991 reduced lettuce yields from November-January. Growers usually control losses from whitefly infestations with a combination of sanitation practices and insecticide spraying.

Plant diseases. Although lettuce in Arizona is subject to damage due to a number of plant diseases, growers are able to control losses with a program of crop rotation and fungicide spraying.

Freeze. Extreme cold temperatures sometimes cause limited losses to lettuce between November and March.

Floods. Limited losses of lettuce occurred in southern Arizona during the spring of 1993, when excessive rain on top of an abundant mountain snowpack caused flooding of the Gila River.

Florida

There does not seem to be very much potential demand in Florida for crop insurance for lettuce and romaine because most of Florida's production is grown by a handful of large producers who manage risk through diversification among crops and by marketing over a long harvesting season. However, several

Florida requests for a lettuce insurance policy have been sent to FCIC in recent years.

Florida ranks a distant third in U.S. lettuce production, harvesting about 8,000 acres of head, leaf, and romaine lettuce annually during the past two years. The farm value of Florida's lettuce output was $25.6 million in 1993 (USDA/NASS), but Florida's output amounted to only about 1.5 percent of total U.S. lettuce production.

Ninety percent of the lettuce in Florida is grown on the organic muck soils in Palm Beach County around the southern tip of Lake Okeechobee (the Everglades area). The remainder is grown on muck soils in central Florida. Head lettuce in Florida is grown almost exclusively in the Everglades area.

There are currently only a handful of lettuce growers in the Everglades area. The Census of Agriculture reported 11 growers in Palm Beach County in 1987 harvesting 9,169 acres. The 1992 Vegetable Chemical Use Survey sampled 12 farms growing lettuce in Florida.

Two or three producers grow most of Florida's lettuce, in combination with a mix of vegetables and other crops. Several producers also grow a large acreage of sugarcane. The largest producers are vertically integrated in that they grow, pack, and sell their own lettuce.

Production Practices

Lettuce is harvested in Florida from October through May, but the most active harvest is from December 1 to May 1 (USDA/FASS). The Florida shipping season typically ends by June 1.[4] Lettuce is hard to grow in the heat and rainfall typical of Florida's summers.

Lettuce in Florida is direct seeded from September 1 through April 1, and requires about 65 days from seeding to harvest.

Virtually all of the lettuce in Florida is irrigated. Irrigation is accomplished with a network of ditches and canals which maintain the sub-surface irrigation water table. The same network is used for rapid drainage after heavy rains because excess water damages the roots of the lettuce plants.

Perils

Excessive rainfall, hail damage, wind damage, and severe cold are the major natural perils to lettuce production in Florida. Frost and hail are minor

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As indicated in the note to Table 10, slight inconsistencies exist between NASS's *Usual Planting and Harvesting Dates* and extension specialists' indications.

problems, while drought has not been a problem in the past because sufficient water has always been available for irrigation (Schueneman).

Excessive Rainfall. Too much rain causes wet fields which can lead to a buildup of root-borne disease and crop losses. Excessive moisture can result in damages ranging from poor quality to complete loss of the crop if the grower can not get into the field to harvest on a timely basis. Excessive moisture may occur several times during the year causing variable damage depending on the stage of the lettuce's development and the amount of rainfall.

Wind Damage. Excessive wind can cause severe losses by blowing dirt into the lettuce heads making it unsalable for the fresh market. While such dirt can be partly washed out of leaf lettuce, it can not be removed from head lettuce. Growers may have little alternative other than to abandon head lettuce in which dirt becomes embedded within the head.

Some head lettuce containing wind-blown dirt may be shredded and marketed for institutional use such as fast food restaurants. The amount that can be marketed this way is limited, however, because the processor usually has a contract for a specified amount of shredded lettuce. Lettuce diverted from the fresh market because of dirt within the head would often represent supply beyond the processor's current needs.

Wind also can break off young lettuce plants, reducing potential yields.

Extreme Low Temperatures. Freezing temperatures damage the leaves and injure the shipping quality of mature lettuce. A freeze in late December 1989 damaged or destroyed much of Florida's lettuce planted at the time. Lettuce shipments from Florida dropped sharply during January and February, and recovered in March after replanted lettuce became available. The freeze played a key role in a 30-percent decline in Florida production from the previous year.

Frost. Frosts can injure small lettuce plants but is not considered a serious peril in lettuce production in Florida.

Hail. Hail can cause damage to mature lettuce but is not considered a serious problem for lettuce production in Florida. Only a small portion of Florida's lettuce is damaged by hail each year.

Harvesting and Marketing

Two harvesting systems are used for lettuce in Florida: 1) hand-cut and field-pack, and 2) hand-cut and packing with mobile "mule trains." In the hand-cut and field-pack system, workers cut, trim, and place the lettuce in shipping crates in the field. With the mule train system, workers hand cut the lettuce and place it on a conveyor belt attached to a mobile packing shed (mule train). The mule train moves through the field harvesting 10 to 12 rows at a time.

Producers in Florida usually pack their own lettuce and deliver it to a

shipper who acts as the sales agent. The larger producers, however, act as their own shipper and sales agent. Practical storage is limited to just a few days due to lettuce's perishability. The primary customers for lettuce are chain stores and other retailer-wholesalers, terminal market brokers, wholesale handlers, and the military.

Colorado

Colorado grew about 1.5 percent of all U.S. head lettuce in 1993. In 1993, 2,700 of Colorado's 3,600 harvested acres of lettuce were located in the San Luis Valley. This is a high valley with a cool climate which is well suited for growing lettuce. The Census of Agriculture reported 45 farms in Colorado with 2,684 acres of lettuce in 1987 (Appendix table 1).

Much of the acreage is grown by 8 or 10 growers (Ellis). Some grower-shippers with operations in California and Arizona come to the San Luis Valley to produce lettuce for the summer market. Lettuce in the San Luis Valley is planted during May and June and harvested during July and August. All lettuce in Colorado is irrigated, either with furrow irrigation or a center pivot system.

The major production peril is hail damage. Excessive heat is not a problem in the San Luis Valley because of its high elevation (7,600 feet). Because all the acreage is irrigated, drought is not a production peril. Cold winters in the Valley reduce pest populations so that insects are not a major concern. The crop is removed before the first frost in the fall so that excessive cold is not a major concern.

Low prices are viewed as a major peril. Sometime the price is too low to warrant the expense of harvesting, packing, and marketing the crop. In such cases, the crop may be abandoned, sometimes before harvesting begins, at other times after partial harvest.

New Jersey

New Jersey produced less than 1 percent of U.S. head lettuce output in 1993. Most lettuce is grown in Cumberland County in south New Jersey. Producers are mostly small family operations (2 to 100 acres of lettuce) and grow lettuce in combination with other vegetables (Reiners). The Census of Agriculture reported 185 farms in New Jersey with 3,555 acres of lettuce in 1987. About 95 percent of New Jersey's lettuce is irrigated.

Growers in New Jersey plant both a spring crop and a fall crop. Harvest for the spring crop is completed by July 1 in order to avoid the summer heat. The fall crop is planted during August and harvested during October and November. The major market outlet is the Vineland produce market in southern New Jersey. Growers harvest early in the morning and take the lettuce directly to the market. A number of growers use the packing and vacuum-cooling facilities at

the Vineland market. A few larger growers may have their own packing and cooling facilities.

There is no industry-sponsored promotional program. The 'Jersey Fresh' program promotes lettuce along with other vegetables, but is sponsored by the New Jersey Department of Agriculture. For many crops, the New Jersey Department of Agriculture assesses a fee (based on growers' production) for promotion.

The major perils are hot, dry weather, insects and diseases, and freezing temperatures. Growers deal with the heat problem by scheduling planting so as not to have lettuce maturing during the heat of summer, and most growers deal with drought by irrigating. The freezing peril is managed by scheduling planting so that harvest is completed before the onset of severe cold temperatures.

New Mexico

New Mexico is a minor lettuce producer, accounting for less than 1 percent of U.S. head lettuce output in 1993. Most production is in Dona Ana county in south central New Mexico. The Census of Agriculture reported 68 New Mexico farms with 2,064 acres of lettuce in 1987.

Lettuce enterprises on New Mexico farms are small compared with those in Arizona and California. Dona Ana county, with 90 percent of the State's lettuce acreage, has lettuce enterprises ranging from about 5-150 acres (Vargas). New Mexico's lettuce growers tend to be diversified, growing onions, chili peppers, and other vegetables as well as field crops such as cotton, alfalfa, and pecans. All lettuce acreage in New Mexico is irrigated. New Mexico has two main crops--spring and fall. The fall crop is usually a little larger than the spring. The spring crop is planted from mid-December to the end of January for harvest in May. The fall crop is planted in August and harvested in October (Gomez and Corgan, a & b).

Growers sell exclusively through packer-shippers. There are no lettuce marketing cooperatives. Because growers and packer-shippers usually have a long-standing relationship, the packer-shipper knows the quality to expect from each grower. Arrangements to handle the grower's lettuce usually are made before the crop is planted. Three or four packer-shippers handle lettuce in Dona Ana County.

The major production peril in New Mexico is thunderstorms, which can result in hail damage or wash out planted seed. Thunderstorms are more of a threat to the spring crop than to the fall crop. Since all of the lettuce is irrigated, dry weather is not a problem. Although potentially a peril, insects are generally kept under control through monitoring and spraying.

Tipburn is the most important disease of spring lettuce in New Mexico. The date of maturity of lettuce in southern New Mexico has a great influence on

the incidence of tipburn. Heads maturing after mid-May are often severely tipburned because of high temperatures.

New York

New York grew less than one percent of all U.S. head lettuce in 1993. New York also grows some leaf and romaine lettuce, though they are not reported in USDA vegetable statistics.

Lettuce acreage in New York has dropped over the last 10 years from about 3,000 to 2,000 acres in 1992 and 1,000 acres in 1993. Production is mainly on muck soils in Oswego county (central New York) and Orange county (southeast New York). Some lettuce is grown in the Eden Valley in western New York which is not on muck soils.

The Census of Agriculture reported 165 farms with 3,347 acres of lettuce in 1987, but most of the lettuce is grown by a few growers. Most lettuce is irrigated following seeding to insure germination, but there is not very much irrigation during the growing period. Lettuce growers also produce onions and a number of other vegetable crops.

Planting begins in late March or early April and continues into mid-July. Harvesting begins in mid-June and continues to early October.

Growers mostly sell directly to supermarket buyers, to the military or to local retailers. One contact estimated that supermarkets and the military purchase 85 percent of New York lettuce (Ellerbrock).

The major perils are flooding, high winds which uproot young plants, and herbicide drift from onions growing alongside lettuce (happened 2-3 times in last 5 years). Disease damage is usually not widespread. Growers plant to avoid fall freeze injury.

Ohio

Ohio grows a small acreage of lettuce. The Census of Agriculture reported 33 farms in Ohio with 1,256 harvested acres of lettuce in 1987. The National Agricultural Statistics Service did not report any head lettuce statistics for Ohio in 1993, but reported 940 harvested acres of leaf lettuce and romaine.

Most of Ohio's lettuce is grown on organic muck soils in the north central part of the State. Lettuce is usually grown in combination with other vegetables, often successively in the same season. Growers raise both a spring and fall crop. Virtually all lettuce in Ohio is irrigated.

The major perils are hail, excessive summer heat, and insect and disease damage. Hail is the most destructive. Excessive heat during the hottest part of the summer is dealt with by scheduling planting to have a spring and fall harvest. Insects and diseases are dealt with through rotating crops and pest spray programs (Gastier).

Ad Hoc Disaster Assistance for Lettuce

Ad hoc disaster assistance legislation was made available for losses of commercially-grown crops in each of the years 1988-93. Ad hoc payments provide an indication of high-loss areas during that period, and may indicate states and counties that would face relatively high risk under a potential FCIC lettuce policy. These data may also suggest the areas where the demand for a lettuce crop insurance policy would be relatively high.

Under the 1988-93 legislation, payments were made under the categories of participating program crops, nonparticipating program crops, sugar, tobacco, peanuts, soybeans, sunflowers, nonprogram crops, ornamentals, and at times, aquaculture. Producers without crop insurance--the case for lettuce--were eligible for payments for losses greater than 40 percent of expected production. If a producer had no individual yield data to use in calculating "expected production," county-level or other data were used as a proxy. Payment rates for lettuce were based on 65 percent of a 5-year average price, dropping the high and low years.

Disaster assistance payments for lettuce totalled more than $8.2 million over the 1988-93 period, and were made in the following lettuce categories: baby gourmet, bibb, boston, fall, head, iceberg, leaf, red, romaine, and spring. Payments for lettuce losses peaked at $2.5 million in 1988, and were over $1 million in each of the years 1989, 1991, and 1993. Ad hoc payments made for lettuce accounted for about 1.5 percent of all ad hoc payments for non-program crops over the 1988-93 period, but far less than 1 percent of total payments (program and non-program crops).

Ad hoc disaster payments for lettuce were scattered over a geographically broad area (Figure 5). Thirty-eight states received payments in at least one of the 6 years. Five states--Michigan, New Jersey, New York, Ohio, and Texas--collected payments for lettuce in all years. Further, payments were reported in a variety of states for which neither NASS nor the Census collects data on lettuce--including Maine, Vermont, and Kansas.

In a ranking of counties, Oswego county, New York ranked first in payments, receiving over $950,000 over the 6-year period. Ingham county, Michigan and Orange county, New York received over $500,000 in payments. Among the top-10 recipient counties, four were in Michigan, two were in New York, and one each were located in New Jersey, Washington, Ohio, and Arizona.

Ad hoc disaster data can be used to indicate which lettuce-producing areas have received large payments relative to their production. For example, California accounted for about 70 percent of total U.S. lettuce harvested acreage between 1988-93, but received only 8 percent of the payments made for lettuce over that period (Table 14). Similarly, Arizona accounted for an average 21 percent of harvested acreage, and 3 percent of lettuce disaster assistance payments over the same period.

In contrast, Michigan and New York collected a high proportion of payments relative to their production. Michigan accounted for 0.3 percent of U.S.

Table 14--Disaster Assistance Payments for Lettuce, 1988-93

State	Average harvested acreage, 1988-93	Share of US acreage	Total lettuce disaster payments, 1988-93	Share of US lettuce disaster payments
	Acres	Percent	Dollars	Percent
Arizona	52,350	21	260,810	3
California	173,383	70	659,470	8
Colorado	3,333	1	284,190	3
Florida	7,250	3	129,800	2
Michigan	697	0.3	2,608,250	32
New Jersey	2,267	1	809,890	10
New Mexico	2,200	1	233,570	3
New York	2,200	1	1,703,950	21
Ohio	1,160	0.5	492,000	6
Texas	1,150	0.5	258,950	3
Washington	1,333	0.5	363,965	4
U.S.	247,050	100	8,213,390	100

Source: ASCS data files, compiled by the General Accounting Office.

harvested area over the years 1988-93, and received 32 percent of all lettuce disaster payments. Michigan lettuce growers collected sizeable payments in each of the 6 years; the minimum collected in any year in that state was $170,000. Likewise, New York accounted for 1 percent of harvested area, and received 21 percent of all lettuce disaster payments over the 6-year period.

These data suggest that the probability of yield loss in the Michigan-New York area is greater than in California and Arizona. Lettuce losses in Michigan were attributed to drought in 1988 and wet, cool weather in 1992. A Michigan farm advisor said that lettuce is too risky and that he does not recommend to those interested in entering lettuce production that it be produced in Michigan. This risky production situation likely accounts for the dramatic drop in Michigan and New York lettuce acreage in recent years (see Table 3). In contrast, yield risk in California seems very low.

Lettuce Insurance Implementation Issues

Multiple Harvests in the Growing Season

A major issue with a number of fresh vegetables, including lettuce, is the question of how to insure an extended-season crop for which the yields, risks, perils, and expected market prices may differ for different parts of the season. Growers with extended seasons may be reluctant to purchase crop insurance which only guarantees season-average yields because the severity of losses during an interval within the season are concealed by averaging over the season.

In some areas, lettuce growers schedule planting over a number of months in order to ensure an extended harvest period. An insurable event that causes severe losses to a portion of the crop, however, may not qualify growers for indemnity payments because normal output for the remainder of the crop raises the season-average yield above the yield guarantee. In Florida, for example, it is not uncommon for a freeze or excessive rain to destroy nearly all the lettuce that would have been harvested during a portion of the season while reducing the season-average yield by only 10 or 20 percent.

One method for dealing with this extended-season problem would be to define distinct planting periods for intervals having more or less similar yield expectations and production risks and establish different premiums for each period. With such a plan, growers would be more likely to qualify for indemnity payments when losses occurred to a part of their crop because losses for one planting period would not be off-set by normal yields during other periods.

Setting Reference Prices

FCIC provides a reference price (price election) for the insured crop which becomes the basis for assigning value (price guarantee) to yield losses. The insured grower elects a price guarantee, normally between 30 and 100 percent of the reference price. The reference price needs to be high enough to provide reasonable protection for insuring farmers, but not so high that it

provides incentive for crop failure (moral hazard).

An appropriate reference price for lettuce may be a pre-harvest, or "in-field" price, because the grower does not bear the normal harvesting and marketing expenses when a crop failure occurs. An in-field price is similar to the "on-tree" price which is used as a reference price in insuring tree crops. An in-field price may be obtained directly if a field market exists, but more likely a price would have to be calculated.

Two possible formulas for calculating "in-field" reference prices are: 1) actual market price minus estimated harvesting and marketing expenses, and 2) estimated total production expenses minus estimated harvesting and marketing expenses. The market price refers to the "free-on-board" (fob) shipping-point price, not a retail price.

The market-price approach reflects the crop's value based on the potential market returns, while the production-cost approach attempts to measure the value of production inputs. The market-price approach should result in a larger value than the production-expense approach in most years because it embodies grower returns for risk-bearing and management into the estimate of in-field price. Because the market-price approach accounts for returns to risk and management, it may provide a more equitable measure of the economic loss from crop failure than the production-expense approach.

The data are readily available for computing in-field prices after the crop has been harvested and marketed. Weekly f.o.b. prices are reported by the U.S. Department of Agriculture's Market News Service and harvesting costs are easily identifiable because harvesting and marketing are frequently contracted with a shipper at a specified contract fee.

The production-expense approach, based on county-level data, is likely a feasible alternative for estimating in-field prices because production practices and expenses are fairly standard among farms within a county. County-level measures (such as representative enterprise budgets) may provide a reasonable approximation of the costs for production inputs such as seed, fertilizer, chemicals, and labor.

FCIC would need projections of the in-field price prior to the season in order for growers to make a price selection at the time they sign up for insurance. The USDA does not project lettuce prices. One method for projecting a lettuce price is to calculate an average for a recent period (perhaps 5 or 10 years). Using an average price to project in-field value, however, will almost certainly result in a figure which, during some periods within the season, is substantially higher than the actual value of the crop. At times during the season, when there is a glut of lettuce on the market, the actual in-field value may fall to zero (the market price falls so low that "you can't give a field away"). If the projected in-field value were higher than the actual value of the crop, growers with crop insurance may have an economic incentive for a crop loss, thus raising concern about moral hazard.

Actual Production History

The actual production history (APH) for insured farmers is established from their production records over the past 4-10 years. But, in the lettuce industry, the rate of harvest is closely related to market conditions, and production per planted acre varies more than if yield fluctuations were caused by natural conditions alone. If market prices fall below the costs for harvesting and marketing when lettuce is mature, the crop may be abandoned for economic reasons. Economic abandonment occurs because the grower incurs a smaller loss by abandoning the crop than by harvesting and selling. When the market price is just slightly above the harvesting and marketing costs, growers may harvest selectively--recovering only that portion of the crop with the best market quality.

Low harvest rates caused by a weak market (either for a year or for continuous years) would lower the APH yield. Since a farmer's APH yields may not reflect yield risk, APH yields may not be a satisfactory basis for classifying farms and setting insurance rates. APH yields also may not work well in setting coverage levels. With a low production history, caused by a weak market, a situation may arise where 75 percent of the APH (the maximum guarantee which growers may currently insure) does not provide an adequate production guarantee. This could discourage growers from participating in crop insurance.

Estimating "Appraised Production"

There is no widely accepted method for estimating appraised production for lettuce. Under typical price conditions, it is possible to make a pretty good estimate of lettuce yield by knowing the number of plants with marketable heads. The reason for this is that packing 24 heads per carton is the standard in the lettuce industry. Usually lettuce that is too small to fill a carton with 24 heads is discarded, though if prices are high enough, smaller heads may be packed 30 per carton. An experienced grower reportedly can look at a field and judge the yield within a few cartons by observing the uniformity of the stand and the condition of the heads.

Modification of two methods used for fresh market tomatoes may provide a workable procedure for an insurance adjuster to estimate an in-field lettuce yield. The modified procedure consists of: 1) estimating the number of surviving plants per acre on the basis of row samples, 2) multiplying the number of surviving plants by an average percentage of marketable heads, and 3) converting to cartons per acre using 24 heads per carton.

A schedule of average percentage marketable heads would be needed for different production areas because the percentage may be quite different from one area to another. For example, in California's Salinas Valley, where yields may average 800 cartons an acre, the packout percentage would be higher than in the Imperial Valley, where average yields of 500 to 600 are more typical.

Insuring Price Risks

Contacts in virtually all production areas cited market risks as the lettuce grower's greatest peril. Growers, they report, can manage insect and disease risks by following prudent pest management practices and can generally deal with weather-related losses because usually only a part of the season's crop is damaged by natural perils. The situation which growers seem to have the hardest time dealing with is, having produced a perfectly good yield, to sell at less than their cost of production or even to abandon part or all of the crop because of low market prices. To make crop insurance attractive to lettuce growers, especially in California, Arizona, and perhaps some other areas where natural risks are at a minimum, a policy may have to contain an element of protection against the risks of low market prices. A revenue insurance plan may provide such protection.

With a revenue insurance plan, lettuce growers could insure against income falling below some guaranteed minimum, regardless of whether the cause was low yield, low prices, or a combination of both. Such an insurance plan could provide a measure of market-risk protection, while at the same time avoiding indemnity payments to growers who, despite low yields, had a good return because of high market prices.

Moral Hazard

There is potential for moral hazard in a lettuce insurance policy since the situation frequently arises where, because of low market prices, an indemnity payment would be higher than the net return from harvesting a crop. As a practical matter, however, moral hazard does not appear likely to be a major problem. In order for moral hazard to arise, a yield loss would need to be due to some contributing action or lack of action (such as neglecting pest control practices) on the part of the grower. Such grower-induced losses are not likely to occur because the major perils in lettuce production are weather-related over which the grower has no influence.

Yield losses to insects and diseases could occur if a grower neglected to follow prudent pest management practices. It is unlikely that a grower would neglect proper pest management in order to collect an insurance indemnity, however, because a pest buildup may be difficult to eradicate and create a peril for future crops when market prices may be higher. In addition, crop insurance for lettuce may not need to include indemnification for insect and disease losses because growers generally view these perils as manageable problems with currently available control methods.

Micro-Climates and Adverse Selection

Variations in micro-climates within production areas could result in different lettuce growers facing substantially different risks, raising the possibility of problems with adverse selection. In Monterey County, California, for instance, the Salinas Valley opens to the sea at Monterey Bay and extends inland for 50 miles or more. The prevailing ocean winds produce an almost ideal climate for lettuce during the summer near the northern end of the Valley. The effects of the cool ocean breezes diminish, however, as the

distance from the sea increases. Lettuce further from the ocean harvested during the hottest part of the summer is more likely to suffer a yield loss due to excessive heat than lettuce planted within 15 miles of the ocean. Consequently, growers further from the ocean would have an increased chance of incurring a crop loss during mid-summer.

Individual Yield Data

The Iceberg Lettuce Advisory Board finances lettuce research from assessments on its growers based on total cartons or carton equivalents sold. The Board does not have any record of acreages, however, from which individual growers' per acre yields could be calculated (Kurtz). Nevertheless, the larger growers in California and Arizona reportedly keep detailed production records and could derive a yield history for their own operations.

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Appendix table 1--Farms Producing Lettuce and Acres of Lettuce Harvested and Irrigated, 1987 and 1982

State/County	1987				1982			
	Farms	Acres harvested	Percent irrigated		Farms	Acres harvested	Percent irrigated	
			Farms	Acres			Farms	Acres
Arizona	107	53,231	100.0	100.0	81	31,880	100.0	100.0
Yuma	45	39,524	100.0	100.0	32	21,265	100.0	100.0
Maricopa	22	5,131	100.0	100.0	26	6,590	100.0	100.0
La Paz	4	4,112	100.0	100.0	N/A	N/A	N/A	N/A
Pima	5	2,188	100.0	100.0	3	940	100.0	100.0
Cochise	17	1,525	100.0	100.0	10	1,399	100.0	100.0
Pinal	10	707	100.0	100.0	6	N/A	100.0	N/A
other	4	44	100.0	100.0	4	1,686	100.0	100.0
California	683	166,695	100.0	100.0	699	164,203	100.0	100.0
Monterey	170	77,595	100.0	100.0	169	68,385	100.0	100.0
Imperial	69	23,032	100.0	100.0	70	27,863	100.0	100.0
Fresno	38	14,782	100.0	100.0	31	8,404	100.0	100.0
Ventura	59	10,454	100.0	100.0	69	10,901	100.0	100.0
San Luis Obispo	33	8,906	100.0	100.0	33	7,260	100.0	100.0
Riverside	29	8,298	100.0	100.0	32	9,820	100.0	100.0
Santa Barbara	50	8,038	100.0	100.0	48	12,772	100.0	100.0
Santa Cruz	20	5,860	100.0	100.0	15	3,920	100.0	100.0
Kern	22	4,337	100.0	100.0	41	6,077	100.0	100.0
San Benito	12	1,701	100.0	100.0	14	1,713	100.0	100.0
other	181	3,692	100.0	100.0	177	7,088	100.0	100.0
Colorado	45	2,684	100.0	100.0	58	2,726	100.0	100.0
Saguache	8	1,592	100.0	100.0	4	611	100.0	100.0
Rio Grande	10	504	100.0	100.0	6	259	100.0	100.0
Adams	10	233	100.0	100.0	12	179	100.0	100.0
other	17	355	100.0	100.0	35	1,677	100.0	100.0
Florida	36	10,082	88.9	99.1	39	8,946	84.6	96.7
Palm Beach	11	9,169	100.0	99.0	13	7,876	84.6	96.3
other	25	913	84.0	99.5	26	1,070	84.6	99.3
Michigan	53	1,533	58.5	97.5	67	1,183	41.8	91.3
Lapeer	6	423	83.3	99.8	7	136	57.1	93.4
Kent	6	147	83.3	98.6	5	N/A	100.0	N/A
Macomb	14	115	35.7	91.3	14	92	50.0	67.4
other	27	848	59.3	96.9	41	955	29.3	93.3
New Jersey	185	3,555	81.1	95.1	223	3,786	75.3	89.3
Cumberland	75	2,555	93.3	99.8	83	2,746	89.2	92.1
Atlantic	26	440	96.2	88.4	37	398	91.9	84.7
Warren	14	218	57.1	59.6	16	172	50.0	50.0
other	70	342	67.1	91.2	87	470	59.8	91.3

Appendix table 1--Farms Producing Lettuce and Acres of Lettuce Harvested and Irrigated, 1987 and 1982

State/County	1987				1982			
	Farms	Acres harvested	Percent irrigated		Farms	Acres harvested	Percent irrigated	
			Farms	Acres			Farms	Acres
New Mexico	68	2,064	100.0	100.0	74	3,562	100.0	100.0
Dona Ana	57	1,857	100.0	100.0	66	3,131	100.0	100.0
other	11	207	100.0	100.0	8	431	100.0	100.0
New York	165	3,347	52.1	66.0	171	3,639	57.3	67.3
Oswego	19	1,475	84.2	61.3	23	1,562	82.6	92.4
Orange	26	1,294	61.5	65.5	28	1,509	60.7	40.2
other	120	578	45.0	79.2	120	568	51.7	70.4
Ohio	33	1,256	60.6	99.4	48	1,228	58.3	96.2
Huron	4	603	100.0	100.0	4	665	75.0	99.5
Stark	6	555	83.3	100.0	11	339	45.5	88.2
other	23	98	47.8	91.8	33	224	60.6	98.2
Oregon	43	442	97.7	94.3	47	348	91.5	94.5
Texas	44	1,898	81.8	98.3	74	4,038	79.7	97.3
Hidalgo	7	689	100.0	100.0	10	1,509	100.0	100.0
other	37	1,209	78.4	97.4	64	2,529	76.6	95.7
Washington	86	1,313	79.1	76.2	96	935	76.0	70.9
Pierce	22	841	77.3	66.5	24	382	54.2	42.1
King	22	212	59.1	85.8	19	132	47.4	75.8
Clark	4	145	100.0	100.0	6	147	100.0	100.0
other	38	115	89.5	100.0	47	274	95.7	93.1
other	652	2,107	51.8	69.0	775	3,413	45.2	58.8
U.S.	2,200	250,207	77.5	99.0	2452	229,887	73.1	98.3

N/A = Not available or not published to avoid disclosure of individual operations.

Source: U.S. Dept. of Commerce, Census of Agriculture.

Appendix table 2--Size distribution of farms producing lettuce, 1987

State	Farms	Value of all crop sales - $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
	Number	Percent of farms				
Arizona	107	62.6	29.9	2.8	1.9	2.8
California	683	48.2	22.3	6.0	7.2	16.4
Colorado	45	22.2	33.3	17.8	8.9	17.8
Florida	36	38.9	13.9	13.9	8.3	25.0
Hawaii	86	1.2	24.4	14.0	15.1	45.3
Michigan	53	13.2	24.5	9.4	20.8	32.1
New Jersey	185	8.1	43.8	11.9	9.7	26.5
New Mexico	68	27.9	38.2	8.8	11.8	13.2
New York	165	10.3	24.2	9.7	10.3	45.5
Ohio	33	18.2	24.2	3.0	15.2	39.4
Oregon	43	4.7	20.9	20.9	14.0	39.5
Texas	44	27.3	27.3	2.3	2.3	40.9
Washington	86	4.7	19.8	15.1	9.3	51.2
Wisconsin	19	0.0	10.5	5.3	5.3	78.9
other	547	1.3	14.1	11.5	13.9	59.2
U.S.	2,200	23.2	23.2	9.4	10.1	34.2

Source: U.S. Dept. of Commerce, Census of Agriculture.

Appendix table 3--LETTUCE: Organizational type of farms, by sales class, 1987

Organizational type	All farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Number of farms				
Individual or family						
Arizona	40	17	18	2	0	3
California	320	72	90	26	38	94
Colorado	32	5	13	4	3	7
Florida	16	0	3	3	3	7
Hawaii	65	0	14	9	10	32
Michigan	35	0	7	3	9	16
New Jersey	128	3	51	12	15	47
New Mexico	44	9	15	6	5	9
New York	106	4	12	14	14	62
Ohio	23	0	5	1	4	13
Oregon	27	2	2	6	4	13
Texas	26	3	4	0	1	18
Washington	67	2	9	9	5	42
Wisconsin	15	0	1	1	0	13
Other States	426	2	40	42	56	286
United States	1,370	119	284	138	167	662
Partnership						
Arizona	28	19	9	0	0	0
California	192	125	32	10	7	18
Colorado	7	1	1	3	1	1
Florida	2	2	0	0	0	0
Hawaii	6	0	2	2	0	2
Michigan	9	3	2	1	2	1
New Jersey	29	4	17	6	1	1
New Mexico	10	3	4	0	3	
New York	32	4	17	2	1	8
Ohio	2	1	1	0	0	0
Oregon	8	0	3	2	2	1
Texas	5	3	1	1	0	0
Washington	9	0	4	0	3	2
Wisconsin	4	0	1	0	1	2
Other States	77	0	26	14	10	27
United States	420	165	120	41	31	63
Corporation						
Family held						
Arizona	25	20	3	1	1	0
California	144	115	26	1	2	0
Colorado	6	4	1	1	0	0
Florida	12	9	1	0	0	2
Hawaii	11	1	4	1	3	2
Michigan	9	4	4	1	0	0
New Jersey	27	8	13	4	2	0
New Mexico	14	7	7	0	0	0
New York	25	9	11	0	2	3
Ohio	7	5	2	0	0	0
Oregon	5	0	4	1	0	0
Texas	7	4	3	0	0	0
Washington	10	2	4	4	0	0
Wisconsin	0	0	0	0	0	0
Other States	33	5	11	7	5	5
United States	335	193	94	21	15	12

continued

Appendix table 3--LETTUCE: Organizational type of farms, by sales class, 1987 continued

Organizational type	All farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Number of farms				
Corporation						
Other than family held						
Arizona	8	6	2	0	0	0
California	20	14	3	1	2	0
Colorado	0	0	0	0	0	0
Florida	5	3	0	2	0	0
Hawaii	0	0	0	0	0	0
Michigan	0	0	0	0	0	0
New Jersey	0	0	0	0	0	0
New Mexico	0	0	0	0	0	0
New York	1	0	0	0	0	1
Ohio	0	0	0	0	0	0
Oregon	1	0	0	0	0	1
Texas	1	1	0	0	0	0
Washington	0	0	0	0	0	0
Wisconsin	0	0	0	0	0	0
Other States	6	0	0	0	3	3
United States	42	24	5	3	5	5
Other						
Arizona	6	5	0	0	1	0
California	7	3	1	3	0	0
Colorado	0	0	0	0	0	0
Florida	1	0	1	0	0	0
Hawaii	4	0	1	0	0	3
Michigan	0	0	0	0	0	0
New Jersey	1	0	0	0	0	1
New Mexico	0	0	0	0	0	0
New York	1	0	0	0	0	1
Ohio	1	0	0	0	1	0
Oregon	2	0	0	0	0	2
Texas	5	1	4	0	0	0
Washington	0	0	0	0	0	0
Wisconsin	0	0	0	0	0	0
Other States	5	0	0	0	2	3
United States	33	9	7	3	4	10

Source: 1987 U.S. Census of Agriculture.

Appendix table 4--LETTUCE: Principal occupation of farm operators and days worked off the farm, by sales class

Item	All farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Number of farms				
Farming is main occupation						
Arizona	97	65	26	2	2	2
California	602	313	143	35	39	72
Colorado	39	10	15	5	4	5
Florida	34	14	5	5	3	7
Hawaii	74	1	21	12	12	28
Michigan	46	7	13	4	10	12
New Jersey	163	15	80	21	16	31
New Mexico	60	19	24	4	8	5
New York	139	17	39	15	16	52
Ohio	30	6	8	1	4	11
Oregon	38	2	9	9	5	13
Texas	34	10	12	1	1	10
Washington	71	4	17	13	8	29
Wisconsin	13	0	1	1	1	10
Other States	428	6	73	61	69	219
United States	1,868	489	486	189	198	506
		Percent of all farms				
Arizona	90.6	60.7	24.3	1.9	1.9	1.8
California	88.1	45.8	21.0	5.1	5.7	10.5
Colorado	86.7	22.2	33.4	11.1	8.9	11.1
Florida	94.5	38.9	13.9	13.9	8.3	19.5
Hawaii	86.2	1.2	24.4	14.0	14.0	32.6
Michigan	86.7	13.2	24.5	7.5	18.9	22.6
New Jersey	88.2	8.1	43.3	11.4	8.6	16.8
New Mexico	88.3	27.9	35.3	5.9	11.8	7.4
New York	84.2	10.3	23.6	9.1	9.7	31.5
Ohio	90.8	18.2	24.2	3.0	12.1	33.3
Oregon	88.3	4.7	20.9	20.9	11.6	30.2
Texas	77.3	22.7	27.3	2.3	2.3	22.7
Washington	82.6	4.7	19.7	15.1	9.3	33.8
Wisconsin	68.5	0.0	5.3	5.3	5.3	52.6
Other States	78.2	1.1	13.3	11.2	12.6	40.0
United States	84.9	22.2	22.1	8.6	9.0	23.0
		Number of farms				
Operator days off-farm						
None						
Arizona	73	48	21	3	1	0
California	435	242	109	28	22	34
Colorado	24	3	13	3	3	2
Florida	24	12	4	3	1	4
Hawaii	51	1	17	10	10	13
Michigan	30	4	11	2	8	5
New Jersey	137	15	69	19	12	22
New Mexico	42	15	16	4	4	3
New York	111	13	37	12	12	37
Ohio	24	6	6	1	4	7
Oregon	26	2	6	8	4	6
Texas	23	8	11	0	1	3
Washington	51	4	14	9	5	19
Wisconsin	6	0	2	0	1	3
Other States	281	3	62	39	36	141
United States	1,338	376	398	141	124	299

continued

Appendix table 4--LETTUCE: Principal occupation of farm operators and days worked off the farm, by sales class, continued

Item	All farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Number of farms				
Operator days off-farm						
Any						
Arizona	26	14	9	0	1	2
California	195	66	30	11	17	71
Colorado	16	5	2	4	0	5
Florida	10	2	1	2	0	5
Hawaii	25	2	1	3	19	0
Michigan	18	1	1	3	2	11
New Jersey	32	0	4	1	4	23
New Mexico	24	3	9	2	4	6
New York	45	1	2	3	5	34
Ohio	8	0	2	0	1	5
Oregon	13	0	2	0	2	9
Texas	19	4	1	1	0	13
Washington	30	0	1	4	3	22
Wisconsin	9	0	0	1	0	8
Other States	233	0	12	18	17	186
United States	703	98	77	53	75	400
1 to 99 days						
Arizona	10	7	3	0	0	0
California	65	24	10	3	7	21
Colorado	7	4	2	0	0	1
Florida	6	1	1	2	0	2
Hawaii	4	0	1	0	1	2
Michigan	6	1	1	1	1	2
New Jersey	7	0	2	0	1	4
New Mexico	10	3	4	1	1	1
New York	13	0	2	0	3	8
Ohio	4	0	1	0	0	3
Oregon	7	0	0	0	1	6
Texas	7	1	0	0	0	6
Washington	6	0	0	4	1	1
Wisconsin	1	0	0	0	0	1
Other States	100	1	8	14	20	57
United States	253	42	35	25	36	115
100 to 199 days						
Arizona	4	2	2	0	0	0
California	50	11	5	4	5	25
Colorado	2	0	0	2	0	0
Florida	2	0	0	0	0	2
Hawaii	6	0	0	0	2	4
Michigan	3	0	0	1	0	2
New Jersey	6	0	0	1	0	5
New Mexico	5	0	2	0	3	0
New York	12	1	0	0	1	10
Ohio	1	0	0	0	0	1
Oregon	1	0	0	0	0	1
Texas	2	1	0	0	0	1
Washington	10	0	1	0	1	8
Wisconsin	3	0	0	1	0	2
Other States	55	0	2	2	6	45
United States	162	15	12	11	18	106

continued

Appendix table 4--LETTUCE: Principal occupation of farm operators and days worked off the farm, by sales class, continued

Item	All farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Number of farms				
200 days or more						
Arizona	12	5	4	0	1	2
California	80	31	15	4	5	25
Colorado	7	1	0	2	0	4
Florida	2	1	0	0	0	1
Hawaii	15	0	1	1	0	13
Michigan	9	0	0	1	1	7
New Jersey	19	0	2	0	3	14
New Mexico	9	0	3	1	0	5
New York	20	0	0	3	1	16
Ohio	3	0	1	0	1	1
Oregon	5	0	2	0	1	2
Texas	10	2	1	1	0	6
Washington	14	0	0	0	5	9
Wisconsin	5	0	0	0	0	5
Other States	78	1	1	4	3	69
United States	288	41	30	17	21	179
Not reported						
Arizona	8	5	2	0	0	1
California	53	21	13	2	10	7
Colorado	5	2	0	1	1	1
Florida	2	0	0	0	2	0
Hawaii	10	0	2	1	0	7
Michigan	5	2	1	0	1	1
New Jersey	16	0	8	2	2	4
New Mexico	2	1	1	0	0	0
New York	9	3	1	1	0	4
Ohio	1	0	0	0	0	1
Oregon	4	0	1	1	0	2
Texas	2	0	0	0	0	2
Washington	5	0	2	0	0	3
Wisconsin	4	0	0	0	0	4
Other States	33	2	4	4	7	16
United States	159	36	35	12	23	53

Source: 1987 U.S. Census of Agriculture.

Appendix Table 5--Lettuce: Harvested acreage, yield, production, and price in California all lettuce, and by type, 1980-92[1]

Year	Harvested Acreage	Yield/Acr (tons)	Production (tons)	Price ($/ton)	Harvested Acreage	Yield/Acr (tons)	Production (tons)	Price, $/ton
	All lettuce				Head lettuce			
1980	180,328	13.09	2,359,644	180				
1981	167,571	14.90	2,496,716	213				
1982	189,914	12.67	2,405,395	228				
1983	202,579	11.95	2,421,421	252				
1984	136,153	11.96	1,628,308	203				
1985	195,536	13.25	2,591,411	221	131,000	15.5	2,027,300	216
1986	178,079	14.68	2,613,446	230	144,800	16.3	2,365,500	223
1987	209,664	13.61	2,853,871	263	154,900	16.1	2,487,200	256
1988	197,590	15.82	3,126,433	277	166,700	16.8	2,789,100	264
1989	197,162	15.58	3,071,223	265	163,200	16.4	2,672,700	255
1990	204,999	15.25	3,127,133	259	161,700	16.5	2,656,700	245
1991	200,574	15.28	3,064,904	267	156,700	16.4	2,557,700	256
1992	203,155	14.76	2,997,747	265	152,500	16.4	2,489,500	239
	Leaf lettuce				Romaine lettuce			
1985	20,000	13.8	268,700	242	6,200	14.2	87,400	242
1986	14,100	10.9	153,800	293	6,200	13.0	80,700	273
1987	15,600	11.2	174,100	352	6,900	11.9	82,300	301
1988	22,200	10.9	233,400	395	8,500	12.1	103,100	351
1989	23,900	11.7	274,300	339	9,900	12.6	123,700	318
1990	30,600	10.6	306,100	354	12,700	13.1	164,100	312
1991	30,500	10.7	325,700	332	13,300	13.6	181,300	300
1992	36,100	10.6	364,700	364	14,600	9.8	143,200	462

[1]The S
began to collect separate data by lettuce type in 1985. The types include head, leaf, romaine and unspecified.
for the unspecified category are not reported here and were very small compared to other
types.

Source: County Agricultural Commissioners' Reports, California Agricultural Statistics Service

Appendix table 6--Head lettuce: Harvested acreage, yield, production, and price, by region and county, 1980-92

Region/county	Year	Harvest Acreage	Yield /acre (tons)	Total Production (tons)	Price $/ton	Comments
Salinas:						
Monterey[1]	1980	67,124	15.10	1,014,085	158	All lettuce: 1980-83
	1981	66,761	16.30	1,089,533	241	only iceberg: 1984-
	1982	66,270	16.20	1,072,649	191	
	1983	61,341	16.70	1,026,485	285	
	1984	54,482	17.30	910,675	323	Official statistics for different lettuce types
	1985	62,640	16.50	1,039,575	234	became available only
	1986	64,800	18.10	1,169,950	233	from 1984 for the major
	1987	68,200	18.40	1,257,225	252	lettuce producing counties
	1988	68,535	20.80	1,424,675	213	
	1989	64,035	20.60	1,318,450	251	
	1990	58,820	20.30	1,181,559	275	
	1991	63,000	19.20	1,208,900	243	
	1992	69,340	18.90	1,311,575	258	
Santa Cruz	1980	4,465	13.40	60,000	187	Data include all lettuce
	1981	4,017	16.20	65,000	238	for the entire period.
	1982	3,275	16.90	55,189	182	Separate data by variety
	1983	3,110	16.60	51,731	269	were not available.
	1984	4,037	17.00	68,770	229	
	1985	5,149	13.80	71,198	265	
	1986	3,668	17.50	64,366	207	
	1987	3,448	18.80	64,650	232	
	1988	3,808	19.90	75,855	244	
	1989	4,477	19.20	86,020	259	
	1990	5,062	19.30	97,697	281	
	1991	5,310	19.30	102,271	228	
	1992	4,985	21.90	109,177	227	
San Benito	1980	3,200	13.50	43,300	177	Data include all
	1981	1,550	17.20	26,700	228	lettuce for all
	1982	2,220	13.50	29,900	176	period.
	1983	2,210	13.80	30,460	289	
	1984	1,470	11.90	17,500	207	
	1985	1,305	13.60	17,750	150	
	1986	1,250	12.00	15,000	172	
	1987	1,000	15.40	15,400	200	
	1988	1,400	16.10	22,540	195	
	1989	1,250	16.20	20,250	205	
	1990	3,623	16.10	58,330	219	
	1991	3,297	18.50	60,994	199	
	1992	4,583	15.10	69,432	235	
Imperial Valley-Blythe:						
Imperial	1980	46,972	7.93	372,255	133	all lettuce: 1980-83
	1981	38,356	10.40	397,214	143	only head: 1984-
	1982	61,516	6.62	407,164	354	
	1983	78,049	5.54	432,430	170	
	1984	30,062	13.40	401,328	218	
	1985	29,450	12.70	373,132	230	
	1986	30,554	10.80	330,888	239	
	1987	28,986	11.60	336,504	229	
	1988	31,144	11.80	368,198	541	
	1989	36,850	9.65	355,620	355	
	1990	39,038	9.81	382,770	161	
	1991	36,138	11.20	402,986	271	
	1992	26,134	9.94	259,801	241	

continued

Appendix table 6--Head lettuce: Harvested acreage, yield, production, and price, by region and county, 1980-92 continued

Region/county	Year	Harvest Acreage	Yield /acre (tons)	Total Production (tons)	Price $/ton	Comments
Imperial Valley-Blythe continued:						
Riverside	1980	10,041	13.40	134,685	124	All lettuce: 1980-83
	1981	9,491	16.30	154,589	279	only head:1984-
	1982	10,210	10.80	110,233	311	
	1983	10,743	14.00	149,953	227	
	1984	9,617	13.20	127,303	139	
	1985	8,884	15.10	134,366	138	
	1986	8,844	16.40	144,660	132	
	1987	12,752	13.70	174,463	193	
	1988	18,711	12.10	227,216	296	
	1989	12,784	17.50	223,669	224	
	1990	12,081	15.20	183,450	158	
	1991	3,696	9.61	35,528	172	
	1992	2,974	13.80	38,738	192	
Inland area:						
Fresno	1980	9,255	14.90	137,900	234	only head lettuce
	1981	8,307	16.60	138,260	164	
	1982	7,721	17.60	135,970	236	
	1983	10,654	18.90	201,540	272	
	1984	13,600	18.10	245,900	202	
	1985	13,400	16.50	221,000	182	
	1986	14,300	17.10	245,200	234	
	1987	17,810	14.60	260,900	314	
	1988	18,000	14.70	264,000	219	
	1989	18,460	14.80	272,900	235	
	1990	17,110	16.50	282,600	289	
	1991	18,310	15.00	274,400	343	
	1992	17,890	15.90	286,500	192	
Kern	1980	7,530	15.30	115,000	211	Data include only
	1981	7,906	15.00	118,950	145	head lettuce for
	1982	8,460	14.50	123,000	194	the entire period.
	1983	7,906	15.80	125,240	197	
	1984	7,920	11.80	93,390	145	
	1985	5,541	17.80	98,900	175	
	1986	5,341	17.90	95,400	241	
	1987	5,628	14.90	84,100	423	
	1988	6,967	14.40	100,600	208	
	1989	9,250	13.00	120,500	182	
	1990	7,878	18.60	146,300	218	
	1991	6,647	19.80	131,490	228	
	1992	6,598	13.70	90,200	174	
Santa Maria-Oceano:						
Santa Barbara	1980	10,290	16.80	172,669	164	all lettuce: 1980-83
	1981	9,530	17.70	168,927	215	only head: 1984-
	1982	8,964	17.30	155,247	168	
	1983	8,324	15.10	125,494	242	
	1984	8,065	16.10	129,830	204	
	1985	7,623	17.00	129,286	204	
	1986	7,732	19.00	146,684	188	
	1987	7,573	17.70	134,370	233	
	1988	8,328	17.60	146,789	214	
	1989	6,817	18.70	127,696	227	
	1990	7,446	18.20	135,854	237	
	1991	9,005	18.80	169,456	262	
	1992	9,909	17.50	173,412	228	

continued

Appendix table 6--Head lettuce: Harvested acreage, yield, production, and price, by region and county, 1980-92 continued

Region/county	Year	Harvest Acreage	Yield /acre (tons)	Total Production (tons)	Price $/ton	Comments
Santa Maria-Oceano continued:						
San Luis Obispo	1980	9,657	17.50	168,663	157	all lettuce: 1980-83
	1981	10,061	19.40	194,696	206	only head lettuce 1984-
	1982	9,615	18.50	177,737	167	
	1983	10,937	15.30	167,560	228	
	1984	9,763	13.70	134,408	204	
	1985	8,956	15.50	138,818	203	
	1986	7,992	18.30	145,854	208	
	1987	7,856	17.30	135,909	268	
	1988	7,686	17.80	137,195	211	
	1989	7,633	17.30	131,860	230	
	1990	9,108	18.30	166,449	274	
	1991	8,374	16.30	136,287	245	
	1992	7,774	17.10	133,324	227	
South Coast:						
Ventura	1981	5,703	12.50	71,003	230	All lettuce: 1981-83
	1982	6,387	12.30	78,600	304	only head:1984-
	1983	5,637	10.80	60,657	384	data for 1980 were not available
	1984	1,099	19.60	21,498	127	
	1985	1,135	12.30	13,914	108	
	1986	1,478	14.60	21,067	200	
	1987	1,692	14.00	23,644	239	
	1988	1,313	16.50	21,634	223	
	1989	1,259	9.63	12,123	234	
	1990	1,267	12.20	15,463	165	
	1991	2,314	13.30	30,750	234	
	1992	1,254	13.50	16,955	281	

[1] Monterey: all lettuce for 1984 includes head lettuce, bulk for shred, and naked pack. Bulk and naked pack are added to head lettuce because they are likely all the head lettuce type.

head	1984	1,882	17.3	32,625	323
BLK	1984	2,600	17.1	44,550	237
Naked	1984	50,000	16.7	833,500	230

Appendix table 7--Leaf lettuce: Harvested acreage, yield, production, and price, by region and county, 1984-92

Region/county	Year	Harvest Acreage	Yield /acre (tons)	Total Production (tons)	Price $/ton	Comments
Salinas:						
Monterey	1984	2,690	12.20	32,871	299	
	1985	4,814	15.10	72,763	233	
	1986	5,745	12.90	74,053	272	
	1987	7,238	12.10	87,665	358	
	1988	6,700	12.50	83,665	251	
	1989	7,334	14.30	105,178	313	
	1990	11,710	10.30	121,063	421	
	1991	15,270	10.00	152,938	354	
	1992	16,310	10.40	169,438	451	
Santa Clara	1984	800	8.00	6,400	260	
	1985	700	10.00	7,000	300	
	1986	800	14.00	11,200	255	
	1987	1,000	13.00	13,000	295	
	1988	1,180	13.00	15,340	290	
	1989	1,200	12.00	14,400	375	
	1990	1,300	10.00	13,000	240	
	1991	1,130	10.50	11,865	305	
	1992	1,260	10.00	12,600	315	
San Benito	1986	350	9.90	3,465	310	
	1987	550	11.10	6,105	363	
	1988	680	12.90	8,772	237	
	1989	700	13.20	9,240	298	
	1990	857	10.90	9,341	341	
	1991	908	11.80	10,714	339	
	1992	1,212	9.97	12,084	400	
Imperial Valley-Blythe:						
Imperial	1988	2,336	10.30	24,042	962	
	1989	3,073	8.94	27,473	457	
	1990	4,241	10.60	45,086	323	
	1991	3,892	12.20	47,336	334	
	1992	5,864	11.70	68,858	198	
Riverside	1985	1,221	7.83	9,565	457	
	1986	855	6.49	5,549	476	
	1987	2,002	8.27	16,561	374	
	1988	1,510	6.25	9,434	987	
	1989	1,174	6.93	8,136	465	
	1990	1,969	7.36	14,490	410	
	1991	1,612	6.00	9,664	432	
	1992	1,579	5.90	9,310	413	
Santa Maria-Oceano:						
Santa Barbara	1984	736	8.37	6,160	299	
	1985	917	7.09	6,502	375	
	1986	1,022	7.99	8,163	274	
	1987	965	9.35	9,022	416	
	1988	1,208	9.11	11,008	287	
	1989	2,043	10.60	21,675	361	
	1990	1,923	9.68	18,620	334	
	1991	1,424	9.63	13,708	346	
	1992	1,644	9.66	15,879	350	

continued

Appendix table 7--Leaf lettuce: Harvested acreage, yield, production, and price, by region and county, 1984-92 continued

Region/county	Year	Harvest Acreage	Yield /acre (tons)	Total Production (tons)	Price $/ton	Comments
Santa Maria-Oceano continued						
San Luis Obispo	1984	518	20.90	10,852	177	
	1985	751	20.60	15,470	178	
	1986	1,105	16.20	17,846	163	
	1987	960	21.60	20,712	234	
	1988	1,663	20.60	34,256	157	
	1989	2,072	19.80	40,922	190	
	1990	1,786	22.00	39,381	179	
	1991	1,738	22.60	39,192	133	
	1992	1,677	20.80	34,882	222	
South Coast:						
Ventura	1984	3,326	8.31	27,639	359	
	1985	3,324	8.19	27,223	380	
	1986	3,527	7.57	26,686	420	
	1987	2,860	7.25	20,732	434	
	1988	5,606	7.33	41,112	518	
	1989	4,647	7.69	35,715	422	
	1990	3,706	8.16	30,252	396	
	1991	3,029	8.73	26,458	440	
	1992	3,672	7.59	27,864	429	
Orange	1984	504	11.50	5,796	250	
	1985	608	10.20	6,214	276	
	1986	577	10.00	5,770	287	
	1988	597	9.15	5,463	429	
	1989	595	10.20	6,051	337	
	1990	692	11.10	7,647	280	
	1991	643	9.61	6,179	291	
	1992	506	12.10	6,138	169	

Appendix table 8--Romaine lettuce: Harvested acreage, yield, production, and price, by region and county, 1984-92

Region/county	Year	Harvest Acreage	Yield (tons /acre	Total Production (tons)	Price $/ton	Comments
Salinas:						
Monterey	1984	2,305	12.00	27,731	259	
	1985	2,452	14.30	35,092	278	
	1986	3,475	13.20	45,806	273	
	1987	3,795	11.90	45,029	335	
	1988	3,985	12.60	50,172	278	
	1989	4,690	14.20	66,637	329	
	1990	7,980	14.00	111,685	314	
	1991	9,790	14.00	137,270	294	
	1992	10,900	9.71	105,788	526	
Santa Clara	1988	125	16.50	2,063	240	
	1989	70	16.00	1,120	300	
	1990	85	13.00	1,105	250	
	1991	80	11.00	880	250	
	1992	80	12.00	960	250	
Imperial Valley-Blythe:						
Riverside	1984	758	12.80	9,737	330	
	1985	648	10.20	6,594	242	
	1986	490	15.30	7,486	396	
	1987	1,266	13.20	16,683	241	
	1988	1,421	9.60	13,603	697	
	1989	1,387	10.70	14,806	291	
	1990	1,346	11.10	14,910	323	
	1991	1,157	12.80	14,801	317	
	1992	1,159	9.45	10,953	217	
Ventura	1984	3,261	13.30	43,371	222	
	1985	2,761	13.60	37,501	230	
	1986	2,173	12.10	26,369	243	
	1987	1,838	11.20	20,590	276	
	1988	2,873	12.50	35,928	331	
	1989	3,436	11.30	38,880	311	
	1990	2,869	11.70	33,585	299	
	1991	2,025	12.90	26,053	323	
	1992	2,239	11.00	24,581	311	
Orange	1986	72	14.20	1,022	158	
	1987	--	--	--	--	
	1988	127	10.70	1,356	251	
	1989	231	9.75	2,252	291	
	1990	300	9.50	2,850	350	
	1991	276	8.39	2,316	319	
	1992	207	4.63	958	258	